CONTRA COSTA
CLEAN WATER
PROGRAM

Thomas E. Dalziel
Program Manager

March 13, 2015

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Ms. Pamela Creedon, Executive Officer
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SUBJECT: Transmittal of the Urban Creeks Monitoring Report in Accordance with Permit Provision C.8.g.iii

Dear Mr. Wolfe and Ms. Creedon:

Enclosed is the Urban Creeks Monitoring Report (UCMR) submitted on behalf of all Contra Costa Permittees per the Municipal Regional Permit (MRP) for urban stormwater issued by the San Francisco Bay Regional Water Quality Control Board (SFRWQCB; Order No. R2-2009-0074) and the East Contra Costa County Municipal NPDES Permit (Central Valley Permit) issued by the Central Valley Regional Water Quality Control Board (CVRWQCB; Order No. R5-2010-0102). This report (including all appendices and attachments) fulfills the requirements of MRP Provision C.8.g.iii for interpreting and reporting monitoring data collected during Water Year (WY) 2014 (October 1, 2013 - September 30, 2014), the third year of water quality monitoring conducted under the MRP, by March 15 of each year. Key technical findings are presented in the body of the report and in its corresponding appendices.

With the approval and direction from each duly authorized representative of each Permittee, I have been authorized to submit and 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 gathered and evaluated 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 possibly of fine and imprisonment for knowing violations.

Sincerely,

Thomas E. Dalziel, Program Manager
Contra Costa Clean Water Program

cc: Selina Louie, Janet O'Hara, Thomas Mumley, Dale Bowyer, Richard Looker, Kevin Lunde, Genevieve Sparks

CONTRA COSTA
CLEAN WATER
PROGRAM

Urban Creeks Monitoring Report Water Year 2014 (October 2013 – September 2014)

Submitted in Compliance with Provision C.8.g.iii

NPDES Permit No. CAS612008

and

NPDES Permit No. CAS083313

March 13, 2015

The Contra Costa Clean Water Program – A Municipal Stormwater Program consisting of Contra Costa County, its 19 Incorporated Cities/Towns, and the Contra Costa County Flood & Water Conservation District

This report is submitted by the agencies of the

Program Participants:

- Cities of: Antioch, Brentwood, Clayton, Concord, Danville (Town), El Cerrito, Hercules, Lafayette, Martinez, Moraga (Town), Oakley, Orinda, Pinole, Pittsburg, Pleasant Hill, Richmond, San Pablo, San Ramon and Walnut Creek
- Contra Costa County
- Contra Costa County Flood Control & Water Conservation District

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Contra Costa Clean Water Program

List of Acronyms

BASMAA	Bay Area Stormwater Management Agencies Association
B-IBI	Benthic Index of Biological Integrity
BOD	Biochemical Oxygen Demand
CCCWP	Contra Costa Clean Water Program
CCWP	Contra Costa Watershed Forum
CEDEN	California Environmental Data Exchange Network
CFWG	Contaminant Fate Workgroup
COLD	Uses of water that support cold water ecosystems
CRAM	California Rapid Assessment Method
CV	Central Valley
CVRWQB	Central Valley Regional Water Quality Control Board
DDD	Dichlorodiphenyldichloroethane (pesticide)
DDE	Dichlorodiphenyldichloroethylene (pesticide)
DDT	Dichlorodiphenyltrichloroethane (pesticide)
DO	Dissolved Oxygen
ECWG	Emerging Contaminant Workgroup
EEWG	Exposure and Effects Workgroup
IBI	Index of Biological Integrity
IMP	Integrated Management Practices
IMS	Information Management System
LID	Low Impact Development
MeHg	Methylmercury
mg/L	milligram per liter
MPC	Monitoring and Pollutants of Concern Committee
MPN	Most Probable Number
MRP	Municipal Regional Permit
MUN	Uses of water for community, military, or individual water supply system
MWAT	Maximum Weekly Average Temperature
NPDES	National Pollutant Discharge Elimination System
P/S Study	Pilot and Special Studies
PCB	Polychlorinated Biphenyl
PEC	Probable Effect Concentration
POC	Pollutants of Concern

POTW	Publicly Owned Treatment Works
QAPP	Quality Assurance Project Plan
RMC	Regional Monitoring Coalition
RMP	Regional Monitoring Program for Water Quality in the San Francisco Estuary
RWQCB	Regional Water Quality Control Board
S&T	Status & Trends
SC	Steering Committee
SF	San Francisco
SFEI	San Francisco Estuary Institute
SFBRWQCB	San Francisco Bay Regional Water Quality Control Board
SOP	Standard Operating Protocol
SPLWG	Sources, Pathways and Loadings Workgroup
SSID	Stressor Source Identification
STLS	Small Tributaries Loading Strategy
SWAMP	Surface Water Ambient Monitoring Program
TEC	Threshold Effect Concentration
TIE	Toxicity Identification Evaluation
TMDL	Total Maximum Daily Load
TRC	Technical Review Committee
TRE	Toxicity Reduction Evaluation
TU	Toxicity Units
USA	Unified Stream Assessment
USEPA	United States Environmental Protection Agency
WARM	Uses of water that support warm water ecosystems
WLA	Wasteload Allocation
WQO	Water Quality Objective
WY	Water Year

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Executive Summary

This Urban Creeks Monitoring Report was prepared by the Contra Costa Clean Water Program (CCCWP) per the Municipal Regional Permit (MRP) for urban stormwater issued by the San Francisco Bay Regional Water Quality Control Board (SFRWQCB; Order No. R2-2009-0074) and the East Contra Costa County Municipal NPDES Permit (Central Valley Permit) issued by the Central Valley Regional Water Quality Control Board (CVRWQCB; Order No. R5-2010-0102). This report (including all appendices and attachments) fulfills the requirements of MRP Provision C.8.g.iii for interpreting and reporting monitoring data collected during Water Year (WY) 2014 (October 1, 2013 - September 30, 2014), the third year of water quality monitoring conducted under the MRP. Key technical findings are summarized below and presented in more detail in the body of the report and in its corresponding appendices.

San Francisco Estuary Receiving Water Monitoring (C.8.b)

The CCCWP contributes to the San Francisco Estuary Institute's (SFEI's) Regional Monitoring Program (RMP). Specifically, the Status & Trends Monitoring Program and the Pilot and Special Studies efforts are useful tools of the CCCWP. CCCWP staff participates in many of the RMP committees. Findings of Status & Trends Monitoring and Pilot and Special Studies results are summarized and/or referenced in the body of this report.

Creek Status Monitoring (C.8.c)

The Regional Monitoring Coalition (RMC) regional monitoring strategy for complying with MRP provision C.8.c includes a regional ambient/probabilistic monitoring component and a component based on local/targeted monitoring. During WY 2014, 10 sites were monitored under the regional/probabilistic design for bioassessment, physical habitat, and related water chemistry parameters. Two of the 10 sites were also monitored for water and sediment toxicity and sediment chemistry. In WY 2014, within Contra Costa County, targeted monitoring was conducted at four continuous water temperature monitoring locations, two general water quality monitoring locations, five pathogen indicator monitoring locations, and 10 riparian assessment monitoring locations. Findings from this monitoring are summarized in the body of this report and described in detail in the appendices.

Monitoring Projects (C.8.d)

Three types of monitoring projects are required by provision C.8.d of the MRP: Stressor/Source Identification Projects, Best Management Practice (BMP) Effectiveness Investigations, and, Geomorphic Projects. Permittees were generally focused on conducting Part A of the stressor/source identification projects during WY 2014. In WY 2012 and WY 2013, the CCCWP's Creek Status Monitoring triggered exceedances for water and sediment toxicity parameters. Follow-up samples were collected upstream and downstream on both Dry Creek and Grayson Creek and confirmed that pyrethroids were the likely cause of the observed toxicity.

The results of the BMP Effectiveness and Geomorphic Projects were presented in the Integrated Monitoring Report submitted to the SFBRWQCB and the CVRWQCB in March 2014.

Pollutants of Concern and Long-Term Trends Monitoring (C.8.e)

Pollutants of Concern (POC) load monitoring is required by provision C.8.e.i of the MRP and Central Valley Permit. Loads monitoring is intended to assess inputs of POCs to the Bay from local tributaries and urban runoff, assess progress toward achieving wasteload allocations (WLAs) for total maximum daily loads (TMDLs), and help resolve uncertainties associated with loading estimates for these pollutants. During the three years studied thus far, winter seasons have been very dry relative to average annual conditions with all observations to-date made during years of between 38-85% mean annual precipitation and 22-82% mean annual flow. Sampling at the six locations over the three water years has included sampling between 7-10 storm events at each location. All samples collected by the RMP and CCCWP in Water Year 2014 were below applicable numeric water quality objectives in both the RMP-sampled North Richmond Pump Station watershed and the CCCWP-sampled Marsh Creek Watershed. At Marsh Creek two fathead minnow samples had 17% mortality rate (WY 2014 sample) and 42% mortality rate (WY 2013). Also, significant reductions in the survival of the amphipod *H. azteca* was observed during both WY 2012 storm events while WY 2013 and 2014 had complete mortality of *H. azteca* between 5 and 10 days of exposure to storm water during all storm events. At North Richmond Pump Station, no significant effects were observed for the crustacean *Ceriodaphnia dubia*, the algae *Selenastrum capricornutum*, or fathead minnows during any tests for either year of monitoring. Two of three WY 2013 samples had a significant decrease in *H. azteca* survival.

Citizen Monitoring and Participation (C.8.f)

CCCWP staff attends and participates in Contra Costa Watershed Forum (CCWF) meetings. The CCWF is an open committee of some fifty organizations, including state and local agencies, local nonprofit environmental and education organizations, community volunteer groups, and private citizens. Additionally, the CCCWP supports citizen and volunteer involvement with monitoring through maintenance of monitoring equipment made available to volunteer monitoring groups by the Contra Costa County Department of Conservation and Development, and by partnering with Contra Costa County Watershed Protection Program in support of the Community Watershed Stewardship Grants. Grants are awarded annually for projects such as: pollution prevention projects, trash mitigation and removal, watershed education, watershed group coordination, and low-impact design projects.

Reporting (C.8.g), Monitoring Protocols and Data Quality (C.8.h)

Provision C.8.g requires Permittees to report annually on water quality data collected in compliance with the MRP. For creek status monitoring, the RMC adapted existing creek status monitoring Standard Operating Protocols (SOPs) and Quality Assurance Project Plan (QAPP) developed by the Surface Water Ambient Monitoring Program (SWAMP) to document the field procedures necessary to maintain comparable, high quality data among RMC participants. Additionally, the RMC participants developed an Information Management System (IMS) to provide SWAMP-compatible storage and import/export of data for all RMC programs. For POC loads monitoring, a field manual and QAPP were developed through the Small Tributaries Loading Strategy (STLS) Workgroup. The Bay Area Stormwater Management Agencies Association (BASMAA) contracted with the San Francisco Estuary Institute (SFEI) to design and maintain an IMS for management of data from stations operated by the RMC programs. The IMS provides standardized data storage formats that allow RMC participants to share data among themselves and to submit data electronically to the SFBRWQCB and CVRWQCB.

1.0 Introduction

This *Urban Creeks Monitoring Report* was prepared by the Contra Costa Clean Water Program (CCCWP) per the Municipal Regional Permit (MRP) for urban stormwater issued by the San Francisco Bay Regional Water Quality Control Board (SFRWQCB; Order No. R2-2009-0074) and the East Contra Costa County Municipal NPDES Permit (Central Valley Permit) issued by the Central Valley Regional Water Quality Control Board (CVRWQCB; Order No. R5-2010-0102). This report (including all appendices and attachments) fulfills the requirements of the MRP and the Central Valley Permit Provision C.8.g.iii for interpreting and reporting monitoring data collected during Water Year (WY) 2014 (October 1, 2013 - September 30, 2014), the third year of water quality monitoring conducted under the MRP and Central Valley Permit. All monitoring data presented in this report were submitted electronically to the Water Boards by the CCCWP and may be obtained via the San Francisco Bay Area Regional Data Center (http://www.sfei.org/sfeidata.htm).

This report is organized into two main parts – the main body and appendices. The main body provides brief summaries of accomplishments made in WY 2014 in compliance with MRP and Central Valley Permit provision C.8. Summaries are organized by sub-provisions of the MRP and Central Valley Permit and grouped into the following sections:

1. Introduction (C.8.a)
2. San Francisco Estuary Receiving Water Monitoring (C.8.b)
3. Creek Status Monitoring (C.8.c)
4. Monitoring Projects (C.8.d)
5. Pollutants of Concern and Long-Term Trends Monitoring (C.8.e)
6. Citizen Monitoring and Participation (C.8.f)
7. Reporting (C.8.g), Monitoring Protocols and Data Quality (C.8.h)

Appendices to this report include interpretive reports focused on specific types of water quality monitoring required by the MRP and Central Valley Permit and are referenced within the applicable sections of the main body of this report.

Provision C.8.a of the MRP and Central Valley Permit allows Permittees to address monitoring requirements either through a "regional collaborative effort," through their countywide stormwater programs, or individually. In June 2010, Permittees notified the SFBRWQCB and CVRWQCB in writing of their agreement to participate in a regional monitoring collaboration to address requirements in Provision C.8. The collaboration is known as the Bay Area Stormwater Management Agencies Association (BASMAA) Regional Monitoring Coalition (RMC). In February 2011, the RMC developed a Multi-Year Work Plan (RMC Work Plan) to provide a framework for implementing regional monitoring and assessment activities required under MRP and Central Valley Permit provision C.8. The RMC Work Plan summarizes RMC projects planned for implementation between Fiscal Years 2009-10 and 2014-15. Projects were collectively developed by RMC representatives to the BASMAA Monitoring and Pollutants of Concern Committee (MPC). A total of 27 regional projects are identified in the RMC Work Plan, based on the requirements described in provision C.8 of the MRP and Central Valley Permit.

Regionally-implemented activities in the RMC Work Plan are conducted under the auspices of the BASMAA, a 501(c)(3) non-profit organization comprised of the municipal stormwater programs in the San Francisco Bay Area. Scopes, budgets, and contracting or in-kind project implementation mechanisms for BASMAA regional projects follow BASMAA's *Operational Policies and Procedures,* approved by the BASMAA Board of Directors. MRP Permittees, through their stormwater program representatives on the Board of Directors and its subcommittees, collaboratively authorize and participate in BASMAA regional projects and tasks. Regional project costs are shared by either all BASMAA members or among those Phase I municipal stormwater programs that are subject to the MRP[1].

The following MRP and Central Valley Permit reporting requirements (Provision C.8.g.iv) are addressed within the main body of this report and the associated appendices:

- Descriptions of monitoring purpose and study design rationale;
- QA/QC summaries for sample collection and analytical methods, including a discussion of any limitations of the data;
- Descriptions of sampling protocols and analytical methods;
- Tables and figures describing: sample location descriptions (including waterbody names, and latitudes/longitudes); sample ID, collection date (and time where relevant), media (e.g., water, filtered water, bed sediment, tissue); concentrations detected, measurement units, and detection limits;
- Data assessment, analysis, and interpretation;
- Pollutant load and concentration at each mass emissions station;
- A listing of volunteer and other non-Permittee entities whose data are included in the report; and
- Assessment of compliance with applicable water quality standards.

[1] The BASMAA programs supporting MRP Regional Projects include all MRP Permittees as well as the cities of Antioch, Brentwood, and Oakley which are not named as Permittees under the MRP but have voluntarily elected to participate in MRP-related regional activities.

2.0 San Francisco Estuary Receiving Water Monitoring (C.8.b)

As described in MRP provision C.8.b, Permittees are required to contribute their fair-share financially on an annual basis towards implementing an estuary receiving water monitoring program that at a minimum is equivalent to the Regional Monitoring Program for Water Quality in the San Francisco Estuary (RMP). Since the adoption of the MRP, all Permittees have complied with this provision by making financial contributions to the RMP. Additionally, Permittees actively participate in RMP committees and work groups through Permittee and/or stormwater program representatives.

The RMP is a long-term monitoring program that is discharger funded and shares direction and participation by regulatory agencies and the regulated community with the goal of assessing water quality in the San Francisco Bay. The regulated community includes Permittees, publicly owned treatment works (POTWs), dredgers, and industrial dischargers. The RMP is intended to answer the following core management questions:

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

The CCCWP contributes annually to the RMP. In WY 2014 the CCCWP contributed $144,821. The RMP budget is generally broken into two major program elements: Status and Trends, and Pilot/Special Studies. The following paragraphs provide a brief overview of these programs.

2.1 RMP Status and Trends Monitoring Program

The Status and Trends Monitoring Program (S&T Program) is the long-term contaminant-monitoring component of the RMP. The S&T Program was initiated as a pilot study in 1989 and redesigned in 2007 based on a more rigorous statistical design that enables the detection of trends. In WY 2014, the S&T Program was composed of the following program elements that collect data to address RMP management questions described in **Section 2.0** above:

- Water/Sediment/Bivalve Chemistry and Toxicity Monitoring
- Episodic Toxicity Monitoring
- Sport Fish Monitoring Studies
- Suspended Sediment, Sediment Transport, and Hydrography
- Bird Egg Monitoring

Additional information on the S&T Program and associated monitoring data are available from the RMP website using the Status and Trends Monitoring Data Access Tool at: www.sfei.org/rmp/wqt.

2.2 RMP Pilot and Special Studies

The RMP conducts Pilot and Special Studies (P/S Studies) on an annual basis. P/T Studies address specific scientific issues that RMP committees and standing workgroups identify as priority for further study. These studies are developed through an open selection process at the workgroup level and selected for funding through the RMP committees. Results and summaries of the P/S Studies can be found on the RMP website (www.sfei.org/rmp/).

2.3 Participation in Committees, Workgroups and Strategy Teams

In WY 2014, CCCWP representatives from the RMC actively participated in the following RMP Committees and work groups:

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

Representation included participating in meetings, reviewing technical reports and work products, co-authoring or reviewing articles included in the RMP's Pulse of the Estuary, and providing general program direction to RMP staff. Representatives of the RMC also provided timely summaries and updates to, and received input from stormwater program representatives (on behalf of Permittees) during MPC and/or BASMAA Board of Directors meetings to ensure Permittees interests were adequately represented.

3.0 Creek Status Monitoring (C.8.c)

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

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

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

3.1 Regional and Local Monitoring Designs

The RMC's regional monitoring strategy for complying with MRP and Central Valley Permit provision C.8.c, creek status monitoring, is described in *Creek Status and Long-Term Trends Monitoring Plan* (BASMAA 2011) and follows the January 2014 *Regional Monitoring Coalition Creek Status Monitoring Program Quality Assurance Project Plan* (BASMAA 2014). The strategy includes a regional ambient/probabilistic monitoring component and a component based on local "targeted" monitoring. The combination of these monitoring designs allows each individual RMC participating program to assess the status of beneficial uses in local creeks within its Program (jurisdictional) area, while also contributing data to answer management questions at the regional scale (e.g., differences between aquatic life condition in urban and non-urban creeks).

Creek status monitoring data were submitted by the CCCWP to the SFBRWQCB and CVRWQCB by January 15, 2015. The analyses of results from creek status monitoring conducted in WY 2014 are presented in **Appendix 1** (Regional/Probabilistic Creek Status Monitoring Report Water Year 2014) and **Appendix 2** (Local/Targeted Creek Status Monitoring Report Water Year 2014). **Table 1** provides a list of which parameters are included in regional and local reports and the following sections provide a brief summary of each report.

Table 1. Location of monitoring result analyses for each parameters in MRP Table 8.1.

Biological Response and Stressor Indicators	**Interpretative Report**	
	Appendix 1 Regional/Probabilistic Creek Status Monitoring Report WY 2014	**Appendix 2** Local/Targeted Creek Status Monitoring Report WY 2014
Bioassessment (Benthic Macroinvertebrates and Algae) & Physical Habitat Assessments	X	
Chlorine	X	
Nutrients	X	
Water Toxicity	X	
Sediment Toxicity	X	
Sediment Chemistry	X	
General Water Quality (Continuous)		X
Temperature (Continuous)		X
Pathogen Indicators		X
Stream Survey (CRAM)		X

3.1.1 Regional/Probabilistic Monitoring

The Regional/Probabilistic Creek Status Monitoring Report documents the results of monitoring performed by CCCWP during WY 2014 under the regional/probabilistic monitoring design developed by the RMC. During WY 2014, 10 sites were monitored by the CCCWP under the regional/probabilistic design for bioassessment, physical habitat, and related water chemistry parameters. Two of the 10 sites were also monitored for water and sediment toxicity and sediment chemistry.

The bioassessment and related data are used to develop a preliminary condition assessment for the monitored sites, to be used in conjunction with the stressor assessment based on sediment chemistry and toxicity. The water and sediment chemistry and toxicity data were used to evaluate potential stressors that may affect aquatic habitat quality and beneficial uses.

Based upon the bioassessment results (principally Benthic Index of Biological Integrity (B-IBI) scores from benthic macroinvertebrate taxonomy), the preliminary condition analysis indicates that sites monitored in WY 2014 and prior years may be impacted from the standpoint of aquatic life beneficial uses. The stressor analysis revealed the following potential stressors:

- Water Quality – Of 11 water quality parameters required in association with bioassessment monitoring, applicable water quality standards were only identified for ammonia, chloride, and nitrate + nitrite (sites with MUN beneficial use only). Of the results generated at the 10 sites monitored by CCCWP for those three parameters, two un-ionized ammonia concentrations and one chloride concentration exceeded the applicable water quality standard or threshold; each of those occurred at different sites. The MRP Table 8.1 trigger threshold for "Nutrients" (i.e., 20% of results in one water body exceed one or more water quality standards or applicable thresholds) was therefore exceeded at those three sites.
- Water Toxicity – Toxicity testing was performed for four test species in water samples collected by CCCWP from two sites during one wet weather event and one dry season event in WY 2014. Samples collected during the wet weather monitoring event (2/26/14) from the Grizzly Creek site exhibited significant acute toxicity (reduction in survival) *to Hyalella azteca (H. azteca)* and fathead minnows. Samples collected from both the San Pablo Creek and Grizzly Creek sites during the dry weather event (7/23/14) exhibited toxicity to *Ceriodaphnia dubia (C. dubia)* per the chronic endpoint (reproduction); the samples were not acutely toxic. None of the toxic water samples reached the MRP Table 8.1 and Central Valley Permit threshold (<50% of the control value) for follow-up action in WY 2014.
- Sediment Toxicity – Bedded sediment samples collected from the same two sites on San Pablo Creek and Grizzly Creek on 7/23/14 were not toxic to the test species (*H. azteca*).
- Sediment Chemistry – Bedded sediment samples were collected from the same two sites on San Pablo Creek and Grizzly Creek on 7/23/14 and analyzed for a suite of sediment chemistry constituents. Analytical results produced less evidence of potential stressors than samples analyzed in WY 2012 and 2013, based on the criteria from MRP Table H-1 (equivalent to Central Valley Permit Table D-1). Neither of the sediment chemistry samples resulted in three or more constituents with Threshold Effect Concentration (TEC) quotients greater than 1.0[2], or a mean Probable Effect Concentration (PEC) quotient >

[2] For nearly all sites, chromium and nickel concentrations in sediment exceeded TEC values. Considering that both metals are naturally occurring at relatively high levels in Bay Area soils, and concentrations generally exceed TEC values in reference or non-urban sites, TEC values presented in MacDonald et al. (2000) may not be applicable to the Bay Area. These observations should be considered in future evaluations of sediment chemistry data collected by RMC participants in Bay Area creeks.

0.5, or a sum of Toxicity Unit (TU) equivalents for all measured pyrethroids greater than or equal to 1.0. The pyrethroid pesticide bifenthrin was found in both creek sediment samples, but not at levels expected to cause toxicity to test organisms.

- Sediment Triad Analyses – Bioassessment, sediment toxicity, and sediment chemistry results were evaluated as the three lines of evidence used in the triad approach for assessing overall stream condition. For the two sites evaluated in WY 2014, follow-up action is not required based on the triad analysis.

3.1.2 Local/Targeted Monitoring

The Local/Targeted Creek Status Monitoring Report documents the results of targeted monitoring performed by CCCWP during WY 2014. Within Contra Costa County, targeted monitoring was conducted at:

- Four continuous water temperature monitoring locations
- Two general water quality monitoring locations
- Five pathogen indicator monitoring locations
- Ten riparian assessment monitoring locations

During the three years studied thus far, winter seasons have been very dry relative to average annual conditions with all observations to-date made during years of between 38-85% mean annual precipitation and 22-82% mean annual flow. Targeted monitoring data, with the exception of California Rapid Assessment Method (CRAM) results and specific conductivity, were evaluated against numeric Water Quality Objectives (WQOs) or other applicable criteria, as described in the MRP and Central Valley Permit Table 8.1. The results are summarized below:

- Temperature – A weekly running average maximum daily temperature (MWAT) of 20.5°C was used as the applicable criterion to evaluate temperature data. At the four stations with continuously recorded temperature from April until October, two stations (Willow Avenue @ Rodeo Creek [206RDO1024] and Investment Street @ Rodeo Creek [206RDO033]) had results that exceeded the MWAT threshold. At both of the other sites, no results were above the MWAT threshold.

- Dissolved Oxygen (DO) – WQOs for dissolved oxygen (DO) in non-tidal waters are applied as follows: 7.0 mg/L minimum for waters designated as cold habitat (COLD) and 5.0 mg/L minimum for waters designated as warm water habitat (WARM). These were used to define thresholds for evaluating DO data for Rodeo Creek and San Pablo Creek. DO concentrations measured below both the COLD and WARM thresholds at Rodeo Creek substantially during the both the April and August deployments. At San Pablo Creek during both deployments, there were no results that measured lower than either threshold.

- pH – pH measurements at Rodeo Creek and San Pablo Creek were within WQOs of 6.5 – 8.5.

- Pathogen Indicator Bacteria – Single sample maximum concentrations of 400 MPN/100 ml fecal coliform (SFBRWQCB 2011) and 410 MPN/100 ml *E. coli* (USEPA 2012) were used as Water Contact Recreation evaluation criteria for the purposes of this evaluation. Samples for fecal coliform and *E.coli* at two of the five stations (Grizzly Creek [207R00843] and Rodeo Creek [206RD0003]) exceeded the maximum single sample concentrations.

Applicable criteria have not been developed for CRAM. The application of CRAM in urban creeks of the San Francisco Bay Region is relatively recent and results should be considered preliminary. Further analysis of existing data and additional information are needed to comprehensively evaluate the utility of CRAM data for assessing stream ecosystem health and aquatic life uses.

4.0 Monitoring Projects (C.8.d)

Three types of monitoring projects are required by provision C.8.d of the MRP:

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

The overall scopes of these projects are generally described in the MRP and Central Valley Permit and the RMC Work Plan. Based on MRP compliance schedules for these provisions, Permittees were generally focused on conducting Part A of the stressor/source identification studies during WY 2014. The results of projects conducted by RMC participants in compliance with provisions C.8.d.ii (BMP Effectiveness) and C.8.d.iii (Geomorphic Project) were presented in the Integrated Monitoring Report submitted to the SFBRWQCB and CVRWQCB in March 2014.

4.1 Stressor/Source Identification Studies

The CCCWP is responsible for performing related follow-up studies triggered by the creek status monitoring. In WY 2012 and WY 2013, the CCCWP's Creek Status Monitoring triggered exceedances for water and sediment toxicity parameters. Both Dry Creek (site 544R00025; Central Valley Region) and Grayson Creek (site 207R00011; San Francisco Bay Region) exhibited water toxicity to *H. azteca* in creek samples collected during wet weather in WY 2012, and retests in WY 2013 confirmed the findings. In July 2012, sediment toxicity testing also revealed toxicity to *H. azteca* in sediment samples from both creeks. Though no other test species were adversely affected by the water toxicity testing, sediment chemistry testing indicated elevated levels of sediment contaminants, and bioassessment monitoring of both creeks reported "Very Low" scores for the B-IBI. The combination of these results triggered the current Stressor/Source Identification (SSID) Studies, which fulfill CCCWP's obligation for follow up actions under the MRP and Central Valley Permit.

As follow up actions to WY 2012 and WY 2013 creek status monitoring, the CCCWP developed a Stressor/Source ID Study Concept Plan (CCCWP 2014a). The Concept Plan includes four parts, corresponding to the four steps required for SSID Studies.

- Part A: Evaluate and investigate the causes and extent of the observed creek toxicity to *H. azteca* in Dry Creek and Grayson Creek watershed (WY 2014.)
- Part B: Identification of potential sources of the pollutant(s) or stressor(s) (WY 2015)
- Part C: Identification and evaluation of potential abatement measures (WY 2016)
- Part D: Evaluate effectiveness of implemented control measures (WY 2019)

Part A of the CCCWP SSID studies seeks to: 1) identify the causes of the observed water and sediment toxicity to *H. azteca* in Dry Creek and Grayson Creek; and, 2) identify temporal and spatial patterns in toxicity and stressors, and better characterize the spatial extent of sediment toxicity impacts. The SSID Part A studies involved both wet weather monitoring for aquatic (water column) chemistry and toxicity, and dry weather monitoring for sediment chemistry and toxicity.

4.1.1 Site Description and Methods

In WY 2014, monitoring was performed at upstream and downstream of the original sampling locations for the two SSID studies, Dry Creek and Grayson Creek, during two wet weather events and one dry weather event. A description of the number and type of samples collected is summarized in **Table 2.** A full description of the methods of collection, standard sample collection procedures, as well as methods of testing and analysis, can be found in **Appendix 3.**

Table 2. SSID Samples Collected (Number and Type)

Parameter Samples	Wet Weather Water Samples	Dry Weather Sediment Samples
Pyrethroid Pesticides	8	2
Fipronil & Degradates	8	2
Organochlorine Pesticides	8	2
Total Organic Carbon	8	2
Suspended Sediment	8	0
Percent Solids	0	2
Dissolved Oxygen	8	2
Specific Conductance	8	2
pH	8	2
Temperature	8	2
Toxicity (*H. azteca)*	8	2

A Toxicity Identification Evaluation (TIE) was performed on a toxic sample for each matrix condition: water (wet weather) and sediment (dry weather). Through the application of different treatment conditions used to amplify or disrupt specific toxicity pathways, the SSID study was able to identify the source of toxicity in the two creeks. Additional information regarding the TIE methods can be found in **Appendix 3**.

4.1.2 Results

The analysis of data generated in the monitoring study conducted for Part A of the CCCWP SSID studies concluded:

- Current-use pesticides – Current-use pesticides were commonly detected in both water and sediment samples of both creeks, including fipronil and its common degradate compounds, as well as several pyrethroid pesticides.
- Dichlorodiphenyltrichloroethane (DDT) – Four DDT breakdown products (variants of dichlorodiphenyldichloroethylene (DDE) and dichlorodiphenyldichloroethane (DDD)) were detected in both the upstream and downstream sediment samples from Dry Creek.
- Toxicity – Toxicity was observed when testing *H. azteca* in all wet weather samples from Dry Creek and Grayson Creek, and in both of the Dry Creek sediment (dry weather) samples.
- Pyrethroid Pesticides – The concentrations of pyrethroid pesticides measured were sufficient to account for the toxicity observed in all eight toxic water samples (upstream and downstream samples for two wet weather events in both Dry Creek and Grayson Creek watersheds) and the two (Dry Creek) toxic sediment samples.

TIE analyses performed on one toxic wet weather water sample and one toxic dry weather sediment sample provided evidentiary support for the idea that pyrethroid pesticides were likely to be the principal cause of the observed toxicity in both water and sediment samples. Part B of the SSID studies will be performed during WY 2015.

4.2 BMP Effectiveness Investigations

Details of the BMP effectiveness investigation were presented in the Integrated Monitoring Report, WY 2012 and WY 2013: Part A, Appendix A-4 (CCCWP 2014a).

4.3 Geomorphic Projects

Details of the geomorphic projects were presented in the Integrated Monitoring Report, WY 2012 and WY 2013: Part A, Appendices A-5 and A-6 (CCCWP 2014a).

5.0 Pollutants of Concern and Long-Term Trends Monitoring (C.8.e)

5.1 POC Loads Monitoring

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

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

To assist Permittees in effectively and efficiently conducting POC loads monitoring required by the MRP and Central Valley Permit and answer POC loads management questions listed above, an RMP Small Tributaries Loading Strategy (STLS) was developed in 2009 by the STLS Team, which included representatives from BASMAA, Water Board staff, RMP/SFEI, and technical advisors. The objective of the STLS was to develop a comprehensive planning framework to coordinate POC loads monitoring/modeling between the RMP and RMC participants.

Based on the consensus of the STLS Team, RMC representatives in coordination with SFEI staff created a STLS Multi-Year Plan intended to assist Permittees in complying with provision C.8.e (POC Monitoring) through an alternative POC monitoring program other than the one described in the MRP. The alternative STLS Multi-year Plan is designed to address the four core POC loads monitoring management questions, while integrating activities funded by BASMAA via the RMC with those funded by the RMP. The STLS Multi-year Plan provides a comprehensive description of activities that will be implemented over the next 5-10 years to provide information and comply with the MRP. The STLS Multi-year Plan provides rationale for the methods and locations of proposed activities to answer the four management questions listed above. Activities include modeling using the regional watershed spreadsheet model (RWSM) to estimate regional scale loads, and pollutant characterization and loads monitoring in local tributaries beginning WY 2011, continuing in WY 2012 and WY 2013, and largely completed in WY 2014.

The framework and a summary of activities and products to date are provided in the STLS Multi-Year Plan (SFEI 2013). With concurrence of participating Water Board Staff, the STLS Multi-Year Plan presents an alternative approach to the POC loads monitoring requirements described in MRP Provision C.8.e.i, as allowed by Provision C.8.e.

In July 2014, the CCCWP submitted a request and rationale for an additional alternative approach to POC and Long-Term Trends Monitoring (**Appendix 5**), which was accepted by both Regional Water Boards. The CCCWP proposed to:

1. Sample no more than two storms at the existing March Creek POC loads station for mercury, methylmercury, and suspended sediment concentrations. The sampling would be timed to capture upper watershed flow (i.e., flow from the March Creek Reservoir).
2. Conduct PCB source identification studies, following the approach proposed in the Integrated Monitoring Report, Part C, submitted in March 2014 (CCCWP 2014c).
3. Increase the number of Low-Impact Development (LID) effectiveness evaluation samples collected and analyzed as part of the approved methylmercury control study plan.

Updates on the methylmercury and PCB efforts are summarized in the following paragraphs.

Methylmercury Control Study
The Methylmercury Control Study is currently being conducted in two phases. Phase 1 is Watershed Assessments, which consist of characterization grab sampling in eastern Contra Costa County during both dry- and wet-weather. The first of three dry-weather samples at seven locations were collected on January 14, 2015. During the next viable storm event, the first of three wet-weather samples at three locations will be collected. Also, methylmercury sampling that has been performed over the past three water years at the POC monitoring station on Lower Marsh Creek will be used in the Phase 1 characterization (the POC station is one of the eight stations selected for monitoring).

Phase 2 of the Methylmercury Control Study, the BMP effectiveness evaluation, is underway. The evaluation is being conducted at two bioretention treatment sites on Cutting Blvd in Richmond. This work is being performed in conjunction with sampling being performed for the BASMAA EPA grant-funded study Clean Watersheds for a Clean Bay (CW4CB). To date, three of four storms have been sampled (November 22, 2014, December 2, 2014 and December 14, 2014).

PCB Source Identification Studies
Permit provisions C.11 and C.12 of the MRP require Bay Area Permittees to implement pilot-scale control measures to reduce PCBs and mercury in MS4 discharges and to evaluate the cost effectiveness of these measures. Lessons learned from the pilot studies, summarized in the 2014 IMR (CCCWP 2014b), and additional implementation actions are intended to inform "focused implementation" in the next permit.

CCCWP and Permittee staff have been conducting source area screening to delineate High, Moderate, and Low/No Opportunity parcels for consideration in focused implementation planning. The CCCWP prepared a guidance document and map files to assist the Permittees in identifying potential PCB source properties through the refinement of the draft source area maps contained in the IMR and a preliminary source property database. Using multiple lines of evidence (e.g., institutional knowledge, records review, windshield surveys, facility inspections, and sampling results), the properties in the database will eventually be categorized as High, Moderate, or Low/No Opportunity for consideration of control measure implementation. As a first step, the Permittees carefully reviewed the parcel database through a desktop screening process. The Permittees are currently conducting windshield surveys of those properties that were considered Potential High Opportunity after the desktop screening. Screening results provided by the Permittees have been used by CCCWP to update the underlying GIS layers and to develop revised source area maps.

5.1.1 STLS Multi-Year Plan Activities

The STLS Multi-Year Plan includes four main elements that collectively address the four priority management questions for POC monitoring:

- Watershed modeling (Regional Watershed Spreadsheet Model)
- Bay margins modeling
- Source-area runoff monitoring
- Small tributaries monitoring

The following paragraphs briefly summarize each of these elements and activities conducted on each element:

Watershed modeling (Regional Watershed Spreadsheet Model)
The Regional Watershed Spreadsheet Model (RWSM) is being updated with the most recent versions of the land use and source area GIS layers. SFEI is evaluating and making available the current version of the GIS layers that were used in the previous RWSM calibration efforts (http://www.sfei.org/projects/spreadsheet-model-estimating-loads-small-tributaries).

Bay margins modeling
SFEI has proposed to perform additional bay margins modeling work in WY 2015 for PCBs. The work proposed would consist of planning activities to prioritize margin units and select an optimal subset for detailed conceptual evaluation and monitoring. This would be followed by the implementation of monitoring in the one or two units of greatest interest in 2016, in parallel with development of conceptual models and monitoring plans for the other few units of greatest interest.

Source-area runoff monitoring
This element of the STLS is intended as a placeholder for studies to develop event mean concentrations (EMCs) of POCs to parameterize the (RWSM). On the advice of the Sources, Pathways and Loadings Workgroup, initial RMP studies used alternative approaches to “back-calculate” EMCs from available data as a cost-effective way to support the first iteration of the RWSM. The STLS work group received progress updates on initial modeling results in 2013 and will determine priorities for possible field-data collection source-area runoff in Water Year 2015.

Small tributaries monitoring
For this STLS element, the approach outlined in the STLS Multi-Year Plan consists of intensively monitoring a total of six “bottom-of-watershed” stations over several years to accumulate samples needed to calibrate the watershed model and assist in developing loading estimates from small tributaries for priority POCs. Monitoring is also intended to provide a more limited characterization of additional lower-priority analytes. Water Year 2014 was the third year of monitoring activities at four stations throughout the RMP region that were set up and mobilized beginning in October 2011. The North Richmond Pump Station and the Pulgas Pump Station, were established in October 2012 to complete the phasing in of watershed stations. The six stations are as follows:

- Lower Marsh Creek (Contra Costa County)
- Guadalupe River (Santa Clara County)
- Lower San Leandro Creek (Alameda County)
- Sunnyvale East Channel (Santa Clara County)
- North Richmond Pump Station (Contra Costa County)
- Pulgas Pump Station (San Mateo County)

During the three years studied thus far, winter seasons have been very dry relative to average annual conditions with all observations to-date made during years of between 38-85% mean annual precipitation and 22-82% mean annual flow. Sampling at the six locations over the three water years has included sampling between 7-10 storm events at each location. Monitoring methods and laboratory analyses according to the descriptions in the STLS Multi-Year Plan are documented in a field manual and quality assurance project plan (QAPP) (SFEI 2013). For WY 2012-2014, BASMAA contracted with SFEI to coordinate laboratory analyses, data management, and data quality assurance to ensure data consistency among all watershed monitoring stations.

5.1.2 Water Year 2014 Results

The preliminary results of POC monitoring conducted in WYs 2012-2014 by the STLS Workgroup are presented in **Appendix 4**. POC monitoring activities conducted by the CCCWP during this period are summarized below. Analytical methods used are summarized in **Table 3** below.

Table 3. Laboratory analysis methods.

Analyte	Analytical Method	Analytical Laboratory
Carbaryl	EPA 632M	DFG WPCL
Fipronil	EPA 619M	DFG WPCL
Suspended Sediment Concentration	ASTM D3977-97B	Caltest Analytical Laboratory
Total Phosphorus	SM20 4500-P E/SM 4500-P F	Caltest Analytical Laboratory
Nitrate	EPA 353.2/SM20 4500-NO3 F	Caltest Analytical Laboratory
Dissolved Orthophosphate	SM20 4500-P E	Caltest Analytical Laboratory
PAHs	AXYS MLA-021 Rev 10	AXYS Analytical Services Ltd.
PBDEs	AXYS MLA-033 Rev 06	AXYS Analytical Services Ltd.
PCBs	AXYS MLA-010 Rev 11	AXYS Analytical Services Ltd.
Pyrethroids	EPA 8270Mod (NCI-SIM)	Caltest Analytical Laboratory
Total Methylmercury	EPA 1630M Rev 8	Caltest Analytical Laboratory
Total Mercury	EPA 1631EM Rev 11	Caltest Analytical Laboratory
Copper[1]	EPA 1638M	Caltest Analytical Laboratory
Selenium[1]	EPA 1638M	Caltest Analytical Laboratory
Total Hardness[2]	SM 2340 C	Caltest Analytical Laboratory
Total Organic Carbon	SM20 5310B	Caltest Analytical Laboratory
Toxicity[3]	See 2 below	Pacific Eco-Risk Labs

[1] Dissolved selenium and dissolved copper were field filtered and field acidified (HNO_3) at the Lower Marsh Creek and San Leandro Creek stations.
[2]Hardness is a calculated property of water based on magnesium and calcium concentrations. The formula is: Hardness (mg/L) = (2.497 [Ca, mg/L] + 4.118 [Mg, mg/L]). Total Hardness was field acidified at all stations in WY 2014.
[3] Toxicity testing includes: chronic algal growth test with *Selenastrum capricornutum* (EPA 821/R-02-013), chronic survival & reproduction test with *Ceriodaphnia dubia* (EPA 821/R-02-013), chronic survival and growth test with fathead minnows, *Pimephales promelas* (EPA 821/R-02-013), and 10-day survival test with *Hyalella azteca* (EPA 600/R-99-064M).

Comparisons to Numeric Water Quality Objectives/Criteria for Specific Analytes

MRP Provision C.8.g.iii ("Urban Creeks Monitoring Report") requires RMC participants to assess all data collected pursuant to Provision C.8 for compliance with applicable water quality standards. This section of the report provides an assessment of data collected at the POC monitoring stations in WY 2012-2014[3]. When conducting a comparison to applicable water

[3]An assessment of data collected in compliance with Provision C.8.c ("Creek Status Monitoring") is provided in Appendices 1 and 2.

quality objectives/criteria, certain considerations should be taken into account to avoid the mischaracterization of water quality data:

- **Freshwater vs. Saltwater** – POC monitoring data were collected in freshwater receiving water bodies above tidal influence and, therefore, comparisons were made to freshwater water quality objectives/criteria.
- **Aquatic Life vs. Human Health** – Comparisons were primarily made to objectives/criteria for the protection of aquatic life, not objectives/criteria for the protection of human health to support the consumption of water or organisms. This decision was based on the assumption that water and organisms are not likely being consumed from the creeks monitored.
- **Acute vs. Chronic Objectives/Criteria** – For POC monitoring required by Provision C.8.e, data were collected in an attempt to develop more robust loading estimates from small tributaries. Therefore, detecting the concentration of a constituent in any single sample was not the primary driver of POC monitoring. Monitoring was conducted during episodic storm events, and the results do not likely represent long-term (chronic) concentrations of monitored constituents. POC monitoring data collected in WY 2012-2014 were therefore compared to "acute" water quality objectives/criteria for aquatic life that represent the highest concentrations of an analyte to which an aquatic community can be exposed briefly (e.g., one hour) without resulting in an unacceptable effect. For analytes for which no water quality objectives/criteria have been adopted, comparisons were not made.

It is important to note that water quality objectives or criteria have been promulgated for only a subset of the analytes collected at POC monitoring stations. These include objectives for trace metals (i.e., copper, selenium, and total mercury) and polychlorinated biphenyls (PCBs). **Table 4** and
Table 5 provide a comparison of data collected in WY 2012-2014 at the CCCWP sites to applicable numeric water quality objectives/criteria for these analytes. Of these analytes, the MRP contains provisions addressing mercury (Provision C.11), copper (Provision C.13), and selenium (Provision C.14).

All samples collected in Water Year 2014 were below applicable numeric water quality objectives (i.e., freshwater acute objective for aquatic life) for mercury, selenium and copper in both the North Richmond Pump Station watershed (**Table 4**) and the Marsh Creek Watershed (
Table 5). For all other analytes measured via POC monitoring in WY 2012-2014 (e.g., pyrethroid pesticides and polycyclic aromatic hydrocarbons), the State of California has yet to adopt numeric water quality objectives applicable to beneficial uses of interest. An assessment of compliance of applicable water quality standards cannot be conducted for these analytes at this time.

Table 4. Comparison of POC loads monitoring data to applicable numeric water quality objectives and water quality criteria for Water Years 2013 and 2014 in the North Richmond Pump Station Watershed (collected by the San Francisco Estuary Institute)

Year	Analyte	WQO/ WQC (µg/L)	# of Samples > WQO/ WQC
2013	Copper, dissolved	13	0/3
	Selenium, total	20	0/3
	Mercury, total	2.1	0/12
2014	Copper, dissolved	13	0/5
	Selenium, total	20	0/5
	Mercury, total	2.1	0/20

*The copper water quality objective is hardness dependent and therefore comparisons were made based on hardness values of samples collected synoptically with samples analyzed for copper. The objective presented in the table is based on a hardness of 100 mg/L.

Type of WQO/WQC: Freshwater Acute Water Quality Objective for Aquatic Life (1-hr average)
Source of WQO/WQC: San Francisco Bay Water Quality Control Plan (SFBRWQCB 2011)

Table 5. Comparison of POC loads monitoring data to applicable numeric water quality objectives and water quality criteria for Water Years 2012, 2013 and 2014 in the Marsh Creek Watershed (collected by the San Francisco Estuary Institute)

Year	Analyte	WQO/ WQC (µg/L)	# of Samples > WQO/ WQC
2012	Copper, dissolved	13*	0/2
	Selenium, total	20	0/2
	Mercury, total	2.1	0/8
2013	Copper, dissolved	13	0/4
	Selenium, total	20	0/4
	Mercury, total	2.1	0/17
2014	Copper, dissolved	13	0/2
	Selenium, total	20	0/2
	Mercury, total	2.1	0/6

*The copper water quality objective is hardness dependent and therefore comparisons were made based on hardness values of samples collected synoptically with samples analyzed for copper. The objective presented in the table is based on a hardness of 100 mg/L.
Type of WQO/WQC: Freshwater Acute Water Quality Objective for Aquatic Life (1-hr average)
Source of WQO/WQC: San Francisco Bay Water Quality Control Plan (SFBRWQCB 2011), Central Valley Regional Water Quality Control Plan (CVRWQCB 2011)

Summary of Toxicity Testing Results

In addition to comparisons of data for specific analytes, the results of toxicity testing conducted on water samples collected during storm events in WY 2012-2014 were evaluated in the context of adopted water quality objectives. Toxicity testing was conducted at each POC monitoring station using four different types of test organisms, as follows:

- *Pimephales promelas* (freshwater fish: fathead minnow)
- *Hyalella azteca* (amphipod)
- *Ceriodaphnia dubia* (crustacean)
- *Selenastrum capricornutum* (algae)

Composite water samples were collected at the Marsh Creek station during two storm events in WY 2012, four storm events in WY 2013 and two events in WY 2014. Two of the freshwater fish*Pimephales promelas* samples had 17% mortality rate (WY 2014 sample) and 42% mortality rate (WY 2013). Significant reductions in the survival of the amphipod *Hyalella azteca* was observed during both WY 2012 storm events while WY 2013 and 2014 had complete mortality of *H. azteca* between 5 and 10 days of exposure to storm water during all storm events. At North Richmond Pump Station, no significant effects were observed for the crustacean *Ceriodaphnia dubia*, the algae *Selenastrum capricornutum*, or fathead minnows during any tests for either year of monitoring. Two of three WY 2013 samples had a significant decrease in *H. azteca* survival. One sample showed an 88% survival rate compared to a 98% lab survival rate. The other sample showed a 12% survival rate compared to a 100% lab survival rate. In the five storm WY 2014 storm events, mortality of *H. azteca* ranged from 8% to 80%.

5.1.3 Selection of Water Year 2015 Stations

After three years of monitoring during relatively dry climatic conditions, some data gaps remain for both of the monitoring locations in Contra Costa County.

- Marsh Creek watershed has been sampled for three water years. Continuous turbidity data were rated excellent at Lower Marsh Creek. Ample lower watershed stormwater runoff data are now available at Lower Marsh Creek, but this site is lacking information on high intensity upper watershed rain events where sediment mobilization from the historic mercury mining area could occur. Any future sampling would ideally be focused on Hg and for storms of greater intensity preferably when spillage is occurring from the upstream reservoir. No further PCB data are recommended. Marsh Creek, which has rural and recent urbanization land uses and few suspected source areas for PCBs, has exhibited lower inter-annual variability and therefore require less sampling to adequately quantify pollutant source-release-transport processes. The sampling design to achieve these goals could be revisited with the objective of increased cost efficiency for data gathering to support remaining unanswered management questions.

- North Richmond Pump Station watershed has been sampled for two water years. Although some data exist, further data in relation to early season (seasonal 1st flush or early season storms) would help improve estimates of loads that could be averted from diversion of early season storms to wastewater treatment. Further data collection in relation to high concentrations of PBDEs would increase our understanding of the existence of PBDE source in this watershed.

To help answer MQ4, sampling during WY 2015 will use the following reconnaissance characterization design:

- Collaboration with stormwater Countywide programs to identify locations with possible PCB and/or mercury sources (based on a GIS based analysis)
- Focused sampling in near Bay (some of which are tidally influenced), older industrial drainages
- Composite sampling design implemented: 1 composite per storm, per analyte for PCB, total mercury, total metals, suspended sediment concentration, grain size, total organic carbon, and dissolved organic carbon
- Pilot testing passive sediment samplers

An advantage of the reconnaissance sampling design is flexibility. Given recent advances on the development of the RWSM (SFEI in preparation), which has indicated the value of data collected using the reconnaissance design, it seems likely that the reconnaissance design may end up being the most cost-effective going forward over the next three or more years. Data and information gathered over the last 10+ years guided by the SPLWG and STLS will continue to help guide the development of a cost effective monitoring design to adapt to changing management needs.

5.2 Long-Term Trends Monitoring

In addition to POC loads monitoring, Provision C.8.e requires Permittees to conduct long-term trends monitoring to evaluate whether stormwater discharges are causing or contributing to toxic impacts on aquatic life. Required long-term monitoring parameters, methods, intervals, and occurrences are included as Category 3 parameters in MRP Table 8.4, and prescribed long-term monitoring locations are included in MRP Table 8.3. The CCCWP collected samples according to these tables, with approved modifications. Similar to creek status and POC loads monitoring, long-term trends monitoring was scheduled to begin in October 2011 for RMC participants.

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

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

Based on discussions with Region 2 SWAMP staff, RMC participants intend to comply with MRP Provision C.8.e that are associated with long-term trends via monitoring conducted by the SPoT program. This manner of compliance is consistent with the MRP language in Provision C.8.e.ii. RMC representatives will continue to coordinate with the SPoT program on long-term monitoring to ensure MRP monitoring and reporting requirements are addressed.5 Additional information on the SPoT program can be found at: http://www.waterboards.ca.gov/water_issues/programs/swamp.

5.2.1 Sediment Delivery Estimate/Budget

Provision C.8.e.vi of the MRP requires Permittees to develop a design for a robust sediment delivery estimate/sediment budget in local tributaries and urban drainages, and implement the study by July 1, 2012. This work has already been completed and reported on in previous Water Years.

5.2.2 Emerging Pollutants Work Plan

Provision C.8.e.vii of the MRP requires Permittees to develop a work plan and schedule for initial loading estimates and source analyses for contaminants of emerging concern (CECs). This work plan has already been developed and included in the 2014 IMR (CCCWP 2014a).

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

In compliance with Provision C.8.f, Permittees are required to make reasonable efforts to seek out citizen and stakeholder input regarding water body function and quality, and to demonstrate within annual reports of their outreach efforts to these groups. CCCWP staff attends and participates in Contra Costa Watershed Forum (CCWF) meetings, an open committee of approximately fifty creek and watershed organizations, including state and local agencies, local nonprofit environmental and education organizations, community volunteer groups, and private citizens. The CCWF operates on the premise that actions in a watershed are inter-related and that broad participation and cooperation is needed to affect change. Members of the CCWF work together in an effort to find common approaches to making local water resources healthy, functional, attractive, and safe community assets.

The CCCWP supports citizen and volunteer involvement with monitoring through partnering with Contra Costa County in support of the Community Watershed Stewardship Grant program. This funding source was established to fund various creek restoration and education projects throughout the County. The grant process is administered by a non-profit watershed organization. Watershed coordinators establish a nexus between the Community Watershed Stewardship Grant program and citizen monitoring. Watershed coordinators are the first point of contact to organize citizen groups who are interested in participating in stream assessments, creek cleanups, and other volunteer activities. Grants are awarded annually in the amount of $5,000 - $20,000 per project. Typical projects include pollution prevention projects, trash mitigation & removal, watershed education, watershed group coordination, and low-impact design projects.

Eighty percent of the funds are allocated to projects that demonstrate a benefit to the unincorporated regions of the County and 20% to projects in the incorporated cities of Contra Costa County. In WY 2014, the Contra Costa County Watershed Protection Program funded $80,000 in Community Watershed Stewardship grants, matched by $20,000 from the CCCWP. Grants awarded in WY 2014, are listed in **Table 6** below.

Table 6. Grant recipients and projects funded by the Watershed Stewardship Grant program in Water Year 2014.

Recipient	Project
Contra Costa Resource Conservation District	Alhambra Creek Watershed Council Watershed Coordinator
Earth Team	Aqua Team
Contra Costa Resource Conservation District	Rodeo Creek Community Watershed Stewardship Program
Friends of Marsh Creek Watershed	Water Pollution Prevention of Marsh Creek Watershed and Expansion of FOCW
SPAWNERS	San Pablo Creek Watershed Stewardship Program
Golden Gate Audubon	Bay View Elementary Bird Friendly Bioswale Design
Save Mount Diablo	Creek Restoration and Habitat Enhancement Projects in Kirker, Marsh, and Hess Creeks
Bringing Back the Natives Garden Tour	Garden tours
Contra Costa Resource Conservation District	Walnut Creek Watershed part-time Coordinator

7.0 Reporting, Data Quality, Data Management (C.8.g)

Provision C.8.g requires Permittees to report annually on water quality data collected in compliance with the MRP and Central Valley Permit. Annual reporting requirements include:

1. Water quality standard exceedances;
2. Creek status monitoring electronic reporting; and
3. Urban creeks monitoring reporting.

For RMC participants, annual reporting requirements began with the initial creek status monitoring electronic data submittal to the SFBRWQCB and CVRWQCB that occurred on January 15, 2013. Preliminary evaluations of data compared to water quality objectives were included in these submittals. Additional evaluations of data collected pursuant to provision C.8 are included in this Urban Creeks Monitoring Report and associated appendices.

Provision C.8.h requires that water quality data collected by Permittees in compliance with the MRP and Central Valley Permit should be of a quality that is consistent with the State of California's Surface Water Ambient Monitoring Program (SWAMP) standards, set forth in the SWAMP Quality Assurance Project Plan (QAPP). To assist Permittees in meeting SWAMP data quality standards and developing data management systems that allow for easy access of water quality monitoring data by Permittees, the RMC made significant progress on the following regional projects during the period of this report:

- Standard Operating and Data Quality Assurance Procedures
  - For creek status monitoring, the RMC adapted existing Standard Operating Protocols (SOPs) and QAPP developed by SWAMP to document the field procedures necessary to maintain comparable, high quality data among RMC participants. The RMC Creek Status Monitoring Program QAPP was finalized in January 2014 (BASMAA 2014).
  - For POC loads monitoring, a draft field manual and QAPP were developed through the STLS Workgroup and described in the STLS Multi-Year Plan. BASMAA implemented a master contract with SFEI to contract for laboratory analyses for all sites operated by RMC programs, as well as those operated by SFEI for the RMP.

- Information Management System Development/Adaptation
  - For creek status monitoring, the RMC participants developed an Information Management System (IMS) to provide SWAMP-compatible storage and import/export of data for all RMC programs. A data management subgroup of the RMC met periodically for training and review of data management issues, and suggested enhancements for data checking and to increase efficiency. These enhancements were implemented in 2013.
  - For POC loads monitoring, BASMAA contracted with SFEI to design and maintain an IMS for management of data from stations operated by the RMC programs. SFEI also provided ongoing updates to the management system and performed quality assurance review of the data collected by RMC programs, consistent with the QAPP for data collected through the RMP. The IMS provides standardized data storage formats that allow RMC participants to share data among themselves and to submit data electronically to the SFBRWQCB and CVRWQCB.

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Appendix 1

Regional/Probabilistic Creek Status Monitoring Report, Water Year 2014

Regional/Probabilistic Creek Status Monitoring Report Water Year 2014

(October 1, 2013 – September 30, 2014)

Prepared for:

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FINAL March 2, 2015

Acknowledgements

This report is in large part derived from the Regional Monitoring Coalition (RMC) Urban Creeks Monitoring Report (UCMR) for Water Year 2012, Appendix A, Regional Urban Creeks Status Monitoring Report, prepared by EOA, Inc. and Armand Ruby Consulting. Analyses contained herein derive in general from the methods, results and formats presented within the WY 2012 Regional UCMR.

In addition to the RMC participants, San Francisco Bay Regional Water Quality Control Board staff, Kevin Lunde and Jan O'Hara, participated in RMC workgroup meetings that contributed to the design and implementation of the RMC Monitoring Plan. These staff also provided input on the outline of the initial *Regional Urban Creeks Status Monitoring Report* and threshold trigger analyses conducted herein.

Staff of the Contra Costa Clean Water Program, specifically Lucile Paquette and Tom Dalziel, provided review of draft documents. Alessandro Hnatt served as project manager for ADH Environmental, lead consultant to CCCWP. Staff of ADH Environmental also contributed to the production of this report.

Preface

The Bay Area Stormwater Management Agencies Association (BASMAA) Regional Monitoring Coalition (RMC) developed a probabilistic design for regional characterization of selected creek status monitoring parameters. 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)

This report fulfills reporting requirements for the portion of the regional/probabilistic Creek Status monitoring data generated within Contra Costa County during Water Year 2014 (October 1, 2013, through September 30, 2014) through the RMC's probabilistic design for certain parameters monitored according to Provision C.8.c. This report is an Appendix to the full Urban Creeks Monitoring Report (UCMR) submitted by each of the participating RMC programs on behalf of their respective Permittees.

This report is submitted by the participating agencies of the

CONTRA COSTA CLEAN WATER PROGRAM

CCCWP Participants:

- Cities/Towns of: Antioch, Brentwood, Clayton, Concord, Danville, El Cerrito, Hercules, Lafayette, Martinez, Moraga, Oakley, Orinda, Pinole, Pittsburg, Pleasant Hill, Richmond, San Pablo, San Ramon and Walnut Creek
- Contra Costa County
- Contra Costa County Flood Control & Water Conservation District

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List of Acronyms

ACCWP	Alameda Countywide Clean Water Program
AFDM	ash-free dry mass
BASMAA	Bay Area Stormwater Management Agencies Association
B-IBI	Benthic Index of Biological Integrity
BMI	Benthic Macroinvertebrate
CCCWP	Contra Costa Clean Water Program
CDFW	California Department of Fish and Wildlife
CMC	Criteria Maximum Concentration
CTR	California Toxics Rule
DW	Dry Weight
DQO	Data Quality Objective
EDD	Electronic Data Deliverable
FSURMP	Fairfield Suisun Urban Runoff Management Program
GIS	Geographic Information System
GRTS	Generalized Random Tessellated Stratified
IBI	Index of Biological Integrity
LC50	Lethal Concentration to 50% of test organisms
LIMS	Laboratory Information Management System
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
MPC	BASMAA Monitoring and Pollutants of Concern Committee
MQO	Measurement Quality Objective
MRP	Municipal Regional Permit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ND	Non-Detect
NorCal B-IBI	Northern California Benthic Index of Biological Integrity
NPDES	National Pollutant Discharge Elimination System
NT	Non-Target
PAH	Polycyclic aromatic hydrocarbon
PEC	Probable Effect Concentration
PHab	Physical Habitat Assessment
POC	Pollutant of Concern
PRM	Pathogen-Related Mortality
PSA	Perennial Streams Assessment
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RL	Reporting Limit
RMC	Regional Monitoring Coalition
RMP	Regional Monitoring Program
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
STLS	Small Tributaries Loading Strategy
SWAMP	Surface Water Ambient Monitoring Program
TEC	Threshold Effect Concentration
TKN	Total Kjeldahl Nitrogen
TNS	Target Not Sampled
TOC	Total Organic Carbon
TS	Target Sampled
U	Unknown
USEPA	U.S. Environmental Protection Agency
TU	Toxicity Unit
WQ	Water Quality
WY	Water Year

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Executive Summary

This Regional/Probabilistic Creek Status Monitoring Report documents the results of monitoring performed by the Contra Costa Clean Water Program (CCCWP) during Water Year (WY) 2014 under the regional/probabilistic monitoring design developed by the Regional Monitoring Coalition (RMC). This report is a component of the Urban Creeks Monitoring Report (UCMR) for WY 2014. Together with the creek status monitoring data reported in the Local/Targeted Creek Status Monitoring Report, this submittal fulfills reporting requirements for status monitoring specified in Table 8.1 under Provision C.8.c of both the Municipal Regional Permit (MRP) for urban stormwater issued by the San Francisco Bay Regional Water Quality Control Board (SFRWQCB; Order No. R2-2009-0074) and the East Contra Costa County Municipal NPDES Permit (Central Valley Permit) issued by the Central Valley Regional Water Quality Control Board (CVRWQCB; Order No. R5-2010-0102). To promote a coordinated countywide program of water quality management, the two permits have nearly identical provisions. Reporting requirements for Table 8.1 constituents are established in provision C.8.g.iii of both permits.

Other creek status monitoring parameters were addressed using a targeted design, with regional coordination and common methodologies. The local/targeted parameters are reported in a separate appendix to the UCMR (ADH, 2015).

During Water Year 2014, 10 sites were monitored by CCCWP under the regional/probabilistic design for bioassessment, physical habitat, and related water chemistry parameters. Two of the 10 sites were also monitored for water and sediment toxicity and sediment chemistry.

The bioassessment and related data are used to develop a preliminary condition assessment for the monitored sites, to be used in conjunction with the stressor assessment based on sediment chemistry and toxicity. The water and sediment chemistry and toxicity data were used to evaluate potential stressors that may affect aquatic habitat quality and beneficial uses. The probabilistic design requires several years to produce sufficient data to develop a statistically-robust characterization of regional creek conditions, so the analysis and interpretation that can be completed with the initial years of data collection are necessarily limited.

Based upon the bioassessment results (principally B-IBI scores from benthic macroinvertebrate taxonomy), the preliminary condition analysis indicates that many sites monitored in WY 2014 and prior years may be impacted from the standpoint of aquatic life beneficial uses. The subsequent stressor analysis revealed the following potential stressors that may be contributing to the observed conditions, based on an analysis of the regional/probabilistic data collected by CCCWP during WY 2014:

- **Water Quality –** Of 11 water quality parameters required in association with bioassessment monitoring, applicable water quality standards were only identified for ammonia, chloride, and nitrate + nitrite (sites with MUN beneficial use only). Of the results generated at the 10 sites monitored by CCCWP for those three parameters, only two un-ionized ammonia concentrations and one chloride concentration exceeded the applicable water quality standard or threshold; each of those occurred at different sites. The MRP Table 8.1 trigger threshold for "Nutrients" (i.e., 20% of results in one water body exceed one or more water quality standards or applicable thresholds) was therefore exceeded at those three sites.

- **Water Toxicity –** Toxicity testing was performed for four test species in water samples collected by CCCWP from two sites, during one wet weather event and one dry season event in WY 2014. Samples collected during the wet weather monitoring event (2/26/14) from the Grizzly Creek site exhibited significant acute toxicity (reduction in survival) to *H. azteca* and fathead minnows.

However, the fathead minnow test was impacted by pathogen-related mortality, presumably unrelated to sample quality. Samples collected from both the San Pablo Creek and Grizzly Creek sites during the dry weather event (7/23/14) exhibited toxicity to *C. daphnia* per the chronic endpoint (reproduction); the samples were not acutely toxic. None of the toxic water samples met the Permit Table 8.1 threshold (<50% of the Control value) for follow-up action in WY 2014.

- **Sediment Toxicity –** Bedded sediment samples collected from the same two sites on San Pablo Creek and Grizzly Creek on 7/23/14 were not toxic to the test species (*H. azteca*).
- **Sediment Chemistry –** Bedded sediment samples collected from the same two sites on San Pablo Creek and Grizzly Creek on 7/23/14 and analyzed for a suite of sediment chemistry constituents. Analytical results produced less evidence of potential stressors than samples analyzed in WY 2012 and 2013, based on the criteria from MRP Table H-1 (equivalent to Central Valley Permit Table D-1). Neither of the sediment chemistry samples resulted in three or more constituents with TEC quotients greater than 1.0, a mean PEC quotient > 0.5, or a sum of TU equivalents for all measured pyrethroids greater than or equal to 1.0. The pyrethroid pesticide bifenthrin was found in both creek sediment samples, but not at levels expected to cause toxicity to test organisms.
- **Sediment Triad Analyses –** bioassessment, sediment toxicity, and sediment chemistry results were evaluated as the three lines of evidence used in the triad approach for assessing overall stream condition. For the two sites evaluated in WY 2014, follow-up action is not required based on the triad analysis.

Additional creek status monitoring will be undertaken in WY 2015 to further add to the data applicable to the regional/probabilistic design. Further work regarding stressor/source identification investigations is also ongoing.

1. Introduction

Contra Costa County lies within the jurisdictions of both the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB; Region 2) and the Central Valley Regional Water Quality Control Board (CVRWQCB; Region 5). Municipal stormwater discharges in Contra Costa County are regulated by the requirements of two National Pollutant Discharge Elimination System (NPDES) stormwater permits: the Municipal Regional Permit (MRP) for urban stormwater in Region 2 (Order No. R2-2009-0074[1]), and the East Contra Costa County Municipal NPDES Permit (Central Valley Permit) in Region 5 (Order No. R5-2010-0102[2]).

This report is a component of the Urban Creeks Monitoring Report (UCMR) for Water Year 2014 (WY 2014; October 1, 2013 - September 30, 2014), covering creek status monitoring conducted under a regional probabilistic design. Together with the creek status monitoring data reported in the Local/Targeted Creek Status Monitoring Report, this submittal fulfills reporting requirements for status monitoring performed per the requirements of Provision C.8.c and Table 8.1 of both Municipal NPDES permits.

The regional probabilistic design was developed and implemented by the Regional Monitoring Coalition (RMC) of the Bay Area Stormwater Management Agencies Association (BASMAA). 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 RMC was formed in early 2010 as a collaborative among several BASMAA members and all MRP Permittees (see Table 1-1) to collaboratively implement the monitoring requirements found in Provision C.8 of the MRP through a regionally-coordinated effort. Participation in the RMC is coordinated by county stormwater programs and/or Permittee representatives, and facilitated through the BASMAA Monitoring and Pollutants of Concern Committee (MPC).

The RMC Work Group is a subgroup of the MPC that meets and communicates regularly to coordinate planning and implementation of monitoring-related activities. This workgroup includes staff from the SFBRWQCB at two levels – those generally engaged with the MRP as well as those working regionally with the State of California's Surface Water Ambient Monitoring Program (SWAMP). Through the RMC Work Group, the BASMAA RMC developed a Quality Assurance Program Plan (QAPP; BASMAA, 2014a), Standard Operating Procedures (SOPs; BASMAA, 2014b), data management tools, and reporting templates and guidelines. Costs for these activities are shared among RMC members.

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[1] The San Francisco Bay Regional Water Quality Control Board (SFBRWQCB) issued the five-year Municipal Regional Permit for Urban Stormwater (MRP, Order No. R2-2011-0083) to 76 cities, counties and flood control districts (i.e., Permittees) in the Bay Area on October 14, 2009 (SFBRWQCB 2009). The BASMAA programs supporting MRP Regional Projects include all MRP Permittees as well as the cities of Antioch, Brentwood, and Oakley which are not named as Permittees under the MRP but have voluntarily elected to participate in MRP-related regional activities. The RMC regional monitoring design was expanded to include the portion of eastern Contra Costa County that drains to the San Francisco Bay, to assist CCCWP in fulfilling parallel provisions in their Central Valley (Region 5) NPDES permit.

[2] The Central Valley Regional Water Quality Control Board (CVRWQCB) issued the East Contra Costa County Municipal NPDES Permit (Central Valley Permit, Order No. R5-2010-0102) on September 23, 2010 (CVRWQCB 2010).

Table 1-1. Regional Monitoring Coalition Participants

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

The goals of the RMC are to:

- Assist RMC Permittees in complying with requirements in MRP Provision C.8 (Water Quality Monitoring);
- Develop and implement regionally consistent creek monitoring approaches and designs in the San Francisco Bay Area, through improved coordination among RMC participants and other agencies that share common goals, e.g., Regional Water Quality Control Boards, Regions 2 and 5, and the State Water Resources Control Water Board's Surface Water Ambient Monitoring Program (SWAMP); and
- Stabilize the costs of creek monitoring by reducing duplication of effort and streamlining monitoring and reporting.

The RMC divided the creek status monitoring requirements specified in Permit 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 1-2. Provision C.8.c monitoring data collected by CCCWP at local/targeted sites (not included in the regional probabilistic design) are reported separately in the UCMR.

The remainder of this report addresses Study Area and Monitoring Design (Section 2.0), Data Collection and Analysis Methods (Section 3.0), Results and Data Interpretation (Section 4.0), and Conclusions and Next Steps (Section 5.0). More specifically, this report includes the standard report content as required by MRP Provision C.8.g.v in the respective sections referenced in Table 1-3. Additional information on other aspects of Permit-required monitoring is found in other Appendices and the main UCMR.

Table 1-2. Creek Status Monitoring Parameters Sampled in Compliance with MRP Provision C.8.c. As Either Regional/Probabilistic or Local/Targeted Parameters

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

Table 1-3. Index to Standard Report Content Per MRP Provision C.8.g.vi

Report Section	Standard Report Content
2.0	Monitoring purpose and study design rationale
3.0	Sampling protocols and analytical methods
3.5	QA/QC summaries for sample collection and analytical methods
2.1	Sample location descriptions, sample dates, IDs
4.0	Sample concentrations detected, measurement units, detection limits
4.0	Data assessment, analysis and interpretation
See UCMR, Main Body [3]	List of volunteer and other non-Permittee entities whose data are included in the report.
5.0	Assessment of compliance with applicable water quality standards

[3] Data collected by the SFBRWQCB are not included in this report.

2. 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.

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 Southern California Stormwater Monitoring Coalition's (SMC's) regional monitoring (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 management questions listed below:

1. What is the condition of aquatic life in creeks in the RMC area; are water quality objectives met and are beneficial uses supported?
    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?

To the extent feasible, these questions are addressed in a preliminary manner in this report for Contra Costa County, based only on an evaluation of WY 2014 data. 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.

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

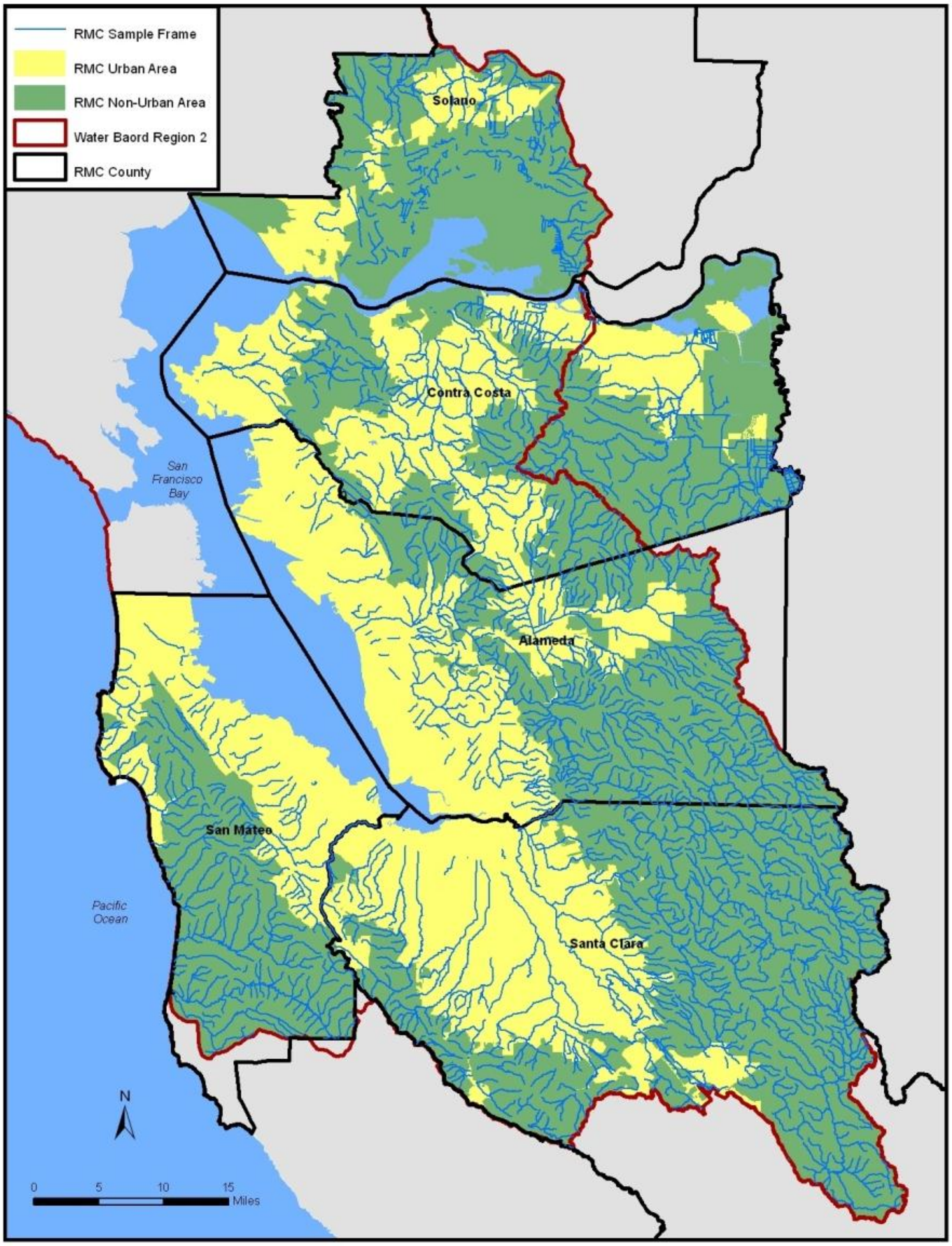


Table 2-1 shows the expected, cumulative progress towards establishing statistically representative sample sizes (estimated to be achieved at approximately n≥30) for each of the classified strata in the regional monitoring design. The cumulative sample numbers are estimated yearly over a five year period, assuming continuation of the present/planned rate of annual bioassessment sampling.

Table 2-1. Cumulative Numbers of Planned Bioassessment Samples Per Monitoring Year

Monitoring Year	Totals for RMC Area (Region-wide)		Santa Clara County		Alameda County		Contra Costa County		San Mateo County		Fairfield, Suisun City, and Vallejo [b]	
Land Use	*Urban*	*Non-Urban*	*Urban*	*Non-Urban*	*Urban*	*Non-Urban*	*Urban*	*Non-Urban*	*Urban*	*Non-Urban*	*Urban*	*Non-Urban*
Year 1 (WY 2012)	**48**	22	16	6	16	6	8	4	8	4	0	2
Year 2 (WY 2013)	**100**	**44**	**32**	12	**32**	12	16	8	16	8	8	0
Year 3[c] (WY 2014)	**156**	**66**	**48**	18	**48**	18	24	12	24	12	12	6
Year 4 (WY 2015)	**204**	**88**	**64**	24	**64**	24	**32**	16	**32**	16	12	8
Year 5 (WY 2016)	**256**	**110**	**80**	**30**	**80**	**30**	**40**	20	**40**	20	16	10

Shaded cells indicate when a minimum sample size (estimated to be n≥30) may be available to develop a statistically representative data set to address management questions related to condition of aquatic life for the strata included within the regional probabilistic design.
[a] Assumes SFBRWQCB will continue monitoring of two non-urban sites annually in each RMC county.
[b] Assumes FSURMP and Vallejo only monitor urban sites; FSURMP monitors four sites in Years 2, 3 and 5; and Vallejo monitors four sites in Year 2.
[c] Final year of monitoring under the initial MRP 5-Year Permit.

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[4] (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 MRP Provision C.8.c sample size requirements (SFBRWQCB, 2009) would be achieved.

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

[4] Based on discussion during RMC meetings, with SFBRWQCB staff present, the sample frame was extended to include the portion of Eastern Contra Costa County that drains to the San Francisco Bay in order to address parallel provisions in CCCWP's Region 5 Permit for Eastern Contra Costa County.

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

Monitoring was conducted in accordance with the RMC Multi-year Monitoring Plan (BASMAA, 2011). The Monitoring Plan illustrates the total number of sites that each RMC Program plans to monitor within the MRP term (SFBRWQCB, 2009), as shown in Table 2-1 above. Table 2-1 also illustrates the number of years required to establish statistically representative samples for each strata (e.g., management unit and urban or non-urban land use) included in the regional monitoring design. Per the RMC Monitoring Plan and the requirements of MRP Provision C.8.c, the RMC creek status monitoring emphasizes monitoring of urban land use sites. RMC participants have set a target of at least 80% of the sites sampled annually to be in urban areas, with up to 20% in non-urban areas. Due to unforeseen field circumstances, however, this percentage may vary by year. For example, some sites may not be sampleable due to seasonal drying and/or access issues, thereby altering the relative proportion of urban-to-nonurban sites sampled in a given year. Some sites classified as urban, using data in a geographic information system, may be considered for reclassification as non-urban based on actual land uses of the drainage area, despite their location inside municipal jurisdictional boundaries. Such outcomes can be addressed in subsequent years by adjusting the relative proportion of urban and non-urban sites in regional statistical analyses.

The numbers of probabilistic sites monitored annually in Water Years 2012-2014 by CCCWP are shown by land use category in Table 2-2.

Table 2-2. Number of Urban and Non-Urban Bioassessment Sites Sampled By CCCWP in Water Years 2012-2014

Monitoring Year	Contra Costa County	
Land Use:	*Urban Sites*	*Non-Urban Sites*
WY 2012	8	2
WY 2013	10	0
WY 2014	10	0
Total	**28**	**2**

3. Monitoring Methods

This section describes the methods used to evaluate monitoring sites identified in the regional sample draw, consistent with the Southern California Coastal Water Research Project (SCCWRP) Bioassessment Program (SCCWRP, 2012), and to sample field data, consistent with the RMC workplan (BASMAA, 2011), Field parameters sampled included bioassessments (benthic macroinvertebrates [BMIs], algae, and physical habitat), physicochemical measurements (dissolved oxygen, temperature, conductivity, and pH), chlorine, nutrients, water samples for testing water toxicity, and sediment samples for testing sediment toxicity and chemistry.

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[5] (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.[6]

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:

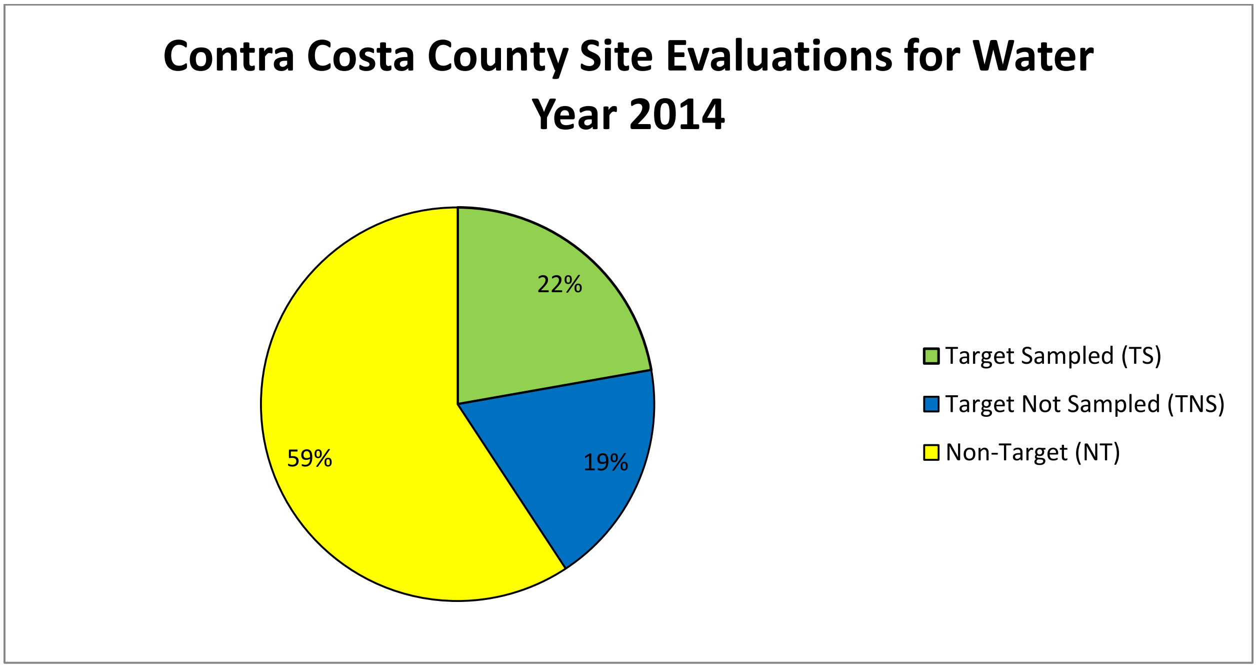
- **Target** – Sites that met all seven criteria above were classified as **target sampleable** status **(TS),** and sites that met criteria 1 through 4, but did not meet at least one of criteria 5 through 7 were classified as **target non-sampleable (TNS)**.
- **Non-Target (NT)** – Sites that did not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

[5] Communication with managers for the SMC and the PSA are ongoing to ensure the consistency of site evaluation protocols.

[6] 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.

The outcomes of these site evaluations for CCCWP sites are illustrated in Figures 3-1 (Water Year 2012) and 3-2 (Water Year 2013). A relatively small fraction of sites evaluated each year are classified as “target sampleable” sites.

Figure 3-1. Results of CCCWP Site Evaluations for Water Year 2014



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)
- 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 monitored in WY 2014 are shown graphically in Figure 3-2 and listed also in Table 3-1.

Figure 3-2. Contra Costa County Sites Sampled From the RMC Probabilistic Monitoring Design in Water Year 2014

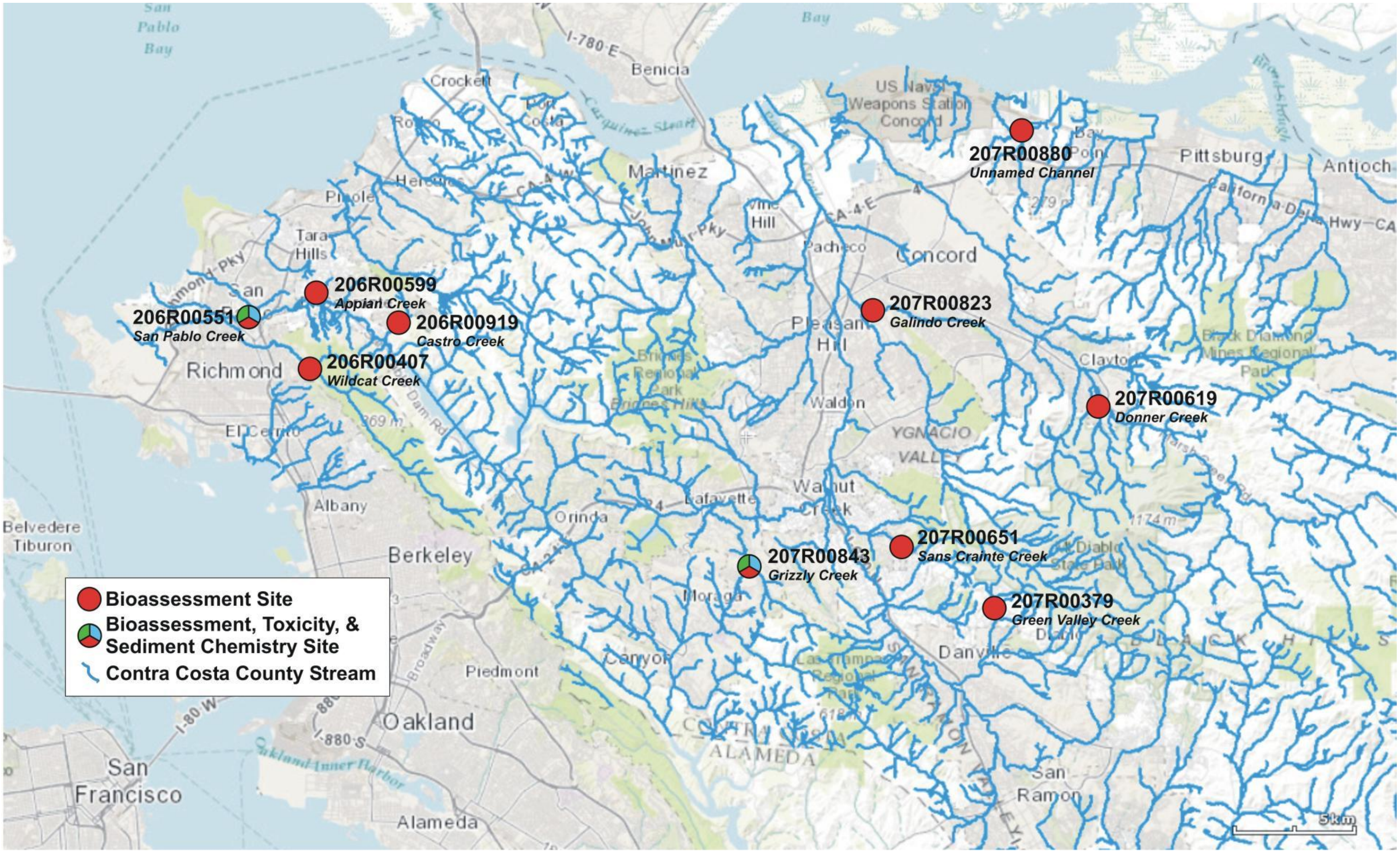


Table 3-1. Parameters Sampled at CCCWP Sites From the RMC Probabilistic Monitoring Design in Water 2014

Site ID	Creek Name	Land Use	Latitude	Longitude	Bioassessment, PHab, Chlorine, Nutrients	Water Toxicity (Wet Weather)	Water & Sediment Toxicity, Sediment Chemistry (Dry Weather)
206R00407	Wildcat Creek	Urban	37.94274	-122.30593	4/24/14		
206R00551	San Pablo Creek	Urban	37.96207	-122.33625	4/30/14	2/26/14	7/23/14
206R00599	Appian Creek	Urban	37.97156	-122.30328	5/5/14		
206R00919	Castro Creek	Urban	37.96030	-122.26370	5/14/14		
207R00379	Green Valley Creek (West Branch)	Urban	37.85224	-121.97756	4/21/14		
207R00619	Donner Creek	Urban	37.92852	-121.92762	4/23/14		
207R00651	Sans Crainte Creek	Urban	37.87545	-122.02232	4/21/14		
207R00823	Galindo Creek	Urban	37.96493	-122.03602	4/23/14		
207R00843	Grizzly Creek	Urban	37.86806	-122.09589	4/22/14	2/26/14	7/23/14
207R00880	Unnamed Flood Control Channel	Urban	38.03292	-121.96469	5/5/14		

3.2 Field Sampling and 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 3-2.

Table 3-2. 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[7] 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).

3.2.1.1 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.

3.2.1.2 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

[7] This number was erroneously reported as 0.25 inch over a 24-hour period in UCMR (BASMAA, 2013).

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 45 mL subsample was taken from the algae composite sample and combined with 5 mL glutaraldehyde into a 50 mL sample tube for taxonomic identification of soft algae. Similarly, 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.

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) 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.

3.2.1.3 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/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 should occur upstream of sampling personnel and equipment and upstream of areas where bed sediments have been disturbed, or prior to such bed disturbance.

3.2.3 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.

3.2.4 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.

3.2.5 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 CCCWP 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 ten sites, as well as water and sediment toxicity and sediment chemistry data from two of those ten 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 (per Table 2-3), 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 these per MRP Provision C.8.g.iii.

Analysis of Provision C.8.c monitoring data generated by CCCWP at local/targeted sites (not included in the probabilistic design) is reported in the Local/Targeted Creek Status Monitoring Report (ADH, 2015).

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 by CCCWP 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.

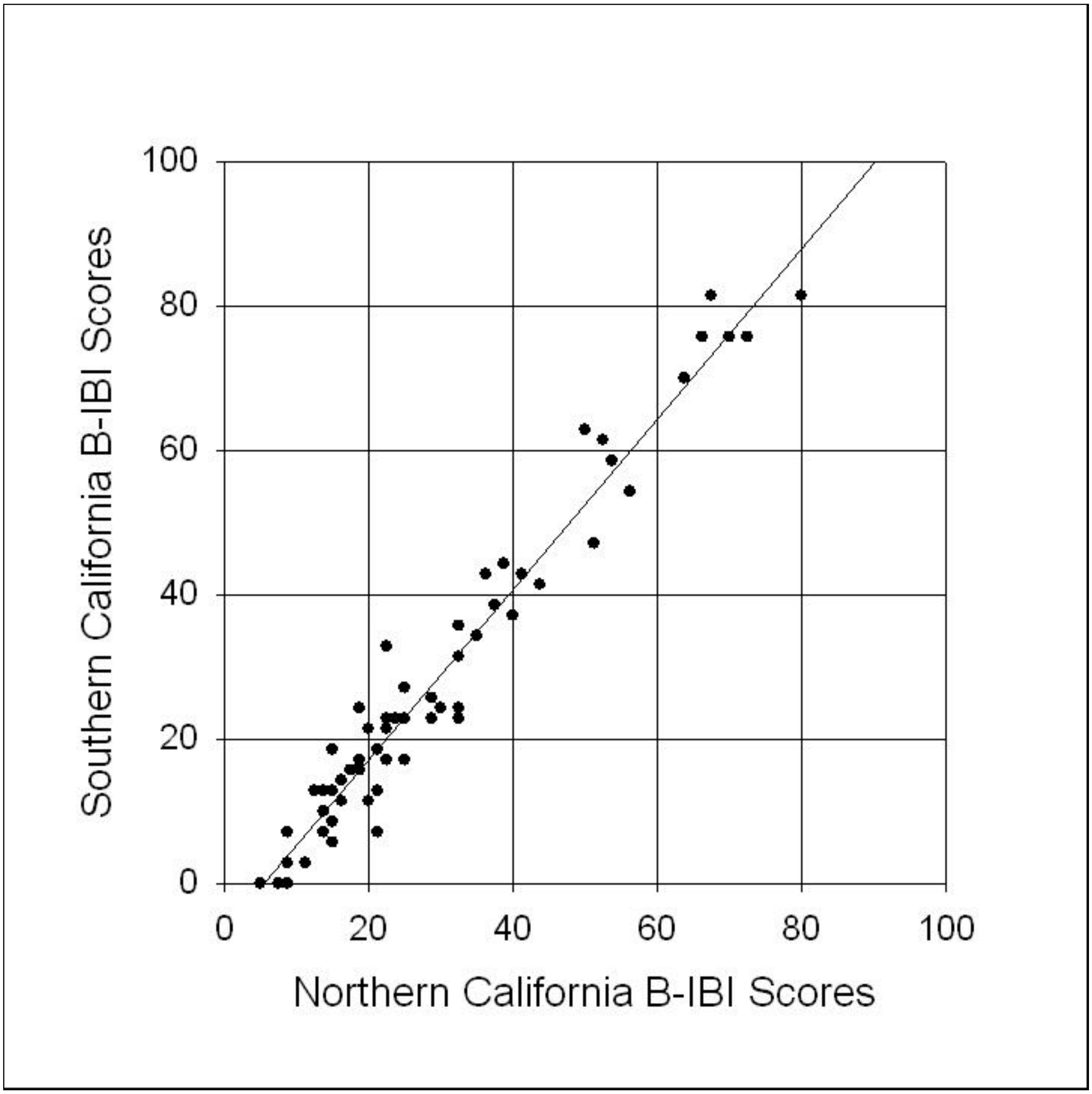
3.4.1.1 Benthic Macroinvertebrate Data Analysis

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.

Figure 3-3. Results of Regressing the Northern and Southern California B-IBIs for RMC sites Sampled in WY 2012 (r^2 = 0.9518, p<0.05).



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

Table 3-3. Condition Categories for Southern California 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

The SoCal and NorCal B-IBIs were developed in perennial streams in their respective regions. The majority of sites sampled by the RMC in Water Year 2012 and by CCCWP in Water Year 2013 were classified as perennial steams. Although no statistical analysis comparing perennial and non-perennial stream is possible, these classifications were considered for interpretations of biological condition.

Work was initiated on a San Francisco Bay Region B-IBI in a collaborative effort by BASMAA participants and others, and the results were provisionally tested previously in Contra Costa (CCCWP, 2007) and Santa Clara (SCVURPPP, 2007) Counties. The Contra Costa County version of the Bay Area B-IBI was subsequently used in analysis and reporting of BMI data for the annual Contra Costa Monitoring and Assessment Program (CCMAP) bioassessment monitoring (c.f., Ruby, 2012). Calculation of the preliminary Contra Costa B-IBI is also presented for CCCWP's BMI data in this report, to allow for comparisons with the historical CCMAP data set.

The scores calculated using the preliminary Contra Costa B-IBI were classified according to condition categories as shown in Table 3-4.

Table 3-4. Condition Categories for Preliminary Contra Costa B-IBI Scores for BMI Taxonomy Data

Condition Category	Contra Costa B-IBI Scores
Very Good	43–50
Good	35–41
Fair	23–34
Marginal	11–22
Poor	0–10

Aquatic life use support at CCCWP sites sampled in Water Year 2014 was evaluated by comparing the SoCal and preliminary Contra Costa B-IBI scores and associated condition categories to warm water (WARM) and cold water (COLD) aquatic life uses as designated by the SF Bay Regional Water Quality Control Board (2013).

3.4.1.2 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 3-5.

Table 3-5. 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	Proportion of diatoms (for which there is information	Higher levels may indicate the presence	Negative

Table 3-5. Metrics Used In Evaluating Algae Taxonomy Data

Metric Name	Description	Implications	Correlation w/Metric Score
(highly motile) *	for both the "motility" and "habit" classifications) that are highly motile (for "motility") OR planktonic (for "habit")	of excess silt and sediment	
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**: 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 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 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 literature values for pyrethroids in sediment LC50 values.[8] 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 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

Data quality assessment and quality control procedures are described in detail in the BASMAA RMC QAPP (BASMAA, 2014a).

Data Quality Objectives (DQOs) were established to ensure that data collected were of sufficient and adequate quality for the intended use. DQOs include both quantitative and qualitative assessment of the acceptability of data. The qualitative goals include representativeness and comparability. The quantitative goals include completeness, sensitivity (detection and quantitation limits), precision, accuracy, and contamination. To ensure consistent and comparable field techniques, pre-monitoring field training and in-situ field assessments were conducted.

Data were collected according to the procedures described in the relevant SOPs (BASMAA, 2014b), including appropriate documentation of data sheets and samples, and sample handling and custody. Laboratories providing analytical support to the RMC were selected based on demonstrated capability to adhere to specified protocols.

All data were thoroughly reviewed by the Programs responsible for collecting them, for conformance with QAPP requirements and field procedures were reviewed for compliance with the methods specified in the relevant SOPs. Data quality was assessed and qualifiers were assigned as necessary in accordance with SWAMP requirements.

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

4. Results and Discussion

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 Permit Table 8.1, and, for sediment triad data, MRP Table H-1 (equivalent to Central Valley Permit Table D-1) to provide a preliminary identification of potential stressors.

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

4.1 Statement of Data Quality

The RMC established a set of guidance and tools to help ensure data quality and consistency implemented through collaborating Programs. Additionally, the RMC participants continue to meet and coordinate in an ongoing basis to plan and coordinate monitoring, data management, and reporting activities, among others.

A comprehensive QA/QC program was implemented by each of the RMC programs, each of which is solely responsible for the quality of the data submitted on its behalf, covering all aspects of the regional/probabilistic monitoring. In general, QA/QC procedures were implemented as specified in the RMC QAPP (BASMAA, 2014a), and monitoring was performed according to protocols specified in the RMC SOPs (BASMAA, 2014b), and in conformity with SWAMP protocols. QA/QC issues noted by the laboratories and/or RMC field crews are summarized below.

4.1.1 Bioassessment

Duplicate samples were collected in the field from 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.

The New Zealand mudsnail (*Potamopyrgus antipodarum*), a non-native invasive species was confirmed at one site: 207R00379 (Green Valley Creek). This finding is not a QA/QC issue *per se*, but requires that field crews take special cautions 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 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

Pathogen-related mortality (PRM) was observed in both samples from site 206R0551 (Sans Crainte Creek) and site 207R0843 (Grizzly Creek) while testing for fathead minnow toxicity (Pacific EcoRisk Tox Batch PER_ADH_PP_C2_W_TOX). In the laboratory's estimation, the presence of PRM caused the site 207R0843 sample to be significantly toxic to fathead minnows.

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 by CCCWP in 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 CCCWP 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 for the available data from urbanized portions of Contra Costa County. Future reports will provide additional analysis at the countywide program and regional levels, as well as comparisons between urban and non-urban land use sites.

Table 4-1. Designated Beneficial Uses Listed in the San Francisco Bay Region Basin Plan (SFBRWQCB, 2013)

		Human Consumptive Uses																Recreational Uses		
									Aquatic Life Uses											
Site ID	Water Body	AGR	MUN	FRSH	GWR	IND	PROC	COMM	SHELL	COLD	EST	MAR	MIGR	RARE	SPWN	WARM	WILD	REC-1	REC-2	NAV
206R00407	Wildcat Creek												E		E	E	E		E	
206R00551	San Pablo Creek			E						E			E	E	E	E	E	E*	E	
206R00599	Appian Creek[1]			E						E			E	E	E	E	E	E*	E	
206R00919	Castro Creek[1]			E						E			E	E	E	E	E	E*	E	
207R00379	Green Valley Creek (West Branch)			E						E					E	E	E	E	E	
207R00619	Donner Creek[2]									E			E		E	E	E	E	E	
207R00651	Sans Crainte Creek[3]									E			E		E	E	E	P	P	
207R00823	Galindo Creek									E						E	E	E	E	
207R00843	Grizzly Creek																			
207R00880	Unnamed Flood Control Channel[4]					E	E	E			E		E	E	E		E	E	E	E

[1] Tributary to San Pablo Creek; San Pablo Creek beneficial use data used.
[2] Tributary to Mount Diablo Creek; Mount Diablo Creek beneficial use data used.
[3] Tributary to Walnut Creek; Walnut Creek beneficial use data used.
[4] Tributary to Suisun Bay; Suisan Bay beneficial use data used.

Notes: Per Basin Plan Ch. 2 (SFBRWQCB, 2013), beneficial uses for freshwater creeks include municipal and domestic supply (MUN), agricultural supply (AGR), industrial process supply (PRO), groundwater recharge (GWR), water contact recreation (REC1), noncontact water recreation (REC2), wildlife habitat (WILD), cold freshwater habitat (COLD), warm freshwater habitat (WARM), fish migration (MIGR), and fish spawning (SPWN). The San Francisco Bay Estuary supports estuarine habitat (EST), industrial service supply (IND), and navigation (NAV) in addition to all of the uses supported by streams. Coastal waters' beneficial uses include water contact recreation (REC1); noncontact water recreation (REC2); industrial service supply (IND); navigation (NAV); marine habitat (MAR); shellfish harvesting (SHELL); ocean, commercial and sport fishing (COMM); and preservation of rare and endangered species (RARE).

4.2.1 Benthic Macroinvertebrate Metrics

From a regional perspective, BMI metrics for 60 sites sampled within the RMC area in the spring index period of Water Year 2012 exhibited a wide range of scores, as described in the 2012 Regional UCMR (BASMAA, 2013). BMI metrics for the 10 regional/probabilistic sites monitored in WY 2014 within Contra Costa County similarly exhibited a wide range of scores, particularly for some important metrics such as taxonomic richness, EPT Index, and % tolerant organisms. BMI taxonomic metrics are shown in Table 4-2 for the CCCWP creek status sites monitored in the spring index period of WY 2014.

B-IBI scores and other essential site characteristics are presented in Table 4-3 for the 10 Contra Costa County sites monitored in 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 condition assessment in this report. The preliminary Contra Costa B-IBI also is reported for purposes of comparison with the extensive historical database of bioassessment data produced by CCCWP during 2001–2011.

4.2.2 Algae Metrics

The average D18 diatom A-IBI score across all ten Contra Costa sites evaluated in WY 2014 was 39.6 (Table 4-4). In comparison, the average D18 scores across 20 samples collected in 2012 and 2013 was 37.8, indicating a slight increase in the overall health of the diatom community for the WY 2014 site assemblage. The highest WY 2014 score occurred at site 207R00619 (72) while three sites had scores of 20 or below [207R00823 (14), 206R00551 (18), 207R00880 (20)]. Higher scores tended to be associated with a lower proportion of halobiontic species and sediment tolerant, highly motile species (Table 4-4, 4-5). All ten sites scored 2 or below for the proportion of diatom species indicative of low total phosphorous 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 A-IBI scores.

The soft algae S2 IBI had an average score of 30, with the highest scoring site again being 207R00619 (73; Table 3). The nine other sites had S2 IBI scores below 50, with four sites at 20 or below [207R00843 (5), 206R00919 (17), 207R00823 (18), 207R00379 (20)]. Seven of the 10 sites scored a perfect 10 because the green algae CRUS (*Cladophora glomerata*, *Rhizoclonium hieroglyphicum*, *Ulva flexuosa*, and *Stigeoclonium* spp.) were not present in the samples (Table 4-6, 4-7). Sites 206R00407 and 207R00619 did not have any soft algae species indicative of higher copper concentrations. Fetscher et al. (2014) found soft algae IBIs were most responsive (negatively) to canopy cover and slope.

The hybrid IBIs (H20, H21, and H23), consisting of both soft algae and diatom metrics, produced similar results in determining the highest-scoring (site 207R00619) and lowest (site 207R00823) scores among the ten sites (Tables 5-7). However, the average IBI score varied slightly among the three IBIs (H20 = 33.9, H21 = 40, H23 = 39.9). The main differences in the H20 IBI scores were due to the proportion of halobiontic diatoms, highly motile diatoms, and soft algae high copper indicators. The proportion of halobiontic diatoms also affected differences in H21 IBI scores in addition to the biomass proportion of Chlorophyta and ZHR (Zygnemataceae, Rhodophyta, heterocystous cyanobacteria) taxonomic groups. The proportion of halobiontic diatom species and proportion of ZHR soft algae species also affected the differences in H23 IBI scores as well as the proportion of green algae belonging to CRUS. 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 207R00619 had the highest score across all five IBIs while sites 207R00823 and 207R00843 had the lowest IBI scores. The proportion of halobiontic and sediment tolerant, highly motile diatom species affected scores across IBIs suggesting the importance of low ionic strength/salinities and sediment qualities on a stronger diatom community. Soft algae scores were more affected by the proportion of taxonomic groups and species found within sites.

Table 4-2. Benthic Macroinvertebrate Metrics for CCCWP Bioassessment Sites Monitored in Water Year 2014

Metrics	CCCWP Sampling Sites, Spring 2014									
	206R00407	206R00551	206R00599	206R00919	207R00379	207R00619	207R00651	207R00823	207R00843***	207R00880
	Wildcat Creek	San Pablo Creek	Appian Creek	Castro Creek	Green Valley Creek (W.Branch)	Donner Creek	Sans Crainte Creek	Galindo Creek	Grizzly Creek	Unnamed Flood Control Channel
Richness										
Taxonomic	27	19	16	23	19	16	17	14	17	12
EPT	10	2	1	3	2	3	1	3	1	1
Ephemeroptera	5	1	1	1	1	2	1	2	1	1
Plecoptera	2	0	0	1	0	1	0	0	0	0
Trichoptera	3	1	0	1	1	0	0	1	0	0
Coleoptera	2	1	0	1	0	2	0	0	0.5	0
Predator	6	6	3	9	7	7	6	2	5	3
Diptera	8	6	5	11	6	8	9	6	8	7
Composition										
EPT Index (%)	40	8.4	0.7	13	1.6	16	0.2	2.6	1.5	0.2
Sensitive EPT Index (%)	7.3	0.0	0.0	1.2	0.0	0.3	0.0	0.0	0.0	0.0
Shannon Diversity	2.4	2.0	2.1	2.1	2.1	1.7	2.1	1.7	1.9	1.5
Dominant Taxon (%)	20	34	27	33	30	41	34	37	29	34
Non-insect Taxa (%)	22	42	56	26	47	19	35	36	38	33
Tolerance										
Tolerance Value	5.1	5.5	6.9	5.9	6.5	5.7	6.9	5.5	5.7	5.6
Intolerant Organisms (%)	5.0	0.0	0.0	1.2	0.0	0.3	0.0	0.0	0.0	0.0
Intolerant Taxa (%)	26	5.3	0.0	8.7	5.3	13	0.0	0.0	0.0	0.0
Tolerant Organisms (%)	1.9	4.6	59	7.1	37	0.8	54	2.0	8.4	3.2
Tolerant Taxa (%)	11	42	38	26	37	13	29	21	32	25
Functional Feeding Groups										
Collector-Gatherers (%)	78	89	58	55	55	52	69	92	87	99
Collector-Filterers (%)	7.1	8.6	10	33	3.8	41	22	6.4	5.9	0.2
Scrapers (%)	6.5	0.5	24	1.0	34	0.0	3.2	0.3	2.5	0.0
Predators (%)	3.2	2.0	8.0	6.9	6.1	7.3	5.8	1.3	4.9	0.8
Shredders (%)	5.6	0.0	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0
Other (%)	0.0	0.2	0.0	2.5	0.3	0.5	0.0	0.2	0.2	0.0
Estimated Abundance										
Composite Sample (11 ft2)	1,984	1,210	9,744	2,037	1,830	5,160	9,872	12,928	3598	3,738
#/ft2	180	110	886	185	166	469	897	1,175	327	340
#/m2	1,926	1,175	9,460	1,978	1,777	5,010	9,584	12,551	3493	3,629

Table 4-2. Benthic Macroinvertebrate Metrics for CCCWP Bioassessment Sites Monitored in Water Year 2014

Metrics	CCCWP Sampling Sites, Spring 2014									
	206R00407	206R00551	206R00599	206R00919	207R00379	207R00619	207R00651	207R00823	207R00843***	207R00880
	Wildcat Creek	San Pablo Creek	Appian Creek	Castro Creek	Green Valley Creek (W.Branch)	Donner Creek	Sans Crainte Creek	Galindo Creek	Grizzly Creek	Unnamed Flood Control Channel
Supplemental Metrics										
Collectors (%)	85	97	68	88	59	92	91	98	92	99
Non-Gastropoda Scrapers (%)	5.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0
Shredder Taxa (%)	15	0.0	0.0	4.3	0.0	0.0	0.0	0.0	0	0.0
Diptera Taxa**	5	3	2	8	3	5	6	3	5	5
SoCal B-IBI	**44**	**11**	**10**	**30**	**23**	**36**	**16**	**13**	**14**	**11**
CC B-IBI	**42**	**24**	**24**	**35**	**33**	**32**	**27**	**22**	**25**	**22**

Notes: Metrics based on level I standard taxonomic effort except Chironomids identified to subfamily/ tribe*.
*Standard taxonomic effort source: Southwest Association of Freshwater Invertebrate Taxonomists /www.waterboards.ca.gov/swamp/docs/safit/ste_list.pdf)
** Calculated based on Chironomids identified to family level.
*** Calculated as averages of two field duplicate samples

Table 4-3. B-IBI scores and Key Characteristics for CCCWP Bioassessment Sites Monitored in Water Year 2014

Site ID	Creek Name	Land Use	Flow Class	3-Sided Concrete Channel	COLD	WARM	SoCal B-IBI Score	SoCal B-IBI Condition	Contra Costa B-IBI Score	Contra Costa B-IBI Condition
206R00407	Wildcat Creek	Urban	NP			E	44	Fair	42	Good
206R00551	San Pablo Creek	Urban	P		E	E	11	Very Poor	24	Fair
206R00599	Appian Creek	Urban	P		E	E	10	Very Poor	24	Fair
206R00919	Castro Creek	Urban	P		E	E	30	Poor	35	Good
207R00379	Green Valley Creek	Urban	P		E	E	23	Poor	33	Fair
207R00619	Donner Creek	Urban	NP		E	E	36	Poor	32	Fair
207R00651	Sans Crainte Creek	Urban	P		E	E	16	Very Poor	27	Fair
207R00823	Galindo Creek	Urban	NP	X	E	E	13	Very Poor	22	Marginal
207R00843	Grizzly Creek	Urban	NP				14	Very Poor	25	Fair
207R00880	Flood Control Channel	Urban	P				11	Very Poor	22	Marginal

P = perennial flow
NP = non-perennial flow (based on site evaluations performed during drought conditions)

Table 4-4. Diatom IBI (D18) and Individual Metric Scores for CCCWP Stations Sampled in 2014

Station Code	Creek Name	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
206R00407	Wildcat Creek	4/24/2014	38	6	0	7	6	0
206R00551	San Pablo Creek	4/30/2014	18	0	0	8	0	1
206R00919	Appian Creek	5/15/2014	26	0	1	0	9	3
207R00379	Castro Creek	4/21/2014	56	6	1	6	9	6
207R00599	Green Valley Creek	6/5/2014	50	6	1	5	8	5
207R00619	Donner Creek	4/23/2014	72	9	2	8	8	9
207R00651	Sans Crainte Creek	4/21/2014	48	6	2	6	7	3
207R00823	Galindo Creek	4/23/2014	14	0	2	2	1	2
207R00843	Grizzly Creek	4/22/2014	54	7	0	7	5	8
207R00880	Flood Control Channel	5/5/2014	20	5	1	3	1	0
		Average:	**39.6**					

Note: The overall IBI score was calculated by converting the sum of individual scores to a 100-point scale by summing the scores and multiplying by the number of metrics [sum x (100/50].

Table 4-5. Diatom Metric Results for CCCWP Stations Sampled in 2014

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)
206R00407	4/24/2014	0	0.211	0.523	0.003	0.003	0.139	0.783	0.833	0.847	0.079	0.526
206R00551	4/30/2014	0	0.761	0.45	0	0	0.058	0.414	0.964	0.595	0.008	0.451
206R00919	5/15/2014	0.017	0.547	0.348	0.039	0.04	0.525	0.378	0.932	0.979	0.041	0.348
207R00379	4/21/2014	0	0.204	0.206	0.076	0.082	0.212	0.638	0.85	0.969	0.025	0.206
207R00599	6/5/2014	0.013	0.19	0.253	0.068	0.086	0.248	0.539	0.918	0.933	0.021	0.254
207R00619	4/23/2014	0.05	0.059	0.071	0.059	0.102	0.065	0.546	0.506	0.935	0.45	0.071
207R00651	4/21/2014	0.033	0.22	0.343	0.133	0.136	0.182	0.472	0.728	0.894	0.091	0.343
207R00823	4/23/2014	0.017	0.839	0.153	0.044	0.127	0.43	0.508	0.908	0.664	0.058	0.415
207R00843	4/22/2014	0.002	0.181	0.114	0.002	0.003	0.127	0.629	0.812	0.826	0.182	0.114
207R00880	5/5/2014	0.002	0.273	0.612	0.035	0.045	0.364	0.389	0.826	0.666	0.015	0.638

Note: All calculations were based on count data.

Table 4-6. Soft Algae IBI (S2) and Individual Metric Scores for Contra Costa Stations Sampled in 2014

Station Code	Creek Name	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
206R00407	Wildcat Creek	4/24/2014	48	10	6	0	3	10	0
206R00551	San Pablo Creek	4/30/2014	38	0	8	0	5	10	0
206R00919	Appian Creek	5/15/2014	17	0	0	0	0	10	0
207R00379	Castro Creek	4/21/2014	20	1	1	0	0	10	0
207R00599	Green Valley Creek	6/5/2014	25	1	1	0	0	10	3
207R00619	Donner Creek	4/23/2014	73	10	4	10	0	10	10
207R00651	Sans Crainte Creek	4/21/2014	23	0	1	0	3	10	0
207R00823	Galindo Creek	4/23/2014	18	1	5	0	5	0	0
207R00843	Grizzly Creek	4/22/2014	5	3	0	0	0	0	0
207R00880	Flood Control Channel	5/5/2014	33	4	8	0	5	1	2

Note: The overall IBI score was calculated by converting the sum of individual scores to a 100-point scale by summing the scores and multiplying by the number of metrics [sum x (100/60].

Table 4-7. Soft Algae Metric Results for CCCWP Stations Sampled in 2014

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)
206R00407	4/24/2014	0	0.333	0	0.333	0	0	0.23	0.23	0	0	0
206R00551	4/30/2014	0.5	0.25	0	0.25	0	0	0	0	0	0	0
206R00919	5/15/2014	0.5	1	0	1	0	0	1	1	0	0	0
207R00379	4/21/2014	0.333	0.667	0	0.667	0	0	0.174	0.174	0	0	0
207R00599	6/5/2014	0.333	0.667	0	0.667	0.333	0	1	1	0	0	0.167
207R00619	4/23/2014	0	0.5	0.5	0.5	0.667	0	0	0	0	1	0.833
207R00651	4/21/2014	0.4	0.667	0	0.333	0	0.001	0.036	0.035	0	0	0
207R00823	4/23/2014	0.333	0.429	0	0.286	0	1	1	1	1	0	0
207R00843	4/22/2014	0.25	0.75	0	0.5	0	1	1	1	1	0	0
207R00880	5/5/2014	0.2	0.25	0	0.25	0.167	0.81	0.92	0.79	0.919	0.06	0.113

Notes: 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.

Table 4-8. Hybrid (diatom and soft algae) IBI (H20) and Individual Metric Scores for CCCWP Stations Sampled in 2014

Station Code	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
206R00407	4/24/2014	44	6	10	6	0	0	7	6	0
206R00551	4/30/2014	21	0	0	8	0	0	8	0	1
206R00919	5/15/2014	16	0	0	0	1	0	0	9	3
207R00379	4/21/2014	38	6	1	1	1	0	6	9	6
207R00599	6/5/2014	34	6	1	1	1	0	5	8	5
207R00619	4/23/2014	74	9	10	4	1	10	8	8	9
207R00651	4/21/2014	31	6	0	1	2	0	6	7	3
207R00823	4/23/2014	15	0	1	5	1	0	2	1	2
207R00843	4/22/2014	38	7	3	0	0	0	7	5	8
207R00880	5/5/2014	28	5	4	8	1	0	3	1	0

Note: The overall IBI score was calculated by converting the sum of individual scores to a 100-point scale by summing the scores and multiplying by the number of metrics [sum x (100/80].

Table 4-9. Hybrid (diatom and soft algae) IBI (H21) and Individual Metric Scores for CCCWP Stations Sampled in 2014

Station Code	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
206R00407	4/24/2014	41	10	6	0	7	6	0	0
206R00551	4/30/2014	27	10	0	0	8	0	1	0
206R00919	5/15/2014	33	10	0	1	0	9	3	0
207R00379	4/21/2014	54	10	6	1	6	9	6	0
207R00599	6/5/2014	50	10	6	1	5	8	5	0
207R00619	4/23/2014	80	10	9	2	8	8	9	10
207R00651	4/21/2014	47	9	6	2	6	7	3	0
207R00823	4/23/2014	10	0	0	2	2	1	2	0
207R00843	4/22/2014	39	0	7	0	7	5	8	0
207R00880	5/5/2014	19	2	5	1	3	1	0	1

Note: The overall IBI score was calculated by converting the sum of individual scores to a 100-point scale by summing the scores and multiplying by the number of metrics [sum x (100/70].

Table 4-10. Hybrid (diatom and soft algae) IBI (H23) and Individual Metric Scores for CCCWP Stations Sampled in 2014

Station Code	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
206R00407	4/24/2014	44	6	6	0	7	10	6	0	0
206R00551	4/30/2014	34	0	8	0	8	10	0	1	0
206R00919	5/15/2014	29	0	0	1	0	10	9	3	0
207R00379	4/21/2014	49	6	1	1	6	10	9	6	0
207R00599	6/5/2014	49	6	1	1	5	10	8	5	3
207R00619	4/23/2014	75	9	4	2	8	10	8	9	10
207R00651	4/21/2014	44	6	1	2	6	10	7	3	0
207R00823	4/23/2014	15	0	5	2	2	0	1	2	0
207R00843	4/22/2014	34	7	0	0	7	0	5	8	0
207R00880	5/5/2014	26	5	8	1	3	1	1	0	2

Note: The overall IBI score was calculated by converting the sum of individual scores to a 100-point scale by summing the scores and multiplying by the number of metrics [sum x (100/80].

4.2.3 Analysis of 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.

4.2.3.1 Benthic Macroinvertebrate Metrics

There are marked differences among the condition categories indicated by the different B-IBI scores, as shown in Table 4-3. The SoCal B-IBI condition categories differ markedly from the Contra Costa B-IBI categories, with the Contra Costa conditions often scoring two categories higher than the SoCal B-IBI categories. A comparison of the number of sites in the various condition categories is shown in Table 4-11 for SoCal B-IBI scores and Contra Costa B-IBI scores.

The discrepancy between the Southern California and Contra Costa condition categories should be further investigated. Based simply on the distribution of sites in the various categories, and on the prior CCMAP monitoring results (which revealed an even broader distribution of scores and categories), it appears that the Contra Costa B-IBI may more accurately represent benthic biological conditions in Contra Costa County streams. Looking at the scores and condition categories at the extremes (highest and lowest), the Contra Costa B-IBI generally appears to reasonably characterize the sites monitored under CCMAP and by CCCWP under the RMC for MRP compliance. However, the SoCal B-IBI was developed using a more rigorous and more recently-evolved protocol than the earlier provisional Contra Costa B-IBI, and the Contra Costa B-IBI should undergo additional investigation in accordance with more recent standards in procedural approach to B-IBI development (e.g., per Stoddard et al., 2008).

As indicated in Table 4-1, most sites monitored by CCCWP for the RMC during Water Year 2014 are presumed to 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, marginal or poor for Contra Costa B-IBI) may indicate some difficulty in supporting the designated aquatic life beneficial uses.

Using the SoCal B-IBI scores, nine of the urban sites monitored by CCCWP in WY 2014 would be considered potentially deficient regarding biological conditions necessary to support a viable fishery. Using the Contra Costa B-IBI scores, only two of the non-urban sites monitored by CCCWP 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. But the differences apparent in the Contra Costa preliminary B-IBI scores indicate that further development of a Contra Costa or SF Bay area B-IBI is warranted.

Table 4-11. Summary of Biological Conditions Categories Based on SoCal B-IBI and Contra Costa B-IBI Scores for CCCWP Bioassessment Sites Sampled in Water Year 2014 (n=10)

So. California B-IBI Condition		Contra Costa B-IBI Condition	
# Sites	Category	# Sites	Category
0	Very Good	0	Very Good
0	Good	2	Good
1	Fair	6	Fair
3	Poor	2	Marginal
6	Very Poor	0	Poor

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 CCCWP 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

4.3.1.1 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 4-12), computed for Contra Costa 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.

In an initial evaluation, the WY 2014 PHab scores correlate moderately well with the Contra Costa B-IBI scores and less well with the SoCal B-IBI scores. 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 4-12. Physical Habitat Scores for CCCWP Bioassessment Sites Sampled in Water Year 2014

Site Code	Creek name	Sample Date	Epifaunal Substrate	Sediment Deposition	Channel Alteration	Mini-PHab Score
206R00407	Wildcat Creek	4/24/2014	18	15	19	52
206R00551	San Pablo Creek	4/30/2014	17	15	18	50
206R00599	Appian Creek	5/6/2014	12	14	14	40
206R00919	Castro Creek	5/15/2014	18	13	18	49
207R00379	Green Valley Creek	4/21/2014	14	17	14	45
207R00619	Donner Creek	4/23/2014	14	13	18	45
207R00651	Sans Crainte Creek	4/21/2014	9	9	14	32
207R00823	Galindo Creek	4/23/2014	1	18	1	20
207R00843	Grizzly Creek	4/22/2014	14	7	11	32
207R00880	Flood Control Channel	5/5/2014	6	5	14	25

4.3.1.2 Water Chemistry Parameters

Table 4-13 provides a summary of descriptive statistics for the nutrients and related conventional constituents collected in association with the bioassessments in receiving waters. For the purposes of data analysis, Total Nitrogen was calculated as the sum of nitrate + nitrite + Total Kjeldahl Nitrogen (TKN).

Table 4-13. Descriptive Statistics for Water Chemistry Results Collected at RMC Sites During Water Year 2014 (Non-detects estimated as ½ MDL for calculation of mean)

Analyte	Units	Mean	Min.	Max.	N	N ≥ MDL
Alkalinity as CaCO3	mg/L	302	141	476	10	10
Ammonia as N	mg/L	0.20	<0.04	1.7	10	4
Ash Free Dry Mass	mg/L	18106	1520	91700	10	10
Bicarbonate	mg/L	297	104	476	10	10
Carbonate	mg/L	4.9	<1.2	37	10	3
Chloride	mg/L	87	9.2	290	10	10
Chlorophyll a	mg/m^3	1439	<50	4400	10	8
Dissolved Organic Carbon	mg/L	3.4	1.2	5	10	10
Hydroxide	mg/L	ND	ND	ND	10	0
Nitrate as N	mg/L	0.21	<0.01	0.46	10	9
Nitrite as N	mg/L	0.005	<0.005	0.013	10	4
Nitrogen, Total Kjeldahl	mg/L	0.69	0.31	2.1	10	10
Nitrogen, Total*	mg/L	0.91	0.37	2.2	10	10
OrthoPhosphate as P	mg/L	0.19	<0.006	0.36	10	9
Phosphorus as P	mg/L	0.25	0.029	0.59	10	10
Silica as SiO2	mg/L	35	12	67	10	10
Suspended Sediment (SSC)	mg/L	7.7	<2	20	10	6

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

4.3.1.3 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.[9] Therefore, in the tables that follow, samples that are identified by the lab as toxic (based on statistical comparison of samples vs. Control at $p < 0.05$) 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).

[9] 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."

Samples for triad sites were 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 water samples
2. Dry season water samples
3. Dry season sediment samples

For each of these groups, the results are first presented in a table indicating which samples were found to be toxic by virtue of a statistically significant difference from the Control as determined by the laboratory. Detailed results are then presented in a subsequent table for the toxic samples, along with an assessment as to whether the toxic effect was less than 50% of the Control for water samples, or more than 20% less than the Control for sediment samples.

Wet Season Aquatic Toxicity

Per the MRP, ambient water samples were collected by CCCWP from two sites during storm events in spring 2014, and tested for toxic effects using four species: an aquatic plant (*Selenastrum capricornutum*), two aquatic invertebrates (*Ceriodaphnia dubia* and *Hyalella azteca*), and one fish species (*Pimephales promelas* or fathead minnow).

As shown in Table 4-14, neither of the 2013 wet weather samples were found to be toxic to *S. capricornutum*. In fact, the sample water from both San Pablo Creek and Grizzly Creek was conducive to algae growth, as the measured cell growth was substantially higher in the test samples than in the control. Neither of the samples was toxic to *C. dubia*, for either the acute endpoint (survival) or the chronic endpoint (growth).

The Grizzly Creek sample was reported as toxic to *H. azteca* and fathead minnow (*P. promelas)*, in each case with statistically significant toxicity relative to the acute endpoint criterion (survival). As also happened previously with fathead minnow tests in 2012 and 2013, the fathead minnow toxic result was identified by the laboratory as having been caused by interference due to pathogen-related mortality (PRM). Per agreement with SFBRWQCB staff, the laboratory provided narrative and photographic documentation of the PRM determination.

Table 4-14. Summary of CCCWP WY 2014 Wet Season Water Toxicity Results

Wet Season Water Samples			Toxicity Relative to the Lab Control Treatment?					
			Selenastrum capricornutum	*Ceriodaphnia dubia*		*Hyalella azteca*	*Pimephales promelas*	
Site Code	Creek Name	Sample Collection Date	Growth (cells/mL x 10^6)	Survival (%)	Reproduction (# neonates/ female)	Survival (%)	Survival (%)	Growth (mg)
Control	-	-	2.83	100	31.3	98	100	0.72
206R00551	San Pablo Creek	2/26/14	7.19	100	28.9	94	92.5[a]	0.73
207R00843	Grizzly Creek	2/26/14	7.01	90	29.1	64*	57.5*[a]	0.59

*The response at this test treatment was significantly less than the Lab Control treatment response at $p < 0.05$;neither sample was toxic at less than 50% of the Control.
a - PRM was observed in multiple replicates for this stormwater sample.

As shown in Table 4-14, while the Grizzly Creek *H. azteca* and fathead minnow survival results were significantly less than the associated laboratory Control values, indicating moderate levels of acute toxicity, the affected results were in each case not less than the associated Permit Table 8.1 threshold of less than 50% of the Control values.

Dry-Season Aquatic Toxicity

Water samples were collected during the summer 2014 period from the same two sites where wet season sampling occurred, and were again tested for aquatic toxicity using the same four test species. The results are summarized in Table 4-15.

There was no toxicity in the summer water samples to *S. capricornutum*, *H. azteca*, or fathead minnows. As with the spring water samples, the samples appeared to enhance algae growth, as the *S. capricornutum* growth results from the field samples exceeded the control sample growth.

Both samples were determined to be toxic to *C. daphnia* in relation to the chronic endpoint (reproduction). Neither of these sample results met the Permit Table 8.1 trigger threshold (more than 50% less than the Control).

Table 4-15. Summary of CCCWP WY 2014 Dry Season Aquatic Toxicity Results

Dry Season Water Samples			Toxicity Relative to the Lab Control Treatment?					
			Selenastrum capricornutum	*Ceriodaphnia dubia*		*Hyalella azteca*	*Pimephales promelas*	
Site Code	Creek Name	Sample Collection Date	Growth (cells/mL x 10^6)	Survival (%)	Repro-duction (# neonates/ female)	Survival (%)	Survival (%)	Growth (mg)
Control	-	-	2.75	100	41.8	100	97.5	0.44
206R00551	San Pablo Creek	7/23/14	7.25	100	26.2*	98	100	0.47
207R00843	Grizzly Creek	7/23/14	7.08	100	25.3*	100	97.5	0.47

*The response at this test treatment was significantly less than the Lab Control treatment response at $p < 0.05$; neither sample was toxic at less than 50% of the Control.

Dry Season Sediment Toxicity

During the dry season, sediment samples were collected at the same sites 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 results of the sediment toxicity testing in Water Year 2014 are summarized in Table 4-16. Neither of the samples were determined to be toxic to *H. azteca* for the acute endpoint (survival) or the chronic endpoint (growth).

Table 4-16. Summary of CCCWP WY 2014 Dry Season Sediment Toxicity Results

Dry-Season Sediment Samples			Toxicity test results	
			H. azteca	
Site Code	Creek Name	Sample Collection Date	Survival (%)	Growth (mg)
Control	-	-	100	0.086
206R00551	San Pablo Creek	7/23/14	97.5	0.092
207R00843	Grizzly Creek	7/23/14	96.3	0.094

Sediment Chemistry Parameters

Results for sediment chemistry constituents for samples collected in WY 2014 are provided in Table 4-17. Analytes are presented in alphabetical order by chemical analyte group.

Table 4-17. CCCWP WY 2014 Sediment Chemistry Results

Analyte	Units*	Site 206R0551 San Pablo Creek			Site 207R00843 Grizzly Creek		
		Result	MDL	RL	Result	MDL	RL
Arsenic	mg/Kg	4	0.31	0.52	6.2	0.32	0.53
Cadmium	mg/Kg	0.3	0.0052	0.04	0.37	0.0053	0.04
Chromium	mg/Kg	25	0.0083	0.1	14	0.0085	0.11
Copper	mg/Kg	10	0.078	0.21	13	0.08	0.21
Lead	mg/Kg	8.2	0.0052	0.1	8	0.0053	0.11
Mercury	mg/Kg	0.038	0.00083	0.021	0.028	0.00083	0.021
Nickel	mg/Kg	33	0.052	0.1	52	0.11	0.21
Zinc	mg/Kg	48	0.83	2.1	64	0.85	2.1
Chlordane, cis-	ng/g	ND	0.65	6	ND	0.66	6
Chlordane, trans-	ng/g	ND	0.66	6	ND	0.67	6
DDD(p,p')	ng/g	ND	0.78	3	ND	0.79	3
DDE(p,p')	ng/g	ND	0.63	3	ND	0.64	3
DDT(p,p')	ng/g	ND	0.4	3	ND	0.41	3
Deltamethrin/Tralomethrin	ng/g	ND	0.29	0.41	ND	0.3	0.42
Dieldrin	ng/g	ND	0.72	3	ND	0.73	3
Endrin	ng/g	ND	0.76	3	ND	0.77	3
HCH, gamma-	ng/g	ND	0.66	6	ND	0.67	6
Heptachlor Epoxide	ng/g	ND	0.63	3	ND	0.64	3
Bifenthrin	ng/g	0.38	0.21	0.33	3.2	0.21	0.33
Cyfluthrin, total	ng/g	ND	0.19	0.33	ND	0.19	0.33
Cyhalothrin, Total lambda-	ng/g	ND	0.23	0.33	ND	0.23	0.33
Cypermethrin, total	ng/g	ND	0.19	0.33	ND	0.19	0.33
Esfenvalerate/Fenvalerate, total	ng/g	ND	0.17	0.33	ND	0.17	0.33
Permethrin, cis-	ng/g	ND	0.73	0.83	ND	0.74	0.84
Permethrin, trans-	ng/g	ND	0.73	0.83	ND	0.74	0.84
Acenaphthene	ng/g	ND	3.1	3.6	ND	3.2	3.7
Acenaphthylene	ng/g	ND	3.1	3.6	ND	3.2	3.7
Anthracene	ng/g	ND	3.1	3.6	5.3	3.2	3.7
Benz(a)anthracene	ng/g	3.4 J	3.1	3.6	11	3.2	3.7
Benzo(a)pyrene	ng/g	3.2 J	3.1	3.6	33	16	18
Benzo(b)fluoranthene	ng/g	ND	3.1	3.6	ND	16	18
Benzo(e)pyrene	ng/g	4	3.1	3.6	33	16	18
Benzo(g,h,i)perylene	ng/g	ND	16	18	21	16	18
Benzo(k)fluoranthene	ng/g	ND	3.1	3.6	ND	16	18
Biphenyl	ng/g	ND	3.4	3.6	ND	3.5	3.7
Chrysene	ng/g	11	3.1	3.6	76	16	18
Dibenz(a,h)anthracene	ng/g	ND	3.1	3.6	ND	16	18
Dibenzothiophene	ng/g	ND	3.4	3.6	ND	3.5	3.7

Table 4-17. CCCWP WY 2014 Sediment Chemistry Results

Analyte	Units*	Site 206R0551 San Pablo Creek			Site 207R00843 Grizzly Creek		
		Result	MDL	RL	Result	MDL	RL
Dimethylnaphthalene, 2,6-	ng/g	ND	3.1	3.6	ND	3.2	3.7
Fluoranthene	ng/g	12	3.1	3.6	48	3.2	3.7
Fluorene	ng/g	ND	3.1	3.6	ND	3.2	3.7
Indeno(1,2,3-c,d)pyrene	ng/g	ND	16	18	17	16	18
Methylnaphthalene, 1-	ng/g	ND	3.1	3.6	ND	3.2	3.7
Methylnaphthalene, 2-	ng/g	ND	3.1	3.6	ND	3.2	3.7
Methylphenanthrene, 1-	ng/g	ND	3.1	3.6	ND	3.2	3.7
Naphthalene	ng/g	ND	3.1	3.6	ND	3.2	3.7
Perylene	ng/g	ND	3.1	3.6	32	16	18
Phenanthrene	ng/g	8	3.1	3.6	23	3.2	3.7
Pyrene	ng/g	13	3.1	3.6	45	3.2	3.7
Total Organic Carbon	%	0.5	0.013	0.13	0.62	0.013	0.13

* All measurements reported as dry weight
J = estimated value; ND = not detected

4.3.2 Stressor Analysis

Stressor analysis provides an analysis of the water and sediment chemistry and 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.

4.3.2.1 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 4-18.

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,[10] 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)[11] for the protection of aquatic life were used for comparison purposes.[12]

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.

Table 4-18. 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

The comparisons of the measured nutrients data to the thresholds listed in Table 4-18 are shown in Table 4-19. Of the 10 sites monitored, the water quality standard was exceeded at one site for chloride (site 207R00880, the unnamed flood control channel). Two results (site 207R00651, Sans Crainte Creek and site 207R00823, Galinda Creek) exceeded the un-ionized ammonia standard.[13] No samples exceeded

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

[11] 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.

[12] 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.

[13] It should be noted that this standard is an annual median concentration, and comparison to an acute threshold may change this determination.

the nitrate + nitrite standard, although that standard does not apply to the WY 2014 sites, as none of them have the MUN beneficial use. 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 be exceeded at three of the 10 sites.

Table 4-19. 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]		
206R00407	Wildcat Creek		0.86	27	0.20	0	0%
206R00551	San Pablo Creek		0.40	69	0.41	0	0%
206R00599	Appian Creek		5.81	140	0.20	0	0%
206R00919	Castro Creek		1.08	76	0.063	0	0%
207R00379	Green Valley Creek		1.05	43	0.078	0	0%
207R00619	Donner Creek		0.76	9.2	0.0075	0	0%
207R00651	Sans Crainte Creek		25.7	22	0.10	1	50%
207R00823	Galindo Creek		31.1	150	0.19	1	50%
207R00843	Grizzly Creek		0.37	39	0.47	0	0%
207R00880	Flood Control Channel		0.74	290	0.45	1	50%
# Values >Threshold:			2	1	NA		
% Values >Threshold:			20%	10%	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
Shaded value indicates threshold exceeded.

4.3.2.2 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 4-20. The MRP trigger criterion for chlorine states, "After immediate resampling, concentrations remain >0.08 mg/L."

Of the 10 measurements collected, only one (10%) exceeded the threshold for free chlorine and total chlorine, at site 207R00823, Galindo Creek.

Table 4-20. 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?
206R00407	Wildcat Creek	4/24/14	NR	NR	NA
206R00551	San Pablo Creek	4/30/14	0	0	No
206R00599	Appian Creek	5/6/14	0	0	No
206R00919	Castro Creek	5/15/14	0	0	No
207R00379	Green Valley Creek	4/21/14	0	0	No
207R00619	Donner Creek	4/23/14	0.01	0.01	No
207R00651	Sans Crainte Creek	4/21/14	0	0	No
207R00823	Galindo Creek	4/23/14	0.1	0.12	Yes
207R00843	Grizzly Creek	4/22/14	0	0	No
207R00880	Flood Control Channel	5/5/14	0	0	No
Number of samples exceeding 0.08 mg/L:			1		
Percentage of samples exceeding 0.08 mg/L:			10%		

NR = not recorded

4.3.2.3 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 4-21 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.

Table 4-21. 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					
207R00843	Grizzly Creek	2/26/14	*H. azteca*	Acute (survival)	No (not <50% of control)
207R00843	Grizzly Creek	2/26/14	*Fathead minnow*	Acute (survival)	No (not <50% of control)
207R00551	San Pablo Creek	7/23/14	*Ceriodaphnia dubia*	Chronic (reproduction)	No (not <50% of control)
207R00843	Grizzly Creek	7/23/14	*Ceriodaphnia dubia*	Chronic (reproduction)	No (not <50% of control)
Sediment					
No toxicity observed					

4.3.2.4 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.[14]
- Calculation of probable effect concentration (PEC) quotients for all analytes at a given site; determine whether 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. For the Total PAHs calculations, the non-detected PAHs were included in the sum at a concentration equal to ½ the MDL. Otherwise, TEC and PEC ratios were not calculated for constituents that were reported as non-detect.

Table 4-22 provides TEC quotients for all non-pyrethroid sediment chemistry constituents, calculated 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 4-22 also provides PEC quotients for all non-pyrethroid sediment chemistry constituents, calculated as the ratio of the measured concentration divided by the PEC value, per MacDonald et al. (2000). This

[14] 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."

table also provides calculated mean values of the PEC quotients for each site, for identification of any sites with mean PEC quotient greater than or equal to 0.5, per the Table H-1 threshold.

Each of the two sites exhibited one TEC ratio higher than 1; in both cases for the constituent nickel. These sample results therefore do not meet 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.

Neither site met the Permit Table H-1 action criteria with a mean PEC greater than 0.5.

Table 4-22. Threshold Effect Concentration (TEC) and Probable Effect Concentration (PEC) Quotients for WY 2014 Sediment Chemistry Constituents

Metals	Sample Units*	Site 206R00551 San Pablo Creek Sample	Site 206R00551 San Pablo Creek TEC Ratio	Site 206R00551 San Pablo Creek PEC Ratio	Site 207R00843 Grizzly Creek Sample	Site 207R00843 Grizzly Creek TEC Ratio	Site 207R00843 Grizzly Creek PEC Ratio
Arsenic	mg/Kg	4	0.41	0.12	6.2	0.63	0.19
Cadmium	mg/Kg	0.3	0.30	0.06	0.37	0.37	0.07
Chromium	mg/Kg	25	0.58	0.23	14	0.32	0.13
Copper	mg/Kg	10	0.32	0.07	13	0.41	0.09
Lead	mg/Kg	8.2	0.23	0.06	8	0.22	0.06
Mercury	mg/Kg	0.038	0.21	0.04	0.028	0.16	0.03
Nickel	mg/Kg	33	**1.45**	0.68	52	**2.29**	**1.07**
Zinc	mg/Kg	48	0.40	0.10	64	0.53	0.14
Pesticides							
Chlordane	ng/g	ND			ND		
Dieldrin	ng/g	ND			ND		
Endrin	ng/g	ND			ND		
Heptachlor Epoxide	ng/g	ND			ND		
Lindane (gamma-BHC)	ng/g	ND			ND		
Sum DDD	ng/g	ND			ND		
Sum DDE	ng/g	ND			ND		
Sum DDT	ng/g	ND			ND		
Total DDTs	ng/g	ND			ND		
PAHs							
Anthracene	ng/g	ND			5.3	0.09	0.01
Fluorene	ng/g	ND			ND		
Naphthalene	ng/g	ND			ND		
Phenanthrene	ng/g	8	0.04	0.01	23	0.11	0.02
Benz(a)anthracene	ng/g	3.4	0.03	0.003	11	0.10	0.01
Benzo(a)pyrene	ng/g	3.2	0.02	0.002	33	0.22	0.02
Chrysene	ng/g	11	0.07	0.01	76	0.46	0.06
Fluoranthene	ng/g	12	0.03	0.01	48	0.11	0.02
Pyrene	ng/g	13	0.07	0.01	45	0.23	0.03
Total PAHs**	ng/g	94.2	0.06	0.004	385	0.24	0.02
Number with TECq ≥ 1.0:			**1**			**1**	
COMBINED TEC RATIOS			**4.21**			**6.51**	
AVERAGE TEC RATIO			**0.28**			**0.41**	
COMBINED PEC RATIOS				**1.40**			**1.96**
AVERAGE PEC RATIO				**0.09**			**0.12**

* All measurements reported as dry weight
** Total PAHs include 24 individual PAH compounds; NDs were substituted at 1/2 MDL to compute total
ND = not detected

Table 4-23 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.

The only pyrethroid pesticide detected was bifenthrin, which was detected at both sites, but in each case at a TU quotient less than 1, as shown in Table 4-23. Therefore neither site met the Permit Table H-1 action criterion of at least one TU quotient greater than or equal to 1.0, although the Grizzly Creek result was just below 1.0.

Table 4-23. Calculated Pyrethroid Toxic Unit Equivalents, WY 2014 Sediment Chemistry Data

Pyrethroid pesticides	LC50 (µg/g organic carbon)	Site 206R00551 San Pablo Creek			Site 207R00843 Grizzly Creek		
		Sample (ng/g)	Sample (µg/g organic carbon)	TU Equiv.	Sample	Sample (µg/g organic carbon)	TU Equiv.
Bifenthrin	0.52	0.38	0.0760	0.146	3.2	0.516	0.99
Cyfluthrin	1.08	ND			ND		
Cyhalothrin, lambda	0.45	ND			ND		
Cypermethrin	0.38	ND			ND		
Esfenvalerate/Fenvalerate	1.54	ND			ND		
Permethrin	10.8	ND			ND		
Sum (Pyrethroid TUs):				0.146			0.99

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.

4.3.2.5 Sediment Triad Analysis

Table 424 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, neither site qualifies for follow-up action based on the sediment triad results.

Table 4-24. Summary of Sediment Quality Triad Evaluation Results, WY 2012 - WY 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
2012	Grayson Creek	207R00011	Very Poor	Yes	10	0.14	2.17	C
2012	Dry Creek	544R00025	Very Poor	Yes	11	0.51	3.62	C
2013	Sycamore Creek	207R00271	Very Poor	Yes	0	0.04	10.48	C
2013	Marsh Creek	544R00281	Very Poor	Yes	4	0.13	1.03	C
2014	San Pablo Creek	206R00551	Very Poor	No	1	0.09	.016	
2014	Grizzly Creek	207R00843	Very Poor	No	1	0.12	.109	

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.

While MacDonald et al. (2000) generated PECs for multiple trace element, PAH, OC pesticide, and pyrethroid pesticide parameters, there was insufficient data at time of its publication to evaluate the published PECs as to their ability to predict associated sediment toxicity for each of the analytes reported. Analytes for which predictive ability is particularly uncertain include various PAHs (anthracene, fluorine, and fluoranthene) and OC pesticides (dieldrin, DDDs, DDTs, endrin, heptachlor epoxide, and lindane).

Additionally, the MacDonald et al. (2000) TECs and PECs were generated with the assumption that the predictive ability of the thresholds would be acceptable if the prediction were correct 75% of the time. For the six samples evaluated by CCCWP during WY 2012-2014, a single sample exceeded the mean PEC criterion of 0.5; significant toxicity was reported associated with this sample (Table 4-24). For the one sample in which more than three analytes exceeded associated PECs, statistically significant toxicity was not reported.

When examining pyrethroids concentrations, a similar degree of uncertainty exists. Weston (2005) reported that predictions of sediment toxicity to H. azteca were supported by observed results for sites with TU ratios below one (little or no mortality) and above four (high or full mortality). For TUs between one and four, however, the predictive ability of the TU is less certain (Weston, 2005).

5. Conclusions and Next Steps

During WY 2014, 10 sites were monitored by CCCWP under the RMC regional probabilistic design for bioassessment, physical habitat, and water chemistry parameters. Two sites were also monitored for water and sediment toxicity and sediment chemistry. The water and sediment chemistry and toxicity data were used to evaluate potential stressors that may affect aquatic habitat quality and beneficial uses. The bioassessment and related data are also used to develop a preliminary condition assessment for the monitored sites, to be used in conjunction with the stressor assessment based on sediment chemistry and toxicity. Based upon the bioassessment results (principally B-IBI scores for benthic macroinvertebrate taxonomy), the sites monitored in WY 2014 may be impacted from the standpoint of aquatic life beneficial uses.

Candidate probabilistic sites classified with unknown sampling status as of Water Year 2014 may continue to be evaluated by the individual stormwater programs for potential sampling in Water Year 2015.

5.1 Summary of Stressor Analyses

The stressor analysis revealed the following potential stressors, based on an analysis of the regional/probabilistic data collected by CCCWP during WY 2014:

- **Water Quality –** Of 11 water quality parameters[15] required in association with bioassessment monitoring, applicable water quality standards were only identified for ammonia, chloride, and nitrate + nitrite (for sites with MUN beneficial use only). Of the results generated at the 10 sites monitored by CCCWP for those three parameters, only two un-ionized ammonia concentrations and one chloride concentration exceeded the applicable water quality standard or threshold; each of those occurred at different sites. The MRP Table 8.1 trigger threshold for "Nutrients" (i.e., 20% of results in one water body exceed one or more water quality standards or applicable thresholds) was therefore exceeded at those three sites.

- **Water Toxicity –** Toxicity testing was performed for four test species in water samples collected by CCCWP from two sites, during one wet weather event and one dry season event in WY 2014. Samples collected during the wet weather monitoring event (2/26/14) from the Grizzly Creek site exhibited significant acute toxicity (reduction in survival) to *H. azteca* and fathead minnows. However, the fathead minnow test was impacted by pathogen-related mortality, presumably unrelated to sample quality. Samples collected from both the San Pablo Creek and Grizzly Creek sites during the dry weather event (7/23/14) exhibited toxicity to *C. daphnia* per the chronic endpoint (reproduction); the samples were not acutely toxic. None of the toxic water samples met the Permit Table 8.1 threshold (<50% of the Control value) for follow-up action in WY 2014.

- **Sediment Toxicity –** Bedded sediment samples collected from the same two sites on San Pablo Creek and Grizzly Creek on 7/23/14 were not toxic to the test species (*H. azteca*).

- **Sediment Chemistry –** Bedded sediment samples collected from the same two sites on San Pablo Creek and Grizzly Creek on 7/23/14 and analyzed for a suite of sediment chemistry

[15] Algal mass (ash-free dry weight), chlorophyll-a, dissolved organic carbon, ammonia, nitrate, total nitrogen, dissolved orthophosphate, phosphorus, suspended sediment concentration, silica, and chloride.

constituents. Analytical results produced less evidence of potential stressors than samples analyzed in WY 2012 and 2013, based on the criteria from MRP Table H-1 (Central Valley Permit Table D-1). Neither of the sediment chemistry samples resulted in three or more constituents with TEC quotients greater than 1.0,[16] a mean PEC quotient > 0.5, or a sum of TU equivalents for all measured pyrethroids greater than or equal to 1.0. The pyrethroid pesticide bifenthrin was found in both creek sediment samples, but not at levels expected to cause toxicity to test organisms.

- **Sediment Triad Analyses –** bioassessment, sediment toxicity, and sediment chemistry results were evaluated as the three lines of evidence used in the triad approach for assessing overall stream condition. For the two sites evaluated in WY 2014, follow-up action is not required based on the triad analysis.

5.2 Next Steps

The analysis presented in this and previous reports has identified a number of potentially impacted sites that may deserve further evaluation and/or investigation, to provide better understanding of the sources/stressors that may be contributing to reduced water quality and lower biological condition at these sites. During Water Year 2013, the RMC collaboratively reviewed trigger results from Water Year 2012 and selected a total of 10 sites in four counties for implementation of SSID projects based on prioritization of the type, extent, and geographic spread of the triggers. For CCCWP, this involves two projects designed to evaluate and further characterize causes of toxicity impacting certain urban creek systems. A summary of CCCWP's SSID projects is included in the WY 2014 UCMR, and the report detailing the results of the first year of that investigation is included as an attachment to the UCMR.

CCCWP and the other RMC participants will continue to implement the regional probabilistic monitoring design in Water Year 2015. Site evaluation and sampling are planned at new sites for this Water Year, as well as resampling and retesting as required to complete the evaluation of trigger thresholds per Permit Table 8.1.

[16] In WY 2014 monitoring, both sites exceeded the TEC value for nickel in sediment. During WY 2012 and 2013, for most sites, chromium and nickel concentrations in sediment exceeded TEC values. Considering that both metals are naturally occurring at relatively high levels in Bay Area soils, and concentrations generally also exceed TEC values in reference or non-urban sites, TEC values presented in MacDonald et al. (2000) may not be reasonably applicable to the Bay Area. These observations should be considered in future evaluations of sediment chemistry data collected by RMC participants in Bay Area creeks.

6. References

American Fisheries Society (AFS). Internet source. http://fisheries.org/docs/pub_hatch/pub_ammonia_fwc.xls, Table 9: Ammonia Calculator (Freshwater) (computes the concentration of un-ionized ammonia as a function of temperature, pH, and salinity). http://fisheries.org/hatchery>http://fisheries.org/hatchery.

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BASMAA. 2011. Regional Monitoring Coalition Final Creek Status and Long-Term Trends Monitoring Plan. Prepared by EOA, Inc. Oakland, Calif. 23 pp.

BASMAA. 2011-2012. Regional Monitoring Coalition Monitoring Status Reports (unofficially submitted on March and Sept 15 of 2011 and 2012 per AEO request), including "RMC Multi-Year Workplan FY2009-10 through FY2014-15" (dated Feb 2011), attached to March 2011 Monitoring Status Report. The September submittals, along with their appendices, are posted along with the Annual Report submittals (see Appendices B1-B3) at: www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/stormwater/MRP/2012_AR/BASMAA/index.shtml

BASMAA. 2013. Regional Urban Creeks Status Monitoring Report, Water Year 2012 (October 1, 2011 – September 30, 2012). Prepared for BASMAA by EOA, Inc. on behalf of the Santa Clara Urban Runoff Pollution Prevention Program and the San Mateo Countywide Water Pollution Prevention Program and Armand Ruby Consulting on behalf of the Contra Costa Clean Water Program.

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Appendix 2

Local/Targeted Creek Status Monitoring Report, Water Year 2014

CONTRA COSTA
CLEAN WATER
PROGRAM

Local/Targeted Creek Status Monitoring Report Water Year 2014

(October 2013 – September 2014)

Submitted to the San Francisco Bay and Central Valley Regional Water Quality Control Boards in Compliance with NPDES Permit Provisions C.8.g.iii

NPDES Permit Nos. CAS612008 and CAS083313

March 12, 2015

A Program of Contra Costa County, its Incorporated Cities/Towns and the Contra Costa Flood & Water Conservation District

This report is submitted by the participating agencies of the

CONTRA COSTA CLEAN WATER PROGRAM

Program Participants:

- Cities/(Towns) of: Antioch, Brentwood, Clayton, Concord, Danville (Town), El Cerrito, Hercules, Lafayette, Martinez, Moraga (Town), Oakley, Orinda, Pinole, Pittsburg, Pleasant Hill, Richmond, San Pablo, San Ramon and Walnut Creek
- Contra Costa County
- Contra Costa County Flood Control & Water Conservation District

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Preface

Contra Costa County lies within both the Region 2 and Region 5 jurisdictions of the State Water Resources Control Boards. The county-wide stormwater program is subject to both the Region 2 Municipal Regional Stormwater National Pollutant Discharge Elimination System (NPDES) Permit (MRP)[1] and the equivalent Region 5 permit (Central Valley Permit)[2].

This Local/Targeted Creek Status Monitoring Report documents the results of targeted (non-probabilistic) monitoring performed by Contra Costa Clean Water Program (CCCWP) in WY 2014 (October 1, 2013-September 30, 2014). Together with the creek status monitoring data reported in the Regional/Probabilistic Creek Status Monitoring Report (ARC 2014), this submittal fulfills monitoring requirements for Table 8.1 monitoring specified in Permit Provision C.8.c and complies with reporting Provision C.8.g of both the MRP and the Central Valley Permit.

In early 2010, several members of the Bay Area Stormwater Management Agencies Association (BASMAA) joined together to form the Regional Monitoring Coalition (RMC) to coordinate and oversee water quality monitoring required by the MRP. The RMC includes the following stormwater program participants:

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

In accordance with the RMC Creek Status and Long-Term Trends Monitoring Plan (EOA and ARC, 2011), targeted monitoring data were collected following methods and protocols specified in the BASMAA RMC Quality Assurance Program Plan (QAPP; BASMAA, 2014a) and BASMAA RMC Standard Operating Procedures (BASMAA, 2014b). Where applicable, monitoring data were derived using methods comparable with methods specified by the California Surface Water Ambient Monitoring Program (SWAMP) QAPP[3]. Data presented in this report also were submitted to the San Francisco Estuary Institute for submittal to the State Water Resources Control Board (SWRCB) on behalf of CCCWP's permittees and pursuant to Permit Provision C.8.g. requirements for electronic data reporting.

[1] The San Francisco Bay Regional Water Quality Control Board (SFBRWQCB) issued the MRP to 76 cities, counties and flood control districts (i.e., Permittees) in the Bay Area on October 14, 2009 (SFBRWQCB 2009). The BASMAA programs supporting MRP Regional Projects include all MRP Permittees as well as the cities of Antioch, Brentwood, and Oakley, which are not named as Permittees under the MRP but have voluntarily elected to participate in MRP-related regional activities.
[2] The Central Valley Regional Water Quality Control Board (CVRWQCB) issued the East Contra Costa County Municipal NPDES Permit (Central Valley Permit, Order No. R5-2010-0102) on September 23, 2010 (CVRWQB 2010).
[3] The current SWAMP QAPP is available at:
http://www.waterboards.ca.gov/water_issues/programs/swamp/docs/qapp/swamp_qapp_master090108a.pdf

List of Acronyms

ACCWP	Alameda Countywide Clean Water Program
ADH	ADH Environmental
ARC	Armand Ruby Consulting
BASMAA	Bay Area Stormwater Management Agencies Association
BMI	Benthic macro invertebrate
CCCCDP	Contra Costa County Community Development Department
CCCWP	Contra Costa Clean Water Program
COLD	Cold water habitat
CDFW	California Department of Fish and Wildlife
CFU	Colony forming units
CRAM	California Rapid Assessment Method
CVRWQB	Central Valley Regional Water Quality Control Board
DO	Dissolved oxygen
DQO	Data quality objectives
EBRPD	East Bay Regional Park District
FSURMP	Fairfield Suisun Urban Runoff Management Program
HDI	Human Disturbance Index
IBI	Index of Biotic Integrity
LQOA	Local Quality Assurance Officer
LTCSMR	Local/Targeted Creeks Status Monitoring Report
MPC	Monitoring and Pollutants of Concern Committee
MPN	Most Probable Number
MRP	Municipal Regional Permit
NPDES	National Pollution Discharge Elimination System
POC	Pollutants of Concern
QAPP	Quality Assurance Project Plan
Region 2	San Francisco Regional Water Quality Control Board
Region 5	Central Valley Regional Water Quality Control Board
RWQC	Recreational Water Quality Criteria
RMC	Regional Monitoring Coalition
RWQCB	Regional Water Quality Control Board
SAP	Sampling and Analysis Plan
SCVURPPP	Santa Clara Valley Urban Runoff Pollution Prevention Program
SFBRWQB	San Francisco Bay Regional Water Quality Control Board
SMCWPPP	San Mateo Countywide Water Pollution Prevention Program
SSID	Stressor/Source Identification
STLS	Small Tributaries Loading Strategy
STV	Standard Threshold Value
SOP	Standard Operating Procedure
SWAMP	Surface Water Ambient Monitoring Program
SWRCB	State Water Resources Control Board
TIE	Toxicity Identification Evaluation
TMDL	Total Maximum Daily Load
USEPA	United States Environmental Protection Agency
WARM	Warm Water Habitat
WAMT	Weekly Average Maximum Daily Temperature
WQOs	Water Quality Objectives
WY	Water Year

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CONTRA COSTA CLEAN WATER PROGRAM

Executive Summary

This Local/Targeted Creek Status Monitoring Report documents the results of targeted monitoring performed by CCCWP during Water Year 2014 (WY 2014).Together with the creek status monitoring data reported in the Regional/Probabilistic Creek Status Monitoring Report, this submittal fulfills reporting requirements for status monitoring specified in Table 8.1 under Provision C.8.c of both the Municipal Regional Permit (MRP) for urban stormwater issued by the San Francisco Bay Regional Water Quality Control Board (SFRWQCB; Order No. R2-2009-0074) and the East Contra Costa County Municipal NPDES Permit (Central Valley Permit) issued by the Central Valley Regional Water Quality Control Board (CVRWQCB; Order No. R5-2010-0102). Reporting requirements for Table 8.1 constituents are established in provision C.8.g.iii of both permits, and to promote a coordinated countywide program of water quality management, the two permits have nearly identical provisions.

Within the County of Contra Costa, targeted monitoring was conducted at:

- Four continuous water temperature monitoring locations
- Two general water quality monitoring locations
- Five pathogen indicator monitoring locations
- Ten riparian assessment monitoring locations

Continuous Water Temperature: Hourly water temperature measurements were recorded using HOBO® data loggers (HOBOs®) deployed at two creeks on April 14, 2014 – three on Rodeo Creek and one on San Pablo Creek. The HOBOs® were retrieved on October 17, 2014.

General Water Quality: Monitoring for temperature, dissolved oxygen (DO), pH, and conductivity was conducted using YSI continuous water quality recording equipment (*Sondes*), also at Rodeo Creek and San Pablo Creek in Contra Costa County, during two time periods at each creek as follows: once during spring (April to May), and once during summer (August) 2014.

Pathogen Indicators: Samples were collected by ADH Environmental (ADH) staff on July 8, 2014 at five stations each along three creeks (i.e., Rodeo, San Pablo and Grizzly) in Contra Costa County, and were analyzed for fecal coliform and *E. coli.*

Riparian Assessments: Assessments were conducted at 10 sites between August 26th and September 3rd using the California Rapid Assessment Method (CRAM). CRAM assessments were conducted at the same locations that were monitored for bioassessment and other parameters under the RMC probabilistic design.

Targeted monitoring data, with the exception of CRAM results and specific conductivity, were evaluated against numeric Water Quality Objectives (WQOs) or other applicable criteria, as described in Table 8.1 in the MRP and Central Valley Permit. The results are summarized below:

- **Temperature:** A weekly running average of maximum daily temperatures (WAMT[4]) of 20.5°C was used as the applicable criterion to evaluate temperature data. At the four

[4] In the previous two CCCWP Local/Targeted Creek Status Monitoring Reports (ADH 2013, ADH 2014), the term "MWAT" was used to define the temperature metric that was calculated to assess compliance with the selected 20.5°C temperature threshold. The term now used ("WAMT") more accurately describes the rolling 7-day (weekly) average of daily maximum temperatures that has been and continues to be computed for this purpose, and use of

stations with continuously recorded temperature from April until October, two stations had results that exceeded the WAMT threshold. At both of the other two sites in the spring and summer index periods, no results were above the WAMT threshold.

- **Dissolved Oxygen (DO):** WQOs for DO in non-tidal waters are applied as follows: 7.0 mg/L minimum for waters designated as cold habitat (COLD) and 5.0 mg/L minimum for waters designated as warm water habitat (WARM) were used to define thresholds for evaluating dissolved oxygen (DO) data for Rodeo Creek and San Pablo Creek. DO concentrations measured below both the COLD and WARM thresholds at Rodeo Creek substantially during the both the April and August deployments. At San Pablo Creek during both deployments, there were no results that measured lower than either threshold.
- **pH:** pH measurements at Rodeo Creek and San Pablo Creek were within WQOs.
- **Pathogen Indicator Bacteria:** Single sample maximum concentrations of 400 MPN/100ml fecal coliform (SFRWQCB 2011) and 410 MPN/100ml *E. coli* (USEPA 2012) were used as Water Contact Recreation evaluation criteria for the purposes of this evaluation. Samples for fecal coliform and *E.coli* at two of the five stations exceeded the maximum single sample concentrations.

Applicable criteria have not been developed for CRAM, but the results were well-correlated with two of four CRAM attributes with benthic Index of Biological Integrity (IBI) scores for the ten bioassessment sites. The application of CRAM in urban creeks of the San Francisco Bay Region is relatively recent and results should be considered preliminary. Further analysis of existing data and additional information are needed to comprehensively evaluate the utility of CRAM data for assessing stream ecosystem health and aquatic life uses.

the new term is intended to avoid confusion with other metrics that use the term "MWAT". The computations and analysis of this 7-day metric are consistent in the CCCWP Local/Targeted Creek Status reports throughout the three years; only the naming of the term has changed to better reflect the definition of this compliance metric.

1.0 Introduction

Contra Costa County lies within the jurisdictions of both the San Francisco Bay Regional Water Quality Control Board (SFRWQCB; Region 2) and the Central Valley Regional Water Quality Control Board (CVRWQCB; Region 5). Municipal stormwater discharges in Contra Costa County are regulated by the requirements of both the Municipal Regional Permit (MRP) for urban stormwater in Region 2 (Order No. R2-2009-0074), and the East Contra Costa County Municipal NPDES Permit (Central Valley Permit) in Region 5 (Order No. R5-2010-0102). This Local/Targeted Creek Status Monitoring Report documents the results of targeted (non-probabilistic) monitoring performed by CCCWP during Water Year (WY) 2014 and is intended for submittal as fulfillment of both Municipal NPDES permits (MRP and Central Valley Permit) from the respective water boards[5,6] and complies with reporting Provision C.8.g for creek status monitoring data collected in WY 2014 (October 1, 2013-September 30, 2014). Together with the creek status monitoring data reported in the Regional/Probabilistic Creek Status Monitoring Report, this submittal fulfills reporting requirements in both permits for Table 8.1 monitoring specified in Provision C.8.c.

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 MRP (see Table 1.1). The BASMAA RMC developed a Quality Assurance Program Plan (QAPP; BASMAA, 2014a), Standard Operating Procedures (SOPs; BASMAA, 2014b), data management tools, and reporting templates and guidelines. Costs for these activities are shared among RMC members on a population-weighted basis by direct contributions and provision of in-kind services by RMC members to complete required tasks. Participation in the RMC is facilitated through the BASMAA Monitoring and Pollutants of Concern Committee (MPC).

The goals of the RMC are to:

1. Assist RMC permittees in complying with requirements of MRP Provision C.8 (Water Quality Monitoring);
2. Develop and implement regionally consistent creek monitoring approaches and designs in the Bay Area, through improved coordination among RMC participants and other agencies (e.g., Regional Water Quality Control Boards, Regions 2 and 5, and the State Water Resources Control Water Board) that share common goals; and
3. Stabilize the costs of creek monitoring by reducing duplication of efforts and streamlining reporting.

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

[5] The San Francisco Bay Regional Water Quality Control Board (SFRWQCB) issued the five-year Municipal Regional Permit for Urban Stormwater (MRP, Order No. R2-2011-0083) to 76 cities, counties and flood control districts (i.e., Permittees) in the Bay Area on October 14, 2009 (SFRWQCB 2009). The BASMAA programs supporting MRP Regional Projects include all MRP Permittees as well as the cities of Antioch, Brentwood, and Oakley which are not named as Permittees under the MRP but have voluntarily elected to participate in MRP-related regional activities.5

[6] The Central Valley Regional Water Quality Control Board (CVRWQCB) issued the East Contra Costa County Municipal NPDES Permit (Central Valley Permit, Order No. R5-2010-0102) on September 23, 2010 (CVRWQB 2010).

targeted (non-probabilistic) design. The monitoring elements included in each category are specified in Table 1.2.

Table 1.1 Regional Monitoring Coalition Participants

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

Table 1.2 Creek Status Monitoring Parameters monitored in compliance with MRP Provision C.8.c. and the associated reporting format

Monitoring Elements of MRP Provision C.8.c	Monitoring Design		Reporting	
	Regional/ Probabilistic	Local/ Targeted	Regional	Local
Bioassessment & Physical Habitat Assessment	X		X	
Chlorine	X		X	
Nutrients	X		X	
Water Toxicity	X		X	
Sediment Toxicity	X		X	
Sediment Chemistry	X		X	
General Water Quality		X		X
Temperature		X		X
Bacteria		X		X
Stream Survey[1]		X		X

[1] California Rapid Assessment Method for Riverine Wetlands (CRAM) was used to fulfill the stream survey monitoring element listed in Table 8.1in the MRP (SFBRWQCB 2009) and Central Vally Permit (CVRWQCB 2010), respectively.

This report focuses on the creek status and long-term trends monitoring activities that were conducted to comply with Provision C.8.c using a targeted (non-probabilistic) monitoring design (see Table 1.2). The results of the stream surveys (riparian assessments) are addressed in this report; as indicated in Table 1.2 they are nominally considered by the RMC to be a local/ targeted monitoring element, but in WY 2014 the surveys were conducted at probabilistic sites to satisfy the stream survey monitoring requirement in MRP Table 8.1.

The remainder of this report describes the study area and design (Section 2.0), monitoring methods (Section 3.0), results and discussion (Section 4.0) and next steps (Section 5.0).

2.0 Study Area and Design

2.1 Regional Monitoring Coalition Area

The RMC area encompasses 3,407 square miles of land in the San Francisco Bay Area. This includes the portions of the five participating counties that fall within the jurisdiction of the SFRWQCB (Figure 2.1). Figure 2.2 illustrates the boundaries of State Water Resources Control Board (SWRCB), Regions 2 and 5 as well as the Contra Costa County Delta boundaries[7]. The eastern portion of Contra Costa County drains to the CVRWQCB region (Region 5), while the rest of the county drains in to Region 2. Status and trends monitoring is conducted in flowing water bodies (i.e., creeks, streams and rivers), interspersed among the RMC area, including perennial and non-perennial creeks and rivers that run through both urban and non-urban areas.

2.2 Contra Costa County Targeted Monitoring Areas and Siting Rationale

Contra Costa County has 31 major watersheds and sub-watersheds containing more than 1,300 miles of creeks and drainages (CCCDD, 2003). The County's creeks discharge into the Sacramento-San Joaquin delta in the east, along the series of bays to the north (including Suisun and San Pablo bays) and to North San Francisco Bay in the west. In addition, two watersheds originate in Contra Costa County and continue through Alameda County before reaching San Francisco Bay.

Rodeo Creek and San Pablo Creek watersheds were the focus of the CCCWP's targeted sampling in WY 2014. Rodeo Creek and San Pablo Creek were sampled for pathogen indicators. In addition, stream surveys were conducted on segments of ten creeks and conveyances using the California Rapid Assessment Method (CRAM). Further details and discussion about the targeted sampling areas can be found in the Methods and Results sections of this report; sections 3 and 4, respectively.

2.2.1 Rodeo Creek Watershed (Region 2)

Rodeo Creek is located in the northwest corner of Contra Costa County and flows in a westerly direction from its headwaters on private ranchland, through East Bay Regional Park District (EBRPD) land, then through residential and industrial areas of Rodeo before reaching San Pablo Bay. It is a relatively short creek with a length of 8.35 miles with its highest elevation at 1,100 feet. Rodeo Creek has 17.3 percent of its stream channel channelized, primarily in its lower third. Impervious surfaces, almost all in this lower third, amounts to 20 percent of its watershed. Rodeo Creek's estimated mean daily flow is 7.0 cubic feet per second (CCCDD, 2003).

Rodeo Creek was electrofished by California Department of Fish and Wildlife (CDFW) at four sites in February and March 1974, but no salmonids were found. Fisheries biologist Robert Leidy sampled Rodeo Creek in June 1981 and again in October 1994, but found no salmonids. Both CDFW and Leidy et al. (2005) concluded that Rodeo Creek did not appear suitable for supporting a steelhead population.

[7] Dvide between the Basin boundary watershed/hydrologic sub basins within the Sacramento-San Joaquin Rivers and Delta Waterways.

Figure 2.1 Map of BASMAA RMC area, county boundaries and major creeks

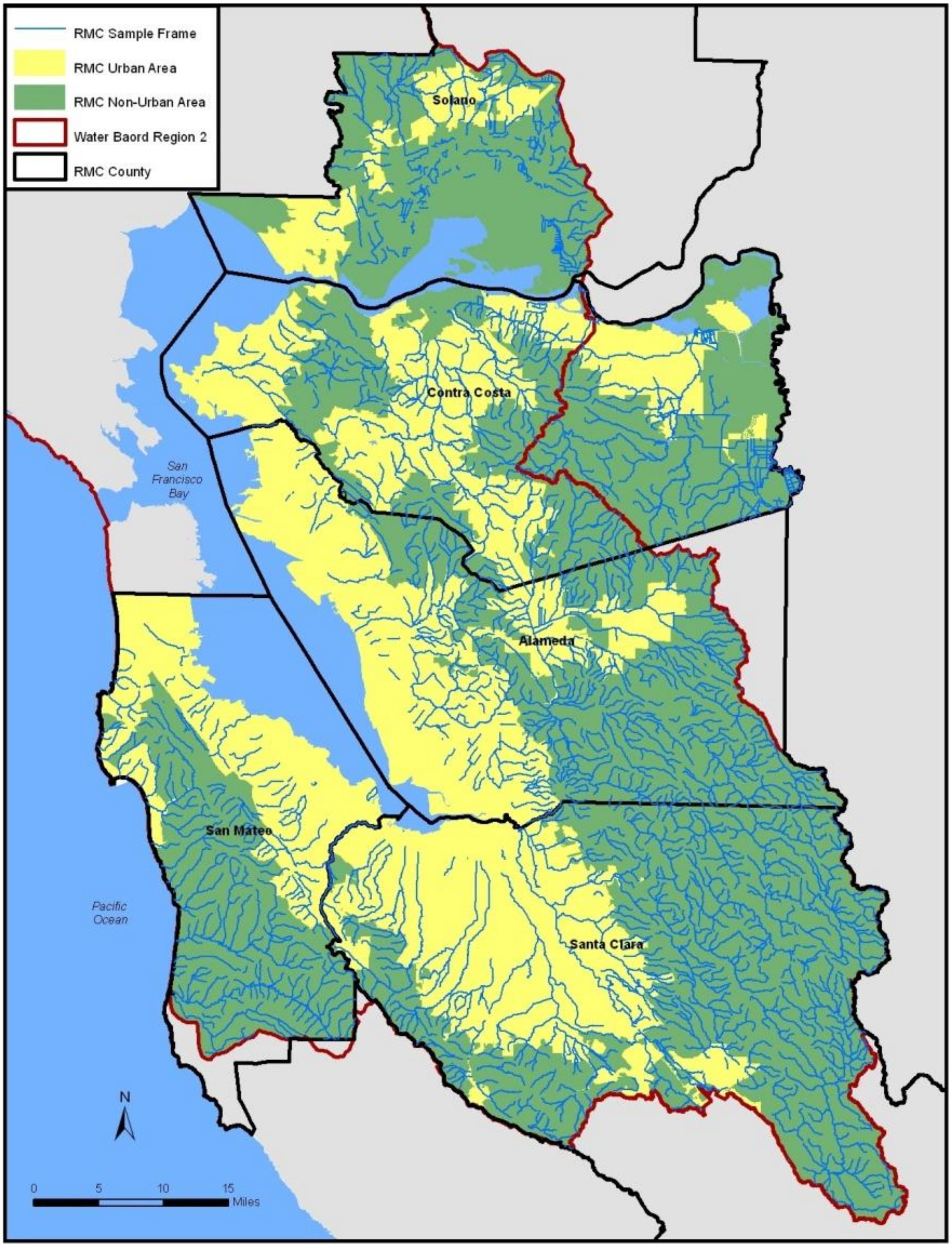
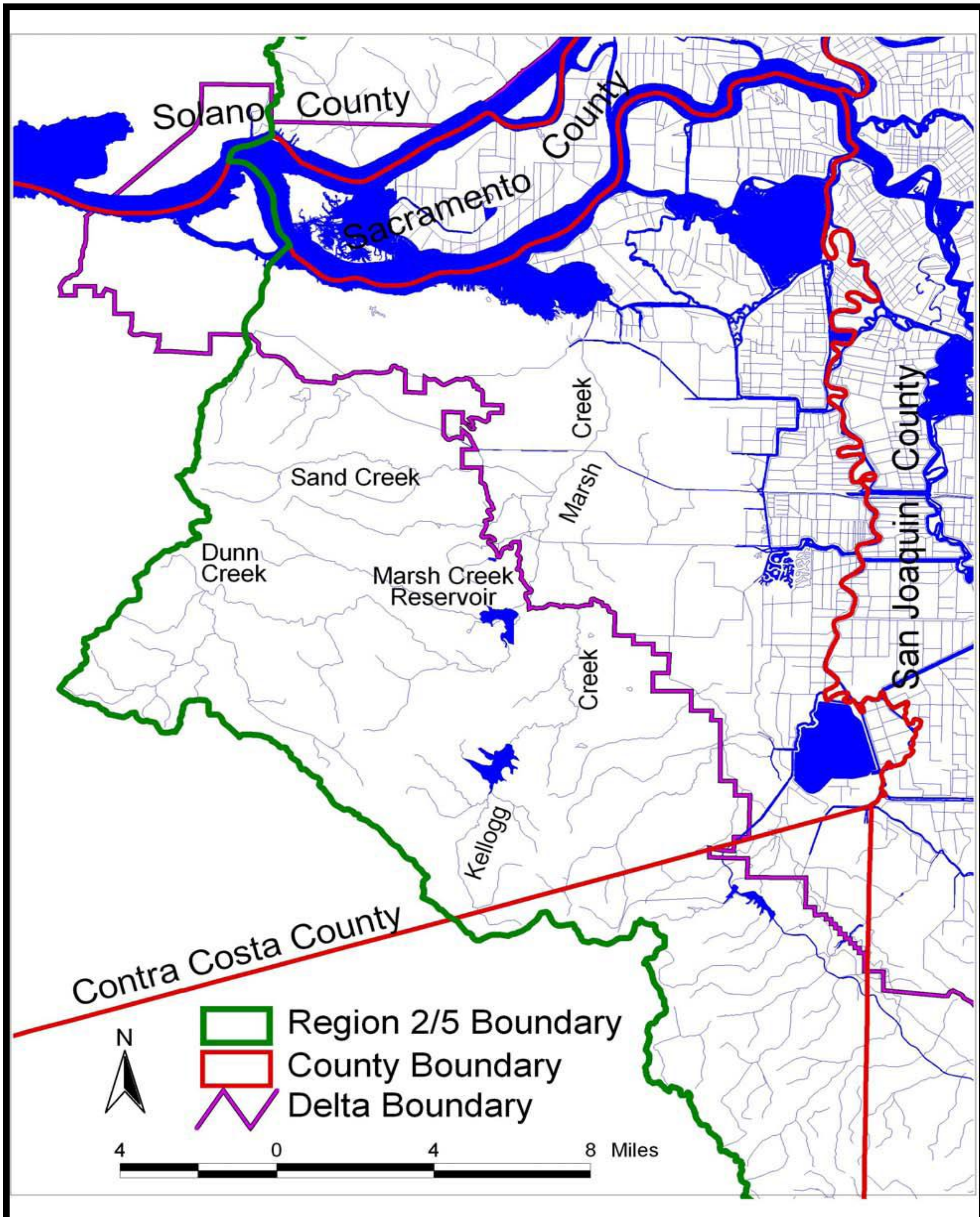


Figure 2.2 State Water Resources Control Board Region 2 and 5 Boundaries (Source Map: CVRWQB 2010)



2.2.2 San Pablo Watershed (Region 2)

The full watershed of San Pablo Creek is 27,640 acres, arising in the City of Orinda at a maximum elevation of 1,905 feet and flowing westerly 19.65 miles to San Pablo Bay. After leaving Orinda, San Pablo Creek flows across East Bay Municipal Utility District (EBMUD) land into San Pablo Reservoir. Water releases from San Pablo Dam feed lower San Pablo Creek, where it flows through first rural, then heavily urbanized residential and commercial property. Earth or concrete channelized portions of San Pablo Creek amount to 10.6 percent of the entire channel and occur as it passes through the City of San Pablo. Impervious surface in the San Pablo Creek watershed is calculated at 20 percent (CCCDD, 2003).

San Pablo Creek once supported runs of steelhead and coho (silver) salmon. Leidy et al. (2005) reported that the lower section of San Pablo Creek below the San Pablo Reservoir Dam still had runs of steelhead in the 1950s. However, San Pablo Creek below San Pablo Reservoir is reported by EBMUD to no longer support steelhead/rainbow trout (personal communication, Jessica Purificato, Fisheries and Wildlife Biologist II with EBMUD, November 10, 2014). EBMUD conducted annual fish sampling of three sites on San Pablo Creek below the reservoir for the past eight years and found no steelhead/rainbow trout other than a few hatchery rainbow trout that appear to have come from San Pablo Reservoir.

2.3 Contra Costa Targeted Monitoring Design

During WY 2014 (October 1, 2013-September 30, 2014) water temperature, general water quality, pathogen indicators and stream surveys were monitored at the targeted locations listed in Table 2.1 and illustrated in Figure 2.3 overview map.

Site locations were identified using a targeted monitoring design based on the directed principle[8] to address the following management questions:

1. What is the range of general water quality measurements at targeted sites of interest?
2. Do general water quality measurements indicate potential impacts to aquatic life?
3. What are the pathogen indicator concentrations at creek sites where water contact recreation may occur?
4. What are the overall physical and/or ecological conditions of creek reaches and specific point impacts within each reach?

Within Contra Costa County, targeted monitoring was conducted with the following:

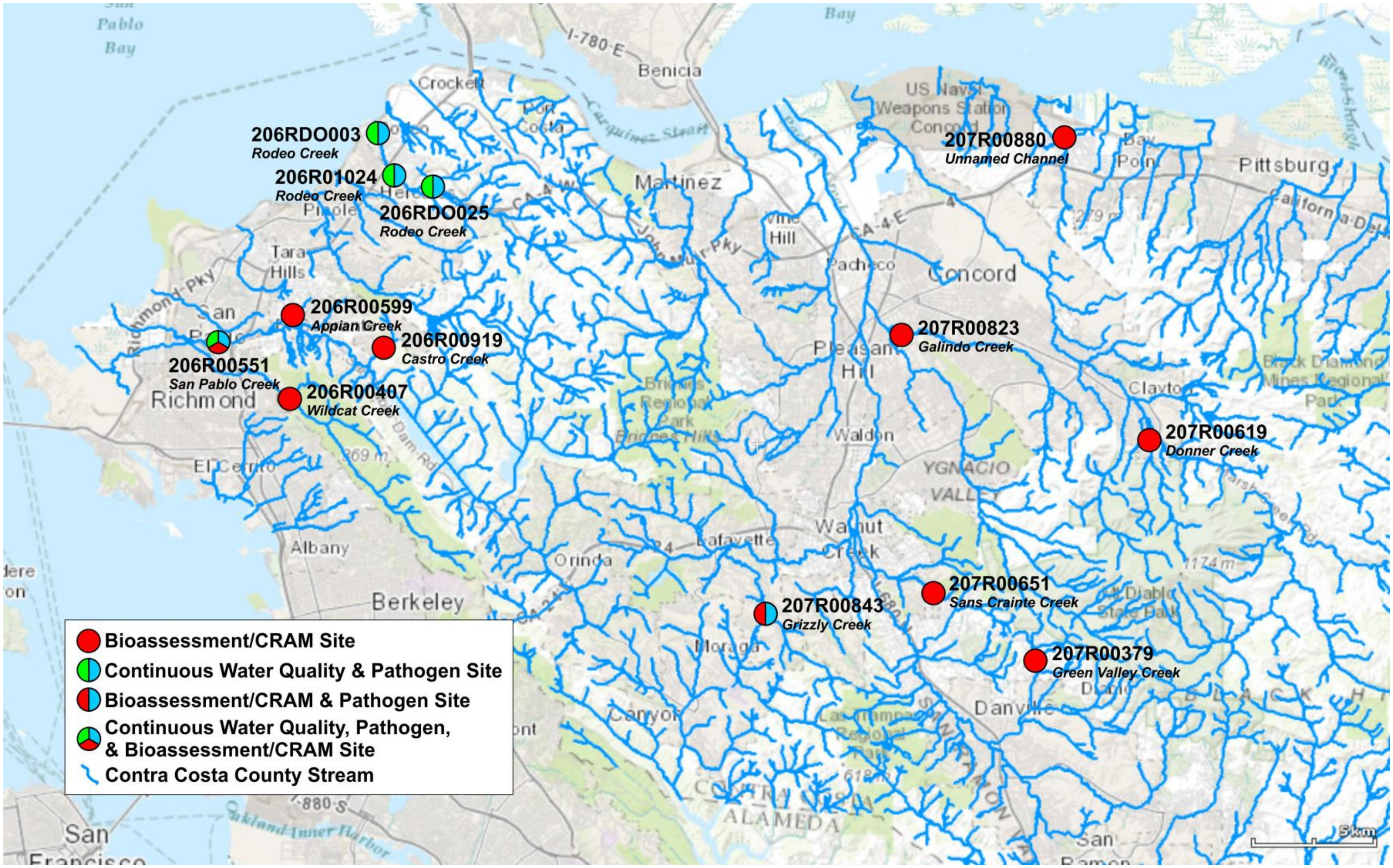
- Four continuous water temperature monitoring locations
- Two general water quality monitoring locations
- Five pathogen indicator monitoring locations
- Ten riparian assessment monitoring locations

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

Table 2.1 Sites and local reporting parameters monitored in Water Year 2014 in Contra Costa County

Site Code	Creek Name	Latitude	Longitude	Bio-assessment / CRAM	Continuous Temperature	Water Quality	Pathogen Indicators
206RDO003	Rodeo	38.01995	-122.25917		X		X
206RDO025	Rodeo	38.01593	-122.24249		X	X	X
206R00407	Wildcat	37.94274	-122.30593	X			
206R00551	San Pablo	37.96207	-122.33625	X	X	X	X
206R00599	Appian	37.97156	-122.30328	X			
206R00919	Castro	37.96030	-122.26370	X			
206R01024	Rodeo	38.03433	-122.26616		X		X
207R00379	Green Valley (West Branch)	37.85224	-121.97756	X			
207R00619	Donner	37.92852	-121.92762	X			
207R00651	Sans Crainte	37.87545	-122.02232	X			
207R00823	Galindo	37.96493	-122.03602	X			
207R00843	Grizzly	37.86806	-122.09589	X			X
207R00880	Unnamed Flood Control Channel	38.03292	-121.96469	X			

Figure 2.3 Overview of targeted sites and CRAM sites monitored by CCCWP in 2014



3.0 Monitoring Methods

Targeted monitoring data were collected in accordance with the BASMAA RMC Quality Assurance Program Plan (EOA, AMS, and ARC, 2014a) and BASMAA RMC Standard Operating Procedures (EOA, AMS, and ARC, 2014b.). Where applicable, monitoring data were collected using methods comparable to those specified by the California Surface Water Ambient Monitoring Program (SWAMP) QAPP[9], and were submitted in SWAMP-compatible format by CCCWP to the SFBRWQCB and the CVRWQCB on behalf of CCCWP permittees and pursuant to Provision C.8.g.

3.1 Data Collection Methods

Water quality data were collected in accordance with SWAMP-comparable methods and procedures described in the BASMAA RMC SOPs (EOA, AMS, and ARC, 2014b) and associated QAPP (EOA, AMS, and ARC, 2014a). These documents are updated as needed to maintain their currency and optimal applicability. The SOPs were developed using a standard format that describes health and safety precautions and considerations, relevant training, site selection, and sampling methods/procedures, including pre-fieldwork mobilization activities to prepare equipment, sample collection, and demobilization activities to preserve and transport samples.

The monitoring locations for general water quality parameter (dissolved oxygen, specific conductivity, pH, and temperature) were located in Rodeo Creek and San Pablo Creek for this monitoring year as discussed below.

3.1.1 General Water Quality Measurements

Water quality monitoring equipment (YSI 6600 V2 *Sondes*) was deployed at one site each in Rodeo Creek and San Pablo Creek. General water quality parameters (dissolved oxygen, specific conductivity, pH, and temperature) were recorded every 15 minutes. The equipment was deployed for two time periods at each creek as follows:

- Rodeo Creek: Once during spring (April 14-25) and once during summer (August 1-18)
- San Pablo Creek: Once during spring (April 30-May 9) and once during summer (August 1-18)

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

3.1.2 Continuous Temperature Monitoring

In WY 2014, the CCCWP monitored water temperature at three locations on Rodeo Creek in the community of Rodeo and at one location on San Pablo Creek in the City of San Pablo. Digital temperature loggers (Onset HOBO® Water Temp Pro V2) were deployed at each of the four sites. Hourly temperature measurements were recorded at each respective site from April 17, 2014 to October 17, 2014.

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

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

3.1.3 Pathogen Indicator Sampling

In order to meet MRP requirements, a set of pathogen indicator samples was collected on July 8, 2014 at five stations. Four of these sampling sites were the same locations where the four of the HOBO® devices were deployed (Figure 2.3). The fifth pathogen sampling site was also a bioassessment/CRAM site (207R00843) located on Grizzly Creek (Figure 2.3). At all sites fecal coliform and *E. coli* were sampled and analyzed.

Sampling techniques employed by ADH included direct filling of containers and immediate transfer of samples to analytical laboratories within specified holding time requirements. Procedures used for sampling and transporting samples by ADH are described in RMC SOP FS-2 (EOA, AMS, and ARC, 2014b).

3.1.4 California Rapid Assessment Method for Riverine Wetlands

Field crews conducted assessments at ten sites from August 26 to September 3 using the California Rapid Assessment Method (CRAM). Assessments were conducted at the same locations that were monitored for the RMC probabilistic design (i.e., biological and physical habitat assessments, nutrients, and physiochemical water quality). CRAM includes an assessment of the following four attributes within a defined riparian Assessment Area: 1) buffer and landscape context; 2) hydrology; 3) physical structure; and 4) biotic structure. Procedures describing methods for scoring riparian attributes are described in Collins et al. (2008).

3.2 Quality Assurance/Quality Control

Data quality assessment and quality control procedures are described in detail in the BASMAA RMC QAPP (EOA, AMS, and ARC, 2014a). Data Quality Objectives (DQOs) were established to ensure that data collected are of adequate quality and sufficient for the intended uses. DQOs address both quantitative and qualitative assessment of the acceptability of data. The qualitative goals include representativeness and comparability. The quantitative goals include specifications for completeness, sensitivity (detection and quantization limits), precision, accuracy, and contamination. To ensure consistent and comparable field techniques, pre-survey field training and an in-situ field audit were conducted by California Department of Fish and Wildlife (CDFW). Field training and inter-calibration exercises were conducted to ensure consistency and quality of CRAM data.

Data were collected according to the procedures described in the relevant SOPs, including appropriate documentation of data sheets and samples, and sample handling and custody. Laboratories providing analytical support to the RMC were selected based on demonstrated capability to adhere to specified protocols. Standard methods for CRAM are included in Collins et al. (2008).

3.3 Data Quality Assessment Procedures

Following completion of the field and laboratory work, the field data sheets and laboratory reports were reviewed by the Local Quality Assurance Officer (LQAO), and compared against the methods and protocols specified in the SOPs and QAPP. The findings and results were then evaluated against the relevant DQOs to provide the basis for an assessment of programmatic data quality. A summary of data quality steps associated with water quality measurements is shown in Table 3.2. The data quality assessment consisted of the following elements:

- Conformance with field and laboratory methods as specified in SOPs and QAPP, including sample collection and analytical methods, sample preservation, sample holding times, etc.
- Numbers of measurements/samples/analyses completed vs. planned, and identification of reasons for any missed samples.
- Temperature data were checked for accuracy by comparing measurements taken by HOBOs® with NIST thermometer readings in room temperature water and ice water.
- General water quality data were checked for accuracy by comparing measurements taken before and after deployment with measurements taken in standard solutions to evaluate potential drift in readings.
- Quality assessment laboratory procedures for accuracy and precision (i.e., lab duplicates, lab blanks) were not implemented for pathogen samples collected this year, but will be in subsequent years.
- Field crews participated in one CRAM training class and two inter-calibration exercises prior to field assessments.

Table 3.2 Data quality steps implemented for temperature and general water quality monitoring

Step	Temperature (HOBOs ®)	General Water Quality (*Sondes*)
Pre-event calibration / accuracy check conducted	X	X
Readiness review conducted	X	X
Check field datasheets for completeness	X	X
Post-deployment accuracy check conducted		X
Post-sampling event report completed	X	X
Post-event calibration conducted		X
Data review – compare drift against SWAMP MQOs		X
Data review – check for outliers / out of water measurements	X	X

3.4 Data Analysis and Interpretation

Continuous temperature and general water quality data were plotted as box and whisker plots for each site during each deployment. The middle line of the box represents the median value (50^{th} percentile), and top and bottom edge of the box indicate the 75^{th} and 25^{th} percentile, respectively. The upper whisker represents the 90^{th} percentile, while the bottom whisker represents the 10^{th} percentile. All data that do not fall between the 10^{th} and 90^{th} percentile are plotted as points outside of the whiskers.

The hourly water temperature measurements were used to calculate daily maxima over a 24-hour period from midnight to 11:00 PM. WAMTs were calculated by averaging each daily maximum temperature with the previous six daily maximum temperatures.

Targeted monitoring data were evaluated against Water Quality Objectives (WQOs) or other applicable thresholds, as described in Table 8.1 in the MRP and Central Valley Permit. Table 3.3 defines thresholds used for selected targeted monitoring parameters, as they apply to Table 8.1. The subsections below provide details on thresholds selected and the underlying rationale. Criteria have not been established for conductivity or CRAM data.

Table 3.3 Description of water quality thresholds for Municipal Regional Permit and Region 5 Permit Provision 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 temperature thresholds:
	• For a water body designated as COLD and/or supports steelhead trout population (SFRWQCB, 2011):
	  ▪ 7-day Mean Temperature should not exceed 20.5°C
	• For a water body designated as COLD or WARM (SFRWQCB 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 < 7.0 mg/L (SFRWQCB 2013) • pH: > 6.5 and < 8.5 (SFRWQCB 2013) • Conductivity: NA
Pathogen Indicators	Single sample result meets one or more of the following criteria: • Fecal coliform: ≥ 400 MPN/100 ml (based on SFRWQCB 2013) • *E. coli*: ≥ 410 MPN/100 ml (based on USEPA 2012, infrequently used area)
CRAM	Not applicable.

3.4.1 Dissolved Oxygen

The Basin Plan (SFRWQCB, 2013) lists WQOs for dissolved oxygen (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 water habitat (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. In these cases, DO data will be evaluated for the salmonid life stage and/or fish community that is expected to be present during the monitoring period. Such evaluations of both historical and current ecological conditions will be made, where possible, when evaluating water quality information.

To evaluate the results against the relevant trigger in Table 8.1 in the MRP and Central Valley Permit, 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

Water Quality Objectives for pH in surface waters are stated in the Basin Plan (SFRWQCB, 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 Table 8.1 in the MRP and Central Valley Permit, 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 (SFRWQCB, 2013) includes Water Contact Recreation WQOs of fecal coliform concentrations less than 200 MPN/100ml (geometric mean of data, based on at least five samples collected over a 30-day period) and less than 400 MPN/100ml (90th percentile of data). For Non-contact Water Recreation, the Basin Plan includes WQOs of fecal coliform concentrations less than 2,000 MPN/100ml (geometric mean of data) and less than 4,000 MPN/100ml (90th percentile of data).

In 2012 the U.S. Environmental Protection Agency (USEPA) 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 USEPA RWQC include two sets of recommended criteria as shown in Table 3.4. 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 (USEPA, 2012), but are considered to represent "established thresholds" for purposes of evaluating threshold triggers per the MRP and Central Valley Permit Table 8.1.

Table 3.4 USEPA 2012 Recreational Water Quality Criteria

Criteria Elements	Recommendation 1 Estimated Illness Rate 36/1000		Recommendation 2 Estimated Illness Rate 32/1,000	
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

The Basin Plan objectives are based on a sampling protocol where a minimum of five consecutive samples are collected from a given site throughout a 30-day period; the USEPA geometrical mean (GM) values are based on a similar sampling regimen. Given that geometric means cannot be calculated from single-sample data, for the purposes of this evaluation, fecal coliform maximum concentrations of 400 MPN/100ml and 4,000 MPN/100ml in a single sample were used per the Basin Plan as the Water Contact Recreation and Non-water Contact Recreation evaluation criteria, respectively. As the Basin Plan does not include WQOs for *E. coli,* the USEPA statistical threshold value (STV) criterion of 410 CFU/100 mL is used to evaluate maximum or single sample concentrations of *E. coli* for Water Contact Recreation. For interpretive purposes, the CFU and MPN measurement units are considered equivalent.

To provide for additional information related to spatial variability in bacteria levels along the selected creek reaches, pathogen indicator samples were collected at five sites along each of three creeks, and analyzed for fecal coliform and *E. coli*. and compared to the Basin Plan objectives (fecal coliform) and the USEPA criteria (*E. coli*) to determine whether pathogen indicator organism concentrations reveal potential impacts to recreational beneficial uses along the selected creek reaches.

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). No specific water temperature objective is presented in the Basin Plan for the COLD and WARM designations; however, the Basin Plan states that a COLD water habitat should be capable of supporting salmonids year-round.

In Table 8.1 of the MRP and Central Valley Permit , the temperature trigger threshold specification is footnoted as follows:

> "[31] 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 *Local Urban Creeks Monitoring Report, Water Year 2012* (ADH, 2013; see also Cressey, 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 Celsius (°C; average of a 7-day maximum temperature) for rearing juvenile steelhead was determined to be the most useful benchmark for evaluating Contra Costa County streams with a COLD beneficial use designation. Therefore, the 20.5°C WAMT threshold is used again in this year's evaluation as the water temperature criterion for cold water streams supporting salmonids in Contra Costa County.

The WAMT was calculated as the 7-day rolling average daily maximum stream temperature (per Sullivan et al., 2000) by averaging each daily maximum temperature with the previous six daily maximum temperatures. To evaluate the results against the relevant trigger in Table 8.1 of the MRP and Central Valley Permit, the WAMT values were evaluated to determine whether 20 percent or more of the measurements were above the applicable 20.5°C temperature threshold.

The potential responsive action to the analysis of temperature as it relates to fish habitat in Rodeo Creek and San Pablo Creek is discussed below.

3.4.1.1 Rodeo Creek

As discussed in Section 2.2.1, Rodeo Creek was electrofished by CDFW at four sites in February and March 1974, but no salmonids were found. Fisheries biologist Robert Leidy sampled Rodeo Creek in June 1981 and again in October 1994, but found no salmonids. Both CDFW and Leidy et al. (2005) concluded that Rodeo Creek did not appear suitable for supporting a steelhead population. The Basin Plan, however, designates Rodeo Creek as both COLD and WARM water habitat and SPWN (spawning) habitat.

The three water quality and water temperature monitoring stations on Rodeo Creek in WY 2014 were located in the western third of the 8.35 mile long creek (Figure 2.3). The most easterly, or upstream, station was the Muir Heritage Land Trust Site 206RDO025 positioned in open space 0.6 miles upstream of developed residential lands east of Highway 80 and 2.5 miles above San Pablo Bay. Although upstream of the channelized portion of Rodeo Creek (the channelized section begins at the residential housing development's eastern boundary), there is minimal to moderate riparian shading along the creek as it flows through the western end of Franklin Canyon. Upstream of this area, Rodeo Creek is well shaded by riparian vegetation throughout its length.

The next monitoring station is the Willow Avenue Site 206RDO1024 located 0.2 miles east of Highway 80 and 1.4 miles above the mouth of Rodeo Creek. Rodeo Creek has been flowing 0.52 miles through the channelized streambed fully exposed to sunlight before it arrives at the location of this monitoring site.

The monitoring station furthest downstream is Investment Street Site 206RDO033 located in downtown Rodeo about 0.32 miles from San Pablo Bay. Rodeo Creek waters reaching this monitoring site have flowed through 1.63 miles of channelized habitat fully exposed to sunlight.

3.4.1.2 San Pablo Creek

As discussed in Section 2.2.2, San Pablo Creek once supported runs of steelhead and coho (silver) salmon. Leidy et al. (2005) reported that the lower section of San Pablo Creek below the San Pablo Reservoir Dam still had runs of steelhead in the 1950s. However, San Pablo Creek below San Pablo Reservoir is reported by East Bay Municipal Utility District (EBMUD) to no longer support steelhead/rainbow trout (personal communication, Jessica Purificato, Fisheries and Wildlife Biologist II with EBMUD, November 10, 2014). EBMUD has conducted annual fish sampling of three sites on San Pablo Creek below the reservoir for the past 8 years and have found no steelhead/rainbow trout other than a few hatchery rainbow trout that appear to have come from San Pablo Reservoir.

The 2014 water quality monitoring program had one monitoring site on San Pablo Creek near the Rock Harbor Church (Site 206R00551) where Church Lane crosses the creek about 0.4 miles west of Highway 80 in the City of San Pablo. This lower section of San Pablo Creek begins below the San Pablo Reservoir Dam in El Sobrante and flows west 7.6 miles to San Pablo Bay. The Rock Harbor Church monitoring site is about 4.6 miles west of the San Pablo Reservoir Dam.

Assessment monitoring results presented in Section 4 of Rodeo Creek and San Pablo Creek were provided in a memorandum authored by Scott Cressey (Cressey, 2014), Fisheries Biologist, who has several years' experience conducting benthic macroinvertebrate monitoring on these two creeks for the CCCWP over the past decade. His evaluation included review of the following reports: Contra Costa County Watershed Atlas (CCCDD, 2003); Contra Costa Creeks Inventory and Watershed Characterization Report (CCCWP and EOA, 2004); and Historical Distribution and Current Status of Steelhead/Rainbow Trout in Streams of the San Francisco Estuary, California (Leidy et al., 2005). Of particular value were personal communications with biologist Jessica Purificato of EBMUD and biologist Joe Sullivan of the East Bay Regional Park District (EBRPD) regarding the results of their annual fish sampling and temperature monitoring.

4.0 Results

4.1 Statement of Data Quality

Field data sheets and laboratory reports were reviewed by the Local Quality Assurance Officer (LQAO), and the results evaluated against the relevant DQOs. Results were compiled for qualitative metrics (representativeness and comparability) and quantitative metrics (completeness, precision, accuracy). The following summarizes the results of the data quality assessment:

- Temperature data from HOBOs® were collected from four stations; 83 percent of the expected data were collected for the following reasons:
    - HOBOs® were deployed on April 14, 2014 at three locations in Rodeo Creek and one in San Pablo Creek. The HOBOs® remained deployed until October 17, 2014, past the September 30, 2014 target pickup date.
    - The HOBO® at station 206R01024 in Rodeo Creek was stolen sometime after August 1, 2014. No data for this device exists past that date.
    - The HOBO® at station 206RDO003 in Rodeo Creek was deployed on April 14, 2014. During the first site visit on June 6, 2014, the HOBO® was found on the creek bank. Apparently, channel maintenance (such as weed clearing), activities took place soon after deployment that resulted in the device being removed from the creek and moved onto the creek bank. As a result, all of the data for this device was eliminated from the data set between the deployment and the first site visit dates.
    - All data recorded during the deployment period were stored without error.
- Continuous water quality data (temperature, pH, DO, conductivity) were collected during the spring and summer seasons; 100 percent of the expected data was collected.
- Continuous water quality data generally met measurement quality objectives (accuracy) for almost all parameters as presented in Table 4.1.
- Quality Assurance laboratory procedures were implemented for pathogen indicator analyses this year. There was one instance of quality assurance samples failing to meet DQOs:
    - At station 207R00843, a laboratory duplicate sample for *E. coli* had a relative percent difference of 75 percent as compared to the native sample value. This exceeds the DQO maximum of 25 percent. However, it is not considered to affect precision of the field data values, since this type of variation with pathogen indicators may be a result of clumping in one of the samples that did not occur in the other sample, resulting in a high degree of variability between the laboratory duplicate samples.
- Total CRAM scores between field crews at two pre-calibration exercises were within 10 percent.

Table 4.1 Accuracy[1] measurement taken for dissolved oxygen, pH and specific conductivity; bold values exceed the Measurement Quality Objectives

Parameter	Measurement Quality Objectives	Site 206RDO025 Rodeo Creek		Site 206R00551 San Pablo Creek	
		Event 1	Event 2	Event 1	Event 2
Dissolved Oxygen (mg/l)	± 0.2 mg/L	**-0.61**	**0.37**	-0.03	**0.27**
pH 7.0	± 0.2	-0.06	0.12	0.08	0.06
pH 10.0	± 0.2	0.19	-0.03	0.01	0.14
Conductivity (uS/cm)	± 2 uS/cm	0.05	0.04	-0.10	0.05

Explanation:

1. Accuracy of the water quality measurements were determined by calculating the difference between the YSI *Sonde* readings using a calibration standard versus the actual concentration of the calibration standard. The results displayed are those taken following measurements taken within the stream, defined as "post calibration" as opposed to the "pre calibration values", where all the YSI *Sonde* probes were offset to match the calibration standard prior to deployment.

4.2 Water Quality Monitoring Results

4.2.1 Water Temperature

Summary statistics for water temperature data collected at the four continuous monitoring locations from April to September 2013 are shown in Table 4.2. Hourly temperature data was collected for approximately 186 consecutive days at each of four stations on Rodeo Creek and San Pablo Creek. At station 206R1024, due to the device theft, only about 109 days of data were retrieved. At station 206RDO003, due to the device movement, only about 139 days of data were retained. Water temperatures measured at each station, along with the upper temperature threshold of 20.5°C (seven-day maximum) for juvenile salmonid rearing, is illustrated in Figures 4.1 – 4.3.

Table 4.2 Descriptive statistics for continuous water temperature measured at four sites in Contra Costa County, April 14-October 17 (Muir Heritage Land Trust), April 14-August 1 (Willow Avenue), June 6-October 17 (Investment Street), and April 14-October 17 (Rock Harbor Church)

Site Temperature	206RDO025 Muir Heritage Land Trust	206R01024 Willow Avenue	206RDO003 Investment Street	206R00551 Rock Harbor Church
	Rodeo Creek	Rodeo Creek	Rodeo Creek	San Pablo Creek
Minimum	11.90	15.82	17.49	12.05
Median	16.89	22.27	23.30	16.34
Mean	16.55	22.52	23.39	16.16
Maximum	19.91	30.19	32.30	20.03
Maximum WAMT [1]	18.23	24.79	26.47	18.15
# Measurements	4455	2608	3189	4457

Note: [1] The maximum of the 7-day running average of the daily maximum temperature

The minimum and maximum temperature for all four stations was 11.9°C and 32.3°C, respectively. The median temperature range for all four stations was 16.34°C to 23.3°C, and the weekly average maximum daily temperature (WAMT) range was 18.15°C to 26.47°C.

Figure 4.1 Water temperature data collected using HOBOs® at four sites in Rodeo Creek and San Pablo Creek, from April through October 2014

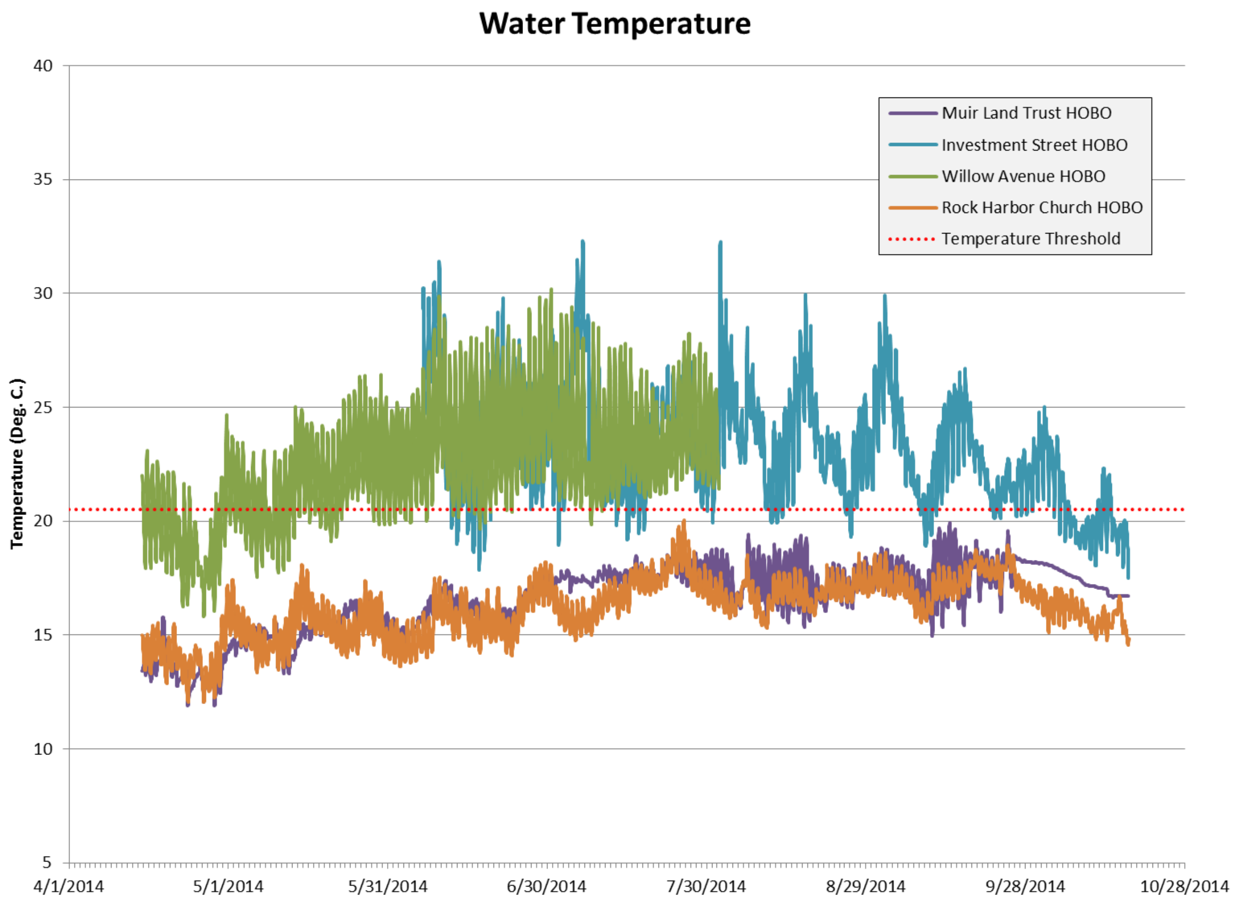


Figure 4.2 Weekly average maximum temperature (WAMT) data collected using HOBOs ® at four sites in Rodeo Creek and San Pablo Creek, from April through October, 2014

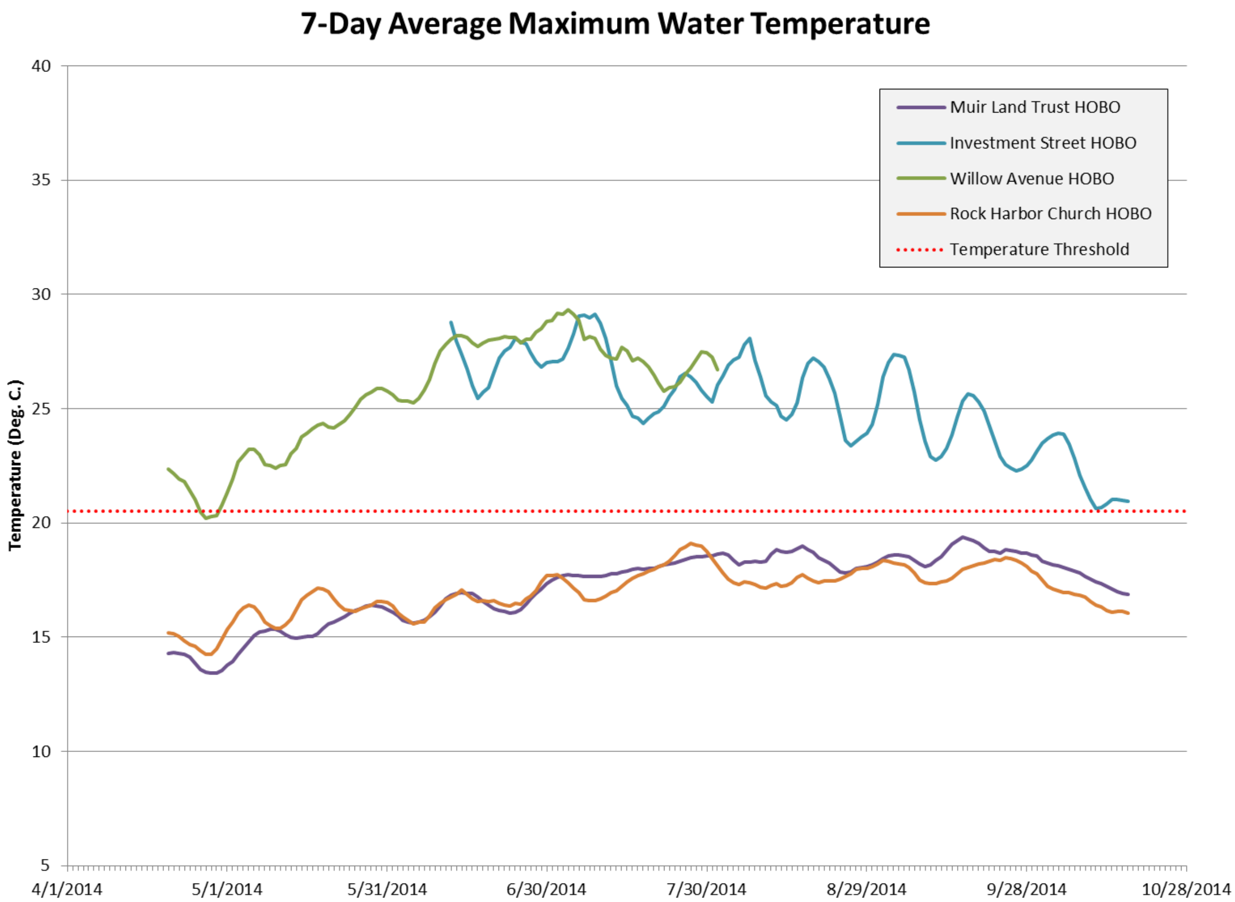
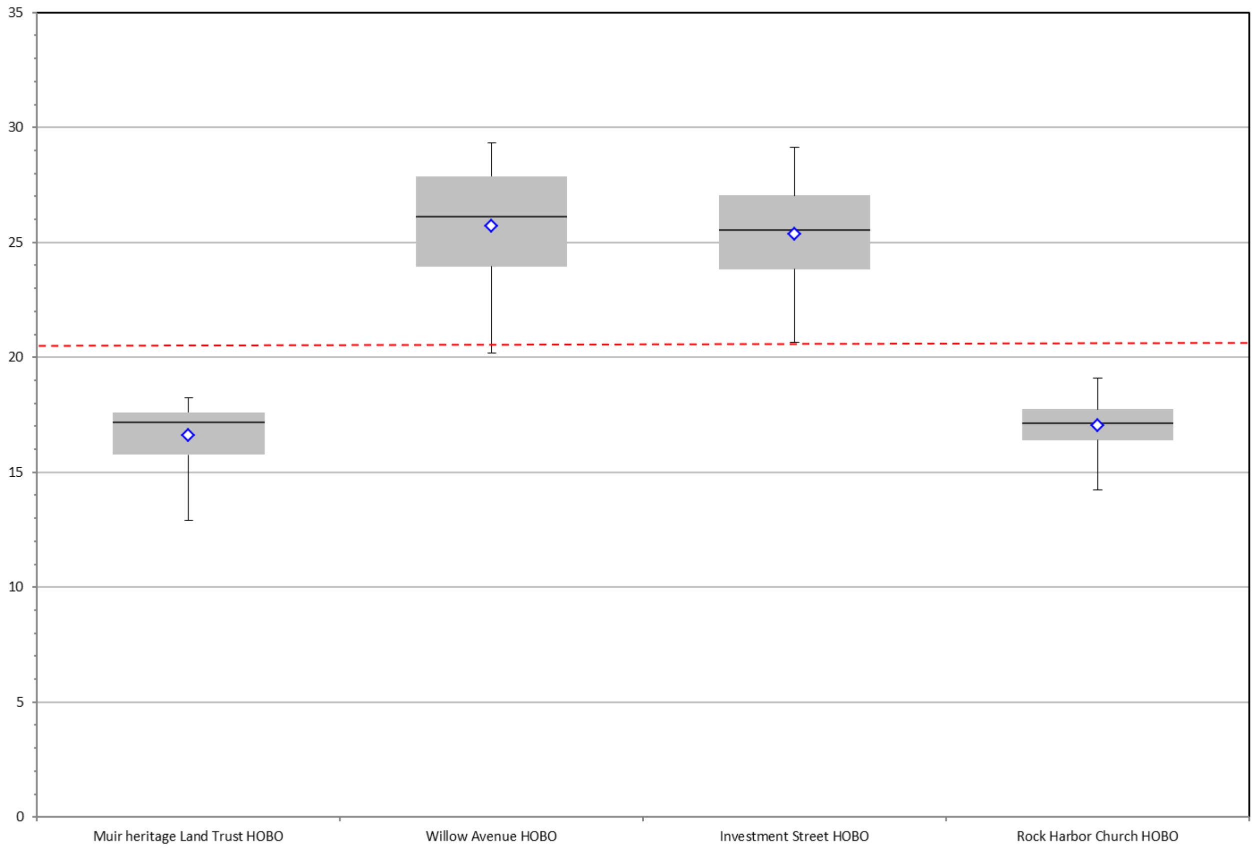


Figure 4.3 Box plots of weekly average maximum temperature (WAMT) at four sites in Rodeo Creek and San Pablo Creek, from April through October 2014



(Any red "X" points are outliers of the distributions. Outliers are defined here as any value outside of the range Q1 – 1.5 (Q3 – Q1) and Q3 + 1.5 (Q3 – Q1), were Q3 = 75th quartile point and Q1 = 25th quartile point for each distribution.) No outliers were found in this graph.

As shown in Table 4.3, the weekly average maximum daily water temperature (WAMT) values measured at the Muir Heritage Land Trust station on Rodeo Creek and the Rock Harbor Church station on San Pablo Creek were all below the selected average maximum temperature threshold for salmonids (20.5˚C) for the entire duration of the sampling period. The WAMT values at the Willow Avenue station were above 20.5˚C for 96 percent of the sampling period, and the WAMT values at the Investment Street station were above 20.5˚C for 100 percent of the sampling period. Both the Willow Avenue and Investment Street stations therefore exceeded the MRP and Central Valley Permit Table 8.1 trigger thresholds for temperature (20 percent or more of values exceed the applicable threshold; see Table 3.3).

Table 4.3 Percent of water temperature data measured at four sites that exceed water quality criteria

Site ID	Creek Name	Monitoring period	*Percent of Results Where WAMT > 20.5°C*
206RDO025 Muir Heritage Land Trust	Rodeo	April 14 – October 17, 2014	0%
206R01024 Willow Avenue	Rodeo	April 14 – August 1, 2014	96%
206RDO003 Investment Street	Rodeo	June 6 – October 17, 2014	100%
206R00551 Rock Harbor Church	San Pablo	April 14 – October 17, 2014	0%

4.2.2 General Water Quality

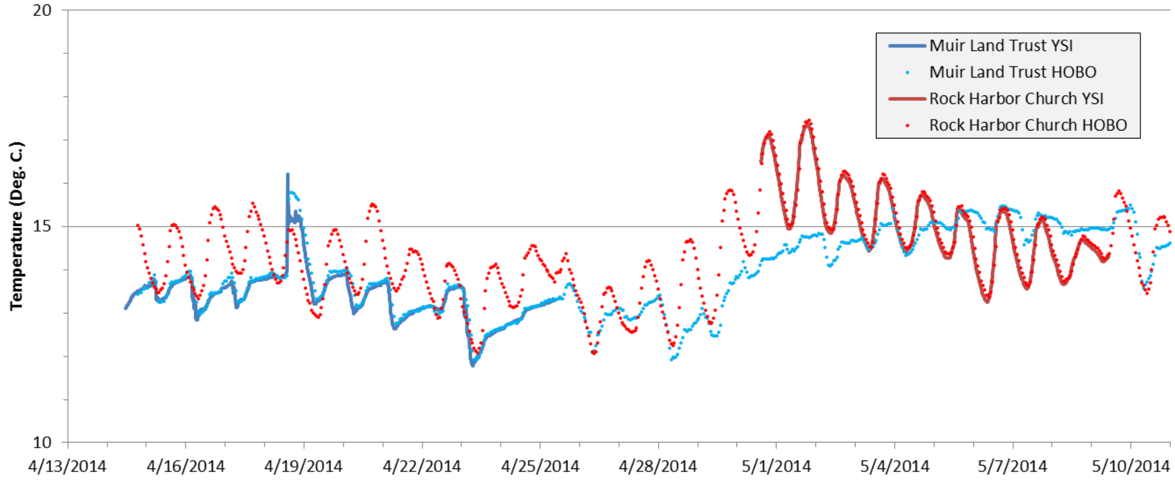
Summary statistics for general water quality measurements collected at stations on Rodeo Creek (near the Heritage Land Trust) and San Pablo Creek (near Rock Harbor Church) during two periods in April-May and August, 2013 are shown in Table 4.4. Data collected during both periods, along with the required thresholds, are plotted in Figures 4.4 - 4.7.

Table 4.4 Descriptive statistics for daily and monthly continuous water temperature, dissolved oxygen, conductivity, and pH measured at two sites in Contra Costa County, April 14–April 25 (Rodeo Creek), April 30-May 9 (San Pablo Creek), August 1-18 (Rodeo Creek) and August 1–13 (San Pablo Creek), 2014

Parameter		Site 206RDO025 Muir Heritage Land Trust		Site 206R00551 Rock Harbor Church	
		May	August [1]	April-May	August
Temperature (°C)	Minimum	11.78	15.34	13.25	15.25
	Median	13.37	16.91	14.95	16.44
	Mean	13.37	16.89	15.04	16.50
	Maximum	16.21	18.63	17.36	18.47
	Maximum WAMT [2]	13.64	17.08	15.46	16.70
Dissolved Oxygen (mg/l)	Minimum	0.85	0.08	7.74	6.86
	Median	3.59	0.78	8.71	7.97
	Mean	3.56	1.17	8.81	8.08
	Maximum	6.04	7.01	9.93	9.67
pH	Minimum	7.23	7.93	7.83	7.72
	Median	7.33	8.29	7.95	7.87
	Mean	7.34	8.26	7.95	7.87
	Maximum	7.51	8.48	8.06	8.01
Specific Conductivity (µS/cm)	Minimum	2650	3150	1160	783
	Median	2750	3230	1220	1090
	Mean	2750	3240	1210	1080
	Maximum	2860	3340	1240	1110

[1] Measurement device deployed in an isolated pool. No flow occurred during the entire deployment.
[2] The maximum of the 7-day running average of the daily maximum temperature

Figure 4.4 General water quality data (continuous temperature) collected at Muir Land Trust (Rodeo Creek) and Rock Harbor Church (San Pablo Creek), April 14-May 9, 2014 and August 1-19, 2014.



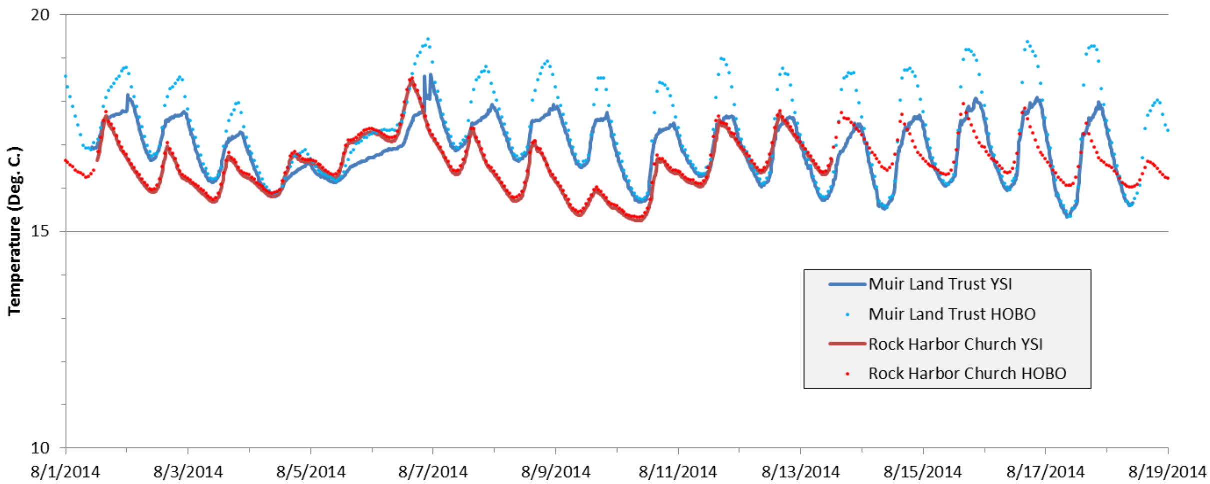


Figure 4.5 General water quality data (continuous pH) collected at Muir Land Trust (Rodeo Creek) and Rock Harbor Church (San Pablo Creek), April 14-May 9, 2014 and August 1-19, 2014

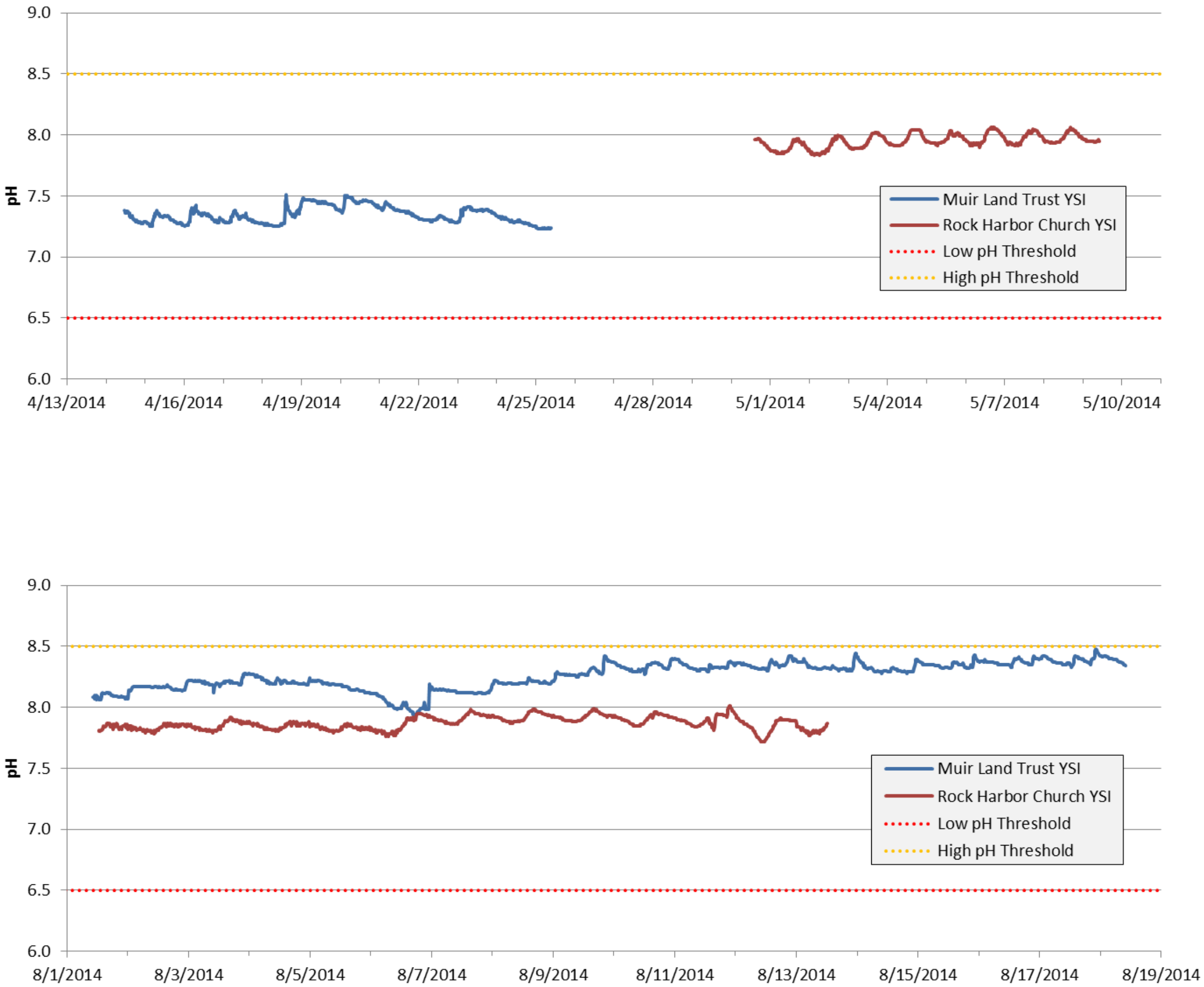
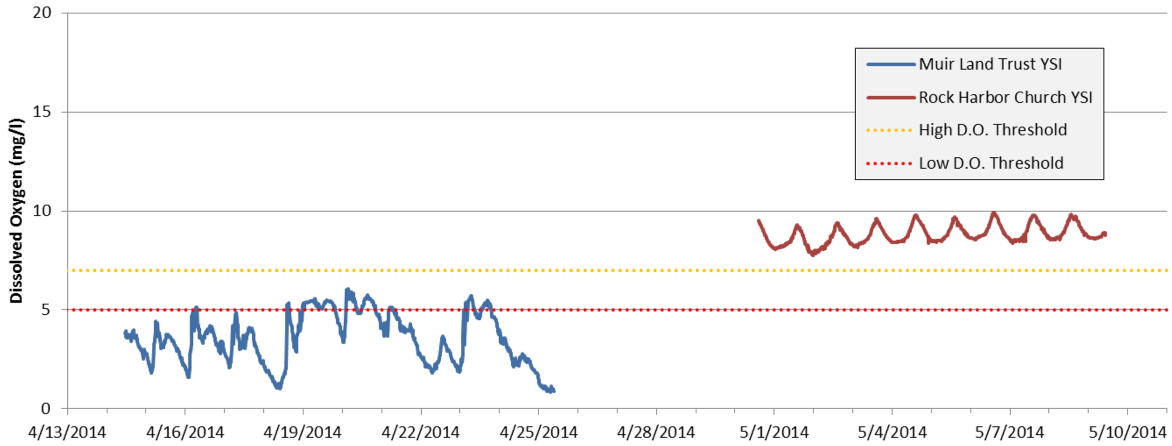


Figure 4.6 General water quality data (continuous dissolved oxygen) collected at Muir Land Trust (Rodeo Creek) and Rock Harbor Church (San Pablo Creek), August 1-18, 2014 and August 1-19, 2014



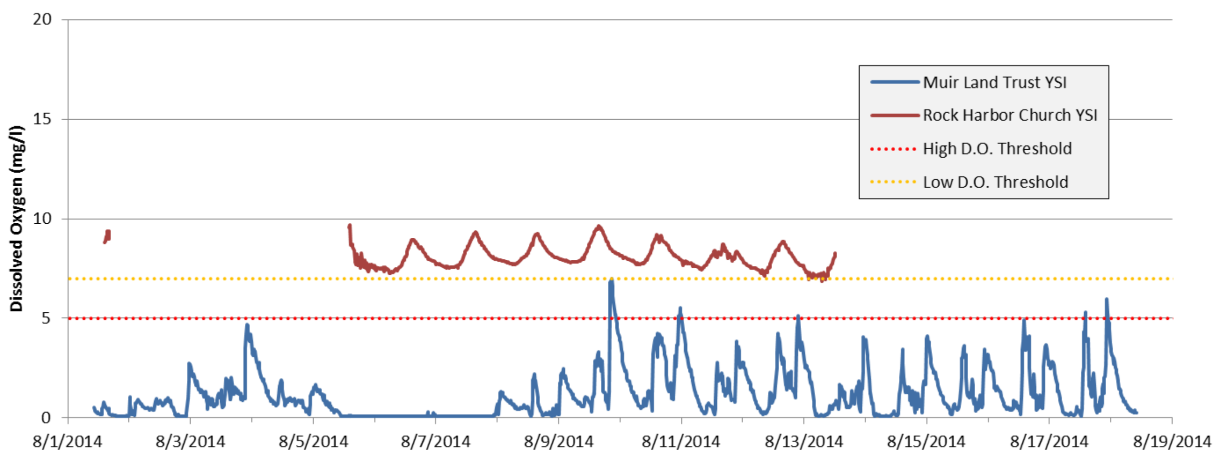
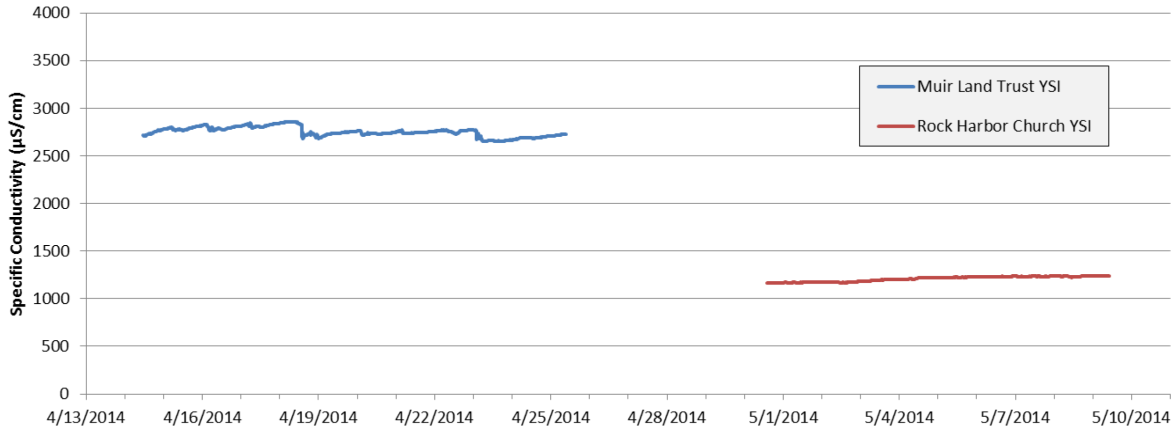
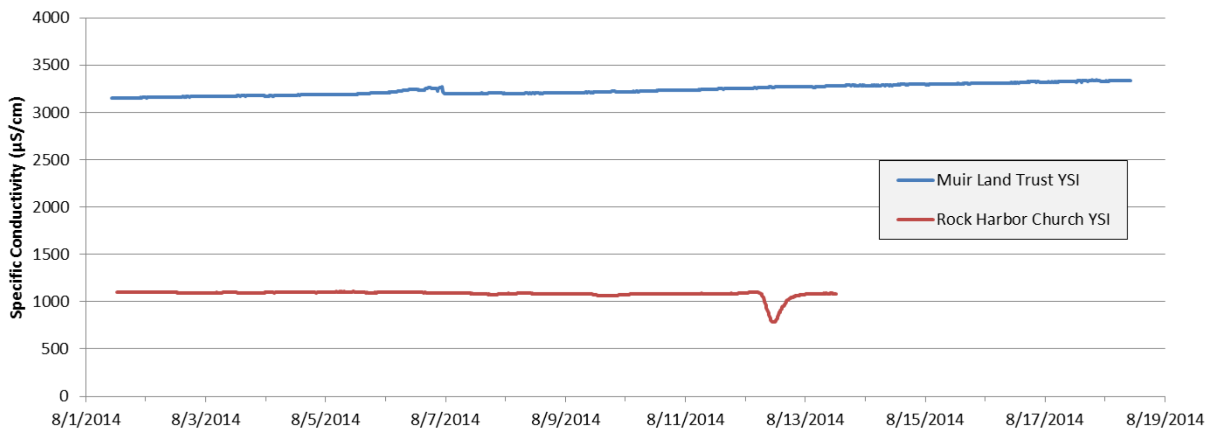


Figure 4.7 General water quality data (continuous specific conductivity) collected at Muir Land Trust (Rodeo Creek) and Rock Harbor Church (San Pablo Creek), August 1-18, 2014 and August 1-19, 2014





The lowest dissolved oxygen concentration (0.08 mg/l) at the Muir Land Trust station on Rodeo Creek occurred during August 2014. The lowest DO concentration (6.86 mg/l) at the Rock Harbor Church (San Pablo Creek) station also occurred during August 2014. The minimum and maximum pH measurements for the Muir Land Trust station during both deployment periods were 7.23 and 8.28, respectively. The minimum and maximum pH measurements at the Rock Harbor Church station during both periods were 7.72 and 8.01, respectively.

During the second deployment at Muir Land Trust (August 1-18, 2014) of the YSI *Sonde*, the device was located in a pool. There was no flow in the creek during this period, as none was observed at deployment. This can partially account for the extremely low DO levels recorded during this time. However, the DO levels recorded during the first deployment (April 14-26, 2014) were also very low, with a range of 0.85 to 6.05 mg/L.

Figure 4.8 compares distributions of WAMT to the annual maximum temperature threshold for salmonids (20.5°C) at the Muir Land Trust and Rock Harbor Church stations as recorded by YSI *Sonde* devices during April-May and August 2014. The results show that the WAMTs at these stations recorded by these devices were always below the temperature threshold. These results are consistent with those for the longer HOBO® temperature series at these two stations.

Figure 4.8 Box plots of weekly average maximum daily water temperature (WAMT) at Muir Land Trust and Rock Harbor Church Sites, during April-May 2014 and August 2014

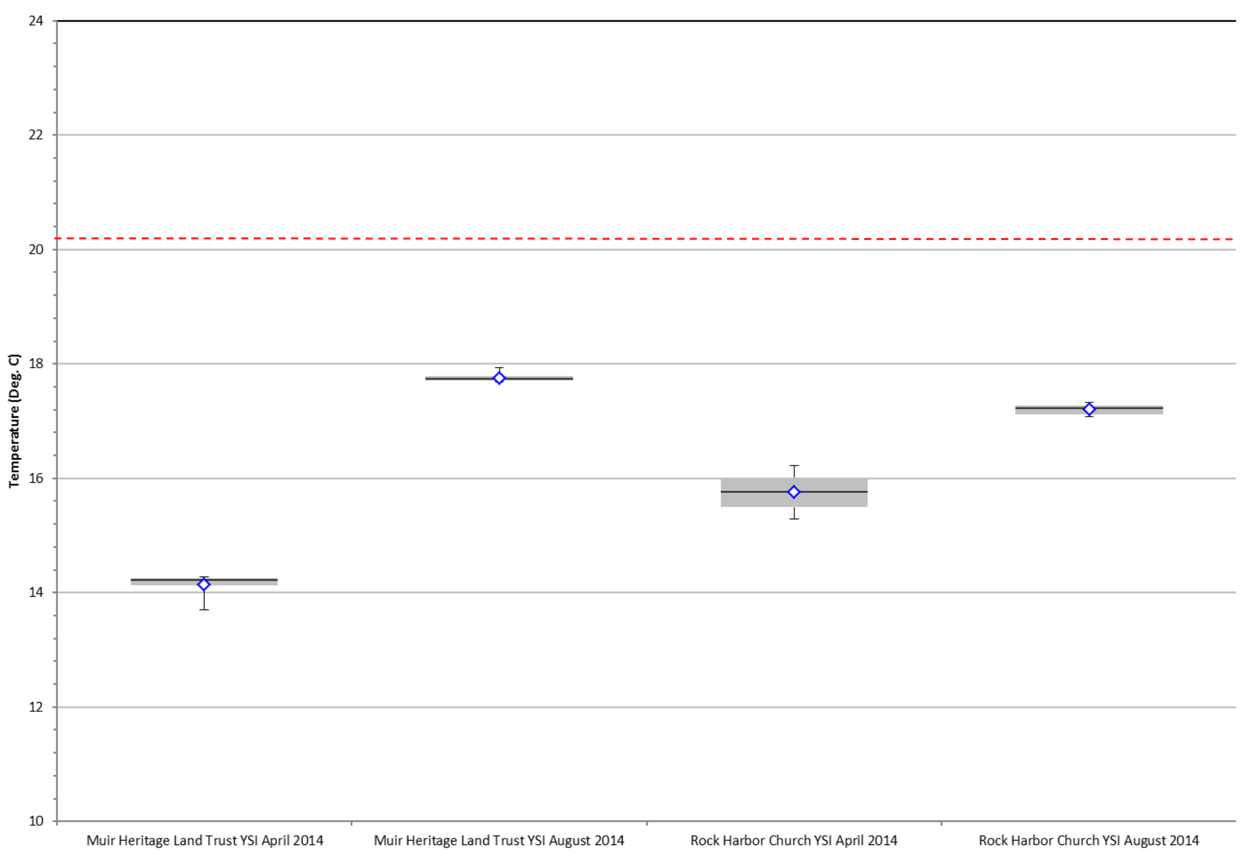


Table 4.5 presents the distribution of continuous water quality data for temperature, DO, and pH measured at the Muir Heritage Land Trust and Rock Harbor Church stations during both monitoring periods, compared to water quality evaluation criteria specified in Table 8.1 of the MRP and Central Valley Permit (Table 3.3). The following summarizes water quality evaluation criteria exceedances that occurred at either creek as follows:

- Muir Land Trust:
    a. During the April 2014 deployment, DO fell below the COLD threshold 100 percent of the time and below the WARM threshold 80 percent of the time.

    b. During the August 2014 deployment, DO fell below the COLD threshold 100 percent of the time and the WARM threshold 99 percent of the time.

The Muir Land Trust station therefore exceeded the MRP and Central Valley Permit Table 8.1 trigger thresholds for dissolved oxygen (20 percent or more of values exceed the applicable threshold; see Table 3.3) during both the April and August measurement periods.

- Rock Harbor Church:
    a. No exceedances occurred during either deployment.

Table 4.5 Percent of water temperature, dissolved oxygen, and pH data measured at two sites for both events that exceed water quality evaluation criteria identified in Table 3.2.

Site Name	Creek Name	Monitoring Period	Temperature Percent Results WAMT > 20.5°C	DO Percent Results < 5.0 mg/l (WARM)	DO Percent Results < 7.0 mg/l (COLD)	pH Percent Results < 6.5 or > 8.5
Muir Heritage Land Trust	Rodeo Creek	April 14–April 25, 2014	0%	80%	100%	0%
		August 1-18, 2014 [1]	0%	99%	100%	0%
Rock Harbor Church	San Pablo Creek	April 30-May 9, 2014	0%	0%	0%	0%
		August 1–13, 2014	0%	0%	0%	0%

[1] Measurement device deployed in an isolated pool. No flow occurred during the entire deployment.

4.2.3 Water Quality Data Evaluation for Steelhead Suitability

4.2.3.1 Rodeo Creek

Water Temperature: The vast majority of the Rodeo Creek channel upstream of the Muir Heritage Land Trust Site 206RDO025 is well shaded by riparian vegetation. This likely explains why Rodeo Creek at this location had a median water temperature from mid-April to October 17, 2014 of 16.89°C, very similar to the San Pablo Creek’s median water temperature of 16.34°C discussed below. Looking at only the water temperature data, the COLD designation appears to apply to Rodeo Creek from this point upstream or, more accurately, upstream from the eastern end of the channelized portion of the creek.

The other two monitoring stations on Rodeo Creek are in the channelized section of the creek. Both of these stations had median water temperatures in 2014 (mid-April to October 17) that exceeded the salmonid rearing criteria of 20.5°C (22.3-23.3°C, Table 4.2). Considering how exposed Rodeo Creek is to solar radiation through this long channelized section, it is not surprising. From the eastern end of the channelized creek west to the mouth of the Rodeo Creek should have the WARM designation as the lack of riparian shading will always raise water temperatures through this stream reach.

Dissolved Oxygen: The Basin Plan's objective for waters designated as COLD water habitat is to have DO concentrations at 7.0 mg/L or greater, and WARM water habitat at 5.0 mg/L DO or greater. Monitoring of DO on Rodeo Creek was performed only at the most easterly site, Station 206RDO025, Muir Heritage Land Trust. Additionally, there were only 11 days of valid monitoring that occurred between April 14-25, 2014, and this period had a median DO concentration of 3.58 mg/L. The location of the August deployment of the measuring device for DO and pH was, in what became, an isolated pool within the creek with no flow during the entire deployment of August 1-18 (Table 4.5). The August median DO level of 0.78 mg/L is not reflective of a normal water year in Rodeo Creek (this is our third drought year), but does show that under the worse-case conditions, even this location could not support salmonids through the summer because of very low levels of DO, even though water temperature and pH are suitable for salmonids.

Even during April, the DO levels (median of 3.58 mg/L) at the Muir Heritage Land Trust Site 206RDO025 do not meet the COLD water habitat objective of a minimum of 7.0 mg/L DO, and also fail to meet the WARM water habitat Basin Plan objective of a minimum of 5.0 mg/L. Based on the DO data for April 2014, Rodeo Creek from this most easterly site monitored in 2014 (Station 206RDO025) west to San Pablo Bay should have the WARM designation as it can't support salmonids through the summer.

pH: The Basin Plan states that pH shall not be depressed below 6.5 or raised above 8.5. Monitoring of pH on Rodeo Creek was done only at the most easterly site, Station 206RDO025, Muir Heritage Land Trust. As discussed above, the location of the August deployment of the measuring device for DO and pH was in what became an isolated pool as there was no creek flow during the entire deployment of August 1 through 18 (Table 4.5). All pH readings met these criteria.

Specific Conductivity: There is no Basin Plan criterion for specific conductivity. However, a comment on the specific conductivity data for the 2014 monitoring of Rodeo Creek is in order as the median conductivities shown in Table 4.4 are high at 2,749 uS/cm (May) an 3,233 uS/cm (August), particularly compared to that of San Pablo Creek (1,222-1,090 uS/cm). Many of the western Contra Costa County streams receive groundwater that seeps through ancient marine layers of rock such that specific conductivity rises from spring through the summer. San Pablo Creek below San Pablo Dam doesn't show this, either because its upper watershed doesn't contain the marine layers of rock, or because flow from San Pablo Reservoir is a mixture of upper San Pablo Creek water and Mokelumne River water (with very low specific conductivity) that is stored in San Pablo Reservoir.

4.2.3.2 San Pablo Creek

Water Temperature: The Basin Plan designates San Pablo Creek as both COLD and WARM water habitat. San Pablo Creek above San Pablo Reservoir is clearly suitable for the COLD designation. Because salmonids no longer seem to reside in San Pablo Creek below the dam, it is assumed that the WARM designation was suitable for this lower portion of San Pablo Creek, particularly at the location of the Rock Harbor Church monitoring site 0.4 miles west of

Highway 80. However, San Pablo Creek from the monitoring site upstream to San Pablo Reservoir Dam is well shaded by riparian vegetation and apparently the shading does a good job of moderating summer water temperatures in the creek. Table 4.2 shows the water temperature statistics for all four monitoring sites. San Pablo Creek is shown in the far right column. A comparison of these data to the upper temperature limit of 20.5°C is shown in Table 4.3.

Surprisingly, even this monitoring location west of Highway 80 shows no instance of the water temperature exceeding 20.5°C throughout the summer of 2014, and the median temperature is 16.34°C. U.C. Davis' fishery professor, Peter Moyle, states in his book, *Inland Fishes of California* (2002) that, "The optimal temperatures for the growth of rainbow trout are around 15-18°C….". All this indicates that the COLD designation could apply to San Pablo Creek all the way into downtown City of San Pablo.

Dissolved Oxygen: As indicated in Table 4.5, the 2014 water quality monitoring data from lower San Pablo Creek at Rock Harbor Church shows that during the monitored period (April 30-May 9 and August 1-13), Basin Plan objectives for dissolved oxygen (COLD criteria) and pH were met without exception. So problems with dissolved oxygen concentration or pH are not responsible for the lack of a salmonid fishery here. Jessica Purificato of EBMUD (personal communication, November 10, 2014), stated that during years when the dam spills, San Pablo Creek below the dam gets heavy flows that may wash out any salmonid spawning redds (fish made depressions in gravel where fish eggs are deposited) present before the eggs can hatch. Additionally, she said there are barriers to adult steelhead upstream passage in San Pablo Creek at the Giant Road culvert and at the Highway 80 culvert (a third barrier culvert at Via Verde Road has recently been made passable). She also said the dissolved oxygen levels at all three of their lower San Pablo Creek monitoring sites were around 3 mg/L this September. Although steelhead cannot presently ascend the creek beyond Giant Road, San Pablo Creek between the dam and the City of San Pablo may be suitable for salmonids and should be managed for the COLD designation of beneficial use.

pH: The Basin Plan states that pH shall not be depressed below 6.5 or raised above 8.5. All pH readings met these criteria.

Specific Conductivity: There is no Basin Plan criterion for specific conductivity. The increase in conductivity seen in the median value of 1366 µS/cm in May versus the median value of 1604 µS/cm in August is likely because streams in the East Bay are reliant on a higher percent of their flow being groundwater as the summer progresses. Many of these streams have groundwater that leaches through old marine formations. The groundwater picks up salts that make the stream flow have higher conductivity as the summer progress until the rainy season begins. Although relatively high in conductivity, San Pablo Creek conductivity values are common in the San Francisco Bay area.

4.2.3.3 Summary Water Quality Data Evaluation for Steelhead Suitability

Rodeo Creek

The WY 2014 temperature monitoring data shows that summer water temperatures in Rodeo downstream of Franklin Canyon are too warm to support salmonids as it flows through an unshaded channelized section to the bay. Although water temperatures at the Muir Heritage Land Trust Site 206RDO025 in lower Franklin Canyon had summer water temperatures in 2014 that were well below the 20.5°C criteria being used for salmonid rearing suitability assessments, the limited dissolved oxygen monitoring in April and August show that salmonids could not have survived here in the summer of 2014 because of low levels of dissolved oxygen. Perhaps suitable conditions for salmonid rearing might occur during a wet water year, but it appears, in general, salmonid suitability in Rodeo Creek is further upstream in Franklin Canyon. The sections of lower Rodeo Creek monitored in 2014 should be considered WARM water habitat.

Regarding salmonid suitability in Rodeo Creek, electrofishing by CDFW in 1974, and Robert Leidy's fish sampling in 1981 and 1994, never found any salmonids in Rodeo Creek. Both CDFW and Leidy et al. (2005) concluded that Rodeo Creek did not appear suitable for supporting a steelhead population.

San Pablo Creek

San Pablo Creek below San Pablo Reservoir Dam all the way downstream to the Rock Harbor Church water quality monitoring site, which is west of Highway 80, has summer water temperatures, DO levels, and pH range that indicates it would support salmonids, and thus should be considered suitable for the COLD beneficial use designation. Although this reach of San Pablo Creek once supported a run of steelhead into the 1950s, EBMUD's annual electrofishing of three locations in this reach for the past eight years have found no steelhead, and just the occasional hatchery rainbow trout that appears to have come from San Pablo Reservoir upstream. The absence of steelhead utilizing this stream appears to be due to passage barriers at Giant Road and Highway 80 that prevent adult steelhead from ascending San Pablo Creek in winter. Another problem is the limited spawning habitat for salmonids and occasional spill flows from the dam that likely scour the incised channel of San Pablo Creek, destroying any salmonid spawning redds that might occur here.

4.2.4 California Rapid Assessment Method

CRAM assessments were performed at the same sites and identified through a probabilistic monitoring design, where bioassessments were conducted to address the following:

- What is the range of stream ecosystem conditions in Contra Costa County?
- Are CRAM indicators useful for understanding aquatic life use conditions?
- Are CRAM results useful for identifying potential stressors or sources of stress to aquatic life?

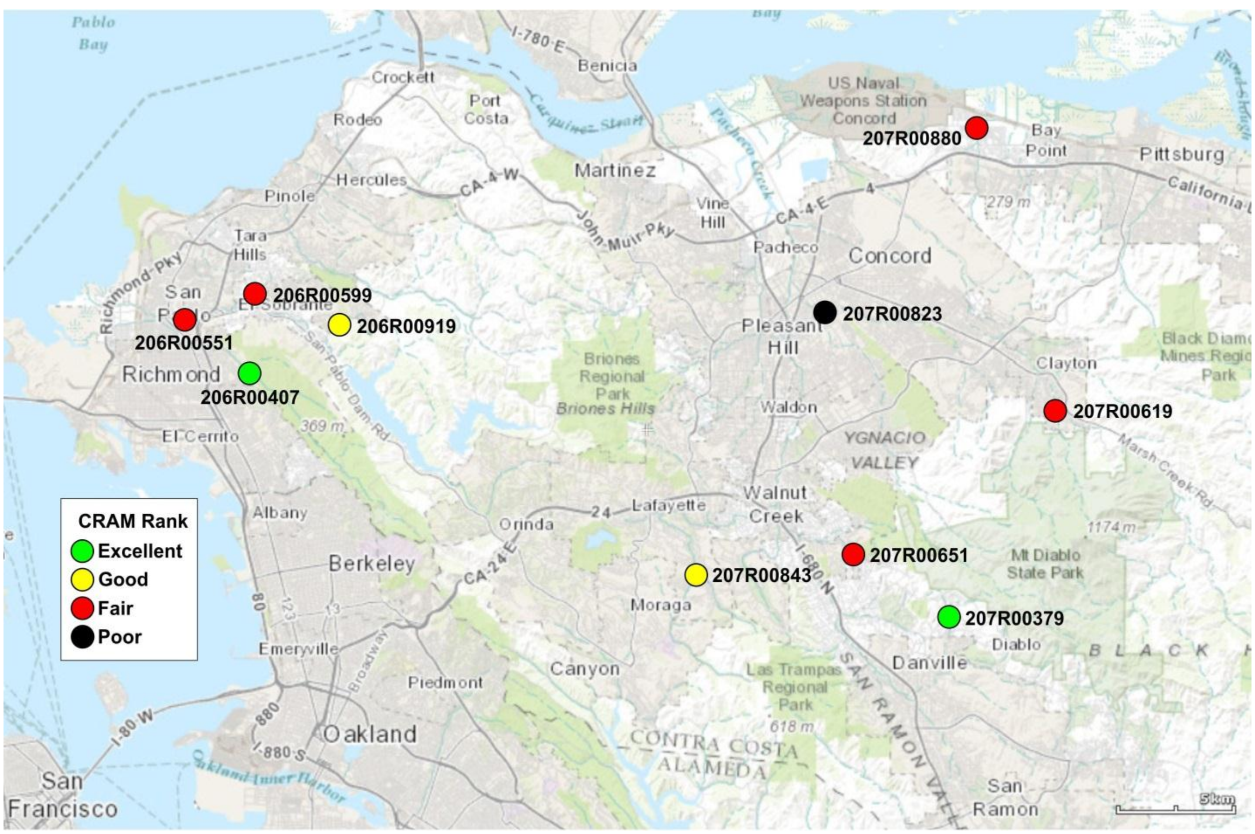
CRAM data has been used to assess the overall condition on the health of stream ecosystem resources and to develop hypotheses regarding the causes of their observed conditions (SCVURPPP, 2011). When collected at bioassessment sites, as done here, it provides a broader and more complete suite of indicators to use to evaluate the conditions of aquatic life uses. Previous studies in a Southern California watershed demonstrated a high correlation between benthic macroinvertebrate communities (as measured by B-IBI) and CRAM scores (Solek et al., 2011). IBI, or Index of Biotic Integrity, as calculated using the Southern California B-IBI (Ode et al., 2005).

CRAM scores were compared to B-IBI scores, calculated using the Southern California IBI (Ode et al. 2005) for ten bioassessment sites in Contra Costa County (see Regional/Probabilistic Creek Status Monitoring Report; ARC, in process). as well as B-IBI are shown in Table 4.6. CRAM scores ranged from 42-82 based on a 0-100 scale and were ranked by quartiles. Four of the ten sites were ranked as either good or excellent while the remaining six sites were ranked as either fair or poor. The CRAM sampling locations and ranking scores are depicted in Figure 4.9.

Table 4.6 Metric and Total CRAM scores and B-IBI results applied to 10 bioassessment monitoring sites in Contra Costa County in 2014

Assessment Area Name	Station Code	Buffer	Hydrology	Physical	Biotic	Overall CRAM Score	CRAM Rank	B-IBI
Wildcat Creek	206R00407	93	66.6	75	91.6	82	Excellent	44.3
W Branch Green Valley Creek	207R00379	81	83	87.5	66.6	80	Excellent	22.9
Castro Creek	206R00919	90	50	87.5	55.5	71	Good	30.0
Grizzly Creek	207R00843	90	67	88	69	79	Good	20.0
San Pablo Creek	206R00551	71.7	58	63	66.6	65	Fair	11.4
Appian Creek	206R00599	46.4	83	75	55.6	65	Fair	10.0
Donner Creek	207R00619	81	58	62.5	75	69	Fair	35.8
Sans Crainte Creek	207R00651	43	67	63	61	59	Fair	15.7
NA (Bay Point - Flood Control Channel)	207R00880	37.5	75	38	66.6	54	Fair	11.4
Galindo Creek	207R00823	27	58	25	58	42	Poor	12.9

Figure 4.9 CRAM ranks for 10 sites assessed in 2014 in Contra Costa County



Correlation coefficients (ρ) were computed and tested for significance between the overall CRAM scores and the individual CRAM attribute scores and the B-IBI. The results are presented below in Table 4.7. Although the sample size was small, two of the CRAM attribute scores were well correlated with B-IBI. The buffer ($\rho = 0.736$, $p = 0.02$) and biotic ($\rho = 0.722$, $p = 0.02$) attributes were significantly correlated with B-IBI at the 5 percent significance level. The hydrology and physical attribute scores were not significantly correlated with B-IBI. The Overall CRAM score just failed to be significantly correlated with B-IBI scores ($\rho = 0.632$, $p = 0.05$). As the Overall CRAM result depends on the four attributes, this result is consistent with the individual attribute degrees of correlation.

These results suggest that buffer and biotic condition are primary drivers for biological health within this sample set. Similarly, the lack of correlation between hydrology and physical structure suggest such attributes have less of an impact on the biological community within urban areas. However, additional CRAM and benthic macro invertebrate (BMI) data collection across a wider range of sites in Contra Costa County watersheds are needed to better evaluate the relationship between riparian and biological condition.

The results are presented graphically in Figure 4.10.

Table 4.7 Statistical test results for significant correlation (i.e., ρ <>0) between CRAM attributes and B-IBI scores

Statistic	CRAM Score Attribute				
	Buffer	Hydrology	Physical	Biotic	Overall
Correlation with IBI (ρ)	**0.736**	-0.304	0.407	**0.722**	0.632
Coefficient of Determination (R^2)*	**0.542**	0.092	0.166	**0.521**	0.400
t-value for ρ	**3.076**	-0.903	1.262	**2.950**	2.308
Probability (ρ<>0)	**0.015**	0.393	0.242	**0.018**	0.050

Note: Results that are significant at the 5 percent level are presented in **bold**

***** The Coefficient of Determination (= ρ^2).is an estimate of the proportion of the total variance of B-IBI that can be explained by variance in the various CRAM attributes.

The application of CRAM in urban creeks of the San Francisco Bay Region is relatively recent and results should be considered preliminary. Further analysis of existing data and new information is needed to comprehensively evaluate the utility of CRAM data for assessing stream ecosystem health and aquatic life uses.

4.3 Pathogen Indicators

To meet MRP and Central Valley Permit Provision C.8.g. requirements, a set of pathogen indicator samples were collected on July 8, 2014, at five stations on creeks in Contra Costa County. They were analyzed for fecal coliform and *E. coli*. Four of these stations were the same sites where the continuous monitoring devices were located. The remaining site was bioassessment site 207R00843 on Grizzly Creek. Table 4.8 summarizes the results of analyses of the samples collected.

As described previously (Section 3.4.3), single sample maximum concentrations of 400 MPN/100ml fecal coliform (per Basin Plan, SFRWQCB 2013) and 410 MPN/100ml *E. coli* (per USEPA 2012 Recreational Water Quality Criteria (RWQC) Standard Threshold Values (STV)) were used as Water Contact Recreation evaluation criteria for the purposes of this evaluation. In addition, a fecal coliform single sample maximum concentration of 4,000 MPN/100ml was used as a Non-water Contact Recreation evaluation criterion.

Fecal coliform concentrations ranged from 50 to 1100 MPN/100 ml; *E. coli* concentrations ranged from 50 to 1100 MPN/100 ml, as well. Two samples collected exceeded both the Basin

Figure 4.10 Graphs and Coefficients of Determination between scores from the California Rapid Assessment Method and the Southern California Benthic Index of Biotic Integrity at 10 bioassessment sites in Contra Costa County sampled in 2014

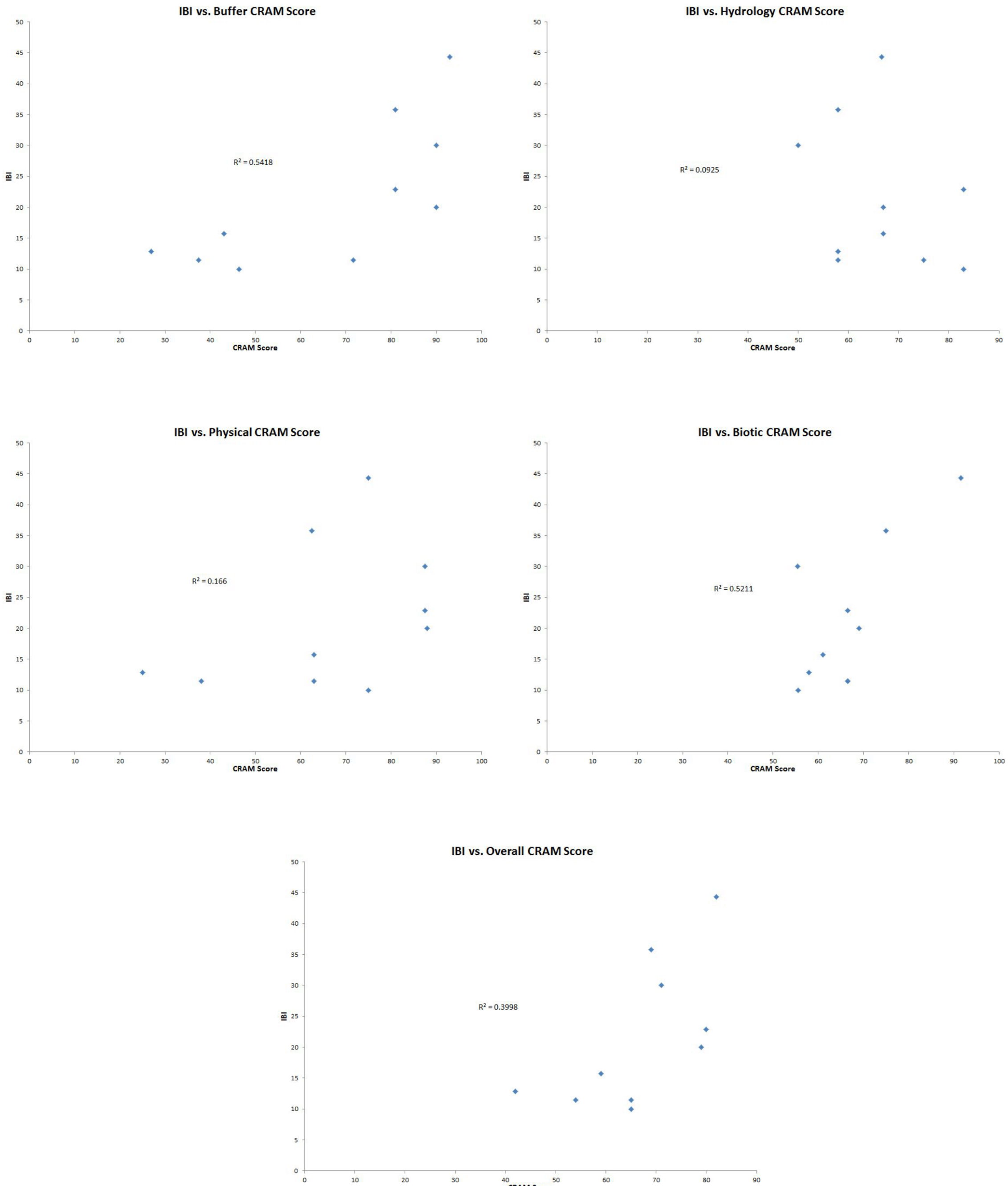


Table 4.8 Fecal coliform and *E. coli* levels measured from water samples collected on July 8, 2014 at five locations in creeks in Contra Costa County.

Site ID	Creek Name	*Fecal Coliform (MPN/100ml)*	*E. Coli (MPN/100ml)*
207R00843	Grizzly Creek	**1100**[1]	**1100**[2,3]
206RD0025	Rodeo Creek	50	50
206R01024	Rodeo Creek	110	80
206RD0003	Rodeo Creek	**500**[1]	**500**[2]
206R00551	San Pablo Creek	300	300

Explanation:
[1] Exceeded Basin Plan WQO of 400 MPN/100ml fecal coliform.
[2] Exceeded USEPA criterion of 410 cfu/100ml *E. coli*
[3] Relative percent differences from a laboratory duplicate sample of 75 percent exceeded the MQO of 25 percent.

Plan fecal coliform objective and the applicable USEPA criteria: the samples collected at stations 207R00843 (Grizzly Creek) and 206RD0003 (Rodeo Creek), at values of 1100 and 500 MPN/ml, respectively.

There was a QA/QC problem with a laboratory duplicate sample result for *E. coli*. In particular, the duplicate had a relative percent difference from the associated field sample of 75 percent, which is well above the MQO of 25 percent. Pathogen indicator sample results do have a tendency to have high variability, which may partially explain this quality control issue. However, a laboratory duplicate sample of Fecal Coliform taken at the same time had a relative percent difference of zero, and two laboratory blank samples had no detection of either pathogen. This indicates the QA/QC problem was insignificant and does not affect data quality reported herein.

5.0 Next Steps

During WY 2015, CCCWP will continue conducting monitoring for local/targeted parameters according to the requirements of Provision C.8 in the MRP and the Central Valley Permit. In addition, CCCWP plans to continue to perform CRAM assessments at all WY 2015 locations to provide additional data that can be used in the assessment of aquatic life conditions in Contra Costa County creeks.

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Appendix 3

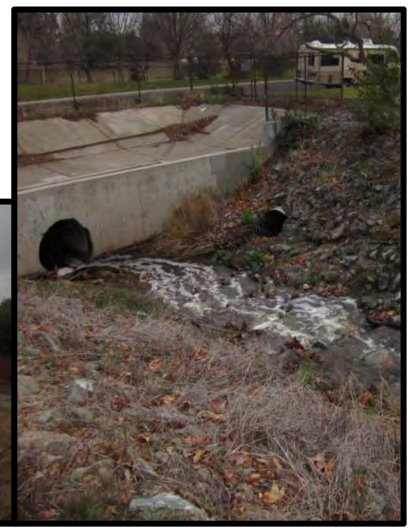
Report of Stressor/Source Identification Studies
in Dry Creek and Grayson Creek, Part A

Report of Stressor/Source Identification Studies in Dry Creek and Grayson Creek Part A

December 3, 2014

Contra Costa Clean Water Program





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List of Acronyms

ADH	ADH Environmental
AMEC	AMEC, Inc.
ARC	Armand Ruby Consulting
ASTM	American Society for Testing and Materials
BASMAA	Bay Area Stormwater Management Agencies Association
BSA	Bovine Serum Albumin
°C	Degrees Celsius
CAL	Caltest Laboratories
CCCWP	Contra Costa Clean Water Program
CVRWQCB	Central Valley Regional Water Quality Control Board
DO	Dissolved oxygen
DQO	Data quality objective
EC	Electrical conductivity
EDD	Electronic Data Deliverable
EOA	EOA, Inc.,
EPA	U.S. Environmental Protection Agency
MDL	Method Detection Limit
mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
MRP	Municipal Regional Permit
mS/cm	Microsiemens per centimeter
ng/L	Nanograms per liter
NPDES	National Pollution Discharge Elimination System
LC_{50}	Lethal Concentration to at least 50 percent of the population
LCS	Laboratory control sample
LCSD	Laboratory control sample duplicate
MS	Matrix spike
MSD	Matrix spike duplicate
PBO	Piperonyl butoxide
PEC	Probable Effects Concentration
PER	Pacific EcoRisk
PR	Percent recovery
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
QPF	Quantity of Precipitation Forecast
RMC	Regional Monitoring Coalition
RLs	Reporting Limits
RPD	Relative percent difference
SFBRWQCB	San Francisco Bay Regional Water Quality Control Board
SM	Standard Methods
SOPs	Standard Operating Procedures
SSID	Stressor/Source Identification
SWAMP	Storm Water Ambient Monitoring Program
TEC	Threshold Effects Concentration
TIE	Toxicity Identification Evaluation
TU	Toxic Unit
USGS	United States Geological Survey
ng/g	Nanogram per gram
µg/L	Microgram per liter
WY	Water Year

1.0 Introduction

The Contra Costa Clean Water Program (CCCWP) is responsible for complying with two National Pollutant Discharge Elimination System (NPDES) permits for urban stormwater discharges:

- Order No. R2-2009-0074, the Municipal Regional Permit (MRP), issued by the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB), Region 2
- Order No. R5-2010-0102 (Central Valley Permit), issued by the Central Valley Regional Water Quality Control Board (CVRWQCB), Region 5

To promote a coordinated countywide program of water quality management, the two permits have nearly identical provisions.

CCCWP entered into a regional collaborative with other Bay Area Stormwater Management Agencies Association (BASMAA) members, known as the Regional Monitoring Coalition (RMC), to plan and conduct Creek Status Monitoring required by provision C.8.c of the permits, to evaluate the monitoring results, and to perform related follow-up studies. The RMC also works cooperatively with staff of both the SFBRWQCB and the CVRWQCB to implement the coordinated monitoring. The Creek Status Monitoring conducted by CCCWP includes monitoring in both West County (Region 2) and East County (Region 5) jurisdictions.

Provision C.8.d.i of both permits (see Appendix A) requires follow-up monitoring projects when creek status monitoring conducted per Provision C.8.c produces results that exceed triggers defined in permit Table 8.1. The follow-up actions may include Stressor/Source Identification (SSID) Studies. MRP Attachment H and Central Valley Permit Attachment D (see Appendix B) also require Permittees to “Identify cause(s) of impacts and spatial extent” when sediment toxicity, chemistry, and bioassessment results meet certain thresholds. Per MRP Provision C.8.d.i, when the creek status monitoring is performed under a regional collaborative (such as the RMC), a maximum of ten SSID studies must be initiated during the permit term; two of those studies must be related to toxicity. By agreement within the RMC, Contra Costa Permittees are responsible for two SSID Studies during the permit term. The Central Valley Permit also caps the SSID studies required of East County Permittees to one study during the permit term. The current SSID studies as reported herein fulfill Contra Costa Permittees’ obligations under both permits.

CCCWP’s Creek Status Monitoring triggered exceedances under NPDES permit Provision C.8.c, Table 8.1 and Attachment H/D, for water and sediment toxicity parameters in both Water Year (WY) 2012 and WY 2013. Both Dry Creek (site 544R00025; Region 5) and Grayson Creek (site 207R00011; Region 2) exhibited water toxicity to *Hyalella azteca* (*H. azteca*) in creek samples collected during wet weather in WY 2012. Retests confirmed water toxicity to *H. azteca* in wet weather samples collected from both creeks in WY 2013. Other test species were not adversely affected in the water toxicity testing. In July 2012, sediment toxicity testing also revealed toxicity to *H. azteca* in sediment samples from both creeks.

In addition to the toxicity testing results, sediment chemistry testing of the dry weather samples in WY 2012 indicated elevated levels of sediment contaminants, including pyrethroid pesticides, in both creeks. Bioassessment monitoring of Dry Creek and Grayson Creek in spring, 2012 also yielded benthic macroinvertebrate index of biological integrity (IBI) scores in the “Very Low” range for both creeks. Taken together, the WY 2012 sediment toxicity, chemistry, and bioassessment results triggered follow-up actions required in NPDES permit Attachment H/D for Dry Creek and Grayson Creek. See Appendix C for a summary of the pertinent WY 2012 and WY 2013 creek status monitoring results.

A recent statewide survey also provides extensive evidence linking the presence of pyrethroid pesticides to aquatic toxicity in both waters and sediments of urban creeks throughout the state of California (Ruby, 2013). That report cites numerous instances where toxicity to *H. Azteca* co-occurs with elevated pyrethroid pesticide concentrations in both water and sediment samples, and references several toxicity identification evaluation studies (TIEs) in which the observed toxicity was found to be likely attributable to the presence of pyrethroid pesticide contamination. Pyrethroids were commonly found in water and sediment samples from urban creeks, typically at levels sufficient to cause toxicity in water and sediment samples. Fipronil, an increasingly common replacement for pyrethroid pesticides, was also frequently found in urban creek water and sediment samples, at potentially toxic levels.

To address the CCCWP WY 2012 and 2013 creek status monitoring results, and in fulfillment of permit requirements pertaining to SSID studies as described above, CCCWP developed a Stressor/Source ID Study Concept Plan (see Appendix D). The Concept Plan includes four parts, corresponding to the four steps required per permit provision C.8.d.i. for SSID Studies. Provision C.8.d.i requires SSID projects to include the following first step:

> "(1) Conduct a site specific study (or non-site specific if the problem is wide-spread) in a stepwise process to identify and isolate the cause(s) of the trigger stressor/source. This study should follow guidance for Toxicity Reduction Evaluations (TRE) or Toxicity Identification Evaluations (TIE)."

Part A of the CCCWP SSID studies, described in this report, involve site-specific studies and TIEs to identify the trigger/stressor as required by permit provision C.8.d.i., and also address causes of sediment quality impacts and spatial extent as required by permit Attachment H/D. As described in the SSID Concept Plan (Appendix D), subsequent phases of the SSID studies will involve identification of potential sources of the pollutant(s) or stressor(s) (Part B), identification and evaluation of potential abatement measures (Part C), and evaluation of the effectiveness of the implemented abatement measures (Part D).

The CCCWP Part A SSID investigations focus on current-use pesticides (pyrethroids and possibly fipronil) as the probable causes of the water and sediment toxicity based on the following factors:

- *H. azteca* is the common affected organism in the water and sediment toxicity at both Contra Costa County creek sites (per WY 2012 and 2013 data, see Appendix C)
- The presence of elevated levels of pyrethroids in sediment samples from those creeks (per WY 2012 data, see Appendix C)
- The preponderance of other evidence linking *H. azteca* toxicity to the presence of pyrethroid pesticides in urban surface waters (Ruby, 2013)

Toxicity SSID studies first require positive identification of the stressor(s). Although pyrethroid pesticides are targeted due to their use in residential areas, and it is presumed that the stressors in the subject creeks are pesticides, additional water and sediment chemistry and toxicity testing are necessary to confirm this supposition. In particular, it is necessary to determine which pesticides are causing toxicity, and whether there are spatial patterns that may pinpoint more specific source areas or land uses.

The SSID Part A studies were conducted by CCCWP during 2014 to evaluate and investigate the extent and causes of the observed creek toxicity to *H. azteca* in Dry Creek and Grayson Creek watersheds. Dry Creek is located in Eastern Contra Costa County in the City of Brentwood (Water Board Region 5). Grayson Creek is in Central Contra Costa County in the City of Pleasant Hill (Water Board Region 2).

The SSID Part A studies involved both wet weather monitoring for aquatic (water column) chemistry and toxicity, and dry weather monitoring for sediment chemistry and toxicity. These projects serve both to fulfill the requirements of MRP Table H-1 and Central Valley Permit Table D-1 with respect to follow-up actions pertinent to the sediment triad results, and also the requirements to conduct the SSID toxicity studies called for in Provision C.8.d.i. in both Regional Permits. This report provides the methods and results of Part A of the two SSID studies, and an analysis of the results.

2.0 SSID Studies – Overview

CCCWP performed the Part A SSID studies during 2014 in the Dry Creek and Grayson Creek watersheds, involving the following parameters:

- Two wet weather monitoring events in each creek, at sites upstream and downstream of the WY 2012 and 2013 Creek Status Monitoring sites in each watershed, with analysis of water samples for pyrethroid pesticides, fipronil and degradates, organochlorine pesticides, organic carbon and suspended sediment, plus field parameters, and toxicity testing for acute and chronic effects on *H. Azteca*.
- One dry weather monitoring event in each creek, at the same set of upstream and downstream sites in each watershed, with analysis of sediment samples for pyrethroid pesticides, fipronil and degradates, organochlorine pesticides, organic carbon and percent solids, plus field parameters, and toxicity testing for acute and chronic effects on *H. Azteca*.

An overview of the area covered by the SSID studies is provided in Figure 1. The Part A SSID Work Plan is included as Appendix E to this report.

Figure 1. SSID Study Area

2.1 Study Objectives

The SSID studies are expected to be performed in four parts over four years. The goals of Part A of the SSID studies are to:

- Identify the causes of the observed water and sediment toxicity to *H. azteca* in Dry Creek and Grayson Creek (i.e., the stressor[s])
- Identify temporal (seasonal) and spatial patterns in toxicity and stressors, and better characterize the spatial extent of sediment toxicity impacts

2.2 Study Personnel

The CCCWP provides contract administration as needed to ensure compliance with the Permit requirements and ensure the work is performed to professional standards of quality. Personnel involved with the SSID study, their respective roles and responsibilities are listed in Table 1.

Table 1. Personnel Names, Affiliation, and Responsibilities

Name	Affiliation	Responsibility
Janet O'Hara	SFBRWQCB	Regulatory Agency
Lucile Paquette	CCCWP	Program Coordinator
Kristine Corneillie	LWA	Technical Advisor
Armand Ruby	ARC	Toxicity Identification Evaluations
Alessandro Hnatt	ADH	Project Manager
Peter Wilde	ADH	Quality Assurance Manager
Kevin Lewis	ADH	Field Sampling
Calvin Sandlin	ADH	Field Sampling

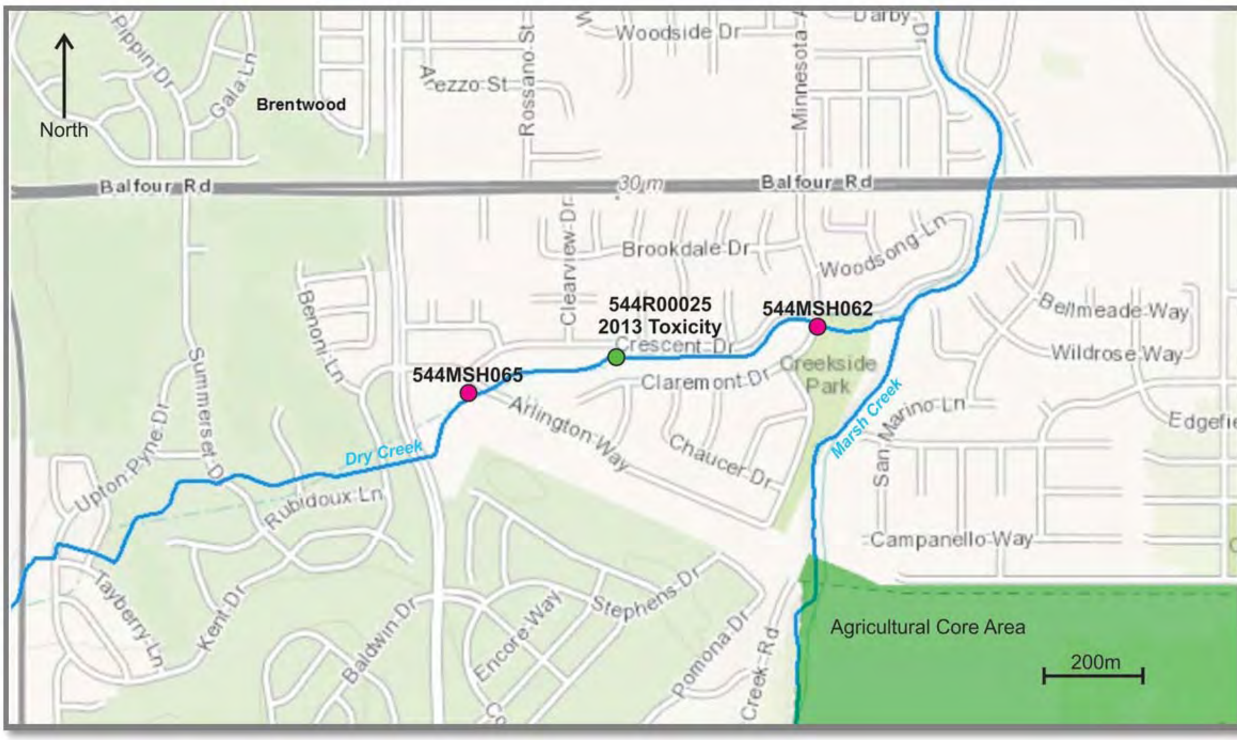
2.3 Monitoring Locations

The WY 2012 Creek Status toxicity sampling locations on Dry Creek and Grayson Creek are shown in Figures 2 and 3, respectively. The original site identification numbers are Site 544R00025 in Dry Creek and Site 207R00011 in Grayson Creek. For these SSID studies, two additional sites were selected for monitoring in each creek: one upstream ("US") and one downstream ("DS") of each of the previously-monitored sites to better characterize spatial extent of the toxicity impacts at those sites. The upstream and downstream sites were selected in coordination with the CCCWP Program Coordinator, and reconnaissance of these selected sites was performed in the 2013-2014 winter season in conjunction with CCCWP Creek Status bioassessment site reconnaissance. The following subsections provide brief descriptions of the target watersheds. Locations of upstream and downstream SSID monitoring sites for Dry Creek and Grayson Creek are also shown in Figures 2 and 3, respectively, and are detailed in Table 2.

2.3.1 Dry Creek

Dry Creek is a tributary to Marsh Creek in eastern Contra Costa County in the City of Brentwood. The creek channel in this area has undergone hydromodification due to urbanization and is mostly conveyed through underground pipeline. The reach sampled in this study is one of the reaches where the creek is above-ground. The creek flows through a culvert from the Brentwood Golf Club west of Arlington Way (upstream sampling site), approximately 350 meters along Crescent Drive (south of Balfour Drive), in a grassed flood control channel. It then enters another culvert just downstream of the downstream sampling location, and flows under Creekside Park to its confluence at Marsh Creek. This reach receives runoff from the neighboring urban development as well as from the golf course. The WY 2012 and 2013 creek status sampling location (Site 544R00025) was approximately halfway between the upstream and downstream SSID sampling sites, as shown in Figure 2.

Figure 2. Dry Creek Monitoring Locations, Brentwood, CA



2.3.2 Grayson Creek

Grayson Creek is a tributary to Walnut Creek in central Contra Costa County in the City of Pleasant Hill. Grayson Creek and the two tributaries sampled in this watershed are concrete flood control channels surrounded by residential land use. The upstream sampling location is sited approximately 30 meters up Tributary to Grayson Creek from the confluence with Grayson Creek, immediately upstream of the walking bridge between Mercury Way and Vineyard Court. This tributary drains a parcel of agricultural land to the northwest as well as residential areas. The downstream sampling location is located on East

Branch of Grayson Creek, upstream of the confluence with Grayson Creek, at the terminus of Ardith Drive. During WY 2012 and 2013, the creek status monitoring site (Site 207R00011) was located in the concrete channel where it crosses the Contra Costa Canal Trail in Pleasant Hill (see Figure 3).

Figure 3. Grayson Creek Monitoring Locations, Pleasant Hill, CA

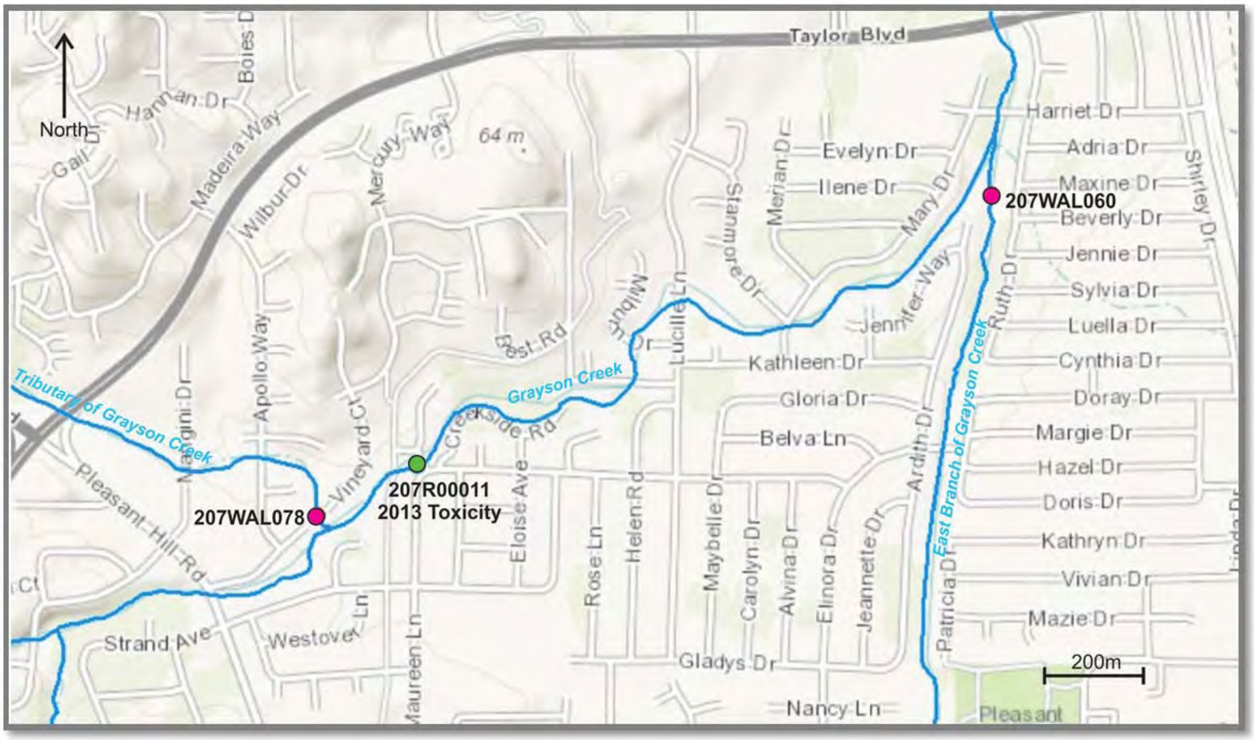


Table 2. CCCWP Part A SSID Study Monitoring Site Location Descriptions for WY 2014				
Creek Name / SSID Study Site	**Site Code***	**Latitude**	**Longitude**	**Monitoring Site Access**
Dry Creek / Downstream	544R00025DS /544MSH062	37.923034	-121.714538	Public access. Park on road next to creek. Monitoring site is located upstream of culvert at Claremont Way.
Dry Creek / Upstream	544R00025US /544MSH065	37.921722	-121.721855	Public access. Park on road next to creek. Monitoring site is located upstream of culvert at Arlington Way.
Grayson Creek/ Downstream	207R00011DS /207WAL060	37.954271	-122.07869	Enter through Flood Control Corp yard. Sampling location is at the bottom of the channel access ramp. DO NOT ENTER CHANNEL DURING STORM SEASON
Grayson Creek/ Upstream	207R00011US /207WAL078	37.95141	-122.08396	Enter Flood Control access gate from walking bridge between Mercury Way and Vineyard Court, above channel. Monitoring location is upstream of the bridge. Storm season sampling requires use of sampling pole and transfer container from the top of the channel bank.

*Site codes are shown as original (as submitted to lab)/new (as assigned by SFBRWQCB).

3.0 Field Monitoring Methods

In 2014, monitoring was performed at two sites for each of the two SSID projects (upstream and downstream sites in Dry Creek and Grayson Creek) during two wet weather events, with analysis for water chemistry and toxicity, and at the same four sites during one dry weather event, with analysis for sediment chemistry and toxicity. Monitoring preparation and logistics, laboratory arrangements, weather tracking, mobilization, sample collection, field measurements, sample delivery and shipping, and demobilization followed standard CCCWP and RMC protocols. The following subsections describe the field sampling methods employed for the collection of wet weather water samples and dry weather bedded sediment samples. Sample collection followed protocols described in the RMC Quality Assurance Project Plan (QAPP; EOA et al., 2012) and Standard Operating Procedures (SOPs; EOA et al., 2014a).

To minimize upstream influence on downstream water quality, in each creek and for every monitoring event, the downstream site was always sampled prior to collection of samples at the upstream monitoring site. Additionally, all sampling was conducted during daylight hours in the interest of health and safety.

3.1 Wet Weather (Stormwater) Sample Collection

Wet weather aquatic toxicity and chemistry sample collection techniques and health and safety considerations adhered to all relevant protocols specified in the RMC's SOP FS-2, *Manual Collection of Water Samples for Chemical Analysis, Bacteriological Analysis, and Toxicity Testing* (EOA et al., 2014a).

The characteristics of the monitored wet weather events for the SSID Part projects are shown in Table 3.

Table 3. Monitored Storm Events

Stream/Stations	Event Date	Total Rainfall (in)	Maximum Intensity (in/hr)	Start of Rainfall	End of Rainfall	Duration of Rainfall (hours)	Antecedent Dry Period (days)
Dry Creek 544MSH065 and 544 MSH062 [1]	02/06/14	0.53	0.17	020/5/14 23:00	02/06/14 08:20	9.3	3.2
	02/28/14	1.08	0.56	02/28/14 01:45	02/28/14 15:30	13.8	1.2
Grayson Creek 207WAL078 and 207WAL060 [2]	02/28/14	1.22	0.28	02/28/14 01:40	02/28/14 16:22	14.7	1.1
	03/26/14	0.47	0.16	03/26/14 06:45	03/26/14 20:19	13.6	20.3

Explanation:

[1] Weather statistics from station KCABRENT7 (37.933N, -121.721W):
http://www.wunderground.com/personal-weather-station/dashboard?ID=KCABRENT7

[2] Weather statistics from station KCAPLEAS20 (37.945N, -122.082W):
http://www.wunderground.com/personal-weather-station/dashboard?ID=KCAPLEAS20

3.2 Sediment Sample Collection

Bedded sediment toxicity and chemistry sampling collection techniques, and health and safety considerations for this SSID Study adhered to all relevant protocols specified in the RMC's SOP FS-6, *Collection of Bedded Sediment Samples for Chemistry Analysis and Toxicity* (EOA et al., 2014a). In accordance with the MRP and Central Valley Permits, dry season sampling was conducted on July 22nd, during the prescribed July – September timeframe.

3.3 Field Water Quality Measurements and Observations

Field water quality measurements and associated equipment preparation and calibration were performed in conformance with all relevant water and sediment toxicity and chemistry monitoring protocols specified in the RMC's SOP FS-3, *Manual Field Measurements* (EOA et al., 2014a).

Water quality measurements were performed using a YSI 556 handheld multi-parameter probe to measure temperature, pH, dissolved oxygen (DO) and specific conductance. Measurements of these parameters as well as the field crew names, standard observations of water quality (e.g., odor, clarity, color, etc.), and site information (e.g., GPS coordinates, stream width and depth, approximate flow rate, etc.) were recorded on a SWAMP field data sheet during all sampling events.

3.4 Sample Handling and Chain of Custody Procedure

Sample containers and handling adhered to all relevant protocols specified in the RMC's FS-9, *Sample Container, Handling, and Chain of Custody Procedures* (EOA et al., 2014a). A summary of the respective analytes or tests, sample volumes, containers, and preservatives is presented for wet weather water sample collection and dry-season bedded sediment sample collection in Tables 4 and 5, respectively.

Table 4. Containers and Handling for Wet Weather Aquatic Toxicity and Chemistry Samples

Sample/Test	Container	Handling Requirements
Pyrethroid pesticides	2 @ 1 L amber glass	Place on wet ice, cool to <6° C, 7 day hold time
Fipronil and degradates	1 @ 2 L amber glass	Place on wet ice, cool to <6° C, 7 day hold time[1]
Organochlorine pesticides	1 @ 2 L amber glass	Place on wet ice, cool to <6° C, 7 day hold time
Total Organic Carbon	3 @ 40 ml x VOA	HCL, place on wet ice, cool to <6° C, 28 day hold time
Suspended Sediment Concentration	1 @ 250 ml HDPE	Place on wet ice, cool to <6° C, 7 day hold time
Aquatic toxicity	10 @ 3.75 L amber glass	Place on wet ice, cool to <6° C, 36 hour hold time

Explanation:

[1] Holding time for Fipronil is 7 days, but certain degradates are 3 days.

Table 5. Containers and Handling for Dry Season Bedded Sediment Toxicity and Chemistry Samples

Sample/Test	Container	Handling Requirements
Pyrethroid pesticides, Fipronil and degradates	1 @ 8 ounces amber glass[1]	Place on wet ice, cool to <6° C, 14 day[2] hold time
Organochlorine pesticides	1 @ 8 ounces clear or amber glass soil jar.[1]	Place on wet ice, cool to <6° C, 14 day hold time
Percent Solids	1 @ 8 ounces clear soil jar.	Place on wet ice, cool to <6° C, 7 day hold time
Total Organic Carbon	1 @ 8 ounce clear soil jar	Place on wet ice, cool to <6° C, 28 day hold time
Sediment toxicity	3 @ 4 L[3] amber glass	Place on wet ice, cool to <6° C, 14 day hold time

Explanation:

[1] 2 jars recommended for back-up
[2] 1 year if frozen
[3] The 10-day *Hyalella azteca* sediment toxicity test requires a total of 2 L of sediment. This does not account for additional volume for a follow-up request or for TIEs. The total for TIEs is dependent on the number of treatments, and can be as much as an additional 2-10 L. In summation, the volume should be ≥ 3 gallons (~12 L on the high end) to cover all possibilities.

4.0 Testing and Analytical Methods

Monitoring was performed at each of the four sites for water chemistry and toxicity during two wet weather events, and during one dry weather event for sediment chemistry and toxicity.

Constituents for water quality analysis included:

- Field parameters [DO, specific conductance, pH, Temperature]
- Pyrethroid pesticides
- Fipronil and degradates
- Organochlorine pesticides
- Total organic carbon
- Suspended sediment concentration
- *Hyalella azteca* – chronic toxicity

Constituents for sediment quality analysis included:

- Field parameters (DO, specific conductance, pH, Temperature) in overlying water
- Pyrethroid pesticides
- Fipronil and degradates
- Organochlorine pesticides
- Percent solids
- Total organic carbon
- *Hyalella azteca* – chronic toxicity

4.1 Wet Weather (Stormwater) Aquatic Analytical Methods and Tests

Analytical methods and tests, method detection limits (MDLs) and reporting limits (RLs) for the 2014 CCCWP SSID Study wet weather monitoring are presented in Table 6. Field water quality parameters were measured in the field. Laboratory chemical analyses were performed by Caltest Analytical Laboratory in Napa. Toxicity testing was performed by Pacific EcoRisk in Fairfield, using *H. azteca* as the test species.

Table 6. Analytical Constituents, Methods, MDLs and RLs or Test Type for CCCWP SSID Study Wet Weather Aquatic Monitoring

Analyte	Analytical Method	Method Detection Limit or Test Duration	Reporting Limit Or Test Type
Water Quality Parameters			
Dissolved Oxygen	YSI 556 field meter	0.01 mg/L	0 - 50 mg/L
Conductivity	YSI 556 field meter	0.001 mS/cm	0 – 200 mS/cm
pH	YSI 556 field meter	0.01 units	0.00 – 14.00 units
Temperature	YSI 556 field meter	-5 – 45°C	0.1°C
Total Organic Carbon	SM20-5310 B	0.50 mg/L	1 mg/L
Suspended Sediment Concentration	ASTM D 3977-97 B-Filtration	2 mg/L	3 mg/L

Table 6. Analytical Constituents, Methods, MDLs and RLs or Test Type for CCCWP SSID Study Wet Weather Aquatic Monitoring

Analyte	Analytical Method	Method Detection Limit or Test Duration	Reporting Limit Or Test Type
Pyrethroid Pesticides			
Allethrin	EPA 8270Mod (NCI SIM)	0.1 ng/L	1.5 ng/L
Bifenthrin	EPA 8270Mod (NCI SIM)	0.1 ng/L	1.5 ng/L
Cyfluthrin	EPA 8270Mod (NCI SIM)	0.2 ng/L	1.5 ng/L
Cypermethrin	EPA 8270Mod (NCI SIM)	0.3 ng/L	1.5 ng/L
Deltamethrin: Tralomethrin	EPA 8270Mod (NCI SIM)	0.2 ng/L	3.0 ng/L
Esfenvalerate: Fenvalerate	EPA 8270Mod (NCI SIM)	0.2 ng/L	3.0 ng/L
Fenpropathrin	EPA 8270Mod (NCI SIM	0.3 ng/L	1.5 ng/L
Lambda-Cyhalothrin	EPA 8270Mod (NCI SIM)	0.2 ng/L	1.5 ng/L
Tau-Fluvalinate	EPA 8270Mod (NCI SIM)	0.2 ng/L	1.5 ng/L
Tetramethrin	EPA 8270Mod (NCI SIM)	0.2 ng/L	1.5 ng/L
Permethrin	EPA 8270Mod (NCI SIM)	2 ng/L	15 ng/L
Fipronil (Degradates Listed Below)	EPA 8270Mod (NCI SIM)	0.002 µg/L	0.01 µg/L
Fipronil Desulfinyl	EPA 8270Mod (NCI SIM)	0.002 µg/L	0.01 µg/L
Fipronil Sulfide	EPA 8270Mod (NCI SIM)	0.002 µg/L	0.01 µg/L
Fipronil Sulfone	EPA 8270Mod (NCI SIM)	0.002 µg/L	0.01 µg/L
Organochlorine Pesticides			
Aldrin	EPA 608	0.0040 µg/L	0.05 µg/L
alpha-BHC	EPA 608	0.0050 µg/L	0.010 µg/L
beta-BHC	EPA 608	0.0040 µg/L	0.005 µg/L
delta-BHC	EPA 608	0.0040 µg/L	0.005 µg/L
gamma-BHC (Lindane)	EPA 608	0.0040 µg/L	0.010 µg/L
Chlordane	EPA 608	0.020 µg/L	0.010 µg/L
4,4'-DDD	EPA 608	0.0040 µg/L	0.010 µg/L
4,4'-DDE	EPA 608	0.0040 µg/L	0.010 µg/L
4,4'-DDT	EPA 608	0.0040 µg/L	0.010 µg/L
Dieldrin	EPA 608	0.0040 µg/L	0.010 µg/L
Endosulfan I	EPA 608	0.0050 µg/L	0.010 µg/L
Endosulfan II	EPA 608	0.0050 µg/L	0.010 µg/L
Endosulfan sulfate	EPA 608	0.0050 µg/L	0.010 µg/L
Endrin	EPA 608	0.0050 µg/L	0.010 µg/L
Endrin aldehyde	EPA 608	0.0050 µg/L	0.010 µg/L
Endrin ketone	EPA 608	0.0050 µg/L	0.010 µg/L
Heptachlor	EPA 608	0.0050 µg/L	0.010 µg/L
Heptachlor epoxide	EPA 608	0.0040 µg/L	0.010 µg/L
Methoxychlor	EPA 608	0.0050 µg/L	0.01 µg/L
Toxaphene	EPA 608	0.30 µg/L	0.5 µg/L

Table 6.	**Analytical Constituents, Methods, MDLs and RLs or Test Type for CCCWP SSID Study Wet Weather Aquatic Monitoring**		
Analyte	**Analytical Method**	**Method Detection Limit or Test Duration**	**Reporting Limit Or Test Type**
Aquatic Toxicity	EPA/600/R-99/064	10-day	Survival

Explanation:

mg/L	Milligram per liter	ng/L	Nanograms per liter
mS/cm	Microsiemens per centimeter	µg/L	Microgram per liter
°C	Degrees Celsius	SM	Standard Methods
EPA	U.S. Environmental Protection Agency	ASTM	American Society for Testing and Materials

4.2 Dry Season Bedded Sediment Analytical Methods and Tests

Analytical constituent methods and tests, MDLs and RLs, or test type for the CCCWP SSID Study dry season bedded sediment toxicity monitoring are presented in Table 7. Field water quality parameters were measured in the field. Laboratory chemical analyses were performed by Caltest Analytical Laboratory in Napa. Toxicity testing was performed by Pacific EcoRisk in Fairfield, using *H. azteca* as the test species.

Table 7.	**Analytical Constituents, Methods, MDLs and RLs or Test Type for CCCWP SSID Study Dry Season Bedded Sediment Monitoring**		
Analyte	**Analytical Method**	**Method Detection Limit or Test Duration**	**Reporting Limit or Test Type**
Water Quality Parameters			
Dissolved Oxygen	YSI 556 field meter	0.01 mg/L	0 - 50 mg/L
Conductivity	YSI 556 field meter	0.001 mS/cm	0 – 200 mS/cm
pH	YSI 556 field meter	0.01 units	0.00 – 14.00 units
Temperature	YSI 556 field meter	-5 – 45°C	0.1°C
Total Organic Carbon	SM20-5310 B	0.30 mg/kg	1 mg/kg
Percent Solids	EPA 9060	0.5 mg/kg	1 mg/kg
Pyrethroid Pesticides			
Allethrin	EPA 8270Mod (NCI SIM)	0.05 ng/g	0.33 ng/g
Bifenthrin	EPA 8270Mod (NCI SIM)	0.1 ng/g	0.33 ng/g
Cyfluthrin	EPA 8270Mod (NCI SIM)	0.11 ng/g	0.33 ng/g
Cypermethrin	EPA 8270Mod (NCI SIM)	0.1 ng/g	0.33 ng/g
Deltamethrin: Tralomethrin	EPA 8270Mod (NCI SIM)	0.12 ng/g	0.33 ng/g
Esfenvalerate: Fenvalerate	EPA 8270Mod (NCI SIM)	0.13 ng/g	0.33 ng/g
Fenpropathrin	EPA 8270Mod (NCI SIM	0.07 ng/g	0.33 ng/g
Lambda-Cyhalothrin	EPA 8270Mod (NCI SIM)	0.06 ng/g	0.33 ng/g
Tau-Fluvalinate	EPA 8270Mod (NCI SIM)	0.04 ng/g	0.33 ng/g
Tetramethrin	EPA 8270Mod (NCI SIM)	0.06 ng/g	0.33 ng/g
Permethrin	EPA 8270Mod (NCI SIM)	0.11 ng/g	0.33 ng/g

Table 7. Analytical Constituents, Methods, MDLs and RLs or Test Type for CCCWP SSID Study Dry Season Bedded Sediment Monitoring

Analyte	Analytical Method	Method Detection Limit or Test Duration	Reporting Limit or Test Type
Fipronil (Degradates Listed Below)	EPA 8270Mod (NCI SIM)	0.1 ng/g	0.33 ng/g
Fipronil Desulfinyl	EPA 8270Mod (NCI SIM)	0.1 ng/g	0.33 ng/g
Fipronil Sulfide	EPA 8270Mod (NCI SIM)	0.1 ng/g	0.33 ng/g
Fipronil Sulfone	EPA 8270Mod (NCI SIM)	0.1 ng/g	0.33 ng/g
Organochlorine Pesticides[1]			
Aldrin	EPA 8081	0.9 ng/g	2 ng/g
alpha-HCH	EPA 8081	0.9 ng/g	2 ng/g
beta-HCH	EPA 8081	0.9 ng/g	2 ng/g
delta-HHC	EPA 8081	0.7 ng/g	2 ng/g
gamma-HCH	EPA 8081	0.7 ng/g	2 ng/g
cis-Chlordane	EPA 8081	1 ng/g	2 ng/g
trans-Chlordane	EPA 8081	1 ng/g	2 ng/g
4,4'-DDD	EPA 8081	0.8 ng/g	2 ng/g
2, 4'-DDD	EPA 8081	2 ng/g	2 ng/g
4,4'-DDE	EPA 8081	1.2 ng/g	2 ng/g
2, 4'-DDE	EPA 8081	2 ng/g	2 ng/g
4,4'-DDT	EPA 8081	1 ng/g	2 ng/g
2, 4'-DDT	EPA 8081	2 ng/g	2 ng/g
Dieldrin	EPA 8081	1.2 ng/g	2 ng/g
Endosulfan I	EPA 8081	0.9 ng/g	2 ng/g
Endosulfan II	EPA 8081	0.7 ng/g	10 ng/g
Endosulfan sulfate	EPA 8081	0.9 ng/g	10 ng/g
Endrin	EPA 8081	1 ng/g	2 ng/g
Endrin aldehyde	EPA 8081	0.9 ng/g	2 ng/g
Endrin ketone	EPA 8081	0.9 ng/g	2 ng/g
Heptachlor	EPA 8081	0.6 ng/g	2 ng/g
Heptachlorepoxide	EPA 8081	1.1 ng/g	2 ng/g
Methoxychlor	EPA 8081	0.9 ng/g	2 ng/g
Toxaphene	EPA 8081	20 ng/g	40 ng/g
Mirex	EPA 8081	0.5 ng/g	20 ng/g
Sediment Toxicity	EPA/600/R-99/064	10-day	Survival

Explanation:

[1] Does not include all analytes listed in Storm Water Ambient Monitoring Program QAPP (SWAMP 2008)
mg/kg = Milligram per kilogram
ng/g = Nanogram per gram

4.3 Reference Toxicant Tests

Per the RMC Creek Status Monitoring Program QAPP (EOA et al., 2012), reference toxicant tests:

> *… must be conducted monthly for species that are raised within a laboratory. Reference Toxicant Tests must be conducted per analytical batch for species from commercial supplier settings. Reference Toxicant Tests must be conducted concurrently for test species or broodstocks that are field collected.*

H. azteca are purchased by Pacific EcoRisk (PER) from commercial suppliers and therefore require reference toxicant tests per analytical batch.

4.4 Toxicity Identification Evaluations

One targeted toxicity identification evaluation (TIE) was performed at Pacific EcoRisk laboratory on a toxic sample for each matrix: water (wet weather) and sediment (dry weather). TIEs were conducted upon discovery of statistically-significant toxicity in water and sediment samples. For the water sample, the targeted TIE included testing of the Baseline Sample (100%), a PBO Treatment (in both 50% dilution and 100% sample) with sample spiking, a Carboxylesterase Treatment (100% sample) with sample spiking, and a Bovine Serum Albumin (BSA) Treatment (100% sample) with sample spiking. For the sediment sample, the targeted TIE included testing of the Baseline Sample (100%), an aeration control sample, a PBO Treatment (100% sample) with sample spiking, and a Carboxylesterase Treatment (100% sample) with sample spiking.

5.0 Data Quality Objectives and Quality Assurance / Quality Control

The data quality objective (DQO) process is implemented through a Quality Assurance/Quality Control (QA/QC) program. The elements of the QA/QC program including required levels of precision and accuracy, and tolerable levels of error are presented in detail in the RMC QAPP (EOA et al., 2012).

A summary of the QA/QC results for the 2014 SSID monitoring is provided in Appendix F.

6.0 Results

Summaries of the chemistry results for detected chemical constituents and toxicity testing results are provided in Table 8 for water samples and Table 9 for sediment samples. The full tables of analytes are provided in Appendix G, and laboratory reports are provided in Appendix H. Field measurements are summarized in Appendix I.

Because the effects of pyrethroid pesticides in sediments have been shown to be mitigated by the presence of organic carbon in the sediment, the Pyrethroid results are also shown normalized per gram of organic carbon, as µg/g of organic carbon.

Table 8. Results for Detected Constituents, Wet Weather Water Samples

	Dry Creek Upstream 544MSHO65		Dry Creek Downstream 544MSHO62		Tributary of Grayson Creek Upstream 207WAL078		East Branch of Grayson Creek Downstream 207WAL060		Mean Concentration[4]
	Sample Collection Date								
	02/06/14	02/28/14	02/06/14	02/28/14	02/28/14	03/26/14	02/28/14	03/26/14	
Fipronil and Degradates (ng/L)									
Fipronil	6.2	4.5	ND	4.3	19	15	23	12	11
Fipronil Desulfinyl	2.2	2.2	ND	1.9	2.9	6.5	2.2	3.5	2.7
Fipronil Sulfide	0.5[J]	ND	ND	ND	1.3[J]	1.4[J]	1.6	2.6	1.0
Fipronil Sulfone	3.8	5.5	0.8[J]	5.2	14	11	9.5	6.8	7.1
Organochlorine Pesticides (µg/L)									
None detected									
Pyrethroid Pesticides (ng/L)									
Bifenthrin	5.3	8.5	5.9	8.6	7.3	11	6.5	4.2	7.2
Cyfluthrin	0.7[J]	1.5[J]	0.7[J]	1.7	ND	1.1[J]	6.4	0.9[J]	1.6
Cypermethrin	ND	ND	ND	ND	ND	ND	ND	0.7[J]	0.19
Deltamethrin: Tralomethrin	ND	ND	ND	ND	4.7	ND	ND	ND	.70
Lambda-Cyhalothrin	0.386[BJ]	ND	0.394[BJ]	ND	ND	1.1[J]	ND	ND	0.31
Permethrin	ND	ND	ND	ND	ND	ND	ND	12[J]	1.6
Suspended Sediment Conc. (mg/L)	7.5	13	9.4	37	37	13	173	14	38
Total Organic Carbon (mg/L)	16	14	15	15	11	11	10	13	13
Hyalella Toxicity									
Average Percent Survival[1]	12	6	18[2]	18	48	0[3]	48	0[3]	

Explanation:

ND Non-detect; indicates analytical result has not been detected

J Reflects estimated analytical result value detected below the Reporting Limit (RL) and above the Method Detecting Limit (MDL). The J flag is equivalent to the DNQ Estimated Concentration flag.

B Indicates the analyte has been detected in the blank associated with the sample.

[1] All results significantly lower than control samples averages. Samples deemed toxic are shaded.

[2] TIE indicated that toxicity was persistent; results are consistent with Type I and Type II pyrethroids.

[3] Complete mortality after 48 hours.

[4] Mean concentration calculated by substituting 1/2 MDL for ND data points.

Table 9. Results for Detected Constituents, Dry Weather Sediment Samples

	Dry Creek Upstream 544MSH065	Dry Creek Downstream 544MSH062	Tributary of Grayson Creek Upstream 207WAL078	East Branch of Grayson Creek Downstream 207WAL060	Mean Concentration[4]
	Sample Collection Date				
	07/22/14	07/22/14	07/22/14	07/22/14	
Fipronil and Degradates (µg/kg)					
Fipronil Desulfinyl	0.56	0.27[J]	ND	ND	0.24
Fipronil Sulfone	3	ND	ND	0.14[J]	0.81
Organochlorine pesticides (mg/kg)					
2,4'-DDD	0.012	0.034	ND	ND	0.012
2,4'-DDE	0.0058	0.019	ND	ND	0.0068
4,4'-DDD	0.0036	0.023	ND	ND	0.0069
4,4'-DDE	0.028	0.076	ND	ND	0.026
Pyrethroid pesticides (µg/kg)					
Bifenthrin	99	40	5.6	3.6	37
Cyfluthrin	6.2	3.4	0.8	0.41	2.7
Cypermethrin	0.30[J]	0.35	0.28[J]	0.21[J]	0.29
Lambda-Cyhalothrin	0.37	0.24[J]	ND	ND	0.17
Permethrin	6	9.4	1.9	2.3	4.9
Total Organic Carbon (%)	4.6	1.9	3.6	1	2.8
Pyrethroid pesticides (µg/g organic carbon)					
Bifenthrin	2.2	2.1	0.16	0.36	1.2
Cyfluthrin	0.13	0.18	0.022	0.041	0.094
Cypermethrin	0.0065	0.018	0.0078	0.021	0.013
Lambda-Cyhalothrin	0.0080	0.013	ND	ND	0.0062
Permethrin	0.13	0.49	0.053	0.23	0.23
Hyalella Toxicity					
Average Percent Survival	3.75 [1,3]	48.8 [1]	97.1 [2]	90 [2]	
Average Weight (mg/individual)	0.00625 [1]	0.0352 [1]	0.0699 [2]	0.0875	

Explanation:

ND Non-detect; indicates analytical result has not been detected

J Estimated analytical result value detected below the Reporting Limit (RL) and above the Method Detecting Limit (MDL). The J flag is equivalent to the DNQ Estimated Concentration flag.

[1] Result was significantly lower than control sample average. Samples deemed toxic are shaded.

[2] Result was significantly higher than control sample average.

[3] TIE indicated baseline toxicity was persistent; addition of PBO increased toxicity; addition of carboxylesterase removed most of toxicity. Weight of evidence suggests toxicity was likely due to pyrethroid pesticides.

[4] Mean concentration calculated by substituting 1/2 MDL for ND data points.

7.0 Data Analysis

As hypothesized in the SSID Conceptual Work Plan (Appendix D), current-use pesticides were commonly detected in both water and sediment samples of both creeks:

- Fipronil and three of its common degradate compounds were detected in most of the water samples
- Six pyrethroids were detected at least once in the set of eight water samples; bifenthrin (8 of 8 samples) and cyfluthrin (7 of 8 samples) were detected in nearly all of the samples.
- Two fipronil degradates were detected, each in two of the four sediment samples.
- Four pyrethroids (bifenthrin, cyfluthrin, cypermethrin, and permethrin) were detected in all four of the sediment samples.
- Four DDT breakdown products were detected in both the upstream and downstream sediment samples from Dry Creek.

Toxicity was observed to the test species *Hyalella azteca* in all eight of the water samples, and in both of the Dry Creek sediment samples. Toxicity testing results for the Grayson Creek sediment samples were anomalous.

The concentrations of pyrethroid pesticides measured were sufficient to account for the toxicity observed in all eight toxic water samples and the two (Dry Creek) toxic sediment samples (see detail below and in Appendix J).

TIE analyses performed on one toxic wet weather water sample and one toxic dry weather sediment sample provided evidentiary support for the idea that pyrethroid pesticides were likely to be the principal cause of the observed toxicity in both water and sediment samples.

7.1 Spatial and Temporal Analysis

The NPDES permits (Attachment H/MRP, Attachment D/Central Valley Permit) require the Permittees to further investigate sediment quality/toxicity issues and “Identify cause(s) of impacts and spatial extent.” The water and sediment quality data were both evaluated for potential evidence of spatial differences. Because there were three wet weather aquatic monitoring events (two per site), it is also possible to investigate to a limited degree the temporal variability in the water chemistry data. Wet weather water quality and dry weather sediment quality are discussed separately below.

7.1.1 Water Quality

Table 10 shows the results of spatial and temporal comparisons for the water chemistry data. Given that the comparisons involved sample sizes (“n”) consisting of from two to four data points, these data are not sufficiently numerous to permit statistical analysis, and the analysis should be considered to provide only indications of possible differences or trends.

Across the board, pesticide concentrations were higher on average in Grayson Creek than in Dry Creek. Suspended sediment concentrations also were substantially higher on average in Grayson Creek, indicating that flows, streambed scour, and sediment mobilization may have been higher in Grayson Creek, leading to higher water column pollutant concentrations.

No clear or consistent patterns are observed in either the upstream/downstream spatial comparisons, or the three-event temporal comparisons for the 2014 SSID study water quality data.

Table 10. Spatial and Temporal Analysis of Wet Weather Water Quality Data

	Dry Creek (mean)	Grayson Creek (mean)	Upstream (mean)	Downstream (mean)	02/06/14 (mean)	02/28/14 (mean)	03/26/14 (mean)
	n=4	n=4	n=4	n=4	n=2	n=4	n=2
Fipronil and Degradates (ng/L)							
Fipronil	3.8	17	11	10	3.2	13	14
Fipronil Desulfinyl	1.6	3.8	3.5	2.0	1.2	2.3	5.0
Fipronil Sulfide	0.3	1.7	0.9	1.2	0.38	0.85	2.0
Fipronil Sulfone	3.8	10	8.6	5.6	2.3	8.6	8.9
Pyrethroid pesticides (ng/L)							
Bifenthrin	7.1	7.3	8.0	6.3	5.6	7.7	7.6
Cyfluthrin	1.2	2.1	0.85	2.4	0.70	2.4	1.0
Cypermethrin	0.10	0.28	0.13	0.25	0.10	0.10	0.45
Deltamethrin:Tralomethrin	0.10	1.3	1.3	0.13	0.10	1.3	0.20
Lambda-Cyhalothrin	0.25	0.38	0.42	0.20	0.39	0.10	0.65
Permethrin	0.10	3.1	0.13	3.1	0.10	0.10	6.1
Suspended Sediment Conc. (mg/L)	17	59	18	58	8.5	65	14
Total Organic Carbon (mg/L)	15	11	13	13	16	13	12

Mean concentrations were calculated by substituting 1/2 MDL for ND data points.

For the wet weather (water matrix) toxicity testing results, as shown in Table 8, there are no clear or consistent patterns in comparisons of Dry Creek vs. Grayson Creek watersheds, upstream vs. downstream sites, or in comparisons of results for the three monitored events. The Grayson Creek samples collected on 3/26/2014 exhibited the highest degree of toxicity, with 0% survival (complete mortality to all test organisms) within three days.

7.1.2 Sediment Quality

For the sediment data, there was only one dry-weather monitoring event during 2014, and therefore limited data analysis can be performed. Visual inspection of the results shown in Table 8 provides no clear indication of substantial or consistent differences between upstream and downstream sites on either of the two creeks studied.

7.1.2.1 DDT Metabolites

However, there are notable differences in the sediment chemistry between the two creek watersheds, principally with respect to detections of four DDT metabolites (breakdown products): 2,4'-DDD, 2,4'-DDE, 4,4'-DDD, and 4,4'-DDE. These four compounds were detected in both the upstream and downstream samples from Dry Creek, and there were no detections in the Grayson Creek watershed samples. Use of DDT, an organochlorine pesticide, has been banned in the United States for over 40 years, but as a persistent organic pollutant, DDT and its breakdown products tend to persist in sediments near areas of prior use. For all four detected compounds, the concentrations were substantially higher in the Dry Creek downstream samples vs. upstream samples.

7.2 Toxic Unit Equivalents

Pyrethroid pesticides are generally toxic to the most sensitive aquatic arthropods (including *H. azteca*) at extremely low levels – generally at concentrations in the single-digit (or lower) nanograms per liter (ng/L) (parts per trillion) range. Toxicity studies typically identify the LC50, the concentration that is lethal on average to 50% of the test organisms, and/or the EC50, the concentration at which a sub-lethal effect is observed on average to 50% of the test organisms.

Chemical mixtures are often evaluated with respect to their potential to cause toxicity by determination of the toxic unit (TU) equivalents for specific compounds. One TU equivalent is the amount of a specific compound expected to produce a toxic effect in a specific organism in a specific matrix (water or sediment). The TU equivalents for known contaminants in a given sample are typically then summed to provide a TU equivalent sum for the sample. This is often done for a specific class of contaminants, such as pyrethroid pesticides, where there may exist toxicological data indicating the toxic levels of the specific contaminants as derived in laboratory studies.

The published water and sediment toxicity *H. azteca* LC50 values (see Ruby, 2013) were used for comparisons to the measured SSID Part A pyrethroids data and to calculate TU equivalents for those pyrethroids for which published LC50 values are available, based on detected pyrethroid concentrations.

USEPA has not developed recommended water quality criteria for the protection of aquatic life for pyrethroids (or for many other current-use pesticides, including fipronil), as it has for other common water pollutants. Therefore other, non-regulatory data are used as comparison values to evaluate the data compiled for this report and calculate TU equivalents. The available comparison values include water quality criteria values developed by UC Davis, as well as USEPA Aquatic Life Benchmark values (see Ruby, 2013 for discussion of available comparison values). For Lambda-Cyhalothrin, the UC Davis acute water column criterion was used, and for Deltamethrin:Tralomethrin, the average of the deltamethrin and tralomethrin USEPA benchmarks was used, due to lack of published water column *H. azteca* LC50s for those compounds.

As sediment toxicity to *H. azteca* is mitigated by the presence of organic carbon in the sediments, the literature sediment LC50s are derived as pyrethroid concentration per unit organic carbon (µg/g organic carbon). The raw pyrethroid sediment concentrations were therefore converted to those units (µg/g organic carbon) prior to computation of the TU equivalents for the sediment samples.

Because pyrethroid toxicity is generally considered to be additive (c.f., Trimble et al., 2009), the actual in-situ toxicity estimated from chemistry results must account for the mixtures of pyrethroids and other pesticides found.

The toxic unit equivalents attributable to each detected pyrethroid pesticide and the sums of the calculated TU equivalents for each sample for the detected pyrethroids are shown in Table 11 for the water samples and Table 12 for sediment samples.

When the TU equivalents are summed, each of the toxic water and sediment samples exhibit a sum of TU equivalents greater than 1.0, indicating that the measured pyrethroid concentrations were sufficient to cause the toxicity observed. It is notable that the two sediment samples from Grayson Creek watershed were the only samples with pyrethroid TU equivalents less than 1.0, and those were also the only two samples that were not acutely toxic to *H. azteca*.

Table 11. Calculation of Pyrethroid Toxic Unit Equivalents for Wet Weather Water Quality Data

	LC50 or Other Criterion* (ng/L)	Dry Creek Upstream 544MSH065		Dry Creek Downstream 544MSH062		Tributary of Grayson Creek Upstream 207WAL078		East Branch of Grayson Creek Downstream 207WAL060	
		Sample Collection Date							
		02/6/14	**02/28/14**	**02/06/14**	**02/28/14**	**02/28/14**	**03/26/14**	**02/28/14**	**03/26/14**
Pyrethroid Pesticides: TU Equivalents									
Bifenthrin	7.5	0.7	1.1	0.8	1.1	1.0	1.5	0.9	0.6
Cyfluthrin	2.4	0.3	0.6	0.3	0.7		0.5	2.7	0.4
Cypermethrin	2.5								0.3
Deltamethrin:Tralomethrin	4.3					1.1			
Lambda-Cyhalothrin	1.0	0.4		0.4			1.1		0.2
Permethrin	21.1								0.6
Sum (Pyrethroid TUs)		**1.4**	**1.8**	**1.5**	**1.9**	**2.1**	**3.0**	**3.5**	**2.0**

* Toxic Unit Equivalents (TUs) are calculated as ratios of measured pyrethroid concentrations to literature *Hyalella azteca* LC50 values, except for Lambda-Cyhalothrin, for which the UC Davis acute criterion was used, and Deltamethrin:Tralomethrin, for which the average of the deltamethrin and tralomethrin USEPA benchmarks were used, due to lack of published water column *Hyalella azteca* LC50s for those compounds. See: http://www.tdcenvironmental.com/resources/Pyrethroids-Aquatic-Tox-Summary.pdf for associated references.

Calculations are based on detected pyrethroids only.

Values in **Bold** indicate TU equivalent sum is greater than 1.0.

Table 12. Calculation of Pyrethroid Toxic Unit Equivalents for Dry Weather Sediment Quality Data

	LC50 (µg/g organic carbon)	Dry Creek Upstream 544MSH065	Dry Creek Downstream 544MSH062	Tributary of Grayson Creek Upstream 207WAL078	E. Branch of Grayson Creek Downstream 207WAL060
		Sample Collection Date			
		07/22/14	07/22/14	07/22/14	07/22/14
Pyrethroid Pesticides: TU Equivalents					
Bifenthrin	0.52	4.1	4.0	0.30	0.69
Cyfluthrin	1.08	0.12	0.17	0.021	0.038
Cypermethrin	0.38	0.017	0.048	0.020	0.055
Lambda-Cyhalothrin	0.45	0.018	0.028	0.002	0.007
Permethrin	10.83	0.012	0.046	0.005	0.021
Sum (Pyrethroid TUs)		**4.3**	**4.3**	0.3	0.8

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.

Calculations are based on detected pyrethroids only.

Values in **Bold** indicate TU equivalent sum is greater than 1.0

7.3 Toxicity Identification Evaluations (TIEs)

The results of the TIEs for both water and sediment samples indicated that the most likely causes of the observed water and sediment toxicity are pyrethroid pesticides. The full TIE laboratory reports are included in Appendix J.

For the water sample TIE testing, the addition of PBO (a pyrethroid synergist) substantially increased the toxicity of the samples, the addition of carboxylesterase, which reduces pyrethroid toxicity, removed the statistically significant toxicity, and BSA, which has less effect on pyrethroids, had a minor effect on the measured toxicity levels. For the sediment TIE testing, the addition of PBO (a pyrethroid synergist) increased the toxicity of the samples, and the addition of carboxylesterase, which reduces pyrethroid toxicity, removed the statistically significant toxicity.

Taken together with the chemistry results and the toxic unit equivalents calculations as described above, the TIE test results confirm that pyrethroid pesticides are the most likely causes of the observed toxicity in the 2014 SSID water and sediment samples.

8.0 Conclusions

The analysis of data generated in the monitoring study conducted for Part A of the CCCWP SSID study provided the following conclusions:

- Current-use pesticides were commonly detected in both water and sediment samples of both creeks, including fipronil and its common degradate compounds, as well as several pyrethroid pesticides.
- Four DDT breakdown products (variants of DDE and DDD) were detected in both the upstream and downstream sediment samples from Dry Creek.
- Toxicity was observed to the test species *Hyalella azteca* in all eight of the 2014 SSID Study water samples (upstream and downstream samples for two wet weather events in both Dry Creek and Grayson Creek watersheds), and in both of the Dry Creek sediment samples. Toxicity testing results for the Grayson Creek sediment samples were anomalous.
- The concentrations of pyrethroid pesticides measured were sufficient to account for the toxicity observed in all eight toxic water samples (upstream and downstream samples for two wet weather events in both Dry Creek and Grayson Creek watersheds) and the two (Dry Creek) toxic sediment samples.
- TIE analyses performed on one toxic wet weather water sample and one toxic dry weather sediment sample provided evidentiary support for the idea that pyrethroid pesticides were likely to be the principal cause of the observed toxicity in both water and sediment samples.

9.0 References

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Appendix A. Permit Provision C.8.d.i., Monitoring Projects (Stressor/Source Identification)

v. Status Monitoring Results – When Status Monitoring produces results such as those described in the final column of Table 8.1, Permittees shall conduct Monitoring Project(s) as described in C.8.d.i.

C.8.d. Monitoring Projects – Permittees shall conduct the Monitoring Projects listed below.

i. Stressor/Source Identification – When Status results trigger a follow-up action as indicated in Table 8.1, Permittees shall take the following actions, as also required by Provision C.1. If the trigger stressor or source is already known, proceed directly to step 2. The first follow-up action shall be initiated as soon as possible, and no later than the second fiscal year after the sampling event that triggered the Monitoring Project.

(1) Conduct a site specific study (or non-site specific if the problem is wide-spread) in a stepwise process to identify and isolate the cause(s) of the trigger stressor/source. This study should follow guidance for Toxicity Reduction Evaluations (TRE)[40] or Toxicity Identification Evaluations (TIE).[41] A TRE, as adapted for urban stormwater data, allows Permittees to use other sources of information (such as industrial facility stormwater monitoring reports) in attempting to determine the trigger cause, potentially eliminating the need for a TIE. If a TRE does not result in identification of the stressor/source, Permittees shall conduct a TIE.

(2) Identify and evaluate the effectiveness of options for controlling the cause(s) of the trigger stressor/source.

(3) Implement one or more controls.

(4) Confirm the reduction of the cause(s) of trigger stressor/source.

(5) Stressor/Source Identification Project Cap: Permittees who conduct this monitoring through a regional collaborative shall be required to initiate no more than ten Stressor/Source Identification projects during the Permit term in total, and at least two must be toxicity follow-ups, unless monitoring results do not indicate the presence of toxicity. If conducted through a stormwater countywide program, the Santa Clara and Alameda

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[40] USEPA. August 1999. *Toxicity Reduction Evaluation Guidance for Municipal Wastewater Treatment Plants*. EPA/833B-99/002. Office of Wastewater Management, Washington, D.C.

[41] Select TIE methods from the following references after conferring with SWAMP personnel: For sediment: (1) Ho KT, Burgess R., Mount D, Norberg-King T, Hockett, RS. 2007. *Sediment toxicity identification evaluation: interstitial and whole methods for freshwater and marine sediments*. USEPA, Atlantic Ecology Division/Mid-Continental Ecology Division, Office of Research and Development, Narragansett, RI, or (2) Anderson, BS, Hunt, JW, Phillips, BM, Tjeerdema, RS. 2007. *Navigating the TMDL Process: Sediment Toxicity*. Final Report- 02-WSM-2. Water Environment Research Federation. 181 pp. For water column: (1) USEPA. 1991. *Methods for aquatic toxicity identification evaluations. Phase I Toxicity Characterization Procedures.* EPA 600/6-91/003. Office of Research and Development, Washington, DC., (2) USEPA. 1993. *Methods for aquatic toxicity identification evaluations. Phase II Toxicity Identification Procedures for Samples Exhibiting Acute and Chronic Toxicity*. EPA 600/R-92/080. Office of Research and Development, Washington, DC., or (3) USEPA. 1996. *Marine Toxicity Identification Evaluation (TIE), Phase I Guidance Document.* EPA/600/R-95/054. Office of Research and Development, Washington, DC.

Permittees each shall be required to initiate no more than five (two for toxicity); the Contra Costa and San Mateo Permittees each shall be required to initiate no more than three (one for toxicity); and the Fairfield-Suisun and Vallejo Permittees each shall be required to initiate no more than one Stressor/Source Identification project(s) during the Permit term.

(6) As long as Permittees have complied with the procedures set forth above, they do not have to repeat the same procedure for continuing or recurring exceedances of the same receiving water limitations unless directed to do so by the Water Board.

ii. BMP Effectiveness Investigation – Investigate the effectiveness of one BMP for stormwater treatment or hydrograph modification control. Permittees who do this project through a regional collaborative are required to initiate no more than one BMP Effectiveness Investigation during the Permit term. If conducted through a stormwater countywide program, the Santa Clara, Alameda, Contra Costa, and San Mateo Permittees shall be required to initiate one BMP Effectiveness Investigation each, and the Fairfield-Suisun and Vallejo Permittees shall be exempt from this requirement. The BMP(s) used to fulfill requirements of C.3.b.iii., C.11.e. and C.12.e. may be used to fulfill this requirement, provided the BMP Effectiveness Investigation includes the range of pollutants generally found in urban runoff. The BMP Effectiveness Investigation will not trigger a Stressor/Source Identification Project. Data from this Monitoring Project need not be SWAMP-comparable.

iii. Geomorphic Project – This monitoring is intended to answer the questions: How and where can our creeks be restored or protected to cost-effectively reduce the impacts of pollutants, increased flow rates, and increased flow durations of urban runoff?

Permittees shall select a waterbody/reach, preferably one that contains significant fish and wildlife resources, and conduct one of the following projects within each county, except that only one such project must be completed within the collective Fairfield-Suisun and Vallejo Permittees' jurisdictions:

(1) Gather geomorphic data to support the efforts of a local watershed partnership[42] to improve creek conditions; or

(2) Inventory locations for potential retrofit projects in which decentralized, landscape-based stormwater retention units can be installed; or

(3) Conduct a geomorphic study which will help in development of regional curves which help estimate equilibrium channel conditions for different-sized drainages. Select a waterbody/reach that is not undergoing changing land use. Collect and report the following data:

- Formally surveyed channel dimensions (profile), planform, and cross-sections. Cross-sections shall include the topmost floodplain terrace and

[42] A list of local watershed partnerships may be obtained from Water Board staff.

iv. Status Monitoring Location – One location in Marsh Creek (Marsh Creek Reservoir to San Joaquin River, partly in Delta Waterways, western portion)

v. Status Monitoring Results – When Status Monitoring produces results such as those described in the final column of Table 8.1, Permittees shall conduct Monitoring Project(s) as described in C.8.c.i.

C.8.d. Monitoring Projects – Permittees shall conduct the Monitoring Projects listed below.

i. **Stressor/Source Identification** – When Status results trigger a follow-up action as indicated in Table 8.1, Permittees shall take the following actions, as also required by Provision C.1. If the trigger stressor or source is already known, proceed directly to step 2. The first follow-up action shall be initiated as soon as possible, and no later than the second fiscal year after the sampling event that triggered the Monitoring Project.

(1) Conduct a site specific study (or non-site specific if the problem is wide-spread) in a stepwise process to identify and isolate the cause(s) of the trigger stressor/source. This study should follow guidance for Toxicity Reduction Evaluations (TRE)[39] or Toxicity Identification Evaluations (TIE).[40] A TRE, as adapted for urban stormwater data, allows Permittees to use other sources of information (such as industrial facility stormwater monitoring reports) in attempting to determine the trigger cause, potentially eliminating the need for a TIE. If a TRE does not result in identification of the stressor/source, Permittees shall conduct a TIE.

(2) Identify and evaluate the effectiveness of options for controlling the cause(s) of the trigger stressor/source.

(3) Implement one or more controls.

(4) Confirm the reduction of the cause(s) of trigger stressor/source.

(5) Stressor/Source Identification Project Cap: Permittees who conduct this monitoring through a regional collaborative shall be required to initiate no

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[39] USEPA. August 1999. *Toxicity Reduction Evaluation Guidance for Municipal Wastewater Treatment Plants*. EPA/833B-99/002. Office of Wastewater Management, Washington, D.C.

[40] Select TIE methods from the following references after conferring with SWAMP personnel: For sediment: (1) Ho KT, Burgess R., Mount D, Norberg-King T, Hockett, RS. 2007. *Sediment toxicity identification evaluation: interstitial and whole methods for freshwater and marine sediments*. USEPA, Atlantic Ecology Division/Mid-Continental Ecology Division, Office of Research and Development, Narragansett, RI, or (2) Anderson, BS, Hunt, JW, Phillips, BM, Tjeerdema, RS. 2007. *Navigating the TMDL Process: Sediment Toxicity*. Final Report- 02-WSM-2. Water Environment Research Federation. 181 pp. For water column: (1) USEPA. 1991. *Methods for aquatic toxicity identification evaluations. Phase I Toxicity Characterization Procedures.* EPA 600/6-91/003. Office of Research and Development, Washington, DC., (2) USEPA. 1993. *Methods for aquatic toxicity identification evaluations. Phase II Toxicity Identification Procedures for Samples Exhibiting Acute and Chronic Toxicity*. EPA 600/R-92/080. Office of Research and Development, Washington, DC., or (3) USEPA. 1996. *Marine Toxicity Identification Evaluation (TIE), Phase I Guidance Document.* EPA/600/R-95/054. Office of Research and Development, Washington, DC.

more than one Stressor/Source Identification project during the Permit term.

(6) As long as Permittees have complied with the procedures set forth above, they do not have to repeat the same procedure for continuing or recurring exceedances of the same receiving water limitations unless directed to do so by the Central Valley Water Board.

ii. BMP Effectiveness Investigation – Investigate the effectiveness of one BMP for stormwater treatment or hydrograph modification control. Permittees who do this project through a regional collaborative are required to initiate no more than one BMP Effectiveness Investigation during the Permit term. If conducted through a stormwater countywide program, the East Contra Costa Permittees in the Central Valley Water Board Region shall be required to participate in one BMP Effectiveness Investigation. The BMP(s) used to fulfill requirements of C.3.b.iii. (Green Street Pilot Project) may be used to fulfill this requirement, provided the BMP Effectiveness Investigation includes the range of pollutants generally found in urban runoff. The BMP Effectiveness Investigation will not trigger a Stressor/Source Identification Project. Data from this Monitoring Project need not be SWAMP-comparable.

iii. Geomorphic Project – This monitoring is intended to answer the questions: How and where can our creeks be restored or protected to cost-effectively reduce the impacts of pollutants, increased flow rates, and increased flow durations of urban runoff?

Permittees shall select a waterbody/reach, preferably one that contains significant fish and wildlife resources, and conduct one of the following projects within the county:

(1) Gather geomorphic data to support the efforts of a local watershed partnership[41] to improve creek conditions; or

(2) Inventory locations for potential retrofit projects in which decentralized, landscape-based stormwater retention units can be installed; or

(3) Conduct a geomorphic study which will help in development of regional curves which help estimate equilibrium channel conditions for different-sized drainages. Select a waterbody/reach that is not undergoing changing land use. Collect and report the following data:

- Formally surveyed channel dimensions (profile), planform, and cross-sections. Cross-sections shall include the topmost floodplain terrace and be marked by a permanent, protruding (not flush with ground) monument.
- Contributing drainage area.
- Best available information on bankfull discharges and width and depth of channel formed by bankfull discharges.

[41] A list of local watershed partnerships may be obtained from Central Valley Water Board staff.

Appendix B. Permit Attachment H/D: Status and Long-Term Monitoring Follow-Up Analysis and Actions for Biological Assessment, Bedded Sediment Toxicity, and Bedded Sediment Pollutants

ATTACHMENT H

Provision C.8.
Status and Long-Term Monitoring
Follow-up Analysis and Actions

Status and Long-Term Monitoring Follow-up Analysis and Actions for Biological Assessment, Bedded Sediment Toxicity, and Bedded Sediment Pollutants

When results from Biological Assessment, Bedded Sediment Toxicity, and/or Bedded Sediment Pollutants monitoring indicate impacts at a monitoring location, Permittees shall evaluate the extent and cause(s) of impacts to determine the potential role of urban runoff as indicated in Table H-1.

Table H-1. Sediment Triad Approach to Determining Follow-Up Actions

Chemistry Results[161]	Toxicity Results[162]	Bioassessment Results[163]	Action
No chemicals exceed Threshold Effect Concentrations (TEC), mean Probable Effects Concentrations (PEC) quotient < 0.5 and pyrethroids < 1.0 Toxicity Unit (TU)[164]	No Toxicity	No indications of alterations	No action necessary
No chemicals exceed TECs, mean PEC quotient < 0.5 and pyrethroids< 1.0 TU	Toxicity	No indications of alterations	(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 causing toxicity; initiate no later than the second fiscal year following the sampling event.

161 TEC and PEC are found in MacDonald, D.D., G.G. Ingersoll, and T.A. Berger. 2000. Development and Evaluation of Consensus-based Sediment Quality Guidelines for Freshwater Ecosystems. *Archives of Environ. Contamination and Toxicology* 39(1):20–31.

162 Toxicity is exhibited when *Hyallela* survival statistically different than and < 20 percent of control.

163 Alterations are exhibited if metrics indicate substantially degraded community.

164 Toxicity Units (TU) are calculated as follows: TU = Actual concentration (organic carbon normalized) ÷ Reported *H. azteca* LC_{50} concentration (organic concentration normalized). Weston, D.P., R.W. Holmes, J. You, and M.J. Lydy, 2005. Aquatic Toxicity Due to Residential Use of Pyrethroid Insecticides. *Environ. Science and Technology* 39(24):9778–9784.

Chemistry Results[161]	Toxicity Results[162]	Bioassessment Results[163]	Action
No chemicals exceed TECs, mean PEC quotient < 0.5 and pyrethroids< 1.0 TU	No Toxicity	Indications of alterations	Identify the most probable cause(s) of the alterations in biological community. Where impacts are under Permittee's control, take management actions to minimize the impacts causing physical habitat disturbance; initiate no later than the second fiscal year following the sampling event.
No chemicals exceed TECs, mean PEC quotient < 0.5 and pyrethroids< 1.0 TU	Toxicity	Indications of alterations	(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.
3 or more chemicals exceed PECs, the mean PEC quotient is > 0.5, or pyrethroids > 1.0 TU	No Toxicity	Indications of alterations	(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.
3 or more chemicals exceed PECs, the mean PEC quotient is > 0.5, or pyrethroids > 1.0 TU	Toxicity	No indications of alterations	(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; initiate no later than the second fiscal year following the sampling event.
3 or more chemicals exceed PECs, the mean PEC quotient is > 0.5, or pyrethroids > 1.0 TU	No Toxicity	No Indications of alterations	If PEC exceedance is Hg or PCBs, address under TMDLs
3 or more chemicals exceed PECs, the mean PEC quotient is > 0.5, or pyrethroids > 1.0 TU	Toxicity	Indications of alterations	(1) Identify cause(s) of impacts and spatial extent. (2) Where impacts are under Permittee's control, take management actions to address impacts.

ATTACHMENT D

Provision C.8.
Status and Long-Term Monitoring
Follow-up Analysis and Actions

Status and Long-Term Monitoring Follow-up Analysis and Actions for Biological Assessment, Bedded Sediment Toxicity, and Bedded Sediment Pollutants

When results from Biological Assessment, Bedded Sediment Toxicity, and/or Bedded Sediment Pollutants monitoring indicate impacts at a monitoring location, Permittees shall evaluate the extent and cause(s) of impacts to determine the potential role of urban runoff as indicated in Table D-1.

Table D-1. Sediment Triad Approach to Determining Follow-Up Actions

Chemistry Results[113]	Toxicity Results[114]	Bioassessment Results[115]	Action
No chemicals exceed Threshold Effect Concentrations (TEC), mean Probable Effects Concentrations (PEC) quotient < 0.5 and pyrethroids < 1.0 Toxicity Unit (TU)[116]	No Toxicity	No indications of alterations	No action necessary
No chemicals exceed TECs, mean PEC quotient < 0.5 and pyrethroids< 1.0 TU	Toxicity	No indications of alterations	(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 causing toxicity; initiate no later than the second fiscal year following the sampling event.

113 TEC and PEC are found in MacDonald, D.D., G.G. Ingersoll, and T.A. Berger. 2000. Development and Evaluation of Consensus-based Sediment Quality Guidelines for Freshwater Ecosystems. *Archives of Environ. Contamination and Toxicology* 39(1):20–31.

114 Toxicity is exhibited when *Hyallela* survival statistically different than and < 20 percent of control.

115 Alterations are exhibited if metrics indicate substantially degraded community.

116 Toxicity Units (TU) are calculated as follows: TU = Actual concentration (organic carbon normalized) ÷ Reported *H. azteca* LC_{50} concentration (organic concentration normalized). Weston, D.P., R.W. Holmes, J. You, and M.J. Lydy, 2005. Aquatic Toxicity Due to Residential Use of Pyrethroid Insecticides. *Environ. Science and Technology* 39(24):9778–9784.

Chemistry Results[113]	Toxicity Results[114]	Bioassessment Results[115]	Action
No chemicals exceed TECs, mean PEC quotient < 0.5 and pyrethroids< 1.0 TU	No Toxicity	Indications of alterations	Identify the most probable cause(s) of the alterations in biological community. Where impacts are under Permittee's control, take management actions to minimize the impacts causing physical habitat disturbance; initiate no later than the second fiscal year following the sampling event.
No chemicals exceed TECs, mean PEC quotient < 0.5 and pyrethroids< 1.0 TU	Toxicity	Indications of alterations	(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.
3 or more chemicals exceed PECs, the mean PEC quotient is > 0.5, or pyrethroids > 1.0 TU	No Toxicity	Indications of alterations	(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.
3 or more chemicals exceed PECs, the mean PEC quotient is > 0.5, or pyrethroids > 1.0 TU	Toxicity	No indications of alterations	(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; initiate no later than the second fiscal year following the sampling event.
3 or more chemicals exceed PECs, the mean PEC quotient is > 0.5, or pyrethroids > 1.0 TU	No Toxicity	No Indications of alterations	If PEC exceedance is Hg or PCBs, address under TMDLs
3 or more chemicals exceed PECs, the mean PEC quotient is > 0.5, or pyrethroids > 1.0 TU	Toxicity	Indications of alterations	(1) Identify cause(s) of impacts and spatial extent. (2) Where impacts are under Permittee's control, take management actions to address impacts.

Appendix C. Summary of Creek Status Monitoring in Dry Creek and Grayson Creek, Water Years 2012 and 2013

Samples were collected from Grayson Creek and Dry Creek, sites 207R00011 and 544R00025, respectively, during the Creek Status Monitoring for WY 2012 in Contra Costa County, as part of the RMC regional monitoring. Results relevant to the SSID Part A Study are summarized in the tables below.

The WY 2012 wet weather water samples were both toxic to *H. azteca* (Table C-1)

Table C-1. Comparison between laboratory control and receiving water sample toxicity results *(H. azteca)* for RMC samples collected in WY 2012 wet season, in the context of MRP trigger criteria

County/ Program	Test Initiation Date	Species Tested	Treatment/ Sample ID	10-Day Mean % Survival	Comparison to MRP Table 8.1 Trigger Criteria
CCCWP	3/15/12	*H. azteca*	Lab Control	100	NA
	3/15/12		207R00011 Grayson Creek	**32***	**<50% of Control**
	3/15/12		Lab Control	94	NA
	3/15/12		544R00025 Dry Creek	**0***	**<50% of Control**

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

Because these samples exceeded permit Table 8.1 trigger criteria, re-testing of these samples was required.

For the retests following up on 2012 triggers, samples from both sites were retested with *H. azteca*, the species exhibiting a toxic response, and both sites again showed an acute toxic response (Table C-2). The two samples identified with significant toxicity, 207R00011 and 544R00025, both again met MRP triggers.

Table C-2. Comparison between laboratory control and receiving water sample toxicity results *(H. azteca)* for RMC samples retested in WY 2013 wet season, in the context of MRP trigger criteria

County/ Program	Test Initiation Date (Time)	Species Tested	Treatment/ Sample ID	10-Day Mean % Survival	Comparison to MRP Table 8.1 Trigger Criteria
CCCWP	3/6/13	*H. azteca*	Lab Control	100	NA
	3/6/13		207R00011 Grayson Creek	**4***	**< 50% of control**
	4/4/13		Lab Control	100	NA
	4/4/13		544R00025 Dry Creek	**20***	**< 50% of control**

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

During WY 2012 dry weather monitoring, the sediment samples from both creeks also were toxic to *H. azteca* (Table C-3).

Table C-3. Detailed sediment toxicity results for dry-season samples exhibiting significant toxicity to *H. azteca* for sampling conducted in WY 2012

County/ Program	Test Initiation Date	Treatment/ Sample ID	Mean % Survival	Mean Dry Weight (mg)	Comparison to MRP Tables 8.1 and H-1 Trigger Criteria
CCCWP	7/28/12	Lab Control	96.3	0.23	NA
	7/28/12	207R00011 Grayson Creek	**43.8***	0.09	**More than 20% < Control**
	7/28/12	Lab Control	96.3	0.23	NA
	7/28/12	544R00025 Dry Creek	**60***	0.23	**More than 20% < Control**

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

Pyrethroid toxic unit equivalents were calculated for the WY 2012 dry weather sediment chemistry samples, and both creeks exhibited sum of TU equivalents > 1.0 (Table C-4), indicating likelihood of toxic conditions.

Table C-4. Calculated pyrethroid toxic unit equivalents, 2012 sediment chemistry data

Pyrethroid	LC50 (ng/g dw)	CCCWP 207R00011 Grayson Creek (2012)	CCCWP 544R00025 Dry Creek (2012)
Bifenthrin	0.52	**1.469**	**3.302**
Cyfluthrin	1.08	0.302	0.043
Cypermethrin	0.38	0.163	0.112
Deltamethrin	0.79	0.092	0.064
Esfenvalerate	1.54	0.051	0.036
Lambda-Cyhalothrin	0.45	0.081	0.056
Permethrin	10.83	0.012	0.009
Sum of Toxic Unit Equivalents Per Site		**2.17**	**3.62**

Yellow highlighted cells indicate sites where the sum of pyrethroid TU equivalents is > 1.0
Values in **Bold** indicate individual pyrethroid TUs > 1.0.

The analysis of sediment triad data (bioassessment, sediment chemistry, sediment toxicity) from WY 2012 monitoring indicated that follow-up investigation would be needed (Table C-5).

Table C-5. Summary of sediment quality triad evaluation results, WY 2012 data

Agency/ Program	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
CCCWP	Grayson Creek	207R00011	Very Poor	Yes	10	0.14	2.17	C
CCCWP	Dry Creek	544R00025	Very Poor	Yes	11	0.51	3.62	C

Yellow highlighted cells indicate results above MRP trigger threshold

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 dentify cause and spatial extent.
		(3) Where impacts are under Permittee’s control, take management actions to minimize upstream sources.

Appendix D. CCCWP SSID Study Concept Plan

DRAFT
CONTRA COSTA CLEAN WATER PROGRAM
STRESSOR / SOURCE ID STUDY CONCEPT PLAN

Submitted to:
Contra Costa Clean Water Program
255 Glacier Drive
Martinez, California 94553

Submitted by:

AMEC Environment & Infrastructure, Inc.
San Diego, California

And

Armand Ruby Consulting

May 2013

AMEC Project No. 5025133001

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ACRONYMS AND ABBREVIATIONS

BASMAA	Bay Area Stormwater Management Agencies Association
BMI	Benthic Macroinvertebrate Index
BMP	Best Management Practice
CASQA	California Association of Stormwater Quality Agencies
CCCWP	Contra Costa Clean Water Program
Central Valley Permit	California Regional Water Quality Control Board Central Valley Region, East Contra Costa County Municipal NPDES Permit Waste Discharge Requirements, Order No. R5-2010-0102.
CVRWQCB	California Regional Water Quality Control Board, Central Valley Region
DPR	California Department of Pesticide Regulation
FY	Fiscal Year
IPM	Integrated Pesticide Management
LID	Low Impact Development
MRP	California Regional Water Quality Control Board San Francisco Bay Region Municipal Regional Stormwater NPDES Permit, Order No. R2-2009-0074, adopted October 14, 2009, revised November 28, 2011
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
PEC	Probable Effects Concentration
RMC	Regional Monitoring Coalition
RWQCB	Regional Water Quality Control Board
SFBRWQCB	Regional Water Quality Control Board, San Francisco Bay Region
SSID	Source/Stressor Identification
TEC	Threshold Effect Concentration
TIEs	Toxicity Identification Evaluations
TU	Toxicity Unit
USEPA	United States Environmental Protection Agency

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1.0 PROBLEM STATEMENT

Provision C.8.d.i of the Municipal Regional Permit (MRP), and a parallel provision in the Central Valley Permit, require that when Creek Status Monitoring conducted through Provision C.8.c produces measurements that exceed triggers defined in the respective permits, follow-up actions are required. The follow-up actions may include Stressor / Source ID (SSID) Studies. The MRP establishes a cap on the number of SSID studies, when the monitoring is performed under a regional collaborative, no more than two SSID Studies need to be initiated by CCCWP during the permit term. The Central Valley Permit also caps the SSID studies required of East County permittees (Antioch, Brentwood, Oakley, Unicorporated County, and the Flood Control District) to one such study during the permit term. Both permits allow for and encourage Creek Status Monitoring and SSID studies to be conducted regionally.

CCCWP has participated in a regional collaborative with Bay Area Stormwater Management Agencies (BASMAA) members, known as the Regional Monitoring Coalition (RMC), to design the Creek Status monitoring approach and to select SSID Studies. CCCWP also worked with staff of both the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB) and the Central Valley Regional Water Quality Control Board (CVRWQCB) during permit negotiations to implement coordinated monitoring requirements. As a result, the Creek Status Monitoring conducted through the BASMAA program includes monitoring locations in East County jurisdictions. SSID studies at the two selected sites will fulfill CCCWP's requirement to conduct SSID studies for both permits for the permit term expiring in 2014 (MRP) and 2015 (Central Valley Permit).

The two selected SSID Studies in Contra Costa County are investigations of water and sediment toxicity to the indicator organism *Hyalella azteca* in samples collected from Dry Creek and Grayson Creek. Dry Creek is a tributary to Marsh Creek in eastern Contra Costa County; Grayson Creek is a tributary to Walnut Creek in central Contra Costa County. The evidence for toxicity and other monitoring results that triggered a SSID study is summarized in Table 1. During wet weather, toxicity to *Hyalella azteca* was observed in both Grayson Creek and Dry Creek. Significant toxicity to other test organisms (water fleas, green algae, and fathead minnows) was not observed. During dry weather, significant water column toxicity to *Hyalella Azteca* was not observed, but sediment toxicity was. In lower Marsh Creek, downstream of Dry Creek, wet weather toxicity to *Hyalella azteca* was observed for the two storms monitored during the 2012 monitoring year.

In addition to toxicity, sediment chemistry results and benthic macroinvertebrate index (BMI) scores from the 2012 RMC monitoring make the selected locations favorable locations for the RMC to consider as places to conduct toxicity-related SSID studies. The two locations have the highest concentrations of pollutant chemicals in sediments relative to thresholds of concern compared to all other Bay Area Creek Status locations sampled thus far (Figure 1). Detailed analysis of the data indicates that pyrethroid pesticides are likely, but not confirmed, causes of observed toxicity.

The goals of this SSID study is to determine what are causes of observed toxicity, identify potential sources, propose abatement measures, and evaluate the effectiveness of the abatement measures.

Table 1.

Details of Creek Status Monitoring Results Triggering Toxicity SSID Studies

Location	Date	Event / Media	Negative Observations	Benign Observations
Grayson Creek	March 2012	Wet Weather / Water Toxicity	Significant reductions in survival of *Hyalella azteca*	No significant toxicity to other test organisms observed
	July 2012	Dry Weather / Water Toxicity		No significant toxicity to *Hyallell azteca* or any other test organism observed
		Dry Weather / Water Toxicity		Ammonia, nitrate, chloride triggers not exceeded
		Dry Weather / Sediment Toxicity	Significant reductions in survival of *Hyalella azteca*	
		Dry Weather / Sediment Chemistry	Second highest concentration of sediment contaminants of all Creek Status stations in the Region	
	Spring 2012	BMI	Very Poor	
Dry Creek	March 2012	Wet Weather / Water Toxicity	Significant reductions in survival of *Hyalella azteca*	No toxicity to other test organisms observed
	July 2012	Dry Weather / Water Toxicity		No significant toxicity to *Hyallell azteca* or any other test organism observed
		Dry Weather / Water Toxicity		Ammonia, nitrate, chloride triggers not exceeded
		Dry Weather / Sediment Toxicity	Significant reductions in survival of *Hyalella azteca*	
		Dry Weather / Sediment Chemistry	Highest concentration of sediment contaminants of all Creek Status stations in the Region	
	Spring 2012	BMI	Very Poor	
Lower Marsh Creek (below Dry Creek)	January 2012 and February 2012	Wet Weather / Water Toxicity	Significant reductions in survival of *Hyalella azteca*	No significant toxicity to other test organisms observed

Agency/ Program	Waterbody	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
ACCWP	Castro Valley	204R00047	Poor	No	16	0.57	2.38	A
ACCWP	Dublin Creek	204R00084	Very Poor	No	12	0.18	1.06	A
ACCWP	Arroyo Mocho	204R00100	Very Poor	No	4	0.16	3.16	A
CCCWP	Grayson	207R00011	Very Poor	Yes	17	0.28	3.16	C
CCCWP	Dry	544R00025	Very Poor	Yes	19	0.72	4.40	C
SCVURPPP	Los Gatos	205R00026	Poor	No	12	0.21	0.41	A
SCVURPPP	Upper Penitencia	205R00035	Poor	No	1	0.07	1.36	A
SCVURPPP	Coyote	205R00042	Very Poor	No	6	0.20	0.22	A
SMCWPPP	Milagra	202R00087	Good	No	12	0.46	1.26	B
SMCWPPP	Corte Madera	205R00088	Good	No	9	0.13	0.23	B

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.

Figure 1. Summary of Sediment Quality Triad Analysis Results, Monitoring Year 2012 Regional Monitoring Coalition Data.

Notes: Yellow Highlights Indicate Trigger Exeedances. Figure from BASMAA (2013).

- **Additional notes**: The terms TEC Quotient (Threshold Effect Quotient), PEC Quotient (Probable Effects Quotient) are defined in an established and accepted sediment quality guidelines publication (Macdonald, 2000) as follows:
- **Threshold Effect Concentration (TEC)**: Represents the concentration below which adverse effects are expected to occur only rarely.
- **TEC Quotient**: ratio of measured concentration to TEC; a TEC Quotient > 1 indicates potential for effects, albeit infrequently. The sixth column in Figure 1 above indicates the number of different pollutants in sediments that have measured TEC quotients exceeding 1.
- **Probable Effects Concentration (PEC)**: Represents the concentration above which adverse effects are expected to occur frequently.
- **PEC Quotient**: ratio of measured concentration to PEC; a higher PEC Quotients indicate greater potential for effects. The mean PEC quotients help evaluate the additive effect of multiple toxicants.
- **The Pyrethroid Toxicity Unit Equivalent (TU Equiv.)** The seventh column indicates the concentration relative to the lethal concentration that causes fifty percent mortality, based on literature data.

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2.0 STUDY LOCATIONS

A map of Grayson Creek is presented in Figure 2. The area in Grayson Creek where toxicity to *Hyalella* was observed is provided in Figure 3. A map of Dry Creek is presented in Figure 4. The area in Dry Creek where toxicity was observed is provided in Figure 5. Toxicity to *Hyalella* was also observed in Marsh Creek, downstream of the Dry Creek confluence. Land uses common to both watersheds include suburban residential, agricultural, golf courses, and additional impervious and pervious areas including light commercial and public facilities such as schools and athletic fields.

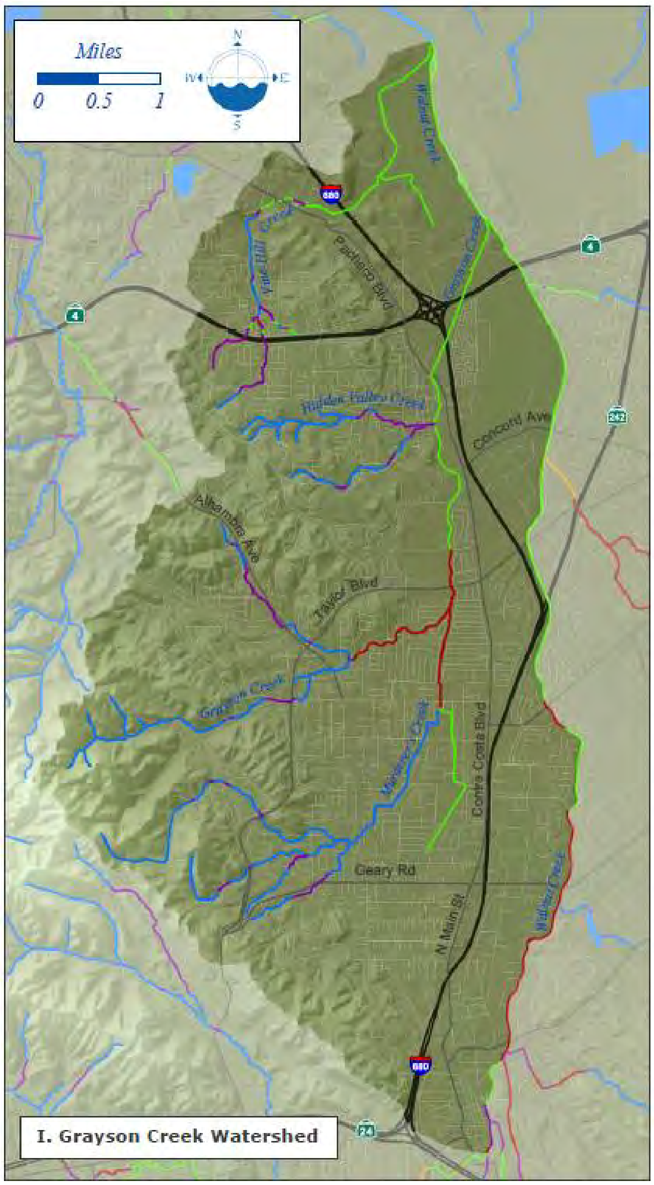

Figure 2. Locator Map of the Grayson Creek Watershed

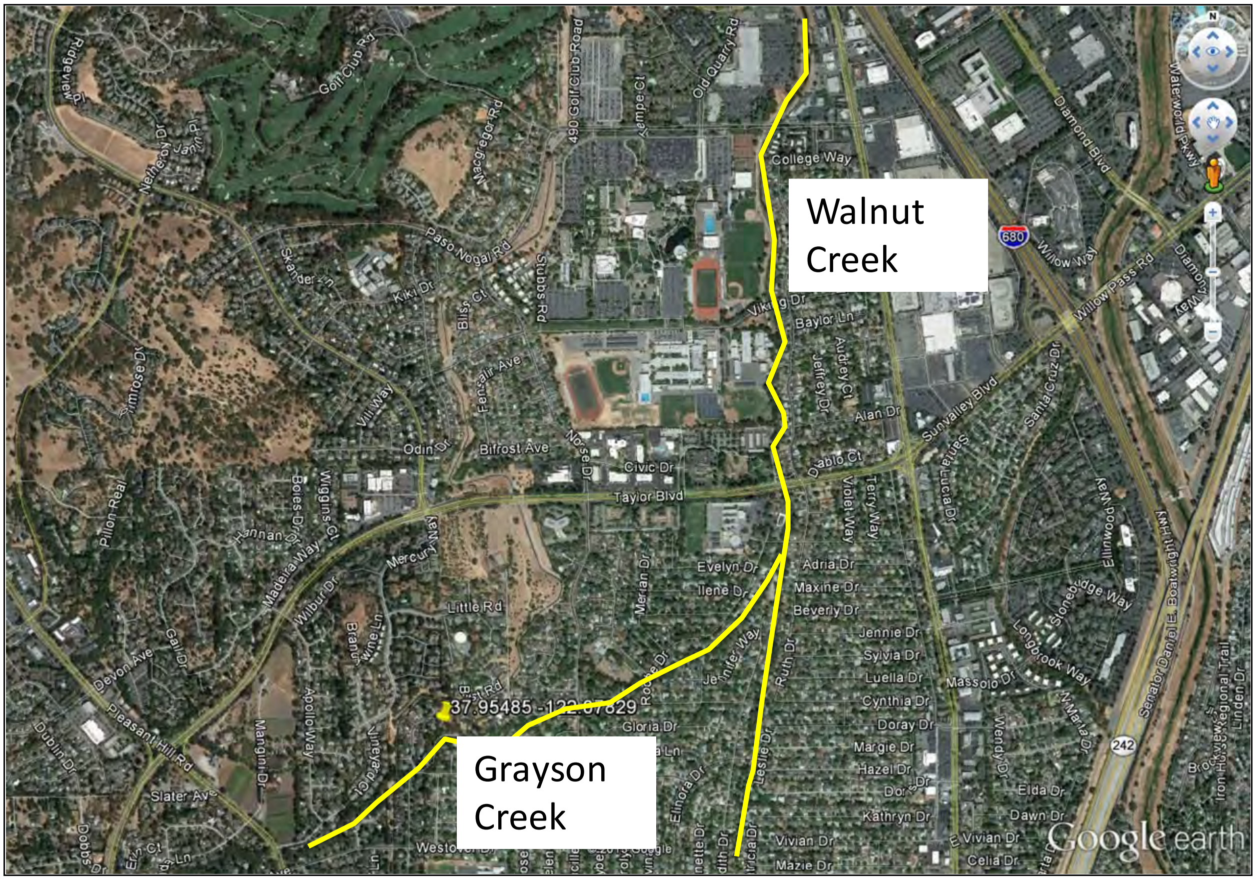

Figure 3. Google Earth View of Lower Grayson Creek in Vicinity of Detected Toxicity

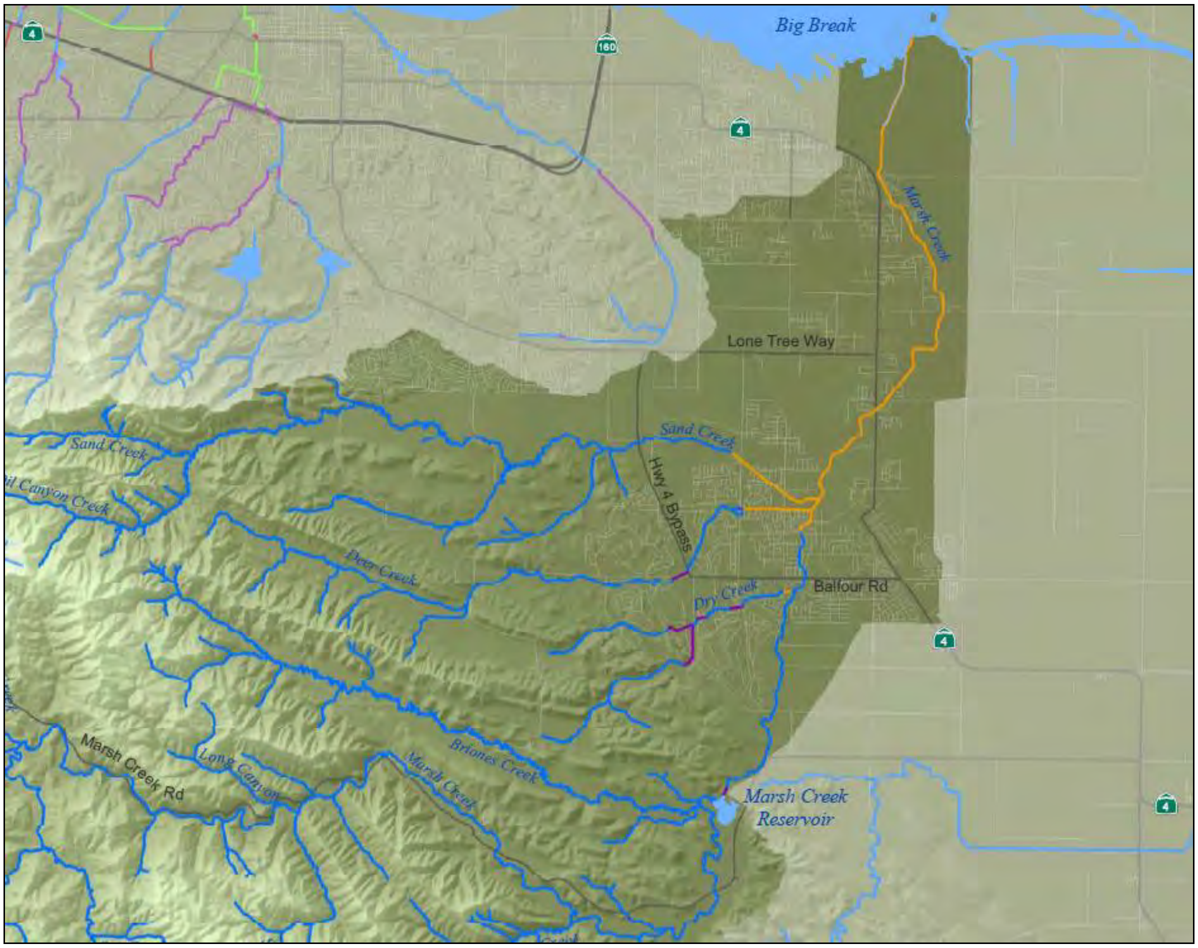

Figure 4. Locator Map of the Dry Creek Watershed

Figure 5. Google Earth View of Lower Grayson Creek in Vicinity of Detected Toxicity

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3.0 APPROACH OUTLINE

MRP Provision C.8.d.i requires four steps for SSID projects; the four parts of the study approach outlined below encompass those four required steps

Part A:

Toxicity studies first require positive identification of the stressor(s). It is presumed in these cases that the stressors are pesticides; however, additional water and sediment chemistry and toxicity testing are necessary to confirm this. In particular, determination of which pesticides are causing toxicity, and whether there are spatial patterns that may pinpoint more specific source areas or land uses. This work would involve data review, initial watershed assessments, reconnaissance using Google Earth, and site visits prior to the chemistry and toxicity testing. The work performed during the site visits would be conducted as part of the required Stream Surveys for labor efficiency. Monitoring would involve instream toxicity testing as well as toxicity identification evaluations(TIEs), as needed. This work is anticipated for Fiscal Year (FY) 2013 – 2014.

Part B:

After confirming the stressors, sources need to be identified.. Presuming that pesticide applications are determined to be the source(s) for the pesticides identified as stressors in Part A, the assessment would attempt to characterize the relative magnitudes of sources attributable to the following: Contra Costa County professional Pest Control Operators vs. homeowners, spatial and temporal characteristics of pesticide applications, the role of impervious surfaces, and any potential contribution from different land uses such as agriculture or golf courses. These activities are anticipated for FY 2014 - 2015.

Part C:

The next step is to identify controls to address the sources of the stressors identified in Parts A and B. CCCWP would coordinate with California Association of Stormwater Quality Agencies (CASQA) efforts to lobby the. California Department of Pesticide Regulation (DPR), as well as federal (United States Environmental Protection Agency (USEPA)) efforts to control pesticide use. CCCWP would also support public education and municipal adoption of Integrated Pesticide Management (IPM) methods and related programs such as Our Water Our World. If specific source areas are identified, public education and outreach may be targeted at those source areas. These activities are anticipated for FY 2015 - 2016.

Part D:

Step 4 would include testing and analyzing effectiveness of controls. This would involve additional sample collection to determine whether conditions have improved following implementation of control measures. In order to give the program a few years to work, it is anticipated that follow-up assessments would begin in FY 2018 – 2019.

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4.0 REFERENCES

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Appendix E. CCCWP SSID Part A Work Plan

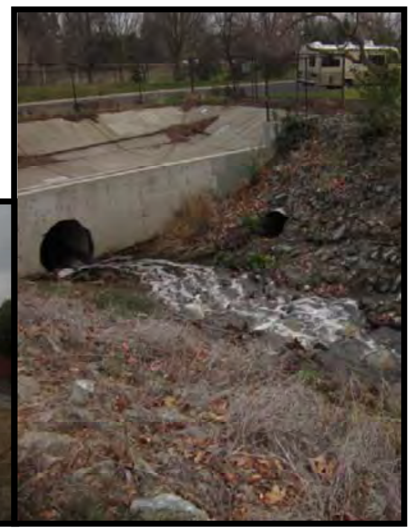
Work Plan

Draft

CONTRA COSTA CLEAN WATER PROGRAM
CREEK STATUS MONITORING
PART A
STRESSOR/SOURCE IDENTIFICATION IN DRY CREEK AND GRAYSON CREEK

January – September 2014





Submitted to:

Contra Costa Clean Water Program

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List of Acronyms

ADH	ADH Environmental
ARC	Armand Ruby Consultants
AMEC	AMEC, Inc.
ASTM	American Society for Testing and Materials
BASMAA	Bay Area Stormwater Management Agencies Association
BSA	Bovine serum albumin
°C	Degrees Celsius
CCCWP	Contra Costa Clean Water Program
CVRWQCB	Central Valley Regional Water Quality Control Board
DQO	Data quality objective
DO	Dissolved oxygen
EC	Electrical conductivity
EOA	EOA, Inc.,
EPA	U.S. Environmental Protection Agency
MDL	Method detection limit
mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
MRP	Municipal Regional Permit
mS/cm	Microsiemens per centimeter
ng/L	Nanograms per liter
NPDES	National Pollution Discharge Elimination System
LC_{50}	Lethal concentration to at least 50 percent of the population
PBO	Piperonly butioxide
PEC	Probable effects concentration
PER	Pacific EcoRisk
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
QPF	Quantity of precipitation forecast
RMC	Regional Monitoring Coalition
RLs	Reporting limits
SFBRWQCB	San Francisco Bay Regional Water Quality Control Board
SM	Standard Methods
SOPs	Standard operating procedures
SSID	Stressor/source identification
SWAMP	Storm Water Ambient Monitoring Program
TEC	Threshold effects concentration
TIE	Toxicity identification evaluation
TU	Toxic unit
ng/g	Nanogram per gram
µg/L	Microgram per liter
WY	Water year

1.0 Introduction

The Contra Costa Clean Water Program (CCCWP) is governed under two National Pollution Discharge Elimination System (NPDES) stormwater permits: the Municipal Regional Permit (MRP) issued by the SFBRWQCB (2009) and the Central Valley Permit issued by the CVRWQCB (2010). The CCCWP participated in a regional collaborative with Bay Area Stormwater Management Agencies Association (BASMAA) members, known as the Regional Monitoring Coalition (RMC), to design and conduct the Creek Status monitoring required by the permits, evaluate the monitoring results, and perform related studies. CCCWP also worked with staff of both the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB) and the Central Valley Regional Water Quality Control Board (CVRWQCB) to implement coordinated monitoring requirements. The Creek Status Monitoring conducted by CCCWP includes monitoring locations in both West County and East County jurisdictions.

Provision C.8.d.i of the MRP and a parallel provision in the Central Valley Permit require follow-up actions ("monitoring projects") when Creek Status Monitoring conducted through Provision C.8.c produces measurements that exceed triggers defined in the permits. The follow-up actions may include Stressor/Source Identification (SSID) Studies. The MRP establishes a cap on the number of SSID studies, such that when the monitoring is performed under a regional collaborative (such as the RMC), no more than two SSID Studies need to be initiated by CCCWP during the permit term. The Central Valley Permit also caps the SSID studies required of East County permittees to one such study during the permit term. Both permits allow for and encourage Creek Status Monitoring and SSID studies to be conducted regionally.

Exceedances were triggered for water and sediment toxicity parameters under Provision C.8.c, Table 8.1 of the MRP in CCCWP's Creek Status Monitoring in both water year (WY) 2012 and WY 2013. Both Dry Creek (site 544R00025) and Grayson Creek (site 207R00011) exhibited water toxicity to *Hyalella azteca* (*H. azteca*) in samples collected during wet weather in WY 2012, with confirmed retests for water toxicity to *H. azteca* in wet weather samples collected in WY 2013. Given that *H. azteca* is the common affected organism in the water and sediment toxicity at both sites, and given the preponderance of evidence linking *H. azteca* toxicity to the presence of pyrethroid pesticides in urban surface waters, this SSID investigation will focus on pyrethroid pesticides as the probable cause of the water and sediment toxicity as detailed in the SSID Draft Scope of Work[1] (ARC, 2013).

Toxicity studies first require positive identification of the stressor(s). Although pyrethroid pesticides are targeted due to their use in residential areas, and it is presumed in these cases that the stressors are pesticides; additional water and sediment chemistry and toxicity testing are necessary to confirm this supposition. In particular, it is necessary to determine which pesticides are causing toxicity, and whether there are spatial patterns that may pinpoint more specific source areas or land uses.

Two SSID studies will be conducted to evaluate and investigate this problem, one each in Dry Creek and Grayson Creek. Dry Creek is located in Eastern Contra Costa County in the City of Brentwood. Grayson Creek is in Central Contra Costa County in the City of Pleasant Hill.

[1] Relevant portions or sections of the SSID Draft Scope of Work have been incorporated into this Work Plan as appropriate.

1.1 Objectives

The SSID studies are expected to be performed in four parts over four years. The goals of Part A of the SSID studies are to:

1) Identify the causes of the observed water and sediment toxicity to *H. azteca* in Dry Creek and Grayson Creek (i.e., the stressor(s)); and
2) Identify temporal (seasonal) and spatial patterns in toxicity, and better characterize the spatial extent of sediment impacts.

Subsequent phases of the SSID studies will involve identification of potential sources of the pollutant(s) or stressor(s), identification and evaluation of potential abatement measures, and evaluation of the effectiveness of the implemented abatement measures. These projects will serve to fulfill the requirements of MRP Table H-1 with respect to follow-up actions pertinent to the sediment triad, as well as CCCWP's requirements to conduct two SSID studies per MRP Provision C.8.d.i.

1.2 Responsible Agency

The CCCWP will provide contract administration as needed to ensure compliance with the contractual agreement and ensure the work is performed to professional standards of quality.

1.3 Personnel

Personnel involved with the SSID Study, their respective roles and responsibilities are listed in Table 1.

Table 1. Personnel Names, Affiliation, and Responsibilities

Name	Affiliation	Responsibility
Jan O'Hara	SFBRWQCB	Regulatory Agency
Lucile Paquette	CCCWP	Program Coordinator
Dr. Khalil Abusaba	AMEC	Technical Advisor
Armand Ruby	ARC	Toxicity Identification Evaluations
Alessandro Hnatt	ADH	Project Manager
Peter Wilde	ADH	Quality Assurance Manager
Kevin Lewis	ADH	Field Sampling
Calvin Sandlin	ADH	Field Sampling

The following sections briefly describe the monitoring sites, field sampling methods, laboratory analytical testing and chemical analyses methods, data quality objectives, quality assurance/quality control (QA/QC) approach, and data analytical approach for Part A of the SSID projects to be performed in Dry Creek and Grayson Creek.

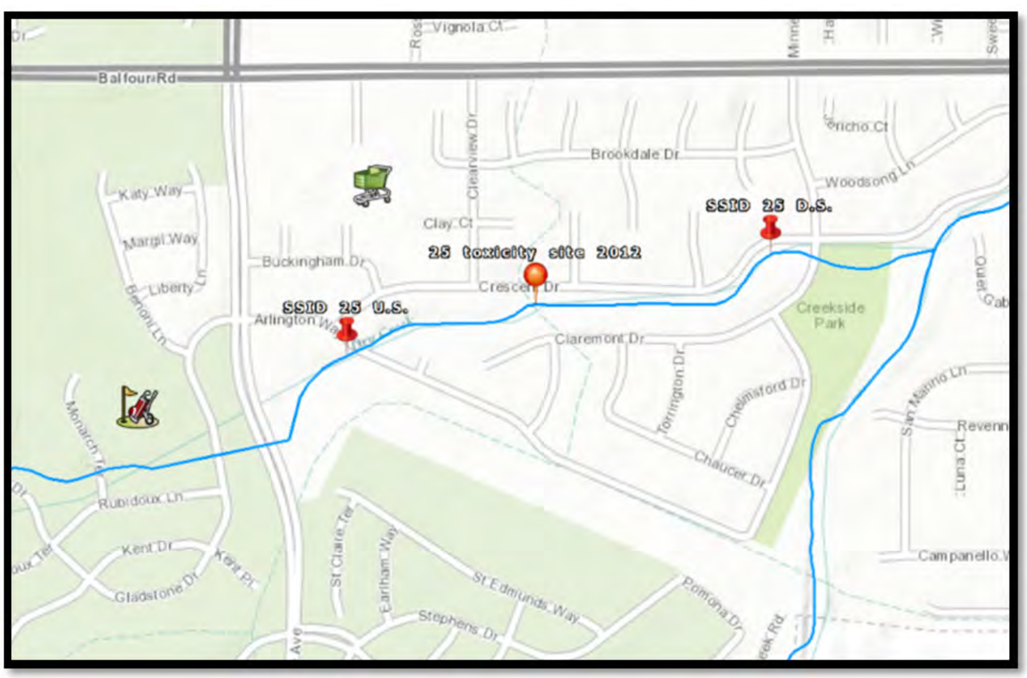
2.0 Monitoring Site and Sampling Area Description

The WY 2012 Creek Status Dry Creek and Grayson Creek toxicity sampling locations are shown on Figures 1 and 2, respectively. For these SSID studies, two additional sites were selected for monitoring in each creek; one each upstream and downstream of the previously-monitored sites (site 544R00025 in Dry Creek and site 207R00011 in Grayson Creek) to better characterize spatial extent of the toxicity impacts. The upstream and downstream sampling sites were selected in coordination with the CCCWP Program Coordinator, and reconnaissance of these selected sites was performed in the 2013-14 winter season in conjunction with CCCWP Creek Status bioassessment site reconnaissance. The following subsections provide brief descriptions of the localized creek watershed, habitat and physical surroundings. Locations of upstream and downstream SSID monitoring sites for Dry Creek and Grayson Creek are shown in Figures 1 and 2, respectively, and are detailed in Table 2.

2.1 Dry Creek

Dry Creek is a tributary to Marsh Creek in eastern Contra Costa County in the City of Brentwood, California (Figure 1). The creek channel in this area has undergone tremendous hydromodification due to urbanization. The reach that has been and will be sampled as part of this study is one of the reaches where the creek is above-ground. At the upstream end of the reach, west of Arlington Way, water is conveyed through a culvert from the Brentwood Golf Club and surrounding neighborhoods into the engineered flood control channel. The creek flows along Crescent Drive receiving runoff from the neighboring urban development south of Balfour Drive where it reaches a culvert. The downstream site is approximately 350 meters upstream of that culvert, after which it flows underneath Creekside Park until its confluence at Marsh Creek.

Figure 1. Dry Creek Site 25 sampling locations, Brentwood, CA



2.2 Grayson Creek

Grayson Creek is a tributary to Walnut Creek in central Contra Costa County in the City of Pleasant Hill (Figure 2). The upstream sampling location for this site is located about 30 meters up tributary to Grayson Creek, between Mercury Way and Vineyard Court. The downstream sampling location is located on East Branch of Grayson Creek, just upstream of the Grayson Creek/East Branch Grayson Creek confluence, at the terminus of Ardith Drive. Both Grayson Creek and Tributary to Grayson Creek are concrete flood control channels. Diazinon is a known pollutant of concern in Grayson Creek Watershed. Water and sediment toxicity sampling were conducted in the concrete channel where it crosses the Contra Costa Canal Trail in Pleasant Hill.

Figure 2. Grayson Creek Site 11 sampling locations, Pleasant Hill, CA

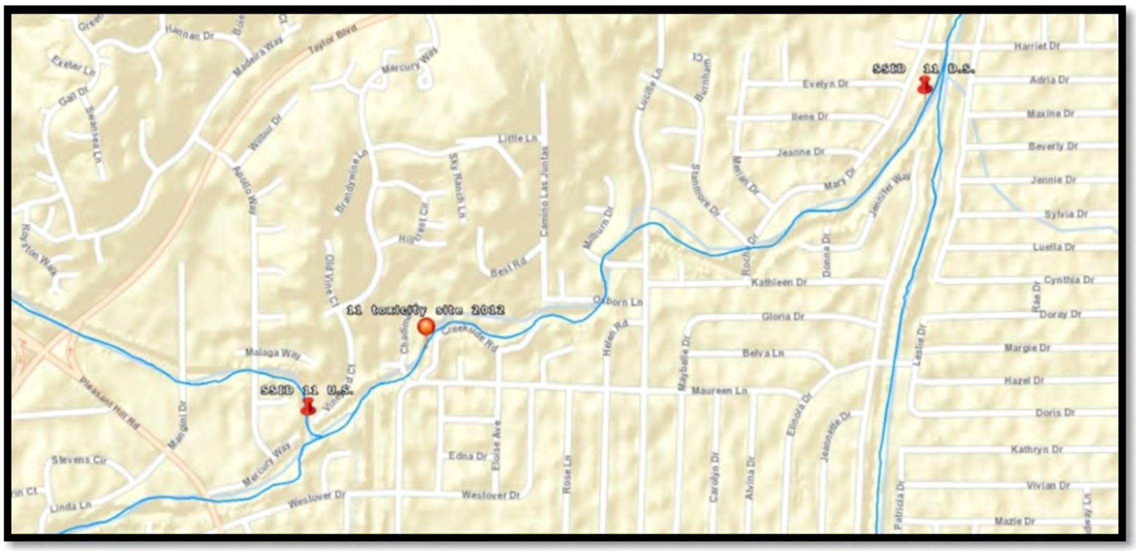


Table 2. Contra Costa County SSID Site Locations for WY 2013 - 2014

Creek Name / SSID Study Site	Site Code*	Latitude	Longitude	Monitoring Site Access
Dry Creek / Downstream	544R00025DS	37.923034	-121.714538	Public Access, park on road next to creek. Monitoring site is located upstream of drop structure at Claremont Way.
Dry Creek / Upstream	544R00025US	37.921722	-121.721855	Public Access, park on road next to creek. Monitoring site is located upstream of culvert at Arlington Way
Grayson Creek/ Downstream	207R00011DS	37.954271	-122.07869	Flood Control Channel, at CC Canal Trail. Monitoring site is located above channel, over fence; requires use of sampling pole and transfer container.
Grayson Creek/ Downstream	207R00011US	37.95141	-122.08396	Flood Control Channel between Mercury Way and Vineyard Court. Monitoring location is on other side of flood control access gate; require use of sampling pole and transfer container from above channel.

*Site codes will change when SWRCB designates new codes.

3.0 Field Monitoring Methods

Monitoring will be performed at each of the four sites during two wet weather events for water chemistry and toxicity, and at each of the same four sites during one dry weather event for sediment chemistry and toxicity. Monitoring preparation and logistics, laboratory arrangements, weather tracking, mobilization, sample collection and field measurements, sample delivery/shipping, demobilization and travel to monitoring sites shall be included as needed. The following subsections describe the field sampling methods that will be employed for the collection of stormwater and dry weather bedded sediment samples for chemical analyses and toxicity testing as well as site observations and water quality measurements taken during all sampling. Sampling methods and procedures will follow the RMC Quality Assurance Project Plan (QAPP; EOA et al., 2012) and Standard Operating Procedures (SOPs; EOA et al., 2014a).

3.1 Stormwater Sampling

Stormwater aquatic toxicity and chemistry sample collection techniques and health and safety considerations will adhere to all relevant protocols specified in the RMC's SOP FS-2, *Manual Collection of Water Samples for Chemical Analysis, Bacteriological Analysis, and Toxicity Testing* (EOA et al., 2014a).

As feasible, ADH Environmental (ADH) will also adhere to RMC guidance in selection of storm events to monitor:

> *Recommended protocols: a) track storms that are likely to produce runoff; 0.5" Quantity of Precipitation Forecast (QPF) is good rule of thumb; b) when feasible observe 72 hour antecedent dry period (i.e., <0.1" rain in prior 72 hours); c) collect sample on rising limb of hydrograph, near peak flow; d) coordinate sample collection when possible to sample multiple sites during same event; e) coordinate events with labs in advance.*

Due to the abnormally low precipitation experienced during the WY 2013 - 2014, ADH, in communication with the CCCWP Program Coordinator, may elect to sample a precipitation event that does not fully meet all above criteria, or may sample fewer sites in any given event, depending on distribution of rainfall across target sampling sites. Every attempt will be made to coordinate sampling efforts with other RMC participants' toxicity sampling efforts. To minimize upstream influence on downstream water quality, the downstream site will always be sampled prior to collection of samples at the upstream monitoring site. Additionally, all sampling will be conducted during daylight hours in the interest of health and safety.

3.2 Sediment Sampling

Bedded sediment toxicity and chemistry sampling collection techniques, and health and safety considerations for this SSID Study will adhere to all relevant protocols specified in the RMC's SOP FS-6, *Collection of Bedded Sediment Samples for Chemistry Analysis and Toxicity* (EOA et al., 2014a). In accordance with the MRP and Central Valley Permit, sampling will be conducted during dry weather in the July – September timeframe.

Every attempt will be made to coordinate the sampling efforts with other CCCWP and RMC participant's dry season Creek Status toxicity sampling efforts however priority will be given to what individual site logistics and conditions require. However. due to the abnormally low precipitation experienced during the

WY 2013, ADH, in communication with the CCCWP Program Coordinator, may elect to sample independent of the RMC participant's WY 2014 Creek Status sampling efforts.. To minimize upstream influence on downstream water and sediment quality, the downstream site will always be sampled prior to collection of samples at the upstream monitoring site. Additionally, all sampling will be conducted during daylight hours in the interest of health and safety.

3.3 Field Water Quality Measurements and Observations

Field water quality measurements methods and procedures and health and safety considerations for this SSID Study will be performed in conjunction with all water and sediment toxicity and chemistry monitoring, and will adhere to all relevant protocols specified in the RMC's SOP FS-3, *Manual Field Measurements* (EOA et al., 2014a).

Water quality measurements will be performed using a YSI 556 handheld multiparameter probe to measure temperature, pH, dissolved oxygen and specific conductance. Measurements of these parameters as well as the field crew names, standard observations of water quality (e.g., odor, clarity, color, etc.), site information (e.g., GIS coordinates, stream width and depth, approximate flow rate, etc.) will be recorded on a SWAMP field data sheet during all sampling events.

3.4 Sample Handling and Chain of Custody Procedure

Sample containers and handling will adhere to all relevant protocols specified in the RMC's FS-9, *Sample Container, Handling, and Chain of Custody Procedures* (EOA et al., 2014a). A summary of the respective analytes or tests, sample volumes, containers, and preservatives are presented for stormwater aquatic toxicity and dry season bedded sediment monitoring in Tables 3 and 4, respectively.

Table 3. Containers and Handling for CCCWP SSID Aquatic Toxicity Monitoring

Sample/Test	Container	Handling Requirements
Pyrethroid pesticides	1 @ 2 L amber glass	Place on wet ice, cool to <6° C, 7 day hold time
Fipronil and degradates	1 @ 2 L amber glass	Place on wet ice, cool to <6° C, 7 day hold time[1]
Organochlorine pesticides	1 @ 2 L amber glass	Place on wet ice, cool to <6° C, 7 day hold time
Total Organic Carbon	3 @ 40 ml x VOA	HCL, place on wet ice, cool to <6° C, 28 day hold time
Suspended Sediment Concentration	1 @ 250ml HDPE	Place on wet ice, cool to <6° C, 7 day hold time
Aquatic toxicity	2 @ 1L amber glass	Place on wet ice, cool to <6° C, 36 hour hold time

Explanation:

1. Firpronil's holding time is 7 days, but certain degradates are 3 days.

Table 4. Containers and Handling for CCCWP SSID Dry Season Bedded Sediment Toxicity Monitoring

Sample/Test	Container	Handling Requirements
Pyrethroid pesticides, Fipronil and degradates	1 @ 8 ounces amber glass[1]	Place on wet ice, cool to <6° C, 14 day[2] hold time
Organochlorine pesticides	1 @ 8 ounces clear or amber glass soil jar.[1]	Place on wet ice, cool to <6° C, 14 day hold time

Sample/Test	Container	Handling Requirements
Percent Solids	1 @ 8 ounces clear soil jar.	Place on wet ice, cool to <6° C, 7 day hold time
Total Organic Carbon	1 @ 8 ounces clear soil jar.	Place on wet ice, cool to <6° C, 28 day hold time
Sediment toxicity	3 @ 4L[3] amber glass	Place on wet ice, cool to <6° C, 14 day hold time

Explanation:

1. 2 jars recommended for back-up
2. 1 year if frozen
3. The 10-day *Hyalella azteca* sediment toxicity test requires a total of 2-L of sediment. This does not account for additional volume for a follow-up request or for TIEs. The total for TIEs is dependent on the number of treatments, and can be as much as an additional 2-10 L. In summation, the volume should be ≥ 3 gallons (~12 L on the high end) to cover all possibilities.

3.5 Sample Labeling

The sample ID labeling system used for the RMC Creek Status Monitoring is described in the SOP FS-11, *Site and Sample ID Naming Conventions* (EOA et al., 2014a) and will be used with a modification to accommodate the upstream and downstream monitoring sites as summarized below:

XXXXXXXXXYY
Where:

XXXXXXXXX	=	Nine digit site code
YY	=	US (for upstream) or DS (for downstream)

4.0 Testing and Analyses

Monitoring will be performed at each of the four sites during two wet weather events for water chemistry and toxicity, and at each of the same four sites once during dry weather for sediment chemistry and toxicity.

Constituents for water quality monitoring will include:

- Field parameters [dissolved oxygen (DO), electrical conductivity (EC), pH, Temperature]
- Pyrethroid pesticides
- Fipronil and degradates
- Organochlorine pesticides
- Total organic carbon
- Suspended sediment concentration
- *Hyalella azteca* – chronic toxicity

Constituents for sediment quality monitoring will include:

- Field parameters (DO, EC, pH, Temperature) in overlying water
- Pyrethroid pesticides
- Fipronil and degradates
- Organochlorine pesticides
- Percent solids

- Total organic carbon
- *Hyalella azteca* – chronic toxicity

4.1 Stormwater Aquatic Analytical Methods and Tests

Analytical methods and tests, method detection limits (MDLs) and reporting limits (RLs), or test type for the CCCWP SSID Study stormwater aquatic monitoring are presented in Table 5.

Table 5. Analytical Constituent and Toxicity Testing Methods, MDLs, and RLs or Test Type for CCCWP SSID Study Stormwater Aquatic Monitoring

Analyte	Analytical Method	Method Detection Limit or Test Duration	Reporting Limit or Test Type
Water Quality Parameters			
Dissolved Oxygen	Field Meter	0.01 mg/L	0 - 50 mg/L
Conductivity	Field Meter	0.001 mS/cm	0 – 200 mS/cm
pH	Field Meter	0.01 units	0.00 – 14.00 units
Temperature	Field Meter	-5 – 45°C	0.1°C
Total Organic Carbon	SM20-5310 B	0.50 mg/L	1 mg/L
Suspended Sediment Concentration	ASTM D 3977-97 B-Filtration	2 mg/L	3 mg/L
Pyrethroid pesticides			
Allethrin	EPA 8270Mod (NCI SIM)	0.1 ng/L	1.5 ng/L
Bifenthrin	EPA 8270Mod (NCI SIM)	0.1 ng/L	1.5 ng/L
Cyfluthrin	EPA 8270Mod (NCI SIM)	0.2 ng/L	1.5 ng/L
Cypermethrin	EPA 8270Mod (NCI SIM)	0.3 ng/L	1.5 ng/L
Deltamethrin: Tralomethrin	EPA 8270Mod (NCI SIM)	0.2 ng/L	3.0 ng/L
Esfenvalerate: Fenvalerate	EPA 8270Mod (NCI SIM)	0.2 ng/L	3.0 ng/L
Fenpropathrin	EPA 8270Mod (NCI SIM	0.3 ng/L	1.5 ng/L
Lambda-Cyhalothrin	EPA 8270Mod (NCI SIM)	0.2 ng/L	1.5 ng/L
Tau-Fluvalinate	EPA 8270Mod (NCI SIM)	0.2 ng/L	1.5 ng/L
Tetramethrin	EPA 8270Mod (NCI SIM)	0.2 ng/L	1.5 ng/L
Permethrin	EPA 8270Mod (NCI SIM)	2 ng/L	15 ng/L
Fipronil (Degradates Listed Below)	EPA 8270Mod (NCI SIM)	0.002 µg/L	0.01 µg/L
Fipronil Desulfinyl	EPA 8270Mod (NCI SIM)	0.002 µg/L	0.01 µg/L
Fipronil Sulfide	EPA 8270Mod (NCI SIM)	0.002 µg/L	0.01 µg/L
Fipronil Sulfone	EPA 8270Mod (NCI SIM)	0.002 µg/L	0.01 µg/L
Organochlorine pesticides			
Aldrin	EPA 608	0.0040 µg/L	0.05 µg/L
alpha-BHC	EPA 608	0.0050 µg/L	0.010 µg/L
beta-BHC	EPA 608	0.0040 µg/L	0.005 µg/L
delta-BHC	EPA 608	0.0040 µg/L	0.005 µg/L
gamma-BHC (Lindane)	EPA 608	0.0040 µg/L	0.010 µg/L
Chlordane	EPA 608	0.020 µg/L	0.010 µg/L

Analyte	Analytical Method	Method Detection Limit or Test Duration	Reporting Limit or Test Type
4,4'-DDD	EPA 608	0.0040 µg/L	0.010 µg/L
4,4'-DDE	EPA 608	0.0040 µg/L	0.010 µg/L
4,4'-DDT	EPA 608	0.0040 µg/L	0.010 µg/L
Dieldrin	EPA 608	0.0040 µg/L	0.010 µg/L
Endosulfan I	EPA 608	0.0050 µg/L	0.010 µg/L
Endosulfan II	EPA 608	0.0050 µg/L	0.010 µg/L
Endosulfan sulfate	EPA 608	0.0050 µg/L	0.010 µg/L
Endrin	EPA 608	0.0050 µg/L	0.010 µg/L
Endrin aldehyde	EPA 608	0.0050 µg/L	0.010 µg/L
Endrin ketone	EPA 608	0.0050 µg/L	0.010 µg/L
Heptachlor	EPA 608	0.0050 µg/L	0.010 µg/L
Heptachlor epoxide	EPA 608	0.0040 µg/L	0.010 µg/L
Methoxychlor	EPA 608	0.0050 µg/L	0.01 µg/L
Toxaphane	EPA 608	0.30 µg/L	0.5 µg/L
Aquatic Toxicity	EPA/600/R-99/064	10-day	Survival

Explanation:

mg/L = Milligram per liter
mS/cm = Microsiemens per centimeter
°C = Degrees Celsius
EPA = U.S. Environmental Protection Agency
ng/L = Nanograms per liter
µg/L = Microgram per liter
SM = Standard Methods
ASTM = American Society for Testing and Materials

4.2 Dry Season Bedded Sediment Analytical Methods and Tests

Analytical methods and tests, MDLs and RLs, or test type for the CCCWP SSID Study dry season bedded sediment toxicity monitoring is presented in Table 6.

Table 6. Analytical Constituent and Toxicity Testing Methods, MDLs and RLs or Test Type for CCCWP SSID Dry Season Bedded Sediment Monitoring

Analyte	Analytical Method	Method Detection Limit or Test Duration	Reporting Limit or Test Type
Water Quality Parameters			
Dissolved Oxygen	Field Meter	0.01 mg/L	0 - 50 mg/L
Conductivity	Field Meter	0.001 mS/cm	0 – 200 mS/cm
pH	Field Meter	0.01 units	0.00 – 14.00 units
Temperature	Field Meter	-5 – 45°C	0.1°C
Total Organic Carbon	EPA 9060	0.30 mg/kg	1 mg/kg
Percent Solids	SM20-2540B	0.5 mg/kg	1 mg/kg
Pyrethroid pesticides			

Analyte	Analytical Method	Method Detection Limit or Test Duration	Reporting Limit or Test Type
Allethrin	EPA 8270Mod (NCI SIM)	0.05 ng/g	0.33 ng/g
Bifenthrin	EPA 8270Mod (NCI SIM)	0.1 ng/g	0.33 ng/g
Cyfluthrin	EPA 8270Mod (NCI SIM)	0.11 ng/g	0.33 ng/g
Cypermethrin	EPA 8270Mod (NCI SIM)	0.1 ng/g	0.33 ng/g
Deltamethrin: Tralomethrin	EPA 8270Mod (NCI SIM)	0.12 ng/g	0.33 ng/g
Esfenvalerate: Fenvalerate	EPA 8270Mod (NCI SIM)	0.13 ng/g	0.33 ng/g
Fenpropathrin	EPA 8270Mod (NCI SIM	0.07 ng/g	0.33 ng/g
Lambda-Cyhalothrin	EPA 8270Mod (NCI SIM)	0.06 ng/g	0.33 ng/g
Tau-Fluvalinate	EPA 8270Mod (NCI SIM)	0.04 ng/g	0.33 ng/g
Tetramethrin	EPA 8270Mod (NCI SIM)	0.06 ng/g	0.33 ng/g
Permethrin	EPA 8270Mod (NCI SIM)	0.11 ng/g	0.33 ng/g
Fipronil (Degradates Listed Below)	EPA 8270Mod (NCI SIM)	0.1 ng/g	0.33 ng/g
Fipronil Desulfinyl	EPA 8270Mod (NCI SIM)	0.1 ng/g	0.33 ng/g
Fipronil Sulfide	EPA 8270Mod (NCI SIM)	0.1 ng/g	0.33 ng/g
Fipronil Sulfone	EPA 8270Mod (NCI SIM)	0.1 ng/g	0.33 ng/g
Organochlorine pesticides[1]			
Aldrin	EPA 8081	0.9 ng/g	2 ng/g
alpha-HCH	EPA 8081	0.9 ng/g	2 ng/g
beta-HCH	EPA 8081	0.9 ng/g	2 ng/g
delta-HHC	EPA 8081	0.7 ng/g	2 ng/g
gamma-HCH	EPA 8081	0.7 ng/g	2 ng/g
cis-Chlordane	EPA 8081	1 ng/g	2 ng/g
trans-Chlordane	EPA 8081	1 ng/g	2 ng/g
4,4'-DDD	EPA 8081	0.8 ng/g	2 ng/g
2, 4'-DDD	EPA 8081	2 ng/g	2 ng/g
4,4'-DDE	EPA 8081	1.2 ng/g	2 ng/g
2, 4'-DDE	EPA 8081	2 ng/g	2 ng/g
4,4'-DDT	EPA 8081	1 ng/g	2 ng/g
2, 4'-DDT	EPA 8081	2 ng/g	2 ng/g
Dieldrin	EPA 8081	1.2 ng/g	2 ng/g
Endosulfan I	EPA 8081	0.9 ng/g	2 ng/g
Endosulfan II	EPA 8081	0.7 ng/g	10 ng/g
Endosulfan sulfate	EPA 8081	0.9 ng/g	10 ng/g
Endrin	EPA 8081	1 ng/g	2 ng/g
Endrin aldehyde	EPA 8081	0.9 ng/g	2 ng/g
Endrin ketone	EPA 8081	0.9 ng/g	2 ng/g

Analyte	Analytical Method	Method Detection Limit or Test Duration	Reporting Limit or Test Type
Heptachlor	EPA 8081	0.6 ng/g	2 ng/g
Heptachlorepoxide	EPA 8081	1.1 ng/g	2 ng/g
Methoxychlor	EPA 8081	0.9 ng/g	2 ng/g
Toxaphene	EPA 8081	20 ng/g	40 ng/g
Mirex	EPA 8081	0.5 ng/g	20 ng/g
Sediment Toxicity	EPA/600/R-99/064	10-day	Survival

Explanation:

1. Does not include all analytes listed in Storm Water Ambient Monitoring Program QAPP (SWAMP 2008).
   mg/kg = Milligram per kilogram
   ng/g = Nanogram per gram

4.3 Reference Toxicant Tests

Per the RMC Creek Status Monitoring Program QAPP (EOA et al., 2012), reference toxicant tests:

> *… must be conducted monthly for species that are raised within a laboratory. Reference Toxicant Tests must be conducted per analytical batch for species from commercial supplier settings. Reference Toxicant Tests must be conducted concurrently for test species or broodstocks that are field collected.*

H. azteca are purchased by Pacific EcoRisk (PER) from commercial suppliers and therefore require reference toxicant tests per analytical batch. Whenever feasible, cooperating RMC programs will attempt to coordinate sampling in order to share the costs of reference toxicant testing among programs sampling the same event.

4.4 Toxicity Identification Evaluations

One targeted toxicity identification evaluation (TIE) is planned for each matrix: water (wet weather) and sediment (dry weather). TIEs will be conducted contingent upon discovery of statistically-significant toxicity in water and sediment samples. The targeted TIEs will include testing of the Baseline Sample (100%), a PBO Treatment (in both 50% dilution and 100% sample) with sample spiking, a Carboxylesterase Treatment (100% sample) with sample spiking, and a Bovine Serum Albumin (BSA) Treatment (100% sample) with sample spiking; these specifications may be modified upon further discussion with toxicity laboratory personnel.

4.5 Contacts

Laboratory contact information for toxicity testing and analytical chemistry is shown in Table 7.

Table 7. Laboratory Contact Information for 2014 CCCWP SSID Study

Laboratory	Contact	Phone
Pacific EcoRisk	Stephen Clark	(707) 207-7766
Pacific EcoRisk	Eddie Kalombo	(707) 207-7760 Ext. 794
Catest Analytical	Todd Albertson	(707) 258-4000

5.0 Data Quality Objectives and Quality Assurance / Quality Control Approach

The data quality objective (DQO) process is implemented through a Quality Assurance/Quality Control (QA/QC) program. The elements of the QA/QC program including required levels of precision and accuracy, and tolerable levels of error are presented in detail in the RMC QAPP (EOA et al., 2012).

6.0 Data Analysis and Reporting

After all data have been received, a brief draft report summarizing the monitoring performed and data analysis, listed below, will be produced. The report will perform the following data analysis tasks:

- Evaluate, summarize, and compare SSID Study toxicity test results to corresponding water and sediment chemistry results, and assess in relation to TIE results.
- Calculate toxic unit (TU) equivalents for all pyrethroids and any other detected pesticides for which LC_{50} (lethal concentration to at least 50 percent of the population) values are available.
- Calculate threshold effects concentration (TEC) and probable effects concentration (PEC) quotients for monitored constituents that are listed in Macdonald et al., 2000.
- Assess TU equivalents, TEC quotients and PEC quotients per MRP Table H-1 criteria.
- Compile current project chemistry and toxicity testing data together with prior 2012/2013 data for evaluation of spatial and temporal differences/patterns; present results of these comparisons graphically.

7.0 References

ARC, 2013. *Draft Scope of Work For Stressor/Source Identification Studies, Part A Contra Costa County - Creek Status*. December 2013.

CVRWQCB, 2010. *California Regional Water Quality Control Board Central Valley Stormwater NPDES Waste Discharge Requirements Order R5-2010-0102 NPDES Permit No. CAS083313*. September 23, 2010.

EOA, AMS, and ARC, 2012. *BASMAA Regional Monitoring Coalition Creek Status Monitoring Program Quality Assurance Project Plan*. Prepared for Bay Area Stormwater Management Agencies Association. Version 1, February 1, 2012.

EOA, AMS, and ARC, 2014a. *BASMAA Regional Monitoring Coalition Creek Status Monitoring Program Standard Operating Procedures*. Prepared for Bay Area Stormwater Management Agencies Association. Final Version 2, January 2014.

EOA, AMS, and ARC, 2014b. *BASMAA Regional Monitoring Coalition Creek Status Monitoring Program Quality Assurance Project Plan*. Prepared for Bay Area Stormwater Management Agencies Association. Final Version 2, January 2014.

Macdonald et al., 2000. *Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems*. 13 January 200.

SFRWQCB, 2009. *California Regional Water Quality Control Board San Francisco Bay Region Municipal Regional Stormwater NPDES Permit, Order R2-2009-0074 NPDES Permit No. CAS612008*. October 14, 2009.

SWAMP, 2008. *Storm Water Ambient Monitoring Program Quality Assurance Project Plan.* Prepared for The State of California's Storm Water Ambient Monitoring Program. Version 1.0. September 1, 2008.

Appendix F. SSID Monitoring - Quality Assurance / Quality Control Results

Quality Assurance / Quality Control

Quality Assurance/Quality Control (QA/QC) analyses included required levels of precision and accuracy, and tolerable levels of error are presented in detail in the RMC QAPP (EOA et al., 2012) for chemical and toxicological analyses. This comprehensive and rigorous suite of Laboratory QA/QC procedures were ultimately successfully conducted in accord with Surface Water Ambient Monitoring Program (SWAMP, 2008).

Caltest Laboratories (CAL) performed all chemical analyses and Pacific EcoRisk (PER) performed all toxicology analyses for the CCCWP SSID Project in accordance with their quality assurance programs. These laboratories performed all appropriate internal QA/QC measures in order to provide information needed to assess analytical precision and accuracy, and serve as a check on laboratory procedures.

CAL and PER provided, as a result of this work, signed laboratory reports and accompanying electronic deliverables (EDDs). These reports and EDDs were initially compared by ADH personnel experienced in data review and verification to check completeness (all required samples were analyzed), agreement (values in one matched values in another), if project reporting limit (RL) goals were met, and if all toxicology required conditions were met. This initial screening produced satisfactory results.

Field QA/QC

No field QA/QC samples were taken or analyzed for this program. This was due to its small size and consequent budgetary constraints.

Field Determination of Conductivity, pH, and Temperature

Temperature, conductivity and pH were determined in the field at the time of collection with a YSI field meter. This instrument was calibrated per the manufacturer's specifications within 24 hours of use. Documentation of calibration is included on the field log sheets associated with each monitoring event (Appendix I).

Laboratory QA/QC

Following is a list of Laboratory QA/QC analyses performed by CAL in conjunction with the CCCWP SSID project samples they analyzed:

- Method Blank Samples
- Laboratory Duplicate Samples (Replicate Samples)
- Laboratory Control Sample/Laboratory Control Sample Duplicates (LCS/LCSD)
- Matrix Spike/Matrix Spike Duplicates (MS/MSD)
- Surrogates

Overall, results of all laboratory QA/QC procedures show that, with several exceptions, there were no significant exceedances of control parameters, all analyses were performed under adequately controlled conditions, the data quality was not affected, and the reported results are acceptable for interpretation These results illustrate that the integrity of the data integrity is strong, as detailed below.

Method Blank Samples

Laboratory blank samples were analyzed to assess the possibility of sample contamination introduced through analysis of samples by the analytical laboratory.

No analytes were detected in any method blank samples except for a single one associated with the February 6, 2014 sampling in which a low level of contamination was found for the pyrethroid λ-Cyhalothrin. This method blank sample for method SW846 8270 Mod (GCMS-NCI-SIM) analysis result was below the RL. As such, this level was an estimate as were the two associated batched field sample results that were also below the RL but of the same order of magnitude as the method blank result. Laboratory contamination of the two field samples almost certainly occurred. λ-Cyhalothrin was not detected in three other method blank samples associated with later season samplings.

Given the single low-level instance of contamination, the laboratory analytical procedures are deemed to have been of sufficiently high quality.

Laboratory Duplicates

Laboratory duplicates (also referred to as split samples) are field samples split and analyzed by the laboratory. They provide a measure of data precision (reproducibility) attributable to laboratory analytical procedures.

A single laboratory duplicate sample was performed for Percent Solids during the dry weather sampling. This sample had a result that was identical to the result of the associated field sample, indicating good precision for this analyte.

Matrix Spike and Laboratory Control Samples

MSs and LCSs are laboratory-created samples made by adding a known concentration of an inpurity (i.e., spiking) to either field sample water (MS) or to laboratory water known to be free of the impurity (LCS). These manufactured samples are then analyzed for the impurity in question, and the amount recovered compared to the spiked amount determines the percent recovery (PR) of the analyte in the spiked sample, which is used as measure of accuracy. For both kinds of samples, PR is calculated as the ratio of the recovered amount to the spike amount, expressed as a percent. There are some slight quantitative differences between MS and LCS PR calculations - details are available in RMC QAPP (EOA et al., 2012).

Matrix spike duplicates (MSD) and laboratory control sample duplicates (LCSD) were analyzed as a measure of precision. This is calculated as the relative percent difference (RPD), which is the ratio of the absolute value of the difference of the main laboratory QA sample and its associated duplicate to their average, expressed as a percentage.

All PRs and RPDs for project LCS/LCSD samples were within control limits set either by the laboratory and/or the analytical method.

All PRs and RPDs for project MS/MSD samples were also within control limits set either by the laboratory and/or the analytical method, with these exceptions:

1. The PR (68%) of Bifenthrin for an MS sample with Lab ID 564487 was barely outside of acceptable control limits (70-165%). The LCS and LCSD sample PRs in the same sample batch

(3357) were in control as well as the RPD for the pair. Additionally, the RPD of the MS/MSD pair of the batch were within acceptance limits, indicating that the analytical batch was in control and the data results of its associated field samples are acceptable. This analytical batch was comprised of aquatic chemistry samples taken on February 6, 2014 .

2. The PRs of Allethrin for an MS sample (35%) with Lab ID 594647 paired with an MSD sample (36%) with Lab ID 594648 were outside of acceptable control limits (50-185%). These low PRs were due to possible matrix influences in the QA/QC samples. However, The LCS and LCSD sample PRs in the same sample batch (3515) were in control as well as the RPD for the pair. Additionally, the RPD of the MS/MSD pair of the batch was within acceptance limits. Due to these results, the analytical batch was accepted as in control and the data results of its associated field samples are acceptable. This analytical batch was comprised of sediment chemistry samples taken on July 23, 2014 .
3. The PR (255%) of Cyfluthrin for an MSD sample with Lab ID 594648 was outside of acceptable control limits (50-150%). Additionally, the RPD (77%) from the associated MS sample with Lab ID 594647 was above the acceptable control limit (30%). The LCS and LCSD sample PRs in the same sample batch (3515) were in control as well as the RPD for the pair. Additionally, Cyfluthrin was not found in a method blank from the same sample batch. Based on these latter results, the results the batch-associated field samples are acceptable. This analytical batch was comprised of sediment chemistry samples taken on July 23, 2014 .
4. The PRs for Fipronil, Fipronil Desulfinyl, Fipronil Sulfide, and Fipronil Sulfone for the MS sample with Lab ID 594647 paired with an MSD sample with Lab ID 594648 were not determined due to matrix interferences concealing added spike concentration. The LCS and LCSD sample PRs in the same sample batch (3515) were in control as well as the RPD for the pair. Additionally, none of these analytes were found in a method blank from the same sample batch. Based on these latter results, the results the batch-associated field samples are acceptable. This analytical batch was comprised of sediment chemistry samples taken on July 23, 2014 .
5. The PRs for Kepone for the MS sample with Lab ID 598129 paired with an MSD sample with Lab ID 598130 were not determined due to matrix interferences concealing added spike concentration. The LCS and LCSD sample PRs in the same sample batch (2176) were in control as well as the RPD for the pair. Additionally, this analyte was not found in a method blank from the same sample batch. Based on these latter results, the results the batch-associated field samples are acceptable. This analytical batch was comprised of sediment chemistry samples taken on July 23, 2014.

Three of the five exceptions listed above were due a single MS/MSD sample pair, indicating only three MS/MSD pairs were out of some control limits for a few analytes. Given these estimates of accuracy and precision, and with all of the field sample results being acceptable, all analyses were performed under adequately controlled conditions.

Surrogate Spikes

Surrogate spikes are pure organic compounds that are similar to the analytes of interest in chemical composition, extraction, and chromatography, but which are not normally found in environmental samples. Surrogate spikes are added to every sample (including QA/QC samples) and their PR is used to examine the overall efficiency of the method from sample preparation through extraction and analysis.

Surrogate spike method blank, LCS/LCSD, and MS/MSD samples were analyzed for Decachlorobiphenyl, Esfenvalerate-d6;#1, Esfenvalerate-d6;#2, and Tetrachloro-m-xylene. All PRs were within acceptable QA/QC limits, except for those listed in Table F-1.

Table F-1. Surrogate Spike QA/QC Samples Failing to Meet Percent Recovery Control Limits

Analyte	Lab Number	Sample Type [1]	Date Received	Percent Recovery	PR Control Limits (%)
Decachlorobiphenyl	598129	MS	7/22/2014	5.3	10-200
	598130	MSD	7/22/2014	4.5	10-200
Esfenvalerate-d6;#1	564487	Matrix QC (MS)	2/7/2014	65	70-130
	564488	Matrix QC (MSD)	2/7/2014	67	70-130
	574094	MB	3/26/2014	68	70-130
Esfenvalerate-d6;#2	564487	Matrix QC (MS)	2/7/2014	64	70-130
	564488	Matrix QC (MSD)	2/7/2014	68	70-130
	574094	MB	3/26/2014	68	70-130
Tetrachloro-m-xylene	594791	MB	7/22/2014	39	64-114
	594792	LCS	7/22/2014	50	64-114
	594793	LCSD	7/22/2014	51	64-114
	598129	MS	7/22/2014	750	10-200
	598130	MSD	7/22/2014	750	10-200

[1] MB = method blank; MS = matrix spike; MSD = matrix spike duplicate; LCS = laboratory control sample; LCSD = laboratory control duplicate sample

Toxicity

Four QA/QC measures were assessed by PER during the toxicity testing on *Hyallela azteca*:

- Maintenance of acceptable test conditions
- Negative Control testing
- Positive Control (reference toxicant) testing
- Concentration Response Relationship assessment

Maintenance of Acceptable Test Conditions

All test conditions (e.g., pH, D.O., temperature, etc.) were within acceptable limits for these tests, except for the July 22, 2014 sediment toxicity test. During that test, as the dissolved oxygen measurements were below the QA/QC limit of 2.5 mg/L immediately prior to test initiation, all of the samples except for the 544MSH062 sample were aerated during testing. All analyses were performed according to laboratory Standard Operating Procedures.

Negative Control Testing

The responses at the Lab Control treatments were acceptable.

Positive Control (reference toxicant) Testing

The February 6, 2014 reference toxicant toxicity test suggests that these organisms may have been slightly less sensitive to toxicant stress than is typical and that the survival responses in the accompanying stormwater tests should be interpreted judiciously.

The February 26, March 26, and July 22, 2014 reference toxicant test results were consistent with the "typical response" range established by the reference toxicant test database for this species, indicating that these organisms were responding to toxic stress in a typical fashion at those times.

Concentration Response Relationships

The concentration-response relationships for the reference toxicant tests were evaluated as per EPA guidelines (EPA-821-B-00-004), and were determined to be acceptable.

Sample Holding Times

The sample holding time refers to the maximum amount of time that can elapse between sample collection and sample analysis before the resulting data is considered to possibly be compromised. The holding time is driven by the properties of the constituent and how a sample is preserved and stored prior to analysis. Holding times were met for all constituents for all samples submitted to the laboratory, except in one case.

The organochlorine pesticide kepone sampled from sediment at the four stations on July 22, 2014 was also flagged by CAL as out of holding time. The samples for this analyte were delivered to the lab and extracted within 14 days as specified by the EPA method SW846 8081. After these samples were analyzed, the laboratory QA/QC sample results for kepone did not meet CAL QAQC criteria, and the kepone sample results were rejected. The original sample was reextracted and reanalyzed by CAL again after the 14 day holding time had elapsed in order to provide the most complete results, which were non-detected for all four stations. As a result, the July 22, 2014 kepone results were flagged as out of holding time by CAL.

References

EOA, AMS, and ARC, 2012. *BASMAA Regional Monitoring Coalition Creek Status Monitoring Program Quality Assurance Project Plan*. Prepared for Bay Area Stormwater Management Agencies Association. Version 1, February 1, 2012.

SWAMP, 2008. *SWAMP Quality Assurance Project Plan, Version 1.0.* Prepared for the California State Water Resources Control Board by the Surface Water Ambient Monitoring Program Quality Assurance Team. September 1, 2008.

SWAMP, 2013. *Quality Control and Sample Handling Guidelines*, Updated appendices to the SWAMP, 2008, Quality Assurance Project Plan, http://www.waterboards.ca.gov/water_issues/programs/swamp/mqo.shtml, April, 2013.

USGS, 2009. Hladik, M., Orlando J., and Kuivila, K., *Collection of Pyrethroids in Water and Sediment Matrices: Development and Validation of a Standard Operating Procedure*, Scientific Investigations Report 2009–5012, U.S. Department of the Interior, U.S. Geological Survey, 2009.

Table F-2: CCCWP SSID Study – Aquatic Chemistry QA/QC Samples

Lab Number	Sample Description [1]	Date Received	Analyte Group [2]	Analyte Name	Result	MDL	Reporting Limit	Units	Expected Result	Percent Recovery	Relative Percent Difference
564956	MB for HBN 508653 [SPR/6308]	2/7/2014	FIP	Fipronil	ND	0.5	1.5	ng/L			
564957	LCS for HBN 508653 [SPR/6308]	2/7/2014	FIP	Fipronil	14		1.5	ng/L	20	70	
564958	LCSD for HBN 508653 [SPR/6308]	2/7/2014	FIP	Fipronil	14		1.5	ng/L	20	70	0
570428	MB for HBN 510076 [SPR/6351]	3/4/2014	FIP	Fipronil	ND	0.5	1.5	ng/L			
570429	LCS for HBN 510076 [SPR/6351]	3/4/2014	FIP	Fipronil	18		1.5	ng/L	20	90	
570430	LCSD for HBN 510076 [SPR/6351]	3/4/2014	FIP	Fipronil	15		1.5	ng/L	20	75	16
574094	MB for HBN 511606 [SPR/6382]	3/26/2014	FIP	Fipronil	ND	0.5	1.5	ng/L			
574095	LCS for HBN 511606 [SPR/6382]	3/26/2014	FIP	Fipronil	16		1.5	ng/L	20	80	
574096	LCSD for HBN 511606 [SPR/6382]	3/26/2014	FIP	Fipronil	16		1.5	ng/L	20	80	0
564956	MB for HBN 508653 [SPR/6308]	2/7/2014	FIP	Fipronil Desulfinyl	ND	0.5	1.5	ng/L			
564957	LCS for HBN 508653 [SPR/6308]	2/7/2014	FIP	Fipronil Desulfinyl	15		1.5	ng/L	20	75	
564958	LCSD for HBN 508653 [SPR/6308]	2/7/2014	FIP	Fipronil Desulfinyl	16		1.5	ng/L	20	80	6.5
570428	MB for HBN 510076 [SPR/6351]	3/4/2014	FIP	Fipronil Desulfinyl	ND	0.5	1.5	ng/L			
570429	LCS for HBN 510076 [SPR/6351]	3/4/2014	FIP	Fipronil Desulfinyl	18		1.5	ng/L	20	90	
570430	LCSD for HBN 510076 [SPR/6351]	3/4/2014	FIP	Fipronil Desulfinyl	16		1.5	ng/L	20	80	10
574094	MB for HBN 511606 [SPR/6382]	3/26/2014	FIP	Fipronil Desulfinyl	ND	0.5	1.5	ng/L			
574095	LCS for HBN 511606 [SPR/6382]	3/26/2014	FIP	Fipronil Desulfinyl	16		1.5	ng/L	20	80	
574096	LCSD for HBN 511606 [SPR/6382]	3/26/2014	FIP	Fipronil Desulfinyl	15		1.5	ng/L	20	75	6.5
564956	MB for HBN 508653 [SPR/6308]	2/7/2014	FIP	Fipronil Sulfide	ND	0.5	1.5	ng/L			
564957	LCS for HBN 508653 [SPR/6308]	2/7/2014	FIP	Fipronil Sulfide	14		1.5	ng/L	20	70	
564958	LCSD for HBN 508653 [SPR/6308]	2/7/2014	FIP	Fipronil Sulfide	16		1.5	ng/L	20	80	13
570428	MB for HBN 510076 [SPR/6351]	3/4/2014	FIP	Fipronil Sulfide	ND	0.5	1.5	ng/L			
570429	LCS for HBN 510076 [SPR/6351]	3/4/2014	FIP	Fipronil Sulfide	17		1.5	ng/L	20	85	
570430	LCSD for HBN 510076 [SPR/6351]	3/4/2014	FIP	Fipronil Sulfide	15		1.5	ng/L	20	75	13
574094	MB for HBN 511606 [SPR/6382]	3/26/2014	FIP	Fipronil Sulfide	ND	0.5	1.5	ng/L			
574095	LCS for HBN 511606 [SPR/6382]	3/26/2014	FIP	Fipronil Sulfide	17		1.5	ng/L	20	85	

Table F-2: CCCWP SSID Study – Aquatic Chemistry QA/QC Samples

Lab Number	Sample Description [1]	Date Received	Analyte Group [2]	Analyte Name	Result	MDL	Reporting Limit	Units	Expected Result	Percent Recovery	Relative Percent Difference
574096	LCSD for HBN 511606 [SPR/6382]	3/26/2014	FIP	Fipronil Sulfide	16		1.5	ng/L	20	80	6.1
564956	MB for HBN 508653 [SPR/6308]	2/7/2014	FIP	Fipronil Sulfone	ND	0.5	1.5	ng/L			
564957	LCS for HBN 508653 [SPR/6308]	2/7/2014	FIP	Fipronil Sulfone	14		1.5	ng/L	20	70	
564958	LCSD for HBN 508653 [SPR/6308]	2/7/2014	FIP	Fipronil Sulfone	14		1.5	ng/L	20	70	0
570428	MB for HBN 510076 [SPR/6351]	3/4/2014	FIP	Fipronil Sulfone	ND	0.5	1.5	ng/L			
570429	LCS for HBN 510076 [SPR/6351]	3/4/2014	FIP	Fipronil Sulfone	16		1.5	ng/L	20	80	
570430	LCSD for HBN 510076 [SPR/6351]	3/4/2014	FIP	Fipronil Sulfone	15		1.5	ng/L	20	75	7.7
574094	MB for HBN 511606 [SPR/6382]	3/26/2014	FIP	Fipronil Sulfone	ND	0.5	1.5	ng/L			
574095	LCS for HBN 511606 [SPR/6382]	3/26/2014	FIP	Fipronil Sulfone	16		1.5	ng/L	20	80	
574096	LCSD for HBN 511606 [SPR/6382]	3/26/2014	FIP	Fipronil Sulfone	14		1.5	ng/L	20	70	13
565093	MB for HBN 508664 [SPR/6309]	2/7/2014	OP	4,4'-DDD	ND	0.004	0.1	µg/L			
565094	LCS for HBN 508664 [SPR/6309]	2/7/2014	OP	4,4'-DDD	0.21		0.1	µg/L	0.2	105	
565095	LCSD for HBN 508664 [SPR/6309]	2/7/2014	OP	4,4'-DDD	0.2		0.1	µg/L	0.2	100	4.9
570101	MB for HBN 510007 [SPR/6346]	3/1/2014	OP	4,4'-DDD	ND	0.004	0.1	µg/L			
570102	LCS for HBN 510007 [SPR/6346]	3/1/2014	OP	4,4'-DDD	0.16		0.1	µg/L	0.2	80	
570103	LCSD for HBN 510007 [SPR/6346]	3/1/2014	OP	4,4'-DDD	0.17		0.1	µg/L	0.2	85	6.1
574847	MB for HBN 511879 [SPR/6386]	3/26/2014	OP	4,4'-DDD	ND	0.004	0.1	µg/L			
574848	LCS for HBN 511879 [SPR/6386]	3/26/2014	OP	4,4'-DDD	0.15		0.1	µg/L	0.2	75	
574849	LCSD for HBN 511879 [SPR/6386]	3/26/2014	OP	4,4'-DDD	0.16		0.1	µg/L	0.2	80	6.5
565093	MB for HBN 508664 [SPR/6309]	2/7/2014	OP	4,4'-DDE	ND	0.003	0.1	µg/L			
565094	LCS for HBN 508664 [SPR/6309]	2/7/2014	OP	4,4'-DDE	0.19		0.1	µg/L	0.2	95	
565095	LCSD for HBN 508664 [SPR/6309]	2/7/2014	OP	4,4'-DDE	0.18		0.1	µg/L	0.2	90	5.4
570101	MB for HBN 510007 [SPR/6346]	3/1/2014	OP	4,4'-DDE	ND	0.003	0.1	µg/L			
570102	LCS for HBN 510007 [SPR/6346]	3/1/2014	OP	4,4'-DDE	0.16		0.1	µg/L	0.2	80	
570103	LCSD for HBN 510007 [SPR/6346]	3/1/2014	OP	4,4'-DDE	0.16		0.1	µg/L	0.2	80	0
574847	MB for HBN 511879 [SPR/6386]	3/26/2014	OP	4,4'-DDE	ND	0.003	0.1	µg/L			

Table F-2: CCCWP SSID Study – Aquatic Chemistry QA/QC Samples

Lab Number	Sample Description [1]	Date Received	Analyte Group [2]	Analyte Name	Result	MDL	Reporting Limit	Units	Expected Result	Percent Recovery	Relative Percent Difference
574848	LCS for HBN 511879 [SPR/6386]	3/26/2014	OP	4,4'-DDE	0.15		0.1	µg/L	0.2	75	
574849	LCSD for HBN 511879 [SPR/6386]	3/26/2014	OP	4,4'-DDE	0.15		0.1	µg/L	0.2	75	0
565093	MB for HBN 508664 [SPR/6309]	2/7/2014	OP	4,4'-DDT	ND	0.004	0.1	µg/L			
565094	LCS for HBN 508664 [SPR/6309]	2/7/2014	OP	4,4'-DDT	0.22		0.1	µg/L	0.2	110	
565095	LCSD for HBN 508664 [SPR/6309]	2/7/2014	OP	4,4'-DDT	0.2		0.1	µg/L	0.2	100	9.5
570101	MB for HBN 510007 [SPR/6346]	3/1/2014	OP	4,4'-DDT	ND	0.004	0.1	µg/L			
570102	LCS for HBN 510007 [SPR/6346]	3/1/2014	OP	4,4'-DDT	0.19		0.1	µg/L	0.2	95	
570103	LCSD for HBN 510007 [SPR/6346]	3/1/2014	OP	4,4'-DDT	0.19		0.1	µg/L	0.2	95	0
574847	MB for HBN 511879 [SPR/6386]	3/26/2014	OP	4,4'-DDT	ND	0.004	0.1	µg/L			
574848	LCS for HBN 511879 [SPR/6386]	3/26/2014	OP	4,4'-DDT	0.16		0.1	µg/L	0.2	80	
574849	LCSD for HBN 511879 [SPR/6386]	3/26/2014	OP	4,4'-DDT	0.17		0.1	µg/L	0.2	85	6.1
565093	MB for HBN 508664 [SPR/6309]	2/7/2014	OP	Aldrin	ND	0.004	0.05	µg/L			
565094	LCS for HBN 508664 [SPR/6309]	2/7/2014	OP	Aldrin	0.19		0.05	µg/L	0.2	95	
565095	LCSD for HBN 508664 [SPR/6309]	2/7/2014	OP	Aldrin	0.18		0.05	µg/L	0.2	90	5.4
570101	MB for HBN 510007 [SPR/6346]	3/1/2014	OP	Aldrin	ND	0.004	0.05	µg/L			
570102	LCS for HBN 510007 [SPR/6346]	3/1/2014	OP	Aldrin	0.15		0.05	µg/L	0.2	75	
570103	LCSD for HBN 510007 [SPR/6346]	3/1/2014	OP	Aldrin	0.16		0.05	µg/L	0.2	80	6.5
574847	MB for HBN 511879 [SPR/6386]	3/26/2014	OP	Aldrin	ND	0.004	0.05	µg/L			
574848	LCS for HBN 511879 [SPR/6386]	3/26/2014	OP	Aldrin	0.14		0.05	µg/L	0.2	70	
574849	LCSD for HBN 511879 [SPR/6386]	3/26/2014	OP	Aldrin	0.15		0.05	µg/L	0.2	75	6.9
565093	MB for HBN 508664 [SPR/6309]	2/7/2014	OP	alpha-BHC	ND	0.005	0.05	µg/L			
565094	LCS for HBN 508664 [SPR/6309]	2/7/2014	OP	alpha-BHC	0.19		0.05	µg/L	0.2	95	
565095	LCSD for HBN 508664 [SPR/6309]	2/7/2014	OP	alpha-BHC	0.19		0.05	µg/L	0.2	95	0
570101	MB for HBN 510007 [SPR/6346]	3/1/2014	OP	alpha-BHC	ND	0.005	0.05	µg/L			
570102	LCS for HBN 510007 [SPR/6346]	3/1/2014	OP	alpha-BHC	0.16		0.05	µg/L	0.2	80	
570103	LCSD for HBN 510007 [SPR/6346]	3/1/2014	OP	alpha-BHC	0.16		0.05	µg/L	0.2	80	0

Table F-2: CCCWP SSID Study – Aquatic Chemistry QA/QC Samples											
Lab Number	Sample Description [1]	Date Received	Analyte Group [2]	Analyte Name	Result	MDL	Reporting Limit	Units	Expected Result	Percent Recovery	Relative Percent Difference
574847	MB for HBN 511879 [SPR/6386]	3/26/2014	OP	alpha-BHC	ND	0.005	0.05	µg/L			
574848	LCS for HBN 511879 [SPR/6386]	3/26/2014	OP	alpha-BHC	0.14		0.05	µg/L	0.2	70	
574849	LCSD for HBN 511879 [SPR/6386]	3/26/2014	OP	alpha-BHC	0.16		0.05	µg/L	0.2	80	13
565093	MB for HBN 508664 [SPR/6309]	2/7/2014	OP	beta-BHC	ND	0.004	0.05	µg/L			
565094	LCS for HBN 508664 [SPR/6309]	2/7/2014	OP	beta-BHC	0.18		0.05	µg/L	0.2	90	
565095	LCSD for HBN 508664 [SPR/6309]	2/7/2014	OP	beta-BHC	0.15		0.05	µg/L	0.2	75	18
570101	MB for HBN 510007 [SPR/6346]	3/1/2014	OP	beta-BHC	ND	0.004	0.05	µg/L			
570102	LCS for HBN 510007 [SPR/6346]	3/1/2014	OP	beta-BHC	0.14		0.05	µg/L	0.2	70	
570103	LCSD for HBN 510007 [SPR/6346]	3/1/2014	OP	beta-BHC	0.15		0.05	µg/L	0.2	75	6.9
574847	MB for HBN 511879 [SPR/6386]	3/26/2014	OP	beta-BHC	ND	0.004	0.05	µg/L			
574848	LCS for HBN 511879 [SPR/6386]	3/26/2014	OP	beta-BHC	0.14		0.05	µg/L	0.2	70	
574849	LCSD for HBN 511879 [SPR/6386]	3/26/2014	OP	beta-BHC	0.15		0.05	µg/L	0.2	75	6.9
565093	MB for HBN 508664 [SPR/6309]	2/7/2014	OP	Chlordane	ND	0.02	0.5	µg/L			
570101	MB for HBN 510007 [SPR/6346]	3/1/2014	OP	Chlordane	ND	0.02	0.5	µg/L			
574847	MB for HBN 511879 [SPR/6386]	3/26/2014	OP	Chlordane	ND	0.02	0.5	µg/L			
565093	MB for HBN 508664 [SPR/6309]	2/7/2014	OP	delta-BHC	ND	0.004	0.05	µg/L			
565094	LCS for HBN 508664 [SPR/6309]	2/7/2014	OP	delta-BHC	0.18		0.05	µg/L	0.2	90	
565095	LCSD for HBN 508664 [SPR/6309]	2/7/2014	OP	delta-BHC	0.17		0.05	µg/L	0.2	85	5.7
570101	MB for HBN 510007 [SPR/6346]	3/1/2014	OP	delta-BHC	ND	0.004	0.05	µg/L			
570102	LCS for HBN 510007 [SPR/6346]	3/1/2014	OP	delta-BHC	0.14		0.05	µg/L	0.2	70	
570103	LCSD for HBN 510007 [SPR/6346]	3/1/2014	OP	delta-BHC	0.15		0.05	µg/L	0.2	75	6.9
574847	MB for HBN 511879 [SPR/6386]	3/26/2014	OP	delta-BHC	ND	0.004	0.05	µg/L			
574848	LCS for HBN 511879 [SPR/6386]	3/26/2014	OP	delta-BHC	0.12		0.05	µg/L	0.2	60	
574849	LCSD for HBN 511879 [SPR/6386]	3/26/2014	OP	delta-BHC	0.13		0.05	µg/L	0.2	65	8
565093	MB for HBN 508664 [SPR/6309]	2/7/2014	OP	Dieldrin	ND	0.004	0.1	µg/L			
565094	LCS for HBN 508664 [SPR/6309]	2/7/2014	OP	Dieldrin	0.22		0.1	µg/L	0.2	110	

Table F-2: CCCWP SSID Study – Aquatic Chemistry QA/QC Samples

Lab Number	Sample Description [1]	Date Received	Analyte Group [2]	Analyte Name	Result	MDL	Reporting Limit	Units	Expected Result	Percent Recovery	Relative Percent Difference
565095	LCSD for HBN 508664 [SPR/6309]	2/7/2014	OP	Dieldrin	0.2		0.1	µg/L	0.2	100	9.5
570101	MB for HBN 510007 [SPR/6346]	3/1/2014	OP	Dieldrin	ND	0.004	0.1	µg/L			
570102	LCS for HBN 510007 [SPR/6346]	3/1/2014	OP	Dieldrin	0.17		0.1	µg/L	0.2	85	
570103	LCSD for HBN 510007 [SPR/6346]	3/1/2014	OP	Dieldrin	0.17		0.1	µg/L	0.2	85	0
574847	MB for HBN 511879 [SPR/6386]	3/26/2014	OP	Dieldrin	ND	0.004	0.1	µg/L			
574848	LCS for HBN 511879 [SPR/6386]	3/26/2014	OP	Dieldrin	0.16		0.1	µg/L	0.2	80	
574849	LCSD for HBN 511879 [SPR/6386]	3/26/2014	OP	Dieldrin	0.17		0.1	µg/L	0.2	85	6.1
565093	MB for HBN 508664 [SPR/6309]	2/7/2014	OP	Endosulfan I	ND	0.004	0.05	µg/L			
565094	LCS for HBN 508664 [SPR/6309]	2/7/2014	OP	Endosulfan I	0.2		0.05	µg/L	0.2	98	
565095	LCSD for HBN 508664 [SPR/6309]	2/7/2014	OP	Endosulfan I	0.18		0.05	µg/L	0.2	90	8
570101	MB for HBN 510007 [SPR/6346]	3/1/2014	OP	Endosulfan I	ND	0.004	0.05	µg/L			
570102	LCS for HBN 510007 [SPR/6346]	3/1/2014	OP	Endosulfan I	0.16		0.05	µg/L	0.2	80	
570103	LCSD for HBN 510007 [SPR/6346]	3/1/2014	OP	Endosulfan I	0.17		0.05	µg/L	0.2	85	6.1
574847	MB for HBN 511879 [SPR/6386]	3/26/2014	OP	Endosulfan I	ND	0.004	0.05	µg/L			
574848	LCS for HBN 511879 [SPR/6386]	3/26/2014	OP	Endosulfan I	0.15		0.05	µg/L	0.2	75	
574849	LCSD for HBN 511879 [SPR/6386]	3/26/2014	OP	Endosulfan I	0.16		0.05	µg/L	0.2	80	6.5
565093	MB for HBN 508664 [SPR/6309]	2/7/2014	OP	Endosulfan II	ND	0.005	0.1	µg/L			
565094	LCS for HBN 508664 [SPR/6309]	2/7/2014	OP	Endosulfan II	0.19		0.1	µg/L	0.2	95	
565095	LCSD for HBN 508664 [SPR/6309]	2/7/2014	OP	Endosulfan II	0.18		0.1	µg/L	0.2	90	5.4
570101	MB for HBN 510007 [SPR/6346]	3/1/2014	OP	Endosulfan II	ND	0.005	0.1	µg/L			
570102	LCS for HBN 510007 [SPR/6346]	3/1/2014	OP	Endosulfan II	0.17		0.1	µg/L	0.2	85	
570103	LCSD for HBN 510007 [SPR/6346]	3/1/2014	OP	Endosulfan II	0.17		0.1	µg/L	0.2	85	0
574847	MB for HBN 511879 [SPR/6386]	3/26/2014	OP	Endosulfan II	ND	0.005	0.1	µg/L			
574848	LCS for HBN 511879 [SPR/6386]	3/26/2014	OP	Endosulfan II	0.16		0.1	µg/L	0.2	80	
574849	LCSD for HBN 511879 [SPR/6386]	3/26/2014	OP	Endosulfan II	0.17		0.1	µg/L	0.2	85	6.1
565093	MB for HBN 508664 [SPR/6309]	2/7/2014	OP	Endosulfan sulfate	ND	0.005	0.1	µg/L			

Table F-2: CCCWP SSID Study – Aquatic Chemistry QA/QC Samples

Lab Number	Sample Description [1]	Date Received	Analyte Group [2]	Analyte Name	Result	MDL	Reporting Limit	Units	Expected Result	Percent Recovery	Relative Percent Difference
565094	LCS for HBN 508664 [SPR/6309]	2/7/2014	OP	Endosulfan sulfate	0.22		0.1	µg/L	0.2	110	
565095	LCSD for HBN 508664 [SPR/6309]	2/7/2014	OP	Endosulfan sulfate	0.2		0.1	µg/L	0.2	100	9.5
570101	MB for HBN 510007 [SPR/6346]	3/1/2014	OP	Endosulfan sulfate	ND	0.005	0.1	µg/L			
570102	LCS for HBN 510007 [SPR/6346]	3/1/2014	OP	Endosulfan sulfate	0.18		0.1	µg/L	0.2	90	
570103	LCSD for HBN 510007 [SPR/6346]	3/1/2014	OP	Endosulfan sulfate	0.18		0.1	µg/L	0.2	90	0
574847	MB for HBN 511879 [SPR/6386]	3/26/2014	OP	Endosulfan sulfate	ND	0.005	0.1	µg/L			
574848	LCS for HBN 511879 [SPR/6386]	3/26/2014	OP	Endosulfan sulfate	0.16		0.1	µg/L	0.2	80	
574849	LCSD for HBN 511879 [SPR/6386]	3/26/2014	OP	Endosulfan sulfate	0.18		0.1	µg/L	0.2	90	12
565093	MB for HBN 508664 [SPR/6309]	2/7/2014	OP	Endrin	ND	0.005	0.1	µg/L			
565094	LCS for HBN 508664 [SPR/6309]	2/7/2014	OP	Endrin	0.18		0.1	µg/L	0.2	90	
565095	LCSD for HBN 508664 [SPR/6309]	2/7/2014	OP	Endrin	0.17		0.1	µg/L	0.2	85	5.7
570101	MB for HBN 510007 [SPR/6346]	3/1/2014	OP	Endrin	ND	0.005	0.1	µg/L			
570102	LCS for HBN 510007 [SPR/6346]	3/1/2014	OP	Endrin	0.14		0.1	µg/L	0.2	70	
570103	LCSD for HBN 510007 [SPR/6346]	3/1/2014	OP	Endrin	0.14		0.1	µg/L	0.2	70	0
574847	MB for HBN 511879 [SPR/6386]	3/26/2014	OP	Endrin	ND	0.005	0.1	µg/L			
574848	LCS for HBN 511879 [SPR/6386]	3/26/2014	OP	Endrin	0.15		0.1	µg/L	0.2	75	
574849	LCSD for HBN 511879 [SPR/6386]	3/26/2014	OP	Endrin	0.16		0.1	µg/L	0.2	80	6.5
565093	MB for HBN 508664 [SPR/6309]	2/7/2014	OP	Endrin aldehyde	ND	0.005	0.05	µg/L			
565094	LCS for HBN 508664 [SPR/6309]	2/7/2014	OP	Endrin aldehyde	0.21		0.05	µg/L	0.2	105	
565095	LCSD for HBN 508664 [SPR/6309]	2/7/2014	OP	Endrin aldehyde	0.2		0.05	µg/L	0.2	100	4.9
570101	MB for HBN 510007 [SPR/6346]	3/1/2014	OP	Endrin aldehyde	ND	0.005	0.05	µg/L			
570102	LCS for HBN 510007 [SPR/6346]	3/1/2014	OP	Endrin aldehyde	0.18		0.05	µg/L	0.2	90	
570103	LCSD for HBN 510007 [SPR/6346]	3/1/2014	OP	Endrin aldehyde	0.19		0.05	µg/L	0.2	95	5.4
574847	MB for HBN 511879 [SPR/6386]	3/26/2014	OP	Endrin aldehyde	ND	0.005	0.05	µg/L			
574848	LCS for HBN 511879 [SPR/6386]	3/26/2014	OP	Endrin aldehyde	0.18		0.05	µg/L	0.2	90	
574849	LCSD for HBN 511879 [SPR/6386]	3/26/2014	OP	Endrin aldehyde	0.2		0.05	µg/L	0.2	100	11

Table F-2: CCCWP SSID Study – Aquatic Chemistry QA/QC Samples

Lab Number	Sample Description [1]	Date Received	Analyte Group [2]	Analyte Name	Result	MDL	Reporting Limit	Units	Expected Result	Percent Recovery	Relative Percent Difference
565093	MB for HBN 508664 [SPR/6309]	2/7/2014	OP	Endrin ketone	ND	0.005	0.1	µg/L			
565094	LCS for HBN 508664 [SPR/6309]	2/7/2014	OP	Endrin ketone	0.21		0.1	µg/L	0.2	105	
565095	LCSD for HBN 508664 [SPR/6309]	2/7/2014	OP	Endrin ketone	0.2		0.1	µg/L	0.2	100	4.9
570101	MB for HBN 510007 [SPR/6346]	3/1/2014	OP	Endrin ketone	ND	0.005	0.1	µg/L			
570102	LCS for HBN 510007 [SPR/6346]	3/1/2014	OP	Endrin ketone	0.18		0.1	µg/L	0.2	90	
570103	LCSD for HBN 510007 [SPR/6346]	3/1/2014	OP	Endrin ketone	0.18		0.1	µg/L	0.2	90	0
574847	MB for HBN 511879 [SPR/6386]	3/26/2014	OP	Endrin ketone	ND	0.005	0.1	µg/L			
574848	LCS for HBN 511879 [SPR/6386]	3/26/2014	OP	Endrin ketone	0.16		0.1	µg/L	0.2	80	
574849	LCSD for HBN 511879 [SPR/6386]	3/26/2014	OP	Endrin ketone	0.17		0.1	µg/L	0.2	85	6.1
565093	MB for HBN 508664 [SPR/6309]	2/7/2014	OP	gamma-BHC (Lindane)	ND	0.004	0.05	µg/L			
565094	LCS for HBN 508664 [SPR/6309]	2/7/2014	OP	gamma-BHC (Lindane)	0.18		0.05	µg/L	0.2	90	
565095	LCSD for HBN 508664 [SPR/6309]	2/7/2014	OP	gamma-BHC (Lindane)	0.15		0.05	µg/L	0.2	75	18
570101	MB for HBN 510007 [SPR/6346]	3/1/2014	OP	gamma-BHC (Lindane)	ND	0.004	0.05	µg/L			
570102	LCS for HBN 510007 [SPR/6346]	3/1/2014	OP	gamma-BHC (Lindane)	0.16		0.05	µg/L	0.2	80	
570103	LCSD for HBN 510007 [SPR/6346]	3/1/2014	OP	gamma-BHC (Lindane)	0.16		0.05	µg/L	0.2	80	0
574847	MB for HBN 511879 [SPR/6386]	3/26/2014	OP	gamma-BHC (Lindane)	ND	0.004	0.05	µg/L			
574848	LCS for HBN 511879 [SPR/6386]	3/26/2014	OP	gamma-BHC (Lindane)	0.14		0.05	µg/L	0.2	70	
574849	LCSD for HBN 511879 [SPR/6386]	3/26/2014	OP	gamma-BHC (Lindane)	0.15		0.05	µg/L	0.2	75	6.9
565093	MB for HBN 508664 [SPR/6309]	2/7/2014	OP	Heptachlor	ND	0.005	0.05	µg/L			
565094	LCS for HBN 508664 [SPR/6309]	2/7/2014	OP	Heptachlor	0.2		0.05	µg/L	0.2	100	
565095	LCSD for HBN 508664 [SPR/6309]	2/7/2014	OP	Heptachlor	0.18		0.05	µg/L	0.2	90	11
570101	MB for HBN 510007 [SPR/6346]	3/1/2014	OP	Heptachlor	ND	0.005	0.05	µg/L			
570102	LCS for HBN 510007 [SPR/6346]	3/1/2014	OP	Heptachlor	0.16		0.05	µg/L	0.2	80	
570103	LCSD for HBN 510007 [SPR/6346]	3/1/2014	OP	Heptachlor	0.16		0.05	µg/L	0.2	80	0
574847	MB for HBN 511879 [SPR/6386]	3/26/2014	OP	Heptachlor	ND	0.005	0.05	µg/L			
574848	LCS for HBN 511879 [SPR/6386]	3/26/2014	OP	Heptachlor	0.14		0.05	µg/L	0.2	70	

Table F-2: CCCWP SSID Study – Aquatic Chemistry QA/QC Samples											
Lab Number	**Sample Description [1]**	**Date Received**	**Analyte Group [2]**	**Analyte Name**	**Result**	**MDL**	**Reporting Limit**	**Units**	**Expected Result**	**Percent Recovery**	**Relative Percent Difference**
574849	LCSD for HBN 511879 [SPR/6386]	3/26/2014	OP	Heptachlor	0.15		0.05	µg/L	0.2	75	6.9
565093	MB for HBN 508664 [SPR/6309]	2/7/2014	OP	Heptachlor epoxide	ND	0.004	0.05	µg/L			
565094	LCS for HBN 508664 [SPR/6309]	2/7/2014	OP	Heptachlor epoxide	0.2		0.05	µg/L	0.2	100	
565095	LCSD for HBN 508664 [SPR/6309]	2/7/2014	OP	Heptachlor epoxide	0.19		0.05	µg/L	0.2	95	5.1
570101	MB for HBN 510007 [SPR/6346]	3/1/2014	OP	Heptachlor epoxide	ND	0.004	0.05	µg/L			
570102	LCS for HBN 510007 [SPR/6346]	3/1/2014	OP	Heptachlor epoxide	0.16		0.05	µg/L	0.2	80	
570103	LCSD for HBN 510007 [SPR/6346]	3/1/2014	OP	Heptachlor epoxide	0.17		0.05	µg/L	0.2	85	6.1
574847	MB for HBN 511879 [SPR/6386]	3/26/2014	OP	Heptachlor epoxide	ND	0.004	0.05	µg/L			
574848	LCS for HBN 511879 [SPR/6386]	3/26/2014	OP	Heptachlor epoxide	0.15		0.05	µg/L	0.2	75	
574849	LCSD for HBN 511879 [SPR/6386]	3/26/2014	OP	Heptachlor epoxide	0.17		0.05	µg/L	0.2	85	13
565093	MB for HBN 508664 [SPR/6309]	2/7/2014	OP	Methoxychlor	ND	0.005	0.5	µg/L			
565094	LCS for HBN 508664 [SPR/6309]	2/7/2014	OP	Methoxychlor	0.22		0.5	µg/L	0.2	110	
565095	LCSD for HBN 508664 [SPR/6309]	2/7/2014	OP	Methoxychlor	0.2		0.5	µg/L	0.2	100	9.5
570101	MB for HBN 510007 [SPR/6346]	3/1/2014	OP	Methoxychlor	ND	0.005	0.5	µg/L			
570102	LCS for HBN 510007 [SPR/6346]	3/1/2014	OP	Methoxychlor	0.18		0.5	µg/L	0.2	90	
570103	LCSD for HBN 510007 [SPR/6346]	3/1/2014	OP	Methoxychlor	0.18		0.5	µg/L	0.2	90	0
574847	MB for HBN 511879 [SPR/6386]	3/26/2014	OP	Methoxychlor	ND	0.005	0.5	µg/L			
574848	LCS for HBN 511879 [SPR/6386]	3/26/2014	OP	Methoxychlor	0.15		0.5	µg/L	0.2	75	
574849	LCSD for HBN 511879 [SPR/6386]	3/26/2014	OP	Methoxychlor	0.17		0.5	µg/L	0.2	85	13
565093	MB for HBN 508664 [SPR/6309]	2/7/2014	OP	Toxaphene	ND	0.3	1	µg/L			
570101	MB for HBN 510007 [SPR/6346]	3/1/2014	OP	Toxaphene	ND	0.3	1	µg/L			
574847	MB for HBN 511879 [SPR/6386]	3/26/2014	OP	Toxaphene	ND	0.3	1	µg/L			
564069	MB for HBN 508501 [SPR/6300]	2/7/2014	PYR	Allethrin	ND	0.1	1.5	ng/L			
564070	LCS for HBN 508501 [SPR/6300]	2/7/2014	PYR	Allethrin	13		1.5	ng/L	20	65	
564071	LCSD for HBN 508501 [SPR/6300]	2/7/2014	PYR	Allethrin	14		1.5	ng/L	20	70	6.6
564487	Matrix QC (MS)	2/7/2014	PYR	Allethrin	14		1.5	ng/L	21	68	

Table F-2: CCCWP SSID Study – Aquatic Chemistry QA/QC Samples											
Lab Number	Sample Description [1]	Date Received	Analyte Group [2]	Analyte Name	Result	MDL	Reporting Limit	Units	Expected Result	Percent Recovery	Relative Percent Difference
564488	Matrix QC (MSD)	2/7/2014	PYR	Allethrin	15		1.5	ng/L	21	73	6.9
P020494001	Matrix QC (ORIG)	2/7/2014	PYR	Allethrin	ND	0.1	1.5	ng/L			
570428	MB for HBN 510076 [SPR/6351]	3/4/2014	PYR	Allethrin	ND	0.1	1.5	ng/L			
570429	LCS for HBN 510076 [SPR/6351]	3/4/2014	PYR	Allethrin	16		1.5	ng/L	20	80	
570430	LCSD for HBN 510076 [SPR/6351]	3/4/2014	PYR	Allethrin	16		1.5	ng/L	20	80	1.9
574094	MB for HBN 511606 [SPR/6382]	3/26/2014	PYR	Allethrin	ND	0.1	1.5	ng/L			
574095	LCS for HBN 511606 [SPR/6382]	3/26/2014	PYR	Allethrin	18		1.5	ng/L	20	90	
574096	LCSD for HBN 511606 [SPR/6382]	3/26/2014	PYR	Allethrin	19		1.5	ng/L	20	95	5.4
564069	MB for HBN 508501 [SPR/6300]	2/7/2014	PYR	Bifenthrin	ND	0.1	1.5	ng/L			
564070	LCS for HBN 508501 [SPR/6300]	2/7/2014	PYR	Bifenthrin	18		1.5	ng/L	20	90	
564071	LCSD for HBN 508501 [SPR/6300]	2/7/2014	PYR	Bifenthrin	18		1.5	ng/L	20	90	1.1
564487	Matrix QC (MS)	2/7/2014	PYR	Bifenthrin	17		1.5	ng/L	24.1	68	
564488	Matrix QC (MSD)	2/7/2014	PYR	Bifenthrin	18		1.5	ng/L	24.1	72	5.7
P020494001	Matrix QC (ORIG)	2/7/2014	PYR	Bifenthrin	3.1	0.1	1.5	ng/L			
570428	MB for HBN 510076 [SPR/6351]	3/4/2014	PYR	Bifenthrin	ND	0.1	1.5	ng/L			
570429	LCS for HBN 510076 [SPR/6351]	3/4/2014	PYR	Bifenthrin	18		1.5	ng/L	20	90	
570430	LCSD for HBN 510076 [SPR/6351]	3/4/2014	PYR	Bifenthrin	17		1.5	ng/L	20	85	3.5
574094	MB for HBN 511606 [SPR/6382]	3/26/2014	PYR	Bifenthrin	ND	0.1	1.5	ng/L			
574095	LCS for HBN 511606 [SPR/6382]	3/26/2014	PYR	Bifenthrin	18		1.5	ng/L	20	90	
574096	LCSD for HBN 511606 [SPR/6382]	3/26/2014	PYR	Bifenthrin	19		1.5	ng/L	20	95	5.4
564069	MB for HBN 508501 [SPR/6300]	2/7/2014	PYR	Cyfluthrin	ND	0.2	1.5	ng/L			
564070	LCS for HBN 508501 [SPR/6300]	2/7/2014	PYR	Cyfluthrin	16		1.5	ng/L	20	80	
564071	LCSD for HBN 508501 [SPR/6300]	2/7/2014	PYR	Cyfluthrin	17		1.5	ng/L	20	85	3.6
564487	Matrix QC (MS)	2/7/2014	PYR	Cyfluthrin	14		1.5	ng/L	21.3	66	
564488	Matrix QC (MSD)	2/7/2014	PYR	Cyfluthrin	15		1.5	ng/L	21.3	71	6.9
P020494001	Matrix QC (ORIG)	2/7/2014	PYR	Cyfluthrin	0.3 J	0.2	1.5	ng/L			

Table F-2: CCCWP SSID Study – Aquatic Chemistry QA/QC Samples

Lab Number	Sample Description [1]	Date Received	Analyte Group [2]	Analyte Name	Result	MDL	Reporting Limit	Units	Expected Result	Percent Recovery	Relative Percent Difference
570428	MB for HBN 510076 [SPR/6351]	3/4/2014	PYR	Cyfluthrin	ND	0.2	1.5	ng/L			
570429	LCS for HBN 510076 [SPR/6351]	3/4/2014	PYR	Cyfluthrin	18		1.5	ng/L	20	90	
570430	LCSD for HBN 510076 [SPR/6351]	3/4/2014	PYR	Cyfluthrin	17		1.5	ng/L	20	85	6.3
574094	MB for HBN 511606 [SPR/6382]	3/26/2014	PYR	Cyfluthrin	ND	0.2	1.5	ng/L			
574095	LCS for HBN 511606 [SPR/6382]	3/26/2014	PYR	Cyfluthrin	17		1.5	ng/L	20	85	
574096	LCSD for HBN 511606 [SPR/6382]	3/26/2014	PYR	Cyfluthrin	18		1.5	ng/L	20	90	5.7
564069	MB for HBN 508501 [SPR/6300]	2/7/2014	PYR	Cypermethrin	ND	0.2	1.5	ng/L			
564070	LCS for HBN 508501 [SPR/6300]	2/7/2014	PYR	Cypermethrin	17		1.5	ng/L	20	85	
564071	LCSD for HBN 508501 [SPR/6300]	2/7/2014	PYR	Cypermethrin	18		1.5	ng/L	20	90	4
564487	Matrix QC (MS)	2/7/2014	PYR	Cypermethrin	14		1.5	ng/L	21.6	65	
564488	Matrix QC (MSD)	2/7/2014	PYR	Cypermethrin	15		1.5	ng/L	21.6	70	6.9
P020494001	Matrix QC (ORIG)	2/7/2014	PYR	Cypermethrin	0.6 J	0.2	1.5	ng/L			
570428	MB for HBN 510076 [SPR/6351]	3/4/2014	PYR	Cypermethrin	ND	0.2	1.5	ng/L			
570429	LCS for HBN 510076 [SPR/6351]	3/4/2014	PYR	Cypermethrin	19		1.5	ng/L	20	95	
570430	LCSD for HBN 510076 [SPR/6351]	3/4/2014	PYR	Cypermethrin	18		1.5	ng/L	20	90	5.9
574094	MB for HBN 511606 [SPR/6382]	3/26/2014	PYR	Cypermethrin	ND	0.2	1.5	ng/L			
574095	LCS for HBN 511606 [SPR/6382]	3/26/2014	PYR	Cypermethrin	18		1.5	ng/L	20	90	
574096	LCSD for HBN 511606 [SPR/6382]	3/26/2014	PYR	Cypermethrin	19		1.5	ng/L	20	95	5.4
564069	MB for HBN 508501 [SPR/6300]	2/7/2014	PYR	Deltamethrin:Tralomethrin	ND	0.2	3	ng/L			
564070	LCS for HBN 508501 [SPR/6300]	2/7/2014	PYR	Deltamethrin:Tralomethrin	28		3	ng/L	40	70	
564071	LCSD for HBN 508501 [SPR/6300]	2/7/2014	PYR	Deltamethrin:Tralomethrin	28		3	ng/L	40	70	1.4
564487	Matrix QC (MS)	2/7/2014	PYR	Deltamethrin:Tralomethrin	21		3	ng/L	41	51	
564488	Matrix QC (MSD)	2/7/2014	PYR	Deltamethrin:Tralomethrin	22		3	ng/L	41	53	4.7
P020494001	Matrix QC (ORIG)	2/7/2014	PYR	Deltamethrin:Tralomethrin	ND	0.2	3	ng/L			
570428	MB for HBN 510076 [SPR/6351]	3/4/2014	PYR	Deltamethrin:Tralomethrin	ND	0.2	3	ng/L			
570429	LCS for HBN 510076 [SPR/6351]	3/4/2014	PYR	Deltamethrin:Tralomethrin	33		3	ng/L	40	83	

Table F-2: CCCWP SSID Study – Aquatic Chemistry QA/QC Samples

Lab Number	Sample Description [1]	Date Received	Analyte Group [2]	Analyte Name	Result	MDL	Reporting Limit	Units	Expected Result	Percent Recovery	Relative Percent Difference
570430	LCSD for HBN 510076 [SPR/6351]	3/4/2014	PYR	Deltamethrin:Tralomethrin	32		3	ng/L	40	80	3.1
574094	MB for HBN 511606 [SPR/6382]	3/26/2014	PYR	Deltamethrin:Tralomethrin	ND	0.2	3	ng/L			
574095	LCS for HBN 511606 [SPR/6382]	3/26/2014	PYR	Deltamethrin:Tralomethrin	31		3	ng/L	40	78	
574096	LCSD for HBN 511606 [SPR/6382]	3/26/2014	PYR	Deltamethrin:Tralomethrin	33		3	ng/L	40	83	6.3
564069	MB for HBN 508501 [SPR/6300]	2/7/2014	PYR	Esfenvalerate:Fenvalerate	ND	0.2	3	ng/L			
564070	LCS for HBN 508501 [SPR/6300]	2/7/2014	PYR	Esfenvalerate:Fenvalerate	31		3	ng/L	40	78	
564071	LCSD for HBN 508501 [SPR/6300]	2/7/2014	PYR	Esfenvalerate:Fenvalerate	32		3	ng/L	40	80	4.1
564487	Matrix QC (MS)	2/7/2014	PYR	Esfenvalerate:Fenvalerate	24		3	ng/L	41	58	
564488	Matrix QC (MSD)	2/7/2014	PYR	Esfenvalerate:Fenvalerate	26		3	ng/L	41	63	8
P020494001	Matrix QC (ORIG)	2/7/2014	PYR	Esfenvalerate:Fenvalerate	ND	0.2	3	ng/L			
570428	MB for HBN 510076 [SPR/6351]	3/4/2014	PYR	Esfenvalerate:Fenvalerate	ND	0.2	3	ng/L			
570429	LCS for HBN 510076 [SPR/6351]	3/4/2014	PYR	Esfenvalerate:Fenvalerate	34		3	ng/L	40	85	
570430	LCSD for HBN 510076 [SPR/6351]	3/4/2014	PYR	Esfenvalerate:Fenvalerate	32		3	ng/L	40	80	7.2
574094	MB for HBN 511606 [SPR/6382]	3/26/2014	PYR	Esfenvalerate:Fenvalerate	ND	0.2	3	ng/L			
574095	LCS for HBN 511606 [SPR/6382]	3/26/2014	PYR	Esfenvalerate:Fenvalerate	34		3	ng/L	40	85	
574096	LCSD for HBN 511606 [SPR/6382]	3/26/2014	PYR	Esfenvalerate:Fenvalerate	35		3	ng/L	40	88	2.9
564069	MB for HBN 508501 [SPR/6300]	2/7/2014	PYR	Fenpropathrin	ND	0.2	1.5	ng/L			
564070	LCS for HBN 508501 [SPR/6300]	2/7/2014	PYR	Fenpropathrin	20		1.5	ng/L	20	100	
564071	LCSD for HBN 508501 [SPR/6300]	2/7/2014	PYR	Fenpropathrin	20		1.5	ng/L	20	100	2
564487	Matrix QC (MS)	2/7/2014	PYR	Fenpropathrin	15		1.5	ng/L	21	73	
564488	Matrix QC (MSD)	2/7/2014	PYR	Fenpropathrin	15		1.5	ng/L	21	73	0
P020494001	Matrix QC (ORIG)	2/7/2014	PYR	Fenpropathrin	ND	0.2	1.5	ng/L			
570428	MB for HBN 510076 [SPR/6351]	3/4/2014	PYR	Fenpropathrin	ND	0.2	1.5	ng/L			
570429	LCS for HBN 510076 [SPR/6351]	3/4/2014	PYR	Fenpropathrin	27		1.5	ng/L	20	135	
570430	LCSD for HBN 510076 [SPR/6351]	3/4/2014	PYR	Fenpropathrin	21		1.5	ng/L	20	105	26
574094	MB for HBN 511606 [SPR/6382]	3/26/2014	PYR	Fenpropathrin	ND	0.2	1.5	ng/L			

Table F-2: CCCWP SSID Study – Aquatic Chemistry QA/QC Samples											
Lab Number	**Sample Description [1]**	**Date Received**	**Analyte Group [2]**	**Analyte Name**	**Result**	**MDL**	**Reporting Limit**	**Units**	**Expected Result**	**Percent Recovery**	**Relative Percent Difference**
574095	LCS for HBN 511606 [SPR/6382]	3/26/2014	PYR	Fenpropathrin	21		1.5	ng/L	20	105	
574096	LCSD for HBN 511606 [SPR/6382]	3/26/2014	PYR	Fenpropathrin	23		1.5	ng/L	20	115	9.1
564069	MB for HBN 508501 [SPR/6300]	2/7/2014	PYR	Lambda-Cyhalothrin	0.3 J	0.2	1.5	ng/L			
564070	LCS for HBN 508501 [SPR/6300]	2/7/2014	PYR	Lambda-Cyhalothrin	14		1.5	ng/L	20	70	
564071	LCSD for HBN 508501 [SPR/6300]	2/7/2014	PYR	Lambda-Cyhalothrin	15		1.5	ng/L	20	75	6.9
564487	Matrix QC (MS)	2/7/2014	PYR	Lambda-Cyhalothrin	12		1.5	ng/L	21.5	56	
564488	Matrix QC (MSD)	2/7/2014	PYR	Lambda-Cyhalothrin	12		1.5	ng/L	21.5	56	0
P020494001	Matrix QC (ORIG)	2/7/2014	PYR	Lambda-Cyhalothrin	0.5 J,B	0.2	1.5	ng/L			
570428	MB for HBN 510076 [SPR/6351]	3/4/2014	PYR	Lambda-Cyhalothrin	ND	0.2	1.5	ng/L			
570429	LCS for HBN 510076 [SPR/6351]	3/4/2014	PYR	Lambda-Cyhalothrin	20		1.5	ng/L	20	100	
570430	LCSD for HBN 510076 [SPR/6351]	3/4/2014	PYR	Lambda-Cyhalothrin	18		1.5	ng/L	20	90	8.5
574094	MB for HBN 511606 [SPR/6382]	3/26/2014	PYR	Lambda-Cyhalothrin	ND	0.2	1.5	ng/L			
574095	LCS for HBN 511606 [SPR/6382]	3/26/2014	PYR	Lambda-Cyhalothrin	16		1.5	ng/L	20	80	
574096	LCSD for HBN 511606 [SPR/6382]	3/26/2014	PYR	Lambda-Cyhalothrin	17		1.5	ng/L	20	85	6.1
564069	MB for HBN 508501 [SPR/6300]	2/7/2014	PYR	Permethrin	ND	2	15	ng/L			
564070	LCS for HBN 508501 [SPR/6300]	2/7/2014	PYR	Permethrin	85		15	ng/L	100	85	
564071	LCSD for HBN 508501 [SPR/6300]	2/7/2014	PYR	Permethrin	92		15	ng/L	100	92	7.9
564487	Matrix QC (MS)	2/7/2014	PYR	Permethrin	69		15	ng/L	100	67	
564488	Matrix QC (MSD)	2/7/2014	PYR	Permethrin	73		15	ng/L	100	71	5.6
P020494001	Matrix QC (ORIG)	2/7/2014	PYR	Permethrin	ND	2	15	ng/L			
570428	MB for HBN 510076 [SPR/6351]	3/4/2014	PYR	Permethrin	ND	2	15	ng/L			
570429	LCS for HBN 510076 [SPR/6351]	3/4/2014	PYR	Permethrin	110		15	ng/L	100	110	
570430	LCSD for HBN 510076 [SPR/6351]	3/4/2014	PYR	Permethrin	110		15	ng/L	100	110	0.9
574094	MB for HBN 511606 [SPR/6382]	3/26/2014	PYR	Permethrin	ND	2	15	ng/L			
574095	LCS for HBN 511606 [SPR/6382]	3/26/2014	PYR	Permethrin	75		15	ng/L	100	75	
574096	LCSD for HBN 511606 [SPR/6382]	3/26/2014	PYR	Permethrin	84		15	ng/L	100	84	11

Table F-2: CCCWP SSID Study – Aquatic Chemistry QA/QC Samples

Lab Number	Sample Description [1]	Date Received	Analyte Group [2]	Analyte Name	Result	MDL	Reporting Limit	Units	Expected Result	Percent Recovery	Relative Percent Difference
564069	MB for HBN 508501 [SPR/6300]	2/7/2014	PYR	Tau-Fluvalinate	ND	0.2	1.5	ng/L			
564070	LCS for HBN 508501 [SPR/6300]	2/7/2014	PYR	Tau-Fluvalinate	14		1.5	ng/L	20	70	
564071	LCSD for HBN 508501 [SPR/6300]	2/7/2014	PYR	Tau-Fluvalinate	15		1.5	ng/L	20	75	6.2
564487	Matrix QC (MS)	2/7/2014	PYR	Tau-Fluvalinate	12		1.5	ng/L	21	58	
564488	Matrix QC (MSD)	2/7/2014	PYR	Tau-Fluvalinate	12		1.5	ng/L	21	58	0
P020494001	Matrix QC (ORIG)	2/7/2014	PYR	Tau-Fluvalinate	ND	0.2	1.5	ng/L			
570428	MB for HBN 510076 [SPR/6351]	3/4/2014	PYR	Tau-Fluvalinate	ND	0.2	1.5	ng/L			
570429	LCS for HBN 510076 [SPR/6351]	3/4/2014	PYR	Tau-Fluvalinate	14		1.5	ng/L	20	70	
570430	LCSD for HBN 510076 [SPR/6351]	3/4/2014	PYR	Tau-Fluvalinate	13		1.5	ng/L	20	65	6
574094	MB for HBN 511606 [SPR/6382]	3/26/2014	PYR	Tau-Fluvalinate	ND	0.2	1.5	ng/L			
574095	LCS for HBN 511606 [SPR/6382]	3/26/2014	PYR	Tau-Fluvalinate	13		1.5	ng/L	20	65	
574096	LCSD for HBN 511606 [SPR/6382]	3/26/2014	PYR	Tau-Fluvalinate	13		1.5	ng/L	20	65	0
564069	MB for HBN 508501 [SPR/6300]	2/7/2014	PYR	Tetramethrin	ND	0.2	1.5	ng/L			
564070	LCS for HBN 508501 [SPR/6300]	2/7/2014	PYR	Tetramethrin	14		1.5	ng/L	20	70	
564071	LCSD for HBN 508501 [SPR/6300]	2/7/2014	PYR	Tetramethrin	12		1.5	ng/L	20	60	14
564487	Matrix QC (MS)	2/7/2014	PYR	Tetramethrin	15		1.5	ng/L	21	73	
564488	Matrix QC (MSD)	2/7/2014	PYR	Tetramethrin	15		1.5	ng/L	21	73	0
P020494001	Matrix QC (ORIG)	2/7/2014	PYR	Tetramethrin	ND	0.2	1.5	ng/L			
570428	MB for HBN 510076 [SPR/6351]	3/4/2014	PYR	Tetramethrin	ND	0.2	1.5	ng/L			
570429	LCS for HBN 510076 [SPR/6351]	3/4/2014	PYR	Tetramethrin	16		1.5	ng/L	20	80	
570430	LCSD for HBN 510076 [SPR/6351]	3/4/2014	PYR	Tetramethrin	15		1.5	ng/L	20	75	3.3
574094	MB for HBN 511606 [SPR/6382]	3/26/2014	PYR	Tetramethrin	ND	0.2	1.5	ng/L			
574095	LCS for HBN 511606 [SPR/6382]	3/26/2014	PYR	Tetramethrin	16		1.5	ng/L	20	80	
574096	LCSD for HBN 511606 [SPR/6382]	3/26/2014	PYR	Tetramethrin	16		1.5	ng/L	20	80	0
565093	MB for HBN 508664 [SPR/6309]	2/7/2014	SUR	Decachlorobiphenyl	93		30-190	%	0.2	93	
565094	LCS for HBN 508664 [SPR/6309]	2/7/2014	SUR	Decachlorobiphenyl	100		30-190	%	0.2	100	

Table F-2: CCCWP SSID Study – Aquatic Chemistry QA/QC Samples

Lab Number	Sample Description [1]	Date Received	Analyte Group [2]	Analyte Name	Result	MDL	Reporting Limit	Units	Expected Result	Percent Recovery	Relative Percent Difference
565095	LCSD for HBN 508664 [SPR/6309]	2/7/2014	SUR	Decachlorobiphenyl	95		30-190	%	0.2	95	5.1
570101	MB for HBN 510007 [SPR/6346]	3/1/2014	SUR	Decachlorobiphenyl	42		30-190	%	0.2	42	
570102	LCS for HBN 510007 [SPR/6346]	3/1/2014	SUR	Decachlorobiphenyl	49		30-190	%	0.2	49	
570103	LCSD for HBN 510007 [SPR/6346]	3/1/2014	SUR	Decachlorobiphenyl	46		30-190	%	0.2	46	7.4
574847	MB for HBN 511879 [SPR/6386]	3/26/2014	SUR	Decachlorobiphenyl	46		30-190	%	0.2	46	
574848	LCS for HBN 511879 [SPR/6386]	3/26/2014	SUR	Decachlorobiphenyl	49		30-190	%	0.2	49	
574849	LCSD for HBN 511879 [SPR/6386]	3/26/2014	SUR	Decachlorobiphenyl	55		30-190	%	0.2	55	13
564069	MB for HBN 508501 [SPR/6300]	2/7/2014	SUR	Esfenvalerate-d6;#1	94		70-130	%	10	94	
564070	LCS for HBN 508501 [SPR/6300]	2/7/2014	SUR	Esfenvalerate-d6;#1	93		70-130	%	10	93	
564071	LCSD for HBN 508501 [SPR/6300]	2/7/2014	SUR	Esfenvalerate-d6;#1	100		70-130	%	20	100	73
564487	Matrix QC (MS)	2/7/2014	SUR	Esfenvalerate-d6;#1	65		70-130	%	10	65	
564488	Matrix QC (MSD)	2/7/2014	SUR	Esfenvalerate-d6;#1	67		70-130	%	10	67	3.1
564956	MB for HBN 508653 [SPR/6308]	2/7/2014	SUR	Esfenvalerate-d6;#1	80		70-130	%	10	80	
564957	LCS for HBN 508653 [SPR/6308]	2/7/2014	SUR	Esfenvalerate-d6;#1	84		70-130	%	10	84	
564958	LCSD for HBN 508653 [SPR/6308]	2/7/2014	SUR	Esfenvalerate-d6;#1	89		70-130	%	10	89	5.8
570428	MB for HBN 510076 [SPR/6351]	3/4/2014	SUR	Esfenvalerate-d6;#1	90		70-130	%	10	90	
570429	LCS for HBN 510076 [SPR/6351]	3/4/2014	SUR	Esfenvalerate-d6;#1	85		70-130	%	10	85	
570430	LCSD for HBN 510076 [SPR/6351]	3/4/2014	SUR	Esfenvalerate-d6;#1	75		70-130	%	10	75	13
574094	MB for HBN 511606 [SPR/6382]	3/26/2014	SUR	Esfenvalerate-d6;#1	68		70-130	%	10	68	
574095	LCS for HBN 511606 [SPR/6382]	3/26/2014	SUR	Esfenvalerate-d6;#1	79		70-130	%	10	79	
574096	LCSD for HBN 511606 [SPR/6382]	3/26/2014	SUR	Esfenvalerate-d6;#1	80		70-130	%	10	80	1.3
564069	MB for HBN 508501 [SPR/6300]	2/7/2014	SUR	Esfenvalerate-d6;#2	89		70-130	%	10	89	
564070	LCS for HBN 508501 [SPR/6300]	2/7/2014	SUR	Esfenvalerate-d6;#2	88		70-130	%	10	88	
564071	LCSD for HBN 508501 [SPR/6300]	2/7/2014	SUR	Esfenvalerate-d6;#2	95		70-130	%	20	95	73
564487	Matrix QC (MS)	2/7/2014	SUR	Esfenvalerate-d6;#2	64		70-130	%	10	64	
564488	Matrix QC (MSD)	2/7/2014	SUR	Esfenvalerate-d6;#2	68		70-130	%	10	68	6

Table F-2: CCCWP SSID Study – Aquatic Chemistry QA/QC Samples											
Lab Number	**Sample Description [1]**	**Date Received**	**Analyte Group [2]**	**Analyte Name**	**Result**	**MDL**	**Reporting Limit**	**Units**	**Expected Result**	**Percent Recovery**	**Relative Percent Difference**
564956	MB for HBN 508653 [SPR/6308]	2/7/2014	SUR	Esfenvalerate-d6;#2	81		70-130	%	10	81	
564957	LCS for HBN 508653 [SPR/6308]	2/7/2014	SUR	Esfenvalerate-d6;#2	83		70-130	%	10	83	
564958	LCSD for HBN 508653 [SPR/6308]	2/7/2014	SUR	Esfenvalerate-d6;#2	90		70-130	%	10	90	8.1
570428	MB for HBN 510076 [SPR/6351]	3/4/2014	SUR	Esfenvalerate-d6;#2	87		70-130	%	10	87	
570429	LCS for HBN 510076 [SPR/6351]	3/4/2014	SUR	Esfenvalerate-d6;#2	85		70-130	%	10	85	
570430	LCSD for HBN 510076 [SPR/6351]	3/4/2014	SUR	Esfenvalerate-d6;#2	75		70-130	%	10	75	13
574094	MB for HBN 511606 [SPR/6382]	3/26/2014	SUR	Esfenvalerate-d6;#2	68		70-130	%	10	68	
574095	LCS for HBN 511606 [SPR/6382]	3/26/2014	SUR	Esfenvalerate-d6;#2	79		70-130	%	10	79	
574096	LCSD for HBN 511606 [SPR/6382]	3/26/2014	SUR	Esfenvalerate-d6;#2	81		70-130	%	10	81	2.5
565093	MB for HBN 508664 [SPR/6309]	2/7/2014	SUR	Tetrachloro-m-xylene	75		25-105	%	0.2	75	
565094	LCS for HBN 508664 [SPR/6309]	2/7/2014	SUR	Tetrachloro-m-xylene	80		25-105	%	0.2	80	
565095	LCSD for HBN 508664 [SPR/6309]	2/7/2014	SUR	Tetrachloro-m-xylene	75		25-105	%	0.2	75	6.5
570101	MB for HBN 510007 [SPR/6346]	3/1/2014	SUR	Tetrachloro-m-xylene	78		25-105	%	0.2	78	
570102	LCS for HBN 510007 [SPR/6346]	3/1/2014	SUR	Tetrachloro-m-xylene	75		25-105	%	0.2	75	
570103	LCSD for HBN 510007 [SPR/6346]	3/1/2014	SUR	Tetrachloro-m-xylene	80		25-105	%	0.2	80	6.5
574847	MB for HBN 511879 [SPR/6386]	3/26/2014	SUR	Tetrachloro-m-xylene	62		25-105	%	0.2	62	
574848	LCS for HBN 511879 [SPR/6386]	3/26/2014	SUR	Tetrachloro-m-xylene	65		25-105	%	0.2	65	
574849	LCSD for HBN 511879 [SPR/6386]	3/26/2014	SUR	Tetrachloro-m-xylene	70		25-105	%	0.2	70	7.4
564892	MB for HBN 508630 [BIO/13477]	2/7/2014	PS	Sediment Concentration	ND	2	3	mg/L			
564893	LCS for HBN 508630 [BIO/13477]	2/7/2014	PS	Sediment Concentration	467		3	mg/L	500	93	
564894	LCSD for HBN 508630 [BIO/13477	2/7/2014	PS	Sediment Concentration	489		3	mg/L	500	98	4.6
570093	MB for HBN 510004 [BIO/13574]	3/1/2014	PS	Sediment Concentration	ND	2	3	mg/L			
570094	LCS for HBN 510004 [BIO/13574]	3/1/2014	PS	Sediment Concentration	508		3	mg/L	500	102	
570095	LCSD for HBN 510004 [BIO/13574	3/1/2014	PS	Sediment Concentration	506		3	mg/L	500	101	0.4
574708	MB for HBN 511837 [BIO/13669]	3/26/2014	PS	Sediment Concentration	ND	2	3	mg/L			
574709	LCS for HBN 511837 [BIO/13669]	3/26/2014	PS	Sediment Concentration	477		3	mg/L	500	95	

Table F-2: CCCWP SSID Study – Aquatic Chemistry QA/QC Samples

Lab Number	Sample Description [1]	Date Received	Analyte Group [2]	Analyte Name	Result	MDL	Reporting Limit	Units	Expected Result	Percent Recovery	Relative Percent Difference
574762	LCSD for HBN 511837 [BIO/13669	4/1/2014	PS	Sediment Concentration	484		3	mg/L	500	97	1.5
566585	MB for HBN 508976 [WET/7444]	2/6/2014	TOC	Total Organic Carbon	ND	0.3	1	mg/L			
566586	LCS for HBN 508976 [WET/7444]	2/6/2014	TOC	Total Organic Carbon	10		1	mg/L	10	100	
566657	Matrix QC (MS)	2/7/2014	TOC	Total Organic Carbon	28		1	mg/L	26	116	
566658	Matrix QC (MSD)	2/7/2014	TOC	Total Organic Carbon	28		1	mg/L	26	116	0
566659	544MSH065-(566659MS)	2/7/2014	TOC	Total Organic Carbon	24		1	mg/L	26	84	
566660	544MSH065-(566659MSD)	2/7/2014	TOC	Total Organic Carbon	25		1	mg/L	26	94	4.1
P020479022	Matrix QC (ORIG)	2/7/2014	TOC	Total Organic Carbon	16	0.3	0.5	mg/L			
571219	MB for HBN 510359 [WET/7502]	3/4/2014	TOC	Total Organic Carbon	ND	0.3	1	mg/L			
571220	LCS for HBN 510359 [WET/7502]	3/4/2014	TOC	Total Organic Carbon	10		1	mg/L	10	100	
571221	Matrix QC (MS)	3/4/2014	TOC	Total Organic Carbon	18		1	mg/L	18.1	99	
571222	Matrix QC (MSD)	3/4/2014	TOC	Total Organic Carbon	18		1	mg/L	18.1	99	0
P030133001	Matrix QC (ORIG)	3/4/2014	TOC	Total Organic Carbon	8.1	0.3	1	mg/L			
574492	MB for HBN 511744 [WET/7533]	3/26/2014	TOC	Total Organic Carbon	ND	0.3	1	mg/L			
574493	LCS for HBN 511744 [WET/7533]	3/26/2014	TOC	Total Organic Carbon	10		1	mg/L	10	100	
574497	Matrix QC (MS)	3/26/2014	TOC	Total Organic Carbon	13		1	mg/L	13.6	94	
574498	Matrix QC (MSD)	3/26/2014	TOC	Total Organic Carbon	13		1	mg/L	13.6	94	0
P031026001	Matrix QC (ORIG)	3/26/2014	TOC	Total Organic Carbon	3.6	0.3	1	mg/L			

J Analyte detected below Reporting Limit. Result is an estimate.
B Analyte detected in method blank.
[1] MB = Method Blank, LCS = Laboratory Control Sample, LCSD = Laboratory Control Duplicate Sample, MS = Matrix Spike, MSD = Matrix Spike Duplicate, DUP = Laboratory Duplicate, ORIG = Original Field Sample Result
[2] FIP = Fipronils, OP = Organochlorine Pesticides, PYR = Pyrethroid Pesticides, SUR = Surrogates, PS = Particle Size, TOC = Total Organic Carbon

Table F-3: CCCWP SSID Study – Sediment Chemistry QA/QC Samples

Lab Number	Sample Description [1]	Date Received	Analyte Group [2]	Analyte Name	Result	MDL	Reporting Limit	Units	Expected Result	Percent Recovery	Relative Percent Difference
594644	MB for HBN 524523 [SPR/6555]	7/22/2014	FIP	Fipronil	ND	0.1	0.25	µg/kg			
594645	LCS for HBN 524523 [SPR/6555]	7/22/2014	FIP	Fipronil	2.2	0.5	1.2	µg/kg	2.5	89	
594646	LCSD for HBN 524523 [SPR/6555]	7/22/2014	FIP	Fipronil	2.6	0.5	1.2	µg/kg	2.5	104	16
594647	Matrix QC (MS)	7/24/2014	FIP	Fipronil	1.7	0.2	0.5	µg/kg			
594648	Matrix QC (MSD)	7/24/2014	FIP	Fipronil	1.4	0.2	0.5	µg/kg			15
594644	MB for HBN 524523 [SPR/6555]	7/22/2014	FIP	Fipronil Desulfinyl	ND	0.1	0.25	µg/kg			
594645	LCS for HBN 524523 [SPR/6555]	7/22/2014	FIP	Fipronil Desulfinyl	2.1	0.5	1.2	µg/kg	2.5	86	
594646	LCSD for HBN 524523 [SPR/6555]	7/22/2014	FIP	Fipronil Desulfinyl	2.6	0.5	1.2	µg/kg	2.5	104	19
594647	Matrix QC (MS)	7/24/2014	FIP	Fipronil Desulfinyl	1.9	0.2	0.5	µg/kg			
594648	Matrix QC (MSD)	7/24/2014	FIP	Fipronil Desulfinyl	1.7	0.2	0.5	µg/kg			12
594644	MB for HBN 524523 [SPR/6555]	7/22/2014	FIP	Fipronil Sulfide	ND	0.1	0.25	µg/kg			
594645	LCS for HBN 524523 [SPR/6555]	7/22/2014	FIP	Fipronil Sulfide	2.2	0.5	1.2	µg/kg	2.5	86	
594646	LCSD for HBN 524523 [SPR/6555]	7/22/2014	FIP	Fipronil Sulfide	2.6	0.5	1.2	µg/kg	2.5	105	20
594647	Matrix QC (MS)	7/24/2014	FIP	Fipronil Sulfide	1.8	0.2	0.5	µg/kg			
594648	Matrix QC (MSD)	7/24/2014	FIP	Fipronil Sulfide	1.5	0.2	0.5	µg/kg			15
594644	MB for HBN 524523 [SPR/6555]	7/22/2014	FIP	Fipronil Sulfone	ND	0.1	0.25	µg/kg			
594645	LCS for HBN 524523 [SPR/6555]	7/22/2014	FIP	Fipronil Sulfone	2.2	0.5	1.2	µg/kg	2.5	87	
594646	LCSD for HBN 524523 [SPR/6555]	7/22/2014	FIP	Fipronil Sulfone	2.7	0.5	1.2	µg/kg	2.5	106	20
594647	Matrix QC (MS)	7/24/2014	FIP	Fipronil Sulfone	2	0.2	0.5	µg/kg			
594648	Matrix QC (MSD)	7/24/2014	FIP	Fipronil Sulfone	1.9	0.2	0.5	µg/kg			8.7
594791	MB for HBN 524561 [SPR/6556]	7/22/2014	OP	2,4'-DDD	ND	0.002	0.002	mg/kg			
594791	MB for HBN 524561 [SPR/6556]	7/22/2014	OP	2,4'-DDE	ND	0.002	0.002	mg/kg			
594791	MB for HBN 524561 [SPR/6556]	7/22/2014	OP	2,4'-DDT	ND	0.002	0.002	mg/kg			
594791	MB for HBN 524561 [SPR/6556]	7/22/2014	OP	4,4'-DDD	ND	0.0008	0.002	mg/kg			
594791	MB for HBN 524561 [SPR/6556]	7/22/2014	OP	4,4'-DDE	ND	0.0012	0.002	mg/kg			
594791	MB for HBN 524561 [SPR/6556]	7/22/2014	OP	4,4'-DDT	ND	0.001	0.002	mg/kg			

Table F-3: CCCWP SSID Study – Sediment Chemistry QA/QC Samples											
Lab Number	Sample Description [1]	Date Received	Analyte Group [2]	Analyte Name	Result	MDL	Reporting Limit	Units	Expected Result	Percent Recovery	Relative Percent Difference
594792	LCS for HBN 524561 [SPR/6556]	7/22/2014	OP	4,4'-DDT	0.0093	0.001	0.002	mg/kg	0.013	70	
594793	LCSD for HBN 524561 [SPR/6556]	7/22/2014	OP	4,4'-DDT	0.0092	0.001	0.002	mg/kg	0.013	69	0.9
594794	Matrix QC (MS)	7/24/2014	OP	4,4'-DDT	0.0081	0.001	0.002	mg/kg	0.013	61	
594795	Matrix QC (MSD)	7/24/2014	OP	4,4'-DDT	0.0075	0.001	0.002	mg/kg	0.013	56	7.4
P070963003	Matrix QC (ORIG)	7/24/2014	OP	4,4'-DDT	ND	0.42	3	ng/g			
594791	MB for HBN 524561 [SPR/6556]	7/22/2014	OP	Aldrin	ND	0.0009	0.002	mg/kg			
594792	LCS for HBN 524561 [SPR/6556]	7/22/2014	OP	Aldrin	0.0098	0.0009	0.002	mg/kg	0.013	73	
594793	LCSD for HBN 524561 [SPR/6556]	7/22/2014	OP	Aldrin	0.009	0.0009	0.002	mg/kg	0.013	68	7.9
594794	Matrix QC (MS)	7/24/2014	OP	Aldrin	0.012	0.0009	0.002	mg/kg	0.013	93	
594795	Matrix QC (MSD)	7/24/2014	OP	Aldrin	0.012	0.0009	0.002	mg/kg	0.013	93	0
594791	MB for HBN 524561 [SPR/6556]	7/22/2014	OP	alpha-BHC	ND	0.0009	0.002	mg/kg			
594791	MB for HBN 524561 [SPR/6556]	7/22/2014	OP	alpha-Chlordane (cis)	ND	0.001	0.002	mg/kg			
594791	MB for HBN 524561 [SPR/6556]	7/22/2014	OP	beta-BHC	ND	0.0009	0.002	mg/kg			
594791	MB for HBN 524561 [SPR/6556]	7/22/2014	OP	Chlordane	ND	0.003	0.004	mg/kg			
594791	MB for HBN 524561 [SPR/6556]	7/22/2014	OP	delta-BHC	ND	0.0007	0.002	mg/kg			
594791	MB for HBN 524561 [SPR/6556]	7/22/2014	OP	Dieldrin	ND	0.0012	0.002	mg/kg			
594792	LCS for HBN 524561 [SPR/6556]	7/22/2014	OP	Dieldrin	0.01	0.0012	0.002	mg/kg	0.013	75	
594793	LCSD for HBN 524561 [SPR/6556]	7/22/2014	OP	Dieldrin	0.01	0.0012	0.002	mg/kg	0.013	76	1
594794	Matrix QC (MS)	7/24/2014	OP	Dieldrin	0.014	0.0012	0.002	mg/kg	0.013	101	
594795	Matrix QC (MSD)	7/24/2014	OP	Dieldrin	0.013	0.0012	0.002	mg/kg	0.013	101	0.7
P070963003	Matrix QC (ORIG)	7/24/2014	OP	Dieldrin	ND	0.74	3	ng/g			
594791	MB for HBN 524561 [SPR/6556]	7/22/2014	OP	Endosulfan I	ND	0.0009	0.002	mg/kg			
594791	MB for HBN 524561 [SPR/6556]	7/22/2014	OP	Endosulfan II	ND	0.0007	0.002	mg/kg			
594791	MB for HBN 524561 [SPR/6556]	7/22/2014	OP	Endosulfan sulfate	ND	0.0009	0.002	mg/kg			
594792	LCS for HBN 524561 [SPR/6556]	7/22/2014	OP	Endosulfan sulfate	0.01	0.0009	0.002	mg/kg	0.013	77	
594793	LCSD for HBN 524561 [SPR/6556]	7/22/2014	OP	Endosulfan sulfate	0.0099	0.0009	0.002	mg/kg	0.013	75	2.6

Table F-3: CCCWP SSID Study – Sediment Chemistry QA/QC Samples

Lab Number	Sample Description [1]	Date Received	Analyte Group [2]	Analyte Name	Result	MDL	Reporting Limit	Units	Expected Result	Percent Recovery	Relative Percent Difference
594794	Matrix QC (MS)	7/24/2014	OP	Endosulfan sulfate	0.013	0.0009	0.002	mg/kg	0.013	99	
594795	Matrix QC (MSD)	7/24/2014	OP	Endosulfan sulfate	0.013	0.0009	0.002	mg/kg	0.013	95	4.7
594791	MB for HBN 524561 [SPR/6556]	7/22/2014	OP	Endrin	ND	0.001	0.002	mg/kg			
594792	LCS for HBN 524561 [SPR/6556]	7/22/2014	OP	Endrin	0.01	0.001	0.002	mg/kg	0.013	77	
594793	LCSD for HBN 524561 [SPR/6556]	7/22/2014	OP	Endrin	0.0099	0.001	0.002	mg/kg	0.013	74	3.2
594794	Matrix QC (MS)	7/24/2014	OP	Endrin	0.013	0.001	0.002	mg/kg	0.013	98	
594795	Matrix QC (MSD)	7/24/2014	OP	Endrin	0.013	0.001	0.002	mg/kg	0.013	95	3.1
P070963003	Matrix QC (ORIG)	7/24/2014	OP	Endrin	ND	0.78	3	ng/g			
594791	MB for HBN 524561 [SPR/6556]	7/22/2014	OP	Endrin aldehyde	ND	0.0009	0.002	mg/kg			
594791	MB for HBN 524561 [SPR/6556]	7/22/2014	OP	Endrin ketone	ND	0.0009	0.002	mg/kg			
594791	MB for HBN 524561 [SPR/6556]	7/22/2014	OP	gamma-BHC (Lindane)	ND	0.0007	0.002	mg/kg			
594792	LCS for HBN 524561 [SPR/6556]	7/22/2014	OP	gamma-BHC (Lindane)	0.009	0.0007	0.002	mg/kg	0.013	67	
594793	LCSD for HBN 524561 [SPR/6556]	7/22/2014	OP	gamma-BHC (Lindane)	0.0086	0.0007	0.002	mg/kg	0.013	64	4.4
594794	Matrix QC (MS)	7/24/2014	OP	gamma-BHC (Lindane)	0.0099	0.0007	0.002	mg/kg	0.013	75	
594795	Matrix QC (MSD)	7/24/2014	OP	gamma-BHC (Lindane)	0.01	0.0007	0.002	mg/kg	0.013	76	1.6
P070963003	Matrix QC (ORIG)	7/24/2014	OP	gamma-BHC (Lindane)	ND	0.68	6	ng/g			
594791	MB for HBN 524561 [SPR/6556]	7/22/2014	OP	gamma-Chlordane (trans)	ND	0.001	0.002	mg/kg			
594791	MB for HBN 524561 [SPR/6556]	7/22/2014	OP	Heptachlor	ND	0.0006	0.002	mg/kg			
594792	LCS for HBN 524561 [SPR/6556]	7/22/2014	OP	Heptachlor	0.0074	0.0006	0.002	mg/kg	0.013	55	
594793	LCSD for HBN 524561 [SPR/6556]	7/22/2014	OP	Heptachlor	0.0076	0.0006	0.002	mg/kg	0.013	57	2.7
594794	Matrix QC (MS)	7/24/2014	OP	Heptachlor	0.0072	0.0006	0.002	mg/kg	0.013	54	
594795	Matrix QC (MSD)	7/24/2014	OP	Heptachlor	0.0073	0.0006	0.002	mg/kg	0.013	55	2.2
594791	MB for HBN 524561 [SPR/6556]	7/22/2014	OP	Heptachlor epoxide	ND	0.0011	0.002	mg/kg			
598126	MB for HBN 525999 [SPR/6584]	7/22/2014	OP	Kepone	ND	0.009	0.02	mg/kg			
598127	LCS for HBN 525999 [SPR/6584]	7/22/2014	OP	Kepone	0.04	0.009	0.02	mg/kg	0.2	22	
598128	LCSD for HBN 525999 [SPR/6584]	7/22/2014	OP	Kepone	0.05	0.009	0.02	mg/kg	0.2	23	1.8

Table F-3: CCCWP SSID Study – Sediment Chemistry QA/QC Samples

Lab Number	Sample Description [1]	Date Received	Analyte Group [2]	Analyte Name	Result	MDL	Reporting Limit	Units	Expected Result	Percent Recovery	Relative Percent Difference
598129	207WAL060-(598129MS)	7/22/2014	OP	Kepone	0	0.009	0.02	mg/kg	0.01	0	
598130	207WAL060-(598130MSD)	7/22/2014	OP	Kepone	0	0.009	0.02	mg/kg	0.01	0	0
594791	MB for HBN 524561 [SPR/6556]	7/22/2014	OP	Methoxychlor	ND	0.0009	0.002	mg/kg			
594792	LCS for HBN 524561 [SPR/6556]	7/22/2014	OP	Methoxychlor	0.0078	0.0009	0.002	mg/kg	0.013	59	
594793	LCSD for HBN 524561 [SPR/6556]	7/22/2014	OP	Methoxychlor	0.0073	0.0009	0.002	mg/kg	0.013	55	6.6
594794	Matrix QC (MS)	7/24/2014	OP	Methoxychlor	0.0094	0.0009	0.002	mg/kg	0.013	70	
594795	Matrix QC (MSD)	7/24/2014	OP	Methoxychlor	0.0086	0.0009	0.002	mg/kg	0.013	64	8.8
594791	MB for HBN 524561 [SPR/6556]	7/22/2014	OP	Mirex	ND	0.0005	0.02	mg/kg			
594791	MB for HBN 524561 [SPR/6556]	7/22/2014	OP	Toxaphene	ND	0.02	0.04	mg/kg			
594644	MB for HBN 524523 [SPR/6555]	7/22/2014	PYR	Allethrin	ND	0.05	0.25	µg/kg			
594645	LCS for HBN 524523 [SPR/6555]	7/22/2014	PYR	Allethrin	2.6	0.25	1.2	µg/kg	2.5	106	
594646	LCSD for HBN 524523 [SPR/6555]	7/22/2014	PYR	Allethrin	3	0.25	1.2	µg/kg	2.5	119	12
594647	Matrix QC (MS)	7/24/2014	PYR	Allethrin	0.86	0.1	0.5	µg/kg	2.5	35	
594648	Matrix QC (MSD)	7/24/2014	PYR	Allethrin	0.89	0.1	0.5	µg/kg	2.5	36	3
594644	MB for HBN 524523 [SPR/6555]	7/22/2014	PYR	Bifenthrin	ND	0.1	0.25	µg/kg			
594645	LCS for HBN 524523 [SPR/6555]	7/22/2014	PYR	Bifenthrin	2.6	0.5	1.2	µg/kg	2.5	104	
594646	LCSD for HBN 524523 [SPR/6555]	7/22/2014	PYR	Bifenthrin	2.7	0.5	1.2	µg/kg	2.5	108	3.4
594647	Matrix QC (MS)	7/24/2014	PYR	Bifenthrin	3.3	0.2	0.5	µg/kg	2.86	119	
594648	Matrix QC (MSD)	7/24/2014	PYR	Bifenthrin	3.4	0.2	0.5	µg/kg	2.86	123	3.5
P070925001	Matrix QC (ORIG)	7/24/2014	PYR	Bifenthrin	0.38	0.21	0.33	ng/g			
594644	MB for HBN 524523 [SPR/6555]	7/22/2014	PYR	Cyfluthrin	ND	0.11	0.25	µg/kg			
594645	LCS for HBN 524523 [SPR/6555]	7/22/2014	PYR	Cyfluthrin	2.8	0.55	1.2	µg/kg	2.5	113	
594646	LCSD for HBN 524523 [SPR/6555]	7/22/2014	PYR	Cyfluthrin	2.8	0.55	1.2	µg/kg	2.5	113	0.4
594647	Matrix QC (MS)	7/24/2014	PYR	Cyfluthrin	2.8	0.22	0.5	µg/kg	2.5	113	
594648	Matrix QC (MSD)	7/24/2014	PYR	Cyfluthrin	6.4	0.22	0.5	µg/kg	2.5	255	77
P070925001	Matrix QC (ORIG)	7/24/2014	PYR	Cyfluthrin	ND	0.19	0.33	ng/g			

Table F-3: CCCWP SSID Study – Sediment Chemistry QA/QC Samples

Lab Number	Sample Description [1]	Date Received	Analyte Group [2]	Analyte Name	Result	MDL	Reporting Limit	Units	Expected Result	Percent Recovery	Relative Percent Difference
594644	MB for HBN 524523 [SPR/6555]	7/22/2014	PYR	Cypermethrin	ND	0.1	0.25	µg/kg			
594645	LCS for HBN 524523 [SPR/6555]	7/22/2014	PYR	Cypermethrin	2.7	0.5	1.2	µg/kg	2.5	108	
594646	LCSD for HBN 524523 [SPR/6555]	7/22/2014	PYR	Cypermethrin	2.7	0.5	1.2	µg/kg	2.5	109	1.1
594647	Matrix QC (MS)	7/24/2014	PYR	Cypermethrin	2.7	0.2	0.5	µg/kg	2.5	108	
594648	Matrix QC (MSD)	7/24/2014	PYR	Cypermethrin	2.7	0.2	0.5	µg/kg	2.5	110	1.5
P070925001	Matrix QC (ORIG)	7/24/2014	PYR	Cypermethrin	ND	0.19	0.33	ng/g			
594644	MB for HBN 524523 [SPR/6555]	7/22/2014	PYR	Deltamethrin:Tralomethrin	ND	0.12	0.25	µg/kg			
594645	LCS for HBN 524523 [SPR/6555]	7/22/2014	PYR	Deltamethrin:Tralomethrin	5.6	0.6	1.2	µg/kg	5	112	
594646	LCSD for HBN 524523 [SPR/6555]	7/22/2014	PYR	Deltamethrin:Tralomethrin	4.6	0.6	1.2	µg/kg	5	92	19
594647	Matrix QC (MS)	7/24/2014	PYR	Deltamethrin:Tralomethrin	6.4	0.24	0.5	µg/kg	5	127	
594648	Matrix QC (MSD)	7/24/2014	PYR	Deltamethrin:Tralomethrin	7.2	0.24	0.5	µg/kg	5	144	12
P070925001	Matrix QC (ORIG)	7/24/2014	PYR	Deltamethrin:Tralomethrin	ND	0.29	0.41	ng/g			
594644	MB for HBN 524523 [SPR/6555]	7/22/2014	PYR	Esfenvalerate:Fenvalerate	ND	0.13	0.25	µg/kg			
594645	LCS for HBN 524523 [SPR/6555]	7/22/2014	PYR	Esfenvalerate:Fenvalerate	5.7	0.65	1.2	µg/kg	5	114	
594646	LCSD for HBN 524523 [SPR/6555]	7/22/2014	PYR	Esfenvalerate:Fenvalerate	5.3	0.65	1.2	µg/kg	5	107	6.5
594647	Matrix QC (MS)	7/24/2014	PYR	Esfenvalerate:Fenvalerate	6	0.26	0.5	µg/kg	5	120	
594648	Matrix QC (MSD)	7/24/2014	PYR	Esfenvalerate:Fenvalerate	6.1	0.26	0.5	µg/kg	5	122	1.3
P070925001	Matrix QC (ORIG)	7/24/2014	PYR	Esfenvalerate:Fenvalerate	ND	0.17	0.33	ng/g			
594644	MB for HBN 524523 [SPR/6555]	7/22/2014	PYR	Fenpropathrin	ND	0.07	0.25	µg/kg			
594645	LCS for HBN 524523 [SPR/6555]	7/22/2014	PYR	Fenpropathrin	2.6	0.35	1.2	µg/kg	2.5	103	
594646	LCSD for HBN 524523 [SPR/6555]	7/22/2014	PYR	Fenpropathrin	2.8	0.35	1.2	µg/kg	2.5	110	6.4
594647	Matrix QC (MS)	7/24/2014	PYR	Fenpropathrin	2.6	0.14	0.5	µg/kg	2.5	104	
594648	Matrix QC (MSD)	7/24/2014	PYR	Fenpropathrin	2.6	0.14	0.5	µg/kg	2.5	105	1.2
594644	MB for HBN 524523 [SPR/6555]	7/22/2014	PYR	Lambda-Cyhalothrin	ND	0.06	0.25	µg/kg			
594645	LCS for HBN 524523 [SPR/6555]	7/22/2014	PYR	Lambda-Cyhalothrin	2.4	0.3	1.2	µg/kg	2.5	96	
594646	LCSD for HBN 524523 [SPR/6555]	7/22/2014	PYR	Lambda-Cyhalothrin	2.7	0.3	1.2	µg/kg	2.5	107	11

Table F-3: CCCWP SSID Study – Sediment Chemistry QA/QC Samples

Lab Number	Sample Description [1]	Date Received	Analyte Group [2]	Analyte Name	Result	MDL	Reporting Limit	Units	Expected Result	Percent Recovery	Relative Percent Difference
594647	Matrix QC (MS)	7/24/2014	PYR	Lambda-Cyhalothrin	1.4	0.12	0.5	µg/kg	2.5	55	
594648	Matrix QC (MSD)	7/24/2014	PYR	Lambda-Cyhalothrin	1.4	0.12	0.5	µg/kg	2.5	55	0.7
P070925001	Matrix QC (ORIG)	7/24/2014	PYR	Lambda-Cyhalothrin	ND	0.23	0.33	ng/g			
594644	MB for HBN 524523 [SPR/6555]	7/22/2014	PYR	Permethrin	ND	0.11	0.25	µg/kg			
594645	LCS for HBN 524523 [SPR/6555]	7/22/2014	PYR	Permethrin	72	0.55	1.2	µg/kg	50	144	
594646	LCSD for HBN 524523 [SPR/6555]	7/22/2014	PYR	Permethrin	68	0.55	1.2	µg/kg	50	137	4.7
594647	Matrix QC (MS)	7/24/2014	PYR	Permethrin	82	0.22	0.5	µg/kg	50.42	162	
594648	Matrix QC (MSD)	7/24/2014	PYR	Permethrin	81	0.22	0.5	µg/kg	50.42	160	1.2
594644	MB for HBN 524523 [SPR/6555]	7/22/2014	PYR	Tau-Fluvalinate	ND	0.04	0.25	µg/kg			
594645	LCS for HBN 524523 [SPR/6555]	7/22/2014	PYR	Tau-Fluvalinate	1.9	0.2	1.2	µg/kg	2.5	78	
594646	LCSD for HBN 524523 [SPR/6555]	7/22/2014	PYR	Tau-Fluvalinate	1.8	0.2	1.2	µg/kg	2.5	72	8
594647	Matrix QC (MS)	7/24/2014	PYR	Tau-Fluvalinate	1.2	0.08	0.5	µg/kg	2.5	49	
594648	Matrix QC (MSD)	7/24/2014	PYR	Tau-Fluvalinate	1.2	0.08	0.5	µg/kg	2.5	46	5.9
594644	MB for HBN 524523 [SPR/6555]	7/22/2014	PYR	Tetramethrin	ND	0.06	0.25	µg/kg			
594645	LCS for HBN 524523 [SPR/6555]	7/22/2014	PYR	Tetramethrin	2.3	0.3	1.2	µg/kg	2.5	91	
594646	LCSD for HBN 524523 [SPR/6555]	7/22/2014	PYR	Tetramethrin	2.5	0.3	1.2	µg/kg	2.5	100	9.6
594647	Matrix QC (MS)	7/24/2014	PYR	Tetramethrin	1.6	0.12	0.5	µg/kg	2.5	62	
594648	Matrix QC (MSD)	7/24/2014	PYR	Tetramethrin	2	0.12	0.5	µg/kg	2.5	80	25
594791	MB for HBN 524561 [SPR/6556]	7/22/2014	SUR	Decachlorobiphenyl	67		'45-188	%	0	67	
594792	LCS for HBN 524561 [SPR/6556]	7/22/2014	SUR	Decachlorobiphenyl	86		'45-188	%	0	86	
594793	LCSD for HBN 524561 [SPR/6556]	7/22/2014	SUR	Decachlorobiphenyl	76		'45-188	%	0	76	12
598126	MB for HBN 525999 [SPR/6584]	7/22/2014	SUR	Decachlorobiphenyl	110		'45-188	%	0	110	
598127	LCS for HBN 525999 [SPR/6584]	7/22/2014	SUR	Decachlorobiphenyl	118		'45-188	%	0	118	
598128	LCSD for HBN 525999 [SPR/6584]	7/22/2014	SUR	Decachlorobiphenyl	119		'45-188	%	0	119	0.6
598129	207WAL060(598129MS)	7/22/2014	SUR	Decachlorobiphenyl	5.3		'10-200	%	0	5.3	
598130	207WAL060(598130MSD)	7/22/2014	SUR	Decachlorobiphenyl	4.5		'10-200	%	0	4.5	15

Table F-3: CCCWP SSID Study – Sediment Chemistry QA/QC Samples

Lab Number	Sample Description [1]	Date Received	Analyte Group [2]	Analyte Name	Result	MDL	Reporting Limit	Units	Expected Result	Percent Recovery	Relative Percent Difference
594794	Matrix QC (MS)	7/24/2014	SUR	Decachlorobiphenyl	95		'10-200	%	0	95	
594795	Matrix QC (MSD)	7/24/2014	SUR	Decachlorobiphenyl	86		'10-200	%	0	86	10
594644	MB for HBN 524523 [SPR/6555]	7/22/2014	SUR	Esfenvalerate-d6;#1	81		'70-130	%	1.3	81	
594645	LCS for HBN 524523 [SPR/6555]	7/22/2014	SUR	Esfenvalerate-d6;#1	112		'70-130	%	1.3	112	
594646	LCSD for HBN 524523 [SPR/6555]	7/22/2014	SUR	Esfenvalerate-d6;#1	107		'70-130	%	1.3	107	4.4
594647	Matrix QC (MS)	7/24/2014	SUR	Esfenvalerate-d6;#1	113		'70-130	%	1.3	113	
594648	Matrix QC (MSD)	7/24/2014	SUR	Esfenvalerate-d6;#1	113		'70-130	%	1.3	113	0.7
594644	MB for HBN 524523 [SPR/6555]	7/22/2014	SUR	Esfenvalerate-d6;#2	78		'70-130	%	1.3	78	
594645	LCS for HBN 524523 [SPR/6555]	7/22/2014	SUR	Esfenvalerate-d6;#2	120		'70-130	%	1.3	120	
594646	LCSD for HBN 524523 [SPR/6555]	7/22/2014	SUR	Esfenvalerate-d6;#2	105		'70-130	%	1.3	105	13
594647	Matrix QC (MS)	7/24/2014	SUR	Esfenvalerate-d6;#2	125		'70-130	%	1.3	125	
594648	Matrix QC (MSD)	7/24/2014	SUR	Esfenvalerate-d6;#2	125		'70-130	%	1.3	125	0
594791	MB for HBN 524561 [SPR/6556]	7/22/2014	SUR	Tetrachloro-m-xylene	39		'64-114	%	0	39	
594792	LCS for HBN 524561 [SPR/6556]	7/22/2014	SUR	Tetrachloro-m-xylene	50		'64-114	%	0	50	
594793	LCSD for HBN 524561 [SPR/6556]	7/22/2014	SUR	Tetrachloro-m-xylene	51		'64-114	%	0	51	0.7
598126	MB for HBN 525999 [SPR/6584]	7/22/2014	SUR	Tetrachloro-m-xylene	83		'64-114	%	0	83	
598127	LCS for HBN 525999 [SPR/6584]	7/22/2014	SUR	Tetrachloro-m-xylene	88		'64-114	%	0	88	
598128	LCSD for HBN 525999 [SPR/6584]	7/22/2014	SUR	Tetrachloro-m-xylene	95		'64-114	%	0	95	8.2
598129	207WAL060(598129MS)	7/22/2014	SUR	Tetrachloro-m-xylene	750		'10-200	%	0	750	
598130	207WAL060(598130MSD)	7/22/2014	SUR	Tetrachloro-m-xylene	750		'10-200	%	0	750	0
594794	Matrix QC (MS)	7/24/2014	SUR	Tetrachloro-m-xylene	59		'10-200	%	0	59	
594795	Matrix QC (MSD)	7/24/2014	SUR	Tetrachloro-m-xylene	56		'10-200	%	0	56	4.8
594819	MB for HBN 524575 [WGR/5525]	7/22/2014	PS	Solids, Percent	ND	0.1	0.1	%			
594820	Matrix QC (DUP)	7/30/2014	PS	Solids, Percent	8.8	0.1	0.1	%			0
P070024013	Matrix QC (ORIG)	7/30/2014	PS	Solids, Percent	8.8	0.1	0.1	%			
600437	MB for HBN 527207 [SUB/1666]	7/22/2014	TOC	Total Organic Carbon	ND	0.01	0.1	%			

Table F-3: CCCWP SSID Study – Sediment Chemistry QA/QC Samples

Lab Number	Sample Description [1]	Date Received	Analyte Group [2]	Analyte Name	Result	MDL	Reporting Limit	Units	Expected Result	Percent Recovery	Relative Percent Difference
600438	LCS for HBN 527207 [SUB/1666]	7/22/2014	TOC	Total Organic Carbon	9.3	0.01	0.1	%	10	93	

[1] MB = Methoc Blank, LCS = Laboratory Control Sample, LCSD = Laboratory Control Duplicate Sample, MS = Matrix Spike, MSD = Matrix Spike Duplicate, DUP = Laboratory Duplicate, ORIG = Original Field Sample Result

[2] FIP = Fipronils, OP = Organochlorine Pesticides, PYR = Pyrethroid Pesticides, SUR = Surrogates, PS = Particle Size, TOC = Total Organic Carbon

Appendix G. Laboratory Analytical Results Tables for SSID Samples

Table G-1: Aquatic Chemistry and Toxicity Results

	Dry Creek Upstream 544MSH065		Dry Creek Downstream 544MSH062		Tributary of Grayson Creek (Upstream) 207WAL078		E. Branch of Grayson Creek (Downstream) 207WAL060	
	Sample Collection Date							
	02/06/14	**02/28/14**	**02/06/14**	**02/28/14**	**02/28/14**	**03/26/14**	**02/28/14**	**03/26/14**
Fipronil and Degradates (ng/L)								
Fipronil	6.2	4.5	ND	4.3	19	15	23	12
Fipronil Desulfinyl	2.2	2.2	ND	1.9	2.9	6.5	2.2	3.5
Fipronil Sulfide	0.5[J]	ND	ND	ND	1.3[J]	1.4[J]	1.6	2.6
Fipronil Sulfone	3.8	5.5	0.8[J]	5.2	14	11	9.5	6.8
Organochlorine Pesticides (µg/L)								
4,4'-DDD	ND	ND	ND	ND	ND	ND	ND	ND
4,4'-DDE	ND	ND	ND	ND	ND	ND	ND	ND
4,4'-DDT	ND	ND	ND	ND	ND	ND	ND	ND
Aldrin	ND	ND	ND	ND	ND	ND	ND	ND
alpha-BHC	ND	ND	ND	ND	ND	ND	ND	ND
beta-BHC	ND	ND	ND	ND	ND	ND	ND	ND
Chlordane	ND	ND	ND	ND	ND	ND	ND	ND
delta-BHC	ND	ND	ND	ND	ND	ND	ND	ND
Dieldrin	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan I	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan II	ND	ND	ND	ND	ND	ND	ND	ND
Endosulfan sulfate	ND	ND	ND	ND	ND	ND	ND	ND
Endrin	ND	ND	ND	ND	ND	ND	ND	ND
Endrin aldehyde	ND	ND	ND	ND	ND	ND	ND	ND
Endrin ketone	ND	ND	ND	ND	ND	ND	ND	ND
gamma-BHC (Lindane)	ND	ND	ND	ND	ND	ND	ND	ND
Heptachlor	ND	ND	ND	ND	ND	ND	ND	ND
Heptachlor epoxide	ND	ND	ND	ND	ND	ND	ND	ND
Methoxychlor	ND	ND	ND	ND	ND	ND	ND	ND
Toxaphene	ND	ND	ND	ND	ND	ND	ND	ND
Pyrethroid Pesticides (ng/L)								
Bifenthrin	5.3	8.5	5.9	8.6	7.3	11	6.5	4.2
Cyfluthrin	0.7[J]	1.5[J]	0.7[J]	1.7	ND	1.1[J]	6.4	0.9[J]
Cypermethrin	ND	ND	ND	ND	ND	ND	ND	0.7[J]
Deltamethrin:Tralomethrin	ND	ND	ND	ND	4.7	ND	ND	ND
Lambda-Cyhalothrin	0.386[B,J]	ND	0.394[B,J]	ND	ND	1.1[J]	ND	ND
Permethrin	ND	ND	ND	ND	ND	ND	ND	12[J]
Total Organic Carbon (mg/L)								
Sediment Concentration	7.5	13	9.4	37	37	13	173	14
Total Organic Carbon	16	14	15	15	11	11	10	13
Hyallela Toxicity								
Average Percent Survival[1]	12	6	18[2]	18	48	0[3]	48	0[3]

ND Not Detected - indicates analytical result has not been detected at or above the MDL.
J Reflects estimated analytical result value detected below the Reporting Limit (RL) and above the Method Detecting Limit (MDL) . The J flag is equivalent to the DNQ Estimated Concentration flag.
B Indicates the analyte has been detected in the blank associated with the sample.
[1] All results significantly lower than control sample averages. Samples deemed toxic are shaded.
[2] TIE indicated that toxicity was persistent; results are consistent with Type I and Type II pyrethroids
[3] Complete mortality after 48 hours

Table G-2: Sediment Chemistry and Toxicity Results				
	Dry Creek Upstream 544MSH065	**Dry Creek Downstream 544MSH062**	**Tributary of Grayson Creek (Upstream) 207WAL078**	**E. Branch of Grayson Creek (Downstream) 207WAL060**
	All samples taken on 7/22/2014			
Fipronil and Degradates (µg/kg)				
Fipronil	ND	ND	ND	ND
Fipronil Desulfinyl	0.56	0.27 [J]	ND	ND
Fipronil Sulfide	ND	ND	ND	ND
Fipronil Sulfone	3	ND	ND	0.14 [J]
Organochlorine Pesticides (mg/kg)				
2,4'-DDD	0.012	0.034	ND	ND
2,4'-DDE	0.0058	0.019	ND	ND
2,4'-DDT	ND	ND	ND	ND
4,4'-DDD	0.0036	0.023	ND	ND
4,4'-DDE	0.028	0.076	ND	ND
4,4'-DDT	ND	ND	ND	ND
Aldrin	ND	ND	ND	ND
alpha-BHC	ND	ND	ND	ND
alpha-Chlordane (cis)	ND	ND	ND	ND
beta-BHC	ND	ND	ND	ND
Chlordane	ND	ND	ND	ND
delta-BHC	ND	ND	ND	ND
Dieldrin	ND	ND	ND	ND
Endosulfan I	ND	ND	ND	ND
Endosulfan II	ND	ND	ND	ND
Endosulfan sulfate	ND	ND	ND	ND
Endrin	ND	ND	ND	ND
Endrin aldehyde	ND	ND	ND	ND
Endrin ketone	ND	ND	ND	ND
gamma-BHC (Lindane)	ND	ND	ND	ND
gamma-Chlordane (trans)	ND	ND	ND	ND
Heptachlor	ND	ND	ND	ND
Heptachlor epoxide	ND	ND	ND	ND
Kepone	ND [H]	ND [H]	ND [H]	ND [H]
Methoxychlor	ND	ND	ND	ND
Mirex	ND	ND	ND	ND
Toxaphene	ND	ND	ND	ND
Pyrethroid Pesticides (µg/kg)				
Allethrin	ND	ND	ND	ND
Bifenthrin	99	40	5.6	3.6
Cyfluthrin	6.2	3.4	0.8	0.41
Cypermethrin	0.30 [J]	0.35	0.28 [J]	0.21 [J]
Deltamethrin:Tralomethrin	ND	ND	ND	ND
Esfenvalerate:Fenvalerate	ND	ND	ND	ND

Table G-2: Sediment Chemistry and Toxicity Results				
	Dry Creek Upstream 544MSH065	**Dry Creek Downstream 544MSH062**	**Tributary of Grayson Creek (Upstream) 207WAL078**	**E. Branch of Grayson Creek (Downstream) 207WAL060**
	All samples taken on 7/22/2014			
Fenpropathrin	ND	ND	ND	ND
Lambda-Cyhalothrin	0.37	0.24 [J]	ND	ND
Permethrin	6	9.4	1.9	2.3
Tau-Fluvalinate	ND	ND	ND	ND
Tetramethrin	ND	ND	ND	ND
Total Organic Carbon (%)				
Solids	92	95	87	97
Total Organic Carbon	4.6	1.9	3.6	1
Hyallela Toxicity				
Average Percent Survival	3.75 [1,3]	48.8 [1]	97.1 [2]	90 [2]
Average Weight (mg/individual)	0.00625 [1]	0.0352 [1]	0.0699 [2]	0.0875

ND Not Detected - indicates analytical result has not been detected at or above the MDL.
J Reflects estimated analytical result value detected below the Reporting Limit (RL) and above the Method Detecting Limit (MDL) . The J flag is equivalent to the DNQ Estimated Concentration flag.
H Analyzed out of holding time.
[1] Result was significantly lower than control sample average. Samples deemed toxic are shaded.
[2] Result was significantly higher than control sample average.
[3] TIE indicated baseline toxicity was persistent; addition of PBO increased toxicity; addition of carboxylesterase removed most of toxicity. Weight of evidence suggst that toxicity was likely due to pyrethroid pesticides.

Appendix H. Laboratory Reports – SSID Samples

Caltest ANALYTICAL LABORATORY

ENVIRONMENTAL ANALYSES

Wednesday, March 05, 2014

Alessandro Hnatt
ADH Environmental
3065 Porter Street, Suite 101
Soquel, CA 95073

RE:	Lab Order:	P020481	Collected By:	Alessandro Hnatt
	Project ID:	CCCWP-SSID 030.001.0202	PO/Contract #:	

Dear Alessandro Hnatt:

Enclosed are the analytical results for sample(s) received by the laboratory on Friday, February 07, 2014. Results reported herein conform to the most current NELAC standards, where applicable, unless otherwise narrated in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Enclosures

Project Manager: Todd Albertson

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SAMPLE SUMMARY

Lab Order: P020481

Project ID: CCCWP-SSID 030.001.0202

Lab ID	Sample ID	Matrix	Date Collected	Date Received
P020481001	**544R00025DS-**	Water	2/6/2014 13:20	2/7/2014 18:14
P020481002	**544R00025US-**	Water	2/6/2014 12:50	2/7/2014 18:14
P020481003	**544R00025DS-**	Water	2/6/2014 13:20	2/7/2014 18:14
P020481004	**544R00025US**	Water	2/6/2014 12:50	2/7/2014 18:14

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NARRATIVE

Lab Order: P020481

Project ID: CCCWP-SSID 030.001.0202

General Qualifiers and Notes

Caltest authorizes this report to be reproduced only in its entirety. Results are specific to the sample(s) as submitted and only to the parameter(s) reported.

Caltest certifies that all test results for wastewater and hazardous waste analyses meet all applicable NELAC requirements; all microbiology and drinking water testing meet applicable ELAP requirements, unless stated otherwise.

All analyses performed by EPA Methods or Standard Methods (SM) 20th Edition except where noted (SMOL=online edition).

Caltest collects samples in compliance with 40 CFR, EPA Methods, Cal. Title 22, and Standard Methods.

Dilution Factors (DF) reported greater than '1' have been used to adjust the result, Reporting Limit (RL), and Method Detection Limit (MDL).

All Solid, sludge, and/or biosolids data is reported in Wet Weight, unless otherwise specified.

Filtrations performed at Caltest for dissolved metals (excluding mercury) and/or pH analysis were not performed within the 15 minute holding time as specified by 40CFR 136.3 table II.

Results Qualifiers: Report fields may contain codes and non-numeric data correlating to one or more of the following definitions:

ND - Non Detect - indicates analytical result has not been detected.

RL - Reporting Limit is the quantitation limit at which the laboratory is able to detect an analyte. An analyte not detected at or above the RL is reported as ND unless otherwise noted or qualified. For analyses pertaining to the State Implementation Plan of the California Toxics Rule, the Caltest Reporting Limit (RL) is equivalent to the Minimum Level (ML). A standard is always run at or below the ML. Where Reporting Limits are elevated due to dilution, the ML calibration criteria has been met.

J - reflects estimated analytical result value detected below the Reporting Limit (RL) and above the Method Detection Limit (MDL). The 'J' flag is equivalent to the DNQ Estimated Concentration flag.

E - indicates an estimated analytical result value.

B - indicates the analyte has been detected in the blank associated with the sample.

NC - means not able to be calculated for RPD or Spike Recoveries.

SS - compound is a Surrogate Spike used per laboratory quality assurance manual.

NOTE: This document represents a complete Analytical Report for the samples referenced herein and should be retained as a permanent record thereof.

Qualifiers and Compound Notes

1 Analyte(s) reported as 'ND' means not detected at or above the listed Method Detection Limits (MDL).

2 This sample was run at a 2X dilution with similar results and surrogates failing low therefore the 1X run was reported.

3 This analysis is not covered under Caltest's NELAP/CAL-ELAP Accreditations.

4 Due to matrix interferences present in the sample, surrogate recoveries failed to meet the QA/QC acceptance criteria.

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ENVIRONMENTAL ANALYSES

NARRATIVE

Lab Order: P020481

Project ID: CCCWP-SSID 030.001.0202

Qualifiers and Compound Notes

5	Ran 2x dilution with similar results.

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ANALYTICAL RESULTS

Lab Order: P020481

Project ID CCCWP-SSID 030.001.0202

Lab ID: **P020481001** Date Collected: 2/6/2014 13:20 Matrix: Water

Sample ID: **544R00025DS-** Date Received: 2/7/2014 18:14

Parameters	Result	Units	R. L.	MDL	DF	Prepared	Batch	Analyzed	Batch	Qual
Total Organic Carbon Analysis		**Analytical Method:**	SM20-5310 B					**Analyzed by:** ATA		
Total Organic Carbon	15	mg/L	1	0.30	1			02/19/14 23:53	WET 7444	

Lab ID: **P020481002** Date Collected: 2/6/2014 12:50 Matrix: Water

Sample ID: **544R00025US-** Date Received: 2/7/2014 18:14

Parameters	Result	Units	R. L.	MDL	DF	Prepared	Batch	Analyzed	Batch	Qual
Total Organic Carbon Analysis		**Analytical Method:**	SM20-5310 B					**Analyzed by:** ATA		
Total Organic Carbon	16	mg/L	1	0.30	1			02/20/14 00:10	WET 7444	

Lab ID: **P020481003** Date Collected: 2/6/2014 13:20 Matrix: Water

Sample ID: **544R00025DS-** Date Received: 2/7/2014 18:14

Parameters	Result	Units	R. L.	MDL	DF	Prepared	Batch	Analyzed	Batch	Qual
Suspended Sediment Concentration		**Analytical Method:**	ASTM D 3977-97 B-Filtration					**Analyzed by:** UK		
Sediment Concentration	9.4	mg/L	3	2	1			02/12/14 14:54	BIO 13477	3
Chlorinated Pesticides & PCBs Analysis		**Prep Method:**	EPA 608			**Prep by:** EAB				
		Analytical Method:	EPA 608					**Analyzed by:** NTA		
Aldrin	ND	ug/L	0.005	0.0040	1	02/12/14 00:00	SPR 6309	02/22/14 19:34	SMS 3366	1
alpha-BHC	ND	ug/L	0.010	0.0050	1	02/12/14 00:00	SPR 6309	02/22/14 19:34	SMS 3366	
beta-BHC	ND	ug/L	0.005	0.0040	1	02/12/14 00:00	SPR 6309	02/22/14 19:34	SMS 3366	
delta-BHC	ND	ug/L	0.005	0.0040	1	02/12/14 00:00	SPR 6309	02/22/14 19:34	SMS 3366	
gamma-BHC (Lindane)	ND	ug/L	0.010	0.0040	1	02/12/14 00:00	SPR 6309	02/22/14 19:34	SMS 3366	
Chlordane	ND	ug/L	0.050	0.020	1	02/12/14 00:00	SPR 6309	02/22/14 19:34	SMS 3366	
4,4'-DDD	ND	ug/L	0.010	0.0040	1	02/12/14 00:00	SPR 6309	02/22/14 19:34	SMS 3366	
4,4'-DDE	ND	ug/L	0.010	0.0030	1	02/12/14 00:00	SPR 6309	02/22/14 19:34	SMS 3366	
4,4'-DDT	ND	ug/L	0.010	0.0040	1	02/12/14 00:00	SPR 6309	02/22/14 19:34	SMS 3366	
Dieldrin	ND	ug/L	0.010	0.0040	1	02/12/14 00:00	SPR 6309	02/22/14 19:34	SMS 3366	
Endosulfan I	ND	ug/L	0.010	0.0040	1	02/12/14 00:00	SPR 6309	02/22/14 19:34	SMS 3366	
Endosulfan II	ND	ug/L	0.010	0.0050	1	02/12/14 00:00	SPR 6309	02/22/14 19:34	SMS 3366	
Endosulfan sulfate	ND	ug/L	0.010	0.0050	1	02/12/14 00:00	SPR 6309	02/22/14 19:34	SMS 3366	
Endrin	ND	ug/L	0.010	0.0050	1	02/12/14 00:00	SPR 6309	02/22/14 19:34	SMS 3366	
Endrin aldehyde	ND	ug/L	0.010	0.0050	1	02/12/14 00:00	SPR 6309	02/22/14 19:34	SMS 3366	
Endrin ketone	ND	ug/L	0.010	0.0050	1	02/12/14 00:00	SPR 6309	02/22/14 19:34	SMS 3366	
Heptachlor	ND	ug/L	0.010	0.0050	1	02/12/14 00:00	SPR 6309	02/22/14 19:34	SMS 3366	

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ENVIRONMENTAL ANALYSES

ANALYTICAL RESULTS

Lab Order: P020481

Project ID CCCWP-SSID 030.001.0202

Lab ID: **P020481003** Date Collected: 2/6/2014 13:20 Matrix: Water

Sample ID: **544R00025DS-** Date Received: 2/7/2014 18:14

Parameters	Result	Units	R. L.	MDL	DF	Prepared	Batch	Analyzed	Batch	Qual
Heptachlor epoxide	ND	ug/L	0.010	0.0040	1	02/12/14 00:00	SPR 6309	02/22/14 19:34	SMS 3366	
Methoxychlor	ND	ug/L	0.010	0.0050	1	02/12/14 00:00	SPR 6309	02/22/14 19:34	SMS 3366	
PCB 1016	ND	ug/L	0.10	0.050	1	02/12/14 00:00	SPR 6309	02/22/14 19:34	SMS 3366	
PCB 1221	ND	ug/L	0.10	0.050	1	02/12/14 00:00	SPR 6309	02/22/14 19:34	SMS 3366	
PCB 1232	ND	ug/L	0.10	0.050	1	02/12/14 00:00	SPR 6309	02/22/14 19:34	SMS 3366	
PCB 1242	ND	ug/L	0.10	0.040	1	02/12/14 00:00	SPR 6309	02/22/14 19:34	SMS 3366	
PCB 1248	ND	ug/L	0.10	0.050	1	02/12/14 00:00	SPR 6309	02/22/14 19:34	SMS 3366	
PCB 1254	ND	ug/L	0.10	0.050	1	02/12/14 00:00	SPR 6309	02/22/14 19:34	SMS 3366	
PCB 1260	ND	ug/L	0.10	0.050	1	02/12/14 00:00	SPR 6309	02/22/14 19:34	SMS 3366	
Toxaphene	ND	ug/L	0.5	0.30	1	02/12/14 00:00	SPR 6309	02/22/14 19:34	SMS 3366	
Decachlorobiphenyl (SS)	63	%	10-195		1	02/12/14 00:00	SPR 6309	02/22/14 19:34	SMS 3366	
Tetrachloro-m-xylene (SS)	55	%	25-105		1	02/12/14 00:00	SPR 6309	02/22/14 19:34	SMS 3366	

Fipronil Analysis, Water **Prep Method:** SW846 3510C **Prep by:** ECB
Analytical Method: SW846 8270 Mod (GCMS-NCI-SIM) **Analyzed by:** RLH

Parameters	Result	Units	R. L.	MDL	DF	Prepared	Batch	Analyzed	Batch	Qual
Fipronil	ND	ng/L	1.5	0.5	1	02/12/14 18:03	SPR 6308	02/27/14 00:00	SMS 3373	1,2
Fipronil Desulfinyl	ND	ng/L	1.5	0.5	1	02/12/14 18:03	SPR 6308	02/27/14 00:00	SMS 3373	
Fipronil Sulfide	ND	ng/L	1.5	0.5	1	02/12/14 18:03	SPR 6308	02/27/14 00:00	SMS 3373	
Fipronil Sulfone	J0.8	ng/L	1.5	0.5	1	02/12/14 18:03	SPR 6308	02/27/14 00:00	SMS 3373	
Esfenvalerate-d6;#1 (SS)	53	%	70-130		1	02/12/14 18:03	SPR 6308	02/27/14 00:00	SMS 3373	4
Esfenvalerate-d6;#2 (SS)	53	%	70-130		1	02/12/14 18:03	SPR 6308	02/27/14 00:00	SMS 3373	4

Pyrethroids Analysis, NCI, Water **Prep Method:** SW846 3510C **Prep by:** MDT
Analytical Method: SW846 8270 Mod (GCMS-NCI-SIM) **Analyzed by:** MDT

Parameters	Result	Units	R. L.	MDL	DF	Prepared	Batch	Analyzed	Batch	Qual
Allethrin	ND	ng/L	1.5	0.1	1	02/09/14 12:32	SPR 6300	02/12/14 10:15	SMS 3357	1
Bifenthrin	5.9	ng/L	1.5	0.1	1	02/09/14 12:32	SPR 6300	02/12/14 10:15	SMS 3357	
Cyfluthrin	J0.7	ng/L	1.5	0.2	1	02/09/14 12:32	SPR 6300	02/12/14 10:15	SMS 3357	
Lambda-Cyhalothrin	BJ.394	ng/L	1.5	0.2	1	02/09/14 12:32	SPR 6300	02/12/14 10:15	SMS 3357	
Cypermethrin	ND	ng/L	1.5	0.2	1	02/09/14 12:32	SPR 6300	02/12/14 10:15	SMS 3357	
Deltamethrin:Tralomethrin	ND	ng/L	3.0	0.2	1	02/09/14 12:32	SPR 6300	02/12/14 10:15	SMS 3357	
Esfenvalerate:Fenvalerate	ND	ng/L	3.0	0.2	1	02/09/14 12:32	SPR 6300	02/12/14 10:15	SMS 3357	
Fenpropathrin	ND	ng/L	1.5	0.2	1	02/09/14 12:32	SPR 6300	02/12/14 10:15	SMS 3357	
Tau-Fluvalinate	ND	ng/L	1.5	0.2	1	02/09/14 12:32	SPR 6300	02/12/14 10:15	SMS 3357	
Permethrin	ND	ng/L	15	2	1	02/09/14 12:32	SPR 6300	02/12/14 10:15	SMS 3357	
Tetramethrin	ND	ng/L	1.5	0.2	1	02/09/14 12:32	SPR 6300	02/12/14 10:15	SMS 3357	
Esfenvalerate-d6;#1 (SS)	49	%	70-130		1	02/09/14 12:32	SPR 6300	02/12/14 10:15	SMS 3357	4,5
Esfenvalerate-d6;#2 (SS)	50	%	70-130		1	02/09/14 12:32	SPR 6300	02/12/14 10:15	SMS 3357	4,5

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ANALYTICAL RESULTS

Lab Order: P020481

Project ID CCCWP-SSID 030.001.0202

Lab ID: **P020481004** Date Collected: 2/6/2014 12:50 Matrix: Water

Sample ID: **544R00025US** Date Received: 2/7/2014 18:14

Parameters	Result	Units	R. L.	MDL	DF	Prepared	Batch	Analyzed	Batch	Qual
Suspended Sediment Concentration		**Analytical Method:**	ASTM D 3977-97 B-Filtration					**Analyzed by:** UK		
Sediment Concentration	7.5	mg/L	3	2	1			02/12/14 14:54	BIO 13477	3
Chlorinated Pesticides & PCBs Analysis		**Prep Method:**	EPA 608			**Prep by:** EAB				
		Analytical Method:	EPA 608					**Analyzed by:** NTA		
Aldrin	ND	ug/L	0.005	0.0040	1	02/12/14 00:00	SPR 6309	02/22/14 20:02	SMS 3366	1
alpha-BHC	ND	ug/L	0.010	0.0050	1	02/12/14 00:00	SPR 6309	02/22/14 20:02	SMS 3366	
beta-BHC	ND	ug/L	0.005	0.0040	1	02/12/14 00:00	SPR 6309	02/22/14 20:02	SMS 3366	
delta-BHC	ND	ug/L	0.005	0.0040	1	02/12/14 00:00	SPR 6309	02/22/14 20:02	SMS 3366	
gamma-BHC (Lindane)	ND	ug/L	0.010	0.0040	1	02/12/14 00:00	SPR 6309	02/22/14 20:02	SMS 3366	
Chlordane	ND	ug/L	0.050	0.020	1	02/12/14 00:00	SPR 6309	02/22/14 20:02	SMS 3366	
4,4'-DDD	ND	ug/L	0.010	0.0040	1	02/12/14 00:00	SPR 6309	02/22/14 20:02	SMS 3366	
4,4'-DDE	ND	ug/L	0.010	0.0030	1	02/12/14 00:00	SPR 6309	02/22/14 20:02	SMS 3366	
4,4'-DDT	ND	ug/L	0.010	0.0040	1	02/12/14 00:00	SPR 6309	02/22/14 20:02	SMS 3366	
Dieldrin	ND	ug/L	0.010	0.0040	1	02/12/14 00:00	SPR 6309	02/22/14 20:02	SMS 3366	
Endosulfan I	ND	ug/L	0.010	0.0040	1	02/12/14 00:00	SPR 6309	02/22/14 20:02	SMS 3366	
Endosulfan II	ND	ug/L	0.010	0.0050	1	02/12/14 00:00	SPR 6309	02/22/14 20:02	SMS 3366	
Endosulfan sulfate	ND	ug/L	0.010	0.0050	1	02/12/14 00:00	SPR 6309	02/22/14 20:02	SMS 3366	
Endrin	ND	ug/L	0.010	0.0050	1	02/12/14 00:00	SPR 6309	02/22/14 20:02	SMS 3366	
Endrin aldehyde	ND	ug/L	0.010	0.0050	1	02/12/14 00:00	SPR 6309	02/22/14 20:02	SMS 3366	
Endrin ketone	ND	ug/L	0.010	0.0050	1	02/12/14 00:00	SPR 6309	02/22/14 20:02	SMS 3366	
Heptachlor	ND	ug/L	0.010	0.0050	1	02/12/14 00:00	SPR 6309	02/22/14 20:02	SMS 3366	
Heptachlor epoxide	ND	ug/L	0.010	0.0040	1	02/12/14 00:00	SPR 6309	02/22/14 20:02	SMS 3366	
Methoxychlor	ND	ug/L	0.010	0.0050	1	02/12/14 00:00	SPR 6309	02/22/14 20:02	SMS 3366	
PCB 1016	ND	ug/L	0.10	0.050	1	02/12/14 00:00	SPR 6309	02/22/14 20:02	SMS 3366	
PCB 1221	ND	ug/L	0.10	0.050	1	02/12/14 00:00	SPR 6309	02/22/14 20:02	SMS 3366	
PCB 1232	ND	ug/L	0.10	0.050	1	02/12/14 00:00	SPR 6309	02/22/14 20:02	SMS 3366	
PCB 1242	ND	ug/L	0.10	0.040	1	02/12/14 00:00	SPR 6309	02/22/14 20:02	SMS 3366	
PCB 1248	ND	ug/L	0.10	0.050	1	02/12/14 00:00	SPR 6309	02/22/14 20:02	SMS 3366	
PCB 1254	ND	ug/L	0.10	0.050	1	02/12/14 00:00	SPR 6309	02/22/14 20:02	SMS 3366	
PCB 1260	ND	ug/L	0.10	0.050	1	02/12/14 00:00	SPR 6309	02/22/14 20:02	SMS 3366	
Toxaphene	ND	ug/L	0.5	0.30	1	02/12/14 00:00	SPR 6309	02/22/14 20:02	SMS 3366	
Decachlorobiphenyl (SS)	63	%	10-195		1	02/12/14 00:00	SPR 6309	02/22/14 20:02	SMS 3366	
Tetrachloro-m-xylene (SS)	64	%	25-105		1	02/12/14 00:00	SPR 6309	02/22/14 20:02	SMS 3366	
Fipronil Analysis, Water		**Prep Method:**	SW846 3510C			**Prep by:** ECB				
		Analytical Method:	SW846 8270 Mod (GCMS-NCI-SIM)					**Analyzed by:** RLH		
Fipronil	6.2	ng/L	1.5	0.5	1	02/12/14 18:03	SPR 6308	02/27/14 00:00	SMS 3373	1,2
Fipronil Desulfinyl	2.2	ng/L	1.5	0.5	1	02/12/14 18:03	SPR 6308	02/27/14 00:00	SMS 3373	

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ANALYTICAL RESULTS

Lab Order: P020481

Project ID CCCWP-SSID 030.001.0202

Lab ID: **P020481004** Date Collected: 2/6/2014 12:50 Matrix: Water

Sample ID: **544R00025US** Date Received: 2/7/2014 18:14

Parameters	Result	Units	R. L.	MDL	DF	Prepared	Batch	Analyzed	Batch	Qual
Fipronil Sulfide	J0.5	ng/L	1.5	0.5	1	02/12/14 18:03	SPR 6308	02/27/14 00:00	SMS 3373	
Fipronil Sulfone	3.8	ng/L	1.5	0.5	1	02/12/14 18:03	SPR 6308	02/27/14 00:00	SMS 3373	
Esfenvalerate-d6;#1 (SS)	49	%	70-130		1	02/12/14 18:03	SPR 6308	02/27/14 00:00	SMS 3373	4
Esfenvalerate-d6;#2 (SS)	50	%	70-130		1	02/12/14 18:03	SPR 6308	02/27/14 00:00	SMS 3373	4

Pyrethroids Analysis, NCI, Water **Prep Method:** SW846 3510C **Prep by:** MDT

Analytical Method: SW846 8270 Mod (GCMS-NCI-SIM) **Analyzed by:** MDT

Parameters	Result	Units	R. L.	MDL	DF	Prepared	Batch	Analyzed	Batch	Qual
Allethrin	ND	ng/L	1.5	0.1	1	02/09/14 12:32	SPR 6300	02/12/14 10:49	SMS 3357	1
Bifenthrin	5.3	ng/L	1.5	0.1	1	02/09/14 12:32	SPR 6300	02/12/14 10:49	SMS 3357	
Cyfluthrin	J0.7	ng/L	1.5	0.2	1	02/09/14 12:32	SPR 6300	02/12/14 10:49	SMS 3357	
Lambda-Cyhalothrin	BJ.386	ng/L	1.5	0.2	1	02/09/14 12:32	SPR 6300	02/12/14 10:49	SMS 3357	
Cypermethrin	ND	ng/L	1.5	0.2	1	02/09/14 12:32	SPR 6300	02/12/14 10:49	SMS 3357	
Deltamethrin:Tralomethrin	ND	ng/L	3.0	0.2	1	02/09/14 12:32	SPR 6300	02/12/14 10:49	SMS 3357	
Esfenvalerate:Fenvalerate	ND	ng/L	3.0	0.2	1	02/09/14 12:32	SPR 6300	02/12/14 10:49	SMS 3357	
Fenpropathrin	ND	ng/L	1.5	0.2	1	02/09/14 12:32	SPR 6300	02/12/14 10:49	SMS 3357	
Tau-Fluvalinate	ND	ng/L	1.5	0.2	1	02/09/14 12:32	SPR 6300	02/12/14 10:49	SMS 3357	
Permethrin	ND	ng/L	15	2	1	02/09/14 12:32	SPR 6300	02/12/14 10:49	SMS 3357	
Tetramethrin	ND	ng/L	1.5	0.2	1	02/09/14 12:32	SPR 6300	02/12/14 10:49	SMS 3357	
Esfenvalerate-d6;#1 (SS)	47	%	70-130		1	02/09/14 12:32	SPR 6300	02/12/14 10:49	SMS 3357	4,5
Esfenvalerate-d6;#2 (SS)	47	%	70-130		1	02/09/14 12:32	SPR 6300	02/12/14 10:49	SMS 3357	4,5

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QUALITY CONTROL DATA

Lab Order: P020481

Project ID: CCCWP-SSID 030.001.0202

Analysis Description:	Suspended Sediment Concentration	**QC Batch:**	BIO/13477
Analysis Method:	ASTM D 3977-97 B-Filtration	**QC Batch Method:**	ASTM D 3977-97 B-Filtration

METHOD BLANK: 564892

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Sediment Concentration	ND	3	2	mg/L	

LABORATORY CONTROL SAMPLE & LCSD: 564893 564894

Parameter	Units	Spike Conc.	LCS Result	LCSD Result	LCS % Rec	LCSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Sediment Concentration	mg/L	500	467	489	93	98	80-120	4.6	20	

Analysis Description:	Pyrethroids Analysis, NCI, Water	**QC Batch:**	SPR/6300
Analysis Method:	SW846 8270 Mod (GCMS-NCI-SIM)	**QC Batch Method:**	SW846 3510C

METHOD BLANK: 564069

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Allethrin	ND	1.5	0.1	ng/L	1
Bifenthrin	ND	1.5	0.1	ng/L	
Cyfluthrin	ND	1.5	0.2	ng/L	
Lambda-Cyhalothrin	J0.3	1.5	0.2	ng/L	6
Cypermethrin	ND	1.5	0.2	ng/L	
Deltamethrin:Tralomethrin	ND	3.0	0.2	ng/L	
Esfenvalerate:Fenvalerate	ND	3.0	0.2	ng/L	
Fenpropathrin	ND	1.5	0.2	ng/L	
Tau-Fluvalinate	ND	1.5	0.2	ng/L	
Permethrin	ND	15	2.0	ng/L	
Tetramethrin	ND	1.5	0.2	ng/L	
Esfenvalerate-d6;#1 (SS)	94	70-130		%	
Esfenvalerate-d6;#2 (SS)	89	70-130		%	

LABORATORY CONTROL SAMPLE & LCSD: 564070 564071

Parameter	Units	Spike Conc.	LCS Result	LCSD Result	LCS % Rec	LCSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Allethrin	ng/L	20	13	14	66	69	50-150	4.5	35	
Bifenthrin	ng/L	20	18	18	89	90	70-165	0.6	35	
Cyfluthrin	ng/L	20	16	17	82	86	55-140	4.8	30	

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QUALITY CONTROL DATA

Lab Order: P020481

Project ID: CCCWP-SSID 030.001.0202

Analysis Description:	Pyrethroids Analysis, NCI, Water	**QC Batch:**	SPR/6300
Analysis Method:	SW846 8270 Mod (GCMS-NCI-SIM)	**QC Batch Method:**	SW846 3510C

LABORATORY CONTROL SAMPLE & LCSD: 564070 564071

Parameter	Units	Spike Conc.	LCS Result	LCSD Result	LCS % Rec	LCSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Lambda-Cyhalothrin	ng/L	20	14	15	70	77	40-120	8.9	35	
Cypermethrin	ng/L	20	17	18	87	90	50-130	4	30	
Deltamethrin:Tralomethrin	ng/L	40	28	28	69	71	30-105	2.5	40	
Esfenvalerate:Fenvalerate	ng/L	40	31	32	77	80	40-140	4.1	35	
Fenpropathrin	ng/L	20	20	20	98	101	30-180	3	35	
Tau-Fluvalinate	ng/L	20	14	15	71	75	30-100	5.5	40	
Permethrin	ng/L	100	85	92	85	92	50-160	8	40	
Tetramethrin	ng/L	20	14	12	69	61	45-140	12	50	
Esfenvalerate-d6;#1 (SS)	%				93	98	70-130	71		
Esfenvalerate-d6;#2 (SS)	%				88	94	70-130	72		

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 564487 564488

Parameter	Units	P020494001 Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Allethrin	ng/L	0	21	14	15	65	73	50-150	11	35	
Bifenthrin	ng/L	3.1	21	17	18	66	70	70-165	5.2	35	7
Cyfluthrin	ng/L	0.3	21	14	14	65	69	55-140	6.4	30	
Lambda-Cyhalothrin	ng/L	0.5	21	12	12	58	54	40-120	5.8	35	
Cypermethrin	ng/L	0.6	21	14	15	64	69	50-130	7.7	30	
Deltamethrin:Tralomethrin	ng/L	0	41	20	22	50	53	30-105	5.7	40	
Esfenvalerate:Fenvalerate	ng/L	0	41	24	26	59	63	40-140	6.8	35	
Fenpropathrin	ng/L	0	21	14	15	70	75	30-180	6	35	
Tau-Fluvalinate	ng/L	0	21	12	12	56	58	30-100	3.4	40	
Permethrin	ng/L	0	100	69	73	67	70	50-160	5.2	40	
Tetramethrin	ng/L	0	21	15	15	71	72	45-140	2	50	
Esfenvalerate-d6;#1 (SS)	%					65	67	70-130	3.1		4
Esfenvalerate-d6;#2 (SS)	%					64	68	70-130	6		4

Analysis Description:	Chlorinated Pesticides & PCBs Analysis	**QC Batch:**	SPR/6309
Analysis Method:	EPA 608	**QC Batch Method:**	EPA 608

METHOD BLANK: 565093

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Aldrin	ND	0.005	0.004	ug/L	
alpha-BHC	ND	0.010	0.005	ug/L	

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ENVIRONMENTAL ANALYSES

QUALITY CONTROL DATA

Lab Order: P020481

Project ID: CCCWP-SSID 030.001.0202

Analysis Description:	Chlorinated Pesticides & PCBs Analysis	**QC Batch:**	SPR/6309
Analysis Method:	EPA 608	**QC Batch Method:**	EPA 608

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
beta-BHC	ND	0.005	0.004	ug/L	
delta-BHC	ND	0.005	0.004	ug/L	
gamma-BHC (Lindane)	ND	0.010	0.004	ug/L	
Chlordane	ND	0.050	0.020	ug/L	
4,4'-DDD	ND	0.010	0.004	ug/L	
4,4'-DDE	ND	0.010	0.003	ug/L	
4,4'-DDT	ND	0.010	0.004	ug/L	
Dieldrin	ND	0.010	0.004	ug/L	
Endosulfan I	ND	0.010	0.004	ug/L	
Endosulfan II	ND	0.010	0.005	ug/L	
Endosulfan sulfate	ND	0.010	0.005	ug/L	
Endrin	ND	0.010	0.005	ug/L	
Endrin aldehyde	ND	0.010	0.005	ug/L	
Endrin ketone	ND	0.010	0.005	ug/L	
Heptachlor	ND	0.010	0.005	ug/L	
Heptachlor epoxide	ND	0.010	0.004	ug/L	
Methoxychlor	ND	0.010	0.005	ug/L	
PCB 1016	ND	0.10	0.050	ug/L	
PCB 1221	ND	0.10	0.050	ug/L	
PCB 1232	ND	0.10	0.050	ug/L	
PCB 1242	ND	0.10	0.040	ug/L	
PCB 1248	ND	0.10	0.050	ug/L	
PCB 1254	ND	0.10	0.050	ug/L	
PCB 1260	ND	0.10	0.050	ug/L	
Toxaphene	ND	0.5	0.3	ug/L	
Decachlorobiphenyl (SS)	93	30-190		%	
Tetrachloro-m-xylene (SS)	75	25-105		%	

LABORATORY CONTROL SAMPLE & LCSD: 565094 565095

Parameter	Units	Spike Conc.	LCS Result	LCSD Result	LCS % Rec	LCSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Aldrin	ug/L	0.2	0.19	.18	95	89	42-122	6	24	
alpha-BHC	ug/L	0.2	0.19	.18	97	93	37-134	4.2	30	
beta-BHC	ug/L	0.2	0.18	.15	91	76	17-147	18	30	
delta-BHC	ug/L	0.2	0.18	.17	92	85	19-140	7.9	30	
gamma-BHC (Lindane)	ug/L	0.2	0.18	.15	89	75	32-127	17	20	
4,4'-DDD	ug/L	0.2	0.21	.2	107	100	31-141	6.8	30	
4,4'-DDE	ug/L	0.2	0.19	.18	96	91	30-145	5.3	30	
4,4'-DDT	ug/L	0.2	0.22	.2	108	100	25-160	7.7	19	
Dieldrin	ug/L	0.2	0.22	.2	109	102	36-146	6.6	17	

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QUALITY CONTROL DATA

Lab Order: P020481

Project ID: CCCWP-SSID 030.001.0202

Analysis Description: Chlorinated Pesticides & PCBs Analysis   **QC Batch:** SPR/6309
Analysis Method: EPA 608   **QC Batch Method:** EPA 608

LABORATORY CONTROL SAMPLE & LCSD: 565094 565095

Parameter	Units	Spike Conc.	LCS Result	LCSD Result	LCS % Rec	LCSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Endosulfan I	ug/L	0.2	0.2	.18	98	92	45-153	6.1	30	
Endosulfan II	ug/L	0.2	0.19	.18	95	90	1-202	5.4	30	
Endosulfan sulfate	ug/L	0.2	0.22	.2	108	101	26-144	6.2	30	
Endrin	ug/L	0.2	0.18	.17	92	85	30-147	7.9	18	
Endrin aldehyde	ug/L	0.2	0.21	.2	105	101	34-105	4.4	30	
Endrin ketone	ug/L	0.2	0.21	.2	105	98	41-127	6.9	30	
Heptachlor	ug/L	0.2	0.2	.18	100	91	34-111	8.9	23	
Heptachlor epoxide	ug/L	0.2	0.2	.19	102	97	37-142	5.5	30	
Methoxychlor	ug/L	0.2	0.22	.2	112	102	1-186	8.9	30	
Decachlorobiphenyl (SS)	%				100	95	30-190	5.7		
Tetrachloro-m-xylene (SS)	%				79	75	25-105	5.9		

Analysis Description: Fipronil Analysis, Water   **QC Batch:** SPR/6308
Analysis Method: SW846 8270 Mod (GCMS-NCI-SIM)   **QC Batch Method:** SW846 3510C

METHOD BLANK: 564956

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Fipronil	ND	1.5	0.5	ng/L	1
Fipronil Desulfinyl	ND	1.5	0.5	ng/L	
Fipronil Sulfide	ND	1.5	0.5	ng/L	
Fipronil Sulfone	ND	1.5	0.5	ng/L	
Esfenvalerate-d6;#1 (SS)	80	70-130		%	
Esfenvalerate-d6;#2 (SS)	81	70-130		%	

LABORATORY CONTROL SAMPLE & LCSD: 564957 564958

Parameter	Units	Spike Conc.	LCS Result	LCSD Result	LCS % Rec	LCSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Fipronil	ng/L	20	14	14	68	71	50-150	4.3	35	
Fipronil Desulfinyl	ng/L	20	15	16	75	79	50-150	5.2	35	
Fipronil Sulfide	ng/L	20	14	16	72	78	50-150	8	35	
Fipronil Sulfone	ng/L	20	14	14	68	71	50-150	3.6	35	
Esfenvalerate-d6;#1 (SS)	%				84	89	70-130	5.8		
Esfenvalerate-d6;#2 (SS)	%				83	90	70-130	8.1		

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QUALITY CONTROL DATA

Lab Order: P020481

Project ID: CCCWP-SSID 030.001.0202

Analysis Description:	Fipronil Analysis, Water	**QC Batch:**	SPR/6308
Analysis Method:	SW846 8270 Mod (GCMS-NCI-SIM)	**QC Batch Method:**	SW846 3510C

Analysis Description:	Total Organic Carbon Analysis	**QC Batch:**	WET/7444
Analysis Method:	SM20-5310 B	**QC Batch Method:**	SM20-5310 B

METHOD BLANK: 566585

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Total Organic Carbon	ND	1	0.3	mg/L	

LABORATORY CONTROL SAMPLE: 566586

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Total Organic Carbon	mg/L	10	10	101	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 566657 566658

Parameter	Units	P020479022 Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Total Organic Carbon	mg/L	16	10	28	28	113	112	80-120	0.4	20	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 566659 566660

Parameter	Units	P020481002 Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Total Organic Carbon	mg/L	16	10	24	25	88	91	80-120	1.2	20	

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QUALITY CONTROL DATA QUALIFIERS

Lab Order: P020481

Project ID: CCCWP-SSID 030.001.0202

QUALITY CONTROL PARAMETER QUALIFIERS

Results Qualifiers: Report fields may contain codes and non-numeric data correlating to one or more of the following definitions:

NS - means not spiked and will not have recoveries reported for Analyte Spike Amounts

QC Codes Keys: These descriptors are used to help identify the specific QC samples and clarify the report.

MB - Method Blank

Method Blanks are reported to the same Method Detection Limits (MDLs) or Reporting Limits (RLs) as the analytical samples in the corresponding QC batch.

LCS/LCSD - Laboratory Control Spike / Laboratory Control Spike Duplicate

DUP - Duplicate of Original Sample Matrix

MS/MSD - Matrix Spike / Matrix Spike Duplicate

RPD - Relative Percent Difference

%Recovery - Spike Recovery stated as a percentage

1	Analyte(s) reported as 'ND' means not detected at or above the listed Method Detection Limits (MDL).
4	Due to matrix interferences present in the sample, surrogate recoveries failed to meet the QA/QC acceptance criteria.
6	Contaminant was detected in the Method Blank.
7	Matrix Spike recovery(ies) outside control limits: LCS(LCSD) recoveries and RPD are in control. Possible Matrix interference in QC sample.

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QUALITY CONTROL DATA CROSS REFERENCE TABLE

Lab Order: P020481

Project ID: CCCWP-SSID 030.001.0202

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
P020481003	**544R00025DS-**	ASTM D 3977-97 B-Filtration	BIO/13477		
P020481004	**544R00025US**	ASTM D 3977-97 B-Filtration	BIO/13477		
P020481003	**544R00025DS-**	SW846 3510C	SPR/6300	SW846 8270 Mod (GCMS-NCI-SIM)	SMS/3357
P020481004	**544R00025US**	SW846 3510C	SPR/6300	SW846 8270 Mod (GCMS-NCI-SIM)	SMS/3357
P020481003	**544R00025DS-**	SW846 3510C	SPR/6308	SW846 8270 Mod (GCMS-NCI-SIM)	SMS/3373
P020481004	**544R00025US**	SW846 3510C	SPR/6308	SW846 8270 Mod (GCMS-NCI-SIM)	SMS/3373
P020481003	**544R00025DS-**	EPA 608	SPR/6309	EPA 608	SMS/3366
P020481004	**544R00025US**	EPA 608	SPR/6309	EPA 608	SMS/3366
P020481001	**544R00025DS-**	SM20-5310 B	WET/7444		
P020481002	**544R00025US-**	SM20-5310 B	WET/7444		

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Caltest ANALYTICAL LABORATORY

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SAMPLE CHAIN OF CUSTODY

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LAB ORDER #: ~~102478~~ 1020481

PROJECT # / PROJECT NAME: CCCWP-SSID 030,001.0202

P.O. #:

CLIENT: ADH Environmental

REPORT ATTN: Alessandro Hnatt.

ADDRESS: 3065 Porter St CITY: Soquel CA STATE: ~~CA~~ ZIP:

BILLING ADDRESS: Same

PHONE #: 831 427 2003 FAX PHONE:

SAMPLER (PRINT & SIGN NAME): Lucile Paquette

ANALYSES REQUESTED: TOC; Pyrethroids; Fipronil (+ degradates); organochlorine pesticides; SSC

TURN-AROUND TIME: ☐ STANDARD ☐ RUSH

DUE DATE:

CALTEST #	DATE SAMPLED	TIME SAMPLED	MATRIX	CONTAINER AMOUNT/TYPE	PRESERVATIVE	SAMPLE IDENTIFICATION SITE	CLIENT LAB #	COMP. or GRAB	TOC	Pyrethroids	Fipronil (+ degradates)	organochlorine pesticides	SSC			REMARKS
-1	2/6/14	13:20	storm water		ice HCl	544R00025DS-		grab	X							
-2	↓	12:50	↓		ice HCl	544R00025US-		↓	X							
-3	↓	13:20	↓		ice	544R00025DS-		↓		X						
↓	↓	13:20	↓		ice	↓		↓			X					
[illegible]	↓	13:20	↓		ice	↓		↓				X				
[illegible]	↓	12:50	↓		ice	↓	-1	↓					X			
-4	↓	12:50	↓		ice	544R00025US	was RS 2/8/14	↓		X						
↓	↓	12:50	↓		ice	↓		↓			X					
↓	↓	12:50	↓		ice	↓		↓				X				
↓	↓	12:50	↓		ice	↓	-2	↓					X			

By submittal of sample(s), client agrees to abide by the Terms and Conditions set forth on the reverse of this document.

RELINQUISHED BY	DATE/TIME	RECEIVED BY	RELINQUISHED BY	DATE/TIME	RECEIVED BY
[signature]	2-7-14 6:17	[signature]			

FOR LAB USE ONLY

Samples: WC___ MICRO___ BIO___ MET___ SV___ VOA___ TEMP:___ °C SEALED: Y___ / N___ INTACT: Y___ / N___

BD: BIO___ WC___ MET___

CC: AA___ SV___ VOA___

SIL: HP___ PT___ QT___ VOA___

W/HNO₃___ H₂SO₄___ NaOH___

PIL: HNO₃___ H₂SO₄___ NaOH___ HCL___

COMMENTS

MATRIX: W = Aqueous Nondrinking Water, Digested Metals; ML = Low R.L.s, Aqueous Nondrinking Water, Digested Metals; DW = Drinking Water; SL = Soil, Sludge, Solid; FP = Free Product

CONTAINER TYPES: AL = Amber Liter; AHL = 500 ml Amber; PT = Pint (Plastic); QT=Quart (Plastic); HG = Half Gallon (Plastic); SJ = Soil Jar; B4 = 4 oz. BACT; BT = Brass Tube; VOA = 40 mL.VOA; OTC = Other Type Container

ENVIRONMENTAL ANALYSES

Wednesday, April 16, 2014

Alessandro Hnatt
ADH Environmental
3065 Porter Street, Suite 101
Soquel, CA 95073

Re	Lab Order:	P030135	Collected By:	CLIENT
	Project ID:	Contra Costa Clean Water Progr	PO/Contract #:	

Dear Alessandro Hnatt:

Enclosed are the analytical results for sample(s) received by the laboratory on Tuesday, March 04, 2014. Results reported herein conform to the most current NELAC standards, where applicable, unless otherwise narrated in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Enclosures

Project Manager: Todd Albertson

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SAMPLE SUMMARY

Lab Order: P030135
Project ID: Contra Costa Clean Water Progr

Lab ID	Sample ID	Matrix	Date Collected	Date Received
P030135001	**544R00025US-W-02**	Water	02/28/2014 10:00	02/28/2014 10:00
P030135002	**544R00025DS-W-02**	Water	02/28/2014 09:30	02/28/2014 09:30
P030135003	**207R00011DS-W-01**	Water	02/28/2014 08:45	02/28/2014 08:45
P030135004	**207R00011US-W-01**	Water	02/28/2014 09:55	02/28/2014 09:55

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NARRATIVE

Lab Order:	P030135
Project ID:	Contra Costa Clean Water Progr

General Qualifiers and Notes

Caltest authorizes this report to be reproduced only in its entirety. Results are specific to the sample(s) as submitted and only to the parameter(s) reported.

Caltest certifies that all test results for wastewater and hazardous waste analyses meet all applicable NELAC requirements; all microbiology and drinking water testing meet applicable ELAP requirements, unless stated otherwise.

All analyses performed by EPA Methods or Standard Methods (SM) 20th Edition except where noted (SMOL=online edition).

Caltest collects samples in compliance with 40 CFR, EPA Methods, Cal. Title 22, and Standard Methods.

Dilution Factors (DF) reported greater than '1' have been used to adjust the result, Reporting Limit (RL), and Method Detection Limit (MDL).

All Solid, sludge, and/or biosolids data is reported in Wet Weight, unless otherwise specified.

Filtrations performed at Caltest for dissolved metals (excluding mercury) and/or pH analysis were not performed within the 15 minute holding time as specified by 40CFR 136.3 table II.

Results Qualifiers: Report fields may contain codes and non-numeric data correlating to one or more of the following definitions:

ND - Non Detect - indicates analytical result has not been detected.

RL - Reporting Limit is the quantitation limit at which the laboratory is able to detect an analyte. An analyte not detected at or above the RL is reported as ND unless otherwise noted or qualified. For analyses pertaining to the State Implementation Plan of the California Toxics Rule, the Caltest Reporting Limit (RL) is equivalent to the Minimum Level (ML). A standard is always run at or below the ML. Where Reporting Limits are elevated due to dilution, the ML calibration criteria has been met.

J - reflects estimated analytical result value detected below the Reporting Limit (RL) and above the Method Detection Limit (MDL). The 'J' flag is equivalent to the DNQ Estimated Concentration flag.

E - indicates an estimated analytical result value.

B - indicates the analyte has been detected in the blank associated with the sample.

NC - means not able to be calculated for RPD or Spike Recoveries.

SS - compound is a Surrogate Spike used per laboratory quality assurance manual.

NOTE: This document represents a complete Analytical Report for the samples referenced herein and should be retained as a permanent record thereof.

Qualifiers and Compound Notes

1	Reporting Limits may be elevated due to limited sample volume.
2	Analyte(s) reported as 'ND' means not detected at or above the listed Method Detection Limits (MDL).
3	The sample was diluted and analyzed in attempt to minimize the matrix interferences. The dilution yielded similar results as the 1X run therefore the 1X run was reported.
4	This analysis is not covered under Caltest's NELAP/CAL-ELAP Accreditations.
5	Due to matrix interferences present in the sample, surrogate recoveries failed to meet the QA/QC acceptance criteria.
6	Surrogates did not meet Caltest internal acceptance criteria. The sample passes all pertinent method criteria.

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ANALYTICAL RESULTS

Lab Order: P030135
Project ID: Contra Costa Clean Water Progr

Lab ID **P030135001** Date Collected 2/28/2014 10:00:00 AM Matrix Water
Sample ID **544R00025US-W-02** Date Received 3/4/2014 12:21:00 PM

Parameters	Result Units	R. L.	MDL	DF Prepared	Prepared	Analyzed	Prepared	Qual
Suspended Sediment Concentration	**Analytical Method:**	ASTM D 3977-97 B-Filtration				**Analyzed by:**	CFG	
Sediment Concentration	13 mg/L	3	2	1		03/06/14 09:38	BIO 13574	4
Chlorinated Pesticides & PCBs Analysis	**Prep Method:**	EPA 608		**Prep by:**	EAB			
	Analytical Method:	EPA 608				**Analyzed by:**	NTA	
Aldrin	ND ug/L	0.006	0.0050	1 03/06/14 00:00	SPR 6346	03/19/14 01:49	SMS 3391	2,1
alpha-BHC	ND ug/L	0.010	0.0062	1 03/06/14 00:00	SPR 6346	03/19/14 01:49	SMS 3391	
beta-BHC	ND ug/L	0.006	0.0050	1 03/06/14 00:00	SPR 6346	03/19/14 01:49	SMS 3391	
delta-BHC	ND ug/L	0.006	0.0050	1 03/06/14 00:00	SPR 6346	03/19/14 01:49	SMS 3391	
gamma-BHC (Lindane)	ND ug/L	0.010	0.0050	1 03/06/14 00:00	SPR 6346	03/19/14 01:49	SMS 3391	
Chlordane	ND ug/L	0.062	0.025	1 03/06/14 00:00	SPR 6346	03/19/14 01:49	SMS 3391	
4,4'-DDD	ND ug/L	0.010	0.0050	1 03/06/14 00:00	SPR 6346	03/19/14 01:49	SMS 3391	
4,4'-DDE	ND ug/L	0.010	0.0038	1 03/06/14 00:00	SPR 6346	03/19/14 01:49	SMS 3391	
4,4'-DDT	ND ug/L	0.010	0.0050	1 03/06/14 00:00	SPR 6346	03/19/14 01:49	SMS 3391	
Dieldrin	ND ug/L	0.010	0.0050	1 03/06/14 00:00	SPR 6346	03/19/14 01:49	SMS 3391	
Endosulfan I	ND ug/L	0.010	0.0050	1 03/06/14 00:00	SPR 6346	03/19/14 01:49	SMS 3391	
Endosulfan II	ND ug/L	0.010	0.0062	1 03/06/14 00:00	SPR 6346	03/19/14 01:49	SMS 3391	
Endosulfan sulfate	ND ug/L	0.010	0.0062	1 03/06/14 00:00	SPR 6346	03/19/14 01:49	SMS 3391	
Endrin	ND ug/L	0.010	0.0062	1 03/06/14 00:00	SPR 6346	03/19/14 01:49	SMS 3391	
Endrin aldehyde	ND ug/L	0.010	0.0062	1 03/06/14 00:00	SPR 6346	03/19/14 01:49	SMS 3391	
Endrin ketone	ND ug/L	0.010	0.0062	1 03/06/14 00:00	SPR 6346	03/19/14 01:49	SMS 3391	
Heptachlor	ND ug/L	0.010	0.0062	1 03/06/14 00:00	SPR 6346	03/19/14 01:49	SMS 3391	
Heptachlor epoxide	ND ug/L	0.010	0.0050	1 03/06/14 00:00	SPR 6346	03/19/14 01:49	SMS 3391	
Methoxychlor	ND ug/L	0.010	0.0062	1 03/06/14 00:00	SPR 6346	03/19/14 01:49	SMS 3391	
PCB 1016	ND ug/L	0.12	0.062	1 03/06/14 00:00	SPR 6346	03/19/14 01:49	SMS 3391	
PCB 1221	ND ug/L	0.12	0.062	1 03/06/14 00:00	SPR 6346	03/19/14 01:49	SMS 3391	
PCB 1232	ND ug/L	0.12	0.062	1 03/06/14 00:00	SPR 6346	03/19/14 01:49	SMS 3391	
PCB 1242	ND ug/L	0.12	0.050	1 03/06/14 00:00	SPR 6346	03/19/14 01:49	SMS 3391	
PCB 1248	ND ug/L	0.12	0.062	1 03/06/14 00:00	SPR 6346	03/19/14 01:49	SMS 3391	
PCB 1254	ND ug/L	0.12	0.062	1 03/06/14 00:00	SPR 6346	03/19/14 01:49	SMS 3391	
PCB 1260	ND ug/L	0.12	0.062	1 03/06/14 00:00	SPR 6346	03/19/14 01:49	SMS 3391	
Toxaphene	ND ug/L	0.6	0.38	1 03/06/14 00:00	SPR 6346	03/19/14 01:49	SMS 3391	
Decachlorobiphenyl (SS)	41 %	10-195		1 03/06/14 00:00	SPR 6346	03/19/14 01:49	SMS 3391	
Tetrachloro-m-xylene (SS)	100 %	25-105		1 03/06/14 00:00	SPR 6346	03/19/14 01:49	SMS 3391	
Pyrethroids+Fipronil Analysis,NCI,Water	**Prep Method:**	SW846 3510C		**Prep by:**	EAB			
	Analytical Method:	SW846 8270 Mod				**Analyzed by:**	RLH	
Allethrin	ND ng/L	1.5	0.1	1 03/07/14 00:00	SPR 6351	04/03/14 08:37	SMS 3410	2,3
Bifenthrin	8.5 ng/L	1.5	0.1	1 03/07/14 00:00	SPR 6351	04/03/14 08:37	SMS 3410	
Cyfluthrin	J1.5 ng/L	1.5	0.2	1 03/07/14 00:00	SPR 6351	04/03/14 08:37	SMS 3410	
Lambda-Cyhalothrin	ND ng/L	1.5	0.2	1 03/07/14 00:00	SPR 6351	04/03/14 08:37	SMS 3410	
Cypermethrin	ND ng/L	1.5	0.2	1 03/07/14 00:00	SPR 6351	04/03/14 08:37	SMS 3410	
Deltamethrin:Tralomethrin	ND ng/L	3.0	0.2	1 03/07/14 00:00	SPR 6351	04/03/14 08:37	SMS 3410	
Esfenvalerate:Fenvalerate	ND ng/L	3.0	0.2	1 03/07/14 00:00	SPR 6351	04/03/14 08:37	SMS 3410	
Fenpropathrin	ND ng/L	1.5	0.2	1 03/07/14 00:00	SPR 6351	04/03/14 08:37	SMS 3410	

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ANALYTICAL RESULTS

Lab Order: P030135
Project ID: Contra Costa Clean Water Progr

Lab ID **P030135001** Date Collected 2/28/2014 10:00:00 AM Matrix Water
Sample ID **544R00025US-W-02** Date Received 3/4/2014 12:21:00 PM

Parameters	Result Units	R. L.	MDL	DF Prepared	Prepared	Analyzed	Prepared	Qual
Fipronil	4.5 ng/L	1.5	0.5	1 03/07/14 00:00	SPR 6351	04/03/14 08:37	SMS 3410	
Fipronil Desulfinyl	2.2 ng/L	1.5	0.5	1 03/07/14 00:00	SPR 6351	04/03/14 08:37	SMS 3410	
Fipronil Sulfide	ND ng/L	1.5	0.5	1 03/07/14 00:00	SPR 6351	04/03/14 08:37	SMS 3410	
Fipronil Sulfone	5.5 ng/L	1.5	0.5	1 03/07/14 00:00	SPR 6351	04/03/14 08:37	SMS 3410	
Tau-Fluvalinate	ND ng/L	1.5	0.2	1 03/07/14 00:00	SPR 6351	04/03/14 08:37	SMS 3410	
Permethrin	ND ng/L	15	2	1 03/07/14 00:00	SPR 6351	04/03/14 08:37	SMS 3410	
Tetramethrin	ND ng/L	1.5	0.2	1 03/07/14 00:00	SPR 6351	04/03/14 08:37	SMS 3410	
Esfenvalerate-d6;#1 (SS)	68 %	70-130		1 03/07/14 00:00	SPR 6351	04/03/14 08:37	SMS 3410	5
Esfenvalerate-d6;#2 (SS)	67 %	70-130		1 03/07/14 00:00	SPR 6351	04/03/14 08:37	SMS 3410	5
Total Organic Carbon Analysis	**Analytical Method:**	SM20-5310 B				**Analyzed by:**	NP	
Total Organic Carbon	14 mg/L	1	0.30	1		03/12/14 18:34	WET 7502	

Lab ID **P030135002** Date Collected 2/28/2014 9:30:00 AM Matrix Water
Sample ID **544R00025DS-W-02** Date Received 3/4/2014 12:21:00 PM

Parameters	Result Units	R. L.	MDL	DF Prepared	Prepared	Analyzed	Prepared	Qual
Suspended Sediment Concentration	**Analytical Method:**	ASTM D 3977-97 B-Filtration				**Analyzed by:**	CFG	
Sediment Concentration	37 mg/L	3	2	1		03/06/14 09:38	BIO 13574	4
Chlorinated Pesticides & PCBs Analysis	**Prep Method:**	EPA 608		**Prep by:**	EAB			
	Analytical Method:	EPA 608				**Analyzed by:**	NTA	
Aldrin	ND ug/L	0.005	0.0040	1 03/06/14 00:00	SPR 6346	03/19/14 02:16	SMS 3391	2
alpha-BHC	ND ug/L	0.010	0.0050	1 03/06/14 00:00	SPR 6346	03/19/14 02:16	SMS 3391	
beta-BHC	ND ug/L	0.005	0.0040	1 03/06/14 00:00	SPR 6346	03/19/14 02:16	SMS 3391	
delta-BHC	ND ug/L	0.005	0.0040	1 03/06/14 00:00	SPR 6346	03/19/14 02:16	SMS 3391	
gamma-BHC (Lindane)	ND ug/L	0.010	0.0040	1 03/06/14 00:00	SPR 6346	03/19/14 02:16	SMS 3391	
Chlordane	ND ug/L	0.050	0.020	1 03/06/14 00:00	SPR 6346	03/19/14 02:16	SMS 3391	
4,4'-DDD	ND ug/L	0.010	0.0040	1 03/06/14 00:00	SPR 6346	03/19/14 02:16	SMS 3391	
4,4'-DDE	ND ug/L	0.010	0.0030	1 03/06/14 00:00	SPR 6346	03/19/14 02:16	SMS 3391	
4,4'-DDT	ND ug/L	0.010	0.0040	1 03/06/14 00:00	SPR 6346	03/19/14 02:16	SMS 3391	
Dieldrin	ND ug/L	0.010	0.0040	1 03/06/14 00:00	SPR 6346	03/19/14 02:16	SMS 3391	
Endosulfan I	ND ug/L	0.010	0.0040	1 03/06/14 00:00	SPR 6346	03/19/14 02:16	SMS 3391	
Endosulfan II	ND ug/L	0.010	0.0050	1 03/06/14 00:00	SPR 6346	03/19/14 02:16	SMS 3391	
Endosulfan sulfate	ND ug/L	0.010	0.0050	1 03/06/14 00:00	SPR 6346	03/19/14 02:16	SMS 3391	
Endrin	ND ug/L	0.010	0.0050	1 03/06/14 00:00	SPR 6346	03/19/14 02:16	SMS 3391	
Endrin aldehyde	ND ug/L	0.010	0.0050	1 03/06/14 00:00	SPR 6346	03/19/14 02:16	SMS 3391	
Endrin ketone	ND ug/L	0.010	0.0050	1 03/06/14 00:00	SPR 6346	03/19/14 02:16	SMS 3391	
Heptachlor	ND ug/L	0.010	0.0050	1 03/06/14 00:00	SPR 6346	03/19/14 02:16	SMS 3391	
Heptachlor epoxide	ND ug/L	0.010	0.0040	1 03/06/14 00:00	SPR 6346	03/19/14 02:16	SMS 3391	
Methoxychlor	ND ug/L	0.010	0.0050	1 03/06/14 00:00	SPR 6346	03/19/14 02:16	SMS 3391	
PCB 1016	ND ug/L	0.10	0.050	1 03/06/14 00:00	SPR 6346	03/19/14 02:16	SMS 3391	
PCB 1221	ND ug/L	0.10	0.050	1 03/06/14 00:00	SPR 6346	03/19/14 02:16	SMS 3391	
PCB 1232	ND ug/L	0.10	0.050	1 03/06/14 00:00	SPR 6346	03/19/14 02:16	SMS 3391	

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ANALYTICAL RESULTS

Lab Order: P030135
Project ID: Contra Costa Clean Water Progr

Lab ID **P030135002** Date Collected 2/28/2014 9:30:00 AM Matrix Water
Sample ID **544R00025DS-W-02** Date Received 3/4/2014 12:21:00 PM

Parameters	Result Units	R. L.	MDL	DF Prepared	Prepared	Analyzed	Prepared	Qual
PCB 1242	ND ug/L	0.10	0.040	1 03/06/14 00:00	SPR 6346	03/19/14 02:16	SMS 3391	
PCB 1248	ND ug/L	0.10	0.050	1 03/06/14 00:00	SPR 6346	03/19/14 02:16	SMS 3391	
PCB 1254	ND ug/L	0.10	0.050	1 03/06/14 00:00	SPR 6346	03/19/14 02:16	SMS 3391	
PCB 1260	ND ug/L	0.10	0.050	1 03/06/14 00:00	SPR 6346	03/19/14 02:16	SMS 3391	
Toxaphene	ND ug/L	0.5	0.30	1 03/06/14 00:00	SPR 6346	03/19/14 02:16	SMS 3391	
Decachlorobiphenyl (SS)	34 %	10-195		1 03/06/14 00:00	SPR 6346	03/19/14 02:16	SMS 3391	
Tetrachloro-m-xylene (SS)	96 %	25-105		1 03/06/14 00:00	SPR 6346	03/19/14 02:16	SMS 3391	

Pyrethroids+Fipronil Analysis,NCI,Water **Prep Method:** SW846 3510C **Prep by:** EAB
Analytical Method: SW846 8270 Mod **Analyzed by:** RLH

Parameters	Result Units	R. L.	MDL	DF Prepared	Prepared	Analyzed	Prepared	Qual
Allethrin	ND ng/L	1.5	0.1	1 03/07/14 00:00	SPR 6351	04/03/14 10:23	SMS 3410	2,3
Bifenthrin	8.6 ng/L	1.5	0.1	1 03/07/14 00:00	SPR 6351	04/03/14 10:23	SMS 3410	
Cyfluthrin	1.7 ng/L	1.5	0.2	1 03/07/14 00:00	SPR 6351	04/03/14 10:23	SMS 3410	
Lambda-Cyhalothrin	ND ng/L	1.5	0.2	1 03/07/14 00:00	SPR 6351	04/03/14 10:23	SMS 3410	
Cypermethrin	ND ng/L	1.5	0.2	1 03/07/14 00:00	SPR 6351	04/03/14 10:23	SMS 3410	
Deltamethrin:Tralomethrin	ND ng/L	3.0	0.2	1 03/07/14 00:00	SPR 6351	04/03/14 10:23	SMS 3410	
Esfenvalerate:Fenvalerate	ND ng/L	3.0	0.2	1 03/07/14 00:00	SPR 6351	04/03/14 10:23	SMS 3410	
Fenpropathrin	ND ng/L	1.5	0.2	1 03/07/14 00:00	SPR 6351	04/03/14 10:23	SMS 3410	
Fipronil	4.3 ng/L	1.5	0.5	1 03/07/14 00:00	SPR 6351	04/03/14 10:23	SMS 3410	
Fipronil Desulfinyl	1.9 ng/L	1.5	0.5	1 03/07/14 00:00	SPR 6351	04/03/14 10:23	SMS 3410	
Fipronil Sulfide	ND ng/L	1.5	0.5	1 03/07/14 00:00	SPR 6351	04/03/14 10:23	SMS 3410	
Fipronil Sulfone	5.2 ng/L	1.5	0.5	1 03/07/14 00:00	SPR 6351	04/03/14 10:23	SMS 3410	
Tau-Fluvalinate	ND ng/L	1.5	0.2	1 03/07/14 00:00	SPR 6351	04/03/14 10:23	SMS 3410	
Permethrin	ND ng/L	15	2	1 03/07/14 00:00	SPR 6351	04/03/14 10:23	SMS 3410	
Tetramethrin	ND ng/L	1.5	0.2	1 03/07/14 00:00	SPR 6351	04/03/14 10:23	SMS 3410	
Esfenvalerate-d6;#1 (SS)	63 %	70-130		1 03/07/14 00:00	SPR 6351	04/03/14 10:23	SMS 3410	5
Esfenvalerate-d6;#2 (SS)	63 %	70-130		1 03/07/14 00:00	SPR 6351	04/03/14 10:23	SMS 3410	5

Total Organic Carbon Analysis **Analytical Method:** SM20-5310 B **Analyzed by:** NP

Parameters	Result Units	R. L.	MDL	DF Prepared	Prepared	Analyzed	Prepared	Qual
Total Organic Carbon	15 mg/L	1	0.30	1		03/12/14 18:51	WET 7502	

Lab ID **P030135003** Date Collected 2/28/2014 8:45:00 AM Matrix Water
Sample ID **207R00011DS-W-01** Date Received 3/4/2014 12:21:00 PM

Suspended Sediment Concentration **Analytical Method:** ASTM D 3977-97 B-Filtration **Analyzed by:** CFG

Parameters	Result Units	R. L.	MDL	DF Prepared	Prepared	Analyzed	Prepared	Qual
Sediment Concentration	173 mg/L	3	2	1		03/06/14 09:38	BIO 13574	4

Chlorinated Pesticides & PCBs Analysis **Prep Method:** EPA 608 **Prep by:** EAB
Analytical Method: EPA 608 **Analyzed by:** NTA

Parameters	Result Units	R. L.	MDL	DF Prepared	Prepared	Analyzed	Prepared	Qual
Aldrin	ND ug/L	0.005	0.0040	1 03/06/14 00:00	SPR 6346	03/19/14 02:44	SMS 3391	2
alpha-BHC	ND ug/L	0.010	0.0050	1 03/06/14 00:00	SPR 6346	03/19/14 02:44	SMS 3391	
beta-BHC	ND ug/L	0.005	0.0040	1 03/06/14 00:00	SPR 6346	03/19/14 02:44	SMS 3391	
delta-BHC	ND ug/L	0.005	0.0040	1 03/06/14 00:00	SPR 6346	03/19/14 02:44	SMS 3391	

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ANALYTICAL RESULTS

Lab Order: P030135
Project ID: Contra Costa Clean Water Progr

Lab ID **P030135003** Date Collected 2/28/2014 8:45:00 AM Matrix Water
Sample ID **207R00011DS-W-01** Date Received 3/4/2014 12:21:00 PM

Parameters	Result Units	R. L.	MDL	DF Prepared	Prepared	Analyzed	Prepared	Qual
gamma-BHC (Lindane)	ND ug/L	0.010	0.0040	1 03/06/14 00:00	SPR 6346	03/19/14 02:44	SMS 3391	
Chlordane	ND ug/L	0.050	0.020	1 03/06/14 00:00	SPR 6346	03/19/14 02:44	SMS 3391	
4,4'-DDD	ND ug/L	0.010	0.0040	1 03/06/14 00:00	SPR 6346	03/19/14 02:44	SMS 3391	
4,4'-DDE	ND ug/L	0.010	0.0030	1 03/06/14 00:00	SPR 6346	03/19/14 02:44	SMS 3391	
4,4'-DDT	ND ug/L	0.010	0.0040	1 03/06/14 00:00	SPR 6346	03/19/14 02:44	SMS 3391	
Dieldrin	ND ug/L	0.010	0.0040	1 03/06/14 00:00	SPR 6346	03/19/14 02:44	SMS 3391	
Endosulfan I	ND ug/L	0.010	0.0040	1 03/06/14 00:00	SPR 6346	03/19/14 02:44	SMS 3391	
Endosulfan II	ND ug/L	0.010	0.0050	1 03/06/14 00:00	SPR 6346	03/19/14 02:44	SMS 3391	
Endosulfan sulfate	ND ug/L	0.010	0.0050	1 03/06/14 00:00	SPR 6346	03/19/14 02:44	SMS 3391	
Endrin	ND ug/L	0.010	0.0050	1 03/06/14 00:00	SPR 6346	03/19/14 02:44	SMS 3391	
Endrin aldehyde	ND ug/L	0.010	0.0050	1 03/06/14 00:00	SPR 6346	03/19/14 02:44	SMS 3391	
Endrin ketone	ND ug/L	0.010	0.0050	1 03/06/14 00:00	SPR 6346	03/19/14 02:44	SMS 3391	
Heptachlor	ND ug/L	0.010	0.0050	1 03/06/14 00:00	SPR 6346	03/19/14 02:44	SMS 3391	
Heptachlor epoxide	ND ug/L	0.010	0.0040	1 03/06/14 00:00	SPR 6346	03/19/14 02:44	SMS 3391	
Methoxychlor	ND ug/L	0.010	0.0050	1 03/06/14 00:00	SPR 6346	03/19/14 02:44	SMS 3391	
PCB 1016	ND ug/L	0.10	0.050	1 03/06/14 00:00	SPR 6346	03/19/14 02:44	SMS 3391	
PCB 1221	ND ug/L	0.10	0.050	1 03/06/14 00:00	SPR 6346	03/19/14 02:44	SMS 3391	
PCB 1232	ND ug/L	0.10	0.050	1 03/06/14 00:00	SPR 6346	03/19/14 02:44	SMS 3391	
PCB 1242	ND ug/L	0.10	0.040	1 03/06/14 00:00	SPR 6346	03/19/14 02:44	SMS 3391	
PCB 1248	ND ug/L	0.10	0.050	1 03/06/14 00:00	SPR 6346	03/19/14 02:44	SMS 3391	
PCB 1254	ND ug/L	0.10	0.050	1 03/06/14 00:00	SPR 6346	03/19/14 02:44	SMS 3391	
PCB 1260	ND ug/L	0.10	0.050	1 03/06/14 00:00	SPR 6346	03/19/14 02:44	SMS 3391	
Toxaphene	ND ug/L	0.5	0.30	1 03/06/14 00:00	SPR 6346	03/19/14 02:44	SMS 3391	
Decachlorobiphenyl (SS)	36 %	10-195		1 03/06/14 00:00	SPR 6346	03/19/14 02:44	SMS 3391	
Tetrachloro-m-xylene (SS)	114 %	25-105		1 03/06/14 00:00	SPR 6346	03/19/14 02:44	SMS 3391	6

Pyrethroids+Fipronil Analysis,NCI,Water **Prep Method:** SW846 3510C **Prep by:** EAB

Analytical Method: SW846 8270 Mod **Analyzed by:** RLH

Parameters	Result Units	R. L.	MDL	DF Prepared	Prepared	Analyzed	Prepared	Qual
Allethrin	ND ng/L	1.5	0.1	1 03/07/14 00:00	SPR 6351	04/03/14 12:09	SMS 3410	2,3
Bifenthrin	6.5 ng/L	1.5	0.1	1 03/07/14 00:00	SPR 6351	04/03/14 12:09	SMS 3410	
Cyfluthrin	6.4 ng/L	1.5	0.2	1 03/07/14 00:00	SPR 6351	04/03/14 12:09	SMS 3410	
Lambda-Cyhalothrin	ND ng/L	1.5	0.2	1 03/07/14 00:00	SPR 6351	04/03/14 12:09	SMS 3410	
Cypermethrin	ND ng/L	1.5	0.2	1 03/07/14 00:00	SPR 6351	04/03/14 12:09	SMS 3410	
Deltamethrin:Tralomethrin	ND ng/L	3.0	0.2	1 03/07/14 00:00	SPR 6351	04/03/14 12:09	SMS 3410	
Esfenvalerate:Fenvalerate	ND ng/L	3.0	0.2	1 03/07/14 00:00	SPR 6351	04/03/14 12:09	SMS 3410	
Fenpropathrin	ND ng/L	1.5	0.2	1 03/07/14 00:00	SPR 6351	04/03/14 12:09	SMS 3410	
Fipronil	23 ng/L	1.5	0.5	1 03/07/14 00:00	SPR 6351	04/03/14 12:09	SMS 3410	
Fipronil Desulfinyl	2.2 ng/L	1.5	0.5	1 03/07/14 00:00	SPR 6351	04/03/14 12:09	SMS 3410	
Fipronil Sulfide	1.6 ng/L	1.5	0.5	1 03/07/14 00:00	SPR 6351	04/03/14 12:09	SMS 3410	
Fipronil Sulfone	9.5 ng/L	1.5	0.5	1 03/07/14 00:00	SPR 6351	04/03/14 12:09	SMS 3410	
Tau-Fluvalinate	ND ng/L	1.5	0.2	1 03/07/14 00:00	SPR 6351	04/03/14 12:09	SMS 3410	
Permethrin	ND ng/L	15	2	1 03/07/14 00:00	SPR 6351	04/03/14 12:09	SMS 3410	
Tetramethrin	ND ng/L	1.5	0.2	1 03/07/14 00:00	SPR 6351	04/03/14 12:09	SMS 3410	
Esfenvalerate-d6;#1 (SS)	62 %	70-130		1 03/07/14 00:00	SPR 6351	04/03/14 12:09	SMS 3410	5
Esfenvalerate-d6;#2 (SS)	63 %	70-130		1 03/07/14 00:00	SPR 6351	04/03/14 12:09	SMS 3410	5

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ANALYTICAL RESULTS

Lab Order: P030135
Project ID: Contra Costa Clean Water Progr

Lab ID **P030135003** Date Collected 2/28/2014 8:45:00 AM Matrix Water
Sample ID **207R00011DS-W-01** Date Received 3/4/2014 12:21:00 PM

Parameters	Result Units	R. L.	MDL	DF Prepared	Prepared	Analyzed	Prepared	Qual
Total Organic Carbon Analysis	**Analytical Method:**	SM20-5310 B				**Analyzed by:**	NP	
Total Organic Carbon	10 mg/L	1	0.30	1		03/12/14 19:04	WET 7502	

Lab ID **P030135004** Date Collected 2/28/2014 9:55:00 AM Matrix Water
Sample ID **207R00011US-W-01** Date Received 3/4/2014 12:21:00 PM

Parameters	Result Units	R. L.	MDL	DF Prepared	Prepared	Analyzed	Prepared	Qual
Suspended Sediment Concentration	**Analytical Method:**	ASTM D 3977-97 B-Filtration				**Analyzed by:**	CFG	
Sediment Concentration	37 mg/L	3	2	1		03/06/14 09:38	BIO 13574	4
Chlorinated Pesticides & PCBs Analysis	**Prep Method:**	EPA 608		**Prep by:**	EAB			
	Analytical Method:	EPA 608				**Analyzed by:**	NTA	
Aldrin	ND ug/L	0.005	0.0040	1 03/06/14 00:00	SPR 6346	03/19/14 03:11	SMS 3391	2
alpha-BHC	ND ug/L	0.010	0.0050	1 03/06/14 00:00	SPR 6346	03/19/14 03:11	SMS 3391	
beta-BHC	ND ug/L	0.005	0.0040	1 03/06/14 00:00	SPR 6346	03/19/14 03:11	SMS 3391	
delta-BHC	ND ug/L	0.005	0.0040	1 03/06/14 00:00	SPR 6346	03/19/14 03:11	SMS 3391	
gamma-BHC (Lindane)	ND ug/L	0.010	0.0040	1 03/06/14 00:00	SPR 6346	03/19/14 03:11	SMS 3391	
Chlordane	ND ug/L	0.050	0.020	1 03/06/14 00:00	SPR 6346	03/19/14 03:11	SMS 3391	
4,4'-DDD	ND ug/L	0.010	0.0040	1 03/06/14 00:00	SPR 6346	03/19/14 03:11	SMS 3391	
4,4'-DDE	ND ug/L	0.010	0.0030	1 03/06/14 00:00	SPR 6346	03/19/14 03:11	SMS 3391	
4,4'-DDT	ND ug/L	0.010	0.0040	1 03/06/14 00:00	SPR 6346	03/19/14 03:11	SMS 3391	
Dieldrin	ND ug/L	0.010	0.0040	1 03/06/14 00:00	SPR 6346	03/19/14 03:11	SMS 3391	
Endosulfan I	ND ug/L	0.010	0.0040	1 03/06/14 00:00	SPR 6346	03/19/14 03:11	SMS 3391	
Endosulfan II	ND ug/L	0.010	0.0050	1 03/06/14 00:00	SPR 6346	03/19/14 03:11	SMS 3391	
Endosulfan sulfate	ND ug/L	0.010	0.0050	1 03/06/14 00:00	SPR 6346	03/19/14 03:11	SMS 3391	
Endrin	ND ug/L	0.010	0.0050	1 03/06/14 00:00	SPR 6346	03/19/14 03:11	SMS 3391	
Endrin aldehyde	ND ug/L	0.010	0.0050	1 03/06/14 00:00	SPR 6346	03/19/14 03:11	SMS 3391	
Endrin ketone	ND ug/L	0.010	0.0050	1 03/06/14 00:00	SPR 6346	03/19/14 03:11	SMS 3391	
Heptachlor	ND ug/L	0.010	0.0050	1 03/06/14 00:00	SPR 6346	03/19/14 03:11	SMS 3391	
Heptachlor epoxide	ND ug/L	0.010	0.0040	1 03/06/14 00:00	SPR 6346	03/19/14 03:11	SMS 3391	
Methoxychlor	ND ug/L	0.010	0.0050	1 03/06/14 00:00	SPR 6346	03/19/14 03:11	SMS 3391	
PCB 1016	ND ug/L	0.10	0.050	1 03/06/14 00:00	SPR 6346	03/19/14 03:11	SMS 3391	
PCB 1221	ND ug/L	0.10	0.050	1 03/06/14 00:00	SPR 6346	03/19/14 03:11	SMS 3391	
PCB 1232	ND ug/L	0.10	0.050	1 03/06/14 00:00	SPR 6346	03/19/14 03:11	SMS 3391	
PCB 1242	ND ug/L	0.10	0.040	1 03/06/14 00:00	SPR 6346	03/19/14 03:11	SMS 3391	
PCB 1248	ND ug/L	0.10	0.050	1 03/06/14 00:00	SPR 6346	03/19/14 03:11	SMS 3391	
PCB 1254	ND ug/L	0.10	0.050	1 03/06/14 00:00	SPR 6346	03/19/14 03:11	SMS 3391	
PCB 1260	ND ug/L	0.10	0.050	1 03/06/14 00:00	SPR 6346	03/19/14 03:11	SMS 3391	
Toxaphene	ND ug/L	0.5	0.30	1 03/06/14 00:00	SPR 6346	03/19/14 03:11	SMS 3391	
Decachlorobiphenyl (SS)	39 %	10-195		1 03/06/14 00:00	SPR 6346	03/19/14 03:11	SMS 3391	
Tetrachloro-m-xylene (SS)	95 %	25-105		1 03/06/14 00:00	SPR 6346	03/19/14 03:11	SMS 3391	
Pyrethroids+Fipronil Analysis,NCI,Water	**Prep Method:**	SW846 3510C		**Prep by:**	EAB			

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ANALYTICAL RESULTS

Lab Order: P030135
Project ID: Contra Costa Clean Water Progr

Lab ID **P030135004** Date Collected 2/28/2014 9:55:00 AM Matrix Water
Sample ID **207R00011US-W-01** Date Received 3/4/2014 12:21:00 PM

Parameters	Result Units	R. L.	MDL	DF Prepared	Prepared	Analyzed	Prepared	Qual
	Analytical Method:	SW846 8270 Mod				**Analyzed by:**	RLH	
Allethrin	ND ng/L	1.5	0.1	1 03/07/14 00:00	SPR 6351	04/03/14 13:54	SMS 3410	2
Bifenthrin	7.3 ng/L	1.5	0.1	1 03/07/14 00:00	SPR 6351	04/03/14 13:54	SMS 3410	
Cyfluthrin	ND ng/L	1.5	0.2	1 03/07/14 00:00	SPR 6351	04/03/14 13:54	SMS 3410	
Lambda-Cyhalothrin	ND ng/L	1.5	0.2	1 03/07/14 00:00	SPR 6351	04/03/14 13:54	SMS 3410	
Cypermethrin	ND ng/L	1.5	0.2	1 03/07/14 00:00	SPR 6351	04/03/14 13:54	SMS 3410	
Deltamethrin:Tralomethrin	4.7 ng/L	3.0	0.2	1 03/07/14 00:00	SPR 6351	04/03/14 13:54	SMS 3410	
Esfenvalerate:Fenvalerate	ND ng/L	3.0	0.2	1 03/07/14 00:00	SPR 6351	04/03/14 13:54	SMS 3410	
Fenpropathrin	ND ng/L	1.5	0.2	1 03/07/14 00:00	SPR 6351	04/03/14 13:54	SMS 3410	
Fipronil	19 ng/L	1.5	0.5	1 03/07/14 00:00	SPR 6351	04/03/14 13:54	SMS 3410	
Fipronil Desulfinyl	2.9 ng/L	1.5	0.5	1 03/07/14 00:00	SPR 6351	04/03/14 13:54	SMS 3410	
Fipronil Sulfide	J1.3 ng/L	1.5	0.5	1 03/07/14 00:00	SPR 6351	04/03/14 13:54	SMS 3410	
Fipronil Sulfone	14 ng/L	1.5	0.5	1 03/07/14 00:00	SPR 6351	04/03/14 13:54	SMS 3410	
Tau-Fluvalinate	ND ng/L	1.5	0.2	1 03/07/14 00:00	SPR 6351	04/03/14 13:54	SMS 3410	
Permethrin	ND ng/L	15	2	1 03/07/14 00:00	SPR 6351	04/03/14 13:54	SMS 3410	
Tetramethrin	ND ng/L	1.5	0.2	1 03/07/14 00:00	SPR 6351	04/03/14 13:54	SMS 3410	
Esfenvalerate-d6;#1 (SS)	71 %	70-130		1 03/07/14 00:00	SPR 6351	04/03/14 13:54	SMS 3410	
Esfenvalerate-d6;#2 (SS)	71 %	70-130		1 03/07/14 00:00	SPR 6351	04/03/14 13:54	SMS 3410	
Total Organic Carbon Analysis	**Analytical Method:**	SM20-5310 B				**Analyzed by:**	NP	
Total Organic Carbon	11 mg/L	1	0.30	1		03/12/14 19:18	WET 7502	

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QUALITY CONTROL DATA

Lab Order: P030135
Project ID: Contra Costa Clean Water Progr

Analysis Description:	Suspended Sediment Concentration	**QC Batch:**	BIO/13574
Analysis Method:	ASTM D 3977-97 B-Filtration	**QC Batch Method:**	ASTM D 3977-97 B-Filtration

METHOD BLANK: 570093

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Sediment Concentration	ND	3	2	mg/L	

LABORATORY CONTROL SAMPLE & LCSD: 570094 570095

Parameter	Units	Spike Conc.	LCS Result	LCSD Result	LCS % Rec	LCSD % Rec	% REC Limits	RPD	Max RPD	Qualifier
Sediment Concentration	mg/L	500	508	506	102	101	80-120	0.3	20	

Analysis Description:	Chlorinated Pesticides & PCBs Analysis	**QC Batch:**	SPR/6346
Analysis Method:	EPA 608	**QC Batch Method:**	EPA 608

METHOD BLANK: 570101

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Aldrin	ND	0.050	0.004	ug/L	
alpha-BHC	ND	0.050	0.005	ug/L	
beta-BHC	ND	0.050	0.004	ug/L	
delta-BHC	ND	0.050	0.004	ug/L	
gamma-BHC (Lindane)	ND	0.050	0.004	ug/L	
Chlordane	ND	0.50	0.020	ug/L	
4,4'-DDD	ND	0.10	0.004	ug/L	
4,4'-DDE	ND	0.10	0.003	ug/L	
4,4'-DDT	ND	0.10	0.004	ug/L	
Dieldrin	ND	0.10	0.004	ug/L	
Endosulfan I	ND	0.050	0.004	ug/L	
Endosulfan II	ND	0.10	0.005	ug/L	
Endosulfan sulfate	ND	0.10	0.005	ug/L	
Endrin	ND	0.10	0.005	ug/L	
Endrin aldehyde	ND	0.050	0.005	ug/L	
Endrin ketone	ND	0.10	0.005	ug/L	
Heptachlor	ND	0.050	0.005	ug/L	
Heptachlor epoxide	ND	0.050	0.004	ug/L	
Methoxychlor	ND	0.50	0.005	ug/L	
PCB 1016	ND	0.10	0.050	ug/L	
PCB 1221	ND	0.10	0.050	ug/L	
PCB 1232	ND	0.10	0.050	ug/L	
PCB 1242	ND	0.10	0.040	ug/L	
PCB 1248	ND	0.10	0.050	ug/L	
PCB 1254	ND	0.10	0.050	ug/L	
PCB 1260	ND	0.10	0.050	ug/L	

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QUALITY CONTROL DATA

Lab Order: P030135
Project ID: Contra Costa Clean Water Progr

Analysis Description:	Chlorinated Pesticides & PCBs Analysis	**QC Batch:**	SPR/6346
Analysis Method:	EPA 608	**QC Batch Method:**	EPA 608

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Toxaphene	ND	1.0	0.3	ug/L	
Decachlorobiphenyl (SS)	42	30-190		%	
Tetrachloro-m-xylene (SS)	78	25-105		%	

LABORATORY CONTROL SAMPLE & LCSD: 570102 570103

Parameter	Units	Spike Conc.	LCS Result	LCSD Result	LCS % Rec	LCSD % Rec	% REC Limits	RPD	Max RPD	Qualifier
Aldrin	ug/L	0.2	0.15	0.16	77	81	42-122	5.1	24	
alpha-BHC	ug/L	0.2	0.16	0.16	79	82	37-134	3.1	30	
beta-BHC	ug/L	0.2	0.14	0.15	71	75	17-147	4.8	30	
delta-BHC	ug/L	0.2	0.14	0.14	70	73	19-140	4.2	30	
gamma-BHC (Lindane)	ug/L	0.2	0.16	0.16	78	81	32-127	3.8	20	
4,4'-DDD	ug/L	0.2	0.16	0.17	82	84	31-141	3	30	
4,4'-DDE	ug/L	0.2	0.16	0.16	79	81	30-145	2.5	30	
4,4'-DDT	ug/L	0.2	0.18	0.19	93	93	25-160	0.5	19	
Dieldrin	ug/L	0.2	0.17	0.17	85	87	36-146	2.3	17	
Endosulfan I	ug/L	0.2	0.16	0.17	82	85	45-153	3.3	30	
Endosulfan II	ug/L	0.2	0.17	0.17	87	86	1-202	0.6	30	
Endosulfan sulfate	ug/L	0.2	0.18	0.18	91	90	26-144	1.1	30	
Endrin	ug/L	0.2	0.14	0.14	69	69	30-147	0.7	18	
Endrin aldehyde	ug/L	0.2	0.18	0.18	92	93	34-105	1.1	30	
Endrin ketone	ug/L	0.2	0.18	0.18	90	89	41-127	0.6	30	
Heptachlor	ug/L	0.2	0.16	0.16	78	80	34-111	2.5	23	
Heptachlor epoxide	ug/L	0.2	0.16	0.17	81	83	37-142	2.4	30	
Methoxychlor	ug/L	0.2	0.18	0.18	90	90	1-186	0	30	
Decachlorobiphenyl (SS)	%				49	46	30-190	7		
Tetrachloro-m-xylene (SS)	%				77	80	25-105	4.5		

Analysis Description:	Pyrethroids+Fipronil Analysis,NCI,Water	**QC Batch:**	SPR/6351
Analysis Method:	SW846 8270 Mod (GCMS-NCI-SIM)	**QC Batch Method:**	SW846 3510C

METHOD BLANK: 570428

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Allethrin	ND	1.5	0.1	ng/L	2
Bifenthrin	ND	1.5	0.1	ng/L	
Cyfluthrin	ND	1.5	0.2	ng/L	
Lambda-Cyhalothrin	ND	1.5	0.2	ng/L	
Cypermethrin	ND	1.5	0.2	ng/L	
Deltamethrin:Tralomethrin	ND	3.0	0.2	ng/L	
Esfenvalerate:Fenvalerate	ND	3.0	0.2	ng/L	

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QUALITY CONTROL DATA

Lab Order: P030135
Project ID: Contra Costa Clean Water Progr

Analysis Description:	Pyrethroids+Fipronil Analysis,NCI,Water	**QC Batch:**	SPR/6351
Analysis Method:	SW846 8270 Mod (GCMS-NCI-SIM)	**QC Batch Method:**	SW846 3510C

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Fenpropathrin	ND	1.5	0.2	ng/L	
Fipronil	ND	1.5	0.5	ng/L	
Fipronil Desulfinyl	ND	1.5	0.5	ng/L	
Fipronil Sulfide	ND	1.5	0.5	ng/L	
Fipronil Sulfone	ND	1.5	0.5	ng/L	
Tau-Fluvalinate	ND	1.5	0.2	ng/L	
Permethrin	ND	15	2.0	ng/L	
Tetramethrin	ND	1.5	0.2	ng/L	
Esfenvalerate-d6;#1 (SS)	90	70-130		%	
Esfenvalerate-d6;#2 (SS)	87	70-130		%	

LABORATORY CONTROL SAMPLE & LCSD: 570429 570430

Parameter	Units	Spike Conc.	LCS Result	LCSD Result	LCS % Rec	LCSD % Rec	% REC Limits	RPD	Max RPD	Qualifier
Allethrin	ng/L	20	16	16	82	80	50-150	2.5	35	
Bifenthrin	ng/L	20	18	17	88	84	70-165	4.7	35	
Cyfluthrin	ng/L	20	18	17	91	84	55-140	7.4	30	
Lambda-Cyhalothrin	ng/L	20	20	18	98	89	40-120	9.6	35	
Cypermethrin	ng/L	20	19	18	96	89	50-130	7.6	30	
Deltamethrin:Tralomethrin	ng/L	40	33	32	83	81	30-105	2.5	40	
Esfenvalerate:Fenvalerate	ng/L	40	34	32	86	81	40-140	6.6	35	
Fenpropathrin	ng/L	20	27	20	137	103	30-180	29	35	
Fipronil	ng/L	20	18	15	88	76	50-150	15	35	
Fipronil Desulfinyl	ng/L	20	18	16	89	80	50-150	10	35	
Fipronil Sulfide	ng/L	20	17	15	85	76	50-150	11	35	
Fipronil Sulfone	ng/L	20	16	15	81	77	50-150	5.7	35	
Tau-Fluvalinate	ng/L	20	14	13	69	63	30-100	9.1	40	
Permethrin	ng/L	100	110	110	111	108	50-160	2.7	40	
Tetramethrin	ng/L	20	16	15	78	76	45-140	2	50	
Esfenvalerate-d6;#1 (SS)	%				85	75	70-130	12		
Esfenvalerate-d6;#2 (SS)	%				86	75	70-130	13		

Analysis Description:	Total Organic Carbon Analysis	**QC Batch:**	WET/7502
Analysis Method:	SM20-5310 B	**QC Batch Method:**	SM20-5310 B

METHOD BLANK: 571219

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Total Organic Carbon	ND	1	0.3	mg/L	

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QUALITY CONTROL DATA

Lab Order: P030135
Project ID: Contra Costa Clean Water Progr

Analysis Description:	Total Organic Carbon Analysis	**QC Batch:**	WET/7502
Analysis Method:	SM20-5310 B	**QC Batch Method:**	SM20-5310 B

LABORATORY CONTROL SAMPLE: 571220

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% REC Limits	Qualifier
Total Organic Carbon	mg/L	10	10	101	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 571221 571222

Parameter	Units	P030133001 Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Total Organic Carbon	mg/L	8.1	10	18	18	95	95	80-120	0.1	20	

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QUALITY CONTROL DATA QUALIFIERS

Lab Order: P030135
Project ID: Contra Costa Clean Water Progr

QUALITY CONTROL PARAMETER QUALIFIERS

Results Qualifiers: Report fields may contain codes and non-numeric data correlating to one or more of the following definitions:

NS - means not spiked and will not have recoveries reported for Analyte Spike Amounts

QC Codes Keys: These descriptors are used to help identify the specific QC samples and clarify the report.

MB - Method Blank

Method Blanks are reported to the same Method Detection Limits (MDLs) or Reporting Limits (RLs) as the analytical samples in the corresponding QC batch.

LCS/LCSD - Laboratory Control Spike / Laboratory Control Spike Duplicate

DUP - Duplicate of Original Sample Matrix

MS/MSD - Matrix Spike / Matrix Spike Duplicate

RPD - Relative Percent Difference

%Recovery - Spike Recovery stated as a percentage

2 Analyte(s) reported as 'ND' means not detected at or above the listed Method Detection Limits (MDL).

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QUALITY CONTROL DATA CROSS REFERENCE TABLE

Lab Order: P030135
Project ID: Contra Costa Clean Water Progr

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
P030135001	**544R00025US-W-02**	ASTM D 3977-97	BIO/13574		
P030135002	**544R00025DS-W-02**	ASTM D 3977-97	BIO/13574		
P030135003	**207R00011DS-W-01**	ASTM D 3977-97	BIO/13574		
P030135004	**207R00011US-W-01**	ASTM D 3977-97	BIO/13574		
P030135001	**544R00025US-W-02**	EPA 608	SPR/6346	EPA 608	SMS/3391
P030135002	**544R00025DS-W-02**	EPA 608	SPR/6346	EPA 608	SMS/3391
P030135003	**207R00011DS-W-01**	EPA 608	SPR/6346	EPA 608	SMS/3391
P030135004	**207R00011US-W-01**	EPA 608	SPR/6346	EPA 608	SMS/3391
P030135001	**544R00025US-W-02**	SW846 3510C	SPR/6351	SW846 8270 Mod	SMS/3410
P030135002	**544R00025DS-W-02**	SW846 3510C	SPR/6351	SW846 8270 Mod	SMS/3410
P030135003	**207R00011DS-W-01**	SW846 3510C	SPR/6351	SW846 8270 Mod	SMS/3410
P030135004	**207R00011US-W-01**	SW846 3510C	SPR/6351	SW846 8270 Mod	SMS/3410
P030135001	**544R00025US-W-02**	SM20-5310 B	WET/7502		
P030135002	**544R00025DS-W-02**	SM20-5310 B	WET/7502		
P030135003	**207R00011DS-W-01**	SM20-5310 B	WET/7502		
P030135004	**207R00011US-W-01**	SM20-5310 B	WET/7502		

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CHAIN OF CUSTODY

PAGE ____ OF ____

PROJECT NAME / PROJECT NUMBER: CCCWP-SSID / 030.001.0202
P.O. NUMBER:
LAB ORDER #: P030135

CLIENT: ADH Environmental
REPORT ATTN: Alessandro Hnatt
MAILING ADDRESS: 3065 Porter St., Suite 101, Soquel
STATE: CA
ZIP: 95073
BILLING ADDRESS: same as above
ATTN: Alessandro Hnatt
PHONE NUMBER: 831-477-2003
FAX PHONE NUMBER: 831-477-0895
SAMPLER (PRINT & SIGN NAME):

TURN-AROUND TIME: [X] STANDARD [ ] RUSH
DUE DATE:

ANALYSES REQUESTED

CALTEST LAB #	DATE SAMPLED	TIME SAMPLED	SAMPLE MATRIX*	CONTAINER TYPE/ AMOUNT**	PRESERVATIVE	SAMPLE IDENTIFICATION / SITE	CLIENT LAB #	COMP. or GRAB	Organochlorine Pesticides	Pyrethroids Pesticides *	Fipronil	Degradates	TOC	SSC					REMARKS
	2-28-14	1000	Strmwtr	2 x 1L AG	<6C	544R00025US-W-02		Grab	x										
	↓	↓	Strmwtr	2 x 1L AG	<6C	↓		Grab		x	x	x							*Rec'd at
	↓	↓	Strmwtr	3 x 40ml VOA	<6C, HCl	↓		Grab					x						Lab past
	↓	↓	Strmwtr	250 ml HDPE	<6C	↓		Grab						x					hold time
	2-28-14	0930	Strmwtr	2 x 1L AG	<6C	544R00025DS-W-02		Grab	x										[illegible] 3/4
	↓	↓	Strmwtr	2 x 1L AG	<6C	↓		Grab		x	x	x							
	↓	↓	Strmwtr	3 x 40ml VOA	<6C, HCl	↓		Grab					x						
	↓	↓	Strmwtr	250 ml HDPE	<6C	↓		Grab						x					

RELINQUISHED BY	DATE/TIME	RECEIVED BY	RELINQUISHED BY	DATE/TIME	RECEIVED BY
[signature]	3-4-14 / 12:21	[signature]		/	
	/			/	

FOR LAB USE ONLY

Samples: WC ___ MICRO ___ BIO ___ AA ___ SV ___ VOA ___ pH? Y/N TEMP: 5.7 SEALED: Y/N INTACT: Y/N

BD: BIO ___ WC ___ AA ___

COMMENTS:

CC: AA ___ SV ___ VOA ___

SIL: HP ___ PT ___ QT ___ VOA ___

W/HNO$_3$ ___ H$_2$SO$_4$ ___ NaOH ___

PIL: HNO$_3$ ___ H$_2$SO$_4$ ___ NaOH ___ HCL ___

*MATRIX: AQ = Aqueous Nondrinking Water, Digested Metals; FE = Low R.L.s, Aqueous Nondrinking Water, Digested Metals; DW = Drinking Water; SL = Soil Sludge, Solid ; FP =

**CONTAINER TYPES: AL = Amber Liter; AHL = 500 ml Amber; PT = Pint (Plastic); QT = Quart (Plastic); HG = Half Gallon (Plastic); SJ = Soil Jar; B4 = 4oz. BACT; BT = Brass Tube; VOA = 40mL VOA; OTC - Other Type Container

R ___ PR ___ M ___ F ___

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CHAIN OF CUSTODY

PAGE ____ OF ____

LAB ORDER # P030135

PROJECT NAME / PROJECT NUMBER: CCCWP-SSID / 030.001.0202

P.O. NUMBER:

CLIENT: ADH Environmental

REPORT ATTN: Alessandro Hnatt

MAILING ADDRESS: 3065 Porter St., Suite 101, Soquel

STATE: CA ZIP: 95073

BILLING ADDRESS: same as above

ATTN: Alessandro Hnatt

PHONE NUMBER: 831-477-2003

FAX PHONE NUMBER: 831-477-0895

SAMPLER (PRINT & SIGN NAME):

TURN-AROUND TIME: [X] STANDARD [ ] RUSH

DUE DATE:

ANALYSES REQUESTED

CALTEST LAB #	DATE SAMPLED	TIME SAMPLED	SAMPLE MATRIX*	CONTAINER TYPE/ AMOUNT**	PRESERVATIVE	SAMPLE IDENTIFICATION / SITE	CLIENT LAB #	COMP. or GRAB	Organochlorine Pesticides	Pyrethroids Pesticides *	Fipronil	Degradates	TOC	SSC	REMARKS
	2-28-14	0845	Strmwtr	2 x 1L AG	<6C	207R00011DS-W-01		Grab	x						
			Strmwtr	2 x 1L AG	<6C	207R00011DS-W-01		Grab		x	x	x			
			Strmwtr	3 x 40ml VOA	<6C, HCl	207R00011DS-W-01		Grab					x		*Rec'd at
			Strmwtr	250 ml HDPE	<6C	207R00011DS-W-01		Grab						x	Lab past
		0955	Strmwtr	2 x 1L AG	<6C	207R00011US-W-01		Grab	x						Hold Cy 3/4
			Strmwtr	2 x 1L AG	<6C	207R00011US-W-01		Grab		x	x	x			Client will
			Strmwtr	3 x 40ml VOA	<6C, HCl	207R00011US-W-01		Grab					x		call if not to
			Strmwtr	250 ml HDPE	<6C	207R00011US-W-01		Grab						x	run CY 3/4/14

RELINQUISHED BY	DATE/TIME	RECEIVED BY	RELINQUISHED BY	DATE/TIME	RECEIVED BY
[signature]	3-4-14 / 17:23	[signature]		/	
	/			/	

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Samples: WC ___ MICRO ___ BIO ___ AA ___ SV ___ VOA ___ pH? Y/N TEMP: 5.7 SEALED: Y/N INTACT: Y/N

BD: BIO ___ WC ___ AA ___

COMMENTS:

CC: AA ___ SV ___ VOA ___

SIL: HP ___ PT ___ QT ___ VOA ___

W/HNO$_3$ ___ H$_2$SO$_4$ ___ NaOH ___

PIL: HNO$_3$ ___ H$_2$SO$_4$ ___ NaOH ___ HCL ___

*MATRIX: AQ = Aqueous Nondrinking Water, Digested Metals; FE = Low R.L.s, Aqueous Nondrinking Water, Digested Metals; DW = Drinking Water; SL = Soil Sludge, Solid ; FP =

**CONTAINER TYPES: AL = Amber Liter; AHL = 500 ml Amber; PT = Pint (Plastic); QT = Quart (Plastic); HG = Half Gallon (Plastic); SJ = Soil Jar; B4 = 4oz. BACT; BT = Brass Tube; VOA = 40mL VOA; OTC - Other Type Container

R ___ PR ___ M ___ F ___

WHITE - LABORATORY YELLOW - CLIENT COPY TO ACCOMPANY FINAL REPORT PINK - CLIENT COPY AS RECEIPT

Wednesday, April 16, 2014

Alessandro Hnatt
ADH Environmental
3065 Porter Street, Suite 101
Soquel, CA 95073

Re	Lab Order:	P031034	Collected By:	CLIENT
	Project ID:	CCCWP-SSID/030.001.0202	PO/Contract #:	

Dear Alessandro Hnatt:

Enclosed are the analytical results for sample(s) received by the laboratory on Wednesday, March 26, 2014. Results reported herein conform to the most current NELAC standards, where applicable, unless otherwise narrated in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Enclosures

Project Manager: Todd Albertson

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SAMPLE SUMMARY

Lab Order: P031034
Project ID: CCCWP-SSID/030.001.0202

Lab ID	Sample ID	Matrix	Date Collected	Date Received
P031034001	**207R00011DS-W-02**	Water	03/26/2014 14:00	03/26/2014 14:00
P031034002	**207R00011US-W-02**	Water	03/26/2014 12:40	03/26/2014 12:40

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ENVIRONMENTAL ANALYSES

NARRATIVE

Lab Order: P031034
Project ID: CCCWP-SSID/030.001.0202

General Qualifiers and Notes

Caltest authorizes this report to be reproduced only in its entirety. Results are specific to the sample(s) as submitted and only to the parameter(s) reported.

Caltest certifies that all test results for wastewater and hazardous waste analyses meet all applicable NELAC requirements; all microbiology and drinking water testing meet applicable ELAP requirements, unless stated otherwise.

All analyses performed by EPA Methods or Standard Methods (SM) 20th Edition except where noted (SMOL=online edition).

Caltest collects samples in compliance with 40 CFR, EPA Methods, Cal. Title 22, and Standard Methods.

Dilution Factors (DF) reported greater than '1' have been used to adjust the result, Reporting Limit (RL), and Method Detection Limit (MDL).

All Solid, sludge, and/or biosolids data is reported in Wet Weight, unless otherwise specified.

Filtrations performed at Caltest for dissolved metals (excluding mercury) and/or pH analysis were not performed within the 15 minute holding time as specified by 40CFR 136.3 table II.

Results Qualifiers: Report fields may contain codes and non-numeric data correlating to one or more of the following definitions:

ND - Non Detect - indicates analytical result has not been detected.

RL - Reporting Limit is the quantitation limit at which the laboratory is able to detect an analyte. An analyte not detected at or above the RL is reported as ND unless otherwise noted or qualified. For analyses pertaining to the State Implementation Plan of the California Toxics Rule, the Caltest Reporting Limit (RL) is equivalent to the Minimum Level (ML). A standard is always run at or below the ML. Where Reporting Limits are elevated due to dilution, the ML calibration criteria has been met.

J - reflects estimated analytical result value detected below the Reporting Limit (RL) and above the Method Detection Limit (MDL). The 'J' flag is equivalent to the DNQ Estimated Concentration flag.

E - indicates an estimated analytical result value.

B - indicates the analyte has been detected in the blank associated with the sample.

NC - means not able to be calculated for RPD or Spike Recoveries.

SS - compound is a Surrogate Spike used per laboratory quality assurance manual.

NOTE: This document represents a complete Analytical Report for the samples referenced herein and should be retained as a permanent record thereof.

Qualifiers and Compound Notes

1	Analyte(s) reported as 'ND' means not detected at or above the listed Method Detection Limits (MDL).
2	Sample diluted due to a high concentration of non-target analyte(s), resulting in increased reporting limits.
3	This analysis is not covered under Caltest's NELAP/CAL-ELAP Accreditations.
4	Due to matrix interferences present in the sample, surrogate recoveries failed to meet the QA/QC acceptance criteria.
5	Reporting Limits may be elevated due to limited sample volume.

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ANALYTICAL RESULTS

Lab Order: P031034
Project ID: CCCWP-SSID/030.001.0202

Lab ID **P031034001** Date Collected 3/26/2014 2:00:00 PM Matrix Water
Sample ID **207R00011DS-W-02** Date Received 3/26/2014 3:18:00 PM

Parameters	Result Units	R. L.	MDL	DF Prepared	Prepared	Analyzed	Prepared	Qual
Suspended Sediment Concentration	**Analytical Method:**	ASTM D 3977-97 B-Filtration				**Analyzed by:**	CFG	
Sediment Concentration	14 mg/L	3	2	1		04/01/14 09:41	BIO 13669	3
Chlorinated Pesticides & PCBs Analysis	**Prep Method:**	EPA 608		**Prep by:**	NTA			
	Analytical Method:	EPA 608				**Analyzed by:**	NTA	
Aldrin	ND ug/L	0.005	0.0040	1 04/02/14 00:00	SPR 6386	04/09/14 22:45	SMS 3412	1
alpha-BHC	ND ug/L	0.010	0.0050	1 04/02/14 00:00	SPR 6386	04/09/14 22:45	SMS 3412	
beta-BHC	ND ug/L	0.005	0.0040	1 04/02/14 00:00	SPR 6386	04/09/14 22:45	SMS 3412	
delta-BHC	ND ug/L	0.005	0.0040	1 04/02/14 00:00	SPR 6386	04/09/14 22:45	SMS 3412	
gamma-BHC (Lindane)	ND ug/L	0.010	0.0040	1 04/02/14 00:00	SPR 6386	04/09/14 22:45	SMS 3412	
Chlordane	ND ug/L	0.050	0.020	1 04/02/14 00:00	SPR 6386	04/09/14 22:45	SMS 3412	
4,4'-DDD	ND ug/L	0.010	0.0040	1 04/02/14 00:00	SPR 6386	04/09/14 22:45	SMS 3412	
4,4'-DDE	ND ug/L	0.010	0.0030	1 04/02/14 00:00	SPR 6386	04/09/14 22:45	SMS 3412	
4,4'-DDT	ND ug/L	0.010	0.0040	1 04/02/14 00:00	SPR 6386	04/09/14 22:45	SMS 3412	
Dieldrin	ND ug/L	0.010	0.0040	1 04/02/14 00:00	SPR 6386	04/09/14 22:45	SMS 3412	
Endosulfan I	ND ug/L	0.010	0.0040	1 04/02/14 00:00	SPR 6386	04/09/14 22:45	SMS 3412	
Endosulfan II	ND ug/L	0.010	0.0050	1 04/02/14 00:00	SPR 6386	04/09/14 22:45	SMS 3412	
Endosulfan sulfate	ND ug/L	0.010	0.0050	1 04/02/14 00:00	SPR 6386	04/09/14 22:45	SMS 3412	
Endrin	ND ug/L	0.010	0.0050	1 04/02/14 00:00	SPR 6386	04/09/14 22:45	SMS 3412	
Endrin aldehyde	ND ug/L	0.010	0.0050	1 04/02/14 00:00	SPR 6386	04/09/14 22:45	SMS 3412	
Endrin ketone	ND ug/L	0.010	0.0050	1 04/02/14 00:00	SPR 6386	04/09/14 22:45	SMS 3412	
Heptachlor	ND ug/L	0.010	0.0050	1 04/02/14 00:00	SPR 6386	04/09/14 22:45	SMS 3412	
Heptachlor epoxide	ND ug/L	0.010	0.0040	1 04/02/14 00:00	SPR 6386	04/09/14 22:45	SMS 3412	
Methoxychlor	ND ug/L	0.010	0.0050	1 04/02/14 00:00	SPR 6386	04/09/14 22:45	SMS 3412	
PCB 1016	ND ug/L	0.10	0.050	1 04/02/14 00:00	SPR 6386	04/09/14 22:45	SMS 3412	
PCB 1221	ND ug/L	0.10	0.050	1 04/02/14 00:00	SPR 6386	04/09/14 22:45	SMS 3412	
PCB 1232	ND ug/L	0.10	0.050	1 04/02/14 00:00	SPR 6386	04/09/14 22:45	SMS 3412	
PCB 1242	ND ug/L	0.10	0.040	1 04/02/14 00:00	SPR 6386	04/09/14 22:45	SMS 3412	
PCB 1248	ND ug/L	0.10	0.050	1 04/02/14 00:00	SPR 6386	04/09/14 22:45	SMS 3412	
PCB 1254	ND ug/L	0.10	0.050	1 04/02/14 00:00	SPR 6386	04/09/14 22:45	SMS 3412	
PCB 1260	ND ug/L	0.10	0.050	1 04/02/14 00:00	SPR 6386	04/09/14 22:45	SMS 3412	
Toxaphene	ND ug/L	0.5	0.30	1 04/02/14 00:00	SPR 6386	04/09/14 22:45	SMS 3412	
Decachlorobiphenyl (SS)	59 %	10-195		1 04/02/14 00:00	SPR 6386	04/09/14 22:45	SMS 3412	
Tetrachloro-m-xylene (SS)	62 %	25-105		1 04/02/14 00:00	SPR 6386	04/09/14 22:45	SMS 3412	
Pyrethroids+Fipronil Analysis,NCI,Water	**Prep Method:**	SW846 3510C		**Prep by:**	EAB			
	Analytical Method:	SW846 8270 Mod				**Analyzed by:**	RLH	
Allethrin	ND ng/L	1.5	0.2	2 03/28/14 00:00	SPR 6382	04/13/14 06:25	SMS 3416	1,2
Bifenthrin	4.2 ng/L	1.5	0.2	2 03/28/14 00:00	SPR 6382	04/13/14 06:25	SMS 3416	
Cyfluthrin	J0.9 ng/L	1.5	0.4	2 03/28/14 00:00	SPR 6382	04/13/14 06:25	SMS 3416	
Lambda-Cyhalothrin	ND ng/L	1.5	0.4	2 03/28/14 00:00	SPR 6382	04/13/14 06:25	SMS 3416	
Cypermethrin	J0.7 ng/L	1.5	0.4	2 03/28/14 00:00	SPR 6382	04/13/14 06:25	SMS 3416	
Deltamethrin:Tralomethrin	ND ng/L	3.0	0.4	2 03/28/14 00:00	SPR 6382	04/13/14 06:25	SMS 3416	
Esfenvalerate:Fenvalerate	ND ng/L	3.0	0.4	2 03/28/14 00:00	SPR 6382	04/13/14 06:25	SMS 3416	
Fenpropathrin	ND ng/L	1.5	0.4	2 03/28/14 00:00	SPR 6382	04/13/14 06:25	SMS 3416	

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ANALYTICAL RESULTS

Lab Order: P031034
Project ID: CCCWP-SSID/030.001.0202

Lab ID **P031034001** Date Collected 3/26/2014 2:00:00 PM Matrix Water
Sample ID **207R00011DS-W-02** Date Received 3/26/2014 3:18:00 PM

Parameters	Result Units	R. L.	MDL	DF Prepared	Prepared	Analyzed	Prepared	Qual
Fipronil	12 ng/L	2.0	1	2 03/28/14 00:00	SPR 6382	04/13/14 06:25	SMS 3416	
Fipronil Desulfinyl	3.5 ng/L	2.0	1	2 03/28/14 00:00	SPR 6382	04/13/14 06:25	SMS 3416	
Fipronil Sulfide	2.6 ng/L	2.0	1	2 03/28/14 00:00	SPR 6382	04/13/14 06:25	SMS 3416	
Fipronil Sulfone	6.8 ng/L	2.0	1	2 03/28/14 00:00	SPR 6382	04/13/14 06:25	SMS 3416	
Tau-Fluvalinate	ND ng/L	1.5	0.4	2 03/28/14 00:00	SPR 6382	04/13/14 06:25	SMS 3416	
Permethrin	J12 ng/L	20	4	2 03/28/14 00:00	SPR 6382	04/13/14 06:25	SMS 3416	
Tetramethrin	ND ng/L	1.5	0.4	2 03/28/14 00:00	SPR 6382	04/13/14 06:25	SMS 3416	
Esfenvalerate-d6;#1 (SS)	69 %	70-130		2 03/28/14 00:00	SPR 6382	04/13/14 06:25	SMS 3416	4
Esfenvalerate-d6;#2 (SS)	70 %	70-130		2 03/28/14 00:00	SPR 6382	04/13/14 06:25	SMS 3416	
Total Organic Carbon Analysis	**Analytical Method:**	SM20-5310 B				**Analyzed by:**	NP	
Total Organic Carbon	13 mg/L	1	0.30	1		04/01/14 00:50	WET 7533	

Lab ID **P031034002** Date Collected 3/26/2014 12:40:00 PM Matrix Water
Sample ID **207R00011US-W-02** Date Received 3/26/2014 3:18:00 PM

Parameters	Result Units	R. L.	MDL	DF Prepared	Prepared	Analyzed	Prepared	Qual
Suspended Sediment Concentration	**Analytical Method:**	ASTM D 3977-97 B-Filtration				**Analyzed by:**	CFG	
Sediment Concentration	13 mg/L	3	2	1		04/01/14 09:41	BIO 13669	3
Chlorinated Pesticides & PCBs Analysis	**Prep Method:**	EPA 608		**Prep by:**	NTA			
	Analytical Method:	EPA 608				**Analyzed by:**	NTA	
Aldrin	ND ug/L	0.006	0.0049	1 04/02/14 00:00	SPR 6386	04/09/14 23:12	SMS 3412	1,5
alpha-BHC	ND ug/L	0.010	0.0061	1 04/02/14 00:00	SPR 6386	04/09/14 23:12	SMS 3412	
beta-BHC	ND ug/L	0.006	0.0049	1 04/02/14 00:00	SPR 6386	04/09/14 23:12	SMS 3412	
delta-BHC	ND ug/L	0.006	0.0049	1 04/02/14 00:00	SPR 6386	04/09/14 23:12	SMS 3412	
gamma-BHC (Lindane)	ND ug/L	0.010	0.0049	1 04/02/14 00:00	SPR 6386	04/09/14 23:12	SMS 3412	
Chlordane	ND ug/L	0.061	0.024	1 04/02/14 00:00	SPR 6386	04/09/14 23:12	SMS 3412	
4,4'-DDD	ND ug/L	0.010	0.0049	1 04/02/14 00:00	SPR 6386	04/09/14 23:12	SMS 3412	
4,4'-DDE	ND ug/L	0.010	0.0037	1 04/02/14 00:00	SPR 6386	04/09/14 23:12	SMS 3412	
4,4'-DDT	ND ug/L	0.010	0.0049	1 04/02/14 00:00	SPR 6386	04/09/14 23:12	SMS 3412	
Dieldrin	ND ug/L	0.010	0.0049	1 04/02/14 00:00	SPR 6386	04/09/14 23:12	SMS 3412	
Endosulfan I	ND ug/L	0.010	0.0049	1 04/02/14 00:00	SPR 6386	04/09/14 23:12	SMS 3412	
Endosulfan II	ND ug/L	0.010	0.0061	1 04/02/14 00:00	SPR 6386	04/09/14 23:12	SMS 3412	
Endosulfan sulfate	ND ug/L	0.010	0.0061	1 04/02/14 00:00	SPR 6386	04/09/14 23:12	SMS 3412	
Endrin	ND ug/L	0.010	0.0061	1 04/02/14 00:00	SPR 6386	04/09/14 23:12	SMS 3412	
Endrin aldehyde	ND ug/L	0.010	0.0061	1 04/02/14 00:00	SPR 6386	04/09/14 23:12	SMS 3412	
Endrin ketone	ND ug/L	0.010	0.0061	1 04/02/14 00:00	SPR 6386	04/09/14 23:12	SMS 3412	
Heptachlor	ND ug/L	0.010	0.0061	1 04/02/14 00:00	SPR 6386	04/09/14 23:12	SMS 3412	
Heptachlor epoxide	ND ug/L	0.010	0.0049	1 04/02/14 00:00	SPR 6386	04/09/14 23:12	SMS 3412	
Methoxychlor	ND ug/L	0.010	0.0061	1 04/02/14 00:00	SPR 6386	04/09/14 23:12	SMS 3412	
PCB 1016	ND ug/L	0.12	0.061	1 04/02/14 00:00	SPR 6386	04/09/14 23:12	SMS 3412	
PCB 1221	ND ug/L	0.12	0.061	1 04/02/14 00:00	SPR 6386	04/09/14 23:12	SMS 3412	
PCB 1232	ND ug/L	0.12	0.061	1 04/02/14 00:00	SPR 6386	04/09/14 23:12	SMS 3412	

ANALYTICAL RESULTS

Lab Order: P031034
Project ID: CCCWP-SSID/030.001.0202

Lab ID **P031034002** Date Collected 3/26/2014 12:40:00 PM Matrix Water
Sample ID **207R00011US-W-02** Date Received 3/26/2014 3:18:00 PM

Parameters	Result Units	R. L.	MDL	DF Prepared	Prepared	Analyzed	Prepared	Qual
PCB 1242	ND ug/L	0.12	0.049	1 04/02/14 00:00	SPR 6386	04/09/14 23:12	SMS 3412	
PCB 1248	ND ug/L	0.12	0.061	1 04/02/14 00:00	SPR 6386	04/09/14 23:12	SMS 3412	
PCB 1254	ND ug/L	0.12	0.061	1 04/02/14 00:00	SPR 6386	04/09/14 23:12	SMS 3412	
PCB 1260	ND ug/L	0.12	0.061	1 04/02/14 00:00	SPR 6386	04/09/14 23:12	SMS 3412	
Toxaphene	ND ug/L	0.6	0.37	1 04/02/14 00:00	SPR 6386	04/09/14 23:12	SMS 3412	
Decachlorobiphenyl (SS)	57 %	10-195		1 04/02/14 00:00	SPR 6386	04/09/14 23:12	SMS 3412	
Tetrachloro-m-xylene (SS)	63 %	25-105		1 04/02/14 00:00	SPR 6386	04/09/14 23:12	SMS 3412	
Pyrethroids+Fipronil Analysis,NCI,Water	**Prep Method:**	SW846 3510C		**Prep by:**	EAB			
	Analytical Method:	SW846 8270 Mod				**Analyzed by:**	RLH	
Allethrin	ND ng/L	1.5	0.2	2 03/28/14 00:00	SPR 6382	04/13/14 10:11	SMS 3416	1,2
Bifenthrin	11 ng/L	1.5	0.2	2 03/28/14 00:00	SPR 6382	04/13/14 10:11	SMS 3416	
Cyfluthrin	J1.1 ng/L	1.5	0.4	2 03/28/14 00:00	SPR 6382	04/13/14 10:11	SMS 3416	
Lambda-Cyhalothrin	J1.1 ng/L	1.5	0.4	2 03/28/14 00:00	SPR 6382	04/13/14 10:11	SMS 3416	
Cypermethrin	ND ng/L	1.5	0.4	2 03/28/14 00:00	SPR 6382	04/13/14 10:11	SMS 3416	
Deltamethrin:Tralomethrin	ND ng/L	3.0	0.4	2 03/28/14 00:00	SPR 6382	04/13/14 10:11	SMS 3416	
Esfenvalerate:Fenvalerate	ND ng/L	3.0	0.4	2 03/28/14 00:00	SPR 6382	04/13/14 10:11	SMS 3416	
Fenpropathrin	ND ng/L	1.5	0.4	2 03/28/14 00:00	SPR 6382	04/13/14 10:11	SMS 3416	
Fipronil	15 ng/L	2.0	1	2 03/28/14 00:00	SPR 6382	04/13/14 10:11	SMS 3416	
Fipronil Desulfinyl	6.5 ng/L	2.0	1	2 03/28/14 00:00	SPR 6382	04/13/14 10:11	SMS 3416	
Fipronil Sulfide	J1.4 ng/L	2.0	1	2 03/28/14 00:00	SPR 6382	04/13/14 10:11	SMS 3416	
Fipronil Sulfone	11 ng/L	2.0	1	2 03/28/14 00:00	SPR 6382	04/13/14 10:11	SMS 3416	
Tau-Fluvalinate	ND ng/L	1.5	0.4	2 03/28/14 00:00	SPR 6382	04/13/14 10:11	SMS 3416	
Permethrin	ND ng/L	20	4	2 03/28/14 00:00	SPR 6382	04/13/14 10:11	SMS 3416	
Tetramethrin	ND ng/L	1.5	0.4	2 03/28/14 00:00	SPR 6382	04/13/14 10:11	SMS 3416	
Esfenvalerate-d6;#1 (SS)	75 %	70-130		2 03/28/14 00:00	SPR 6382	04/13/14 10:11	SMS 3416	
Esfenvalerate-d6;#2 (SS)	75 %	70-130		2 03/28/14 00:00	SPR 6382	04/13/14 10:11	SMS 3416	
Total Organic Carbon Analysis	**Analytical Method:**	SM20-5310 B				**Analyzed by:**	NP	
Total Organic Carbon	11 mg/L	1	0.30	1		04/01/14 01:04	WET 7533	

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QUALITY CONTROL DATA

Lab Order: P031034
Project ID: CCCWP-SSID/030.001.0202

Analysis Description:	Suspended Sediment Concentration	**QC Batch:**	BIO/13669
Analysis Method:	ASTM D 3977-97 B-Filtration	**QC Batch Method:**	ASTM D 3977-97 B-Filtration

METHOD BLANK: 574708

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Sediment Concentration	ND	3	2	mg/L	

LABORATORY CONTROL SAMPLE & LCSD: 574709 574762

Parameter	Units	Spike Conc.	LCS Result	LCSD Result	LCS % Rec	LCSD % Rec	% REC Limits	RPD	Max RPD	Qualifier
Sediment Concentration	mg/L	500	477	484	95	97	80-120	1.5	20	

Analysis Description:	Chlorinated Pesticides & PCBs Analysis	**QC Batch:**	SPR/6386
Analysis Method:	EPA 608	**QC Batch Method:**	EPA 608

METHOD BLANK: 574847

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Aldrin	ND	0.050	0.004	ug/L	
alpha-BHC	ND	0.050	0.005	ug/L	
beta-BHC	ND	0.050	0.004	ug/L	
delta-BHC	ND	0.050	0.004	ug/L	
gamma-BHC (Lindane)	ND	0.050	0.004	ug/L	
Chlordane	ND	0.50	0.020	ug/L	
4,4'-DDD	ND	0.10	0.004	ug/L	
4,4'-DDE	ND	0.10	0.003	ug/L	
4,4'-DDT	ND	0.10	0.004	ug/L	
Dieldrin	ND	0.10	0.004	ug/L	
Endosulfan I	ND	0.050	0.004	ug/L	
Endosulfan II	ND	0.10	0.005	ug/L	
Endosulfan sulfate	ND	0.10	0.005	ug/L	
Endrin	ND	0.10	0.005	ug/L	
Endrin aldehyde	ND	0.050	0.005	ug/L	
Endrin ketone	ND	0.10	0.005	ug/L	
Heptachlor	ND	0.050	0.005	ug/L	
Heptachlor epoxide	ND	0.050	0.004	ug/L	
Methoxychlor	ND	0.50	0.005	ug/L	
PCB 1016	ND	0.10	0.050	ug/L	
PCB 1221	ND	0.10	0.050	ug/L	
PCB 1232	ND	0.10	0.050	ug/L	
PCB 1242	ND	0.10	0.040	ug/L	
PCB 1248	ND	0.10	0.050	ug/L	
PCB 1254	ND	0.10	0.050	ug/L	
PCB 1260	ND	0.10	0.050	ug/L	

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QUALITY CONTROL DATA

Lab Order: P031034
Project ID: CCCWP-SSID/030.001.0202

Analysis Description:	Chlorinated Pesticides & PCBs Analysis	**QC Batch:**	SPR/6386
Analysis Method:	EPA 608	**QC Batch Method:**	EPA 608

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Toxaphene	ND	1.0	0.3	ug/L	
Decachlorobiphenyl (SS)	46	30-190		%	
Tetrachloro-m-xylene (SS)	62	25-105		%	

LABORATORY CONTROL SAMPLE & LCSD: 574848 574849

Parameter	Units	Spike Conc.	LCS Result	LCSD Result	LCS % Rec	LCSD % Rec	% REC Limits	RPD	Max RPD	Qualifier
Aldrin	ug/L	0.2	0.14	0.15	68	74	42-122	8.5	24	
alpha-BHC	ug/L	0.2	0.14	0.16	71	79	37-134	11	30	
beta-BHC	ug/L	0.2	0.14	0.15	68	74	17-147	9.2	30	
delta-BHC	ug/L	0.2	0.12	0.13	62	67	19-140	7.8	30	
gamma-BHC (Lindane)	ug/L	0.2	0.14	0.15	70	76	32-127	8.9	20	
4,4'-DDD	ug/L	0.2	0.15	0.16	76	81	31-141	5.8	30	
4,4'-DDE	ug/L	0.2	0.14	0.15	73	77	30-145	6	30	
4,4'-DDT	ug/L	0.2	0.16	0.17	78	85	25-160	8.6	19	
Dieldrin	ug/L	0.2	0.16	0.17	79	85	36-146	8	17	
Endosulfan I	ug/L	0.2	0.15	0.16	76	82	45-153	7.9	30	
Endosulfan II	ug/L	0.2	0.16	0.17	78	84	1-202	7.5	30	
Endosulfan sulfate	ug/L	0.2	0.16	0.18	81	90	26-144	11	30	
Endrin	ug/L	0.2	0.15	0.16	75	80	30-147	7.1	18	
Endrin aldehyde	ug/L	0.2	0.18	0.2	92	99	34-105	6.8	30	
Endrin ketone	ug/L	0.2	0.16	0.17	79	86	41-127	8.5	30	
Heptachlor	ug/L	0.2	0.14	0.15	71	77	34-111	8.8	23	
Heptachlor epoxide	ug/L	0.2	0.15	0.17	77	83	37-142	8.2	30	
Methoxychlor	ug/L	0.2	0.15	0.17	76	83	1-186	9.5	30	
Decachlorobiphenyl (SS)	%				48	54	30-190	11		
Tetrachloro-m-xylene (SS)	%				63	69	25-105	9.9		

Analysis Description:	Pyrethroids+Fipronil Analysis,NCI,Water	**QC Batch:**	SPR/6382
Analysis Method:	SW846 8270 Mod (GCMS-NCI-SIM)	**QC Batch Method:**	SW846 3510C

METHOD BLANK: 574094

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Allethrin	ND	1.5	0.1	ng/L	1
Bifenthrin	ND	1.5	0.1	ng/L	
Cyfluthrin	ND	1.5	0.2	ng/L	
Lambda-Cyhalothrin	ND	1.5	0.2	ng/L	
Cypermethrin	ND	1.5	0.2	ng/L	
Deltamethrin:Tralomethrin	ND	3.0	0.2	ng/L	
Esfenvalerate:Fenvalerate	ND	3.0	0.2	ng/L	

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QUALITY CONTROL DATA

Lab Order: P031034

Project ID: CCCWP-SSID/030.001.0202

Analysis Description:	Pyrethroids+Fipronil Analysis,NCI,Water	**QC Batch:**	SPR/6382
Analysis Method:	SW846 8270 Mod (GCMS-NCI-SIM)	**QC Batch Method:**	SW846 3510C

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Fenpropathrin	ND	1.5	0.2	ng/L	
Fipronil	ND	1.5	0.5	ng/L	
Fipronil Desulfinyl	ND	1.5	0.5	ng/L	
Fipronil Sulfide	ND	1.5	0.5	ng/L	
Fipronil Sulfone	ND	1.5	0.5	ng/L	
Tau-Fluvalinate	ND	1.5	0.2	ng/L	
Permethrin	ND	15	2.0	ng/L	
Tetramethrin	ND	1.5	0.2	ng/L	
Esfenvalerate-d6;#1 (SS)	68	70-130		%	6,
Esfenvalerate-d6;#2 (SS)	68	70-130		%	6,,

LABORATORY CONTROL SAMPLE & LCSD: 574095 574096

Parameter	Units	Spike Conc.	LCS Result	LCSD Result	LCS % Rec	LCSD % Rec	% REC Limits	RPD	Max RPD	Qualifier
Allethrin	ng/L	20	18	19	89	94	50-150	5.5	35	
Bifenthrin	ng/L	20	18	19	91	93	70-165	2.2	35	
Cyfluthrin	ng/L	20	17	18	84	92	55-140	9.7	30	
Lambda-Cyhalothrin	ng/L	20	16	17	78	85	40-120	9.2	35	
Cypermethrin	ng/L	20	18	19	92	96	50-130	4.3	30	
Deltamethrin:Tralomethrin	ng/L	40	31	33	78	83	30-105	5.9	40	
Esfenvalerate:Fenvalerate	ng/L	40	34	35	84	88	40-140	4.1	35	
Fenpropathrin	ng/L	20	21	23	106	114	30-180	7.3	35	
Fipronil	ng/L	20	16	16	79	78	50-150	1.9	35	
Fipronil Desulfinyl	ng/L	20	16	15	82	77	50-150	6.9	35	
Fipronil Sulfide	ng/L	20	17	16	85	80	50-150	6.7	35	
Fipronil Sulfone	ng/L	20	16	14	81	71	50-150	13	35	
Tau-Fluvalinate	ng/L	20	13	13	64	65	30-100	1.6	40	
Permethrin	ng/L	100	75	84	75	84	50-160	12	40	
Tetramethrin	ng/L	20	16	16	82	81	45-140	0.6	50	
Esfenvalerate-d6;#1 (SS)	%				79	80	70-130	1.9		
Esfenvalerate-d6;#2 (SS)	%				79	81	70-130	2.9		

Analysis Description:	Total Organic Carbon Analysis	**QC Batch:**	WET/7533
Analysis Method:	SM20-5310 B	**QC Batch Method:**	SM20-5310 B

METHOD BLANK: 574492

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Total Organic Carbon	ND	1	0.3	mg/L	

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QUALITY CONTROL DATA

Lab Order: P031034
Project ID: CCCWP-SSID/030.001.0202

Analysis Description:	Total Organic Carbon Analysis	**QC Batch:**	WET/7533
Analysis Method:	SM20-5310 B	**QC Batch Method:**	SM20-5310 B

LABORATORY CONTROL SAMPLE: 574493

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% REC Limits	Qualifier
Total Organic Carbon	mg/L	10	10	101	80-120	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 574497 574498

Parameter	Units	P031026001 Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Total Organic Carbon	mg/L	3.6	10	13	13	93	93	80-120	0.1	20	

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QUALITY CONTROL DATA QUALIFIERS

Lab Order: P031034
Project ID: CCCWP-SSID/030.001.0202

QUALITY CONTROL PARAMETER QUALIFIERS

Results Qualifiers: Report fields may contain codes and non-numeric data correlating to one or more of the following definitions:

NS - means not spiked and will not have recoveries reported for Analyte Spike Amounts

QC Codes Keys: These descriptors are used to help identify the specific QC samples and clarify the report.

MB - Method Blank

Method Blanks are reported to the same Method Detection Limits (MDLs) or Reporting Limits (RLs) as the analytical samples in the corresponding QC batch.

LCS/LCSD - Laboratory Control Spike / Laboratory Control Spike Duplicate

DUP - Duplicate of Original Sample Matrix

MS/MSD - Matrix Spike / Matrix Spike Duplicate

RPD - Relative Percent Difference

%Recovery - Spike Recovery stated as a percentage

1 Analyte(s) reported as 'ND' means not detected at or above the listed Method Detection Limits (MDL).

6 Surrogate recoveries were not within QC Acceptance Criteria.

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QUALITY CONTROL DATA CROSS REFERENCE TABLE

Lab Order: P031034
Project ID: CCCWP-SSID/030.001.0202

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
P031034001	**207R00011DS-W-02**	ASTM D 3977-97	BIO/13669		
P031034002	**207R00011US-W-02**	ASTM D 3977-97	BIO/13669		
P031034001	**207R00011DS-W-02**	SW846 3510C	SPR/6382	SW846 8270 Mod	SMS/3416
P031034002	**207R00011US-W-02**	SW846 3510C	SPR/6382	SW846 8270 Mod	SMS/3416
P031034001	**207R00011DS-W-02**	EPA 608	SPR/6386	EPA 608	SMS/3412
P031034002	**207R00011US-W-02**	EPA 608	SPR/6386	EPA 608	SMS/3412
P031034001	**207R00011DS-W-02**	SM20-5310 B	WET/7533		
P031034002	**207R00011US-W-02**	SM20-5310 B	WET/7533		

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Caltest ANALYTICAL LABORATORY

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CHAIN OF CUSTODY

PAGE ____ OF ____

PROJECT NAME / PROJECT NUMBER: CCCWP-SSID / 030.001.0202

P.O. NUMBER:

LAB ORDER #: P031834

CLIENT: ADH Environmental

REPORT ATTN: Alessandro Hnatt

MAILING ADDRESS: 3065 Porter St., Suite 101, Soquel

STATE: CA ZIP: 95073

BILLING ADDRESS: same as above

ATTN: Alessandro Hnatt

PHONE NUMBER: 831-477-2003

FAX PHONE NUMBER: 831-477-0895

SAMPLER (PRINT & SIGN NAME):

TURN-AROUND TIME: [X] STANDARD [ ] RUSH

DUE DATE:

ANALYSES REQUESTED

CALTEST LAB #	DATE SAMPLED	TIME SAMPLED	SAMPLE MATRIX*	CONTAINER TYPE/ AMOUNT**	PRESERVATIVE	SAMPLE IDENTIFICATION / SITE	CLIENT LAB #	COMP. or GRAB	Organochlorine Pesticides	Pyrethroids Pesticides	Fipronil	Degradates	TOC	SSC	REMARKS
	3-26-14	12:40	Strmwtr	2 x 1L AG	<6C	207R00011DS-W-02		Grab	x						
			Strmwtr	2 x 1L AG	<6C	207R00011DS-W-02		Grab		x	x	x			
			Strmwtr	3 x 40ml VOA	<6C, HCl	207R00011DS-W-02		Grab					x		
			Strmwtr	250 ml HDPE	<6C	207R00011DS-W-02		Grab						x	
		14:00	Strmwtr	2 x 1L AG	<6C	207R00011US-W-02		Grab	x						
			Strmwtr	2 x 1L AG	<6C	207R00011US-W-02		Grab		x	x	x			
			Strmwtr	3 x 40ml VOA	<6C, HCl	207R00011US-W-02		Grab					x		
			Strmwtr	250 ml HDPE	<6C	207R00011US-W-02		Grab						x	
						+ glass Carboy									

RELINQUISHED BY	DATE/TIME	RECEIVED BY	RELINQUISHED BY	DATE/TIME	RECEIVED BY
[signature]	3/26/15 18	[signature]			

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Samples: WC ___ MICRO ___ BIO ___ AA ___ SV ___ VOA ___ pH? Y/N TEMP: ___ SEALED: Y/N INTACT: Y/N

BD: BIO ___ WC ___ AA ___

CC: AA ___ SV ___ VOA ___

SIL: HP ___ PT ___ QT ___ VOA ___

W/HNO_3 ___ H_2SO_4 ___ NaOH ___

PIL: HNO_3 ___ H_2SO_4 ___ NaOH ___ HCL ___

COMMENTS:

*MATRIX: AQ = Aqueous Nondrinking Water, Digested Metals; FE = Low R.L.s, Aqueous Nondrinking Water, Digested Metals; DW = Drinking Water; SL = Soil Sludge, Solid ; FP =

**CONTAINER TYPES: AL = Amber Liter; AHL = 500 ml Amber; PT = Pint (Plastic); QT = Quart (Plastic); HG = Half Gallon (Plastic); SJ = Soil Jar; B4 = 4oz. BACT; BT = Brass Tube; VOA = 40mL VOA; OTC - Other Type Container

R ___ PR ___ M ___ F ___

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Caltest
ANALYTICAL LABORATORY

1885 N. KELLY ROAD NAPA, CA 94558 (707) 258-4000 FAX (707) 226-1001

CHAIN OF CUSTODY

PAGE ____ OF ____

PROJECT NAME / PROJECT NUMBER: CCCWP-SSID / 030.001.0202

P.O. NUMBER:

LAB ORDER #: P031634

CLIENT: ADH Environmental

REPORT ATTN: Alessandro Hnatt

MAILING ADDRESS: 3065 Porter St., Suite 101, Soquel

STATE: CA ZIP: 95073

BILLING ADDRESS: same as above

ATTN: Alessandro Hnatt

PHONE NUMBER: 831-477-2003

FAX PHONE NUMBER: 831-477-0895

SAMPLER (PRINT & SIGN NAME):

ANALYSES REQUESTED

TURN-AROUND TIME: [X] STANDARD [ ] RUSH

DUE DATE:

CALTEST LAB #	DATE SAMPLED	TIME SAMPLED	SAMPLE MATRIX*	CONTAINER TYPE/ AMOUNT**	PRESERVATIVE	SAMPLE IDENTIFICATION / SITE	CLIENT LAB #	COMP. or GRAB	Organochlorine Pesticides	Pyrethroids Pesticides	Fipronil	Degradates	TOC	SSC	REMARKS
	3-26-14	~~12:00~~ 14 00 (KL)	Strmwtr	2 x 1L AG	<6C	207R00011DS-W-01		Grab	x						
			Strmwtr	2 x 1L AG	<6C	207R00011DS-W-02		Grab		x	x	x			
			Strmwtr	3 x 40ml VOA	<6C, HCl	207R00011DS-W-02		Grab					x		
			Strmwtr	250 ml HDPE	<6C	207R00011DS-W-01		Grab						x	
		~~11:00~~ 12:40 (KL)	Strmwtr	2 x 1L AG	<6C	207R00011US-W-01		Grab	x						
			Strmwtr	2 x 1L AG	<6C	207R00011US-W-01		Grab		x	x	x			
			Strmwtr	3 x 40ml VOA	<6C, HCl	207R00011US-W-01		Grab					x		
			Strmwtr	250 ml HDPE	<6C	207R00011US-W-01		Grab						x	

+ 9 glass Carboy

RELINQUISHED BY	DATE/TIME	RECEIVED BY	RELINQUISHED BY	DATE/TIME	RECEIVED BY
[signature]	3/26/ 1518	[signature]			

FOR LAB USE ONLY

Samples: WC ___ MICRO ___ BIO ___ AA ___ SV ___ VOA ___ pH? Y/N TEMP: SEALED: Y/N INTACT: Y/N

BD: BIO ___ WC ___ AA ___

COMMENTS:

CC: AA ___ SV ___ VOA ___

SIL: HP ___ PT ___ QT ___ VOA ___

W/HNO₃ ___ H₂SO₄ ___ NaOH ___

PIL: HNO₃ ___ H₂SO₄ ___ NaOH ___ HCL ___

*MATRIX: AQ = Aqueous Nondrinking Water, Digested Metals; FE = Low R.L.s Aqueous Nondrinking Water, Digested Metals; DW = Drinking Water; SL = Soil Sludge, Solid ; FP =

**CONTAINER TYPES: AL = Amber Liter; AHL = 500 ml Amber; PT = Pint (Plastic); QT = Quart (Plastic); HG = Half Gallon (Plastic); SJ = Soil Jar; B4 = 4oz. BACT; BT = Brass Tube; VOA = 40mL VOA; OTC - Other Type Container

R ___ FR ___ M ___ F ___

02/25/14

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Alessandro D. Hnatt
ADH Environmental
3065 Porter Street, Suite 101
Soquel, CA 95073

April 10, 2014

Alessandro:

I have enclosed one copy of our report "Evaluation of the Toxicity of Contra Costa Clean Water Program Stormwater Samples" for the samples that were collected February 26 and 28, 2014. The results of this testing are summarized below.

Toxicity summary for CCCWP stormwater samples.						
Sample Station	Toxicity relative to the Lab Control treatment?					
	Selenastrum capricornutum	*Ceriodaphnia dubia*		*Hyalella azteca*	Fathead Minnow	
	Growth	Survival	Reproduction	Survival	Survival	Growth
206R00551	no	no	no	no	no	no
207R00843	no	no	no	**Yes**	**Yes**	no
207R00011US				**Yes**		
207R00011DS				**Yes**		
544R00025US				**Yes**		
544R00025DS				**Yes**		

Chronic Toxicity of CCCWP Stormwater to *Selenastrum capricornutum*
There was ***no*** significant reduction in algal growth in the CCCWP stormwater samples.

Chronic Toxicity of CCCWP Stormwater to *Ceriodaphnia dubia*
There was ***no*** significant reduction in *C. dubia* survival or reproduction in the CCCWP stormwater samples.

Toxicity of CCCWP Stormwater to *Hyalella azteca*
There was ***no*** significant reduction in survival in the 206R00551 stormwater sample. However, there were significant reductions in *H. azteca* survival in the remaining CCCWP stormwater samples.

Chronic Toxicity of CCCWP Stormwater to Fathead Minnows

There was ***no*** significant reduction in fathead minnow survival or growth in the 206R00551 stormwater sample. There was a significant reduction in fathead minnow survival in the 207R00843 stormwater sample. However, pathogen-related mortality (PRM) was observed in both stormwater samples. It is our best professional judgment that the observations of PRM are not associated with or indicative of stormwater toxicity (indeed, had the stormwater been toxic, the pathogens might have been killed or otherwise impaired before the fish were [e.g., toxicants are often used as therapeutic treatments for control of pathogens in fish cultures]).

If you have any questions regarding the performance and interpretation of these tests, feel free to contact my colleague Eddie Kalombo or myself at (707) 207-7760.

Sincerely,

Stephen L. Clark
Vice President/Special Projects Director

Pacific EcoRisk is accredited in accordance with NELAP (ORELAP ID 4043). Pacific EcoRisk certifies that the test results reported herein conform to the most current NELAP requirements for parameters for which accreditation is required and available. Any exceptions to NELAP requirements are noted, where applicable, in the body of the report. This report shall not be reproduced, except in full, without the written consent of Pacific EcoRisk. This testing was performed under Lab Order 19397.

Evaluation of the Toxicity of Contra Costa Clean Water Program Stormwater Samples

Samples collected February 26 and 28, 2014

Prepared For:

ADH Environmental
3065 Porter Street, Suite 101
Soquel, CA 95073

Prepared By:

Pacific EcoRisk
2250 Cordelia Road
Fairfield, CA 94534

April 2014

PACIFIC ECORISK
ENVIRONMENTAL CONSULTING & TESTING

Evaluation of the Toxicity of Contra Costa Clean Water Program Stormwater Samples

Samples collected February 26 and 28, 2014

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Appendix J Supplemental Data/Information Required to Document Observations of Pathogen-Related Mortality in the Chronic Fathead Minnow Test

1. INTRODUCTION

Under contract to ADH Environmental, and in support of the Bay Area Stormwater Management Agencies Association (BASMAA) Regional Monitoring Coalition ongoing monitoring efforts, Pacific EcoRisk (PER) has been contracted to evaluate the chronic toxicity of stormwater samples collected for the Contra Costa Clean Water Program (CCCWP). This evaluation consist of performing the following US EPA and modified-EPA short-term chronic toxicity tests:

- 96-hour algal growth test with the green alga *Selenastrum capricornutum;*
- 3-brood (6-8 day) survival and reproduction test with the crustacean *Ceriodaphnia dubia*;
- 10-day survival test with the freshwater amphipod *Hyalella azteca;* and
- 7-day survival and growth test with larval fathead minnows (*Pimephales promelas*).

These toxicity tests were conducted on stormwater samples collected on February 26 and 28, 2014. In order to assess the sensitivity of the test organisms to toxic stress, reference toxicant tests were also performed. This report describes the performance and results of these tests.

2. TOXICITY TEST PROCEDURES

The methods used in conducting the testing with *S. capricornutum*, *C. dubia,* and fathead minnows followed the guidelines established by the EPA manual "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, Fourth Edition" (EPA-821-R-02-013).

Testing with *H. azteca* followed the SWAMP test protocol, which is based on a modification of the US EPA guidelines, “Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates” (EPA/600/R-99/064).

2.1 Sample Receipt and Handling

On February 26 and 28, ADH collected stormwater samples into appropriately-cleaned containers, which were transported, on ice and under chain-of-custody, to the PER testing laboratory in Fairfield, CA. Upon receipt at the testing laboratory, aliquots of each sample were collected for analysis of initial water quality characteristics (Table 1), with the remainder of each sample being stored at 0-6˚C except when being used to prepare test solutions.

The chain-of-custody records for the collection and delivery of these stormwater samples are provided as Appendix A.

Table 1. Initial water quality characteristics of the CCCWP stormwater samples.

Date Sample Received	Sample ID	Temp (°C)	pH	D.O. (mg/L)	Alkalinity (mg/L)	Hardness (mg/L)	Conductivity (µS/cm)	Total Ammonia (mg/L N)
2/27/14	206R00551	0.4	7.46	10.4	226	304	907	<1.0
2/27/14	207R00843	0.6	7.63	10.7	83	104	283	<1.0
2/28/14	207R00011US-W-01	8.5	7.87	9.9	59	92	323	<1.0
2/28/14	207R00011DS-W-01	8.2	7.98	9.6	37	64	186	<1.0
2/28/14	544R00025US-W-02	4.3	7.87	9.8	76	244	1153	<1.0
2/28/14	544R00025DS-W-02	10.7	7.87	9.5	72	229	1080	<1.0

2.2 Algal Growth Toxicity Testing with *Selenastrum capricornutum*

The short-term chronic toxicity algal test consists of exposing *Selenastrum capricornutum* to the stormwater samples for ~ 96-hrs, after which the effects on cell growth are evaluated. The specific procedures used in this test are described below.

The Lab Control water for this test consisted of Type 1 Lab Water (reverse-osmosis, de-ionized water). The stormwater sample was tested at the 100% concentration only. The Lab Control water and the stormwater sample were filtered (using sterile 0.45 µm filters) and then spiked with nutrients (without any added EDTA) before use in this test, as per testing guidelines. “New” water quality characteristics (pH, dissolved oxygen [D.O.], and conductivity) were measured on the resulting test solutions prior to use in the test.

There were 4 replicates at each test treatment, each replicate consisting of a 250-mL glass Erlenmeyer flask containing 100 mL of test solution. Each flask was inoculated to an initial algal cell density of 10,000 cells/mL from a laboratory culture of *S. capricornutum* that is maintained in log growth phase. These flasks were loosely-capped and randomly positioned within a temperature-controlled room at 25°C, under continuous cool-white fluorescent illumination.

Each day, the temperature and pH were measured and recorded from one randomly-selected replicate at each treatment; each replicate flask was gently shaken in the three times daily and re-positioned within the temperature-controlled room.

After 96 (±2) hrs exposure, the flasks were removed from the temperature-controlled room and the algal cell density in each was determined by spectrophotometric analysis. The resulting cell density data were analyzed to evaluate any growth impairment, or toxicity, caused by the stormwater sample; all statistical analyses were performed using CETIS® statistical software (TidePool Scientific, McKinleyville, CA).

2.2.1 Reference Toxicant Testing of the *Selenastrum capricornutum*

In order to assess the sensitivity of the *S. capricornutum* to toxic stress, a monthly reference toxicant test was performed. The reference toxicant test was performed similarly to the stormwater tests except that test solutions consisted of Lab Control water spiked with NaCl at concentrations of 0.125, 0.25, 0.5, 1, 2, and 4 g/L. The resulting test response data were statistically analyzed to determine key dose-response point estimates (e.g., IC_{50}); all statistical analyses were made using the CETIS® software. These response endpoints were then compared to the typical response range established by the mean ± 2 SD of the point estimates generated by the most recent previous reference toxicant tests performed by this lab.

2.3 Survival and Reproduction Toxicity Testing with *Ceriodaphnia dubia*

The short-term chronic *C. dubia* test consists of exposing individual females to the stormwater samples for the length of time it takes for the Lab Control treatment females to produce 3 broods (typically 6-8 days), after which effects on survival and reproduction are evaluated. The specific procedures used in this test are described below.

The Lab Control water for this test consisted of modified EPA synthetic moderately-hard water. The stormwater sample was tested at the 100% concentration only. For each treatment, a 200 mL aliquot of test solution was amended with the alga *Selenastrum capricornutum* and Yeast-Cerophyll®-Trout (YCT) to provide food for the test organisms. “New” water quality characteristics (pH, D.O., and conductivity) were measured on these food-amended test solutions prior to use in this test.

There were 10 replicates at each test treatment, each replicate consisting of 15 mL of test solution in a 30-mL plastic cup. These “3-brood” tests were initiated by allocating one neonate (<24 hours old, and within 8 hours of age) *C. dubia*, obtained from in-house laboratory cultures, into each replicate cup. The replicate cups were placed into a temperature-controlled room at 25˚C, under cool-white fluorescent lighting on a 16L:8D photoperiod.

Each day of the test, fresh test solutions and a “new” set of replicate cups were prepared, as before. “New” water quality characteristics (pH, D.O., and conductivity) were measured on these solutions prior to use in the tests. The test replicate cups were removed from the temperature-controlled room and then each replicate was examined, with surviving “original” individual organisms being transferred to the corresponding new replicate cup; the new replicate cups, now carrying *C. dubia* in fresh media, were then returned to the temperature-controlled room. Each old replicate cup was carefully examined to determine the number of neonate offspring produced by each original organism, after which the “old” water quality characteristics (pH, D.O., and conductivity) were measured for the old test solution from one randomly-selected replicate at each treatment.

After it was determined that ≥60% of the *C. dubia* in the Lab Control treatments had produced their third brood of offspring, the accompanying stormwater sample test was terminated. The resulting survival and reproduction (number of offspring) data were analyzed to evaluate any impairments caused by the stormwater sample; all statistical analyses were performed using the CETIS® statistical software.

2.3.1 Reference Toxicant Testing of the *Ceriodaphnia dubia*

In order to assess the sensitivity of the *C. dubia* test organisms to toxic stress, a monthly reference toxicant test was performed. The reference toxicant test was performed similarly to the stormwater tests, except that test solutions consisted of the Lab Control water spiked with NaCl at concentrations of 500, 1000, 1500, 2000, and 2500 mg/L. The resulting test response data were statistically analyzed to determine key dose-response point estimates (e.g., IC_{50}); all statistical analyses were made using the CETIS® software. These response endpoints were then compared to the typical response range established by the mean ± 2 SD of the point estimates generated by the most recent previous reference toxicant tests performed by this lab.

2.4 Survival Toxicity Testing of Stormwater Samples with *Hyalella azteca*

This test consists of exposing the amphipods to the stormwater samples for 10 days, after which effects on survival are evaluated. The specific procedures used in this testing are described below.

The *H. azteca* used in this testing were obtained from a commercial supplier (Chesapeake Cultures, VA). Upon receipt at the PER laboratory, the organisms were maintained at 23˚C in aerated aquaria containing Standard Artificial Medium (SAM-5S) water (Borgmann 1996) prior to their use in this test. During this pre-test period, the organisms were fed the alga *Selenastrum capricornutum* and YCT amended with *Spirulina*.

The Lab Control water for these tests consisted of SAM-5S water. The stormwater samples were tested at the 100% concentration only. "New" water quality characteristics (pH, D.O., and conductivity) were measured on the test solutions prior to use in these tests.

There were 5 replicates for each test treatment, each replicate consisting a 250-mL glass beaker containing 100 mL of test solution. These tests were initiated by allocating 10 *H. azteca*, into each replicate, followed by the addition of 1.5 mL of *Spirulina* amended YCT. The replicate beakers were placed into a temperature-controlled room at 23˚C, under cool-white fluorescent lighting on a 16L:8D photoperiod.

Each day of the tests, each replicate beaker was examined and the number of surviving organisms determined; 'old' water quality characteristics were measured in one randomly-selected beaker at each test treatment at this time. On Days 2, 4, 6, and 8 of the test, the organisms were fed 1.5 mL of *Spirulina* amended YCT in each test chamber.

On Day 5 of the 10-day tests, fresh test solutions were prepared and characterized, as before. Each replicate was examined, with any dead animals, uneaten food, wastes, and other detritus being removed. The number of live organisms in each replicate was determined and then approximately 80% of the test media in each beaker was carefully poured out and replaced with fresh test solution. “Old” water quality characteristics (pH, D.O., and conductivity) were measured on the old test solution that had been discarded from one randomly-selected replicate at each treatment.

After 10 days of exposure, the tests were terminated and the number of live organisms in each replicate was recorded. The resulting survival data were analyzed to evaluate any impairment due to the stormwater samples; all statistical analyses were performed using CETIS® statistical software.

2.4.1 Reference Toxicant Testing of the *Hyalella azteca*

In order to assess the sensitivity of the *H. azteca* test organisms to toxic stress, a reference toxicant test was performed. The reference toxicant test was performed similarly to the stormwater tests, except that test solutions consisted of Control water spiked with KCl at test concentrations of 0, 0.1, 0.2, 0.4, 0.8 and 1.6 g/L, and the test was performed for 96 hours. The resulting survival data were statistically analyzed to determine key dose-response point estimates (e.g., EC_{50}); all statistical analyses were made using the CETIS® software. This response endpoint was then compared to the ‘typical response’ range established by the mean ± 2 SD of the point estimates generated by the 20 most recent previous reference toxicant tests performed by this lab.

2.5 Survival and Growth Toxicity Testing with Larval Fathead Minnows

The short-term chronic fathead minnow test consists of exposing larval fish to the stormwater for 7 days, after which effects on survival and growth are evaluated. The specific procedures used in this testing are described below.

The larval fathead minnows used in this test were obtained from a commercial supplier (Aquatox, Hot Springs, AR). Upon receipt at the testing lab, the larval fish were maintained in aerated tanks of EPA moderately-hard water at 25˚C, and were fed brine shrimp nauplii *ad libitum*.

The Lab Water Control/dilution water for this test consisted of EPA synthetic moderately-hard water. The stormwater samples were tested at the 100% concentration only. "New" water quality characteristics (pH, D.O., and conductivity) were measured on these test solutions prior to use in the tests.

There were 4 replicates for each test treatment, each replicate consisting of 400 mL of test solution in a 600-mL glass beaker. The test was initiated by randomly allocating 10 larval fathead minnows (<48 hrs old) into each replicate. These replicate beakers were placed in a temperature-controlled room at 25˚C, under cool-white fluorescent lighting on a 16L:8D photoperiod. The test fish were fed brine shrimp nauplii twice daily.

Each day of the test, fresh test solutions were prepared for each treatment, and water quality characteristics were determined as before. The beakers containing the fathead minnows were examined, with any dead animals, uneaten food, wastes, and other detritus being removed. The number of live fish in each replicate was determined and then approximately 80% of the old test media in each beaker was carefully poured out and replaced with fresh test solution. “Old” water quality characteristics (pH, D.O., and conductivity) were measured on the old test water that had been discarded from one randomly selected replicate at each treatment.

After 7 days exposure, the tests were terminated and the number of live fish in each replicate beaker was recorded. The fish from each replicate were then carefully euthanized in methanol, rinsed in de-ionized water, and transferred to a pre-dried and pre-tared weighing pan. These fish were then dried at 100˚C for >24 hrs and re-weighed to determine the total weight of fish in each replicate. The total weight was then divided by the initial number of fish per replicate (n=10) to determine the “biomass value”. The resulting survival and growth data were analyzed to evaluate any impairment(s) caused by the stormwater sample; all statistical analyses were performed using the CETIS® statistical software.

2.5.1 Reference Toxicant Testing of the Fathead Minnows

In order to assess the sensitivity of the fish to toxic stress, a reference toxicant test was performed. The reference toxicant test was performed similarly to the stormwater tests, except that test solutions consisted of “Lab Control” media spiked with NaCl at test concentrations of 0.75, 1.5, 3, 6, and 9 g/L. The resulting test response data were analyzed to determine key dose-response point estimates (e.g., EC_{50}); all statistical analyses were made using the CETIS® software. These response endpoints were then compared to the ‘typical response’ range established by the mean ± 2 SD of the point estimates generated by the 20 most recent previous reference toxicant tests performed by this lab.

3. RESULTS

3.1 Effects of the CCCWP Stormwater on *Selenastrum capricornutum*

The results for this test are summarized below in Table 2. There was ***no*** significant reduction in algal growth in the CCCWP stormwater samples.

The test data and summary of statistical analyses for this test are presented in Appendix B.

Table 2. Effects of CCCWP stormwater on *Selenastrum capricornutum*.

Test Initiation Date (Time)	Treatment/Sample ID	Mean Algal Cell Density (cells/mL x 10^6)
2/27/24 (1715)	Lab Control	2.83
	206R00551	7.19
	207R00843	7.01

3.2 Effects of the CCCWP Stormwater on *Ceriodaphnia dubia*

The results for this test are summarized below in Table 3. There was ***no*** significant reduction in *Ceriodaphnia dubia* survival or reproduction in the CCCWP stormwater samples.

The test data and summary of statistical analyses for this test are presented in Appendix C.

Table 3. Effects of CCCWP stormwater on *Ceriodaphnia dubia*.

Test Initiation Date (Time)	Treatment/Sample ID	Mean % Survival	Mean Reproduction (# neonates/female)
2/27/14 (1600)	Lab Control	100	31.3
	206R00551	100	28.9
	207R00843	90	29.1

3.3 Effects of the CCCWP Stormwater on *Hyalella azteca*

The results for these tests are summarized below in Table 4. There was ***no*** significant reduction in survival in the 206R00551 stormwater sample. However, there were significant reductions in *H. azteca* survival in the remaining CCCWP stormwater samples. The test data and summary of statistical analyses for these tests are presented in Appendix D.

Table 4. Effects of CCCWP stormwater on *Hyalella azteca*.		
Test Initiation Date (Time)	Treatment/Sample ID	10-Day Mean % Survival
2/27/14 (1800)	Lab Control	98
	206R00551	94
	207R00843	**64***
2/28/14 (1750)	Lab Control	96
	207R00011US	**48***
	207R00011DS	**48***
	544R00025US	**18***
	544R00025DS	**6***

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

3.4 Effects of the CCCWP Stormwater on Fathead Minnows

The results for this test are summarized below in Table 5. There was ***no*** significant reduction in fathead minnow survival or growth in the 206R00551 stormwater sample. There was a significant reduction in fathead minnow survival in the 207R00843 stormwater sample. However, pathogen-related mortality (PRM) was observed in both stormwater samples. It is our best professional judgment that the observations of PRM are not associated with or indicative of stormwater toxicity (indeed, had the stormwater been toxic, the pathogens might have been killed or otherwise impaired before the fish were [e.g., toxicants are often used as therapeutic treatments for control of pathogens in fish cultures]). The test data and summary of statistical analyses for this test are presented in Appendix E.

Table 5. Effects of CCCWP stormwater on fathead minnows ("Standard" test method).			
Test Initiation Date (Time)	Treatment/Sample ID	Mean % Survival	Mean Biomass Value (mg)
2/27/14 (1700)	Lab Control	100	0.72
	206R00551	92.5[a]	0.73
	207R00843	**57.5***[a]	0.59

* The response at this test treatment was significantly less than the Lab Control treatment response at $p < 0.05$.
a – PRM was observed in multiple replicates for this stormwater sample.

3.4.1 Pathogen Related Mortality (PRM) Evaluation

Per contractual requirements ADH Environmental, PER has agreed to include all observations leading identification PRM. This evaluation consisted of performing tasks:

1. Provide a brief narrative describing the observations leading to the determination that PRM interference had occurred.
   - On March 1, 2 and 3, PRM was observed in test replicate B and C the 206R00551 stormwater sample, and all test replicates of the 207R00843 stormwater sample.

2. Provide "Comments and Observations" sheets with daily records completed by PER identifying PRM in treatments (i.e., stormwater sample ID) and replicates, as well as the number(s) of affected fish.
   - The Comments and Observation sheet is provided in Appendix J.

3. Provide photographs of representative fish from each affected water sample identified by treatment, replicate, and date.

Figure 1: Photo of PRM affected fish in Replicate B of 206R00551. Observed on March 2, 2014.

Figure 2: Photo of PRM affected fish in Replicate D of 207R00843. Observed on March 1, 2014.

4. Provide a photograph of a non-pathogenic fish from a replicate affected by PRM, identified by treatment, replicate, and date.

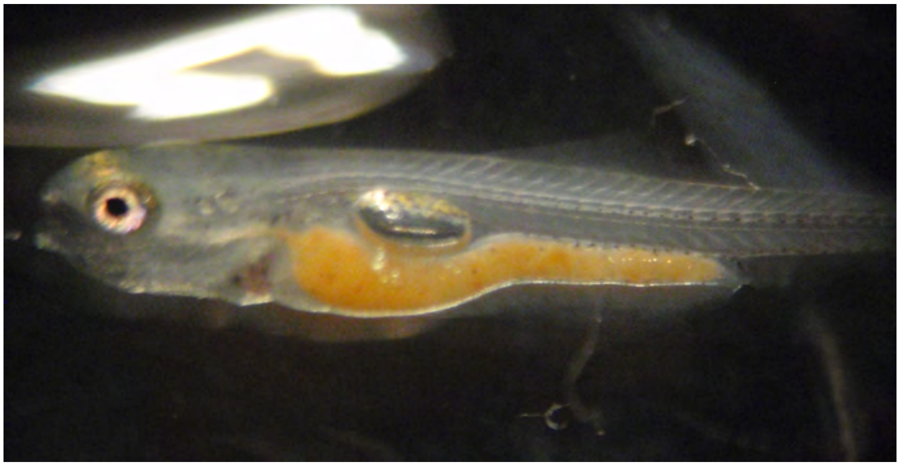


Figure 3: Photo of non-pathogenic fish in Replicate B of 206R00551. Taken at test termination, March 6, 2014.

5. Provide a photograph of a fish from a lab control treatment documenting the absence of PRM in the Lab Control treatment, identified by treatment, replicate, and date.

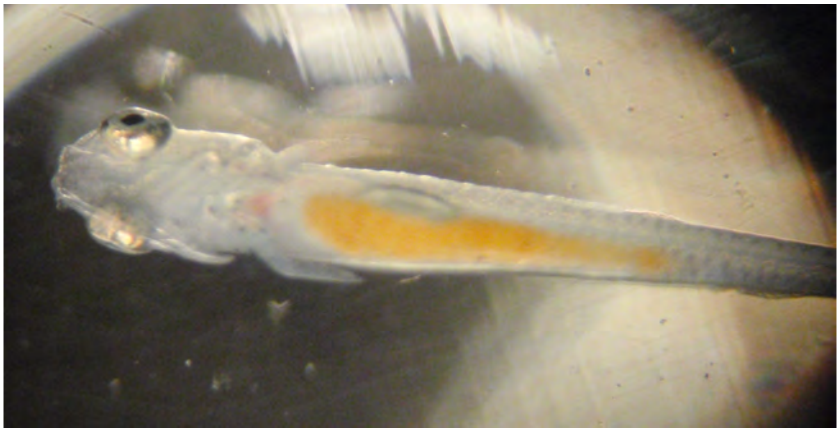


Figure 4: Photo of Control fish in Replicate A. Taken at test termination, March 6, 2014.

6. Provide a photograph of a lab control beaker showing the water in a lab control replicate and a photograph of a replicate beaker affected by PRM prior to test termination.

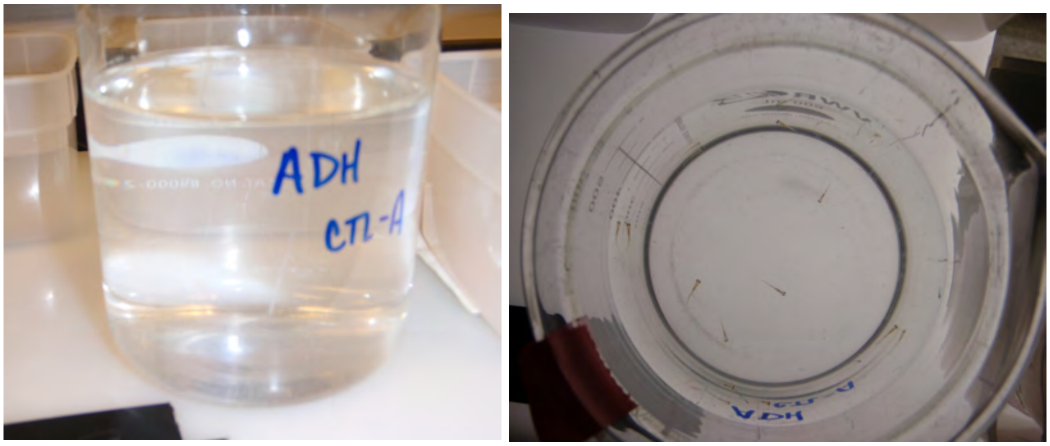


Figure 5: Photo of Lab Control Replicate A. Taken at test termination, March 6, 2014.

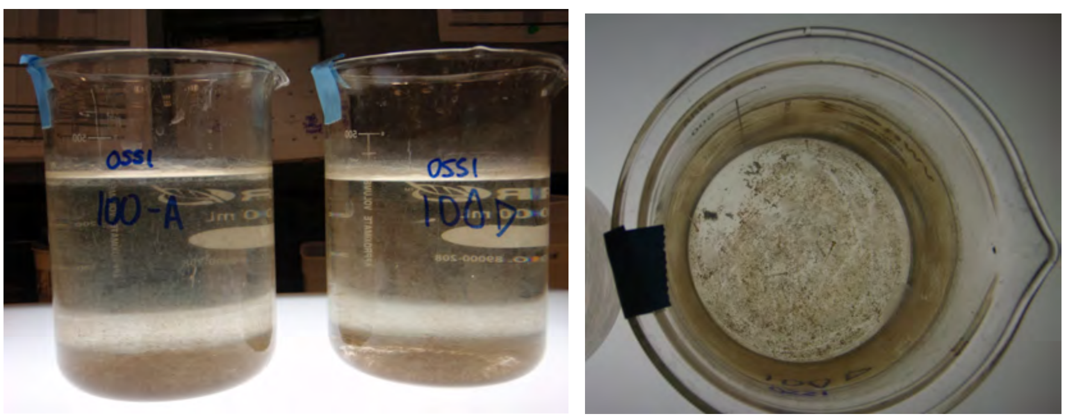


Figure 6: Photo of non-pathogen affected (Rep A & D) of 206R00551 stormwater sample.

Figure 7: Photo of pathogen affected (Rep B &C) of 207R00843 stormwater sample.

7. Provide a discussion of the calculated CV for the PRM-affected sample(s).
   - The EPA testing manual indicates a CV of >40% "***may be***" an indication of pathogen interference. However it is worth noting that there is no mandate that CV **must be** >40% in order to characterize mortalities as related to pathogen interference.
   - The supporting documentation (pictures and test observations) clearly indicates that PRM was present in the 206R00551 and 207R00843 stormwater samples.
   - The survival CV was 10.4% and the growth CV was 13.0%for the affected 206R00551 stormwater sample. Although though test CVs for the affected sample were not >40%, the photo documentation clearly supports the presence of PRM.
   - The survival CV was 57.5% and the growth CV was 38.4% for the affected 207R00843 stormwater sample.

8. Provide documentation that the presence of PRM was not a reflection of poor laboratory.
   - As is clearly evident, PRM accounted for all mortality observed in the 206R00551 and 207R00843 stormwater samples. There was 100% survival at the Lab water control treatment and 92.5% survival in the 206R00551 and 57.5% survival in the 207R00843 stormwater sample. The absence of PRM in the Laboratory Control treatment eliminates the fish source, husbandry, etc., as causes of PRM.
   - Pacific EcoRisk adheres to good laboratory practices when performing aquatic toxicity tests, as per guidance found in Section 11.3.4.3 of the EPA testing manual (USEPA, 2002). Our test change procedures requires that:
     - All test equipment, glassware, and pipettes are kept dry and clean during the duration of the test.
     - For all stormwater samples, staff use of separate glassware, pipettes, and siphons for each test replicate in order to minimize cross-contamination from an affected test replicate into a non-affected replicate.
     - Prior of each test renewal, care was taken to properly clean test chambers by removing excess food, dead fish larvae, and other debris.

In conclusion, PRM was present in the 206R00551 and 207R00843 stormwater samples and was not present in the Laboratory Control treatment, as is supported by photo documentation. It is important to note that PRM was present in the 206R00551 stormwater sample even though the test CV was much less than 40%. The observed PRM was not related to the source of the test organisms (i.e., PRM was not observed in the Lab Control treatment) or laboratory practices (i.e., all good laboratory practices were followed).

4. AQUATIC TOXICITY DATA QUALITY CONTROL

Four QC measures were assessed during the toxicity testing:

- Maintenance of acceptable test conditions;
- Negative Control testing;
- Positive Control (reference toxicant) testing; and
- Concentration Response Relationship assessment.

4.1 Maintenance of Acceptable Test Conditions

All test conditions (pH, D.O., temperature, etc.) were within acceptable limits for these tests. All analyses were performed according to laboratory Standard Operating Procedures.

4.2 Negative Control Testing

The responses at the Lab Control treatments were acceptable.

4.3 Positive Control Testing

4.3.1 Reference Toxicant Toxicity to *Selenastrum capricornutum*

The results of this test are summarized below in Table 6. The IC_{50} for this test was consistent with the "typical response" range established by the reference toxicant test database for this species, indicating that these organisms were responding to toxic stress in a typical fashion. The test data and summary of statistical analyses for this test are presented in Appendix F.

Table 6. Reference toxicant testing: Effects of NaCl on *Selenastrum capricornutum* growth.	
NaCl Treatment (g/L)	Mean Algal Cell Density (cells/mL x 10^6)
Lab Control	3.12
0.125	**2.87***
0.25	**2.93***
0.5	**2.75***
1	**2.49***
2	**1.98***
4	**0.48***
Summary of Statistics	
IC_{25} =	2.6 g/L NaCl
"Typical response" range (mean ± 2 SD)	1.0 – 3.2 g/L NaCl

* Significantly less than the Lab Control treatment response at $p < 0.05$.

4.3.2 Reference Toxicant Toxicity to *Ceriodaphnia dubia*

The results of this test are summarized below in Table 7. The EC_{50} and IC_{50} for this test were both consistent with the "typical response" ranges established by reference toxicant test database for this species, indicating that these organisms were responding to toxic stress in a typical fashion. The test data and the summary of statistical analyses for this test are presented in Appendix G.

Table 7. Reference toxicant testing: Effects of NaCl on *Ceriodaphnia dubia*.

NaCl Treatment (mg/L)	Mean % Survival	Reproduction (# neonates/female)
Lab Water Control	90	22.9
500	80	18.2
1000	100	24.6
1500	80	**8.2***
2000	60	**0.2***
2500	**10***	**-**
Summary of Key Statistics		
Survival EC_{50} or Reproduction IC_{50} =	2120 mg/L NaCl	1380 mg/L NaCl
"Typical response" range (mean ± 2 SD)	1708 – 2142 mg/L NaCl	1333 – 1792 mg/L NaCl

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

4.3.3 Reference Toxicant Toxicity to *Hyalella azteca*

The results of this test are presented in Table 8. The EC_{50} for this test was consistent with the "typical response" range established by the reference toxicant test database for this species, indicating that these organisms were responding to toxic stress in a typical fashion. The test data and summary of statistical analyses for this test are presented in Appendix H.

Table 8. Reference toxicant testing: Effects of KCl on *Hyalella azteca* survival.

KCl Treatment (g/L)	Mean% Survival
Control	100
0.1	100
0.2	100
0.4	100
0.8	**10***
1.6	**0***
Summary of Statistics	
EC_{50} =	0.61 g/L KCl
"Typical response" range (mean ±2 SD)	0.25 – 0.62 g/L KCl

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

4.3.4 Reference Toxicant Toxicity to Fathead Minnows

The results of this test are summarized below in Table 9. The EC_{50} and IC_{50} for this test were both consistent with the "typical response" ranges established by the reference toxicant test database for this species, indicating that these organisms were responding to toxic stress in a typical fashion. The test data and summary of statistical analyses for this test are presented in Appendix I.

Table 9. Reference toxicant testing: Effects of NaCl on fathead minnows.

NaCl Treatment (gm/L)	Mean % Survival	Mean Biomass Value (mg)
Lab Control	100	0.73
0.75	92.5	0.72
1.5	90	**0.65***
3	**37.5***	0.24
6	**47.5***	0.24
9	**0***	-
Summary of Statistics		
Survival EC_{50} or Growth IC_{50} =	3.3 g/L NaCl	2.5 g/L NaCl
"Typical response" range (mean ±2 SD)	2.6 – 6.1 g/L NaCl	2.1 – 4.8 g/L NaCl

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

4.4 Concentration Response Relationships

The concentration-response relationships for the reference toxicant tests were evaluated as per EPA guidelines (EPA-821-B-00-004), and were determined to be acceptable.

5. SUMMARY & CONCLUSIONS

Chronic Toxicity of CCCWP Stormwater to *Selenastrum capricornutum*
There was ***no*** significant reduction in algal growth in the CCCWP stormwater samples.

Chronic Toxicity of CCCWP Stormwater to *Ceriodaphnia dubia*
There was ***no*** significant reduction in *C. dubia* survival or reproduction in the CCCWP stormwater samples.

Chronic Toxicity of CCCWP Stormwater to *Hyalella azteca*
There was ***no*** significant reduction in survival in the 206R00551 stormwater sample. However, there were significant reductions in *H. azteca* survival in the remaining CCCWP stormwater samples

Chronic Toxicity of CCCWP Stormwater to Fathead Minnows
There was ***no*** significant reduction in fathead minnow survival or growth in the 206R00551 stormwater sample. There was a significant reduction in fathead minnow survival in the 207R00843 stormwater sample. However, pathogen-related mortality (PRM) was observed in both stormwater samples. It is our best professional judgment that the observations of PRM are not associated with or indicative of stormwater toxicity (indeed, had the stormwater been toxic, the pathogens might have been killed or otherwise impaired before the fish were [e.g., toxicants are often used as therapeutic treatments for control of pathogens in fish cultures]).

Appendix A

Chain-of-Custody Records for the Collection and Delivery of the CCCWP Stormwater Samples

Pacific EcoRisk
2250 Cordelia Rd., Fairfield, CA 94534
(707) 207-7760 FAX (707) 207-7916

CHAIN-OF-CUSTODY RECORD

Client Name:	ADH Environmental
Client Address:	3065 Porter Street, Suite 101
	Soquel, CA 95073
Phone:	831 477-2003 FAX:
Project Manager:	Alessandro Hnatt
Project Name:	CCCWP - Creek Status
Project # / P.O. Number:	030.001.0100

REQUESTED ANALYSIS

	Client Sample ID	Sample Date	Sample Time	Sample Matrix*	Container Number	Container Type	Chronic *Selenastrum capricornutum*	Chronic *Ceriodaphnia dubia*	Chronic *Pimephales promelas*	10-day *Hyalella azteca* (water)	10-day *Hyalella azteca* (sediment)						
1	206R00551	02-26-14	15:20	STRMW		10 x 1 ga AG	x	x	x	x							
2	207R00843	02-26-14	17:45	STRMW		10 x 1 ga AG	x	x	x	x							
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
12																	

Samples collected by: Kevin Lewis, Eric Dhakni / ADH Environmental

Comments/Special Instruction:
contract # 030.001.0100
CCCWP - Creek Status

RELINQUISHED BY:		RECEIVED BY:	
Signature: [signature]		Signature: [signature]	
Print: Cameron Carothers		Print: Y. Khadiyeva	
Organization: ADH		Organization: PER	
Date: 2-27-14	Time: 1611	Date: 2/27/14	Time: 1611
RELINQUISHED BY:		**RECEIVED BY:**	
Signature:		Signature:	
Print:		Print:	
Organization:		Organization:	
Date:	Time:	Date:	Time:

***Example Matrix Codes**: (**FW** = Freshwater); (**SW** = Saltwater); (**WW** = Wastewater); (**STRMW** = Stormwater); (**SED** = Sediment); or other

Pacific EcoRisk
2250 Cordelia Rd., Fairfield, CA 94534
(707) 207-7760 FAX (707) 207-7916

CHAIN-OF-CUSTODY RECORD

Client Name:	ADH Environmental
Client Address:	3065 Porter Street, Suite 101 Soquel, CA 95073
Phone:	831 477-2003 **FAX:**
Project Manager:	Alessandro Hnatt
Project Name:	CCCWP - SSID
Project # / P.O. Number:	030.001.0202

	Client Sample ID	Sample Date	Sample Time	Sample Matrix*	Container Number	Container Type	Chronic *Selenastrum capricornutum*	Chronic *Ceriodaphnia dubia*	Chronic *Pimephales promelas*	10-day *Hyalella azteca* (water)	10-day *Hyalella azteca* (sediment)						
1	207R00011DS-W-01	2-28-14	0845	STRMW	10	3.7L glass				x							
2	207R00011US-W-01	2-28-14	0955	STRMW	10	3.7L glass				x							
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
12																	

Samples collected by:

Comments/Special Instruction:

RELINQUISHED BY:	RECEIVED BY:
Signature: Cal. Ad.	Signature: Y. Khadiyeva
Print: Calvin Sandlin	Print: Y. Khadiyeva
Organization: ADH	Organization: PER
Date: 2.28.14 Time: 1143	Date: 2-28-14 Time: 1143

RELINQUISHED BY:	RECEIVED BY:
Signature:	Signature:
Print:	Print:
Organization:	Organization:
Date: Time:	Date: Time:

*Example Matrix Codes: (FW = Freshwater); (SW = Saltwater); (WW = Wastewater); (STRMW = Stormwater); (SED = Sediment); or other

Pacific EcoRisk
2250 Cordelia Rd., Fairfield, CA 94534
(707) 207-7760 FAX (707) 207-7916

CHAIN-OF-CUSTODY RECORD

Client Name:	ADH Environmental
Client Address:	
Phone:	FAX:
Project Manager:	
Project Name:	CCCWP-SSI
Project # / P.O. Number:	030.001.0202

	Client Sample ID	Sample Date	Sample Time	Sample Matrix*	Container Number	Container Type	Chronic *Selenastrum capricornutum*	Chronic *Ceriodaphnia dubia*	Chronic *Pimephales promelas*	10-day Survival *Hyalella azteca* (water)	10-day *Hyalella azteca* (sediment)						
1	544R00025DS-W-02	2-28-14	0930	STRMW	10	1 gall. amber				x							
2	544R00025US-W-02	2-28-14	1000	STRMW	~~10~~ 9 AW	1 gal amber				X							
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
12																	

Samples collected by:

Comments/Special Instruction:

Note - Fathead minnow testing is to be performed using the standard EPA protocol (i.e., 4 replicates)

contract # 030.001.0202

SSID Study task 2y

RELINQUISHED BY:		RECEIVED BY:	
Signature: Adam Wainscoat		Signature: [signature]	
Print: Adam Wainscoat		Print: C. Glover	
Organization:		Organization: PER	
Date: 2-28-14	Time: 1520	Date: 2/28/14	Time: 1520
RELINQUISHED BY:		**RECEIVED BY:**	
Signature:		Signature:	
Print:		Print:	
Organization:		Organization:	
Date:	Time:	Date:	Time:

***Example Matrix Codes:** (FW = Freshwater); (SW = Saltwater); (WW = Wastewater); (STRMW = Stormwater); (SED = Sediment); or other

Appendix B

Test Data and Summary of Statistics for the Evaluation of the Chronic Toxicity of the CCCWP Stormwater to *Selenastrum capricornutum*

CETIS Summary Report

Report Date: 12 Mar-14 12:14 (p 1 of 1)
Test Code: ADH_0227_SC_C1 | 02-3497-5955

Algal Growth Test — **Pacific EcoRisk**

Batch ID:	01-1997-4859	**Test Type:**	Cell Growth	**Analyst:**	Cassy Glover
Start Date:	27 Feb-14 17:15	**Protocol:**	EPA-821-R-02-013 (2002)	**Diluent:**	Not Applicable
Ending Date:	03 Mar-14 16:00	**Species:**	Selenastrum capricornutum	**Brine:**	Not Applicable
Duration:	95h	**Source:**	In-House Culture	**Age:**	6

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
LABQA	09-8486-0532	27 Feb-14 17:15	27 Feb-14 17:15	NA (25.3 °C)	ADH Environmental, Inc.	19397
207R00843	14-6517-7241	26 Feb-14 17:45	27 Feb-14 16:11	23h (0.6 °C)		
206R00551	08-4072-0786	26 Feb-14 15:20	27 Feb-14 16:11	26h (0.4 °C)		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
LABQA	Lab Water	ADH Environmental, Inc.	LABQA		
207R00843	Ambient Water	ADH Environmental, Inc.	207R00843		
206R00551	Ambient Water	ADH Environmental, Inc.	206R00551		

96h Cell Density-without EDTA Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
LABQA	4	2.83E+6	2.75E+6	2.91E+6	2.63E+6	3.10E+6	1.03E+5	2.05E+5	7.26%	0.0%
207R00843	4	7.01E+6	6.88E+6	7.14E+6	6.51E+6	7.29E+6	1.73E+5	3.46E+5	4.93%	-148.0%
206R00551	4	7.19E+6	7.09E+6	7.28E+6	6.86E+6	7.43E+6	1.31E+5	2.62E+5	3.64%	-154.0%

96h Cell Density-without EDTA Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4
LABQA	2.63E+6	3.10E+6	2.72E+6	2.87E+6
207R00843	7.29E+6	7.17E+6	7.08E+6	6.51E+6
206R00551	6.86E+6	7.36E+6	7.09E+6	7.43E+6

Analyst: [signature] QA: SVV

Algal Growth Test					Pacific EcoRisk
Analysis ID:	03-6506-0778	**Endpoint:**	96h Cell Density-without EDTA	**CETIS Version:**	CETISv1.8.5
Analyzed:	12 Mar-14 12:13	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Untransformed	NA	C > T	NA	NA	11.4%	

Equal Variance t Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
LABQA		206R00551	-26.2	1.94	3E+05	6	1.0000	CDF	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	3.793205E+13	3.793205E+13	1	686	<0.0001	Significant Effect
Error	3.319E+11	55316670000	6			
Total	3.826395E+13		7			

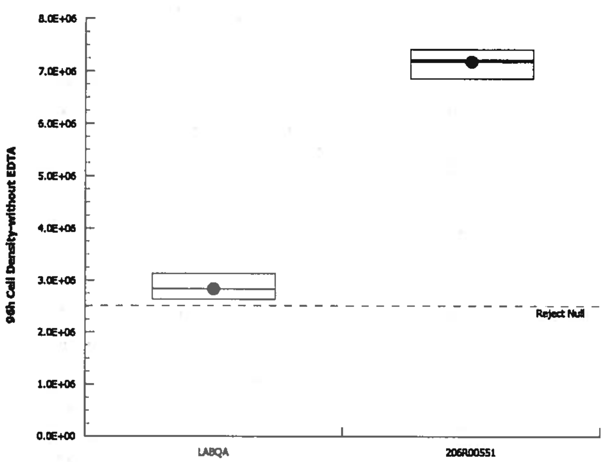
Distributional Tests

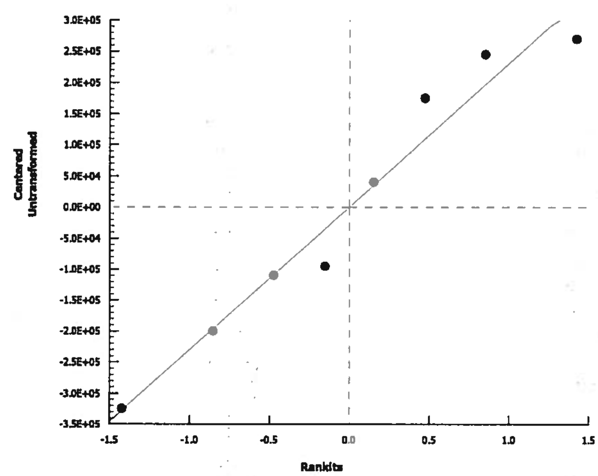
Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Variance Ratio F	1.62	47.5	0.7009	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.939	0.645	0.6025	Normal Distribution

96h Cell Density-without EDTA Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
LABQA	4	2.83E+6	2.50E+6	3.16E+6	2800000	2.63E+6	3.10E+6	1.03E+5	7.26%	0.0%
206R00551	4	7.19E+6	6.77E+6	7.60E+6	7230000	6.86E+6	7.43E+6	1.31E+5	3.64%	-154.0%

Graphics





Selenastrum capricornutum Algal Toxicity Test Data Sheet

Client: **ADH / CCCWP** Material: **206R00551**

Test Start Date: 2/27/14 Test ID #: 55486 Project #: 19397

Test End Date: 3/3/14 Control/Diluent: Lab water w/o EDTA Location: TR6/R4/S1

Test Treatment	Temp (°C)	pH	D.O. (mg/L)	Conductivity (µS/cm)	Sign-Off
Lab Water Control	25.3	7.59	8.1	94.6	Date: 2/27/14
100%	25.3	7.69	12.1	961	Sample ID #: 34205
					Test Solution Prep: KP
					New WQ: CA
					Inoculation Time: 1715
Meter ID	62A	pH19	RD04	EC04	Innoculation Signoff: KP
Lab Water Control	25.0	7.91			Date: 2-28-14
100%	25.0	8.32			WQ Time: 0845
Meter ID	62A	PH19			WQ Signoff: APF
Lab Water Control	~~25.0~~ 25.0	~~7.91~~ 8.20			Date: 03/01/14
100%	~~25.0~~ 25.0	~~8.32~~ 8.49			WQ Time: 1000
Meter ID	62A	~~PH19~~ PH15			WQ Signoff: AS
Lab Water Control	25.7	8.98			Date: 03/02/14
100%	25.7	8.89			WQ Time: 1000
Meter ID	62A	PH19			WQ Signoff: AS
Lab Water Control	26.0	9.56	11.6	96.5	Date: 3-3-14
100%	26.0	9.55	20.7	771	WQ Time: 0850
Meter ID	62A	pH16	RD04	EC09	WQ Signoff: APF

Initial Count: 10,000 cells/mL Termination Time: 1600 Enumerating Scientist: PG

Treatment	Cell Density (cells/mL x 10^6) Rep A	Rep B	Rep C	Rep D	Mean Cell Density (cells/mL x 10^6)
Lab Water Control	2.63	3.10	2.72	2.87	~~2.83~~ ~~2.82~~ 2.83
100%	6.86	7.36	7.09	7.43	7.19

This datasheet has been reviewed for completeness and consistency with Test Acceptability Criteria and/or other issues of concern.	Control Mean Density (cells/mL x 10^6)	% CV	Date:	Time:	Signoff:
	2.83	7.26	~~3.3.13~~ 3.3.14	1630	PG

Initial Test Conditions	Alkalinity	Hardness	Light Intensity (ftc)
	237	319	373.6

Algal Growth Test				Pacific EcoRisk
Analysis ID: 07-7504-2489	**Endpoint:** 96h Cell Density-without EDTA		**CETIS Version:** CETISv1.8.5	
Analyzed: 12 Mar-14 12:13	**Analysis:** Parametric-Two Sample		**Official Results:** Yes	

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Untransformed	NA	C > T	NA	NA	13.8%	

Equal Variance t Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
LABQA		207R00843	-20.8	1.94	4E+05	6	1.0000	CDF	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	3.498661E+13	3.498661E+13	1	432	<0.0001	Significant Effect
Error	4.85475E+11	80912500000	6			
Total	3.547209E+13		7			

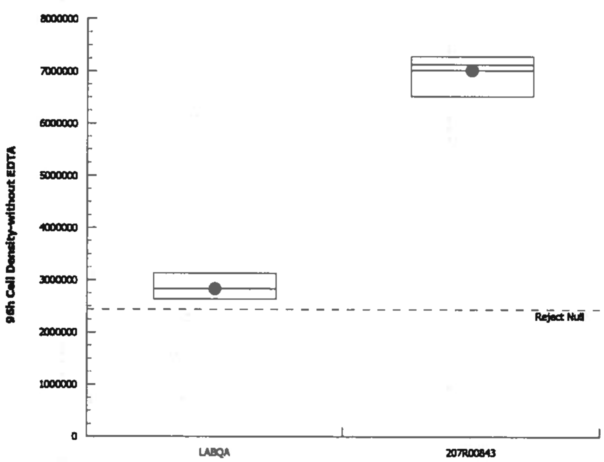
Distributional Tests

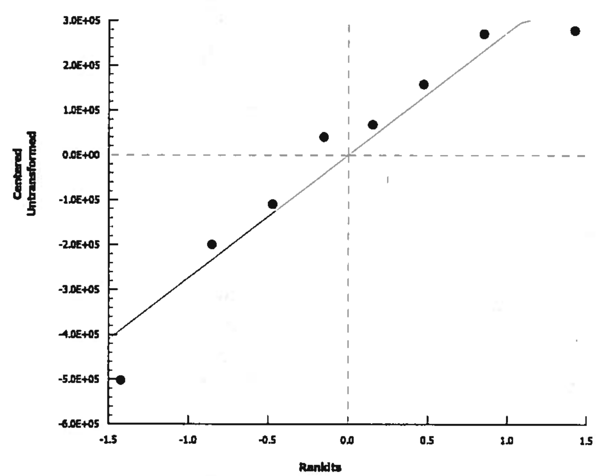
Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Variance Ratio F	2.83	47.5	0.4149	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.922	0.645	0.4456	Normal Distribution

96h Cell Density-without EDTA Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
LABQA	4	2.83E+6	2.50E+6	3.16E+6	2800000	2.63E+6	3.10E+6	1.03E+5	7.26%	0.0%
207R00843	4	7.01E+6	6.46E+6	7.56E+6	7130000	6.51E+6	7.29E+6	1.73E+5	4.93%	-148.0%

Graphics





Selenastrum capricornutum Algal Toxicity Test Data Sheet

Client: ADH / CCCWP
Material: 207R00843
Test Start Date: 2/27/14
Test ID #: 55490
Project #: 19397
Test End Date: 3/3/14
Control/Diluent: Lab water w/o EDTA
Location: TR6/R4/S1

Test Treatment	Temp (°C)	pH	D.O. (mg/L)	Conductivity (μS/cm)	Sign-Off
Lab Water Control	~~7.59~~ 25.3	7.59	8.1	94.6	Date: 2/27/14
100%	25.3	7.65	10.3	350	Sample ID #: 34206
					Test Solution Prep: KP
					New WQ: [illegible]
					Inoculation Time: 1715
Meter ID	62A	PH19	RD04	EC04	Innoculation Signoff: KP
Lab Water Control	25.0	7.91			Date: 2-28-14
100%	25.0	8.14			WQ Time: 0850
Meter ID	62A	PH19			WQ Signoff: ARF
Lab Water Control	25.0	8.20			Date: 03/01/14
100%	25.0	8.32			WQ Time: 1000
Meter ID	62A	PH15			WQ Signoff: AS
Lab Water Control	25.7	8.98			Date: 03/02/14
100%	25.7	9.16			WQ Time: 1000
Meter ID	62A	PH19			WQ Signoff: AS
Lab Water Control	26.0	~~10.02~~ 9.56	11.6	96.5	Date: 3-3-14
100%	26.0	10.02	18.3	352	WQ Time: 0850
Meter ID	62A	PH16	RD04	EC09	WQ Signoff: ARF

Initial Count: 10,000 cells/mL
Termination Time: 1600
Enumerating Scientist: PR

Treatment	Cell Density (cells/mL x 10⁶) Rep A	Rep B	Rep C	Rep D	Mean Cell Density (cells/mL x 10⁶)
Lab Water Control	2.63	3.10	2.72	2.82	~~2.82~~ ~~2.82~~ 2.83
100%	7.29	7.17	7.08	6.51	7.01

This datasheet has been reviewed for completeness and consistency with Test Acceptability Criteria and/or other issues of concern.	Control Mean Density (cells/mL x 10⁶)	% CV	Date:	Time:	Signoff:
	2.83	7.26	~~3.3.13~~ 3.3.14	1630	PR

Initial Test Conditions	Alkalinity	Hardness	Light Intensity (ftc)
	93	113	373.6

Appendix C

Test Data and Summary of Statistics for the Evaluation of the Chronic Toxicity of the CCCWP Stormwater to *Ceriodaphnia dubia*

CETIS Summary Report

Ceriodaphnia Survival and Reproduction Test — **Pacific EcoRisk**

Batch ID:	10-6010-4569	**Test Type:**	Reproduction-Survival (7d)	**Analyst:**	Cassy Glover
Start Date:	27 Feb-14 16:00	**Protocol:**	EPA-821-R-02-013 (2002)	**Diluent:**	Not Applicable
Ending Date:	05 Mar-14 17:00	**Species:**	Ceriodaphnia dubia	**Brine:**	Not Applicable
Duration:	6d 1h	**Source:**	In-House Culture	**Age:**	1

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
LABQA	07-1612-1969	27 Feb-14 16:00	27 Feb-14 16:00	NA (25.5 °C)	ADH Environmental, Inc.	19397
207R00843	14-6517-7241	26 Feb-14 17:45	27 Feb-14 16:11	22h (0.6 °C)		
206R00551	08-4072-0786	26 Feb-14 15:20	27 Feb-14 16:11	25h (0.4 °C)		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
LABQA	Lab Water	ADH Environmental, Inc.	LABQA		
207R00843	Ambient Water	ADH Environmental, Inc.	207R00843		
206R00551	Ambient Water	ADH Environmental, Inc.	206R00551		

Reproduction Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
LABQA	10	31.3	30.1	32.5	28	37	1.04	3.3	10.5%	0.0%
207R00843	10	29.1	27.1	31.1	16	34	1.73	5.47	18.8%	7.03%
206R00551	10	28.9	27.7	30.1	23	33	1.05	3.31	11.5%	7.67%

Survival Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
LABQA	10	1	1	1	1	1	0	0	0.0%	0.0%
207R00843	10	0.9	0.782	1	0	1	0.1	0.316	35.1%	10.0%
206R00551	10	1	1	1	1	1	0	0	0.0%	0.0%

Reproduction Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
LABQA	29	29	34	30	28	30	32	36	37	28
207R00843	27	33	26	34	33	16	34	31	29	28
206R00551	23	31	29	31	32	30	33	29	24	27

Survival Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
LABQA	1	1	1	1	1	1	1	1	1	1
207R00843	1	1	1	1	1	0	1	1	1	1
206R00551	1	1	1	1	1	1	1	1	1	1

Survival Binomials

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
LABQA	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
207R00843	1/1	1/1	1/1	1/1	1/1	0/1	1/1	1/1	1/1	1/1
206R00551	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1

Ceriodaphnia Survival and Reproduction Test — **Pacific EcoRisk**

Analysis ID:	17-9071-7117	**Endpoint:**	Survival	**CETIS Version:**	CETISv1.8.5
Analyzed:	12 Mar-14 10:51	**Analysis:**	Single 2x2 Contingency Table	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	Test Result
Untransformed		C > T	NA	NA	

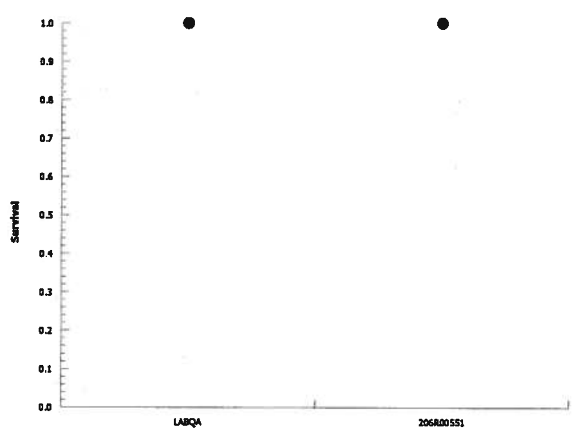
Fisher Exact Test

Sample	vs	Sample	Test Stat	P-Value	P-Type	Decision(α:5%)
LABQA		206R00551	1	1.0000	Exact	Non-Significant Effect

Data Summary

Sample Code		NR	R	NR + R	Prop NR	Prop R	%Effect
LABQA	Lab Water	10	0	10	1	0	0.0%
206R00551		10	0	10	1	0	0.0%

Graphics



CETIS Analytical Report

Report Date: 12 Mar-14 10:51 (p 1 of 2)
Test Code: ADH_0227_CD_C1 | 03-0011-7960

Ceriodaphnia Survival and Reproduction Test	**Pacific EcoRisk**

Analysis ID:	02-5680-4343	**Endpoint:**	Reproduction	**CETIS Version:**	CETISv1.8.5
Analyzed:	12 Mar-14 10:51	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Untransformed	NA	C > T	NA	NA	8.2%	

Equal Variance t Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
LABQA		206R00551	1.62	1.73	2.57	18	0.0611	CDF	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	28.8	28.8	1	2.63	0.1221	Non-Significant Effect
Error	197	10.94444	18			
Total	225.8		19			

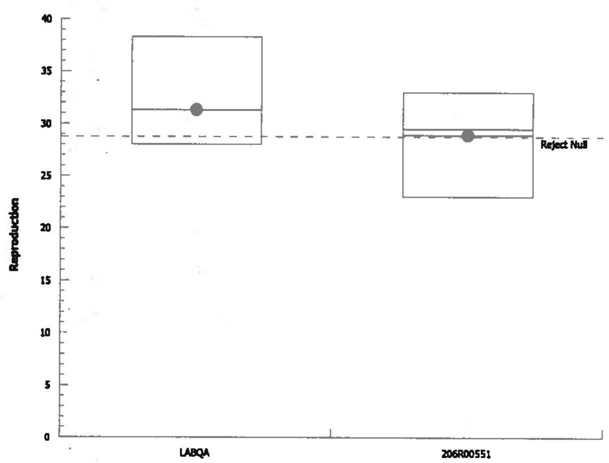
Distributional Tests

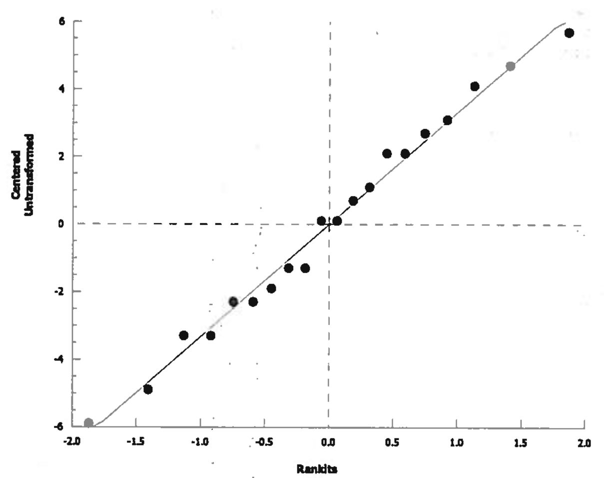
Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Variance Ratio F	1.01	6.54	0.9905	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.98	0.866	0.9391	Normal Distribution

Reproduction Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
LABQA	10	31.3	28.9	33.7	30	28	37	1.04	10.5%	0.0%
206R00551	10	28.9	26.5	31.3	29.5	23	33	1.05	11.5%	7.67%

Graphics





Short-Term Chronic 3-Brood *Ceriodaphnia dubia* Survival & Reproduction Test Data

Client: ADH / CCCWP
Project #: 19397 — Test ID: 55487
Material: 206R00551 — Randomization: 10.4.3
Test Date: 2-27-14 — Control Water: Modified EPAMH

Lab Water Control

Day	pH New	pH Old	D.O. New	D.O. Old	Cond. (µS/cm)	Temp (°C)	A	B	C	D	E	F	G	H	I	J	SIGN-OFF
0	~~8.01~~ 7.81 SM		~~9.7~~ 7.8 SM		~~881~~ 349 SM	25.5	0	0	0	0	0	0	0	0	0	0	Date: 2/27/14; New WQ: SM; Test Init.: SM; Sol'n Prep: SM; Time: 1600
1	8.04	7.96	8.3	8.1	349	25.2	0	0	0	0	0	0	0	0	0	0	Date: 2/28/14; New WQ: LH; Counts: [illegible]; Sol'n Prep: CD; Old WQ: JLA; Time: 1715
2	7.97	8.08	8.2	8.2	351	25.7	0	0	0	0	0	0	0	0	0	0	Date: 3/1/14; New WQ: CD; Counts: COD; Sol'n Prep: SS; Old WQ: CP; Time: 1200
3	7.92	8.14	8.5	7.3	350	25.9	6	6	5	3	5	6	7	6	7	5	Date: 3/2/14; New WQ: D.M.S.; Counts: [illegible]; Sol'n Prep: CJD; Old WQ: FWP; Time: 1600
4	7.90	7.97	8.4	7.9	350	25.7	8	7	0	0	7	7	8	11	0	10	Date: 3/3/14; New WQ: CP; Counts: [illegible]; Sol'n Prep: [illegible]; Old WQ: [illegible]; Time: 1650
5	8.14	7.97	8.0	8.2	338	25.5	0	0	12	12	0	0	0	0	14	0	Date: 3-4-14; New WQ: KS; Counts: [illegible]; Sol'n Prep: SM; Old WQ: CP; Time: 1600
6	–	7.73	–	8.1	371	25.7	15	16	17	15	16	17	17	19	16	13	Date: 3-5-14; New WQ: –; Counts: [illegible]; Sol'n Prep: –; Old WQ: [illegible]; Time: 1700
7																	Date: ; New WQ: ; Counts: ; Sol'n Prep: ; Old WQ: ; Time:
8																	Date: ; New WQ: ; Counts: ; Sol'n Prep: ; Old WQ: ; Time:
						Total=	29	29	34	30	28	30	32	36	37	28	Mean Neonates/Female = 31.3

100%

Day	pH New	pH Old	D.O. New	D.O. Old	Cond. (µS/cm)		A	B	C	D	E	F	G	H	I	J	SAMPLE ID
0	8.01		9.7		881		0	0	0	0	0	0	0	0	0	0	34205
1	7.95	8.37	10.0	7.3	902		0	0	0	0	0	0	0	0	0	0	34205
2	7.89	8.34	8.8	7.3	871		0	0	0	0	0	0	0	0	0	0	34205
3	7.93	8.32	9.8	7.1	832		3	4	6	5	6	5	6	7	4	3	34205
4	7.92	8.27	9.0	7.7	893		3	11	9	9	11	11	12	9	7	10	34205
5	8.30	8.35	9.3	8.1	884		3	0	0	0	0	0	0	6	0	0	34205
6	–	8.18	–	8.1	968		14	16	14	17	15	14	15	7	13	14	–
7																	
8																	
						Total=	23	31	29	31	32	30	33	29	24	27	Mean Neonates/Female = 28.9

CETIS Analytical Report

Report Date: 12 Mar-14 10:51 (p 1 of 2)
Test Code: ADH_0227_CD_C1 | 03-0011-7960

Ceriodaphnia Survival and Reproduction Test — **Pacific EcoRisk**

Analysis ID:	15-9148-3656	**Endpoint:**	Survival	**CETIS Version:**	CETISv1.8.5
Analyzed:	12 Mar-14 10:51	**Analysis:**	Single 2x2 Contingency Table	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	Test Result
Untransformed		C > T	NA	NA	

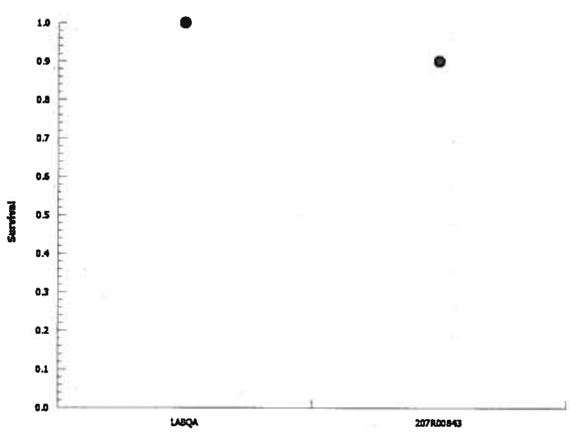
Fisher Exact Test

Sample	vs	Sample	Test Stat	P-Value	P-Type	Decision(α:5%)
LABQA		207R00843	0.5	0.5000	Exact	Non-Significant Effect

Data Summary

Sample Code		NR	R	NR + R	Prop NR	Prop R	%Effect
LABQA	Lab Water	10	0	10	1	0	0.0%
207R00843		9	1	10	0.9	0.1	10.0%

Graphics



Ceriodaphnia Survival and Reproduction Test — **Pacific EcoRisk**

Analysis ID:	10-5914-5607	**Endpoint:**	Reproduction	**CETIS Version:**	CETISv1.8.5
Analyzed:	12 Mar-14 10:51	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Untransformed	NA	C > T	NA	NA	11.2%	

Equal Variance t Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
LABQA		207R00843	1.09	1.73	3.5	18	0.1452	CDF	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	24.2	24.2	1	1.19	0.2903	Non-Significant Effect
Error	367	20.38889	18			
Total	391.2		19			

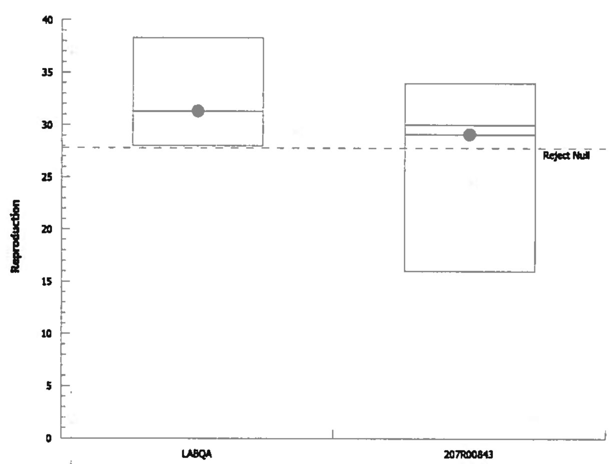
Distributional Tests

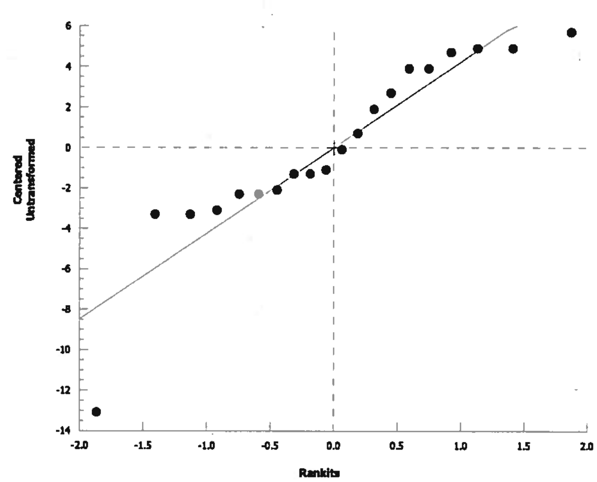
Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Variance Ratio F	2.74	6.54	0.1492	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.878	0.866	0.0160	Normal Distribution

Reproduction Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
LABQA	10	31.3	28.9	33.7	30	28	37	1.04	10.5%	0.0%
207R00843	10	29.1	25.2	33	30	16	34	1.73	18.8%	7.03%

Graphics





Short-Term Chronic 3-Brood *Ceriodaphnia dubia* Survival & Reproduction Test Data

Client: ADH / CCCWP Material: 207R00843 Test Date: 2-27-14

Project #: 19397 Test ID: 55491 Randomization: 10.4.3 Control Water: Modified EPAMH

Lab Water Control

Day	pH New	pH Old	D.O. New	D.O. Old	Cond. (µS/cm)	Temp (°C)	A	B	C	D	E	F	G	H	I	J
0	7.81		7.8		349	25.5	0	0	0	0	0	0	0	0	0	0
1	8.04	7.96	8.3	8.1	349	25.2	0	0	0	0	0	0	0	0	0	0
2	7.97	8.08	8.2	8.2	351	25.7	0	0	0	0	0	0	0	0	0	0
3	7.92	8.14	8.5	7.3	350	25.9	6	6	5	3	5	6	7	6	7	5
4	7.90	7.97	8.4	7.9	350	25.7	8	7	0	0	7	7	8	11	0	10
5	8.14	7.97	8.6	8.2	338	25.5	0	0	12	12	0	0	0	0	14	0
6	–	7.73	–	8.1	371	25.9	15	16	17	15	16	17	17	19	16	13
7																
8																
						Total=	29	29	34	30	28	30	32	36	37	28

SIGN-OFF

Day	Date	Sol'n Prep	New WQ	Old WQ	Test Init / Counts	Time
0	2/27/14	SM	SM		Test Init: SM	1600
1	2/28/14	CD	LH	JRA	Counts: [illegible]	1715
2	3/1/14	SS	CO	CP	Counts: COD	1200
3	3/2/14	COD	D.M.S.	[illegible]	Counts: [illegible]	1600
4	3/3/14	[illegible]	CP	[illegible]	Counts: [illegible]	1650
5	3-4-14	SM	AS	CP	Counts: [illegible]	1600
6	3-5-14	–	–	[illegible]	Counts: [illegible]	1700
7						
8						

Mean Neonates/Female = 31.3

100%

Day	pH New	pH Old	D.O. New	D.O. Old	Cond. (µS/cm)		A	B	C	D	E	F	G	H	I	J	SAMPLE ID
0	7.75		10.4		272		0	0	0	0	0	0	0	0	0	0	34206
1	7.72	7.94	10.6	7.9	307		0	0	0	0	0	0	0	0	0	0	34206
2	7.69	7.97	10.6	7.1	278		0	0	0	0	0	0	0	0	0	0	34206
3	7.67	8.03	10.8	7.4	288		5	4	7	6	5	6	7	6	4	3	34206
4	7.64	7.84	8.9	7.6	280		0	11	5	10	11	10	11	9	8	9	34206
5	8.05	8.00	8.9	8.2	285		8	0	0	0	0	x/0	0	0	0	0	34206
6	–	7.99	–	8.1	336		14	18	14	18	17	–	16	16	17	16	–
7												–					
8												–					
						Total=	27	33	26	34	33	x/16	34	31	29	28	

Mean Neonates/Female = 29.1

Appendix D

Test Data and Summary of Statistics for the Evaluation of the Chronic Toxicity of the CCCWP Stormwater to *Hyalella azteca*

CETIS Summary Report

Report Date: 11 Mar-14 16:19 (p 1 of 1)
Test Code: ADH_0227_HA_C1 | 06-3972-8324

Hyalella Survival and Growth Test — **Pacific EcoRisk**

Batch ID:	01-9938-1231	**Test Type:**	Survival-Growth (10 day)	**Analyst:**	Cassy Glover
Start Date:	27 Feb-14 18:00	**Protocol:**	GCML	**Diluent:**	Not Applicable
Ending Date:	09 Mar-14 09:20	**Species:**	Hyalella azteca	**Brine:**	Not Applicable
Duration:	9d 15h	**Source:**	Chesapeake Cultures, Inc.	**Age:**	9

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
LABQA	11-0836-4836	27 Feb-14 18:00	27 Feb-14 18:00	NA (23.1 °C)	ADH Environmental, Inc.	19397
207R00843	14-6517-7241	26 Feb-14 17:45	27 Feb-14 16:11	24h (0.6 °C)		
206R00551	08-4072-0786	26 Feb-14 15:20	27 Feb-14 16:11	27h (0.4 °C)		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
LABQA	Sediment	ADH Environmental, Inc.	LABQA		
207R00843	Ambient Water	ADH Environmental, Inc.	207R00843		
206R00551	Ambient Water	ADH Environmental, Inc.	206R00551		

Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
LABQA	5	0.98	0.963	0.997	0.9	1	0.02	0.0447	4.56%	0.0%
207R00843	5	0.64	0.572	0.708	0.4	0.9	0.0812	0.182	28.4%	34.7%
206R00551	5	0.94	0.907	0.973	0.8	1	0.04	0.0894	9.52%	4.08%

Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
LABQA	1	0.9	1	1	1
207R00843	0.4	0.6	0.7	0.6	0.9
206R00551	0.9	0.8	1	1	1

Survival Rate Binomials

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
LABQA	10/10	9/10	10/10	10/10	10/10
207R00843	4/10	6/10	7/10	6/10	9/10
206R00551	9/10	8/10	10/10	10/10	10/10

Analyst: CG QA: SNV

Hyalella Survival and Growth Test — **Pacific EcoRisk**

Analysis ID:	19-1284-5857	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.5
Analyzed:	11 Mar-14 16:19	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	8.11%	

Equal Variance t Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
LABQA		206R00551	0.876	1.86	0.129	8	0.2034	CDF	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.009294413	0.009294413	1	0.767	0.4068	Non-Significant Effect
Error	0.0969765	0.01212206	8			
Total	0.1062709		9			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Variance Ratio F	3.56	23.2	0.2460	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.829	0.741	0.0324	Normal Distribution

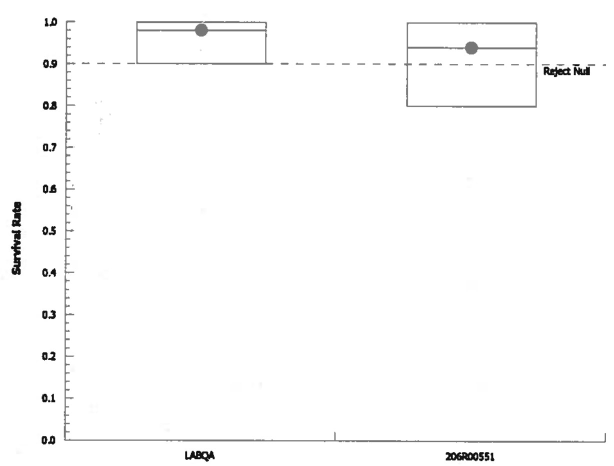
Survival Rate Summary

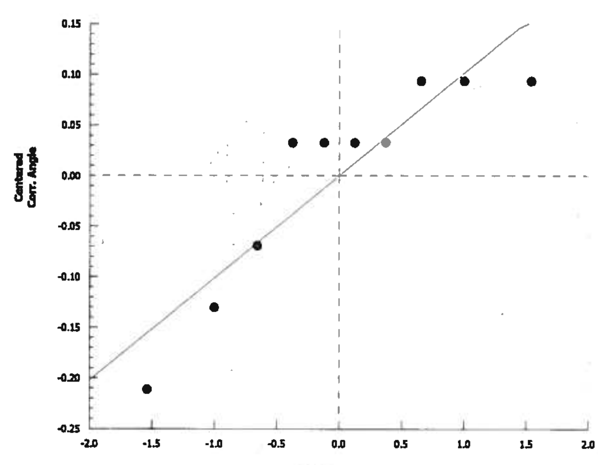
Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
LABQA	5	0.98	0.924	1	1	0.9	1	0.02	4.56%	0.0%
206R00551	5	0.94	0.829	1	1	0.8	1	0.04	9.52%	4.08%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
LABQA	5	1.38	1.29	1.47	1.41	1.25	1.41	0.0326	5.28%	0.0%
206R00551	5	1.32	1.15	1.49	1.41	1.11	1.41	0.0615	10.4%	4.42%

Graphics





10 Day Acute *Hyalella azteca* Toxicity Test Data

Client: ADH / CCCWP
Test Material: 206R00551
Test ID#: 55488 Project #: 19397
Test Date: 2/27/14

Organism Log#: 7993 Age: 9 days
Organism Supplier: Chesapeake Cultures
Control/Diluent: SAM-5 Hyalella Water
Control Water Batch: 92

Treatment	Temp (°C)	pH new	pH old	D.O. (mg/L) new	D.O. (mg/L) old	Conductivity (µS/cm)	# Live Organisms A	B	C	D	E	SIGN-OFF
Lab Control	23.1	7.91		9.0		410	10	10	10	10	10	Date: 2/27/14; Sample ID: 34205
100%	23.1	7.94		10.8		899	10	10	10	10	10	Test Solution Prep: [illegible]; New WQ: [illegible]
Meter ID	43A	PH19		RD04		EC04						Initiation Time: 1800; Initiation Signoff: SM
Lab Control	23.1				8.3		10	9	10	10	10	Date: 2/28/14; Count Time: 1040
100%	23.1				7.9		10	10	10	10	10	Count Signoff: MK; Old WQ: MA
Meter ID	43A				RD07							
Lab Control	23.2				7.2		10 9	9	10	10	10	Date: 3/1/14; Count Time: 905
100%	23.2				7.2		10	10	10	10	10	Count Signoff: [illegible]; Old WQ: AS
Meter ID	43A				RD04							Feed: [illegible]
Lab Control	23.1				7.5		10	9	10	10	10	Date: 3/2/14; Count Time: 0925
100%	23.1				7.8		10	9	10	10	10	Count Signoff: [illegible]; Old WQ: FO/AS
Meter ID	43A				RD07							
Lab Control	23.0				7.7		10	9	10	10	10	Date: 3/3/14; Count Time: 1600
100%	23.0				7.5		10	9	10	10	10	Count Signoff: [illegible]; Old WQ: CJD
Meter ID	43A				RD09							Feed: [illegible]
Lab Control	23.0	7.99	7.73	8.7	6.8	413	10	9	10	10	10	Date: 3-4-14; Sample ID: 34205
100%	23.0	8.07	8.19	9.0	5.8	894	9	9	10	10	10	Test Solution Prep: SM; New WQ: CP
Meter ID	43A	PH16	Ph19	RD07	RD09	EC06						Renewal Time: 1615; Renewal Signoff: [illegible]; Old WQ: [illegible]
Lab Control	23.0				7.3		10	9	10	10	10	Date: 3/5/14; Count Time: 1100
100%	23.0				7.4		9	9	10	10	10	Count Signoff: CJD; Old WQ: AFF
Meter ID	43A				RD08							Feed: CJD
Lab Control	23.1				6.7		10	9	10	10	10	Date: 3.6.14; Count Time: 1045
100%	23.1				5.7		9	9	10	10	10	Count Signoff: [illegible]; Old WQ: [illegible]
Meter ID	43A				RD07							
Lab Control	22.9				6.8		10	9	10	10	10	Date: 3/7/14; Count Time: 1405
100%	22.9				6.3		9	8	10	10	10	Count Signoff: [illegible]; Old WQ: GG
Meter ID	43A				RD07							Feed: [illegible]
Lab Control	22.5				4.9		10	9	10	10	10	Date: 3-8-14; Count Time: 1330
100%	22.5				5.2		9	8	10	10	10	Count Signoff: [illegible]; Old WQ: GG
Meter ID	43A				RD07							
Lab Control	22.9		7.63		6.8	443	10	9	10	10	10	Date: 3/9/14; Termination Time: 0920
100%	22.9		7.89		5.9	907	9	8	10	10	10	Termination Signoff: MF; Old WQ: GP
Meter ID	43A		PH21		RD07	EC04						

CETIS Analytical Report

Hyalella Survival and Growth Test — **Pacific EcoRisk**

Analysis ID:	00-2680-1465	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.5
Analyzed:	11 Mar-14 16:19	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	11.5%	

Equal Variance t Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
LABQA		207R00843	4.51	1.86	0.181	8	0.0010	CDF	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.4840151	0.4840151	1	20.3	0.0020	Significant Effect
Error	0.1903557	0.02379446	8			
Total	0.6743708		9			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Variance Ratio F	7.96	23.2	0.0692	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.895	0.741	0.1905	Normal Distribution

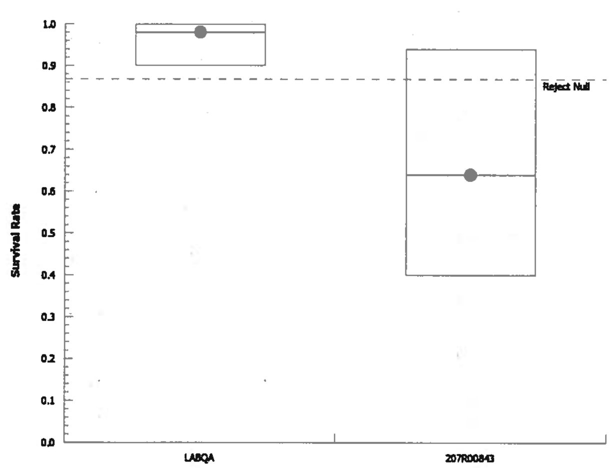
Survival Rate Summary

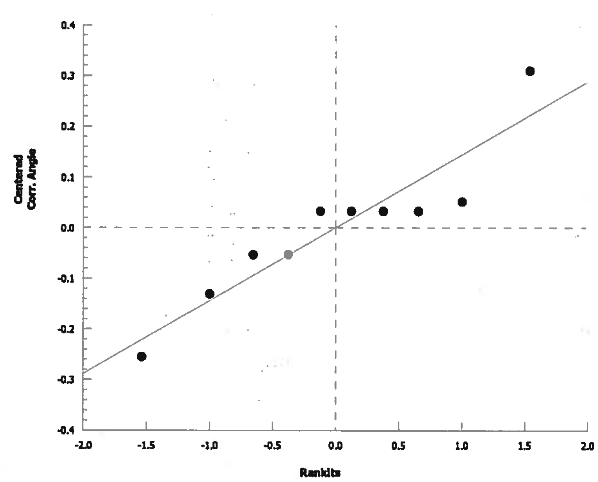
Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
LABQA	5	0.98	0.924	1	1	0.9	1	0.02	4.56%	0.0%
207R00843	5	0.64	0.414	0.866	0.6	0.4	0.9	0.0812	28.4%	34.7%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
LABQA	5	1.38	1.29	1.47	1.41	1.25	1.41	0.0326	5.28%	0.0%
207R00843	5	0.939	0.684	1.19	0.886	0.685	1.25	0.092	21.9%	31.9%

Graphics





Analyst: [signature] QA: [signature]

10 Day Acute *Hyalella azteca* Toxicity Test Data

Client: ADH / CCCWP
Test Material: 207R00843
Test ID#: 55492 Project #: 19397
Test Date: 2/27/14

Organism Log#: 7993 Age: 9 days
Organism Supplier: Chesapeake Cultures
Control/Diluent: SAM-5 Hyalella Water
Control Water Batch: 92

Treatment	Temp (°C)	pH new	pH old	D.O. (mg/L) new	D.O. (mg/L) old	Conductivity (µS/cm)	# Live Organisms A	B	C	D	E	SIGN-OFF
Lab Control	23.1	7.91		9.0		410	10	10	10	10	10	Date: 2/27/14; Sample ID: 34206
100%	23.1	8.04		12.0		299	10	10	10	10	10	Test Solution Prep: MA; New WQ: MA
Meter ID	43A	PH19		RD04		EC04						Initiation Time: 1400; Initiation Signoff: SM
Lab Control	23.1				8.3		10	9	10	10	10	Date: 2/28/14; Count Time: 1040
100%	23.1				7.7		10	10	10	10	10	Count Signoff: MK; Old WQ: MA
Meter ID	43A				RD07							
Lab Control	23.2				7.2		10	9	10	10	10	Date: 3/1/14; Count Time: 905
100%	23.2				7.2		10	10	10	10	10	Count Signoff: [illegible]; Old WQ: AS
Meter ID	43A				RD04							Feed: [illegible]
Lab Control	23.1				7.5		10	9	10	10	10	Date: 3/2/14; Count Time: 0925
100%	23.1				7.8		8	10	10	10	10	Count Signoff: [illegible]; Old WQ: FOWB
Meter ID	43A				RD07							
Lab Control	23.0				7.7		10	9	10	10	10	Date: 3/3/14; Count Time: 1600
100%	23.0				7.6		6	10	10	8	10	Count Signoff: [illegible]; Old WQ: CJD
Meter ID	43A				RD09							Feed: [illegible]
Lab Control	23.0	7.99	7.73	8.7	6.8	413	10	9	10	10	10	Date: 3-4-14; Sample ID: 34206
100%	23.0	8.03	8.08	9.0	6.0	276	4	~~8~~ 10	8	7	10	Test Solution Prep: SM; New WQ: CP
Meter ID	43A	PH16	PH19	RD07	RD04	EC06						Renewal Time: 1615; Renewal Signoff: [illegible]; Old WQ: [illegible]
Lab Control	23.0				7.3		10	9	10	10	10	Date: 3/5/14; Count Time: 1100
100%	23.0				7.0		4	10	7	6	10	Count Signoff: CJD; Old WQ: ARF
Meter ID	43A				RD07							Feed: CJD
Lab Control	23.1				6.7		10	9	10	10	10	Date: 3.6.14; Count Time: 1045
100%	23.1				6.3		4	10	7	6	10	Count Signoff: [illegible]; Old WQ: [illegible]
Meter ID	43A				RD07							
Lab Control	22.9				6.8		10	9	10	10	10	Date: 3/7/14; Count Time: 1405
100%	22.9				7.1		4	8	7	6	10	Count Signoff: [illegible]; Old WQ: GG
Meter ID	43A				RD07							Feed: [illegible]
Lab Control	22.5				4.9		10	9	10	10	10	Date: 3-8-14; Count Time: 1330
100%	22.5				6.6		4	8	7	6	9	Count Signoff: [illegible]; Old WQ: GG
Meter ID	43A				RD07							
Lab Control	22.9		7.63		6.8	443	10	9	10	10	10	Date: 3/9/14; Termination Time: 0920
100%	22.9		7.85		6.7	313	4	6	7	6	9	Termination Signoff: MF; Old WQ: CP
Meter ID	43A		PH21		RD07	EC04						

CETIS Summary Report

Hyalella Survival and Growth Test | **Pacific EcoRisk**

Batch ID:	02-1871-2871	**Test Type:**	Survival-Growth (10 day)	**Analyst:**	Cassy Glover
Start Date:	28 Feb-14 17:50	**Protocol:**	GCML	**Diluent:**	Not Applicable
Ending Date:	10 Mar-14 10:15	**Species:**	Hyalella azteca	**Brine:**	Not Applicable
Duration:	9d 16h	**Source:**	Chesapeake Cultures, Inc.	**Age:**	10

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
LABQA	07-1122-1925	28 Feb-14 17:50	28 Feb-14 17:50	NA (22.8 °C)	ADH Environmental, Inc.	19397
207R00011US	12-4879-0307	28 Feb-14 09:55	28 Feb-14 11:43	8h (8.5 °C)		
207R00011DS	19-7063-6676	28 Feb-14 08:45	28 Feb-14 11:43	9h (8.2 °C)		
544R00025US	00-0717-3326	28 Feb-14 10:00	28 Feb-14 15:20	8h (4.3 °C)		
544R00025DS	15-1384-1621	28 Feb-14 09:30	28 Feb-14 15:20	8h (10.7 °C)		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
LABQA	Lab Control	ADH Environmental, Inc.	LABQA		
207R00011US	Ambient Water	ADH Environmental, Inc.	207R00011US		
207R00011DS	Ambient Water	ADH Environmental, Inc.	207R00011DS		
544R00025US	Ambient Water	ADH Environmental, Inc.	544R00025US		
544R00025DS	Ambient Water	ADH Environmental, Inc.	544R0025DS		

Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
LABQA	5	0.96	0.94	0.98	0.9	1	0.0245	0.0548	5.71%	0.0%
207R00011US	5	0.48	0.463	0.497	0.4	0.5	0.02	0.0447	9.32%	50.0%
207R00011DS	5	0.48	0.364	0.596	0.1	0.8	0.139	0.311	64.9%	50.0%
544R00025US	5	0.18	0.139	0.221	0.1	0.3	0.049	0.11	60.9%	81.3%
544R00025DS	5	0.06	0.0395	0.0805	0	0.1	0.0245	0.0548	91.3%	93.8%

Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
LABQA	1	1	1	0.9	0.9
207R00011US	0.5	0.4	0.5	0.5	0.5
207R00011DS	0.8	0.1	0.2	0.6	0.7
544R00025US	0.3	0.3	0.1	0.1	0.1
544R00025DS	0.1	0.1	0	0	0.1

Survival Rate Binomials

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
LABQA	10/10	10/10	10/10	9/10	9/10
207R00011US	5/10	4/10	5/10	5/10	5/10
207R00011DS	8/10	1/10	2/10	6/10	7/10
544R00025US	3/10	3/10	1/10	1/10	1/10
544R00025DS	1/10	1/10	0/10	0/10	1/10

Analyst: [signature] QA: SVV

CETIS Analytical Report

Hyalella Survival and Growth Test — **Pacific EcoRisk**

Analysis ID:	02-7452-7739	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.5
Analyzed:	12 Mar-14 10:58	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	5.35%	

Equal Variance t Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
LABQA		207R00011US	13	1.86	0.083	8	<0.0001	CDF	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.8455464	0.8455464	1	169	<0.0001	Significant Effect
Error	0.0399802	0.004997525	8			
Total	0.8855265		9			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Variance Ratio F	3.93	23.2	0.2135	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.796	0.741	0.0128	Normal Distribution

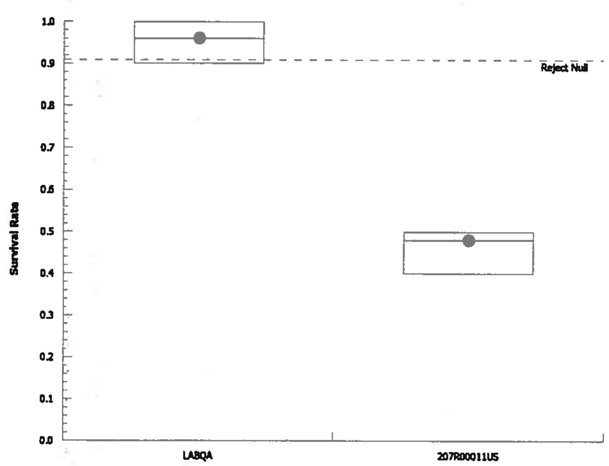
Survival Rate Summary

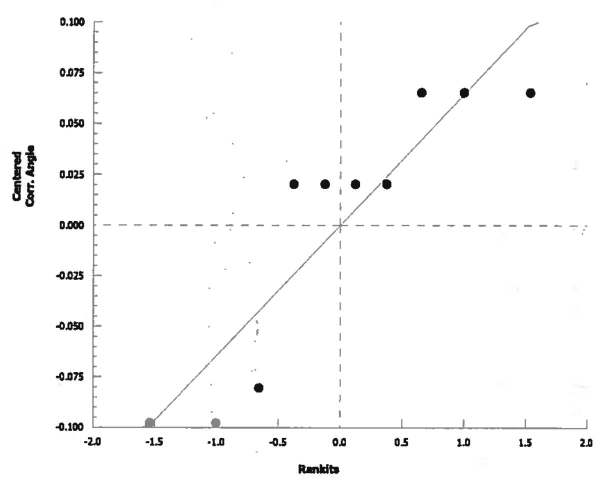
Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
LABQA	5	0.96	0.892	1	1	0.9	1	0.0245	5.71%	0.0%
207R00011US	5	0.48	0.424	0.536	0.5	0.4	0.5	0.02	9.32%	50.0%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
LABQA	5	1.35	1.24	1.46	1.41	1.25	1.41	0.0399	6.63%	0.0%
207R00011US	5	0.765	0.709	0.821	0.785	0.685	0.785	0.0201	5.88%	43.2%

Graphics





Analyst: [signature] QA: [signature]

10 Day Acute *Hyalella azteca* Toxicity Test Data

Client: ADH / CCCWP
Test Material: 207R00011US
Test ID#: 55494 Project #: 19397
Test Date: 2/28/14

Organism Log#: 7993 Age: 9-10 d
Organism Supplier: Chesapeake
Control/Diluent: SAM-5 Hyalella Water
Control Water Batch: 92

Treatment	Temp (°C)	pH new	pH old	D.O. (mg/L) new	D.O. (mg/L) old	Conductivity (µS/cm)	# Live A	B	C	D	E	SIGN-OFF
Lab Control	22.8	7.76		8.8		410	10	10	10	10	10	Date: 2/28/14
100%	22.8	7.79		10.0		323	10	10	10	10	10	Sample ID: 34220; Test Solution Prep: MF
Meter ID	43A	pH19		RD07		EC06						New WQ: LH; Initiation Time: 1750; Initiation Signoff: [illegible]
Lab Control	23.2				9.1		10	10	10	10	10	Date: 3/1/14; Count Time: 930
100%	23.2				8.7		10	10	10	10	10	Count Signoff: [illegible]; Old WQ: CP
Meter ID	43A				RD07							
Lab Control	23.1				7.5		10	10	10	9	9	Date: 3/2/14; Count Time: 1010
100%	23.1				7.4		10	9	10	9	9	Count Signoff: [illegible]; Old WQ: [illegible]
Meter ID	43A				RD07							Feed: [illegible]
Lab Control	23.0				5.6		10	10	10	9	9	Date: 3/3/14; Count Time: 1045
100%	23.0				5.4		10	9	9	~~8~~ 9	9	Count Signoff: [illegible]; Old WQ: [illegible]
Meter ID	43A				RD06							
Lab Control	22.9				5.7		10	10	10	9	9	Date: ~~3/3/14~~ 3/4/14; Count Time: ~~1045~~ 0940
100%	22.9				4.8		8	7	6	9	6	Count Signoff: [illegible]; Old WQ: CP
Meter ID	43A				RD07							Feed: [illegible]
Lab Control	23.0	7.81	7.67	8.8	7.8	407	10	10	10	9	9	Date: 3/5/14; Sample ID: 34220
100%	23.0	7.83	7.77	9.6	7.5	346	6	4	5	9	6	Test Solution Prep: [illegible]; New WQ: [illegible]
Meter ID	43A	pH14	pH19	RD07	RD09	EC04						Renewal Time: 1445; Renewal Signoff: [illegible]; Old WQ: [illegible]
Lab Control	23.0				4.9		10	10	10	9	9	Date: 3-6-14; Count Time: 0900
100%	23.0				4.8		6	4	5	8	6	Count Signoff: SM; Old WQ: SM
Meter ID	43A				RD07							Feed: SM
Lab Control	22.9				6.5		10	10	10	9	9	Date: 3/7/14; Count Time: 1440
100%	22.9				6.0		5	4	5	6	5	Count Signoff: [illegible]; Old WQ: GG
Meter ID	43A				RD07							
Lab Control	22.6				6.7		10	10	10	9	9	Date: 3-8-14; Count Time: 1315
100%	22.6				6.3		5	4	5	6	5	Count Signoff: [illegible]; Old WQ: GG
Meter ID	43A				RD07							Feed: [illegible]
Lab Control	22.8				6.3		10	10	10	9	9	Date: ~~[illegible]~~ 3/9/14; Count Time: 1015
100%	22.8				5.8		5	4	5	5	5	Count Signoff: [illegible]; Old WQ: CP
Meter ID	43A				RD07							
Lab Control	22.9		8.01		7.6	454	10	10	10	9	9	Date: 3-10-14; Termination Time: 1615
100%	22.9		7.73		6.9	440	5	4	5	5	5	Termination Signoff: SM; Old WQ: [illegible]
Meter ID	43A		PD21		RD09	EC07						

Hyalella Survival and Growth Test				Pacific EcoRisk
Analysis ID: 19-2142-4264	Endpoint: Survival Rate		CETIS Version: CETISv1.8.5	
Analyzed: 12 Mar-14 10:59	Analysis: Parametric-Two Sample		Official Results: Yes	

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	21.4%	

Equal Variance t Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
LABQA		207R00011DS	3.74	1.86	0.294	8	0.0028	CDF	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.8787426	0.8787426	1	14	0.0057	Significant Effect
Error	0.5014169	0.06267712	8			
Total	1.380159		9			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Variance Ratio F	14.7	23.2	0.0232	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.959	0.741	0.7738	Normal Distribution

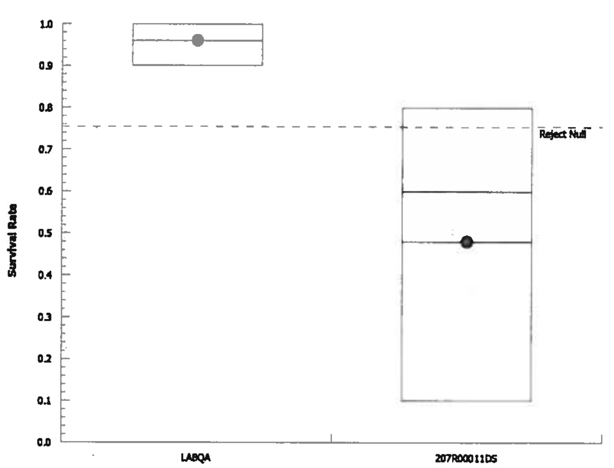
Survival Rate Summary

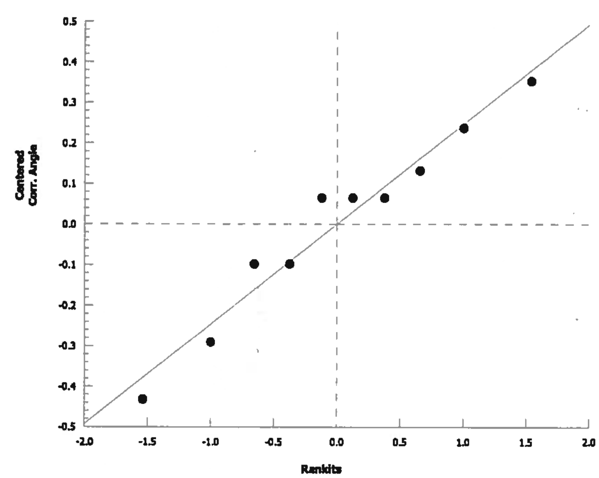
Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
LABQA	5	0.96	0.892	1	1	0.9	1	0.0245	5.71%	0.0%
207R00011DS	5	0.48	0.0933	0.867	0.6	0.1	0.8	0.139	64.9%	50.0%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
LABQA	5	1.35	1.24	1.46	1.41	1.25	1.41	0.0399	6.63%	0.0%
207R00011DS	5	0.754	0.329	1.18	0.886	0.322	1.11	0.153	45.4%	44.0%

Graphics





10 Day Acute *Hyalella azteca* Toxicity Test Data

Client: ADH / CCCWP
Test Material: 207R00011DS
Test ID#: 55495 Project #: 19397
Test Date: 2/28/14

Organism Log#: 7993 Age: 9-10 d
Organism Supplier: Chesapeake
Control/Diluent: SAM-5 Hyalella Water
Control Water Batch: 92

Treatment	Temp (°C)	pH new	pH old	D.O. (mg/L) new	D.O. (mg/L) old	Conductivity (µS/cm)	# Live Organisms A	B	C	D	E	SIGN-OFF
Lab Control	22.8	7.76		8.8		410	10	10	10	10	10	Date: 2/28/14 Sample ID: 34219 Test Solution Prep: MF
100%	22.8	7.70		10.1		187	10	10	10	10	10	New WQ: LH
Meter ID	43A	pH19		RD07		EC06						Initiation Time: 1750 Initiation Signoff: [illegible]
Lab Control	23.2				9.1		10	10	10	10	10	Date: 3/1/14 Count Time: 930
100%	23.2				8.8		10	10	10	10	10	Count Signoff: [illegible] Old WQ: CP
Meter ID	43A				RD07							
Lab Control	23.1				7.5		10	10	10	9	9	Date: 3/2/14 Count Time: 1010
100%	23.1				7.8		10	7	8	10	10	Count Signoff: [illegible] Old WQ: FOUB
Meter ID	43A				RD07							Feed: [illegible]
Lab Control	23.0				5.6		10	10	10	9	9	Date: 3/3/14 Count Time: 1045
100%	23.0				5.5		10	2	8	10	10	Count Signoff: [illegible] Old WQ: [illegible]
Meter ID	43A				RD08							
Lab Control	22.9				5.7		10	10	10	9	9	Date: 3/4/14 Count Time: 0940
100%	22.9				5.3		10	2	5	9	10	Count Signoff: [illegible] Old WQ: CP
Meter ID	43A				RD07							Feed: [illegible]
Lab Control	23.0	7.81	7.67	8.8	7.8	407	10	10	10	9	9	Date: 3/5/14 Sample ID: 34219 Test Solution Prep: [illegible]
100%	23.0	7.71	7.67	9.5	7.4	188	10	1	4	9	10	New WQ: [illegible]
Meter ID	43A	pH14	pH19	RD07	RD09	EC06						Renewal Time: 1445 Renewal Signoff: SW Old WQ: [illegible]
Lab Control	23.0				4.9		10	10	10	9	9	Date: 3-6-14 Count Time: 0900
100%	23.0				5.1		10	1	4	9	9	Count Signoff: SM Old WQ: SM
Meter ID	43A				RD07							Feed: SM
Lab Control	22.9				6.5		10	10	10	9	9	Date: 3/7/14 Count Time: 1440
100%	22.9				6.4		10	1	3	6	8	Count Signoff: [illegible] Old WQ: GG
Meter ID	43A				RD07							
Lab Control	22.6				6.7		10	10	10	9	9	Date: 3/8/14 Count Time: 1315
100%	22.6				6.4		9	1	3	6	8	Count Signoff: [illegible] Old WQ: GG
Meter ID	43A				RD07							Feed: [illegible]
Lab Control	22.8				6.3		10	10	10	9	9	Date: 3/9/14 Count Time: 1015
100%	22.8				6.0		9	1	2	6	8	Count Signoff: [illegible] Old WQ: CP
Meter ID	43A				RD07							
Lab Control	22.9		8.01		7.6	454	10	10	10	9	9	Date: 3-10-14 Termination Time: 1015
100%	22.9		7.80		6.8	209	8	1	2	6	7	Termination Signoff: SM Old WQ: [illegible]
Meter ID	43A		pH21		RD07	EC04						

Hyalella Survival and Growth Test — Pacific EcoRisk

Analysis ID:	18-7418-2319	Endpoint:	Survival Rate	CETIS Version:	CETISv1.8.5
Analyzed:	12 Mar-14 10:59	Analysis:	Nonparametric-Two Sample	Official Results:	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	8.96%	

Wilcoxon Rank Sum Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
LABQA		544R00025US	15	NA	0	8	0.0040	Exact	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	2.124849	2.124849	1	152	<0.0001	Significant Effect
Error	0.1116794	0.01395992	8			
Total	2.236529		9			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Variance Ratio F	2.5	23.2	0.3957	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.781	0.741	0.0086	Non-normal Distribution

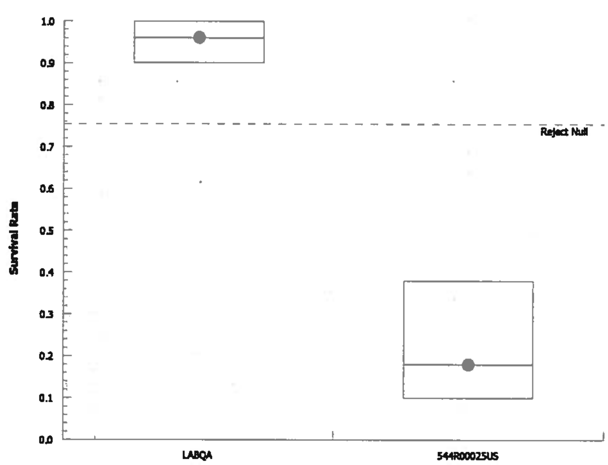
Survival Rate Summary

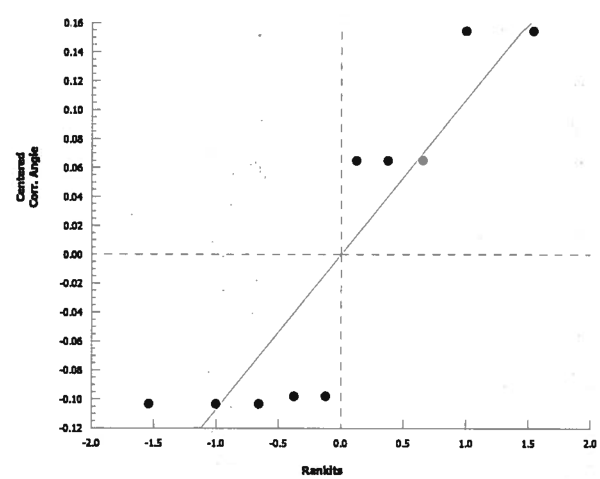
Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
LABQA	5	0.96	0.892	1	1	0.9	1	0.0245	5.71%	0.0%
544R00025US	5	0.18	0.044	0.316	0.1	0.1	0.3	0.049	60.9%	81.3%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
LABQA	5	1.35	1.24	1.46	1.41	1.25	1.41	0.0399	6.63%	0.0%
544R00025US	5	0.425	0.25	0.6	0.322	0.322	0.58	0.0632	33.2%	68.5%

Graphics





10 Day Acute *Hyalella azteca* Toxicity Test Data

Client: ADH / CCCWP
Test Material: 544R00025US
Test ID#: 55552 Project #: 19397
Test Date: 2/28/14

Organism Log#: 7993 Age: 9-10d
Organism Supplier: Chesapeake
Control/Diluent: SAM-5 Hyalella Water
Control Water Batch: 92

Treatment	Temp (°C)	pH new	pH old	D.O. (mg/L) new	D.O. (mg/L) old	Conductivity (µS/cm)	# Live Organisms A	B	C	D	E	SIGN-OFF
Lab Control	22.8	7.76		8.8		410	10	10	10	10	10	Date: 2/28/14; Sample ID: 34242
100%	22.8	7.69		9.8		1117	10	10	10	10	10	Test Solution Prep: [illegible]; New WQ: LH
Meter ID	43A	PH19		RD07		EC06						Initiation Time: 1750; Initiation Signoff: [illegible]
Lab Control	23.2				9.1		10	10	10	10	10	Date: 3/1/14; Count Time: 930
100%	23.2				9.0		10	10	10	10	10	Count Signoff: [illegible]; Old WQ: CP
Meter ID	43A				RD07							
Lab Control	23.1				7.5		10	10	10	9	9	Date: 3/2/14; Count Time: 1010
100%	23.1				6.4		9	10	9	6	9	Count Signoff: [illegible]; Old WQ: [illegible]
Meter ID	43A				RD07							Feed: [illegible]
Lab Control	23.0				5.6		10	10	10	9	9	Date: 3/3/14; Count Time: 1045
100%	23.0				4.8		4	9	9	5	9	Count Signoff: [illegible]; Old WQ: [illegible]
Meter ID	43A				RD08							
Lab Control	22.9				5.7		10	10	10	9	9	Date: 3/4/14; Count Time: 0940
100%	22.9				3.1		4	6	5	3	6	Count Signoff: [illegible]; Old WQ: CP
Meter ID	43A				RD07							Feed: [illegible]
Lab Control	23.0	7.81	7.67	8.8	7.8	407	10	10	10	9	9	Date: 3/5/14; Sample ID: 34242
100%	23.0	7.71	7.61	9.4	6.9	1148	3	3	4	2	3	Test Solution Prep: [illegible]; New WQ: [illegible]
Meter ID	43A	PH16	PH19	RD07	RD09	EC06						Renewal Time: 1445; Renewal Signoff: SVV; Old WQ: [illegible]
Lab Control	23.0				4.9		10	10	10	9	9	Date: 3-6-14; Count Time: 0900
100%	23.0				3.9		3	3	3	2	3	Count Signoff: SM; Old WQ: SM
Meter ID	43A				RD07							Feed: SM
Lab Control	22.9				6.5		10	10	10	9	9	Date: 3/7/14; Count Time: 1440
100%	22.9				6.2		3	3	3	2	3	Count Signoff: [illegible]; Old WQ: [illegible]
Meter ID	43A				RD07							
Lab Control	22.6				6.7		10	10	10	9	9	Date: 3-8-14; Count Time: 1315
100%	22.6				6.2		3	3	3	2	2	Count Signoff: [illegible]; Old WQ: [illegible]
Meter ID	43A				RD07							Feed: [illegible]
Lab Control	22.8				6.3		10	10	10	9	9	Date: 3/9/14; Count Time: 1015
100%	22.8				4.5		3	3	2	1	1	Count Signoff: [illegible]; Old WQ: CP
Meter ID	43A				RD07							
Lab Control	22.9		8.01		7.6	454	10	10	10	9	9	Date: 3-9-14; Termination Time: 1015
100%	22.9		7.85		7.2	1145	3	3	1	1	1	Termination Signoff: SM; Old WQ: [illegible]
Meter ID	43A		PH21		RD09	EC09						

Hyalella Survival and Growth Test — Pacific EcoRisk

Analysis ID:	19-1235-0465	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.5
Analyzed:	12 Mar-14 10:59	**Analysis:**	Nonparametric-Two Sample	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	6.7%	

Wilcoxon Rank Sum Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
LABQA		544R00025DS	15	NA	0	8	0.0040	Exact	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	2.971698	2.971698	1	373	<0.0001	Significant Effect
Error	0.0637424	0.0079678	8			
Total	3.03544		9			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Variance Ratio F	1	23.2	1.0000	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.64	0.741	0.0002	Non-normal Distribution

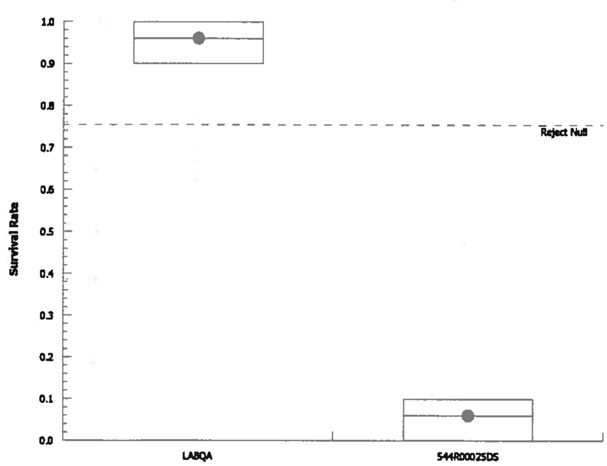
Survival Rate Summary

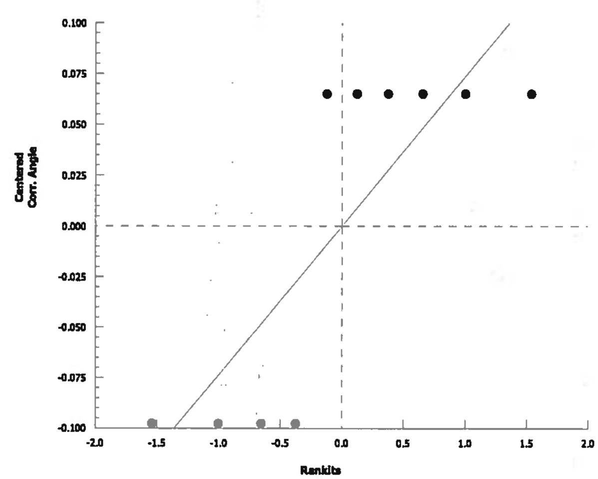
Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
LABQA	5	0.96	0.892	1	1	0.9	1	0.0245	5.71%	0.0%
544R00025DS	5	0.06	0	0.128	0.1	0	0.1	0.0245	91.3%	93.8%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
LABQA	5	1.35	1.24	1.46	1.41	1.25	1.41	0.0399	6.63%	0.0%
544R00025DS	5	0.257	0.146	0.367	0.322	0.159	0.322	0.0399	34.8%	81.0%

Graphics





Analyst: [signature] QA: [signature]

10 Day Acute *Hyalella azteca* Toxicity Test Data

Client: ADH / CCCWP
Test Material: 544R00025DS
Test ID#: 55553 Project #: 19397
Test Date: 2/28/14

Organism Log#: 7993 Age: 9-10 d
Organism Supplier: Chesapeake
Control/Diluent: SAM-5 Hyalella Water
Control Water Batch: 92

Treatment	Temp (°C)	pH new	pH old	D.O. (mg/L) new	D.O. (mg/L) old	Conductivity (µS/cm)	# Live Organisms A	B	C	D	E	SIGN-OFF
Lab Control	22.8	7.76		8.8		410	10	10	10	10	10	Date: 2/28/14; Sample ID: 34243
100%	22.8	7.72		10.1		1073	10	10	10	10	10	Test Solution Prep: [illegible]; New WQ: [illegible]
Meter ID	43A	PH19		RD07		EC09						Initiation Time: 1750; Initiation Signoff: [illegible]
Lab Control	23.2				9.1		10	10	10	10	10	Date: 3/1/14; Count Time: 930
100%	23.2				8.6		10	10	10	10	10	Count Signoff: [illegible]; Old WQ: CP
Meter ID	43A				RD07							
Lab Control	23.1				7.5		10	10	10	9	9	Date: 3/2/14; Count Time: 1010
100%	23.1				7.5		7	8	8	6	9	Count Signoff: [illegible]; Old WQ: [illegible]
Meter ID	43A				RD07							Feed: [illegible]
Lab Control	23.0				5.6		10	10	10	9	9	Date: 3/3/14; Count Time: 1045
100%	23.0				5.5		5	6	6	6	8	Count Signoff: [illegible]; Old WQ: [illegible]
Meter ID	43A				RD08							
Lab Control	22.9				5.7		10	10	10	9	9	Date: 3/4/14; Count Time: 0940
100%	22.9				4.9		2	2	0	0	5	Count Signoff: [illegible]; Old WQ: CP
Meter ID	43A				RD07							Feed: [illegible]
Lab Control	23.0	7.81	7.67	8.8	7.8	407	10	10	10	9	9	Date: 3/5/14; Sample ID: 34243
100%	23.0	7.70	7.76	9.6	7.5	1083	1	1	—	—	1	Test Solution Prep: [illegible]; New WQ: [illegible]
Meter ID	43A	PH14	PH19	RD07	RD09	EC04						Renewal Time: 1445; Renewal Signoff: [illegible]; Old WQ: [illegible]
Lab Control	23.0				4.9		10	10	10	9	9	Date: 3-6-14; Count Time: 0900
100%	23.0				4.0		1	1	—	—	1	Count Signoff: SM; Old WQ: SM
Meter ID	43A				RD07							Feed: SM
Lab Control	22.9				6.5		10	10	10	9	9	Date: 3/7/14; Count Time: 1440
100%	22.9				6.8		1	1	—	—	1	Count Signoff: [illegible]; Old WQ: GG
Meter ID	43A				RD07							
Lab Control	22.6				6.7		10	10	10	9	9	Date: 3-8-14; Count Time: 1315
100%	22.6				6.4		1	1	—	—	1	Count Signoff: [illegible]; Old WQ: GG
Meter ID	43A				RD07							Feed: [illegible]
Lab Control	22.8				6.3		10	10	10	9	9	Date: 3/9/14; Count Time: 1013
100%	22.8				5.7		1	1	—	—	1	Count Signoff: [illegible]; Old WQ: CP
Meter ID	43A				RD07							
Lab Control	22.9		8.01		7.6	454	10	10	10	9	9	Date: 3-10-14; Termination Time: 1015
100%	22.9		7.64		6.6	1114	1	1	—	—	1	Termination Signoff: SM; Old WQ: [illegible]
Meter ID	43A		PH21		RD04	EC04						

Appendix E

Test Data and Summary of Statistics for the Evaluation of the Chronic Toxicity of the CCCWP Stormwater to Fathead Minnows

CETIS Summary Report

Report Date: 12 Mar-14 10:55 (p 1 of 1)
Test Code: ADH_0227_PP_C1 | 15-6006-6778

Chronic Larval Fish Survival and Growth Test — Pacific EcoRisk

Batch ID:	17-6115-7814	**Test Type:**	Growth-Survival (7d)	**Analyst:**	Cassy Glover
Start Date:	27 Feb-14 17:00	**Protocol:**	EPA-821-R-02-013 (2002)	**Diluent:**	Not Applicable
Ending Date:	06 Mar-14 08:00	**Species:**	Pimephales promelas	**Brine:**	Not Applicable
Duration:	6d 15h	**Source:**	Aquatox, AR	**Age:**	1

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
LABQA	14-0598-7522	27 Feb-14 17:00	27 Feb-14 17:00	NA (25.1 °C)	ADH Environmental, Inc.	19397
207R00843	14-6517-7241	26 Feb-14 17:45	27 Feb-14 16:11	23h (0.6 °C)		
206R00551	08-4072-0786	26 Feb-14 15:20	27 Feb-14 16:11	26h (0.4 °C)		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
LABQA	Lab Water	ADH Environmental, Inc.	LABQA		
207R00843	Ambient Water	ADH Environmental, Inc.	207R00843		
206R00551	Ambient Water	ADH Environmental, Inc.	206R00551		

7d Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
LABQA	4	1	1	1	1	1	0	0	0.0%	0.0%
207R00843	4	0.575	0.452	0.698	0.2	0.9	0.165	0.33	57.5%	42.5%
206R00551	4	0.925	0.889	0.961	0.8	1	0.0479	0.0957	10.4%	7.5%

Mean Dry Biomass-mg Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
LABQA	4	0.715	0.679	0.75	0.613	0.831	0.0482	0.0964	13.5%	0.0%
207R00843	4	0.59	0.505	0.674	0.293	0.776	0.113	0.226	38.4%	17.5%
206R00551	4	0.733	0.698	0.768	0.656	0.865	0.0475	0.0951	13.0%	-2.59%

Mean Dry Weight-mg Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
LABQA	4	0.715	0.679	0.75	0.613	0.831	0.0482	0.0964	13.5%	0.0%
207R00843	4	1.15	1.04	1.26	0.84	1.46	0.148	0.295	25.6%	-61.3%
206R00551	4	0.797	0.754	0.841	0.672	0.924	0.0584	0.117	14.7%	-11.6%

7d Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4
LABQA	1	1	1	1
207R00843	0.4	0.8	0.9	0.2
206R00551	1	0.8	0.9	1

Mean Dry Biomass-mg Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4
LABQA	0.613	0.663	0.751	0.831
207R00843	0.534	0.776	0.756	0.293
206R00551	0.672	0.739	0.656	0.865

Mean Dry Weight-mg Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4
LABQA	0.613	0.663	0.751	0.831
207R00843	1.34	0.97	0.84	1.46
206R00551	0.672	0.924	0.729	0.865

7d Survival Rate Binomials

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4
LABQA	10/10	10/10	10/10	10/10
207R00843	4/10	8/10	9/10	2/10
206R00551	10/10	8/10	9/10	10/10

Chronic Larval Fish Survival and Growth Test		Pacific EcoRisk

Analysis ID:	08-0438-6910	**Endpoint:**	7d Survival Rate	**CETIS Version:**	CETISv1.8.5
Analyzed:	12 Mar-14 10:54	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	8.82%	

Equal Variance t Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
LABQA		206R00551	1.59	1.94	0.143	6	0.0813	CDF	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.02735902	0.02735902	1	2.53	0.1625	Non-Significant Effect
Error	0.06478542	0.01079757	6			
Total	0.09214444		7			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	10.9	13.7	0.0165	Equal Variances
Variances	Levene Equality of Variance	16.3	13.7	0.0068	Unequal Variances
Distribution	Shapiro-Wilk W Normality	0.86	0.645	0.1195	Normal Distribution

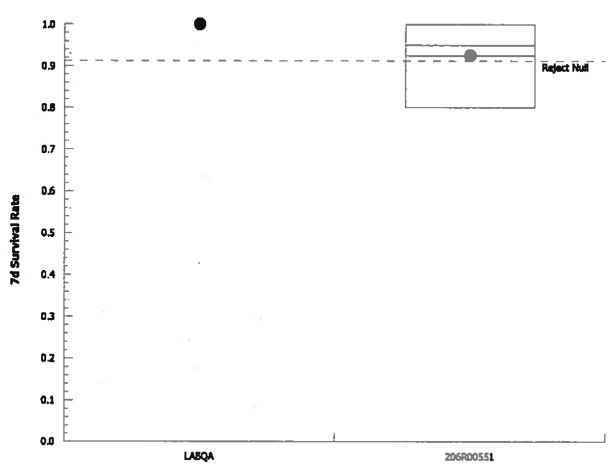
7d Survival Rate Summary

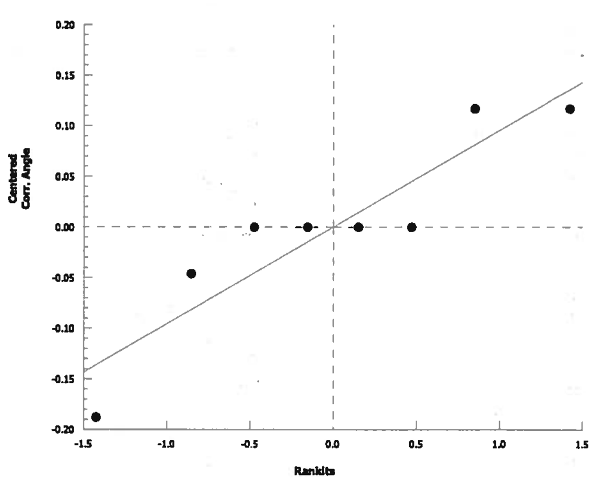
Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
LABQA	4	1	1	1	1	1	1	0	0.0%	0.0%
206R00551	4	0.925	0.773	1	0.95	0.8	1	0.0479	10.4%	7.5%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
LABQA	4	1.41	1.41	1.41	1.41	1.41	1.41	0	0.0%	0.0%
206R00551	4	1.3	1.06	1.53	1.33	1.11	1.41	0.0735	11.3%	8.28%

Graphics





Chronic Larval Fish Survival and Growth Test					**Pacific EcoRisk**
Analysis ID:	18-2591-0104	**Endpoint:**	Mean Dry Biomass-mg	**CETIS Version:**	CETISv1.8.5
Analyzed:	12 Mar-14 10:54	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Untransformed	NA	C > T	NA	NA	18.4%	

Equal Variance t Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
LABQA		206R00551	-0.273	1.94	0.132	6	0.6031	CDF	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.0006844824	0.0006844824	1	0.0747	0.7938	Non-Significant Effect
Error	0.05496849	0.009161416	6			
Total	0.05565298		7			

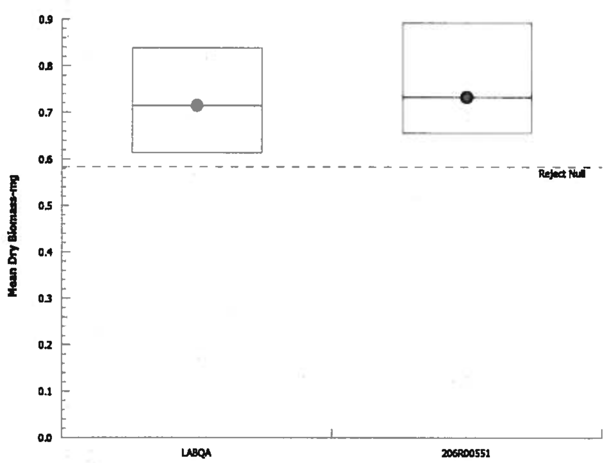
Distributional Tests

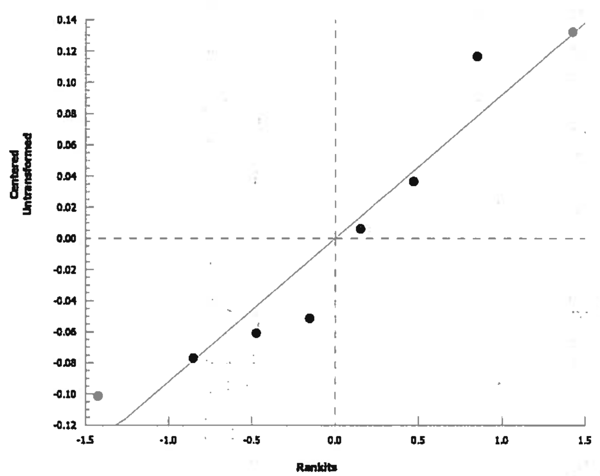
Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Variance Ratio F	1.03	47.5	0.9826	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.903	0.645	0.3081	Normal Distribution

Mean Dry Biomass-mg Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
LABQA	4	0.715	0.561	0.868	0.707	0.613	0.831	0.0482	13.5%	0.0%
206R00551	4	0.733	0.582	0.884	0.706	0.656	0.865	0.0475	13.0%	-2.59%

Graphics





7 Day Chronic Fathead Minnow Toxicity Test Data

Client: ADH / CCCWP
Test Material: 206R00551
Test ID#: 55489 Project #: 19397
Test Date: 2/27/14 Randomization: 4.6.2

Organism Log#: 7990 Age: <48 hrs
Organism Supplier: Aquatox
Control/Diluent: EPAMH
Control Water Batch: ~~2/27/14~~ 1666

Test Treatment	Temp (°C)	pH new	pH old	D.O. (mg/L) new	D.O. (mg/L) old	Conductivity (µS/cm)	# Live Organisms A	B	C	D	SIGN-OFF
Lab Control	25.1	8.01		8.3		297	10	10	10	10	Date: 2/27/14 Test Solution Prep: [illegible]
100%	25.1	7.80		11.4		908	10	10	10	10	Sample ID: 34205 Initiation Time: 1700
Meter ID	30A	pH19		RD04		EC04	New WQ: [illegible]				Initiation Signoff: CJD
Lab Control	25.2	7.98	7.85	8.2	7.6	297	10	10	10	10	Date: 2/28/14 Test Solution Prep: CD
100%	25.2	7.87	8.24	11.6	6.4	902	10	10	10	9	Sample ID: 34205 Renewal Time: 1456
Meter ID	30A	pH21	pH19	RD07	RD07	EC06	New WQ: LH		Old WQ: LH		Renewal Signoff: [illegible]
Lab Control	25.7	8.17	7.83	8.6	7.2	307	10	10	10	10	Date: 3/1/14 Test Solution Prep: SS
100%	25.7	7.91	8.26	11.0	7.0	911	10	9	10	10	Sample ID: 34205 Renewal Time: 1045
Meter ID	30A	pH16	PH19	RD09	RD08	EC06	New WQ: CD		Old WQ: CJD		Renewal Signoff: SM
Lab Control	26.0	8.08	7.64	8.8	7.1	296	10	10	10	10	Date: 3/2/14 Test Solution Prep: CJD
100%	26.0	7.98	~~7.9~~ 8.03	10.5	7.6	902	10	8	10	10	Sample ID: 34205 Renewal Time: 1125
Meter ID	30A	PH21	PH21	RD08	RD08	EC09	New WQ: AHP		Old WQ: AFF		Renewal Signoff: PL
Lab Control	25.7	8.22	7.70	8.7	5.9	295	10	10	10	10	Date: 3/3/14 Test Solution Prep: PL
100%	25.7	7.91	7.95	10.4	5.5	899	10	8	9	10	Sample ID: 34205 Renewal Time: 1500
Meter ID	30A	pH21	pH16	RD07	RD04	EC06	New WQ: TM		Old WQ: AFF		Renewal Signoff: [illegible]
Lab Control	25.4	8.43	7.73	8.3	7.3	305	10	10	10	10	Date: 3-4-14 Test Solution Prep: SM
100%	25.4	8.05	8.21	10.1	6.9	889	10	8	9	10	Sample ID: 34205 Renewal Time: 1120
Meter ID	30A	pH19	pH19	RD07	RD09	EC04	New WQ: [illegible]		Old WQ: [illegible]		Renewal Signoff: SV
Lab Control	25.3	8.03	7.71	8.6	8.1	307	10	10	10	10	Date: 3/5/14 Test Solution Prep: JW
100%	25.3	7.94	8.19	10.5	8.3	895	10	8	9	10	Sample ID: 34205 Renewal Time: 1115
Meter ID	30A	pH16	pH19	RD07	RD09	EC06	New WQ: AFF		Old WQ: MA		Renewal Signoff: CP
Lab Control	25.5		7.92		7.1	309	10	10	10	10	Date: 3.6.14 Termination Time: 0800
100%	25.5		8.09		6.7	918	10	8	9	10	Termination Signoff: [illegible]
Meter ID	30A		pH21		RD04	EC06			Old WQ: [illegible]		

Fathead Minnow Dry Weight Data Sheet

Client: ADH / CCCWP Test ID #: 55489 Project # 19397

Sample ID: 206R00551 Tare Weight Date: 2/28/14 Sign-off: JLA

Test Date: 2.27.14 Final Weight Date: 3/7/14 Sign-off: MA

Pan ID	Concentration	Replicate	Initial Pan Weight (mg)	Final Pan Weight (mg)	Initial # of Organisms	Biomass Value (mg)
1	Lab Control	A	157.42	163.55	10	0.613
2		B	180.78	187.41	10	0.663
3		C	152.31	159.82	10	0.751
4		D	161.99	170.30	10	0.831
5	100%	A	175.53	182.25	10	0.672
6		B	175.41	182.80	10	0.739
7		C	159.01	165.57	10	0.656
8		D	157.47	166.12	10	0.865
QA1			166.39	166.36		

CETIS Analytical Report

Report Date: 12 Mar-14 10:55
Test Code: ADH_0227_PP_C1 | 15-6006-6778

Chronic Larval Fish Survival and Growth Test — **Pacific EcoRisk**

Analysis ID:	14-0465-2445	**Endpoint:**	7d Survival Rate	**CETIS Version:**	CETISv1.8.5
Analyzed:	12 Mar-14 10:54	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	30.8%	

Unequal Variance t Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
LABQA		207R00843	2.94	2.35	0.429	3	0.0303	CDF	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.5743257	0.5743257	1	8.63	0.0260	Significant Effect
Error	0.3992156	0.06653594	6			
Total	0.9735414		7			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	30.3	13.7	0.0015	Unequal Variances
Variances	Levene Equality of Variance	31.7	13.7	0.0013	Unequal Variances
Distribution	Shapiro-Wilk W Normality	0.929	0.645	0.5026	Normal Distribution

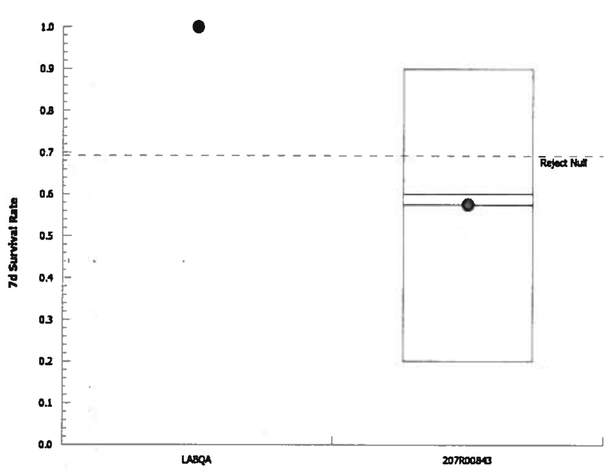
7d Survival Rate Summary

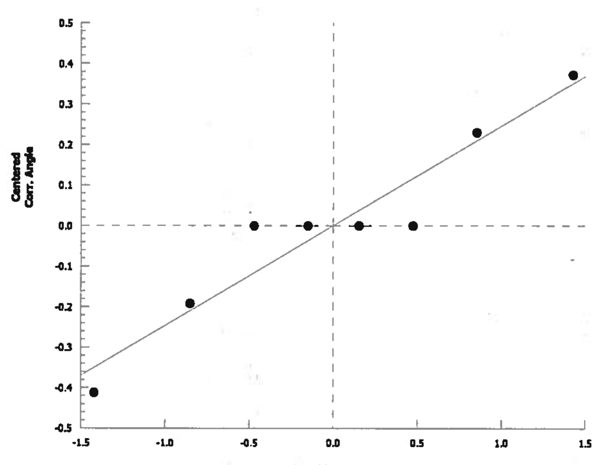
Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
LABQA	4	1	1	1	1	1	1	0	0.0%	0.0%
207R00843	4	0.575	0.0493	1	0.6	0.2	0.9	0.165	57.5%	42.5%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
LABQA	4	1.41	1.41	1.41	1.41	1.41	1.41	0	0.0%	0.0%
207R00843	4	0.876	0.296	1.46	0.896	0.464	1.25	0.182	41.6%	38.0%

Graphics





Analyst: [signature] QA: [signature]

Chronic Larval Fish Survival and Growth Test — Pacific EcoRisk

Analysis ID:	16-2171-3786	**Endpoint:**	Mean Dry Biomass-mg	**CETIS Version:**	CETISv1.8.5
Analyzed:	12 Mar-14 10:54	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Untransformed	NA	C > T	NA	NA	33.4%	

Equal Variance t Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
LABQA		207R00843	1.01	1.94	0.239	6	0.1747	CDF	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.03112519	0.03112519	1	1.03	0.3494	Non-Significant Effect
Error	0.1813561	0.03022602	6			
Total	0.2124813		7			

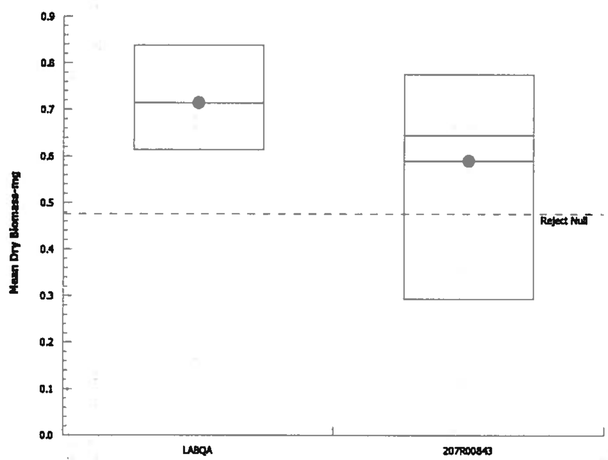
Distributional Tests

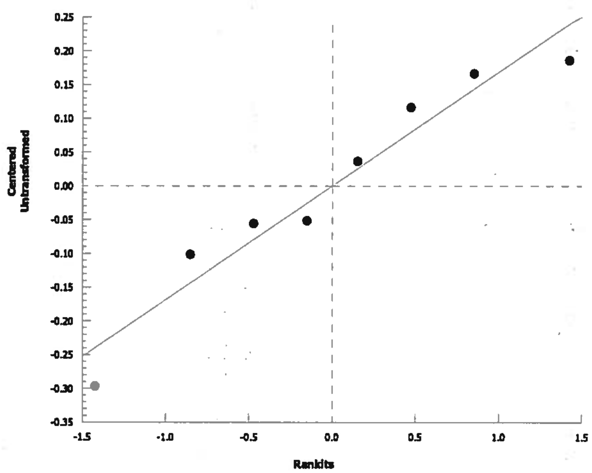
Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Variance Ratio F	5.51	47.5	0.1947	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.936	0.645	0.5749	Normal Distribution

Mean Dry Biomass-mg Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
LABQA	4	0.715	0.561	0.868	0.707	0.613	0.831	0.0482	13.5%	0.0%
207R00843	4	0.59	0.23	0.95	0.645	0.293	0.776	0.113	38.4%	17.5%

Graphics





7 Day Chronic Fathead Minnow Toxicity Test Data

Client: ADH / CCCWP
Test Material: 207R00843
Test ID#: 55493 Project #: 19397
Test Date: 2/27/14 Randomization: 4.6.2

Organism Log#: 7990 Age: <48hrs
Organism Supplier: Aquatox
Control/Diluent: EPAMH
Control Water Batch: 1666

Test Treatment	Temp (°C)	pH new	pH old	D.O. (mg/L) new	D.O. (mg/L) old	Conductivity (µS/cm)	# Live Organisms A	B	C	D	SIGN-OFF
Lab Control	25.1	8.01		8.3		297	10	10	10	10	Date: 2/27/14; Test Solution Prep: [illegible]
100%	25.1	7.92		11.4		280	10	10	10	10	Sample ID: ~~1700~~ 34206; Initiation Time: 1700
Meter ID	30A	pH19		RD04		EC04	New WQ: [illegible]				Initiation Signoff: CJD
Lab Control	25.2	7.98	7.85	8.2	7.6	297	10	10	10	10	Date: 2/28/14; Test Solution Prep: CD
100%	25.2	7.76	7.89	10.2	7.0	279	10	10	10	10	Sample ID: 34206; Renewal Time: 1450
Meter ID	30A	pH21	pH19	RD07	RD07	EC06	New WQ: LH		Old WQ: LH		Renewal Signoff: [illegible]
Lab Control	25.7	8.11	7.83	8.6	7.2	307	10	10	10	10	Date: 3/1/14; Test Solution Prep: SS
100%	25.7	7.75	7.88	~~9.~~ 11.2 CD	7.1	269	10	10	10	8	Sample ID: ~~324~~ SS 34206; Renewal Time: 1045
Meter ID	30A	pH16	PH19	RD09	RD08	EC06	New WQ: CD		Old WQ: CJD		Renewal Signoff: SM
Lab Control	26.0	8.08	7.64	8.8	7.1	296	10	10	10	10	Date: 3/2/14; Test Solution Prep: CJD
100%	26.0	7.80	7.60	10.6	7.0	281	5	8	9	4	Sample ID: 34206; Renewal Time: 1125
Meter ID	~~30A~~	pH21	pH21	RD08	RD08	EC09	New WQ: ARF		Old WQ: ARF		Renewal Signoff: [illegible]
Lab Control	25.7	8.22	7.70	8.7	5.9	295	10	10	10	10	Date: 3/3/14; Test Solution Prep: [illegible]
100%	25.7	7.79	7.60	10.1	6.0	276	4	8	9	2	Sample ID: 34206; Renewal Time: 1500
Meter ID	30A	PH21	pH16	RD07	RD04	EC06	New WQ: TM		Old WQ: ARF		Renewal Signoff: [illegible]
Lab Control	25.4	8.43	7.73	8.3	7.3	305	10	10	10	10	Date: 3-4-14; Test Solution Prep: SM
100%	25.4	7.88	7.73	9.7	7.0	281	4	8	9	2	Sample ID: 34206; Renewal Time: 1120
Meter ID	30A	PH19	PH19	RD09	RD09	EC04	New WQ: [illegible]		Old WQ: [illegible]		Renewal Signoff: SVV
Lab Control	25.3	8.03	~~8.6~~ 7.71	8.6	8.1	301	10	10	10	10	Date: 3/5/14; Test Solution Prep: [illegible]
100%	25.3	7.86	7.82	~~9.~~ 10.0	8.3	276	4	8	9	2	Sample ID: 34206; Renewal Time: 1115
Meter ID	30A	PH16	PH19	RD07	RD09	EC06	New WQ: ARF		Old WQ: MA		Renewal Signoff: CP
Lab Control	25.5		7.92		7.1	309	10	10	10	10	Date: 3.6.14; Termination Time: 0800
100%	25.5		7.78		7.2	287	4	8	9	2	Termination Signoff: [illegible]
Meter ID	30A		pH21		RD04	EC06			Old WQ: [illegible]		

Fathead Minnow Dry Weight Data Sheet

Client:	ADH / CCCWP	Test ID #:	55493	Project #	19397
Sample ID:	207R00843	Tare Weight Date:	2 / 28 / 14	Sign-off:	JLA
Test Date:	2. 27. 14	Final Weight Date:	3 / 7 / 14	Sign-off:	MA

Pan ID	Concentration	Replicate	Initial Pan Weight (mg)	Final Pan Weight (mg)	Initial # of Organisms	Biomass Value (mg)
1	Lab Control	A	172.50	163.55	10	0.613
2		B	142.59	187.41	10	0.663
3		C	146.67	159.82	10	0.751
4		D	148.36	170.30	10	0.831
9	100%	A	169.48	174.82	10	0.534
10		B	162.66	170.42	10	0.776
11		C	160.40	167.96	10	0.756
12		D	168.80	171.73	10	0.293
QA1			172.30	172.38		

Appendix F

Test Data and Summary of Statistics for the Reference Toxicant Evaluation of the *Selenastrum capricornutum*

CETIS Summary Report

Algal Growth Test — **Pacific EcoRisk**

Batch ID:	02-1961-7457	**Test Type:**	Cell Growth	**Analyst:**	Cassy Glover
Start Date:	27 Feb-14 15:45	**Protocol:**	EPA-821-R-02-013 (2002)	**Diluent:**	Laboratory Water
Ending Date:	03 Mar-14 15:15	**Species:**	Selenastrum capricornutum	**Brine:**	Not Applicable
Duration:	95h	**Source:**	In-House Culture	**Age:**	6

Sample ID:	01-6567-6579	**Code:**	NaCl	**Client:**	Pacific Ecorisk
Sample Date:	27 Feb-14 15:45	**Material:**	Sodium chloride	**Project:**	22124
Receive Date:	27 Feb-14 15:54	**Source:**	Reference Toxicant		
Sample Age:	NA (25.1 °C)	**Station:**	In House		

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
13-1183-7724	96h Cell Density-without E	<0.125	0.125	NA	5.98%		Dunnett Multiple Comparison Test

Point Estimate Summary

Analysis ID	Endpoint	Level	g/L	95% LCL	95% UCL	TU	Method
04-7067-6656	96h Cell Density-without E	IC5	0.0882	0.043	0.524		Linear Interpolation (ICPIN)
		IC10	0.4	N/A	0.72		
		IC15	0.686	0.344	0.999		
		IC20	0.989	0.717	1.27		
		IC25	1.29	0.998	1.57		
		IC40	2.14	1.82	2.38		
		IC50	2.55	2.31	2.76		

96h Cell Density-without EDTA Summary

C-g/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Lab Water Contr	4	3.12E+6	3.07E+6	3.17E+6	2.93E+6	3.20E+6	6.49E+4	1.30E+5	4.15%	0.0%
0.125		4	2.87E+6	2.82E+6	2.92E+6	2.70E+6	3.01E+6	7.08E+4	1.42E+5	4.94%	8.09%
0.25		4	2.93E+6	2.90E+6	2.97E+6	2.80E+6	3.01E+6	4.85E+4	9.71E+4	3.31%	6.08%
0.5		4	2.75E+6	2.71E+6	2.79E+6	2.62E+6	2.87E+6	5.12E+4	1.02E+5	3.72%	11.9%
1		4	2.49E+6	2.46E+6	2.52E+6	2.41E+6	2.59E+6	3.71E+4	7.41E+4	2.97%	20.2%
2		4	1.98E+6	1.93E+6	2.02E+6	1.80E+6	2.10E+6	6.61E+4	1.32E+5	6.7%	36.7%
4		4	4.84E+5	4.68E+5	4.99E+5	4.36E+5	5.23E+5	2.05E+4	4.10E+4	8.48%	84.5%

96h Cell Density-without EDTA Detail

C-g/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Water Contr	3.20E+6	3.16E+6	2.93E+6	3.20E+6
0.125		2.70E+6	3.01E+6	2.96E+6	2.81E+6
0.25		2.80E+6	3.00E+6	3.01E+6	2.92E+6
0.5		2.76E+6	2.62E+6	2.87E+6	2.75E+6
1		2.49E+6	2.41E+6	2.59E+6	2.48E+6
2		2.05E+6	2.10E+6	1.80E+6	1.95E+6
4		5.12E+5	4.36E+5	5.23E+5	4.63E+5

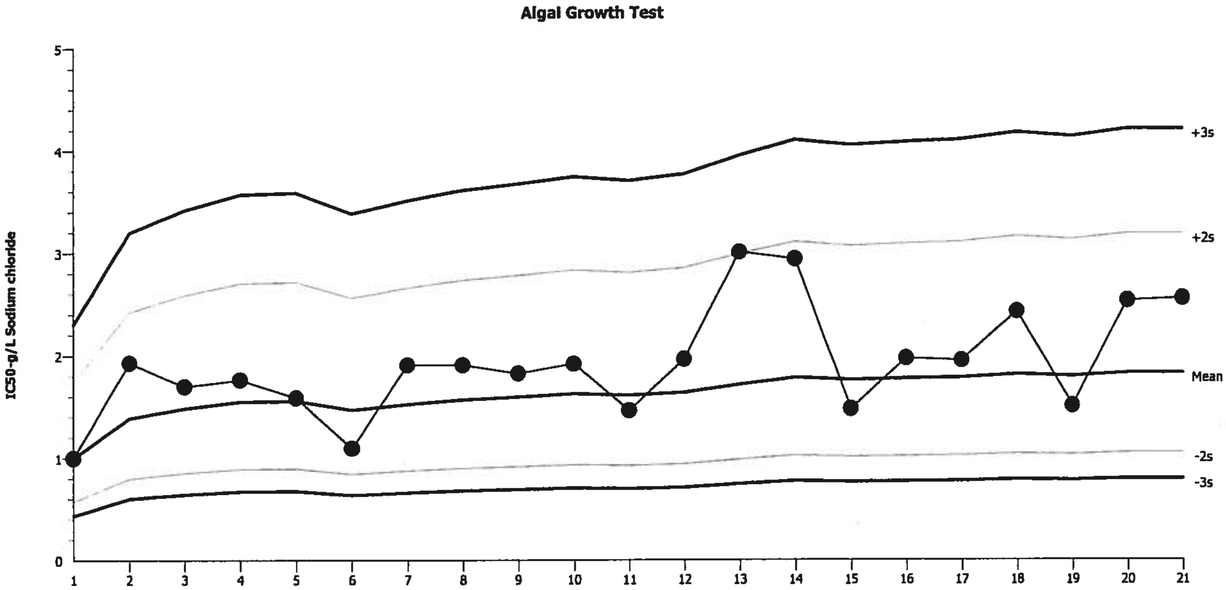
Analyst: [signature] QA: [signature]

CETIS QC Plot

Report Date: 11 Mar-14 14:17 (1 of 1)

Algal Growth Test **Pacific EcoRisk**

Test Type:	Cell Growth	**Organism:**	Selenastrum capricornutum (Green	**Material:**	Sodium chloride
Protocol:	EPA-821-R-02-013 (2002)	**Endpoint:**	96h Cell Density-without EDTA	**Source:**	Reference Toxicant-REF



Mean:	1.826	**Count:**	20	**-2s Warning Limit:**	1.047	**-3s Action Limit:**	0.7929
Sigma:	NA	**CV:**	32.10%	**+2s Warning Limit:**	3.185	**+3s Action Limit:**	4.206

Quality Control Data

Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID
1	2012	Nov	14	11:35	1	-0.8263	-2.166	(-)		19-3651-9449	02-4093-7643
2			30	11:45	1.928	0.102	0.1953			06-8774-9598	00-2376-6641
3		Dec	12	14:00	1.698	-0.128	-0.2613			21-1404-8287	09-6532-2652
4	2013	Jan	9	14:50	1.764	-0.06267	-0.1256			20-3540-5103	02-4694-0562
5		Feb	20	14:25	1.589	-0.2377	-0.5014			19-4816-2041	19-1093-3601
6		Mar	6	17:00	1.096	-0.7307	-1.837			18-8696-2927	19-9405-0991
7		Apr	18	14:30	1.908	0.08193	0.1578			04-8640-5545	13-1906-6299
8		May	15	14:25	1.908	0.08199	0.1579			12-4530-9929	20-4208-0803
9		Jun	12	16:30	1.825	-0.00114	-0.00224			03-8736-5752	05-2456-6169
10		Jul	10	16:30	1.919	0.09293	0.1785			00-7938-6478	19-4822-0015
11		Aug	14	12:07	1.46	-0.3658	-0.8038			03-5576-3584	12-8935-7956
12		Sep	11	11:26	1.962	0.1352	0.2568			11-1345-1076	05-7278-8891
13		Oct	9	14:32	3.006	1.18	1.792			13-2313-5960	13-5763-7826
14			9	14:32	2.939	1.113	1.711			11-7111-2371	05-1907-8644
15			24	16:25	1.477	-0.3496	-0.764			08-9082-3583	05-0631-1673
16		Nov	13	16:31	1.97	0.1437	0.2723			10-6527-3067	07-8249-1370
17		Dec	11	15:05	1.95	0.1238	0.2359			19-9359-6560	16-1399-8784
18	2014	Jan	15	15:03	2.426	0.5999	1.021			06-3179-4459	01-5918-9112
19		Feb	3	15:15	1.505	-0.3217	-0.6967			05-4911-8245	14-2525-8722
20			7	16:40	2.533	0.7066	1.176			12-2944-4902	10-9013-2498
21			27	15:45	2.555	0.7285	1.207			05-3854-9335	04-7067-6656

Analyst: [signature] QA: [signature]

Selenastrum capricornutum Cell Density Enumeration Data

Client: **Reference Toxicant**
Test Material: NaCl
Test Start Date: 2/27/14 Start Time: 1545
Test End Date: 2.28.14 End Time: 1515
Initial Count: 10,000 cells/mL
Enumerating Scientist: PG
Project #: 22131
Test ID #: 55636

Treatment	Cell Density (cells/mL x 10^6)				
	Rep A	Rep B	Rep C	Rep D	Mean
Lab Water Control	3.20	3.16	2.93	3.20	3.12
0.125	2.70	3.01	2.96	2.81	2.87
0.25	2.80	3.00	3.01	2.92	2.93
0.5	2.76	2.62	2.87	2.75	2.75
1	2.49	2.41	2.59	2.48	2.49
2	2.05	2.10	1.80	1.95	1.98
4	0.512	0.436	0.523	0.463	0.484

This datasheet has been reviewed for completeness and consistency with Test Acceptability Criteria and/or other issues of concern.	**Control Mean Density (cells/mL x 10^6)**	**% CV**	**Date:**	**Time:**	**Signoff:**
	3.12	4.15	~~2~~ ~~2.4~~ 3.3.14	1537	PG

Selenastrum capricornutum Algal Toxicity Test Water Quality Data

Client: Reference Toxicant Test ID #: 55554 Test Date: 2/27/14

Test Material: NaCl Project #: 22124 Control/Diluent: Lab Water Without EDTA

Reference Toxicant Test Treatment (g/L NaCl)	Temp (°C)	pH	D.O. (mg/L)	Conductivity (µS/cm)	Sign-Off
Lab Water Control	~~7.59~~ 25.1 KP	7.59	8.1	94.6	Date 2/27/14
0.125	25.1	7.59	8.9	KP ~~386~~ 368	Test Solution Prep KP
0.25	25.1	7.57	8.8	611	New WQ TM
0.5	25.1	7.51	8.7	1075	Innoculation Time 1545
1	25.1	7.49	8.6	2240 KP	Innoculation Signoff KP
2	25.1	7.44	8.7	3960 KP	Shelf ID TR6/R2/S1
4	25.1	7.39	8.7	KP ~~7959~~ 7510	
Meter ID:	65A	pH19	RDO4	EC04	
Lab Water Control	25.4	7.72			Date 2-28-14
0.125	25.4	7.56			WQ Time 0930
0.25	25.4	7.53			WQ Signoff APF
0.5	25.4	7.48			
1	25.4	7.41			
2	25.4	7.37			
4	25.4	7.28			
Meter ID:	65A	pH19			
Lab Water Control	25.3	8.39			Date 3-1-14
0.125	25.3	8.29			WQ Time 0900
0.25	25.3	8.25			WQ Signoff LH
0.5	25.3	8.21			
1	25.3	8.12			
2	25.3	8.03			
4	25.3	7.74			
Meter ID:	65A	pH16			
Lab Water Control	24.8	9.55			Date 3/2/14
0.125	24.8	9.42			WQ Time 0900
0.25	24.8	9.29			WQ Signoff LH
0.5	24.8	9.30			
1	24.8	9.01			
2	24.8	8.68			
4	24.8	7.69			
Meter ID:	65A	pH19			
Lab Water Control	25.0	9.69	12.5	~~8~~ 95.0	Date 3-3-14
0.125	25.0	9.46	12.0	367	Termination Time 1515
0.25	25.0	9.50	12.2	621	Termination Signoff PG
0.5	25.0	9.40	12.1	1088	WQ Time 0955
1	25.0	9.35	11.5	2285	WQ Signoff APF
2	25.0	9.07	11.0	3940	
4	25.0	8.44	APF ~~10~~ 9.7	7510	
Meter ID:	65A	pH16	RDO4	EC09	

Initial Test Conditions			
Target: 8.000 g NaCl in 2 L	Alkalinity	Hardness	Light Intensity (ftc)
Actual:	12	14	412.5

Appendix G

Test Data and Summary of Statistics for the Reference Toxicant Evaluation of the *Ceriodaphnia dubia*

CETIS Summary Report

Report Date: 06 Mar-14 15:56 (p 1 of 2)
Test Code: 55555 | 06-7069-6201

Ceriodaphnia Survival and Reproduction Test — **Pacific EcoRisk**

Batch ID:	17-2490-4388	**Test Type:**	Reproduction-Survival (7d)	**Analyst:**	Cassy Glover
Start Date:	27 Feb-14 14:20	**Protocol:**	EPA-821-R-02-013 (2002)	**Diluent:**	Laboratory Water
Ending Date:	05 Mar-14 14:40	**Species:**	Ceriodaphnia dubia	**Brine:**	Not Applicable
Duration:	6d 0h	**Source:**	In-House Culture	**Age:**	1

Sample ID:	16-7726-1869	**Code:**	NaCl	**Client:**	Pacific Ecorisk
Sample Date:	27 Feb-14 14:20	**Material:**	Sodium chloride	**Project:**	22125
Receive Date:	27 Feb-14 14:20	**Source:**	Reference Toxicant		
Sample Age:	NA (25.8 °C)	**Station:**	In House		

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
19-4434-6354	Reproduction	1000	1500	1225	40.2%		Steel Many-One Rank Sum Test
17-2587-0001	Survival	2000	2500	2236	NA		Fisher Exact/Bonferroni-Holm Test

Point Estimate Summary

Analysis ID	Endpoint	Level	mg/L	95% LCL	95% UCL	TU	Method
12-4436-7470	Reproduction	IC5	382	76.7	1060		Linear Interpolation (ICPIN)
		IC10	1030	153	1110		
		IC15	1070	230	1170		
		IC20	1120	307	1220		
		IC25	1160	383	1280		
		IC40	1290	1110	1460		
		IC50	1380	1210	1560		
01-7956-2087	Survival	EC5	1680	101	1960		Linear Regression (MLE)
		EC10	1770	178	2020		
		EC15	1830	260	2070		
		EC20	1880	352	2110		
		EC25	1930	455	2150		
		EC40	2050	860	2280		
		EC50	2120	1230	2420		

Reproduction Summary

C-mg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Lab Water Contr	10	22.9	17.8	28	0	35	4.33	13.7	59.7%	0.0%
500		10	18.2	13.2	23.2	0	32	4.22	13.3	73.3%	20.5%
1000		10	24.6	22.9	26.3	19	34	1.4	4.43	18.0%	-7.42%
1500		10	8.2	5.72	10.7	0	18	2.1	6.65	81.1%	64.2%
2000		10	0.2	0.0426	0.357	0	1	0.133	0.422	211.0%	99.1%
2500		10	0	0	0	0	0	0	0		100.0%

Survival Summary

C-mg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Lab Water Contr	10	0.9	0.782	1	0	1	0.1	0.316	35.1%	0.0%
500		10	0.8	0.643	0.957	0	1	0.133	0.422	52.7%	11.1%
1000		10	1	1	1	1	1	0	0	0.0%	-11.1%
1500		10	0.8	0.643	0.957	0	1	0.133	0.422	52.7%	11.1%
2000		10	0.6	0.407	0.793	0	1	0.163	0.516	86.1%	33.3%
2500		10	0.1	0	0.218	0	1	0.1	0.316	316.0%	88.9%

Ceriodaphnia Survival and Reproduction Test | **Pacific EcoRisk**

Reproduction Detail

C-mg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Lab Water Contr	32	27	29	0	32	10	35	1	32	31
500		15	29	26	0	0	29	0	24	27	32
1000		20	25	19	26	25	20	25	24	28	34
1500		12	0	15	14	18	0	6	8	9	0
2000		0	0	0	0	0	0	0	0	1	1
2500		0	0	0	0	0	0	0	0	0	0

Survival Detail

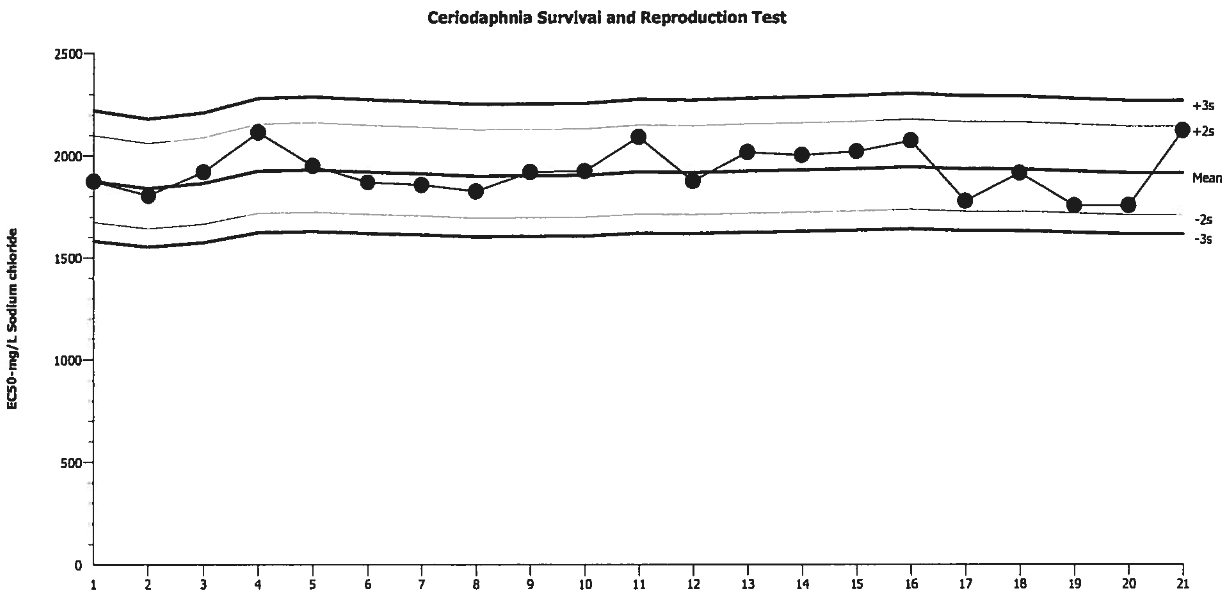
C-mg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Lab Water Contr	1	1	1	1	1	1	1	0	1	1
500		0	1	1	1	0	1	1	1	1	1
1000		1	1	1	1	1	1	1	1	1	1
1500		1	1	1	1	1	0	0	1	1	1
2000		0	1	0	1	0	0	1	1	1	1
2500		1	0	0	0	0	0	0	0	0	0

Survival Binomials

C-mg/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Lab Water Contr	1/1	1/1	1/1	1/1	1/1	1/1	1/1	0/1	1/1	1/1
500		0/1	1/1	1/1	1/1	0/1	1/1	1/1	1/1	1/1	1/1
1000		1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
1500		1/1	1/1	1/1	1/1	1/1	0/1	0/1	1/1	1/1	1/1
2000		0/1	1/1	0/1	1/1	0/1	0/1	1/1	1/1	1/1	1/1
2500		1/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1

Ceriodaphnia Survival and Reproduction Test — **Pacific EcoRisk**

Test Type:	Reproduction-Survival (7d)	**Organism:**	Ceriodaphnia dubia (Water Flea)	**Material:**	Sodium chloride
Protocol:	EPA-821-R-02-013 (2002)	**Endpoint:**	Survival	**Source:**	Reference Toxicant-REF



Mean:	1912	**Count:**	20	**-2s Warning Limit:**	1708	**-3s Action Limit:**	1614
Sigma:	NA	**CV:**	5.82%	**+2s Warning Limit:**	2142	**+3s Action Limit:**	2266

Quality Control Data

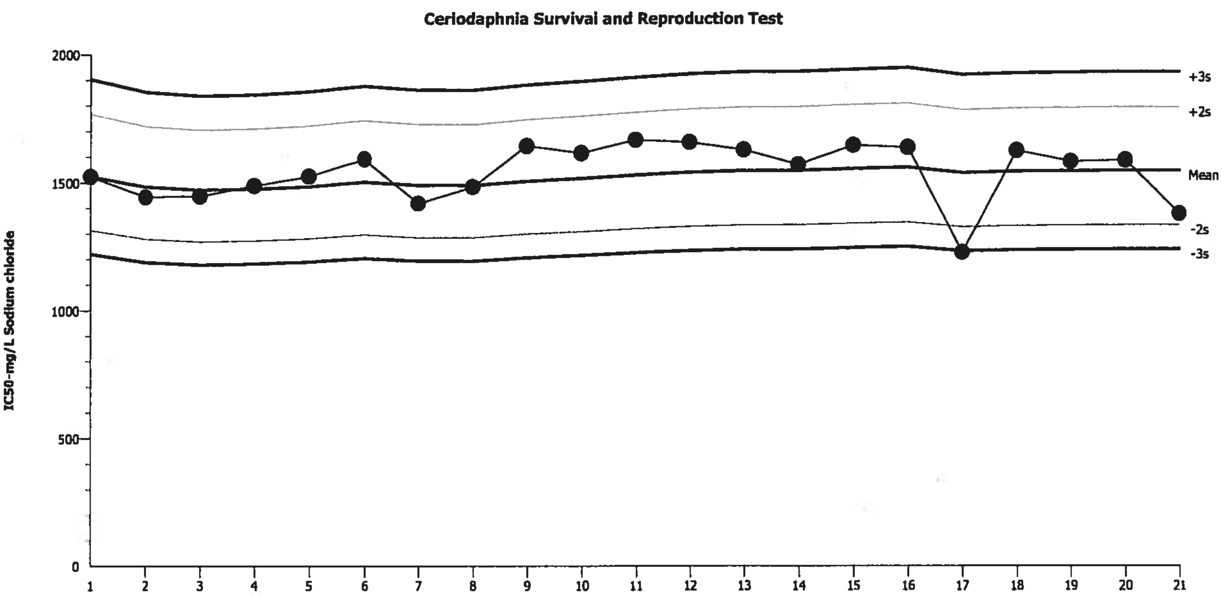
Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID
1	2013	Dec	3	11:15	1874	-38.52	-0.3598			12-5884-0560	21-4298-8538
2			4	16:05	1804	-107.9	-1.026			09-5622-2304	14-7350-4776
3			10	15:30	1918	6.18	0.05705			15-2935-9896	14-4880-2619
4			12	15:20	2113	200.5	1.763			14-8624-9987	17-8299-3643
5			17	15:19	1948	36.04	0.3302			02-9668-0960	17-7617-0085
6			27	11:30	1869	-43.46	-0.4065			12-5245-4230	15-7366-0270
7			28	11:00	1855	-57.24	-0.5373			12-0330-1397	15-7695-0801
8			31	15:00	1825	-87.22	-0.8254			09-7312-0881	18-4154-6303
9	2014	Jan	4	13:45	1918	6.18	0.05705			09-6104-7564	05-9919-1152
10			7	15:00	1923	11.21	0.1034			16-7246-6353	12-7662-2537
11			8	14:00	2091	178.5	1.578			01-9031-3368	18-5138-9208
12			14	14:15	1874	-38.52	-0.3598			09-8747-3748	16-6708-5060
13			15	14:45	2015	102.8	0.9259			08-6494-0499	17-9141-6278
14			18	13:30	2001	88.54	0.8003			17-1468-6197	11-6280-7655
15			21	14:30	2019	106.7	0.9602			00-6454-2258	07-5797-6910
16			23	12:00	2071	159	1.412			17-1293-4057	08-5501-2982
17		Feb	4	14:25	1776	-136.7	-1.311			07-2877-2070	10-6962-3923
18			5	14:40	1913	0.5345	0.004945			18-1807-5589	02-4863-0686
19			7	14:45	1753	-159.3	-1.538			20-3710-9112	04-8582-3441
20			11	15:55	1754	-158.2	-1.527			16-5289-2619	00-2481-8592
21			27	14:20	2121	208.4	1.829			06-7069-6201	01-7956-2087

CETIS QC Plot

Report Date: 06 Mar-14 15:57 (1 of 1)

Ceriodaphnia Survival and Reproduction Test — **Pacific EcoRisk**

Test Type:	Reproduction-Survival (7d)	**Organism:**	Ceriodaphnia dubia (Water Flea)	**Material:**	Sodium chloride
Protocol:	EPA-821-R-02-013 (2002)	**Endpoint:**	Reproduction	**Source:**	Reference Toxicant-REF



Mean:	1545	**Count:**	20	**-2s Warning Limit:**	1333	**-3s Action Limit:**	1238
Sigma:	NA	**CV:**	7.69%	**+2s Warning Limit:**	1792	**+3s Action Limit:**	1930

Quality Control Data

Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID
1	2013	Dec	3	11:15	1525	-20.83	-0.1833			12-5884-0560	15-0597-1397
2			4	16:05	1444	-101.5	-0.9173			09-5622-2304	14-3869-0648
3			10	15:30	1447	-97.86	-0.8835			15-2935-9896	14-2020-4870
4			12	15:20	1487	-58.2	-0.5184			14-8624-9987	00-7585-2713
5			17	15:19	1525	-20.69	-0.1821			02-9668-0960	09-7177-9871
6			27	11:30	1591	45.78	0.3943			12-5245-4230	01-2027-4739
7			28	11:00	1418	-127	-1.158			12-0330-1397	17-0523-0865
8			31	15:00	1482	-62.92	-0.5613			09-7312-0881	13-4764-4425
9	2014	Jan	4	13:45	1643	97.33	0.8248			09-6104-7564	12-3234-0188
10			7	15:00	1614	68.68	0.5872			16-7246-6353	12-1079-9052
11			8	14:00	1665	120.1	1.011			01-9031-3368	13-9221-2159
12			14	14:15	1656	111.1	0.9372			09-8747-3748	14-9137-2943
13			15	14:45	1626	81.06	0.6904			08-6494-0499	11-1750-3693
14			18	13:30	1570	24.33	0.211			17-1468-6197	01-8126-0604
15			21	14:30	1644	99.02	0.8388			00-6454-2258	19-6243-3715
16			23	12:00	1636	90.65	0.7698			17-1293-4057	17-6505-0888
17		Feb	4	14:25	1225	-320.3	-3.137	(-)	(-)	07-2877-2070	21-4219-1483
18			5	14:40	1623	77.36	0.6597			18-1807-5589	21-1964-3214
19			7	14:45	1580	34.98	0.3023			20-3710-9112	02-2044-4977
20			11	15:55	1586	40.52	0.3495			16-5289-2619	03-9065-0204
21			27	14:20	1377	-168.4	-1.559			06-7069-6201	12-4436-7470

Analyst: [signature] QA: SVV

Short-Term Chronic 3-Brood *Ceriodaphnia dubia* Survival & Reproduction Test Data

Client: **Reference Toxicant** Material: **Sodium Chloride** Test Date: 2-27-14

Project #: 22125 Test ID: 55555 Randomization: 10.6.2 Control Water: Modified EPAMH

Lab Water Control

Day	pH New	pH Old	D.O. New	D.O. Old	Conductivity (µS/cm) New	Conductivity (µS/cm) Old	Temp (°C)	A	B	C	D	E	F	G	H	I	J	SIGN-OFF
0	8.01		7.9		343		25.8	0	0	0	0	0	0	0	0	0	0	Date: 2/27/14 New WQ: MA Test Init: [illegible] Sol'n Prep: CP Time: 1420
1	7.93	8.20	8.0	7.8	350	366	25.1	0	0	0	0	0	0	0	0	0	0	Date: 2/28/14 New WQ: LH Counts: AB Sol'n Prep: CD Old WQ: AS Time: 1510
2	7.99	8.06	8.1	7.4	351	358	25.7	0	0	0	0	0	0	0	0	0	0	Date: 3-1-14 New WQ: CP Counts: SM Sol'n Prep: [illegible] Old WQ: AWS Time: 1145
3	7.94	7.97	8.3	7.2	350	360	25.8	0	3	0	0	0	4	3	0	0	0	Date: 3/2/14 New WQ: DMS Counts: DS Sol'n Prep: KP Old WQ: LH Time: 1550
4	7.93	7.92	8.5	8.7	349	380	25.6	5	1	4	0	6	0	1	X/1	5	3	Date: 3/3/14 New WQ: CP Counts: CP Sol'n Prep: CP Old WQ: [illegible] Time: 1500
5	7.83	7.92	8.2	8.8	341	393	25.7	10	7	10	0	9	6	10	–	12	13	Date: 3/4/14 New WQ: CP Counts: [illegible] Sol'n Prep: CP Old WQ: CJD Time: 1550
6	8.26	8.16	8.4	8.0	350	383	25.6	17	16	15	0	17	0	21	–	15	15	Date: 3/5/14 New WQ: AK Counts: KS Sol'n Prep: CP Old WQ: SVV Time: 1410
7															–			Date: New WQ: Counts: Sol'n Prep: Old WQ: Time:
8															–			Date: Old WQ: Counts: Time:
							Total=	32	27	29	0	32	10	35	X/1	32	31	Mean Neonates/Female = 22.9

500 mg/L

Day	pH New	pH Old	D.O. New	D.O. Old	Conductivity (µS/cm) New	Conductivity (µS/cm) Old		A	B	C	D	E	F	G	H	I	J	RT BATCH NUMBER
0	8.01		7.9		1368			0	0	0	0	0	0	0	0	0	0	~~123~~ CP 122
1	7.95	8.16	8.3	7.8	1363	1422		0	0	0	0	0	0	0	0	0	0	122
2	7.94	8.07	8.3	7.4	1388	1410		0	0	0	0	0	0	0	0	0	0	122
3	7.90	7.99	8.3	7.2	1343	1436		0	0	0	0	X/0	0	0	0	0	0	124
4	7.99	7.91	8.4	8.4	1314	1406		4	6	6	0	–	0	0	5	3	4	124
5	7.85	7.92	8.2	8.7	1318	1377		X/11	11	12	0	–	12	0	7	10	13	124
6	8.17	8.01	8.6	8.0	1300	1439		–	12	8	0	–	17	0	12	14	15	124
7												–						
8												–						
							Total=	X/15	29	26	0	X/0	29	0	24	27	32	Mean Neonates/Female = 18.2

Short-Term Chronic 3-Brood *Ceriodaphnia dubia* Survival & Reproduction Test Data

Client: **Reference Toxicant** Material: **Sodium Chloride** Test Date: 2-27-14

Project #: 22125 Test ID: 55555 Randomization: 10.6.2 Control Water: Modified EPAMH

Concentration	Day	pH New	pH Old	D.O. New	D.O. Old	Conductivity (µS/cm) New	Conductivity (µS/cm) Old	Temp (°C)	A	B	C	D	E	F	G	H	I	J
1000 mg/L	0	7.98		8.2		2306			0	0	0	0	0	0	0	0	0	0
	1	7.96	8.13	8.7	7.7	2247	2435		0	0	0	0	0	0	0	0	0	0
	2	7.91	8.03	8.4	7.4	2236	2358		0	0	0	0	0	0	0	0	0	0
	3	7.90	7.98	8.5	7.2	2288	2358		0	0	0	0	0	0	0	0	2	0
	4	7.96	7.89	8.5	8.3	2296	2515		0	5	7	4	3	1	3	4	0	8
	5	7.85	7.90	8.3	8.6	2300	2431		9	11	0	9	10	8	11	11	12	13
	6	8.13	7.99	8.7	8.2	2289	2605		11	9	12	13	12	11	11	9	14	13
	7																	
	8																	
								Total=	20	25	19	26	25	20	25	24	28	34

Mean Neonates/Female = 24.6

Concentration	Day	pH New	pH Old	D.O. New	D.O. Old	Conductivity (µS/cm) New	Conductivity (µS/cm) Old	Temp (°C)	A	B	C	D	E	F	G	H	I	J
1500 mg/L	0	7.96		8.3		3220			0	0	0	0	0	0	0	0	0	0
	1	7.95	8.09	9.1	7.7	3220	3410		0	0	0	0	0	0	0	0	0	0
	2	7.88	8.05	8.6	7.5	3120	3380		0	0	0	0	0	X/0	0	0	0	0
	3	7.86	7.98	8.7	7.2	3240	3230		0	0	0	0	0	-	0	0	0	0
	4	7.94	7.88	8.6	8.2	3260	3460		3	0	0	3	2	-	2	0	1	0
	5	7.84	7.91	8.4	8.7	3250	3590		5	0	10	5	7	-	X/4	3	6	0
	6	8.10	7.93	8.9	8.3	3210	3510		4	0	5	6	9	-	-	5	2	0
	7													-				
	8													-				
								Total=	12	0	15	14	18	X/0	X/6	8	9	0

Mean Neonates/Female = 8.2

Short-Term Chronic 3-Brood *Ceriodaphnia dubia* Survival & Reproduction Test Data

Client: Reference Toxicant Material: Sodium Chloride Test Date: 2-27-14

Project #: 22125 Test ID: 55555 Randomization: 10.6.2 Control Water: Modified EPAMH

Concentration	Day	pH New	pH Old	D.O. New	D.O. Old	Conductivity (µS/cm) New	Conductivity (µS/cm) Old	Temp (°C)	A	B	C	D	E	F	G	H	I	J
2000 mg/L	0	7.91		9.2		4170			0	0	0	0	0	0	0	0	0	0
	1	7.94	8.08	9.4	7.8	4130	4390		0	0	0	0	0	0	0	0	0	0
	2	7.87	8.04	8.9	7.5	4110	4310		0	0	0	0	0	0	0	0	0	0
	3	7.79	7.96	8.9	7.2	4100	4300		0	0	0	0	0	0	0	0	0	0
	4	7.94	7.86	8.7	8.1	4110	4570		0	0	X/0	0	0	X/0	0	0	1	1
	5	7.83	7.89	8.5	8.5	4180	4500		X/0	0	–	0	X/0	–	0	0	0	0
	6	8.06	7.97	9.1	8.4	4120	4640		–	0	–	0	–	–	0	0	0	0
	7								–		–		–	–				
	8										–			–				
								Total=	X/0	0	X/0	0	X/0	X/0	0	0	1	1

Mean Neonates/Female = 0.2

Concentration	Day	pH New	pH Old	D.O. New	D.O. Old	Conductivity (µS/cm) New	Conductivity (µS/cm) Old		A	B	C	D	E	F	G	H	I	J
2500 mg/L	0	7.87		8.9		5000			0	0	0	0	0	0	0	0	0	0
	1	7.92	8.18	10.1	8.1	5040	5320		0	X/0	X/0	X/0	0	0	0	X/0	X/0	0
	2	7.84	7.99	9.1	7.4	5070	5640		0	–	–	–	X/0	X/0	X/0	–	–	X/0
	3	7.78	7.88	9.0	7.2	5040	5200		0	–	–	–	–	–	–	–	–	–
	4	7.92	7.86	8.8	8.1	5040	5310		0	–	–	–	–	–	–	–	–	–
	5	7.82	7.87	8.6	8.5	5140	5640		0	–	–	–	–	–	–	–	–	–
	6	8.04	7.93	9.6	8.6	4980	5670		0	–	–	–	–	–	–	–	–	–
	7									–	–	–	–	–	–	–	–	–
	8									–	–	–	–	–	–	–	–	–
								Total=	0	X/0	X/0	X/0	X/0	X/0	X/0	X/0	X/0	X/0

Mean Neonates/Female = 0.0

Appendix H

Test Data and Summary of Statistics for the Reference Toxicant Evaluation of the *Hyalella azteca*

CETIS Summary Report

Report Date: 06 Mar-14 15:44 (p 1 of 1)
Test Code: 55556 | 00-8786-3488

Hyalella 96-h Acute Survival Test — **Pacific EcoRisk**

Batch ID:	03-3671-5678	**Test Type:**	Survival (96h)	**Analyst:**	Cassy Glover
Start Date:	27 Feb-14 18:10	**Protocol:**	EPA-821-R-02-012 (2002)	**Diluent:**	SAM-5S
Ending Date:	03 Mar-14 16:30	**Species:**	Hyalella azteca	**Brine:**	Not Applicable
Duration:	94h	**Source:**	Chesapeake Cultures, Inc.	**Age:**	9

Sample ID:	08-3593-4881	**Code:**	KCl	**Client:**	Reference Toxicant
Sample Date:	27 Feb-14 18:10	**Material:**	Potassium chloride	**Project:**	22126
Receive Date:	27 Feb-14 18:10	**Source:**	Reference Toxicant		
Sample Age:	NA (22.9 °C)	**Station:**	In House		

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
17-1121-4972	96h Survival Rate	0.4	0.8	0.5657	NA		Fisher Exact/Bonferroni-Holm Test

Point Estimate Summary

Analysis ID	Endpoint	Level	g/L	95% LCL	95% UCL	TU	Method
13-6064-7851	96h Survival Rate	EC50	0.606	0.532	0.692		Spearman-Kärber

96h Survival Rate Summary

C-g/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Lab Water Contr	10	1	1	1	1	1	0	0	0.0%	0.0%
0.1		10	1	1	1	1	1	0	0	0.0%	0.0%
0.2		10	1	1	1	1	1	0	0	0.0%	0.0%
0.4		10	1	1	1	1	1	0	0	0.0%	0.0%
0.8		10	0.1	0	0.218	0	1	0.1	0.316	316.0%	90.0%
1.6		10	0	0	0	0	0	0	0		100.0%

96h Survival Rate Detail

C-g/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Lab Water Contr	1	1	1	1	1	1	1	1	1	1
0.1		1	1	1	1	1	1	1	1	1	1
0.2		1	1	1	1	1	1	1	1	1	1
0.4		1	1	1	1	1	1	1	1	1	1
0.8		0	0	1	0	0	0	0	0	0	0
1.6		0	0	0	0	0	0	0	0	0	0

96h Survival Rate Binomials

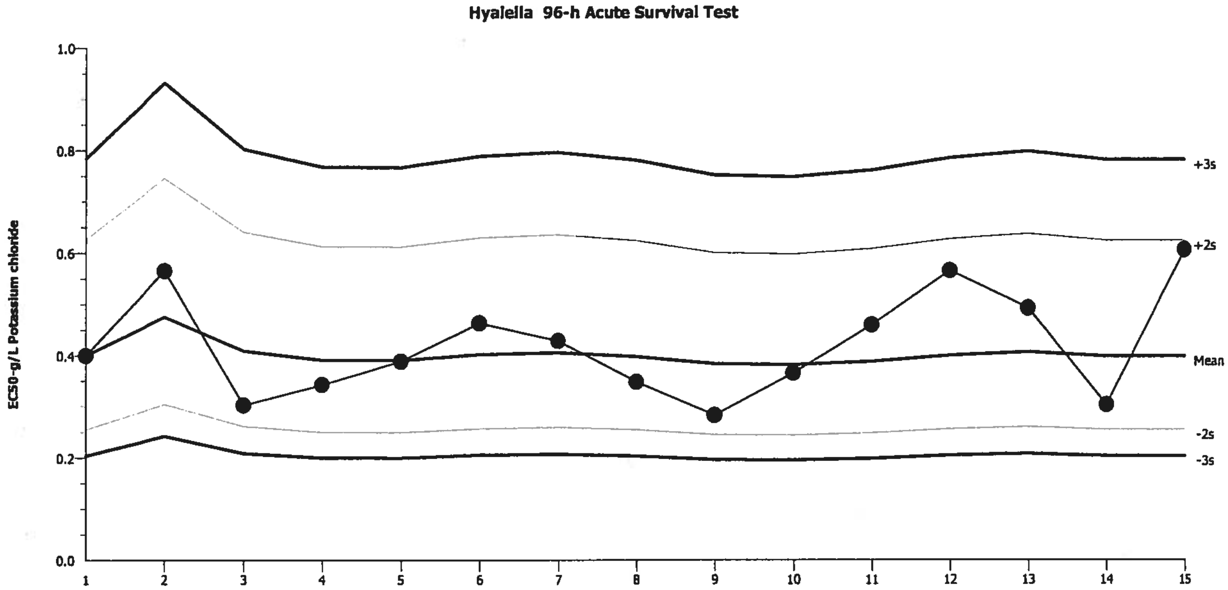
C-g/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Lab Water Contr	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
0.1		1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
0.2		1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
0.4		1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
0.8		0/1	0/1	1/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1
1.6		0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1

Analyst: [signature] QA: [signature]

CETIS QC Plot

Hyalella 96-h Acute Survival Test — **Pacific EcoRisk**

Test Type:	Survival (96h)	**Organism:**	Hyalella azteca (Freshwater Amphip	**Material:**	Potassium chloride
Protocol:	EPA-821-R-02-012 (2002)	**Endpoint:**	96h Survival Rate	**Source:**	Reference Toxicant-REF



Mean:	0.3984	**Count:**	14	**-2s Warning Limit:**	0.2543	**-3s Action Limit:**	0.2032
Sigma:	NA	**CV:**	25.20%	**+2s Warning Limit:**	0.624	**+3s Action Limit:**	0.781

Quality Control Data

Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID
1	2013	Nov	6	15:40	0.4	0.00164	0.01831			15-7026-7439	19-7036-5835
2			20	17:00	0.5657	0.1673	1.563			01-7958-1543	09-3590-7589
3			21	16:55	0.3031	-0.09522	-1.217			17-4328-3485	11-7628-5959
4		Dec	11	17:45	0.3429	-0.05549	-0.6685			06-4892-3798	02-7681-8091
5	2014	Jan	22	15:30	0.3887	-0.00964	-0.1092			15-1323-9580	12-5039-1906
6			23	12:20	0.4634	0.06507	0.6742			12-4927-8114	03-4534-5077
7			24	13:50	0.4287	0.03035	0.3272			04-8256-1553	14-6784-2933
8			29	12:45	0.3482	-0.05014	-0.5995			02-0910-9206	20-3009-8021
9			30	13:00	0.2828	-0.1155	-1.526			07-7453-2234	19-6136-6595
10			31	15:00	0.3651	-0.03323	-0.3881			07-3562-2451	09-8419-3354
11		Feb	4	16:00	0.4595	0.06112	0.6361			07-2556-9878	06-3437-8862
12			7	17:40	0.5657	0.1673	1.563			12-2780-2249	04-4756-7462
13			15	17:00	0.4925	0.0941	0.945			20-0080-3088	01-2359-2306
14			20	15:45	0.3031	-0.09522	-1.217			05-7047-7703	05-1521-5106
15			27	18:10	0.6063	0.2079	1.872			00-8786-3488	13-6064-7851

Analyst: [signature] QA: SW

96 Hour *Hyalella azteca* Reference Toxicant Test Data

Client: **Reference Toxicant**
Test Material: Potassium Chloride
Test ID#: 55556 Project # 22126
Test Date: 2/27/14 Randomization: 10-6-13
Feeding T0 Time: 800 Initials: DS

Organism Log #: 7993 Age: 8-9 days
Organism Supplier: Chesapeake Cult.
Control/Diluent: SAM-5 *Hyalella* Water
Control Water Batch: 92
Feeding T46 Time: 0945 Initials: [illegible]

Treatment (g/L)	Temp (°C)	pH	D.O. (mg/L)	Conductivity (µS/cm)	# Live Animals A	B	C	D	E	F	G	H	I	J	Sign-Off
Control	22.9	8.26	9.0	407	1	1	1	1	1	1	1	1	1	1	Test Solution Prep: CJD
0.1	22.9	8.14	8.6	600	1	1	1	1	1	1	1	1	1	1	New WQ: MA
0.2	22.9	8.09	8.7	778	1	1	1	1	1	1	1	1	1	1	Initiation Date: 2/27/14
0.4	22.9	8.03	8.7	1096	1	1	1	1	1	1	1	1	1	1	Initiation Time: 1810
0.8	22.9	7.97	8.8	1850	1	1	1	1	1	1	1	1	1	1	Initiation Signoff: [illegible]
1.6	22.9	7.84	8.7	3190	1	1	1	1	1	1	1	1	1	1	RT Batch #: 14
Meter ID	43A	PH19	RD04	EC04											
Control	22.8				1	1	1	1	1	1	1	1	1	1	Count Date: 2/28/14
0.1	22.8				1	1	1	1	1	1	1	1	1	1	Count Time: 1230
0.2	22.8				1	1	1	1	1	1	1	1	1	1	Count Signoff: CA
0.4	22.8				1	1	1	1	1	1	1	1	1	1	
0.8	22.8				1	1	1	1	0	1	1	1	1	1	
1.6	22.8				0	0	0	0	0	0	0	0	0	0	
Meter ID	43A														
Control	23.1				1	1	1	1	1	1	1	1	1	1	Count Date: 3/1/14
0.1	23.1				1	1	1	1	1	1	1	1	1	1	Count Time: 0930
0.2	23.1				1	1	1	1	1	1	1	1	1	1	Count Signoff: CS
0.4	23.1				1	1	1	1	1	1	1	1	1	1	
0.8	23.1				0	0	1	0	–	0	0	0	1	0	
1.6	–				–	–	–	–	–	–	–	–	–	–	
Meter ID	43A														
Control	23.1				1	1	1	1	1	1	1	1	1	1	Count Date: 3/2/14
0.1	23.1				1	1	1	1	1	1	1	1	1	1	Count Time: 0910
0.2	23.1				1	1	1	1	1	1	1	1	1	1	Count Signoff: SVV
0.4	23.1				1	1	1	1	1	1	1	1	1	1	
0.8	23.1				–	–	1	–	–	–	–	–	1	–	
1.6	–				–	–	–	–	–	–	–	–	–	–	
Meter ID	43A														
Control	23.0	7.86	8.8	447	1	1	1	1	1	1	1	1	1	1	Termination Date: 3/3/14
0.1	23.0	7.80	8.8	691	1	1	1	1	1	1	1	1	1	1	Termination Time: 1630
0.2	23.0	7.82	8.7	964	1	1	1	1	1	1	1	1	1	1	Termination Signoff: MF
0.4	23.0	7.84	8.7	1314	1	1	1	1	1	1	1	1	1	1	Old WQ: CJD
0.8	23.0	7.81	8.3	2197	–	–	1	–	–	–	–	–	0	–	
1.6	–	7.74	8.1	3750	–	–	–	–	–	–	–	–	–	–	
Meter ID	43A	PH15	RD09	EC06											

Appendix I

Test Data and Summary of Statistics for the Reference Toxicant Evaluation of the Fathead Minnow

CETIS Summary Report

Report Date: 12 Mar-14 16:31 (p 1 of 2)
Test Code: 55557 | 00-5491-0321

Chronic Larval Fish Survival and Growth Test — Pacific EcoRisk

Batch ID:	10-3510-1967	Test Type:	Growth-Survival (7d)	Analyst:	Stevi Vasquez
Start Date:	27 Feb-14 17:00	Protocol:	EPA-821-R-02-013 (2002)	Diluent:	Laboratory Water
Ending Date:	06 Mar-14 08:15	Species:	Pimephales promelas	Brine:	Not Applicable
Duration:	6d 15h	Source:	Aquatox, AR	Age:	1

Sample ID:	12-9771-3014	Code:	NaCl	Client:	Pacific Ecorisk
Sample Date:	27 Feb-14 17:00	Material:	Sodium chloride	Project:	22127
Receive Date:	27 Feb-14 17:00	Source:	Reference Toxicant		
Sample Age:	NA (25.1 °C)	Station:	In House		

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
07-0393-4181	7d Survival Rate	1.5	3	2.121	13.0%		Steel Many-One Rank Sum Test
07-1700-5636	Mean Dry Biomass-mg	0.75	1.5	1.061	10.2%		Dunnett Multiple Comparison Test

Point Estimate Summary

Analysis ID	Endpoint	Level	g/L	95% LCL	95% UCL	TU	Method
07-9451-9891	7d Survival Rate	EC5	0.772	0.377	1.16		Linear Regression (MLE)
		EC10	1.06	0.59	1.5		
		EC15	1.31	0.795	1.79		
		EC20	1.56	1	2.06		
		EC25	1.8	1.22	2.35		
		EC40	2.61	1.95	3.33		
		EC50	3.25	2.52	4.21		
00-1230-5703	Mean Dry Biomass-mg	IC5	1.04	0.444	1.86		Linear Interpolation (ICPIN)
		IC10	1.42	0.828	1.83		
		IC15	1.6	1.16	1.94		
		IC20	1.74	1.41	2.14		
		IC25	1.87	1.59	2.35		
		IC40	2.27	2.07	2.99		
		IC50	2.54	2.33	3.89		

7d Survival Rate Summary

C-g/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Lab Water Contr	4	1	1	1	1	1	0	0	0.0%	0.0%
0.75		4	0.925	0.906	0.944	0.9	1	0.025	0.05	5.41%	7.5%
1.5		4	0.9	0.87	0.93	0.8	1	0.0408	0.0816	9.07%	10.0%
3		4	0.375	0.292	0.458	0.2	0.7	0.111	0.222	59.1%	62.5%
6		4	0.475	0.456	0.494	0.4	0.5	0.025	0.05	10.5%	52.5%
9		4	0	0	0	0	0	0	0		100.0%

Mean Dry Biomass-mg Summary

C-g/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Lab Water Contr	4	0.73	0.715	0.744	0.696	0.786	0.0193	0.0387	5.3%	0.0%
0.75		4	0.721	0.713	0.73	0.704	0.754	0.0116	0.0231	3.2%	1.15%
1.5		4	0.649	0.622	0.675	0.579	0.718	0.0352	0.0704	10.8%	11.1%
3		4	0.241	0.19	0.291	0.14	0.431	0.0676	0.135	56.2%	67.0%
6		4	0.24	0.229	0.252	0.208	0.266	0.015	0.03	12.5%	67.0%
9		4	0	0	0	0	0	0	0		100.0%

Chronic Larval Fish Survival and Growth Test — **Pacific EcoRisk**

7d Survival Rate Detail

C-g/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Water Contr	1	1	1	1
0.75		0.9	1	0.9	0.9
1.5		0.8	0.9	0.9	1
3		0.7	0.3	0.3	0.2
6		0.4	0.5	0.5	0.5
9		0	0	0	0

Mean Dry Biomass-mg Detail

C-g/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Water Contr	0.696	0.717	0.721	0.786
0.75		0.722	0.706	0.704	0.754
1.5		0.598	0.579	0.7	0.718
3		0.431	0.242	0.14	0.149
6		0.208	0.222	0.266	0.266
9		0	0	0	0

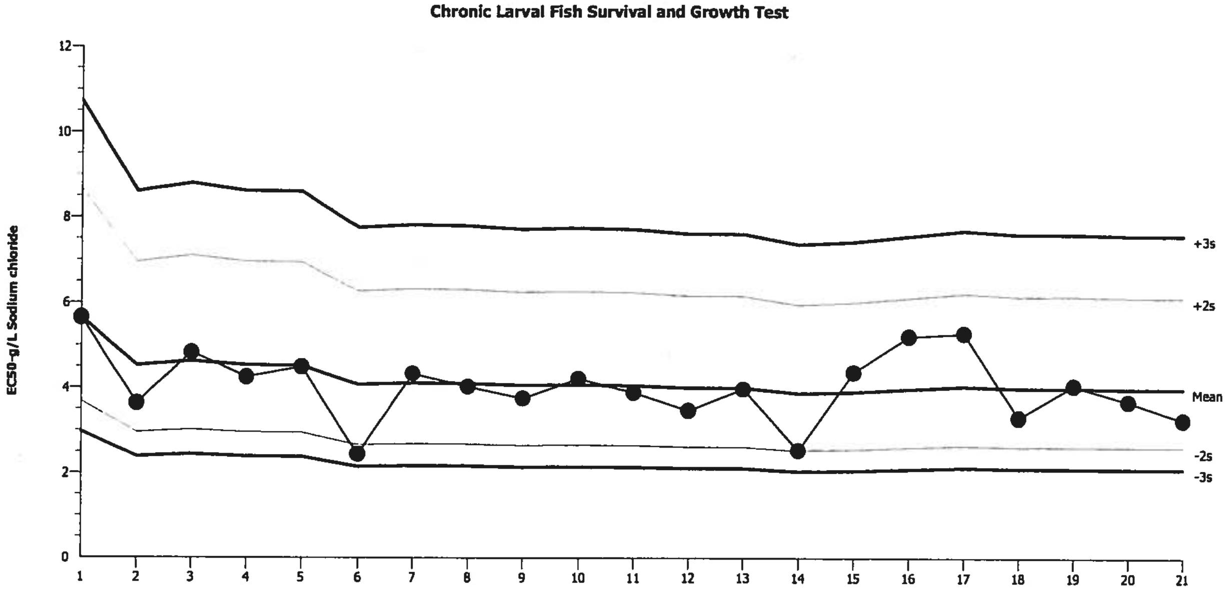
7d Survival Rate Binomials

C-g/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4
0	Lab Water Contr	10/10	10/10	10/10	9/9
0.75		9/10	10/10	9/10	9/10
1.5		8/10	9/10	9/10	10/10
3		7/10	3/10	3/10	2/10
6		4/10	5/10	5/10	5/10
9		0/10	0/10	0/10	0/10

CETIS QC Plot

Chronic Larval Fish Survival and Growth Test — **Pacific EcoRisk**

Test Type:	Growth-Survival (7d)	**Organism:**	Pimephales promelas (Fathead Minn	**Material:**	Sodium chloride
Protocol:	EPA-821-R-02-013 (2002)	**Endpoint:**	7d Survival Rate	**Source:**	Reference Toxicant-REF



Mean:	3.987	**Count:**	20	**-2s Warning Limit:**	2.598	**-3s Action Limit:**	2.097
Sigma:	NA	**CV:**	23.90%	**+2s Warning Limit:**	6.118	**+3s Action Limit:**	7.578

Quality Control Data

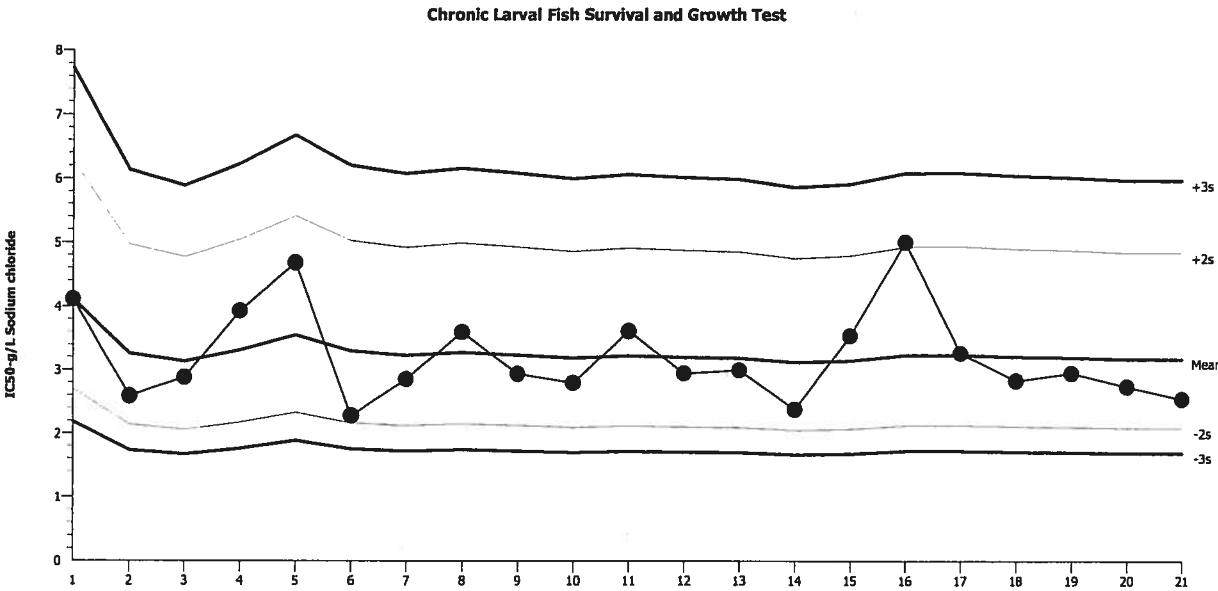
Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID
1	2013	Oct	1	16:40	5.646	1.66	1.626			15-8925-1363	13-7186-9661
2			2	15:30	3.632	-0.3544	-0.4348			10-0960-8572	00-5987-4084
3			8	15:05	4.833	0.8462	0.899			15-0374-2073	07-5438-7669
4			15	15:30	4.254	0.267	0.3028			20-5469-9563	16-9983-9699
5			17	15:10	4.496	0.5092	0.5614			09-9216-5569	17-2634-3422
6		Nov	5	15:35	2.437	-1.55	-2.299	(-)		14-2080-3139	10-0967-0697
7			7	14:00	4.335	0.3485	0.3914			14-5006-8214	19-9459-5987
8			12	15:30	4.026	0.03871	0.04513			16-1508-4402	15-0857-3987
9			19	16:40	3.751	-0.2363	-0.2853			10-1364-1127	10-8722-5568
10		Dec	3	16:00	4.221	0.2338	0.2661			16-2647-7149	00-2423-1163
11			10	18:30	3.892	-0.09524	-0.1129			15-5516-6346	16-6930-0253
12			17	17:20	3.464	-0.5229	-0.6567			14-4525-2754	01-4087-1734
13			31	17:00	3.974	-0.01307	-0.01533			17-4848-2922	19-9554-7447
14	2014	Jan	7	16:15	2.532	-1.455	-2.121	(-)		00-8911-3467	08-0589-7337
15			14	16:30	4.373	0.3863	0.432			06-8606-1268	14-0370-1802
16			21	14:35	5.214	1.227	1.254			02-6681-4000	00-1989-7275
17		Feb	4	15:30	5.283	1.297	1.315			03-2406-2742	20-9102-1057
18			7	17:00	3.301	-0.6855	-0.8813			07-1665-5566	03-0403-9044
19			11	15:45	4.06	0.07321	0.08499			08-6176-1319	13-6169-4175
20			18	16:00	3.68	-0.3064	-0.3735			06-6722-5517	14-1919-5029
21			27	17:00	3.254	-0.7332	-0.9492			00-5491-0321	07-9451-9891

Analyst: SW QA: [signature]

CETIS QC Plot

Chronic Larval Fish Survival and Growth Test — **Pacific EcoRisk**

Test Type:	Growth-Survival (7d)	**Organism:**	Pimephales promelas (Fathead Minn	**Material:**	Sodium chloride
Protocol:	EPA-821-R-02-013 (2002)	**Endpoint:**	Mean Dry Biomass-mg	**Source:**	Reference Toxicant-REF



Mean:	3.174	**Count:**	20	**-2s Warning Limit:**	2.084	**-3s Action Limit:**	1.688
Sigma:	NA	**CV:**	23.40%	**+2s Warning Limit:**	4.836	**+3s Action Limit:**	5.969

Quality Control Data

Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID
1	2013	Oct	1	16:40	4.109	0.935	1.227			15-8925-1363	02-3852-0541
2			2	15:30	2.59	-0.5839	-0.9658			10-0960-8572	09-4900-2290
3			8	15:05	2.883	-0.2915	-0.4576			15-0374-2073	02-1681-8042
4			15	15:30	3.926	0.7523	1.01			20-5469-9563	17-1640-4628
5			17	15:10	4.682	1.508	1.846			09-9216-5569	10-6908-2283
6		Nov	5	15:35	2.284	-0.8903	-1.564			14-2080-3139	15-4499-5202
7			7	14:00	2.851	-0.3225	-0.5091			14-5006-8214	08-9769-4709
8			12	15:30	3.594	0.4195	0.5897			16-1508-4402	14-7453-1475
9			19	16:40	2.935	-0.2387	-0.3715			10-1364-1127	17-5976-0050
10		Dec	3	16:00	2.793	-0.3807	-0.6071			16-2647-7149	05-7650-2111
11			10	18:30	3.613	0.4391	0.6155			15-5516-6346	15-3099-3517
12			17	17:20	2.943	-0.2312	-0.3593			14-4525-2754	16-6836-6369
13			31	17:00	2.99	-0.1843	-0.2842			17-4848-2922	12-0714-0529
14	2014	Jan	7	16:15	2.376	-0.7979	-1.375			00-8911-3467	20-3219-7836
15			14	16:30	3.538	0.364	0.5158			06-8606-1268	05-1045-9218
16			21	14:35	5.006	1.832	2.165	(+)		02-6681-4000	05-4831-2782
17		Feb	4	15:30	3.267	0.0927	0.1368			03-2406-2742	01-0421-5918
18			7	17:00	2.829	-0.345	-0.5466			07-1665-5566	17-6292-1670
19			11	15:45	2.947	-0.2267	-0.352			08-6176-1319	04-0035-1288
20			18	16:00	2.737	-0.4373	-0.7043			06-6722-5517	08-4679-3575
21			27	17:00	2.543	-0.6313	-1.053			00-5491-0321	00-1230-5703

7 Day Chronic Fathead Minnow Reference Toxicant Test Data

Client: **Reference Toxicant**
Test Material: Sodium Chloride
Test ID#: 55557 Project #: 22127
Test Date: 2/27/14 Randomization: 4.6.1

Organism Log#: 7990 Age: < 48 hrs
Organism Supplier: Aquatox
Control/Diluent: EPAMH
Control Water Batch: 1666

Treatment (g/L)	Temp (°C)	pH New	pH Old	D.O. (mg/L) New	D.O. (mg/L) Old	Conductivity (µs/cm) New	Conductivity (µs/cm) Old	# Live Organisms A	B	C	D	SIGN-OFF
Control	25.1	8.11		8.2		298		10	10	10	10	Date 2/27/14
0.75	25.1	8.01		8.3		1940		10	10	10	10	Test Solution Prep CJD
1.5	25.1	7.97		8.3		3250		10	10	10	10	New WQ MA
3	25.1	7.75		8.5		5880		10	10	10	10	Initiation Time 1700
6	25.1	7.70		9.0		11040		10	10	10	10	Initiation Signoff CP
9	25.1	7.66		9.4		16050		10	10	10	10	RT Stock Batch #: 188 / 189
Meter ID	30A	PH19		RD04		EC04						
Control	25.6	8.06	7.93	8.0	7.6	299	1103	10	10	10	10	Date 2.28.14
0.75	25.6	7.98	7.80	8.2	7.1	1775	1952	10	10	10	10	Test Solution Prep DS
1.5	25.6	7.95	7.70	8.3	7.3	3180	3280	10	10	10	10	New WQ DS
3	25.6	7.90	7.64	8.4	7.4	5920	6030	10	10	10	10	Renewal Time 1200
6	25.6	7.81	7.65	8.9	7.7	11080	11270	10	10	10	10	Renewal Signoff DS
9	25.6	7.76	7.61	9.2	7.9	16280	16270	0	0	0	0	Old WQ LH
Meter ID	30A	pH16	PH19	RD04	RD07	EC09	EC09					RT Stock Batch #: 189
Control	25.7	8.16	7.96	7.5	7.0	299	315	10	10	10	10	Date 3/1/14
0.75	25.7	8.04	7.98	7.5	6.9	1861	1792	10	10	10	10	Test Solution Prep [illegible]
1.5	25.7	8.01	7.85	7.7	7.0	3320	3190	10	9	10	10	New WQ MA
3	25.7	7.95	7.83	7.5	7.2	6110	5920	10	9	10	9	Renewal Time 1030
6	25.7	7.85	7.80	7.8	7.3	11190	11110	8	10	8	10	Renewal Signoff SS
9	25.7	—	—	—	—	—	—	—	—	—	—	Old WQ AS
Meter ID	30A	PH19	PH21	RD08	RD04	EC04	EC09					RT Stock Batch #: 189
Control	25.9	7.97	8.04	8.5	8.4	296	304	10	10	10	9	Date 3/2/14
0.75	25.9	7.91	7.89	8.7	8.0	1775	1890	9	10	10	9	Test Solution Prep MF
1.5	25.9	7.88	7.82	8.7	7.9	3220	3330	9	9	9	10	New WQ D.M.S.
3	25.9	7.84	7.76	8.8	7.8	5880	6210	10	9	10	9	Renewal Time 1030
6	25.9	7.76	7.71	9.1	7.9	11130	11340	8	10	7	9	Renewal Signoff CP
9	—	—	—	—	—	—	—	—	—	—	—	Old WQ CP
Meter ID	30A	pH15	PH16	RD09	RD08	EC08	EC04					RT Stock Batch #: 189

7 Day Chronic Fathead Minnow Reference Toxicant Test Data

Client: **Reference Toxicant**
Test Material: Sodium Chloride
Test ID#: 55557 Project #: 22127
Test Date: 2/27/14 Randomization: 4.6.1

Organism Log#: 7990 Age: <48 hrs
Organism Supplier: Aquatox
Control/Diluent: EPAMH
Control Water Batch: 1666

Treatment (g/L)	Temp (°C)	pH new	pH old	D.O. (mg/L) new	D.O. (mg/L) old	Conductivity (µs/cm) New	Conductivity (µs/cm) Old	# Live Organisms A	B	C	D	SIGN-OFF
Control	25.4	8.23	7.81	8.6	7.0	299	304	10	10	10	9	Date ~~2/27~~ 3/3/14
0.75	25.4	8.07	7.74	8.7	7.0	1847	1796	9	10	9	9	Test Solution Prep CJD
1.5	25.4	7.95	7.67	8.9	7.0	3200	3240	9	9	9	10	New WQ TM
3	25.4	7.92	7.60	9.0	6.8	5880	5950	9	9	8	9	Renewal Time 1220
6	25.4	7.81	7.58	9.5	7.0	11010	11180	8	10	7	8	Renewal Signoff [signature]
9	–	–	–	–	–	–	–	–	–	–	–	Old WQ CP
Meter ID	30A	PH21	PH16	RD07	RD04	EC06	EC09					RT Stock Batch #: 189
Control	25.5	7.99	7.90	8.5	8.3	300	305	10	10	10	9	Date 3/4/14
0.75	25.5	7.99	7.83	8.5	8.2	1875	1883	9	10	9	9	Test Solution Prep CP
1.5	25.5	7.97	7.79	8.6	8.1	3140	3250	9	9	9	10	New WQ CP
3	25.5	7.94	7.75	8.9	8.0	5890	5990	9	8	7	8	Renewal Time 1020
6	25.5	7.87	7.70	9.6	8.0	11110	11260	8	9	6	8	Renewal Signoff [signature]
9	–	–	–	–	–	–	–	–	–	–	–	Old WQ [signature]
Meter ID	30A	PH16	pH16	RD07	~~RD08~~	EC06	~~EC08~~					RT Stock Batch #: 189
Control	25.9	8.03	7.81	8.6	8.1	301	307	10	10	10	9	Date 3/5/14
0.75	25.9	7.91	7.71	8.5	8.2	1951	1897	9	10	9	9	Test Solution Prep SNV
1.5	25.9	7.90	7.69	8.7	7.9	33~~90~~ 70 ARF	3170	9	9	9	10	New WQ ARF
3	25.9	7.86	7.66	8.9	8.0	6040	5970	8	7	6	6	Renewal Time 0945
6	25.9	7.81	7.62	9.3	7.8	11300	11220	5	7	6	5	Renewal Signoff [signature]
9	–	–	–	–	–	–	–	–	–	–	–	Old WQ [signature]
Meter ID	30A	PH16	Ph21	RD07	RD09	EC06	EC09					RT Stock Batch #: 189
Control	25.4		7.70		7.8		310	10	10	10	9	Date 3/6/14
0.75	25.4		7.62		7.8		1971	9	10	9	9	Termination Time 0815
1.5	25.4		7.60		7.8		3300	8	9	9	10	Termination Signoff CJD
3	25.4		7.57		7.7		6050	7	3	3	2	Old WQ [signature]
6	25.4		7.53		7.9		11320	4	5	5	5	
9	–		–		–		–	–	–	–	–	
Meter ID	30A		Ph15		RD08		EC08					

Fathead Minnow Dry Weight Data Sheet

Client: **Reference Toxicant** Test ID #: 55557 Project #: 22127

Sample: Sodium Chloride Tare Weight Date: 3/2/14 Sign-off: FOMB

Test Date: 2. 27. 14 Final Weight Date: 3/8/14 Sign-off: MA

Pan ID	Concentration	Replicate	Initial Pan Weight (mg)	Final Pan Weight (mg)	Initial # of Organisms	Biomass Value (mg)
1	Control	A	173.21	180.17	10	0.696
2		B	172.99	180.16	10	0.717
3		C	179.88	187.09	10	0.721
4		D	179.83	186.90	~~10~~ 9	0.786
5	0.75	A	182.03	189.25	10	0.722
6		B	189.77	196.83	10	0.706
7		C	181.66	188.70	10	0.704
8		D	189.05	196.59	10	0.754
9	1.5	A	181.93	187.91	10	0.598
10		B	174.65	180.44	10	0.579
11		C	180.81	~~185~~ 187.81	10	0.700
12		D	189.97	197.15	10	0.718
13	3	A	182.27	186.58	10	0.431
14		B	182.95	185.37	10	0.242
15		C	177.45	178.85	10	0.140
16		D	174.87	176.36	10	0.149
17	6	A	178.32	180.40	10	0.208
18		B	181.60	183.82	10	0.222
19		C	175.37	178.03	10	0.266
20		D	176.06	178.72	10	0.266
21	9	A	179.17	—	10	—
22		B	205.15	—	10	—
23		C	209.70	—	10	—
24		D	194.54	—	10	—
QA1			176.29	176.34		
QA2			185.83	185.80		
QA3			207.18	207.25		
Balance ID:			BAL01	BAL01		

Appendix J

Supplemental Data/Information Required to Document Observations of Pathogen-Related Mortality in the Chronic Fathead Minnow Test

Comments and Observations

Client: KLI & ADH
Test Date: 2/27/14
Sample Description: Stormwater
Test ID #: 55481
Species and Test Description: C. FHM
Project #: 19399

Date	Initials	Description of Observation:
2/28/14	CA	No fish present in 20SR00883
		~~rep~~ D. Confirmed by KW
3/1/14	SM	0843D: Two mortalities, PRM observed.
		0551B: One mortality, PRM observed.
		0883A: One mortality, PRM observed.
		0979D: One mortality, PRM observed.
3/2/14	PL	PRM observed in all reps of 0843
		PRM observed in 0551-B
		PRM observed in 0883-A
		PRM observed in 0973-A
		all beakers changed, Photos Taken
3.3.14	Ekk	0843 - 3 PRM → 1... REP A, 2... REP D
		0551 - 1 PRM → 1... REP C

General Guidance:
1) All observations are to be recorded on this sheet and transcibed by a QA Officer onto the original test data sheet(s) at the completion of testing, if deemed necessary.
2) Record the Species and Test Description, Client, Sample Description, Test Date, Test ID #, and Project # of the test in the header..
3) Record the date of the observation, your initials, the treatment affected, and the test replicate affected for each entry.
4) Record observations in brief sentences. It is VERY IMPORTANT to also record any corrective actions taken.
5) Leave a blank line between entries.

Typical obversations that should be recorded: Conductivity verification, presence or absence of PRM when mortalities are observed, etc.

Example: 8/26/08 AB New chem of 100% effluent > 10% different than previous day.
Confirmed on second meter and confirmed conductivity of sample.
New sample had >10% difference in conductivity than previous sample.

Alessandro D. Hnatt
ADH Environmental
3065 Porter Street, Suite 101
Soquel, CA 95073

May 14, 2014

Alessandro:

I have enclosed one copy of our report "Evaluation of the Toxicity of Contra Costa Clean Water Program Stormwater Samples" for the samples that were collected March 26, 2014. The results of this testing are summarized below.

Hyalella azteca toxicity summary for CCCWP stormwater samples.	
Sample Station	Survival Toxicity relative to the Lab Control treatment?
207R00011US	**Yes** (100% effect)
207R00011DS	**Yes** (100% effect)

Toxicity of CCCWP Stormwater to *Hyalella azteca*
There was complete mortality in both upstream (US) and downstream (DS) 207R00011 stormwater samples.

If you have any questions regarding the performance and interpretation of these tests, feel free to contact my colleague Eddie Kalombo or myself at (707) 207-7760.

Sincerely,

Stephen L. Clark
Vice President/Special Projects Director

Pacific EcoRisk is accredited in accordance with NELAP (ORELAP ID 4043). Pacific EcoRisk certifies that the test results reported herein conform to the most current NELAP requirements for parameters for which accreditation is required and available. Any exceptions to NELAP requirements are noted, where applicable, in the body of the report. This report shall not be reproduced, except in full, without the written consent of Pacific EcoRisk. This testing was performed under Lab Order 19397.

Evaluation of the Toxicity of Contra Costa Clean Water Program Stormwater Samples

Samples collected March 26, 2014

Prepared For:

ADH Environmental
3065 Porter Street, Suite 101
Soquel, CA 95073

Prepared By:

Pacific EcoRisk
2250 Cordelia Road
Fairfield, CA 94534

May 2014

PACIFIC ECORISK
ENVIRONMENTAL CONSULTING & TESTING

Evaluation of the Toxicity of Contra Costa Clean Water Program Stormwater Samples

Samples collected March 26, 2014

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Appendices

Appendix A Chain-of-Custody Record for the Collection and Delivery of the CCCWP Stormwater Samples

Appendix B Test Data and Summary of Statistics for the Evaluation of the Toxicity of CCCWP Stormwater Samples to *Hyalella azteca*

Appendix C Test Data and Summary of Statistics for the Reference Toxicant Evaluation of the *Hyalella azteca*

1. INTRODUCTION

Under contract to ADH Environmental, and in support of the Bay Area Stormwater Management Agencies Association (BASMAA) Regional Monitoring Coalition ongoing monitoring efforts, Pacific EcoRisk (PER) has been contracted to evaluate the toxicity of stormwater samples collected for the Contra Costa Clean Water Program (CCCWP). This evaluation consist of performing the following US EPA toxicity test:

- 10-day survival test with the freshwater amphipod *Hyalella azteca.*

This toxicity test was conducted on stormwater samples collected on March 26, 2014. In order to assess the sensitivity of the test organisms to toxic stress, a concurrent reference toxicant test was also performed. This report describes the performance and results of these tests.

2. TOXICITY TEST PROCEDURES

The method used in conducting testing with *H. azteca* followed a test protocol that is based on a modification of the US EPA guidelines, "Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates" (EPA/600/R-99/064).

2.1 Sample Receipt and Handling

On March 26, ADH collected stormwater samples into appropriately-cleaned containers, which were transported, on ice and under chain-of-custody, to the PER testing laboratory in Fairfield, CA. Upon receipt at the testing laboratory, aliquots of each sample were collected for analysis of initial water quality characteristics (Table 1), with the remainder of each sample being stored at 0-6˚C except when being used to prepare test solutions.

The chain-of-custody record for the collection and delivery of these stormwater samples is provided as Appendix A.

Table 1. Initial water quality characteristics of the CCCWP stormwater samples.

Date Sample Received	Sample ID	Temp (°C)	pH	D.O. (mg/L)	Alkalinity (mg/L)	Hardness (mg/L)	Conductivity (µS/cm)	Total Ammonia (mg/L N)
3/26/14	207R00011US-W-02	5.3	7.79	10.0	72	108	425	<1.0
3/26/14	207R00011DS-W-02	5.8	8.10	10.1	70	96	320	<1.0

2.2 Survival Toxicity Testing of Stormwater Samples with *Hyalella azteca*

This test consists of exposing the amphipods to the stormwater samples for 10 days, after which effects on survival are evaluated. The specific procedures used in this testing are described below.

The *H. azteca* used in this testing were obtained from a commercial supplier (Chesapeake Cultures, VA). Upon receipt at the PER laboratory, the organisms were maintained at 23˚C in aerated aquaria containing Standard Artificial Medium (SAM-5S) water (Borgmann 1996) prior to their use in this test. During this pre-test period, the organisms were fed the alga *Selenastrum capricornutum* and Yeast-Cerophyll®-Trout (YCT) food amended with *Spirulina*.

The Lab Control water for these tests consisted of SAM-5S water. The stormwater samples were tested at the 100% concentration only. "New" water quality characteristics (pH, D.O., and conductivity) were measured on the test solutions prior to use in these tests.

There were 5 replicates for each test treatment, each replicate consisting of a 250-mL glass beaker containing 100 mL of test solution. These tests were initiated by allocating ten 8-day old *H. azteca*, into each replicate, followed by the addition of 1.5 mL of *Spirulina* amended YCT. The replicate beakers were placed into a temperature-controlled room at 23˚C, under cool-white fluorescent lighting on a 16L:8D photoperiod.

Each day of the tests, each replicate beaker was examined and the number of surviving organisms determined; 'old' water quality characteristics were measured in one randomly-selected beaker at each test treatment at this time. On Days 2, 4, 6, and 8 of the test, the organisms were fed 1.5 mL of *Spirulina* amended YCT in each test chamber.

On Day 5 of the 10-day tests, fresh test solutions were prepared and characterized, as before. Each replicate was examined, with any dead animals, uneaten food, wastes, and other detritus being removed. The number of live organisms in each replicate was determined and then approximately 80% of the test media in each beaker was carefully poured out and replaced with fresh test solution. "Old" water quality characteristics (pH, D.O., and conductivity) were measured on the old test solution that had been discarded from one randomly-selected replicate at each treatment.

After 10 days of exposure, the tests were terminated and the number of live organisms in each replicate was recorded. The resulting survival data were analyzed to evaluate any impairment due to the stormwater samples; all statistical analyses were performed using CETIS® statistical software (TidePool Scientific, McKinleyville, CA).

2.2.1 Reference Toxicant Testing of the *Hyalella azteca*

In order to assess the sensitivity of the *H. azteca* test organisms to toxic stress, a reference toxicant test was performed. The reference toxicant test was performed as a 96-hr waterborne exposure to Control water spiked with KCl at test concentrations of 0, 0.1, 0.2, 0.4, 0.8 and 1.6 g/L. The resulting survival data were statistically analyzed to determine key dose-response point estimates (e.g., EC_{50}); all statistical analyses were made using the CETIS® software. This response endpoint was then compared to the 'typical response' range established by the mean ± 2 SD of the point estimates generated by the 20 most recent previous reference toxicant tests performed by this lab.

3. RESULTS

3.1 Effects of the CCCWP Stormwater on *Hyalella azteca*

The results for these tests are summarized below in Table 2. There was complete mortality in both upstream (US) and downstream (DS) 207R00011 stormwater samples.

The test data and summary of statistical analyses for these tests are presented in Appendix B.

Table 2. Effects of CCCWP stormwater on *Hyalella azteca*.

Test Initiation Date (Time)	Treatment/Sample ID	10-Day Mean % Survival
4/27/14 (1615)	Lab Control	98
	207R00011US	**0***
	207R00011DS	**0***

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

4. AQUATIC TOXICITY DATA QUALITY CONTROL

Four QC measures were assessed during the toxicity testing:

- Maintenance of acceptable test conditions;
- Negative Control testing;
- Positive Control (reference toxicant) testing; and
- Concentration Response Relationship assessment.

4.1 Maintenance of Acceptable Test Conditions

All test conditions (e.g., pH, D.O., temperature, etc.) were within acceptable limits for these tests. All analyses were performed according to laboratory Standard Operating Procedures.

4.2 Negative Control Testing

The responses at the Lab Control treatments were acceptable.

4.3 Positive Control Testing

4.3.1 Reference Toxicant Toxicity to *Hyalella azteca*

The results of this test are presented in Table 3. The EC_{50} for this test was consistent with the "typical response" range established by the reference toxicant test database for this species, indicating that these organisms were responding to toxic stress in a typical fashion.

The test data and summary of statistical analyses for this test are presented in Appendix C.

Table 3. Reference toxicant testing: Effects of KCl on *Hyalella azteca* survival.

KCl Treatment (g/L)	Mean% Survival
Control	100
0.1	100
0.2	100
0.4	**40***
0.8	**0***
1.6	**0***
Summary of Statistics	
EC_{50} =	0.37 g/L KCl
"Typical response" range (mean ±2 SD)	0.26 – 0.66 g/L KCl

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

4.4 Concentration Response Relationships

The concentration-response relationship for the reference toxicant test was evaluated as per EPA guidelines (EPA-821-B-00-004), and determined to be acceptable.

5. SUMMARY & CONCLUSIONS

Toxicity of CCCWP Stormwater to *Hyalella azteca*

There was complete mortality in both upstream (US) and downstream (DS) 207R00011 stormwater samples.

Appendix A

Chain-of-Custody Record for the Collection and Delivery of the CCCWP Stormwater Samples

Pacific EcoRisk
2250 Cordelia Rd., Fairfield, CA 94534
(707) 207-7760 FAX (707) 207-7916

CHAIN-OF-CUSTODY RECORD

Client Name:	
Client Address:	ADH 3065 Porter St suite 101
Phone:	FAX:
Project Manager:	
Project Name:	CCCW ISSID / 030.001.0202
Project # / P.O. Number:	

	Client Sample ID	Sample Date	Sample Time	Sample Matrix*	Container Number	Container Type	Chronic *Selenastrum capricornutum*	Chronic *Ceriodaphnia dubia*	Chronic *Pimephales promelas*	10-day Survival *Hyalella azteca* (water)	10-day *Hyalella azteca* (sediment)						
1	207R00011DS-W-02	3-26-14	1300	STRMW	10	1 gall. amber				x							
2	207R00011US-W-02	3-26-14	1240	STRMW	10	1 gal Amber				^							
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
12																	

Samples collected by:

Comments/Special Instruction:

Note - Fathead minnow testing is to be performed using the standard EPA protocol (i.e., 4 replicates)

RELINQUISHED BY:	RECEIVED BY:
Signature: [signature]	Signature: [signature]
Print: LUCAS ALDINGER	Print: Y. Khadiyeva
Organization: ADH	Organization: PER
Date: 3-26-14 Time: 16:00	Date: 3/26/14 Time: 1600
RELINQUISHED BY:	**RECEIVED BY:**
Signature:	Signature:
Print:	Print:
Organization:	Organization:
Date: Time:	Date: Time:

***Example Matrix Codes:** (**FW** = Freshwater); (**SW** = Saltwater); (**WW** = Wastewater); (**STRMW** = Stormwater); (**SED** = Sediment); or other

Appendix B

Test Data and Summary of Statistics for the Evaluation of the Toxicity of the CCCWP Stormwater Samples to *Hyalella azteca*

CETIS Summary Report

Hyalella Survival and Growth Test — **Pacific EcoRisk**

Batch ID:	21-2937-9939	**Test Type:**	Survival-Growth (10 day)	**Analyst:**	Eddie Kalombo
Start Date:	27 Mar-14 16:15	**Protocol:**	GCML	**Diluent:**	Not Applicable
Ending Date:	06 Apr-14 08:30	**Species:**	Hyalella azteca	**Brine:**	Not Applicable
Duration:	9d 16h	**Source:**	Chesapeake Cultures, Inc.	**Age:**	8

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
ADH_0327_HA_C1	20-7657-3526	27 Mar-14 16:15	27 Mar-14 16:15	NA (22.5 °C)	ADH Environmental, Inc.	19397
207R00011US	09-8287-0810	26 Mar-14 12:40	26 Mar-14 16:00	28h (5.3 °C)	CCCWP	
207R00011DS	09-0740-7073	26 Mar-14 14:00	26 Mar-14 16:00	26h (5.8 °C)		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
ADH_0327_HA_C1	Lab Control	ADH Environmental, Inc.	LABQA		
207R00011US	Stormwater	ADH Environmental, Inc.	207R00011US		
207R00011DS	Stormwater	ADH Environmental, Inc.	207R00011DS		

Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
ADH_0327_HA_C1	5	0.98	0.963	0.997	0.9	1	0.02	0.0447	4.56%	0.0%
207R00011US	5	0	0	0	0	0	0	0		100.0%
207R00011DS	5	0	0	0	0	0	0	0		100.0%

Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
ADH_0327_HA_C1	1	1	1	0.9	1
207R00011US	0	0	0	0	0
207R00011DS	0	0	0	0	0

Survival Rate Binomials

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
ADH_0327_HA_C1	10/10	10/10	10/10	9/10	10/10
207R00011US	0/10	0/10	0/10	0/10	0/10
207R00011DS	0/10	0/10	0/10	0/10	0/10

CETIS Analytical Report

Hyalella Survival and Growth Test				Pacific EcoRisk
Analysis ID: 16-5696-1328	Endpoint: Survival Rate		CETIS Version: CETISv1.8.5	
Analyzed: 10 Apr-14 8:19	Analysis: Nonparametric-Two Sample		Official Results: Yes	

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	4.3%	

Wilcoxon Rank Sum Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
ADH_0327_HA_C1		207R00011US	15	NA	0	8	0.0040	Exact	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	3.724916	3.724916	1	1400	<0.0001	Significant Effect
Error	0.02124747	0.002655933	8			
Total	3.746164		9			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	1	13.7	0.3559	Equal Variances
Variances	Levene Equality of Variance	7.11	11.3	0.0285	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.625	0.741	0.0001	Non-normal Distribution

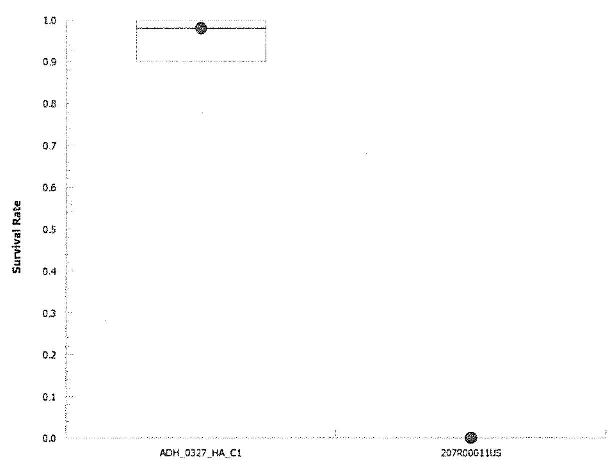
Survival Rate Summary

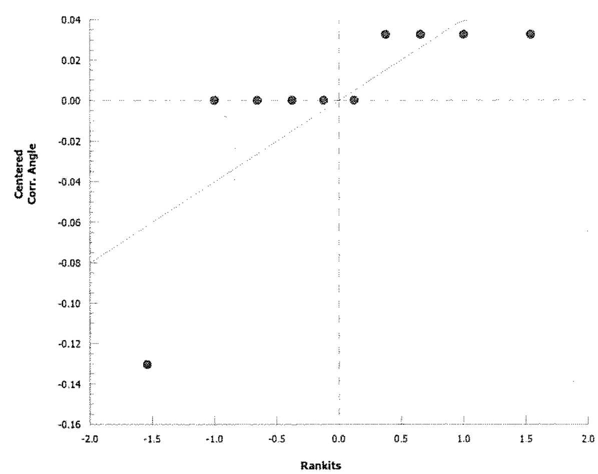
Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
ADH_0327_HA_C1	5	0.98	0.924	1	1	0.9	1	0.02	4.56%	0.0%
207R00011US	5	0	0	0	0	0	0	0		100.0%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
ADH_0327_HA_C1	5	1.38	1.29	1.47	1.41	1.25	1.41	0.0326	5.28%	0.0%
207R00011US	5	0.159	0.159	0.159	0.159	0.159	0.159	0	0.0%	88.5%

Graphics





10 Day Acute *Hyalella azteca* Toxicity Test Data

Client: ADH / CCCWP
Test Material: 207R00011US
Test ID#: 56062 Project #: 19397
Test Date: 3/27/14

Organism Log#: 8066 Age: 8 days
Organism Supplier: ABS
Control/Diluent: SAM-5 Hyalella Water
Control Water Batch: 99

Treatment	Temp (°C)	pH new	pH old	D.O. (mg/L) new	D.O. (mg/L) old	Conductivity (µS/cm)	# Live Organisms A	B	C	D	E	SIGN-OFF
Lab Control	22.5	7.70		8.2		411	10	10	10	10	10	Date 3/27/14; Sample ID 34566
100%	22.5	7.89		9.1		420	10	10	10	10	10	Test Solution Prep [illegible]; New WQ RD
Meter ID	43A	PH21		RD07		EC04						Initiation Time 1615; Initiation Signoff KP
Lab Control	22.5				8.1		10	10	10	10	10	Date 3/28/14; Count Time 1400
100%	22.5				7.4		10	10	10	10	10	Count Signoff [illegible]; Old WQ CJG
Meter ID	43A				RD08							
Lab Control	22.7				7.9		10	~~9~~ 10	10	10	10	Date 3/29/14; Count Time 1140
100%	22.7				7.3		6	5	4	5	4	Count Signoff MK; Old WQ CJG
Meter ID	43A				RD08							Feed MK
Lab Control	22.9				6.9		10	10	10	10	10	Date 3/30/14; Count Time 1100
100%	22.9				6.8		0	0	0	0	0	Count Signoff CP; Old WQ CJG
Meter ID	43A				RD09							
Lab Control	23.1				6.7		10	10	10	10	10	Date 3-31-14; Count Time 1130
100%	~~23.1~~				—		—	—	—	—	—	Count Signoff [illegible]; Old WQ CJG
Meter ID	43A				RD04							Feed [illegible]
Lab Control	23.2	8.36	7.55	8.8	6.8	415	10	10	10	10	10	Date 4/1/14; Sample ID —
100%	—	—	—	—	—	—	—	—	—	—	—	Test Solution Prep [illegible]; New WQ [illegible]
Meter ID	43A	pH19	pH21	RD08	RD04	EC06						Renewal Time 0930; Renewal Signoff CJD; Old WQ [illegible]
Lab Control	23.2				8.4		~~10~~ 10	10	10	10	10	Date 4/2/14; Count Time 1550
100%	—				—		—	—	—	—	—	Count Signoff [illegible]; Old WQ [illegible]
Meter ID	43A				RD04							Feed [illegible]
Lab Control	23.2				5.4		10	10	10	10	10	Date 4/3/14; Count Time 0915
100%	—				—		—	—	—	—	—	Count Signoff CJD; Old WQ [illegible]
Meter ID	43A				RD08							
Lab Control	23.2				8.0		10	10	10	10	10	Date 4/4/14; Count Time 1322
100%	—				—		—	—	—	—	—	Count Signoff [illegible]; Old WQ DS
Meter ID	43A				RD09							Feed [illegible]
Lab Control	23.3				~~3.4~~ 3.9		10	10	10	9	10	Date 4/5/14; Count Time 1025
100%	—				—		—	—	—	—	—	Count Signoff [illegible]; Old WQ CJA
Meter ID	43A				RD08							
Lab Control	23.3		7.54		5.4	473	10	10	10	9	10	Date 4/6/14; Termination Time 0830
100%	—		—		—	—	—	—	—	—	—	Termination Signoff CP; Old WQ RD
Meter ID	43A		PH19		RD09	EC08						

Hyalella Survival and Growth Test					Pacific EcoRisk
Analysis ID:	11-6870-9117	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.5
Analyzed:	10 Apr-14 8:19	**Analysis:**	Nonparametric-Two Sample	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	4.3%	

Wilcoxon Rank Sum Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
ADH_0327_HA_C1		207R00011DS	15	NA	0	8	0.0040	Exact	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	3.724916	3.724916	1	1400	<0.0001	Significant Effect
Error	0.02124747	0.002655933	8			
Total	3.746164		9			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	1	13.7	0.3559	Equal Variances
Variances	Levene Equality of Variance	7.11	11.3	0.0285	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.625	0.741	0.0001	Non-normal Distribution

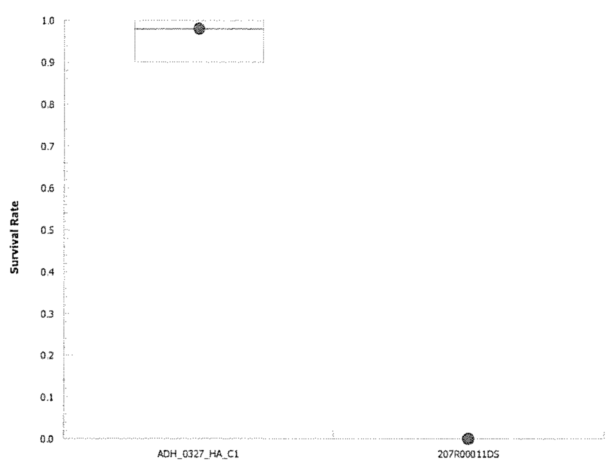
Survival Rate Summary

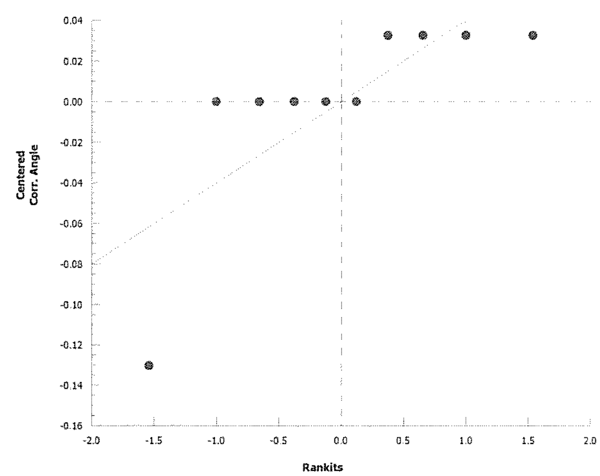
Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
ADH_0327_HA_C1	5	0.98	0.924	1	1	0.9	1	0.02	4.56%	0.0%
207R00011DS	5	0	0	0	0	0	0	0		100.0%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
ADH_0327_HA_C1	5	1.38	1.29	1.47	1.41	1.25	1.41	0.0326	5.28%	0.0%
207R00011DS	5	0.159	0.159	0.159	0.159	0.159	0.159	0	0.0%	88.5%

Graphics





10 Day Acute *Hyalella azteca* Toxicity Test Data

Client: ADH / CCCWP
Test Material: 207R00011DS
Test ID#: 56063 Project #: 19397
Test Date: 3/27/14

Organism Log#: 8066 Age: 8 days
Organism Supplier: ABS
Control/Diluent: SAM-5 Hyalella Water
Control Water Batch: 99

Treatment	Temp (°C)	pH new	pH old	D.O. (mg/L) new	D.O. (mg/L) old	Conductivity (μS/cm)	# Live Organisms A	B	C	D	E	SIGN-OFF
Lab Control	22.5	7.70		8.2		411	10	10	10	10	10	Date: 3/27/14; Sample ID: 34567
100%	22.5	7.95		9.6		319	10	10	10	10	10	Test Solution Prep: Le; New WQ: RD
Meter ID	43A	pH21		RD07		EC04						Initiation Time: 1615; Initiation Signoff: KP
Lab Control	22.5				8.1		10	10	10	10	10	Date: 3/28/14; Count Time: 1400
100%	22.5				7.3		10	10	10	10	10	Count Signoff: [illegible]; Old WQ: CJG
Meter ID	43A				RD08							
Lab Control	22.7				7.9		10	10	10	10	10	Date: 3/29/14; Count Time: 1140
100%	22.7				7.3		10	8	6	10	10	Count Signoff: MK; Old WQ: CJG
Meter ID	43A				RD07							Feed: MK
Lab Control	22.9				6.9		10	10	10	10	10	Date: 3/30/14; Count Time: 1100
100%	22.9				7.0		0	0	0	0	0	Count Signoff: CP; Old WQ: CJG
Meter ID	43A				R209							
Lab Control	23.1				6.7		10	10	10	10	10	Date: 3-31-14; Count Time: 1130
100%	–				–		–	–	–	–	–	Count Signoff: [illegible]; Old WQ: CJG
Meter ID	43A				RD04							Feed: [illegible]
Lab Control	23.2	8.36	7.55	8.8	6.8	415	10	10	10	10	10	Date: 4/1/14; Sample ID: –
100%	–	–	–	–	–	–	–	–	–	–	–	Test Solution Prep: [illegible]; New WQ: Le
Meter ID	43A	pH19	pH21	RD08	RD04	EC06						Renewal Time: 0930; Renewal Signoff: CJD; Old WQ: Le
Lab Control	23.2				8.4		10	10	10	10	10	Date: 4/2/14; Count Time: 1550
100%	–				–		–	–	–	–	–	Count Signoff: [illegible]; Old WQ: CG
Meter ID	43A				RD04							Feed: [illegible]
Lab Control	23.2				5.4		10	10	10	10	10	Date: 4/3/14; Count Time: 0915
100%	–				–		–	–	–	–	–	Count Signoff: CJD; Old WQ: [illegible]
Meter ID	43A				RD08							
Lab Control	23.2				8.0		10	10	10	10	10	Date: 4/4/14; Count Time: 1322
100%	–				–		–	–	–	–	–	Count Signoff: [illegible]; Old WQ: [illegible]
Meter ID	43A				RD08							Feed: [illegible]
Lab Control	23.3				3.9		10	10	10	9	10	Date: 4/5/14; Count Time: 1025
100%	–				–		–	–	–	–	–	Count Signoff: Le; Old WQ: CJG
Meter ID	43A				RD09							
Lab Control	23.3		7.54		5.4	473	10	10	10	9	10	Date: 4/6/14; Termination Time: 0830
100%	–		–		–	–	–	–	–	–	–	Termination Signoff: CP; Old WQ: RD
Meter ID	43A		pH19		RD09	EC08						

Appendix C

Test Data and Summary of Statistics for the Reference Toxicant Evaluation of the *Hyalella azteca*

CETIS Summary Report

Report Date: 02 Apr-14 11:17 (p 1 of 1)
Test Code: 56010 | 08-8207-4257

Hyalella 96-h Acute Survival Test — Pacific EcoRisk

Batch ID:	02-2070-1586	Test Type:	Survival (96h)	Analyst:	Stevi Vasquez
Start Date:	27 Mar-14 13:00	Protocol:	EPA-821-R-02-012 (2002)	Diluent:	SAM-5S
Ending Date:	31 Mar-14 13:45	Species:	Hyalella azteca	Brine:	Not Applicable
Duration:	4d 1h	Source:	Aquatic Biosystems, CO	Age:	8

Sample ID:	13-5495-2751	Code:	KCl	Client:	Reference Toxicant
Sample Date:	27 Mar-14 13:00	Material:	Potassium chloride	Project:	22246
Receive Date:	27 Mar-14 13:00	Source:	Reference Toxicant		
Sample Age:	NA (23 °C)	Station:	In House		

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
16-1326-9012	96h Survival Rate	0.2	0.4	0.2828	NA		Fisher Exact/Bonferroni-Holm Test

Point Estimate Summary

Analysis ID	Endpoint	Level	g/L	95% LCL	95% UCL	TU	Method
13-7765-3936	96h Survival Rate	EC50	0.373	0.301	0.463		Spearman-Kärber

96h Survival Rate Summary

C-g/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Lab Water Contr	10	1	1	1	1	1	0	0	0.0%	0.0%
0.1		10	1	1	1	1	1	0	0	0.0%	0.0%
0.2		10	1	1	1	1	1	0	0	0.0%	0.0%
0.4		10	0.4	0.207	0.593	0	1	0.163	0.516	129.0%	60.0%
0.8		10	0	0	0	0	0	0	0		100.0%
1.6		10	0	0	0	0	0	0	0		100.0%

96h Survival Rate Detail

C-g/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Lab Water Contr	1	1	1	1	1	1	1	1	1	1
0.1		1	1	1	1	1	1	1	1	1	1
0.2		1	1	1	1	1	1	1	1	1	1
0.4		1	0	0	1	0	1	0	0	0	1
0.8		0	0	0	0	0	0	0	0	0	0
1.6		0	0	0	0	0	0	0	0	0	0

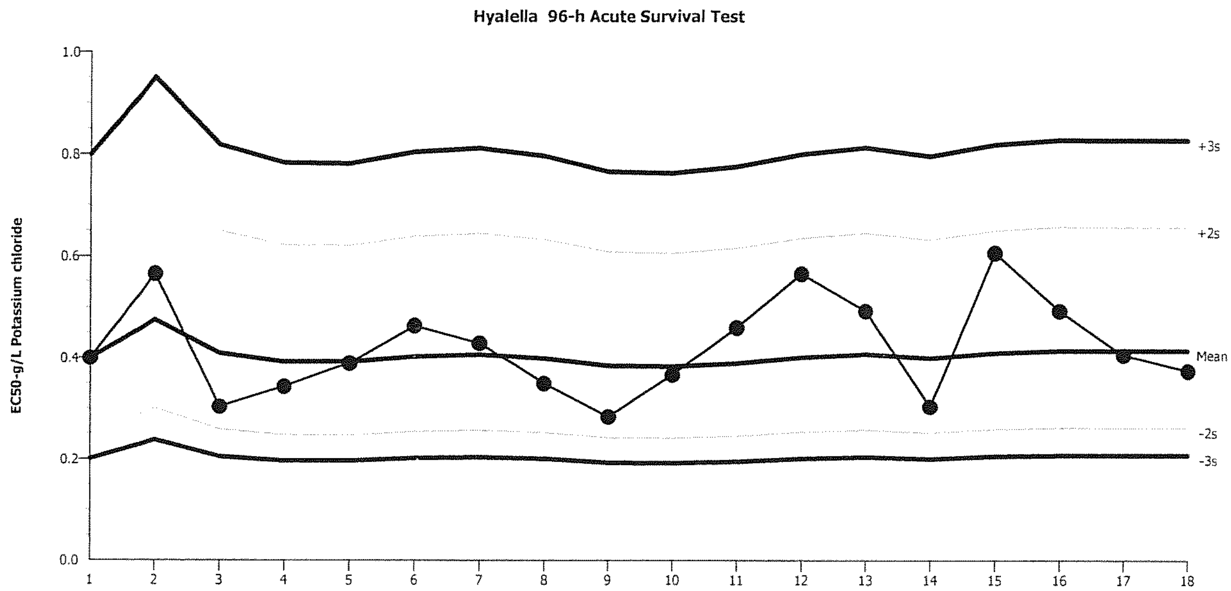
96h Survival Rate Binomials

C-g/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Lab Water Contr	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
0.1		1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
0.2		1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
0.4		1/1	0/1	0/1	1/1	0/1	1/1	0/1	0/1	0/1	1/1
0.8		0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1
1.6		0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1

CETIS QC Plot

Hyalella 96-h Acute Survival Test — **Pacific EcoRisk**

Test Type:	Survival (96h)	**Organism:**	Hyalella azteca (Freshwater Amphipo	**Material:**	Potassium chloride
Protocol:	EPA-821-R-02-012 (2002)	**Endpoint:**	96h Survival Rate	**Source:**	Reference Toxicant-REF



Mean:	0.4138	**Count:**	17	**-2s Warning Limit:**	0.2609	**-3s Action Limit:**	0.2071
Sigma:	NA	**CV:**	25.90%	**+2s Warning Limit:**	0.6565	**+3s Action Limit:**	0.8268

Quality Control Data

Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID
1	2013	Nov	6	15:40	0.4	-0.01383	-0.1473			15-7026-7439	19-7036-5835
2			20	17:00	0.5657	0.1519	1.355			01-7958-1543	09-3590-7589
3			21	16:55	0.3031	-0.1107	-1.349			17-4328-3485	11-7628-5959
4		Dec	11	17:45	0.3429	-0.07096	-0.8154			06-4892-3798	02-7681-8091
5	2014	Jan	22	15:30	0.3887	-0.02511	-0.2713			15-1323-9580	12-5039-1906
6			23	12:20	0.4634	0.0496	0.4907			12-4927-8114	03-4534-5077
7			24	13:50	0.4287	0.01488	0.1531			04-8256-1553	14-6784-2933
8			29	12:45	0.3482	-0.06561	-0.7482			02-0910-9206	20-3009-8021
9			30	13:00	0.2828	-0.131	-1.65			07-7453-2234	19-6136-6595
10			31	15:00	0.3651	-0.0487	-0.5427			07-3562-2451	09-8419-3354
11		Feb	4	16:00	0.4595	0.04565	0.4536			07-2556-9878	06-3437-8862
12			7	17:40	0.5657	0.1519	1.355			12-2780-2249	04-4756-7462
13			15	17:00	0.4925	0.07863	0.754			20-0080-3088	01-2359-2306
14			20	15:45	0.3031	-0.1107	-1.349			05-7047-7703	05-1521-5106
15			27	18:10	0.6063	0.1925	1.655			00-8786-3488	13-6064-7851
16			28	18:20	0.4925	0.07863	0.754			17-7114-0796	13-7617-1964
17		Mar	1	17:30	0.4048	-0.009021	-0.09554			13-0688-9437	00-6627-1218
18			27	13:00	0.3732	-0.04062	-0.4478			08-8207-4257	13-7765-3936

96 Hour *Hyalella azteca* Reference Toxicant Test Data

Client: **Reference Toxicant** — Organism Log #: 8066 — Age: 8 days
Test Material: **Potassium Chloride** — Organism Supplier: **ABS**
Project # 22246 — Test ID#: ~~22246~~-56010 — Control/Diluent: **SAM-5**
Test Date: 3/27/14 — Randomization: 10-6-13 — Control Water Batch: 97
Feeding T0 Time: 1300 — Initials: [illegible] — Feeding T46 Time: 1245 — Initials: [illegible]

Treatment (g/L)	Temp (°C)	pH	D.O. (mg/L)	Conductivity (µS/cm)	# Live Animals A	B	C	D	E	F	G	H	I	J	Sign-off
Control	23.0	7.93	8.8	419	1	1	1	1	1	1	1	1	1	1	Test Solution Prep: CJD
0.1	23.0	7.93	8.9	671	1	1	1	1	1	1	1	1	1	1	New WQ: CJD
0.2	23.0	7.94	9.0	810	1	1	1	1	1	1	1	1	1	1	Initiation Date: 3/27/14
0.4	23.0	7.94	9.2	1143	1	1	1	1	1	1	1	1	1	1	Initiation Time: 1300
0.8	23.0	7.96	9.4	1875	1	1	1	1	1	1	1	1	1	1	Initiation Signoff: [illegible]
1.6	23.0	7.86	9.8	3310	1	1	1	1	1	1	1	1	1	1	RT Batch #: 14
Meter ID	84A	PH21	RD09	EC06											
Control	23.2				1	1	1	1	1	1	1	1	1	1	Count Date: 3/28/14
0.1	23.2				1	1	1	1	1	1	1	1	1	1	Count Time: 1145
0.2	23.2				1	1	1	1	1	1	1	1	1	1	Count Signoff: MM
0.4	23.2				1	1	1	1	1	1	1	1	1	1	
0.8	23.2				0	0	0	0	1	0	0	0	0	0	
1.6	23.2				0	0	0	0	0	0	0	0	0	0	
Meter ID	84A														
Control	23.1				1	1	1	1	1	1	1	1	1	1	Count Date: 3/29/14
0.1	23.1				1	1	1	1	1	1	1	1	1	1	Count Time: 1245
0.2	23.1				1	1	1	1	1	1	1	1	1	1	Count Signoff: [illegible]
0.4	23.1				1	0	0	1	1	1	1	0	1	1	
0.8	23.1				–	–	–	–	0	–	–	–	–	–	
1.6	23.1				–	–	–	–	–	–	–	–	–	–	
Meter ID	84A														
Control	22.8				1	1	1	1	1	1	1	1	1	1	Count Date: 3/30/14
0.1	22.8				1	1	1	1	1	1	1	1	1	1	Count Time: 1000
0.2	22.8				1	1	1	1	1	1	1	1	1	1	Count Signoff: CP
0.4	22.8				1	–	–	1	0	1	1	–	0	1	
0.8	22.8				–	–	–	–	–	–	–	–	–	–	
1.6	22.8				–	–	–	–	–	–	–	–	–	–	
Meter ID	84A														
Control	23.2	7.65	8.5	441	1	1	1	1	1	1	1	1	1	1	Termination Date: 3-31-14
0.1	23.2	7.70	8.4	703	1	1	1	1	1	1	1	1	1	1	Termination Time: 1345
0.2	23.2	7.70	8.4	843	1	1	1	1	1	1	1	1	1	1	Termination Signoff: [illegible]
0.4	23.2	7.71	8.5	1167	1	–	–	1	–	1	0	–	–	1	Old WQ: LS
0.8	–	7.76	8.6	1919	–	–	–	–	–	–	–	–	–	–	
1.6	–	7.73	8.5	3260	–	–	–	–	–	–	–	–	–	–	
Meter ID	84A	PH21	RD09	EC06											

ENVIRONMENTAL ANALYSES

REVISED

Tuesday, September 30, 2014

Alessandro Hnatt
ADH Environmental
3065 Porter Street, Suite 101
Soquel, CA 95073

Re	Lab Order:	P070867	Collected By:	KEVIN LEWIS
	Project ID:	CCCWP-SSID SEDIMENTS	PO/Contract #:	030.001.0202

Dear Alessandro Hnatt:

Enclosed are the analytical results for sample(s) received by the laboratory on Tuesday, July 22, 2014. Results reported herein conform to the most current NELAC standards, where applicable, unless otherwise narrated in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Enclosures

Project Manager: Todd Albertson

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SAMPLE SUMMARY

Lab Order: P070867
Project ID: CCCWP-SSID SEDIMENTS

Lab ID	Sample ID	Matrix	Date Collected	Date Received
P070867001	**544MSH065**	Solid	07/22/2014 11:45	07/22/2014 17:54
P070867002	**544MSH062**	Solid	07/22/2014 10:15	07/22/2014 17:54
P070867003	**207WAL078**	Solid	07/22/2014 14:45	07/22/2014 17:54
P070867004	**207WAL060**	Solid	07/22/2014 11:45	07/22/2014 17:54
P070867005	**544MSH065**	Solid	07/22/2014 11:45	07/22/2014 17:54
P070867006	**544MSH062**	Solid	07/22/2014 10:15	07/22/2014 17:54
P070867007	**207WAL078**	Solid	07/22/2014 14:45	07/22/2014 17:54
P070867008	**207WAL060**	Solid	07/22/2014 11:45	07/22/2014 17:54

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NARRATIVE

Lab Order: P070867
Project ID: CCCWP-SSID SEDIMENTS

General Qualifiers and Notes

Caltest authorizes this report to be reproduced only in its entirety. Results are specific to the sample(s) as submitted and only to the parameter(s) reported.

Caltest certifies that all test results for wastewater and hazardous waste analyses meet all applicable NELAC requirements; all microbiology and drinking water testing meet applicable ELAP requirements, unless stated otherwise.

All analyses performed by EPA Methods or Standard Methods (SM) 20th Edition except where noted (SMOL=online edition).

Caltest collects samples in compliance with 40 CFR, EPA Methods, Cal. Title 22, and Standard Methods.

Dilution Factors (DF) reported greater than '1' have been used to adjust the result, Reporting Limit (RL), and Method Detection Limit (MDL).

All Solid, sludge, and/or biosolids data is reported in Wet Weight, unless otherwise specified.

Filtrations performed at Caltest for dissolved metals (excluding mercury) and/or pH analysis are not performed within the 15 minute holding time as specified by 40CFR 136.3 table II.

Results Qualifiers: Report fields may contain codes and non-numeric data correlating to one or more of the following definitions:

ND - Non Detect - indicates analytical result has not been detected.

RL - Reporting Limit is the quantitation limit at which the laboratory is able to detect an analyte. An analyte not detected at or above the RL is reported as ND unless otherwise noted or qualified. For analyses pertaining to the State Implementation Plan of the California Toxics Rule, the Caltest Reporting Limit (RL) is equivalent to the Minimum Level (ML). A standard is always run at or below the ML. Where Reporting Limits are elevated due to dilution, the ML calibration criteria has been met.

J - reflects estimated analytical result value detected below the Reporting Limit (RL) and above the Method Detection Limit (MDL). The 'J' flag is equivalent to the DNQ Estimated Concentration flag.

E - indicates an estimated analytical result value.

B - indicates the analyte has been detected in the blank associated with the sample.

NC - means not able to be calculated for RPD or Spike Recoveries.

SS - compound is a Surrogate Spike used per laboratory quality assurance manual.

NOTE: This document represents a complete Analytical Report for the samples referenced herein and should be retained as a permanent record thereof.

Workorder Notes

Revised to include complete list of 8081 compounds for sample P070867004.

Qualifiers and Compound Notes

1	Analyte(s) reported as 'ND' means not detected at or above the listed Method Detection Limits (MDL).
2	This sample was analyzed following Florisil column cleanup (EPA Method 3620B).
3	Due to severe matrix interferences this compounds result should be considered an estimated value. The sample was run at a 2X and 5X dilution with similar results.
4	Due to matrix interferences present in the sample, surrogate recoveries failed to meet the QA/QC acceptance criteria.
5	Analysis performed past regulatory holding time per client authorization.
6	Due to severe matrix interferences all results should be considered estimated values. The sample was run at a 2X and 5X dilution with similar results.

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NARRATIVE

Lab Order: P070867
Project ID: CCCWP-SSID SEDIMENTS

Qualifiers and Compound Notes

7	Sample diluted to bring concentration of target analyte(s) within the working range of the instrument, resulting in increased reporting limits.

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ANALYTICAL RESULTS

Lab Order: P070867
Project ID: CCCWP-SSID SEDIMENTS

Solid results are reported on a dry weight basis.

Lab ID **P070867001** Date Collected 7/22/2014 11:45 Matrix Solid
Sample ID **544MSH065** Date Received 7/22/2014 17:54 Results are expressed as dry weight values

Parameters	Result Units	R. L.	MDL	DF Prepared	Batch	Analyzed	Batch	Qual
Chlorinated Pesticides Analysis	**Prep Method:**	SW846 3541		**Prep by:**	EAB			
	Analytical Method:	SW846 8081				**Analyzed by:**	MDT	
Aldrin	ND mg/kg	0.0022	0.00097	1 07/30/14 00:00	SPR 6556	08/14/14 18:56	SEC 2174	2,1
alpha-BHC	ND mg/kg	0.0022	0.00097	1 07/30/14 00:00	SPR 6556	08/14/14 18:56	SEC 2174	
beta-BHC	ND mg/kg	0.0022	0.00097	1 07/30/14 00:00	SPR 6556	08/14/14 18:56	SEC 2174	
delta-BHC	ND mg/kg	0.0022	0.00076	1 07/30/14 00:00	SPR 6556	08/14/14 18:56	SEC 2174	
gamma-BHC (Lindane)	ND mg/kg	0.0022	0.00076	1 07/30/14 00:00	SPR 6556	08/14/14 18:56	SEC 2174	
alpha-Chlordane (cis)	ND mg/kg	0.0060	0.0011	1 07/30/14 00:00	SPR 6556	08/14/14 18:56	SEC 2174	
Chlordane	ND mg/kg	0.0043	0.0032	1 07/30/14 00:00	SPR 6556	08/14/14 18:56	SEC 2174	
gamma-Chlordane (trans)	ND mg/kg	0.0060	0.0011	1 07/30/14 00:00	SPR 6556	08/14/14 18:56	SEC 2174	
2,4'-DDD	0.012 mg/kg	0.0050	0.0022	1 07/30/14 00:00	SPR 6556	08/11/14 17:59	SEC 2174	
2,4'-DDE	0.0058 mg/kg	0.0050	0.0022	1 07/30/14 00:00	SPR 6556	08/11/14 17:59	SEC 2174	
2,4'-DDT	ND mg/kg	0.0050	0.0022	1 07/30/14 00:00	SPR 6556	08/11/14 17:59	SEC 2174	
4,4'-DDD	0.0036 mg/kg	0.0022	0.00086	1 07/30/14 00:00	SPR 6556	08/14/14 18:56	SEC 2174	
4,4'-DDE	0.028 mg/kg	0.0022	0.0013	1 07/30/14 00:00	SPR 6556	08/14/14 18:56	SEC 2174	
4,4'-DDT	ND mg/kg	0.0022	0.0011	1 07/30/14 00:00	SPR 6556	08/14/14 18:56	SEC 2174	
Dieldrin	ND mg/kg	0.0022	0.0013	1 07/30/14 00:00	SPR 6556	08/14/14 18:56	SEC 2174	
Endosulfan I	ND mg/kg	0.0022	0.00097	1 07/30/14 00:00	SPR 6556	08/14/14 18:56	SEC 2174	
Endosulfan II	ND mg/kg	0.0022	0.00076	1 07/30/14 00:00	SPR 6556	08/14/14 18:56	SEC 2174	
Endosulfan sulfate	ND mg/kg	0.0022	0.00097	1 07/30/14 00:00	SPR 6556	08/14/14 18:56	SEC 2174	
Endrin	ND mg/kg	0.0022	0.0011	1 07/30/14 00:00	SPR 6556	08/14/14 18:56	SEC 2174	
Endrin aldehyde	ND mg/kg	0.0022	0.00097	1 07/30/14 00:00	SPR 6556	08/14/14 18:56	SEC 2174	
Endrin ketone	ND mg/kg	0.0022	0.00097	1 07/30/14 00:00	SPR 6556	08/14/14 18:56	SEC 2174	
Heptachlor	ND mg/kg	0.0022	0.00065	1 07/30/14 00:00	SPR 6556	08/14/14 18:56	SEC 2174	
Heptachlor epoxide	ND mg/kg	0.0022	0.0012	1 07/30/14 00:00	SPR 6556	08/14/14 18:56	SEC 2174	
Kepone	ND mg/kg	0.03	0.0097	1 08/19/14 00:00	SPR 6584	09/05/14 05:46	SEC 2176	5
Methoxychlor	ND mg/kg	0.0022	0.00097	1 07/30/14 00:00	SPR 6556	08/14/14 18:56	SEC 2174	
Mirex	ND mg/kg	0.022	0.00054	1 07/30/14 00:00	SPR 6556	08/14/14 18:56	SEC 2174	
Toxaphene	ND mg/kg	0.04	0.022	1 07/30/14 00:00	SPR 6556	08/14/14 18:56	SEC 2174	
Decachlorobiphenyl (SS)	2.9 %	10-200		1 08/19/14 00:00	SPR 6584	09/05/14 05:46	SEC 2176	4
Decachlorobiphenyl (SS)	4.9 %	10-200		1 07/30/14 00:00	SPR 6556	08/14/14 18:56	SEC 2174	4
Tetrachloro-m-xylene (SS)	65 %	10-200		1 08/19/14 00:00	SPR 6584	09/05/14 05:46	SEC 2176	
Tetrachloro-m-xylene (SS)	43 %	10-200		1 07/30/14 00:00	SPR 6556	08/14/14 18:56	SEC 2174	
Pyrethroids+Fipronil Analysis,NCI,Solid	**Prep Method:**	SW846 3540C Soxhlet		**Prep by:**	EAB			
	Analytical Method:	SW846 8270 Mod				**Analyzed by:**	RLH	
Allethrin	ND ug/kg	0.33	0.054	1 07/29/14 00:00	SPR 6555	08/08/14 01:58	SMS 3515	1
Bifenthrin	99 ug/kg	0.33	0.11	1 07/29/14 00:00	SPR 6555	08/08/14 01:58	SMS 3515	3
Cyfluthrin	6.2 ug/kg	0.33	0.12	1 07/29/14 00:00	SPR 6555	08/08/14 01:58	SMS 3515	
Lambda-Cyhalothrin	0.37 ug/kg	0.33	0.065	1 07/29/14 00:00	SPR 6555	08/08/14 01:58	SMS 3515	3
Cypermethrin	J0.30 ug/kg	0.33	0.11	1 07/29/14 00:00	SPR 6555	08/08/14 01:58	SMS 3515	
Deltamethrin:Tralomethrin	ND ug/kg	0.33	0.13	1 07/29/14 00:00	SPR 6555	08/08/14 01:58	SMS 3515	
Esfenvalerate:Fenvalerate	ND ug/kg	0.33	0.14	1 07/29/14 00:00	SPR 6555	08/08/14 01:58	SMS 3515	
Fenpropathrin	ND ug/kg	0.33	0.076	1 07/29/14 00:00	SPR 6555	08/08/14 01:58	SMS 3515	
Fipronil	ND ug/kg	0.33	0.11	1 07/29/14 00:00	SPR 6555	08/08/14 01:58	SMS 3515	

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ANALYTICAL RESULTS

Lab Order: P070867
Project ID: CCCWP-SSID SEDIMENTS

Solid results are reported on a dry weight basis.

Lab ID **P070867001** Date Collected 7/22/2014 11:45 Matrix Solid
Sample ID **544MSH065** Date Received 7/22/2014 17:54 Results are expressed as dry weight values

Parameters	Result Units	R. L.	MDL	DF Prepared	Batch	Analyzed	Batch	Qual
Fipronil Desulfinyl	0.56 ug/kg	0.33	0.11	1 07/29/14 00:00	SPR 6555	08/08/14 01:58	SMS 3515	3
Fipronil Sulfide	ND ug/kg	0.33	0.11	1 07/29/14 00:00	SPR 6555	08/08/14 01:58	SMS 3515	
Fipronil Sulfone	3.0 ug/kg	0.33	0.11	1 07/29/14 00:00	SPR 6555	08/08/14 01:58	SMS 3515	3
Tau-Fluvalinate	ND ug/kg	0.33	0.043	1 07/29/14 00:00	SPR 6555	08/08/14 01:58	SMS 3515	
Permethrin	6.0 ug/kg	0.33	0.12	1 07/29/14 00:00	SPR 6555	08/08/14 01:58	SMS 3515	3
Tetramethrin	ND ug/kg	0.33	0.065	1 07/29/14 00:00	SPR 6555	08/08/14 01:58	SMS 3515	
Esfenvalerate-d6;#1 (SS)	94 %	70-130		1 07/29/14 00:00	SPR 6555	08/08/14 01:58	SMS 3515	
Esfenvalerate-d6;#2 (SS)	102 %	70-130		1 07/29/14 00:00	SPR 6555	08/08/14 01:58	SMS 3515	
Dried Sediment as Extracted	**Analytical Method:**	SM20-2540 G				**Analyzed by:**	CFG	
Solids, Percent	92 %	0.1	0.1	1		07/30/14 14:18	WGR 5525	

Lab ID **P070867002** Date Collected 7/22/2014 10:15 Matrix Solid
Sample ID **544MSH062** Date Received 7/22/2014 17:54 Results are expressed as dry weight values

Parameters	Result Units	R. L.	MDL	DF Prepared	Batch	Analyzed	Batch	Qual
Chlorinated Pesticides Analysis	**Prep Method:**	SW846 3541		**Prep by:**	EAB			
	Analytical Method:	SW846 8081				**Analyzed by:**	MDT	
Aldrin	ND mg/kg	0.0021	0.00094	1 07/30/14 00:00	SPR 6556	08/11/14 18:20	SEC 2174	2,1
alpha-BHC	ND mg/kg	0.0021	0.00094	1 07/30/14 00:00	SPR 6556	08/11/14 18:20	SEC 2174	
beta-BHC	ND mg/kg	0.0021	0.00094	1 07/30/14 00:00	SPR 6556	08/11/14 18:20	SEC 2174	
delta-BHC	ND mg/kg	0.0021	0.00073	1 07/30/14 00:00	SPR 6556	08/11/14 18:20	SEC 2174	
gamma-BHC (Lindane)	ND mg/kg	0.0021	0.00073	1 07/30/14 00:00	SPR 6556	08/11/14 18:20	SEC 2174	
alpha-Chlordane (cis)	ND mg/kg	0.0060	0.0010	1 07/30/14 00:00	SPR 6556	08/11/14 18:20	SEC 2174	
Chlordane	ND mg/kg	0.0042	0.0031	1 07/30/14 00:00	SPR 6556	08/11/14 18:20	SEC 2174	
gamma-Chlordane (trans)	ND mg/kg	0.0060	0.0010	1 07/30/14 00:00	SPR 6556	08/11/14 18:20	SEC 2174	
2,4'-DDD	0.034 mg/kg	0.0050	0.0021	1 07/30/14 00:00	SPR 6556	08/11/14 18:20	SEC 2174	
2,4'-DDE	0.019 mg/kg	0.0050	0.0021	1 07/30/14 00:00	SPR 6556	08/11/14 18:20	SEC 2174	
2,4'-DDT	ND mg/kg	0.0050	0.0021	1 07/30/14 00:00	SPR 6556	08/11/14 18:20	SEC 2174	
4,4'-DDD	0.023 mg/kg	0.0021	0.00084	1 07/30/14 00:00	SPR 6556	08/11/14 18:20	SEC 2174	
4,4'-DDE	0.076 mg/kg	0.010	0.0063	5 07/30/14 00:00	SPR 6556	08/14/14 20:49	SEC 2174	7
4,4'-DDT	ND mg/kg	0.0021	0.0010	1 07/30/14 00:00	SPR 6556	08/11/14 18:20	SEC 2174	
Dieldrin	ND mg/kg	0.0021	0.0013	1 07/30/14 00:00	SPR 6556	08/11/14 18:20	SEC 2174	
Endosulfan I	ND mg/kg	0.0021	0.00094	1 07/30/14 00:00	SPR 6556	08/11/14 18:20	SEC 2174	
Endosulfan II	ND mg/kg	0.0021	0.00073	1 07/30/14 00:00	SPR 6556	08/11/14 18:20	SEC 2174	
Endosulfan sulfate	ND mg/kg	0.0021	0.00094	1 07/30/14 00:00	SPR 6556	08/11/14 18:20	SEC 2174	
Endrin	ND mg/kg	0.0021	0.0010	1 07/30/14 00:00	SPR 6556	08/11/14 18:20	SEC 2174	
Endrin aldehyde	ND mg/kg	0.0021	0.00094	1 07/30/14 00:00	SPR 6556	08/11/14 18:20	SEC 2174	
Endrin ketone	ND mg/kg	0.0021	0.00094	1 07/30/14 00:00	SPR 6556	08/11/14 18:20	SEC 2174	
Heptachlor	ND mg/kg	0.0021	0.00063	1 07/30/14 00:00	SPR 6556	08/11/14 18:20	SEC 2174	
Heptachlor epoxide	ND mg/kg	0.0021	0.0012	1 07/30/14 00:00	SPR 6556	08/11/14 18:20	SEC 2174	
Kepone	ND mg/kg	0.03	0.0094	1 08/19/14 00:00	SPR 6584	09/05/14 06:14	SEC 2176	5
Methoxychlor	ND mg/kg	0.0021	0.00094	1 07/30/14 00:00	SPR 6556	08/11/14 18:20	SEC 2174	
Mirex	ND mg/kg	0.021	0.00052	1 07/30/14 00:00	SPR 6556	08/11/14 18:20	SEC 2174	
Toxaphene	ND mg/kg	0.04	0.021	1 07/30/14 00:00	SPR 6556	08/11/14 18:20	SEC 2174	

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ANALYTICAL RESULTS

Lab Order: P070867
Project ID: CCCWP-SSID SEDIMENTS

Solid results are reported on a dry weight basis.

Lab ID **P070867002** Date Collected 7/22/2014 10:15 Matrix Solid
Sample ID **544MSH062** Date Received 7/22/2014 17:54 Results are expressed as dry weight values

Parameters	Result	Units	R. L.	MDL	DF	Prepared	Batch	Analyzed	Batch	Qual
Decachlorobiphenyl (SS)	3.9	%	10-200		1	08/19/14 00:00	SPR 6584	09/05/14 06:14	SEC 2176	4
Decachlorobiphenyl (SS)	16	%	10-200		1	07/30/14 00:00	SPR 6556	08/11/14 18:20	SEC 2174	
Tetrachloro-m-xylene (SS)	60	%	10-200		1	07/30/14 00:00	SPR 6556	08/11/14 18:20	SEC 2174	
Tetrachloro-m-xylene (SS)	66	%	10-200		1	08/19/14 00:00	SPR 6584	09/05/14 06:14	SEC 2176	
Pyrethroids+Fipronil Analysis,NCI,Solid	**Prep Method:**		SW846 3540C Soxhlet		**Prep by:**	EAB				
	Analytical Method:		SW846 8270 Mod					**Analyzed by:**	RLH	
Allethrin	ND	ug/kg	0.33	0.052	1	07/29/14 00:00	SPR 6555	08/08/14 03:44	SMS 3515	1,6
Bifenthrin	40	ug/kg	0.33	0.10	1	07/29/14 00:00	SPR 6555	08/08/14 03:44	SMS 3515	3
Cyfluthrin	3.4	ug/kg	0.33	0.12	1	07/29/14 00:00	SPR 6555	08/08/14 03:44	SMS 3515	
Lambda-Cyhalothrin	J0.24	ug/kg	0.33	0.063	1	07/29/14 00:00	SPR 6555	08/08/14 03:44	SMS 3515	3
Cypermethrin	0.35	ug/kg	0.33	0.10	1	07/29/14 00:00	SPR 6555	08/08/14 03:44	SMS 3515	
Deltamethrin:Tralomethrin	ND	ug/kg	0.33	0.13	1	07/29/14 00:00	SPR 6555	08/08/14 03:44	SMS 3515	
Esfenvalerate:Fenvalerate	ND	ug/kg	0.33	0.14	1	07/29/14 00:00	SPR 6555	08/08/14 03:44	SMS 3515	
Fenpropathrin	ND	ug/kg	0.33	0.073	1	07/29/14 00:00	SPR 6555	08/08/14 03:44	SMS 3515	
Fipronil	ND	ug/kg	0.33	0.10	1	07/29/14 00:00	SPR 6555	08/08/14 03:44	SMS 3515	
Fipronil Desulfinyl	J0.27	ug/kg	0.33	0.10	1	07/29/14 00:00	SPR 6555	08/08/14 03:44	SMS 3515	3
Fipronil Sulfide	ND	ug/kg	0.33	0.10	1	07/29/14 00:00	SPR 6555	08/08/14 03:44	SMS 3515	
Fipronil Sulfone	ND	ug/kg	0.33	0.10	1	07/29/14 00:00	SPR 6555	08/08/14 03:44	SMS 3515	
Tau-Fluvalinate	ND	ug/kg	0.33	0.042	1	07/29/14 00:00	SPR 6555	08/08/14 03:44	SMS 3515	
Permethrin	9.4	ug/kg	0.33	0.12	1	07/29/14 00:00	SPR 6555	08/08/14 03:44	SMS 3515	3
Tetramethrin	ND	ug/kg	0.33	0.063	1	07/29/14 00:00	SPR 6555	08/08/14 03:44	SMS 3515	
Esfenvalerate-d6;#1 (SS)	103	%	70-130		1	07/29/14 00:00	SPR 6555	08/08/14 03:44	SMS 3515	
Esfenvalerate-d6;#2 (SS)	118	%	70-130		1	07/29/14 00:00	SPR 6555	08/08/14 03:44	SMS 3515	
Dried Sediment as Extracted	**Analytical Method:**		SM20-2540 G					**Analyzed by:**	CFG	
Solids, Percent	95	%	0.1	0.1	1			07/30/14 14:18	WGR 5525	

Lab ID **P070867003** Date Collected 7/22/2014 14:45 Matrix Solid
Sample ID **207WAL078** Date Received 7/22/2014 17:54 Results are expressed as dry weight values

Parameters	Result	Units	R. L.	MDL	DF	Prepared	Batch	Analyzed	Batch	Qual
Chlorinated Pesticides Analysis	**Prep Method:**		SW846 3541		**Prep by:**	EAB				
	Analytical Method:		SW846 8081					**Analyzed by:**	MDT	
Aldrin	ND	mg/kg	0.0023	0.0010	1	07/30/14 00:00	SPR 6556	08/11/14 18:41	SEC 2174	2,1
alpha-BHC	ND	mg/kg	0.0023	0.0010	1	07/30/14 00:00	SPR 6556	08/11/14 18:41	SEC 2174	
beta-BHC	ND	mg/kg	0.0023	0.0010	1	07/30/14 00:00	SPR 6556	08/11/14 18:41	SEC 2174	
delta-BHC	ND	mg/kg	0.0023	0.00081	1	07/30/14 00:00	SPR 6556	08/11/14 18:41	SEC 2174	
gamma-BHC (Lindane)	ND	mg/kg	0.0023	0.00081	1	07/30/14 00:00	SPR 6556	08/11/14 18:41	SEC 2174	
alpha-Chlordane (cis)	ND	mg/kg	0.0060	0.0012	1	07/30/14 00:00	SPR 6556	08/11/14 18:41	SEC 2174	
Chlordane	ND	mg/kg	0.0046	0.0035	1	07/30/14 00:00	SPR 6556	08/11/14 18:41	SEC 2174	
gamma-Chlordane (trans)	ND	mg/kg	0.0060	0.0012	1	07/30/14 00:00	SPR 6556	08/11/14 18:41	SEC 2174	
2,4'-DDD	ND	mg/kg	0.0050	0.0023	1	07/30/14 00:00	SPR 6556	08/11/14 18:41	SEC 2174	
2,4'-DDE	ND	mg/kg	0.0050	0.0023	1	07/30/14 00:00	SPR 6556	08/11/14 18:41	SEC 2174	

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ANALYTICAL RESULTS

Lab Order: P070867
Project ID: CCCWP-SSID SEDIMENTS

Solid results are reported on a dry weight basis.

Lab ID **P070867003** Date Collected 7/22/2014 14:45 Matrix Solid
Sample ID **207WAL078** Date Received 7/22/2014 17:54 Results are expressed as dry weight values

Parameters	Result Units	R. L.	MDL	DF Prepared	Batch	Analyzed	Batch	Qual
2,4'-DDT	ND mg/kg	0.0050	0.0023	1 07/30/14 00:00	SPR 6556	08/11/14 18:41	SEC 2174	
4,4'-DDD	ND mg/kg	0.0023	0.00092	1 07/30/14 00:00	SPR 6556	08/11/14 18:41	SEC 2174	
4,4'-DDE	ND mg/kg	0.0023	0.0014	1 07/30/14 00:00	SPR 6556	08/11/14 18:41	SEC 2174	
4,4'-DDT	ND mg/kg	0.0023	0.0012	1 07/30/14 00:00	SPR 6556	08/11/14 18:41	SEC 2174	
Dieldrin	ND mg/kg	0.0023	0.0014	1 07/30/14 00:00	SPR 6556	08/11/14 18:41	SEC 2174	
Endosulfan I	ND mg/kg	0.0023	0.0010	1 07/30/14 00:00	SPR 6556	08/11/14 18:41	SEC 2174	
Endosulfan II	ND mg/kg	0.0023	0.00081	1 07/30/14 00:00	SPR 6556	08/11/14 18:41	SEC 2174	
Endosulfan sulfate	ND mg/kg	0.0023	0.0010	1 07/30/14 00:00	SPR 6556	08/11/14 18:41	SEC 2174	
Endrin	ND mg/kg	0.0023	0.0012	1 07/30/14 00:00	SPR 6556	08/11/14 18:41	SEC 2174	
Endrin aldehyde	ND mg/kg	0.0023	0.0010	1 07/30/14 00:00	SPR 6556	08/11/14 18:41	SEC 2174	
Endrin ketone	ND mg/kg	0.0023	0.0010	1 07/30/14 00:00	SPR 6556	08/11/14 18:41	SEC 2174	
Heptachlor	ND mg/kg	0.0023	0.00069	1 07/30/14 00:00	SPR 6556	08/11/14 18:41	SEC 2174	
Heptachlor epoxide	ND mg/kg	0.0023	0.0013	1 07/30/14 00:00	SPR 6556	08/11/14 18:41	SEC 2174	
Kepone	ND mg/kg	0.03	0.010	1 08/19/14 00:00	SPR 6584	09/05/14 06:41	SEC 2176	5
Methoxychlor	ND mg/kg	0.0023	0.0010	1 07/30/14 00:00	SPR 6556	08/11/14 18:41	SEC 2174	
Mirex	ND mg/kg	0.023	0.00058	1 07/30/14 00:00	SPR 6556	08/11/14 18:41	SEC 2174	
Toxaphene	ND mg/kg	0.05	0.023	1 07/30/14 00:00	SPR 6556	08/11/14 18:41	SEC 2174	
Decachlorobiphenyl (SS)	9.5 %	10-200		1 08/19/14 00:00	SPR 6584	09/05/14 06:41	SEC 2176	4
Decachlorobiphenyl (SS)	12 %	10-200		1 07/30/14 00:00	SPR 6556	08/11/14 18:41	SEC 2174	
Tetrachloro-m-xylene (SS)	36 %	10-200		1 07/30/14 00:00	SPR 6556	08/11/14 18:41	SEC 2174	
Tetrachloro-m-xylene (SS)	33 %	10-200		1 08/19/14 00:00	SPR 6584	09/05/14 06:41	SEC 2176	

Pyrethroids+Fipronil Analysis,NCI,Solid — **Prep Method:** SW846 3540C Soxhlet **Prep by:** EAB
Analytical Method: SW846 8270 Mod **Analyzed by:** RLH

Parameters	Result Units	R. L.	MDL	DF Prepared	Batch	Analyzed	Batch	Qual
Allethrin	ND ug/kg	0.33	0.058	1 07/29/14 00:00	SPR 6555	08/08/14 05:32	SMS 3515	1
Bifenthrin	5.6 ug/kg	0.33	0.12	1 07/29/14 00:00	SPR 6555	08/08/14 05:32	SMS 3515	3
Cyfluthrin	0.80 ug/kg	0.33	0.13	1 07/29/14 00:00	SPR 6555	08/08/14 05:32	SMS 3515	3
Lambda-Cyhalothrin	ND ug/kg	0.33	0.069	1 07/29/14 00:00	SPR 6555	08/08/14 05:32	SMS 3515	
Cypermethrin	J0.28 ug/kg	0.33	0.12	1 07/29/14 00:00	SPR 6555	08/08/14 05:32	SMS 3515	3
Deltamethrin:Tralomethrin	ND ug/kg	0.33	0.14	1 07/29/14 00:00	SPR 6555	08/08/14 05:32	SMS 3515	
Esfenvalerate:Fenvalerate	ND ug/kg	0.33	0.15	1 07/29/14 00:00	SPR 6555	08/08/14 05:32	SMS 3515	
Fenpropathrin	ND ug/kg	0.33	0.081	1 07/29/14 00:00	SPR 6555	08/08/14 05:32	SMS 3515	
Fipronil	ND ug/kg	0.33	0.12	1 07/29/14 00:00	SPR 6555	08/08/14 05:32	SMS 3515	
Fipronil Desulfinyl	ND ug/kg	0.33	0.12	1 07/29/14 00:00	SPR 6555	08/08/14 05:32	SMS 3515	
Fipronil Sulfide	ND ug/kg	0.33	0.12	1 07/29/14 00:00	SPR 6555	08/08/14 05:32	SMS 3515	
Fipronil Sulfone	ND ug/kg	0.33	0.12	1 07/29/14 00:00	SPR 6555	08/08/14 05:32	SMS 3515	
Tau-Fluvalinate	ND ug/kg	0.33	0.046	1 07/29/14 00:00	SPR 6555	08/08/14 05:32	SMS 3515	
Permethrin	1.9 ug/kg	0.33	0.13	1 07/29/14 00:00	SPR 6555	08/08/14 05:32	SMS 3515	3
Tetramethrin	ND ug/kg	0.33	0.069	1 07/29/14 00:00	SPR 6555	08/08/14 05:32	SMS 3515	
Esfenvalerate-d6;#1 (SS)	97 %	70-130		1 07/29/14 00:00	SPR 6555	08/08/14 05:32	SMS 3515	
Esfenvalerate-d6;#2 (SS)	115 %	70-130		1 07/29/14 00:00	SPR 6555	08/08/14 05:32	SMS 3515	

Dried Sediment as Extracted — **Analytical Method:** SM20-2540 G **Analyzed by:** CFG

Parameters	Result Units	R. L.	MDL	DF Prepared	Batch	Analyzed	Batch	Qual
Solids, Percent	87 %	0.1	0.1	1		07/30/14 14:18	WGR 5525	

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ANALYTICAL RESULTS

Lab Order: P070867
Project ID: CCCWP-SSID SEDIMENTS

Solid results are reported on a dry weight basis.

Lab ID **P070867004** Date Collected 7/22/2014 11:45 Matrix Solid
Sample ID **207WAL060** Date Received 7/22/2014 17:54 Results are expressed as dry weight values

Parameters	Result Units	R. L.	MDL	DF Prepared	Batch	Analyzed	Batch	Qual
Chlorinated Pesticides Analysis	**Prep Method:**	SW846 3541		**Prep by:**	EAB			
	Analytical Method:	SW846 8081				**Analyzed by:**	MDT	
Aldrin	ND mg/kg	0.0021	0.00092	1 07/30/14 00:00	SPR 6556	08/11/14 19:02	SEC 2174	2,1
alpha-BHC	ND mg/kg	0.0021	0.00092	1 07/30/14 00:00	SPR 6556	08/11/14 19:02	SEC 2174	
beta-BHC	ND mg/kg	0.0021	0.00092	1 07/30/14 00:00	SPR 6556	08/11/14 19:02	SEC 2174	
delta-BHC	ND mg/kg	0.0021	0.00072	1 07/30/14 00:00	SPR 6556	08/11/14 19:02	SEC 2174	
gamma-BHC (Lindane)	ND mg/kg	0.0021	0.00072	1 07/30/14 00:00	SPR 6556	08/11/14 19:02	SEC 2174	
alpha-Chlordane (cis)	ND mg/kg	0.0060	0.0010	1 07/30/14 00:00	SPR 6556	08/11/14 19:02	SEC 2174	
Chlordane	ND mg/kg	0.0041	0.0031	1 07/30/14 00:00	SPR 6556	08/11/14 19:02	SEC 2174	
gamma-Chlordane (trans)	ND mg/kg	0.0060	0.0010	1 07/30/14 00:00	SPR 6556	08/11/14 19:02	SEC 2174	
2,4'-DDD	ND mg/kg	0.0050	0.0021	1 07/30/14 00:00	SPR 6556	08/11/14 19:02	SEC 2174	
2,4'-DDE	ND mg/kg	0.0050	0.0021	1 07/30/14 00:00	SPR 6556	08/11/14 19:02	SEC 2174	
2,4'-DDT	ND mg/kg	0.0050	0.0021	1 07/30/14 00:00	SPR 6556	08/11/14 19:02	SEC 2174	
4,4'-DDD	ND mg/kg	0.0021	0.00082	1 07/30/14 00:00	SPR 6556	08/11/14 19:02	SEC 2174	
4,4'-DDE	ND mg/kg	0.0021	0.0012	1 07/30/14 00:00	SPR 6556	08/11/14 19:02	SEC 2174	
4,4'-DDT	ND mg/kg	0.0021	0.0010	1 07/30/14 00:00	SPR 6556	08/11/14 19:02	SEC 2174	
Dieldrin	ND mg/kg	0.0021	0.0012	1 07/30/14 00:00	SPR 6556	08/11/14 19:02	SEC 2174	
Endosulfan I	ND mg/kg	0.0021	0.00092	1 07/30/14 00:00	SPR 6556	08/11/14 19:02	SEC 2174	
Endosulfan II	ND mg/kg	0.0021	0.00072	1 07/30/14 00:00	SPR 6556	08/11/14 19:02	SEC 2174	
Endosulfan sulfate	ND mg/kg	0.0021	0.00092	1 07/30/14 00:00	SPR 6556	08/11/14 19:02	SEC 2174	
Endrin	ND mg/kg	0.0021	0.0010	1 07/30/14 00:00	SPR 6556	08/11/14 19:02	SEC 2174	
Endrin aldehyde	ND mg/kg	0.0021	0.00092	1 07/30/14 00:00	SPR 6556	08/11/14 19:02	SEC 2174	
Endrin ketone	ND mg/kg	0.0021	0.00092	1 07/30/14 00:00	SPR 6556	08/11/14 19:02	SEC 2174	
Heptachlor	ND mg/kg	0.0021	0.00062	1 07/30/14 00:00	SPR 6556	08/11/14 19:02	SEC 2174	
Heptachlor epoxide	ND mg/kg	0.0021	0.0011	1 07/30/14 00:00	SPR 6556	08/11/14 19:02	SEC 2174	
Kepone	ND mg/kg	0.03	0.0092	1 08/19/14 00:00	SPR 6584	09/05/14 07:09	SEC 2176	5
Methoxychlor	ND mg/kg	0.0021	0.00092	1 07/30/14 00:00	SPR 6556	08/11/14 19:02	SEC 2174	
Mirex	ND mg/kg	0.021	0.00051	1 07/30/14 00:00	SPR 6556	08/11/14 19:02	SEC 2174	
Toxaphene	ND mg/kg	0.04	0.021	1 07/30/14 00:00	SPR 6556	08/11/14 19:02	SEC 2174	
Decachlorobiphenyl (SS)	4.6 %	10-200		1 08/19/14 00:00	SPR 6584	09/05/14 07:09	SEC 2176	4
Decachlorobiphenyl (SS)	7.3 %	10-200		1 07/30/14 00:00	SPR 6556	08/11/14 19:02	SEC 2174	4
Tetrachloro-m-xylene (SS)	20 %	10-200		1 07/30/14 00:00	SPR 6556	08/11/14 19:02	SEC 2174	
Tetrachloro-m-xylene (SS)	915 %	10-200		1 08/19/14 00:00	SPR 6584	09/05/14 07:09	SEC 2176	4
Pyrethroids+Fipronil Analysis,NCI,Solid	**Prep Method:**	SW846 3540C Soxhlet		**Prep by:**	EAB			
	Analytical Method:	SW846 8270 Mod				**Analyzed by:**	RLH	
Allethrin	ND ug/kg	0.33	0.051	1 07/29/14 00:00	SPR 6555	08/08/14 07:19	SMS 3515	1
Bifenthrin	3.6 ug/kg	0.33	0.10	1 07/29/14 00:00	SPR 6555	08/08/14 07:19	SMS 3515	3
Cyfluthrin	0.41 ug/kg	0.33	0.11	1 07/29/14 00:00	SPR 6555	08/08/14 07:19	SMS 3515	3
Lambda-Cyhalothrin	ND ug/kg	0.33	0.062	1 07/29/14 00:00	SPR 6555	08/08/14 07:19	SMS 3515	
Cypermethrin	J0.21 ug/kg	0.33	0.10	1 07/29/14 00:00	SPR 6555	08/08/14 07:19	SMS 3515	3
Deltamethrin:Tralomethrin	ND ug/kg	0.33	0.12	1 07/29/14 00:00	SPR 6555	08/08/14 07:19	SMS 3515	
Esfenvalerate:Fenvalerate	ND ug/kg	0.33	0.13	1 07/29/14 00:00	SPR 6555	08/08/14 07:19	SMS 3515	
Fenpropathrin	ND ug/kg	0.33	0.072	1 07/29/14 00:00	SPR 6555	08/08/14 07:19	SMS 3515	
Fipronil	ND ug/kg	0.33	0.10	1 07/29/14 00:00	SPR 6555	08/08/14 07:19	SMS 3515	

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ANALYTICAL RESULTS

Lab Order: P070867
Project ID: CCCWP-SSID SEDIMENTS

Solid results are reported on a dry weight basis.

Lab ID **P070867004** Date Collected 7/22/2014 11:45 Matrix Solid
Sample ID **207WAL060** Date Received 7/22/2014 17:54 Results are expressed as dry weight values

Parameters	Result Units	R. L.	MDL	DF Prepared	Batch	Analyzed	Batch	Qual
Fipronil Desulfinyl	ND ug/kg	0.33	0.10	1 07/29/14 00:00	SPR 6555	08/08/14 07:19	SMS 3515	
Fipronil Sulfide	ND ug/kg	0.33	0.10	1 07/29/14 00:00	SPR 6555	08/08/14 07:19	SMS 3515	
Fipronil Sulfone	J0.14 ug/kg	0.33	0.10	1 07/29/14 00:00	SPR 6555	08/08/14 07:19	SMS 3515	3
Tau-Fluvalinate	ND ug/kg	0.33	0.041	1 07/29/14 00:00	SPR 6555	08/08/14 07:19	SMS 3515	
Permethrin	2.3 ug/kg	0.33	0.11	1 07/29/14 00:00	SPR 6555	08/08/14 07:19	SMS 3515	3
Tetramethrin	ND ug/kg	0.33	0.062	1 07/29/14 00:00	SPR 6555	08/08/14 07:19	SMS 3515	
Esfenvalerate-d6;#1 (SS)	102 %	70-130		1 07/29/14 00:00	SPR 6555	08/08/14 07:19	SMS 3515	
Esfenvalerate-d6;#2 (SS)	120 %	70-130		1 07/29/14 00:00	SPR 6555	08/08/14 07:19	SMS 3515	
Dried Sediment as Extracted	**Analytical Method:**	SM20-2540 G				**Analyzed by:**	CFG	
Solids, Percent	97 %	0.1	0.1	1		07/30/14 14:18	WGR 5525	

Lab ID **P070867005** Date Collected 7/22/2014 11:45 Matrix Solid
Sample ID **544MSH065** Date Received 7/22/2014 17:54 Results are expressed as dry weight values

Parameters	Result Units	R. L.	MDL	DF Prepared	Batch	Analyzed	Batch	Qual
Client provided Data	**Analytical Method:**	Client Method				**Analyzed by:**	PJB	
Solids, Percent	25 %			1		07/22/14 11:45	CSV 1205	
TOC SO by EPA 9060 - Ref.Lab	**Analytical Method:**	EPA 9060				**Analyzed by:**	PJB	
Total Organic Carbon	4.6 %	0.40	0.040	1		08/06/14 13:00	SUB 1666	

Lab ID **P070867006** Date Collected 7/22/2014 10:15 Matrix Solid
Sample ID **544MSH062** Date Received 7/22/2014 17:54 Results are expressed as dry weight values

Parameters	Result Units	R. L.	MDL	DF Prepared	Batch	Analyzed	Batch	Qual
Client provided Data	**Analytical Method:**	Client Method				**Analyzed by:**	PJB	
Solids, Percent	52 %			1		07/22/14 10:15	CSV 1205	
TOC SO by EPA 9060 - Ref.Lab	**Analytical Method:**	EPA 9060				**Analyzed by:**	PJB	
Total Organic Carbon	1.9 %	0.19	0.019	1		08/06/14 13:00	SUB 1666	

Lab ID **P070867007** Date Collected 7/22/2014 14:45 Matrix Solid
Sample ID **207WAL078** Date Received 7/22/2014 17:54 Results are expressed as dry weight values

Parameters	Result Units	R. L.	MDL	DF Prepared	Batch	Analyzed	Batch	Qual
Client provided Data	**Analytical Method:**	Client Method				**Analyzed by:**	PJB	
Solids, Percent	40 %			1		07/22/14 14:45	CSV 1205	
TOC SO by EPA 9060 - Ref.Lab	**Analytical Method:**	EPA 9060				**Analyzed by:**	PJB	
Total Organic Carbon	3.6 %	0.25	0.025	1		08/06/14 13:00	SUB 1666	

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ANALYTICAL RESULTS

Lab Order: P070867
Project ID: CCCWP-SSID SEDIMENTS

Solid results are reported on a dry weight basis.

Lab ID **P070867008** Date Collected 7/22/2014 11:45 Matrix Solid
Sample ID **207WAL060** Date Received 7/22/2014 17:54 Results are expressed as dry weight values

Parameters	Result Units	R. L.	MDL	DF	Prepared	Batch	Analyzed	Batch	Qual
Client provided Data	**Analytical Method:**	Client Method					**Analyzed by:**	PJB	
Solids, Percent	69 %			1			07/22/14 11:45	CSV 1205	
TOC SO by EPA 9060 - Ref.Lab	**Analytical Method:**	EPA 9060					**Analyzed by:**	PJB	
Total Organic Carbon	1.0 %	0.14	0.014	1			08/06/14 13:00	SUB 1666	

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QUALITY CONTROL DATA

Lab Order: P070867
Project ID: CCCWP-SSID SEDIMENTS

Analysis Description:	Pyrethroids+Fipronil Analysis,NCI,Solid	**QC Batch:**	SPR/6555
Analysis Method:	SW846 8270 Mod (GCMS-NCI-SIM)	**QC Batch Method:**	SW846 3540C Soxhlet Extraction

METHOD BLANK: 594644

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Allethrin	ND	0.25	0.050	ug/kg	
Bifenthrin	ND	0.25	0.10	ug/kg	1
Cyfluthrin	ND	0.25	0.11	ug/kg	
Lambda-Cyhalothrin	ND	0.25	0.060	ug/kg	
Cypermethrin	ND	0.25	0.10	ug/kg	
Deltamethrin:Tralomethrin	ND	0.25	0.12	ug/kg	
Esfenvalerate:Fenvalerate	ND	0.25	0.13	ug/kg	
Fenpropathrin	ND	0.25	0.070	ug/kg	
Fipronil	ND	0.25	0.10	ug/kg	
Fipronil Desulfinyl	ND	0.25	0.10	ug/kg	
Fipronil Sulfide	ND	0.25	0.10	ug/kg	
Fipronil Sulfone	ND	0.25	0.10	ug/kg	
Tau-Fluvalinate	ND	0.25	0.040	ug/kg	
Permethrin	ND	0.25	0.11	ug/kg	
Tetramethrin	ND	0.25	0.060	ug/kg	
Esfenvalerate-d6;#1 (SS)	81	70-130		%	
Esfenvalerate-d6;#2 (SS)	78	70-130		%	

LABORATORY CONTROL SAMPLE & LCSD: 594645 594646

Parameter	Units	Spike Conc.	LCS Result	LCSD Result	LCS % Rec	LCSD % Rec	% REC Limits	RPD	Max RPD	Qualifier
Allethrin	ug/kg	2.5	2.6	3	106	119	50-150	12	40	
Bifenthrin	ug/kg	2.5	2.6	2.7	104	108	50-150	3.4	40	7
Cyfluthrin	ug/kg	2.5	2.8	2.8	113	113	50-150	0.4	30	
Lambda-Cyhalothrin	ug/kg	2.5	2.4	2.7	96	107	50-150	11	30	
Cypermethrin	ug/kg	2.5	2.7	2.7	108	109	50-150	1.1	30	
Deltamethrin:Tralomethrin	ug/kg	5	5.6	4.6	112	92	50-150	19	30	
Esfenvalerate:Fenvalerate	ug/kg	5	5.7	5.3	114	107	50-150	6.5	30	
Fenpropathrin	ug/kg	2.5	2.6	2.8	103	110	50-200	6.4	40	
Fipronil	ug/kg	2.5	2.2	2.6	89	104	50-150	16	35	
Fipronil Desulfinyl	ug/kg	2.5	2.1	2.6	86	104	50-150	19	35	
Fipronil Sulfide	ug/kg	2.5	2.2	2.6	86	105	50-150	20	35	
Fipronil Sulfone	ug/kg	2.5	2.2	2.7	87	106	50-150	20	35	
Tau-Fluvalinate	ug/kg	2.5	1.9	1.8	78	72	1-122	8	50	
Permethrin	ug/kg	50	72	68	144	137	50-150	4.7	40	
Tetramethrin	ug/kg	2.5	2.3	2.5	91	100	50-150	9.6	50	
Esfenvalerate-d6;#1 (SS)	%				112	107	70-130	4.4		
Esfenvalerate-d6;#2 (SS)	%				120	105	70-130	13		

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QUALITY CONTROL DATA

Lab Order: P070867
Project ID: CCCWP-SSID SEDIMENTS

Analysis Description:	Pyrethroids+Fipronil Analysis,NCI,Solid	**QC Batch:**	SPR/6555
Analysis Method:	SW846 8270 Mod (GCMS-NCI-SIM)	**QC Batch Method:**	SW846 3540C Soxhlet Extraction

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 594647 594648

Parameter	Units	P070925001 Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Allethrin	ug/kg	0	2.5	0.86	0.89	35	36	50-185	3	40	10
Bifenthrin	ug/kg	0.36	2.5	3.3	3.4	119	123	25-200	3.5	40	8
Cyfluthrin	ug/kg	0	2.5	2.8	6.4	113	255	50-150	77	30	11
Lambda-Cyhalothrin	ug/kg	0	2.5	1.4	1.4	55	55	30-160	0.7	30	
Cypermethrin	ug/kg	0	2.5	2.7	2.7	108	110	50-170	1.5	30	
Deltamethrin:Tralomethrin	ug/kg	0	5	6.4	7.2	127	144	35-150	12	30	
Esfenvalerate:Fenvalerate	ug/kg	0	5	6	6.1	120	122	50-175	1.3	30	
Fenpropathrin	ug/kg	0	2.5	2.6	2.6	104	105	50-200	1.2	40	
Fipronil	ug/kg			1.7	1.4				15	35	
Fipronil Desulfinyl	ug/kg			1.9	1.7				12	35	
Fipronil Sulfide	ug/kg			1.8	1.5				15	35	
Fipronil Sulfone	ug/kg			2	1.9				8.7	35	
Tau-Fluvalinate	ug/kg	0	2.5	1.2	1.2	49	46	30-150	5.9	50	
Permethrin	ug/kg	0.42	50	82	81	162	160	40-200	1.2	40	
Tetramethrin	ug/kg	0	2.5	1.6	2	62	80	30-150	25	50	
Esfenvalerate-d6;#1 (SS)	%					113	113	70-130	0.7		
Esfenvalerate-d6;#2 (SS)	%					125	125	70-130	0		

Analysis Description:	Chlorinated Pesticides Analysis	**QC Batch:**	SPR/6556
Analysis Method:	SW846 8081	**QC Batch Method:**	SW846 3541

METHOD BLANK: 594791

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Aldrin	ND	0.0020	0.0009	mg/kg	
alpha-BHC	ND	0.0020	0.0009	mg/kg	
beta-BHC	ND	0.0020	0.0009	mg/kg	
delta-BHC	ND	0.0020	0.0007	mg/kg	
gamma-BHC (Lindane)	ND	0.0020	0.0007	mg/kg	
alpha-Chlordane (cis)	ND	0.0020	0.0010	mg/kg	
Chlordane	ND	0.0040	0.0030	mg/kg	
gamma-Chlordane (trans)	ND	0.0020	0.0010	mg/kg	
2,4'-DDD	ND	0.0020	0.0020	mg/kg	
2,4'-DDE	ND	0.0020	0.0020	mg/kg	
2,4'-DDT	ND	0.0020	0.0020	mg/kg	
4,4'-DDD	ND	0.0020	0.0008	mg/kg	
4,4'-DDE	ND	0.0020	0.0012	mg/kg	
4,4'-DDT	ND	0.0020	0.0010	mg/kg	
Dieldrin	ND	0.0020	0.0012	mg/kg	
Endosulfan I	ND	0.0020	0.0009	mg/kg	
Endosulfan II	ND	0.0020	0.0007	mg/kg	
Endosulfan sulfate	ND	0.0020	0.0009	mg/kg	
Endrin	ND	0.0020	0.0010	mg/kg	

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QUALITY CONTROL DATA

Lab Order: P070867
Project ID: CCCWP-SSID SEDIMENTS

Analysis Description:	Chlorinated Pesticides Analysis	**QC Batch:**	SPR/6556
Analysis Method:	SW846 8081	**QC Batch Method:**	SW846 3541

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Endrin aldehyde	ND	0.0020	0.0009	mg/kg	
Endrin ketone	ND	0.0020	0.0009	mg/kg	
Heptachlor	ND	0.0020	0.0006	mg/kg	
Heptachlor epoxide	ND	0.0020	0.0011	mg/kg	
Methoxychlor	ND	0.0020	0.0009	mg/kg	
Mirex	ND	0.020	0.0005	mg/kg	
Toxaphene	ND	0.04	0.02	mg/kg	
Decachlorobiphenyl (SS)	67	45-188		%	
Tetrachloro-m-xylene (SS)	39	64-114		%	12

LABORATORY CONTROL SAMPLE & LCSD: 594792 594793

Parameter	Units	Spike Conc.	LCS Result	LCSD Result	LCS % Rec	LCSD % Rec	% REC Limits	RPD	Max RPD	Qualifier
Aldrin	mg/kg	0.013	0.0098	0.009	73	68	67-109	7.9	60	
gamma-BHC (Lindane)	mg/kg	0.013	0.009	0.0086	67	64	57-106	4.4	52	
4,4'-DDT	mg/kg	0.013	0.0093	0.0092	70	69	52-139	0.9	59	
Dieldrin	mg/kg	0.013	0.01	0.01	75	76	63-111	1	19	
Endosulfan sulfate	mg/kg	0.013	0.01	0.0099	77	75	50-150	2.6	50	
Endrin	mg/kg	0.013	0.01	0.0099	77	74	55-127	3.2	18	
Heptachlor	mg/kg	0.013	0.0074	0.0076	55	57	52-149	2.7	98	
Methoxychlor	mg/kg	0.013	0.0078	0.0073	59	55	50-150	6.6	50	
Decachlorobiphenyl (SS)	%				86	76	45-188	12		
Tetrachloro-m-xylene (SS)	%				50	51	64-114	0.7		12

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 594794 594795

Parameter	Units	P070963003 Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Aldrin	mg/kg	0	0.013	0.012	0.012	93	93	67-109	0	24	
gamma-BHC (Lindane)	mg/kg	0	0.013	0.0099	0.01	75	76	57-106	1.6	29	
4,4'-DDT	mg/kg	0	0.013	0.0081	0.0075	61	56	52-139	7.4	46	
Dieldrin	mg/kg	0	0.013	0.014	0.013	101	101	63-111	0.7	24	
Endosulfan sulfate	mg/kg	0	0.013	0.013	0.013	99	95	50-150	4.7	30	
Endrin	mg/kg	0	0.013	0.013	0.013	98	95	55-127	3.1	23	
Heptachlor	mg/kg	0	0.013	0.0072	0.0073	54	55	52-149	2.2	52	
Methoxychlor	mg/kg	0	0.013	0.0094	0.0086	70	64	50-150	8.8	30	
Decachlorobiphenyl (SS)	%					95	86	10-200	10		
Tetrachloro-m-xylene (SS)	%					59	56	10-200	4.8		

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QUALITY CONTROL DATA

Lab Order: P070867
Project ID: CCCWP-SSID SEDIMENTS

Analysis Description:	Chlorinated Pesticides Analysis	**QC Batch:**	SPR/6584
Analysis Method:	SW846 8081	**QC Batch Method:**	SW846 3540

METHOD BLANK: 598126

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Kepone	ND	0.02	0.009	mg/kg	
Decachlorobiphenyl (SS)	110	45-188		%	
Tetrachloro-m-xylene (SS)	83	64-114		%	

LABORATORY CONTROL SAMPLE & LCSD: 598127 598128

Parameter	Units	Spike Conc.	LCS Result	LCSD Result	LCS % Rec	LCSD % Rec	% REC Limits	RPD	Max RPD	Qualifier
Kepone	mg/kg	0.2	0.04	0.05	22	23	10-200	1.8	50	
Decachlorobiphenyl (SS)	%				118	119	45-188	0.6		
Tetrachloro-m-xylene (SS)	%				88	95	64-114	8.2		

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 598129 598130

Parameter	Units	P070867004 Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Kepone	mg/kg	0	0.01	0	0	RNC	RNC	10-200	0	50	13
Decachlorobiphenyl (SS)	%					5.3	4.5	10-200	15		
Tetrachloro-m-xylene (SS)	%					750	750	10-200	0		

Analysis Description:	TOC SO by EPA 9060 - Ref.Lab	**QC Batch:**	SUB/1666
Analysis Method:	EPA 9060	**QC Batch Method:**	EPA 9060

METHOD BLANK: 600437

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Total Organic Carbon	ND	0.10	0.010	%	

LABORATORY CONTROL SAMPLE: 600438

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% REC Limits	Qualifier
Total Organic Carbon	%	10	9.3	93	75-125	

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QUALITY CONTROL DATA

Lab Order: P070867
Project ID: CCCWP-SSID SEDIMENTS

Analysis Description:	Dried Sediment as Extracted	**QC Batch:**	WGR/5525
Analysis Method:	SM20-2540 G	**QC Batch Method:**	SM20-2540 G

METHOD BLANK: 594819

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Solids, Percent	ND	0.1	0.1	%	

SAMPLE DUPLICATE: 594820

Parameter	Units	P070024013 Result	DUP Result	RPD	Max RPD	Qualifiers
Solids, Percent	%	8.8	8.8	0	20	

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QUALITY CONTROL DATA QUALIFIERS

Lab Order: P070867
Project ID: CCCWP-SSID SEDIMENTS

QUALITY CONTROL PARAMETER QUALIFIERS

Results Qualifiers: Report fields may contain codes and non-numeric data correlating to one or more of the following definitions:

NS - means not spiked and will not have recoveries reported for Analyte Spike Amounts

QC Codes Keys: These descriptors are used to help identify the specific QC samples and clarify the report.

MB - Method Blank

Method Blanks are reported to the same Method Detection Limits (MDLs) or Reporting Limits (RLs) as the analytical samples in the corresponding QC batch.

LCS/LCSD - Laboratory Control Spike / Laboratory Control Spike Duplicate

DUP - Duplicate of Original Sample Matrix

MS/MSD - Matrix Spike / Matrix Spike Duplicate

RPD - Relative Percent Difference

%Recovery - Spike Recovery stated as a percentage

1	Analyte(s) reported as 'ND' means not detected at or above the listed Method Detection Limits (MDL).
7	Sample diluted to bring concentration of target analyte(s) within the working range of the instrument, resulting in increased reporting limits.
8	Sample diluted due to a high concentration of non-target analyte(s), resulting in increased reporting limits.
10	Low Matrix Spike recovery(ies) due to possible matrix interferences in the QC sample. QC batch accepted based on LCS and RPD results.
11	Matrix spike recovery(ies) and RPD outside control limit. Sample result accepted based on LCS and Method Blank.
12	The data is acceptable when no more than one surrogate is outside the acceptance limits.
13	RNC = Recovery Not Calculated. Matrix Spike/Matrix Spike Duplicate (MS/MSD) recoveries were not calculated due to matrix interferences concealing the added spike concentration.

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QUALITY CONTROL DATA CROSS REFERENCE TABLE

Lab Order: P070867
Project ID: CCCWP-SSID SEDIMENTS

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
P070867005	**544MSH065**	Client Method	CSV/1205		
P070867006	**544MSH062**	Client Method	CSV/1205		
P070867007	**207WAL078**	Client Method	CSV/1205		
P070867008	**207WAL060**	Client Method	CSV/1205		
P070867001	**544MSH065**	SW846 3541	SPR/6556	SW846 8081	SEC/2174
P070867002	**544MSH062**	SW846 3541	SPR/6556	SW846 8081	SEC/2174
P070867003	**207WAL078**	SW846 3541	SPR/6556	SW846 8081	SEC/2174
P070867004	**207WAL060**	SW846 3541	SPR/6556	SW846 8081	SEC/2174
P070867001	**544MSH065**	SW846 3540	SPR/6584	SW846 8081	SEC/2176
P070867002	**544MSH062**	SW846 3540	SPR/6584	SW846 8081	SEC/2176
P070867003	**207WAL078**	SW846 3540	SPR/6584	SW846 8081	SEC/2176
P070867004	**207WAL060**	SW846 3540	SPR/6584	SW846 8081	SEC/2176
P070867001	**544MSH065**	SW846 3540C Soxhlet	SPR/6555	SW846 8270 Mod	SMS/3515
P070867002	**544MSH062**	SW846 3540C Soxhlet	SPR/6555	SW846 8270 Mod	SMS/3515
P070867003	**207WAL078**	SW846 3540C Soxhlet	SPR/6555	SW846 8270 Mod	SMS/3515
P070867004	**207WAL060**	SW846 3540C Soxhlet	SPR/6555	SW846 8270 Mod	SMS/3515
P070867005	**544MSH065**	EPA 9060	SUB/1666		
P070867006	**544MSH062**	EPA 9060	SUB/1666		
P070867007	**207WAL078**	EPA 9060	SUB/1666		
P070867008	**207WAL060**	EPA 9060	SUB/1666		
P070867001	**544MSH065**	SM20-2540 G	WGR/5525		
P070867002	**544MSH062**	SM20-2540 G	WGR/5525		
P070867003	**207WAL078**	SM20-2540 G	WGR/5525		
P070867004	**207WAL060**	SM20-2540 G	WGR/5525		

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ANALYTICAL LABORATORY

SAMPLE CHAIN OF CUSTODY

LAB ORDER #: B070867

PROJECT # / PROJECT NAME: CCCWP - SSID

P.O. #: 030.001.0202

CLIENT: ADH Environmental

REPORT ATTN: Alessandro Hnatt

ADDRESS: 3065 Porter St Ste. 101 CITY: Soquel, STATE: CA ZIP: 95073

BILLING ADDRESS: same as above

PHONE #: 831.477.2003 FAX PHONE: 831.477.0895 SAMPLER (PRINT & SIGN NAME): Kevin Lewis [signature]

ANALYSES REQUESTED: Pyrethroids, Fipronil & degradates; Organochlorine pesticides; Percent solids; Total organic carbon

TURN-AROUND TIME: ☒ STANDARD ☐ RUSH

DUE DATE: ____

CALTEST #	DATE SAMPLED	TIME SAMPLED	MATRIX	CONTAINER AMOUNT/TYPE	PRESERVATIVE	SAMPLE IDENTIFICATION SITE	CLIENT LAB #	COMP. or GRAB (COMP. circled)	Pyrethroids, Fipronil & degradates	Organochlorine pesticides	Percent solids	Total organic carbon				REMARKS
-1	7-22-14	11:45	sed	2x8oz AG	4°C	544R00025US-01	-1	~~grab~~	X							
-5	↓	↓	↓	2x8oz AG	↓	544R00025US-02	↓	↓		X						
-9				1x8oz CG		544R00025US-03					X					
-13		↓		1x8oz CG		544R00025US-04	↓					X				
-2		10:15		2x8oz AG		544R00025DS-01	-2		X							
-6		10:15		2x8oz AG		544R00025DS-02	↓			X						
-10		↓		1x8oz CG		544R00025DS-03					X					
-14	↓	↓	↓	1x8oz CG	↓	544R00025DS-04	↓	↓				X				
CW 7/23/14																

By submittal of sample(s), client agrees to abide by the Terms and Conditions set forth on the reverse of this document.

RELINQUISHED BY	DATE/TIME	RECEIVED BY	RELINQUISHED BY	DATE/TIME	RECEIVED BY
[signature]	7-22-14 17:54	[signature]			

Samples: WC____ MICRO____ BIO____ MET____ SV____ VOA____ **TEMP:**____°C **SEALED: Y__ / N__** **INTACT: Y__ / N__**

FOR LAB USE ONLY

BD: BIO____ WC____ MET____

CC: AA____ SV____ VOA____

SIL: HP____ PT____ QT____ VOA____

W/HNO_3____ H_2SO_4____ NaOH____

PIL: HNO_3____ H_2SO_4____ NaOH____ HCL____

COMMENTS

MATRIX: W = Aqueous Nondrinking Water, Digested Metals; ML = Low R.L.s, Aqueous Nondrinking Water, Digested Metals; DW = Drinking Water; SL = Soil, Sludge, Solid; FP = Free Product

CONTAINER TYPES: AL = Amber Liter; AHL = 500 ml Amber; PT = Pint (Plastic); QT=Quart (Plastic); HG = Half Gallon (Plastic); SJ = Soil Jar; B4 = 4 oz. BACT; BT = Brass Tube; VOA = 40 mL.VOA; OTC = Other Type Container

Caltest ANALYTICAL LABORATORY

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SAMPLE CHAIN OF CUSTODY

PAGE 2 OF 2

LAB ORDER #: P070867

PROJECT # / PROJECT NAME: 030.001.0202 / CCCWP-SSID

P.O. #:

CLIENT: ADH Environmental

REPORT ATTN: Alessandro Hnatt

ADDRESS: 3065 Porter St Ste 101 CITY: Soquel STATE: CA ZIP: 95073

BILLING ADDRESS: same as above

PHONE #: 831-477-2003 FAX PHONE: 831-477-0895 SAMPLER (PRINT & SIGN NAME): Kevin Lewis

ANALYSES REQUESTED: Pyrethroids, Fipronil, Degradates / Organochlorine pesticides / Percent solids / Total organic carbon

TURN-AROUND TIME: [X] STANDARD [ ] RUSH

DUE DATE:

CALTEST #	DATE SAMPLED	TIME SAMPLED	MATRIX	CONTAINER AMOUNT/TYPE	PRESERVATIVE	SAMPLE IDENTIFICATION SITE	CLIENT LAB #	COMP. or GRAB	Pyrethroids, Fipronil, Degradates	Organochlorine pesticides	Percent solids	Total organic carbon				REMARKS
-3	07-22-14	1445	Sed	2x8oz AG	4°C	207R00011US-01	-3	Comp	X							
-7	↓	1445		2x8oz AG	↓	207R00011US-02	↓	↓		X						
-11	↓	1445		1x8oz CG	↓	207R00011US-03	↓	↓			X					
-15	↓	1445		1x8oz CG	↓	207R00011US-04	↓	↓				X				
-4	↓	1145		2x8oz AG	↓	207R00011DS-01	-4	↓	X							
-8	↓	1145		2x8oz AG	↓	207R00011DS-02	↓	↓		X						
-12	↓	1145		1x8oz CG	↓	207R00011DS-03	↓	↓			X					
-16	↓	1145		1x8oz CG	↓	207R00011DS-04	↓	↓				X				

07/23/14

By submittal of sample(s), client agrees to abide by the Terms and Conditions set forth on the reverse of this document.

RELINQUISHED BY	DATE/TIME	RECEIVED BY	RELINQUISHED BY	DATE/TIME	RECEIVED BY
Brad Haeger	07-22-14 1755	[signature]			

Samples: WC____ MICRO____ BIO____ MET____ SV____ VOA____ TEMP:____°C SEALED: Y__ / N__ INTACT: Y__ / N__

FOR LAB USE ONLY

BD: BIO____ WC____ MET____

CC: AA____ SV____ VOA____

SIL: HP____ PT____ QT____ VOA____

W/HNO$_3$____ H$_2$SO$_4$____ NaOH____

PIL: HNO$_3$____ H$_2$SO$_4$____ NaOH____ HCL____

COMMENTS

MATRIX: W = Aqueous Nondrinking Water, Digested Metals; ML = Low R.L.s, Aqueous Nondrinking Water, Digested Metals; DW = Drinking Water; SL = Soil, Sludge, Solid; FP = Free Product

CONTAINER TYPES: AL = Amber Liter; AHL = 500 ml Amber; PT = Pint (Plastic); QT=Quart (Plastic); HG = Half Gallon (Plastic); SJ = Soil Jar; B4 = 4 oz. BACT; BT = Brass Tube; VOA = 40 mL.VOA; OTC = Other Type Container

Appendix I. Field Measurements and Data Sheets

Table I-1. Field Measurements

Event Date	Station ID	Station Name	Water Temperature (C)	pH	O_2 (mg/l)	O_2 (%)	Specific Conductivity (µS/cm)
02/06/14	544MSH065	Dry Creek - US	10.64	7.67	10.09	90.8	2.732
02/06/14	544MSH062	Dry Creek - DS	10.55	7.40	10.09	94.3	2.374
02/28/14	207WAL078	Grayson Creek - US	13.50	6.60	9.42	91.2	0.314
02/28/14	207WAL060	Grayson Creek - DS	12.80	7.82	NR	100.9	0.166
02/28/14	544MSH065	Dry Creek - US	13.10	7.84	7.67	NR	NR
02/28/14	544MSH062	Dry Creek - DS	13.10	7.90	8.20	NR	NR
03/26/14	207WAL078	Grayson Creek - US	14.90	7.80	10.66	101.0	0.410
03/26/14	207WAL060	Grayson Creek - DS	15.59	8.20	11.62	116.1	0.294
07/22/14	544MSH065	Dry Creek - US	22.45	7.61	3.75	44.0	1683
07/22/14	544MSH062	Dry Creek - DS	21.66	7.80	5.28	60.6	1592
07/22/14	207WAL078	Grayson Creek - US	25.76	8.46	12.17	NR	1637
07/22/14	207WAL060	Grayson Creek - DS	21.20	8.30	16.60	NR	1219

US = Upstream; DS = Downstream; NR = Not Recorded

1380° ARLINGTON WAY BRENTWOOD.

SWAMP Field Data Sheet (Water Chemistry & Discrete Probe) - EventType=WQ

*StationCode: 544R00025 MS	*Date (mm/dd/yyyy): 02 / 05 / 14	Entered in d-base (initial/date)	Pg of Pgs
*Funding: CCCWP	ArrivalTime: 12 30 DepartureTime: 1307	*Group: CCCWP - RMC/ADH	*Agency: CCCWP
*ProjectCode: 030-001.0202	*Personnel: L. Paquette, B Haeger	*SampleTime (1st sample): 12:50	*Protocol: RMC
		*Purpose (circle applicable): WaterChem (WaterTox) Habitat FieldMeas	*PurposeFailure:

*Location: Bank Thalweg (Midchannel) OpenWater	*GPS/DGPS	Lat (dd.ddddd)	Long (ddd.ddddd)	OCCUPATION METHOD: (Walk-in) Bridge R/V ____ Other
GPS Device: I PHONE	Target:	37.921507	-121.721746	STARTING BANK (facing downstream): (LB) / RB / NA
Datum: NAD83 Accuracy (ft / m):	*Actual:	↗	-	Point of Sample (if integrated, then -88 in dbase)

Habitat Observations (CollectionMethod = Habitat_generic)

WADEABILITY: (Y) / N / Unk	BEAUFORT SCALE (see attachment): 2	DISTANCE FROM BANK (m): 1 m	STREAM WIDTH (m): 2 M; WATER DEPTH (m): 30 cm

- SITE ODOR: (None) Sulfides, Sewage, Petroleum, Smoke, Other
- SKY CODE: Clear, Partly Cloudy, (Overcast) Fog, Smoky, Hazy
- WIND DIRECTION (from): SW
- HYDROMODIFICATION: None, Bridge, Pipes, ConcreteChannel, GradeControl, (Culvert), AerialZipline, Other NA — LOCATION (to sample): US (DS) WI /
- OTHER PRESENCE: (Vascular) Nonvascular, OilySheen (Foam) (Trash) Other
- DOMINANT SUBSTRATE: Bedrock, Concrete, (Cobble) Gravel, (Sand) Mud, Unk, Other
- PHOTOS (RB & LB assigned when facing downstream; RENAME to StationCode_yyyy_mm_dd_uniquecode): yes
  - 1: (RB / LB / BB / US / DS / ##)
  - 2: (RB / LB / BB / US / DS / ##)
  - 3: (RB / LB / BB / US / DS / ##)
- WATERCLARITY: Clear (see bottom), (Cloudy (>4" vis)), Murky (<4" vis)
- PRECIPITATION: (None) Fog, Drizzle, Rain, Snow
- WATERODOR: (None) Sulfides, Sewage, Petroleum, Mixed, Other
- PRECIPITATION (last 24 hrs): Unknown, (<1"), >1", None
- WATERCOLOR: Colorless, (Green) Yellow, Brown
- EVIDENCE OF FIRES: (No) <1 year, <5 years
- OVERLAND RUNOFF (Last 24 hrs): none, (light) moderate / heavy, unknown
- OBSERVED FLOW: NA, Dry Waterbody Bed, No Obs Flow, Isolated Pool, Trickle (<0.1cfs), (0.1-1cfs) 1-5cfs, 5-20cfs, 20-50cfs, 50-200cfs, >200cfs

Field Measurements (SampleType = FieldMeasure; Method = Field)

	DepthCollec (m)	Velocity (fps)	Air Temp (°C)	Water Temp (°C)	pH	O_2 (mg/L)	O_2 (%)	Specific Conductivity (uS/cm)	Salinity (ppt)	Turbidity (ntu)			
SUBSURF/MID/BOTTOM/REP	10 cm			10.64	7.67	10.04	90.8	2.732					
SUBSURF/MID/BOTTOM/REP													
SUBSURF/MID/BOTTOM/REP													
Instrument:	YSI 556												
Calib. Date:	2/6/14												

Samples Taken (# of containers filled) - Method=Water_Grab

Field Dup YES / NO: (SampleType = Grab / Integrated; LABEL_ID = FieldQA; create collection record upon data entry

SAMPLE TYPE: Grab / Integrated — COLLECTION DEVICE: Indiv bottle (by hand, by pole, by bucket); Teflon tubing; Kemmer; Pole & Beaker; Other

	DepthCollec (m)	~~Inorganics~~	~~Bacteria~~	~~Chl a~~	~~TSS~~/ SSC	TOC ~~DOC~~	~~Total Hg~~	~~Dissolved Mercury~~	~~Total Metals~~	~~Dissolved Metals~~	Organics	~~Toxicity~~	~~VOAs~~
Sub/Surface	10 cm				1	1						TOX	
Sub/Surface												10 x	1gal

COMMENTS: pyrethroid x1
Fipronil + degradates x1
Organochlorine pest x1

Modified 02/10/11

SWAMP Field Data Sheet (Water Chemistry & Discrete Probe) - EventType=WQ

*StationCode: 544R00025DS	*Date (mm/dd/yyyy): 02/06/14	Entered in d-base (initial/date)	Pg of Pgs
*Funding: CCCWP	ArrivalTime: 13:12 DepartureTime: 13:50	*Group: CCCWP - RMC/ABH	*Agency: CCCWP
*ProjectCode: 030.001.0202	*Personnel: Paquette, Haeger	*SampleTime (1st sample): 13:20	*Protocol: RMC
*Location: Bank Thalweg (Midchannel) OpenWater		*Purpose (circle applicable): WaterChem (WaterTox) Habitat FieldMeas	*PurposeFailure:
GPS Device: I-PHONE	*GPS/DGPS Lat (dd.ddddd) / Long (ddd.ddddd) — Target: 37.923005 N / -121.714414 W; *Actual: ↗ / -	OCCUPATION METHOD: (Walk-In) Bridge R/V ______ Other	
Datum: NAD83 Accuracy (ft / m): NA		STARTING BANK (facing downstream): (LB) / RB / NA	

Habitat Observations (CollectionMethod = Habitat_generic)

SITE ODOR:	(None), Sulfides, Sewage, Petroleum, Smoke, Other
SKY CODE:	Clear, Partly Cloudy, (Overcast), Fog, Smoky, Hazy
OTHER PRESENCE:	(Vascular), Nonvascular, OilySheen, (Foam), Trash, Other
DOMINANT SUBSTRATE:	Bedrock, Concrete, Cobble, Gravel, Sand, (Mud), Unk, Other
WATERCLARITY:	Clear (see bottom), (Cloudy (>4" vis)), Murky (<4" vis)
WATERODOR:	(None), Sulfides, Sewage, Petroleum, Mixed, Other
WATERCOLOR:	Colorless, (Green), Yellow, Brown
OVERLAND RUNOFF (Last 24 hrs):	none, (light), moderate / heavy, unknown
OBSERVED FLOW:	NA, Dry Waterbody Bed, No Obs Flow, Isolated Pool, Trickle (<0.1cfs), (0.1-1cfs), 1-5cfs, 5-20cfs, 20-50cfs, 50-200cfs, >200cfs

WADEABILITY: (Y) / N / Unk

BEAUFORT SCALE (see attachment): 3

WIND DIRECTION (from): SW

*PRECIPITATION: (None), Fog, Drizzle, Rain, Snow

PRECIPITATION (last 24 hrs): Unknown, (<1"), >1", None

EVIDENCE OF FIRES: (No), <1 year, <5 years

Point of Sample (If Integrated, then 88 in dbase)

DISTANCE FROM BANK (m): .75

STREAM WIDTH (m): 1.5

WATER DEPTH (m): .4

HYDROMODIFICATION: None, Bridge, Pipes, ConcreteChannel, GradeControl, Culvert, AerialZipline, Other ~~pump~~ culvert

LOCATION (to sample): US / (DS) / WI / NA

PHOTOS (RB & LB assigned when facing downstream; RENAME to StationCode_yyyy_mm_dd_uniquecode):

1: (RB / LB / BB / US / DS / ##) yes

2: (RB / LB / BB / US / DS / ##)

3: (RB / LB / BB / US / DS / ##)

Field Measurements (SampleType = FieldMeasure; Method = Field)

	DepthCollec (m)	Velocity (fps)	Air Temp (°C)	Water Temp (°C)	pH	O_2 (mg/L)	O_2 (%)	Specific Conductivity (uS/cm)	Salinity (ppt)	Turbidity (ntu)			
SUBSURF/MID/BOTTOM/REP	.1			10.55°C	7.4	10.09	94.3	2.374	/	/			
SUBSURF/MID/BOTTOM/REP													
SUBSURF/MID/BOTTOM/REP													
Instrument:	YSI 556												
Calib. Date:	2/6/14												

Samples Taken (# of containers filled) - Method=Water_Grab

Field Dup YES / (NO) (SampleType = Grab / Integrated; LABEL_ID = FieldQA; create collection record upon data entry

SAMPLE TYPE: (Grab) / Integrated

COLLECTION DEVICE: Indiv bottle (by hand) by pole, by bucket); Teflon tubing; Kemmer; Pole & Beaker; Other

	DepthCollec (m)	~~Inorganics~~	~~Bacteria~~	~~Chl-a~~	~~TSS~~ / SSC	TOC / ~~DOC~~	~~Total Hg~~	~~Dissolved Mercury~~	~~Total Metals~~	~~Dissolved Metals~~	Organics	Toxicity	~~VOAs~~
Sub/Surface	.1				1	1						10 ×1 gal	7
Sub/Surface													

COMMENTS: pyrethroids ×1
Fipronil + degradates × 1
Organochlorine pest. × 1

Modified 02/10/11

Caltest ANALYTICAL LABORATORY
1885 N. KELLY ROAD • NAPA, CA 94558 • (707) 258-4000 • Fax (707) 226-1001 • www.caltestlabs.com

SAMPLE CHAIN OF CUSTODY

PAGE ____ OF 2/7 LAB ORDER #: ~~B20478~~ B020481

PROJECT # / PROJECT NAME: CCCWP-SSID 030,001 .0202 P.O. #

CLIENT: ADH Environmental | REPORT ATTN: Alessandro Hnatt.

ADDRESS: 3065 Porter St CITY: Soquel CA STATE: ~~CA~~ ZIP:

BILLING ADDRESS: Same

PHONE #: 831 477 2003 FAX PHONE: SAMPLER (PRINT & SIGN NAME): Lucile Paquette

ANALYSES REQUESTED: TOC; Pyrethroids; Fipronil + degradates; Organochlorine pesticides; SSC

TURN-AROUND TIME ☐ STANDARD ☐ RUSH DUE DATE:______

CALTEST #	DATE SAMPLED	TIME SAMPLED	MATRIX	CONTAINER AMOUNT/TYPE	PRESERVATIVE	SAMPLE IDENTIFICATION SITE	CLIENT LAB #	COMP. or GRAB	TOC	Pyrethroids	Fipronil + degradates	Organochlorine pesticides	SSC			REMARKS
-1	2/6/14	13:20	Storm water		ice HCl	544R00025DS-		grab	x							
-2	↓	12:50	↓		ice HCl	544R00025US-		↓	x							
-3	↓	13:20	↓		ice	544R00025DS-		↓		x						
↓	↓	13:20	↓		ice	↓		↓			x					
~~↓~~	↓	13:20	↓		ice	↓		↓				x				
~~↓~~	↓	12:50	↓		ice	↓	~~1~~	↓					x			
-4	↓	12:50	↓		ice	544R00025US	has RS 2/8/14	↓		x						
↓	↓	12:50	↓		ice	↓		↓			x					
↓	↓	12:50	↓		ice	↓		↓				x				
↓	↓	12:50	↓		ice	↓	~~2~~	↓					x			

By submittal of sample(s), client agrees to abide by the Terms and Conditions set forth on the reverse of this document.

RELINQUISHED BY	DATE/TIME	RECEIVED BY	RELINQUISHED BY	DATE/TIME	RECEIVED BY
[signature]	2-7-14 6:12	[signature]			

FOR LAB USE ONLY

Samples: WC____ MICRO____ BIO____ MET____ SV____ VOA____ TEMP:____°C SEALED: Y__ / N__ INTACT: Y__ / N__

BD: BIO____ WC____ MET____

CC: AA____ SV____ VOA____

SIL: HP____ PT____ QT____ VOA____

W/HNO3____ H2SO4____ NaOH____

PIL: HNO3____ H2SO4____ NaOH____ HCL____

COMMENTS

MATRIX: W = Aqueous Nondrinking Water, Digested Metals; ML = Low R.L.s, Aqueous Nondrinking Water, Digested Metals; DW = Drinking Water; SL = Soil, Sludge, Solid; FP = Free Product

CONTAINER TYPES: AL = Amber Liter; AHL = 500 ml Amber; PT = Pint (Plastic); QT=Quart (Plastic); HG = Half Gallon (Plastic); SJ = Soil Jar; B4 = 4 oz. BACT; BT = Brass Tube; VOA = 40 mL VOA; OTC = Other Type Container

Pacific EcoRisk
2250 Cordelia Rd., Fairfield, CA 94534
(707) 207-7760 FAX (707) 207-7916

CHAIN-OF-CUSTODY RECORD

Client Name:	ADH Environmental
Client Address:	3065 Porter St. Suite 101 Soquel CA 95073
Phone:	8314772003 FAX: 8314770895
Project Manager:	Alessandro Hnatt.
Project Name:	CCCWP - SSID
Project # / P.O. Number:	030.001.0202 (task 2G)

REQUESTED ANALYSIS: ~~Chronic Selenastrum capricornutum~~; ~~Chronic Ceriodaphnia dubia~~; ~~Chronic Pimephales promelas~~; 10-day Hyalella azteca (water); ~~10-day Hyalella azteca (sediment)~~

	Client Sample ID	Sample Date	Sample Time	Sample Matrix*	Container Number	Container Type	~~Chronic Selenastrum capricornutum~~	~~Chronic Ceriodaphnia dubia~~	~~Chronic Pimephales promelas~~	10-day Hyalella azteca (water)	~~10-day Hyalella azteca (sediment)~~							
1	~~544R00025-W~~			~~STRMW~~		~~1 gall. amber~~	~~x~~	~~x~~	~~x~~	~~x~~								
2	544R00025DS-W-0	12-6-14	20:50		10	gal amber				X								
3	544R00025US-W-0	12-6-14	20:50		10	gal amber				X								
4																		
5																		
6																		
7																		
8																		
9																		
10																		
12																		

Samples collected by:

Comments/Special Instruction:

Note - Fathead minnow testing is to be performed using the standard EPA protocol (i.e., 4 replicates)

Contract # 030.001.0202
SSID Study

RELINQUISHED BY:		RECEIVED BY:	
Signature:	[signature]	Signature:	[signature]
Print:	Justin Cervelt	Print:	Marlon Orlina
Organization:	ADH	Organization:	PER
Date: 2-7-14	Time: ~~5:40~~ 1740	Date: 02.07.14	Time: 1740

RELINQUISHED BY:		RECEIVED BY:	
Signature:		Signature:	
Print:		Print:	
Organization:		Organization:	
Date:	Time:	Date:	Time:

*Example Matrix Codes: (FW = Freshwater); (SW = Saltwater); (WW = Wastewater); (STRMW = Stormwater); (SED = Sediment); or other

SSID
207R00011US5

& Not wadeable in storm

SWAMP Field Data Sheet (Water Chemistry & Discrete Probe) - EventType=WQ		Entered in d-base (initial/date)	Pg 1 of 1 Pgs
*StationCode:	*Date (mm/dd/yyyy): 2 / 28 / 14	*Group: ADH	*Agency: CCCWP
*Funding: CCCWP SSID	ArrivalTime: 945 DepartureTime: 10:30	*SampleTime (1st sample): 0955	*Protocol: RMC
*ProjectCode: 030.001.0202	*Personnel: Sandlin, T. Ohman	*Purpose (circle applicable): WaterChem WaterTox Habitat FieldMeas	*PurposeFailure:

*Location: Bank Thalweg Midchannel OpenWater	*GPS/DGPS	Lat (dd.ddddd)	Long (ddd.ddddd)	OCCUPATION METHOD: Walk-in Bridge R/V ____ Other
GPS Device: LG cell phone	Target:		-	STARTING BANK (facing downstream): LB / RB / NA
Datum: NAD83 Accuracy (ft / m):	Actual:	37.95275	-122.08150	Point of Sample (If Integrated then -88 in dbase)

Habitat Observations (CollectionMethod = Habitat_generic)

WADEABILITY: Y / N / Unk

BEAUFORT SCALE (see attachment): 0

DISTANCE FROM BANK (m): above channel

STREAM WIDTH (m): 10

WATER DEPTH (m): 1.5

SITE ODOR: None, Sulfides, Sewage, Petroleum, Smoke, Other

SKY CODE: Clear, Partly Cloudy, Overcast, Fog, Smoky, Hazy

WIND DIRECTION (from):

HYDROMODIFICATION: None, Bridge, Pipes, ConcreteChannel, GradeControl, Culvert, AerialZipline, Other directly below

LOCATION (to sample): US / DS / WI / NA

OTHER PRESENCE: Vascular, Nonvascular, OilySheen, Foam, Trash, Other None

DOMINANT SUBSTRATE: Bedrock, Concrete, Cobble, Gravel, Sand, Mud, Unk, Other DUCKS

PHOTOS (RB & LB assigned when facing downstream; RENAME to StationCode_yyyy_mm_dd_uniquecode):

1: (RB / LB / BB / US / DS / ##)

2: (RB / LB / BB / US / DS / ##)

3: (RB / LB / BB / US / DS / ##)

WATERCLARITY: Clear (see bottom), Cloudy (>4" vis), Murky (<4" vis)

PRECIPITATION: None, Fog, Drizzle, Rain, Snow

WATERODOR: None, Sulfides, Sewage, Petroleum, Mixed, Other

PRECIPITATION (last 24 hrs): Unknown, <1", >1", None

WATERCOLOR: Colorless, Green, Yellow, Brown turbid

EVIDENCE OF FIRES: No, <1 year, <5 years

OVERLAND RUNOFF (Last 24 hrs): none, light, moderate / heavy, unknown

OBSERVED FLOW: NA, Dry Waterbody Bed, No Obs Flow, Isolated Pool, Trickle (<0.1cfs), 0.1-1cfs, 1-5cfs, 5-20cfs, 20-50cfs, 50-200cfs, >200cfs

Field Measurements (SampleType = FieldMeasure; Method = Field)

	DepthCollec (m)	Velocity (fps)	Air Temp (°C)	Water Temp (°C)	pH	O_2 (mg/L)	O_2 (%)	Specific Conductivity (uS/cm)	Salinity (ppt)	Turbidity (ntu)			
SUBSURF/MID/BOTTOM/REP	.2		54	13.5	6.6	9.42	91.2	.314					
SUBSURF/MID/BOTTOM/REP					6.6								
SUBSURF/MID/BOTTOM/REP													
Instrument:	YSI 556												
Calib. Date:													

Samples Taken (# of containers filled) - Method=Water_Grab

Field Dup YES / NO: (SampleType = Grab / Integrated; LABEL_ID = FieldQA; create collection record upon data entry

SAMPLE TYPE: Grab / Integrated

COLLECTION DEVICE: Indiv bottle (by hand, by pole, by bucket); Teflon tubing; Kemmer; Pole & Beaker; Other

	DepthCollec (m)	Inorganics	Bacteria	Chl a	TSS / SSC	TOC / DOC	Total Hg	Dissolved Mercury	Total Metals	Dissolved Metals	Organics	Toxicity	VOAs
Sub/Surface	.2				1	1 x3voa						10 x1 sed	
Sub/Surface													

COMMENTS:

samples collected at walking bridge btwn Mercury Way + Vineyard Dr. top of channel w/ grab pole

Modified 02/10/11

channel 20' top width
8' bottom width

Tributary of Grayson

organochlorine pesticides (x2)
Pyrethroid Pesticides, Fip, Fip Degradates (x2)

E Branch Grayson
207R00011 DS

SSID 11DS

SWAMP Field Data Sheet (Water Chemistry & Discrete Probe) - EventType=WQ

*StationCode:	*Date (mm/dd/yyyy): 02 / 28 / 14	Entered in d-base (initial/date)	Pg of Pgs
*Funding: CCCWP	ArrivalTime: 0830 DepartureTime:	*Group: CCCWP	*Agency: CCCWP
*ProjectCode: 030.00L.0202	*SampleTime (1st sample): 0845		*Protocol: BMC
	*Personnel: C.Sandl, T.Thomas	*Purpose (circle applicable): WaterChem WaterTox Habitat FieldMeas	*PurposeFailure:
*Location: Bank Thalweg Midchannel OpenWater	*GPS/DGPS	Lat (dd.ddddd)	Long (ddd.ddddd)
GPS Device: LG Verizon Phone	Target:	3	-
Datum: NAD83 Accuracy (ft / m): 10ft	Actual:	37.95826	-122.06645

OCCUPATION METHOD: Walk-in Bridge R/V _____ Other

STARTING BANK (facing downstream): LB / RB / NA

Point of Sample (if integrated, then -88 in dbase)

Habitat Observations (CollectionMethod = Habitat_generic)

SITE ODOR:	None, Sulfides, Sewage, Petroleum, Smoke, Other	WADEABILITY: Y / N / Unk	BEAUFORT SCALE (see attachment): 0	DISTANCE FROM BANK (m): 2m LB	STREAM WIDTH (m): 20 WATER DEPTH (m): 2'+
SKY CODE:	Clear, Partly Cloudy, Overcast, Fog, Smoky, Hazy	WIND DIRECTION (from): ND		HYDROMODIFICATION: None, Bridge, Pipes, ConcreteChannel, GradeControl, Culvert, AerialZipline, Other NA	LOCATION (to sample): US / DS / WI /
OTHER PRESENCE:	Vascular, Nonvascular, OilySheen, Foam, Trash, Other			PHOTOS (RB & LB assigned when facing downstream; RENAME to StationCode_yyyy_mm_dd_uniquecode):	1: (RB / LB / BB / US / DS / ##) down ramp
DOMINANT SUBSTRATE:	Bedrock, Concrete, Cobble, Gravel, Sand, Mud, Unk, Other Not in storm				
WATERCLARITY:	Clear (see bottom), Cloudy (>4" vis), Murky (<4" vis)	PRECIPITATION:	None, Fog, Drizzle, Rain, Snow		2: (RB / LB / BB / US / DS / ##)
WATERODOR:	None, Sulfides, Sewage, Petroleum, Mixed, Other	PRECIPITATION (last 24 hrs):	Unknown, <1", >1", None		
WATERCOLOR:	Colorless, Green, Yellow, Brown, turbid	EVIDENCE OF FIRES:	No, <1 year, <5 years		3: (RB / LB / BB / US / DS / ##)
OVERLAND RUNOFF (Last 24 hrs):	none, light, moderate / heavy, unknown				
OBSERVED FLOW:	NA, Dry Waterbody Bed, No Obs Flow, Isolated Pool, Trickle (<0.1cfs), 0.1-1cfs, 1-5cfs, 5-20cfs, 20-50cfs, 50-200cfs, >200cfs				

Field Measurements (SampleType = FieldMeasure; Method = Field)

	DepthCollec (m)	Velocity (fps)	Air Temp (°C)	Water Temp (°C)	pH	O_2 (mg/L)	O_2 (%)	Specific Conductivity (uS/cm)	Salinity (ppt)	Turbidity (ntu)			
SUBSURF/MID/BOTTOM/REP	0.3			12.77	7.82		100.9	0.166	–				
SUBSURF/MID/BOTTOM/REP													
SUBSURF/MID/BOTTOM/REP													
Instrument:	YSI 556												
Calib. Date:	2/27/14												

Samples Taken (# of containers filled) - Method=Water_Grab

Field Dup YES / NO: (SampleType = Grab / Integrated; LABEL_ID = FieldQA; create collection record upon data entry

SAMPLE TYPE: Grab / Integrated

COLLECTION DEVICE: Indiv bottle (by hand, by pole, by bucket); Teflon tubing; Kemmer; Pole & Beaker; Other

	DepthCollec (m)	Inorganics	Bacteria	Chl a	TSS / SSC	TOC / DOC	Total Hg	Dissolved Mercury	Total Metals	Dissolved Metals	Organics	Toxicity	VOAs
Sub/Surface	0.3				1	1x3voa						10 x 1Gal	
Sub/Surface													

COMMENTS:

sampled w/ pole from Arth St FC channel ramp

Modified 02/10/11

Organochlorine Pesticides (X2)
Pyrethroid Pesticides, Fipronil, Degradates (X2)

Caltest ANALYTICAL LABORATORY

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CHAIN OF CUSTODY

PAGE ____ OF ____

PROJECT NAME / PROJECT NUMBER: CCCWP-SSID / 030.001.0202

P.O. NUMBER:

LAB ORDER #:

CLIENT: ADH Environmental

REPORT ATTN: Alessandro Hnatt

MAILING ADDRESS: 3065 Porter St., Suite 101, Soquel

STATE: CA

ZIP: 95073

BILLING ADDRESS: same as above

ATTN: Alessandro Hnatt

PHONE NUMBER: 831-477-2003

FAX PHONE NUMBER: 831-477-0895

SAMPLER (PRINT & SIGN NAME):

TURN-AROUND TIME: [X] STANDARD [ ] RUSH

DUE DATE:

ANALYSES REQUESTED

CALTEST LAB #	DATE SAMPLED	TIME SAMPLED	SAMPLE MATRIX*	CONTAINER TYPE/ AMOUNT**	PRESERVATIVE	SAMPLE IDENTIFICATION / SITE	CLIENT LAB #	COMP. or GRAB	Organochlorine Pesticides	Pyrethroids Pesticides	Fipronil	Degradates	TOC	SSC					REMARKS
	2-28-14	0845	Strmwtr	2 x 1L AG	<6C	207R00011DS-W-01		Grab	x										
			Strmwtr	2 x 1L AG	<6C	207R00011DS-W-01		Grab		x	x	x							
			Strmwtr	3 x 40ml VOA	<6C, HCl	207R00011DS-W-01		Grab					x						
			Strmwtr	250 ml HDPE	<6C	207R00011DS-W-01		Grab						x					
		0955	Strmwtr	2 x 1L AG	<6C	207R00011US-W-01		Grab	x										
			Strmwtr	2 x 1L AG	<6C	207R00011US-W-01		Grab		x	x	x							
			Strmwtr	3 x 40ml VOA	<6C, HCl	207R00011US-W-01		Grab					x						
			Strmwtr	250 ml HDPE	<6C	207R00011US-W-01		Grab						x					

RELINQUISHED BY	DATE/TIME	RECEIVED BY	RELINQUISHED BY	DATE/TIME	RECEIVED BY
	/			/	
	/			/	

FOR LAB USE ONLY

Samples: WC ___ MICRO ___ BIO ___ AA ___ SV ___ VOA ___ pH? Y/N TEMP: ___ SEALED: Y/N INTACT: Y/N

BD: BIO ___ WC ___ AA ___

COMMENTS:

CC: AA ___ SV ___ VOA ___

SIL: HP ___ PT ___ QT ___ VOA ___

W/HNO_3 ___ H_2SO_4 ___ NaOH ___

PIL: HNO_3 ___ H_2SO_4 ___ NaOH ___ HCL ___

*MATRIX: AQ = Aqueous Nondrinking Water, Digested Metals; FE = Low R.L.s, Aqueous Nondrinking Water, Digested Metals; DW = Drinking Water; SL = Soil Sludge, Solid ; FP =

**CONTAINER TYPES: AL = Amber Liter; AHL = 500 ml Amber; PT = Pint (Plastic); QT = Quart (Plastic); HG = Half Gallon (Plastic); SJ = Soil Jar; B4 = 4oz. BACT; BT = Brass Tube; VOA = 40mL VOA; OTC - Other Type Container

R ___ PR ___ M ___ F ___

WHITE - LABORATORY YELLOW - CLIENT COPY TO ACCOMPANY FINAL REPORT PINK - CLIENT COPY AS RECEIPT

02/25/14

Pacific EcoRisk
2250 Cordelia Rd.. Fairfield. CA 94534
(707) 207-7760 FAX (707) 207-7916

CHAIN-OF-CUSTODY RECORD

Client Name:	ADH Environmental
Client Address:	3065 Porter Street, Suite 101
	Soquel, CA 95073
Phone:	831 477-2003 FAX:
Project Manager:	Alessandro Hnatt
Project Name:	CCCWP - SSID
Project # / P.O. Number:	030.001.0202

REQUESTED ANALYSIS

#	Client Sample ID	Sample Date	Sample Time	Sample Matrix*	Container Number	Container Type	Chronic *Selenastrum capricornutum*	Chronic *Ceriodaphnia dubia*	Chronic *Pimephales promelas*	10-day *Hyalella azteca* (water)	10-day *Hyalella azteca* (sediment)						
1	207R00011DS-W-01	2-28-14	0845	STRMW	10	3.7L glass				x							
2	207R00011US-W-01	2-28-14	0955	STRMW	10	3.7L glass				x							
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
12																	

Samples collected by: Calvin Sandlin

Comments/Special Instruction:

RELINQUISHED BY:		RECEIVED BY:	
Signature: [signature]		Signature: [signature]	
Print: Calvin Sandlin		Print: Y. Khadizyeva	
Organization: ADH		Organization: PER	
Date: 2.28.14	Time: 1143	Date: 2-28-14	Time: 1143
RELINQUISHED BY:		**RECEIVED BY:**	
Signature:		Signature:	
Print:		Print:	
Organization:		Organization:	
Date:	Time:	Date:	Time:

***Example Matrix Codes**: (**FW** = Freshwater); (**SW** = Saltwater); (**WW** = Wastewater); (**STRMW** = Stormwater); (**SED** = Sediment); or other

SWAMP Field Data Sheet (Water Chemistry & Discrete Probe) - EventType=WQ			Entered in d-base (initial/date) AW,	Pg of Pgs
*StationCode: 544R00025-US-W02	*Date (mm/dd/yyyy): 02 / 28 / 14		*Group: CCCWP-ADH	*Agency: CCCWP
*Funding: CCCWP	ArrivalTime: 0955	DepartureTime: 1040	*SampleTime (1st sample): 1000	*Protocol: RMC
*ProjectCode: 030.001.0202	*Personnel: AW, MA		*Purpose (circle applicable): WaterChem WaterTox Habitat FieldMeas	*PurposeFailure:
*Location: Bank Thalweg Midchannel OpenWater (circled: Midchannel)	*GPS/DGPS	Lat (dd.ddddd)	Long (ddd.ddddd)	OCCUPATION METHOD: Walk-in Bridge R/V ___ Other (circled: Walk-in)
GPS Device: iPhone	Target:	37.92157	-121.72174	STARTING BANK (facing downstream): LB / RB / NA (circled: LB)
Datum: NAD83 Accuracy (ft / m):	*Actual:		-	Point of Sample (If Integrated, then -88 in dbase)

Habitat Observations (CollectionMethod = Habitat_generic)

SITE ODOR:	None, Sulfides, Sewage, Petroleum, Smoke, Other (circled: Sewage)	WADEABILITY: Y / N / Unk (circled: Y)	BEAUFORT SCALE (see attachment): 1	DISTANCE FROM BANK (m): 1 m	STREAM WIDTH (m): 108" ; WATER DEPTH (m): 12"
SKY CODE:	Clear, Partly Cloudy, Overcast, Fog, Smoky, Hazy (circled: Partly Cloudy)	WIND DIRECTION (from): S		HYDROMODIFICATION: None, Bridge, Pipes, ConcreteChannel, GradeControl, Culvert, AerialZipline, Other (circled: Culvert)	LOCATION (to sample): US / DS / WI / NA (circled: DS)
OTHER PRESENCE:	Vascular, Nonvascular, OilySheen, Foam, Trash, Other (circled: Nonvascular, Foam)			PHOTOS (RB & LB assigned when facing downstream; RENAME to StationCode_yyyy_mm_dd_uniquecode): yes	1: (RB / LB / BB / US / DS / ##) (circled: LB, US, DS)
DOMINANT SUBSTRATE:	Bedrock, Concrete, Cobble, Gravel, Sand, Mud, Unk, Other (circled: Mud)				
WATERCLARITY:	Clear (see bottom), Cloudy (>4" vis), Murky (<4" vis) (circled: Murky)	PRECIPITATION:	None, Fog, Drizzle, Rain, Snow (circled: None)		2: (RB / LB / BB / US / DS / ##) (circled: LB, DS)
WATERODOR:	None, Sulfides, Sewage, Petroleum, Mixed, Other (circled: Sewage)	PRECIPITATION (last 24 hrs):	Unknown, <1", >1", None		
WATERCOLOR:	Colorless, Green, Yellow, Brown (circled: Brown)	EVIDENCE OF FIRES:	No, <1 year, <5 years (circled: No)		3: (RB / LB / BB / US / DS / ##) (circled: LB, BB)
OVERLAND RUNOFF (Last 24 hrs):	none, light, moderate / heavy, unknown (circled: moderate / heavy)				
OBSERVED FLOW:	NA, Dry Waterbody Bed, No Obs Flow, Isolated Pool, Trickle (<0.1cfs), 0.1-1cfs, 1-5cfs, 5-20cfs, 20-50cfs, 50-200cfs, >200cfs (circled: 1-5cfs)				

Field Measurements (SampleType = FieldMeasure; Method = Field)

	DepthCollec (m)	Velocity (fps)	Air Temp (°C)	Water Temp (°C)	pH	O_2 (mg/L)	O_2 (%)	Specific Conductivity (uS/cm)	Salinity (ppt)	Turbidity (ntu)			
SUBSURF/MID/BOTTOM/REP	10cm			13.1°C	7.84	7.67							
SUBSURF/MID/BOTTOM/REP													
SUBSURF/MID/BOTTOM/REP													
Instrument:													
Calib. Date:													

Samples Taken (# of containers filled) - Method=Water_Grab

Field Dup YES / NO (circled: NO) (SampleType = Grab / Integrated; LABEL_ID = FieldQA; create collection record upon data entry

SAMPLE TYPE: Grab / Integrated (circled: Grab) COLLECTION DEVICE: Indiv bottle (by hand, by pole, by bucket); Teflon tubing; Kemmer; Pole & Beaker; Other (circled: by hand)

	DepthCollec (m)	~~Inorganics~~	~~Bacteria~~	~~Chl a~~	~~TSS~~ / SSC	TOC / ~~DOC~~	~~Total Hg~~	~~Dissolved Mercury~~	~~Total Metals~~	~~Dissolved Metals~~	Organics	Toxicity	VOAs
Sub/Surface	.1				1	1						109 AW	
Sub/Surface												X 1 gal.	

COMMENTS: Water levels consistant through sampling. No Rain. Collected up stream from the culvert that goes under the road. Approached from the LB looking down stream. Samples put on ice immidiately.

Modified 02/10/11

collected pyrethroids, Fipronil + degradates, organochlorine pesticides

SWAMP Field Data Sheet (Water Chemistry & Discrete Probe) - EventType=WQ

Entered in d-base (initial/date) AW, MA 2-28-14 | Pg of Pgs

*StationCode: 544R00025DS-W-02	*Date (mm/dd/yyyy): 02 / 28 / 2014	*Group: CCCWD-ADH	*Agency: CCCWD
*Funding: CCCWD	ArrivalTime: 9:20 am / DepartureTime: 9:50	*SampleTime (1st sample): 930	*Protocol: RMC
*ProjectCode: 030.001.0202	*Personnel: MA, AW.	*Purpose (circle applicable): WaterChem WaterTox Habitat FieldMeas	*PurposeFailure:

*Location: Bank Thalweg Midchannel OpenWater	*GPS/DGPS	Lat (dd.ddddd)	Long (ddd.ddddd)
GPS Device: iPhone	Target:	37.923005	-121.714414
Datum: NAD83 / Accuracy (ft / m):	*Actual:		-

OCCUPATION METHOD: Walk-in Bridge R/V ______ Other

STARTING BANK (facing downstream): LB / RB / NA

Point of Sample (If Integrated, then -88 in dbase)

DISTANCE FROM BANK (m): 1 m | STREAM WIDTH (m): 116" | WATER DEPTH (m): 16"

Habitat Observations (CollectionMethod = Habitat_generic)

SITE ODOR:	None, Sulfides, Sewage, Petroleum, Smoke, Other
SKY CODE:	Clear, Partly Cloudy, Overcast, Fog, Smoky, Hazy
OTHER PRESENCE:	Vascular, Nonvascular, OilySheen, Foam, Trash, Other
DOMINANT SUBSTRATE:	Bedrock, Concrete, Cobble, Gravel, Sand, Mud, Unk, Other rocks
WATERCLARITY:	Clear (see bottom), Cloudy (>4" vis), Murky (<4" vis)
WATERODOR:	None, Sulfides, Sewage, Petroleum, Mixed, Other
WATERCOLOR:	Colorless, Green, Yellow, Brown
OVERLAND RUNOFF (Last 24 hrs):	none, light, moderate / heavy, unknown
OBSERVED FLOW:	NA, Dry Waterbody Bed, No Obs Flow, Isolated Pool, Trickle (<0.1cfs), 0.1-1cfs, 1-5cfs, 5-20cfs, 20-50cfs, 50-200cfs, >200cfs

WADEABILITY: Y / N / Unk (Y circled)

BEAUFORT SCALE (see attachment): 1

WIND DIRECTION (from): S

HYDROMODIFICATION: None, Bridge, Pipes, ConcreteChannel, GradeControl, Culvert, AerialZipline, Other / LOCATION (to sample): US / DS / WI / NA

PHOTOS (RB & LB assigned when facing downstream; RENAME to StationCode_yyyy_mm_dd_uniquecode): Yes
1: (RB / LB / BB / US / DS / ##)
2: (RB / LB / BB / US / DS / ##)
3: (RB / LB / BB / US / DS / ##)

PRECIPITATION: None, Fog, Drizzle, Rain, Snow

PRECIPITATION (last 24 hrs): Unknown, <1", >1", None

EVIDENCE OF FIRES: No, <1 year, <5 years

Field Measurements (SampleType = FieldMeasure; Method = Field)

	DepthCollec (m)	Velocity (fps)	Air Temp (°C)	Water Temp (°C)	pH	O_2 (mg/L)	O_2 (%)	Specific Conductivity (uS/cm)	Salinity (ppt)	Turbidity (ntu)			
SUBSURF/MID/BOTTOM/REP	10cm			13.1	7.9	8.2							
SUBSURF/MID/BOTTOM/REP													
SUBSURF/MID/BOTTOM/REP													
Instrument:													
Calib. Date:													

Samples Taken (# of containers filled) - Method=Water_Grab

Field Dup YES / NO (SampleType = Grab / Integrated; LABEL_ID = FieldQA; create collection record upon data entry

SAMPLE TYPE: Grab / Integrated

COLLECTION DEVICE: Indiv bottle (by hand) by pole, by bucket); Teflon tubing; Kemmer; Pole & Beaker; Other

	DepthCollec (m)	Inorganics	Bacteria	Chl a	~~TSS~~ / SSC	TOC / ~~DOC~~	~~Total Hg~~	~~Dissolved Mercury~~	~~Total Metals~~	~~Dissolved Metals~~	Organics	Toxicity	VOAs
Sub/Surface	.1 m				1	1						10	
Sub/Surface											X	1 gal	

COMMENTS: No rain while sampling. Water level maintained it's hight and width. Samples taken from the LB looking down stream, above the control channel. Samples put on ice immidiately.

Modified 02/10/11

collected Pyrethroids, Fipronil + Degradates, Organochlorine Pesticides

Caltest ANALYTICAL LABORATORY

1885 N. KELLY ROAD NAPA, CA 94558 (707) 258-4000 FAX (707) 226-1001

CHAIN OF CUSTODY

PAGE ____ OF ____

PROJECT NAME / PROJECT NUMBER: CCCWP-SSID / 030.001.0202

P.O. NUMBER:

LAB ORDER #:

CLIENT: ADH Environmental

REPORT ATTN: Alessandro Hnatt

MAILING ADDRESS: 3065 Porter St., Suite 101, Soquel

STATE: CA ZIP: 95073

BILLING ADDRESS: same as above

ATTN: Alessandro Hnatt

PHONE NUMBER: 831-477-2003

FAX PHONE NUMBER: 831-477-0895

SAMPLER (PRINT & SIGN NAME):

ANALYSES REQUESTED

TURN-AROUND TIME: X STANDARD ___ RUSH

DUE DATE:

CALTEST LAB #	DATE SAMPLED	TIME SAMPLED	SAMPLE MATRIX*	CONTAINER TYPE/ AMOUNT**	PRESERVATIVE	SAMPLE IDENTIFICATION / SITE	CLIENT LAB #	COMP or GRAB	Organochlorine Pesticides	Pyrethroids Pesticides	Fipronil	Degradates	TOC	SSC	REMARKS
	2 28 14	1000	Strmwtr	2 x 1L AG	<6C	544R00025 JS-W-02		Grab	x						
	↓	↓	Strmwtr	2 x 1L AG	<6C	↓		Grab		x	x	x			
	↓	↓	Strmwtr	3 x 40ml VOA	<6C, HCl	↓		Grab					x		
	↓	↓	Strmwtr	250 ml HDPE	<6C	↓		Grab						x	
	2 28 14	0930	Strmwtr	2 x 1L AG	<6C	544R00025 DS-W-02		Grab	x						
	↓	↓	Strmwtr	2 x 1L AG	<6C	↓		Grab		x	x	x			
	↓	↓	Strmwtr	3 x 40ml VOA	<6C, HCl	↓		Grab					x		
	↓	↓	Strmwtr	250 ml HDPE	<6C	↓		Grab						x	

RELINQUISHED BY	DATE/TIME	RECEIVED BY	RELINQUISHED BY	DATE/TIME	RECEIVED BY
	/			/	
	/			/	

FOR LAB USE ONLY

Samples WC MICRO BIO AA SV VOA pH? Y/N TEMP: SEALED: Y/N INTACT: Y/N

BD BIO WC AA

CC AA SV VOA

SIL HP PT QT VOA

W/HNO_3 H_2SO_4 NaOH

PIL HNO_3 H_2SO_4 NaOH HCL

COMMENTS:

*MATRIX: AQ = Aqueous Nondrinking Water, Digested Metals; FE = Low R.L.s, Aqueous Nondrinking Water, Digested Metals; DW = Drinking Water; SL = Soil Sludge, Solid; FP =

**CONTAINER TYPES: AL = Amber Liter; AHL = 500 ml Amber; PT = Pint (Plastic); QT = Quart (Plastic); HG = Half Gallon (Plastic); SJ = Soil Jar; B4 = 4oz. BACT; BT = Brass Tube; VOA = 40mL VOA; OTC - Other Type Container

R ____ PR ____ M ____ F ____

WHITE: LABORATORY; YELLOW: CLIENT COPY TO ACCOMPANY FINAL REPORT; PINK: CLIENT COPY AS RECEIPT

Pacific EcoRisk
2250 Cordelia Rd., Fairfield, CA 94534
(707) 207-7760 FAX (707) 207-7916

CHAIN-OF-CUSTODY RECORD

Client Name:	ADH Environmental
Client Address:	
Phone:	FAX:
Project Manager:	
Project Name:	CCCWP-SSI
Project # / P.O. Number:	030.001.0202

	Client Sample ID	Sample Date	Sample Time	Sample Matrix*	Container Number	Container Type	Chronic *Selenastrum capricornutum*	Chronic *Ceriodaphnia dubia*	Chronic *Pimephales promelas*	10-day Survival *Hyalella azteca* (water)	10-day *Hyalella azteca* (sediment)						
1	544R00025DS-W-02	2-28-14	0930	STRMW	10	1 gall. amber				x							
2	544R00025US-W-02	2-28-14	1000	STRMW	~~10~~ 9 AW	1 gal amber				X							
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
12																	

Samples collected by:

Comments/Special Instruction:

Note - Fathead minnow testing is to be performed using the standard EPA protocol (i.e., 4 replicates)

contract # 030.001.0202
SSID Study task 2g

RELINQUISHED BY:		RECEIVED BY:	
Signature: Adam Wainscoat		Signature: [signature]	
Print: Adam Wainscoat		Print: C. Glover	
Organization:		Organization: PER	
Date: 2-28-14	Time: 1520	Date: 2/28/14	Time: 1520
RELINQUISHED BY:		**RECEIVED BY:**	
Signature:		Signature:	
Print:		Print:	
Organization:		Organization:	
Date:	Time:	Date:	Time:

***Example Matrix Codes:** (**FW** = Freshwater); (**SW** = Saltwater); (**WW** = Wastewater); (**STRMW** = Stormwater); (**SED** = Sediment); or other

US

SWAMP Field Data Sheet (Water Chemistry & Discrete Probe) - EventType=WQ

*StationCode: 207R00U1U3	*Date (mm/dd/yyyy): 03 / 26 / 14	*Group: ADH	*Agency: CCCWP
*Funding: CCCWP SSID	ArrivalTime: 12:00 DepartureTime: 13:15	*SampleTime (1st sample): 12 40	*Protocol: RMC
*ProjectCode: 030.001.0202	*Personnel: C. Sandi LA Dinkel	*Purpose (circle applicable): WaterChem WaterTox Habitat FieldMeas	*PurposeFailure:

Entered in d-base (initial/date): | Pg 1 of 1 Pgs

*Location: Bank Thalweg Midchannel OpenWater	*GPS/DGPS	Lat (dd.ddddd)	Long (ddd.ddddd)	OCCUPATION METHOD: Walk-in Bridge R/V ____ Other
GPS Device: LG Cell Phone	Target:		-	STARTING BANK (facing downstream): LB / RB / NA
Datum: NAD83 Accuracy (ft / m):	Actual:	37.95275	- 122.08150	Point of Sample (if integrated, then -88 in dbase)

Habitat Observations (CollectionMethod = Habitat_generic)

SITE ODOR:	None, Sulfides, Sewage, Petroleum, Smoke, Other____	WADEABILITY: Y / N / Unk (in storm)	BEAUFORT SCALE (see attachment): 0
SKY CODE:	Clear, Partly Cloudy, Overcast, Fog, Smoky, Hazy	WIND DIRECTION (from):	
OTHER PRESENCE:	Vascular, Nonvascular, OilySheen, Foam, Trash, Other N/A		
DOMINANT SUBSTRATE:	Bedrock, Concrete, Cobble, Gravel, Sand, Mud, Unk, Other____		
WATERCLARITY:	Clear (see bottom), Cloudy (>4" vis), Murky (<4" vis)	PRECIPITATION:	None, Fog, Drizzle, Rain, Snow
WATERODOR:	None, Sulfides, Sewage, Petroleum, Mixed, Other____	PRECIPITATION (last 24 hrs):	Unknown, <1", >1", None
WATERCOLOR:	Colorless, Green, Yellow, Brown Lt	EVIDENCE OF FIRES:	No, <1 year, <5 years
OVERLAND RUNOFF (Last 24 hrs):	none, light, moderate / heavy, unknown		
OBSERVED FLOW:	NA, Dry Waterbody Bed, No Obs Flow, Isolated Pool, Trickle (<0.1cfs), 0.1-1cfs, 1-5cfs, 5-20cfs, 20-50cfs, 50-200cfs, >200cfs		

DISTANCE FROM BANK (m): above channel | STREAM WIDTH (m): 8 m | WATER DEPTH (m): 1.0 m

HYDROMODIFICATION: None, Bridge, Pipes, ConcreteChannel, GradeControl, Culvert, AerialZipline, Other Directly below | LOCATION (to sample): US / DS / WI / NA

PHOTOS (RB & LB assigned when facing downstream; RENAME to StationCode_yyyy_mm_dd_uniquecode):
1: (RB / LB / BB / US / DS / ##)
2: (RB / LB / BB / US / DS / ##)
3: (RB / LB / BB / US / DS / ##)

Field Measurements (SampleType = FieldMeasure; Method = Field)

	DepthCollec (m)	Velocity (fps)	Air Temp (°C)	Water Temp (°C)	pH	O_2 (mg/L)	O_2 (%)	Specific Conductivity (uS/cm)	Salinity (ppt)	Turbidity (ntu)			
SUBSURF/MID/ BOTTOM/REP	.2	[illegible]	55	14.9	7.8	10.66	101	.410	.2				
SUBSURF/MID/ BOTTOM/REP													
SUBSURF/MID/ BOTTOM/REP													
Instrument:													
Calib. Date:													

Samples Taken (# of containers filled) - Method=Water_Grab

Field Dup YES / NO: (SampleType = Grab / Integrated; LABEL_ID = FieldQA; create collection record upon data entry

SAMPLE TYPE: Grab / Integrated | COLLECTION DEVICE: Indiv bottle (by hand, by pole, by bucket); Teflon tubing; Kemmer; Pole & Beaker; Other ____

	DepthCollec (m)	Inorganics	Bacteria	Chl a	TSS / SSC	TOC / DOC	Total Hg	Dissolved Mercury	Total Metals	Dissolved Metals	Organics	Toxicity	VOAs
Sub/Surface	.2				1	1x3 voa					4	10x1gal	
Sub/Surface													

COMMENTS: Samples collected @ walking Bridge between Mercury way & Vineyard Dr top of channel with Grab pole

Modified 02/10/11

20' top width
8' bottom width

Trib of Grayson

Organochlorine pesticides (2x)
Pyrethroid Pesticides, FiP, Degradates (2x)

E Branch
SSID 11DS, Grayson @ Ardith

SWAMP Field Data Sheet (Water Chemistry & Discrete Probe) - EventType=WQ

Entered in d-base (initial/date) | Pg 1 of 1 Pgs

*StationCode: 207R00011DS | *Date (mm/dd/yyyy): 3/26/14 | *Group: ADH | *Agency: CCCWP

*Funding: CCCWP SSID | ArrivalTime: 13:45 | DepartureTime: 14:30 | *SampleTime (1st sample): 14:00 | *Protocol: RMC

*ProjectCode: 030.001.0202 | *Personnel: C. Sandlin L. Aldi... | *Purpose (circle applicable): (WaterChem) (WaterTox) Habitat FieldMeas | *PurposeFailure:

*Location: Bank Thalweg (Midchannel) OpenWater | *GPS/DGPS | Lat (dd.ddddd) | Long (ddd.ddddd) | OCCUPATION METHOD: (Walk-in) Bridge R/V ______ Other

GPS Device: iphone gps location app | Target: | - | STARTING BANK (facing downstream): (LB) / RB / NA

Datum: NAD83 | Accuracy (ft / m): | *Actual: 37.95995 | -122.07304 | Point of Sample (if Integrated, then -88 in dbase)

Habitat Observations (CollectionMethod = Habitat_generic)

WADEABILITY: (Y) / N / Unk | BEAUFORT SCALE (see attachment): 2 | DISTANCE FROM BANK (m): 3M | STREAM WIDTH (m): | WATER DEPTH (m): 0.3

SITE ODOR: (None), Sulfides, Sewage, Petroleum, Smoke, Other ______

SKY CODE: Clear, Partly (Cloudy), Overcast, Fog, Smoky, Hazy

WIND DIRECTION (from): ↖

HYDROMODIFICATION: None, Bridge, Pipes, (ConcreteChannel), GradeControl, Culvert, AerialZipline, Other | HYDROMOD LOCATION (to sample): US / DS / (WI) / NA

OTHER PRESENCE: Vascular, Nonvascular, OilySheen, Foam, Trash, Other leaves

DOMINANT SUBSTRATE: Bedrock, (Concrete), Cobble, Gravel, Sand, Mud, Unk, Other ______

PHOTOS (RB & LB assigned when facing downstream; RENAME to StationCode_yyyy_mm_dd_uniquecode):
1: (RB / (LB) / BB / (US) / DS / ##)
2: (RB / LB / BB / (US) / DS / ##)
3: (RB / LB / BB / US / (DS) / ##)

WATERCLARITY: Clear (see bottom), (Cloudy (>4" vis)), Murky (<4" vis)

PRECIPITATION: None, Fog, (Drizzle), Rain, Snow

WATERODOR: (None), Sulfides, Sewage, Petroleum, Mixed, Other ______

PRECIPITATION (last 24 hrs): Unknown, (<1"), >1", None

WATERCOLOR: Colorless, (Green), Yellow, (Brown)

EVIDENCE OF FIRES: (No), <1 year, <5 years

OVERLAND RUNOFF (Last 24 hrs): none, (light), moderate / heavy, unknown

OBSERVED FLOW: NA, Dry Waterbody Bed, No Obs Flow, Isolated Pool, Trickle (<0.1cfs), (0.1-1cfs), 1-5cfs, 5-20cfs, 20-50cfs, 50-200cfs, >200cfs

Field Measurements (SampleType = FieldMeasure; Method = Field)

	DepthCollec (m)	Velocity (fps)	Air Temp (°C)	Water Temp (°C)	pH	O_2 (mg/L)	O_2 (%)	Specific Conductivity (uS/cm)	Salinity (ppt)	Turbidity (ntu)			
SUBSURF/MID/BOTTOM/REP	.25	[illegible]	60	15.59	8.2	11.62	116.1	0.295	0.14				
SUBSURF/MID/BOTTOM/REP													
SUBSURF/MID/BOTTOM/REP													
Instrument:													
Calib. Date:													

Samples Taken (# of containers filled) - Method=Water_Grab

Field Dup YES / (NO): (SampleType = (Grab) / Integrated; LABEL_ID = FieldQA; create collection record upon data entry

SAMPLE TYPE: (Grab) / Integrated | COLLECTION DEVICE: Indiv bottle (by hand), by pole, by bucket); Teflon tubing; Kemmer; Pole & Beaker; Other ______

	DepthCollec (m)	Inorganics	Bacteria	Chl a	TSS / (SSC)	(TOC) / DOC	Total Hg	Dissolved Mercury	Total Metals	Dissolved Metals	(Organics)	Toxicity	VOAs
Sub/Surface	.2				1	1					4	1	
Sub/Surface					250 ml	3 x 40						10 x 1 gal	

COMMENTS:
Samples from mid stream by hand

Modified 02/10/11

Organochlorine Pesticides (x2)
Pyrethroid Pesticides, Fipronil, Degradates (x2)

Caltest ANALYTICAL LABORATORY

1885 N. KELLY ROAD NAPA, CA 94558 (707) 258-4000 FAX (707) 226-1001

CHAIN OF CUSTODY

PAGE ____ OF ____

PROJECT NAME / PROJECT NUMBER: CCCWP-SSID / 030.001.0202

P.O. NUMBER:

LAB ORDER #: P031834

CLIENT: ADH Environmental

REPORT ATTN: Alessandro Hnatt

MAILING ADDRESS: 3065 Porter St., Suite 101, Soquel

STATE: CA

ZIP: 95073

BILLING ADDRESS: same as above

ATTN: Alessandro Hnatt

PHONE NUMBER: 831-477-2003

FAX PHONE NUMBER: 831-477-0895

SAMPLER (PRINT & SIGN NAME):

TURN-AROUND TIME: [X] STANDARD [ ] RUSH

DUE DATE:

ANALYSES REQUESTED

CALTEST LAB #	DATE SAMPLED	TIME SAMPLED	SAMPLE MATRIX*	CONTAINER TYPE/ AMOUNT**	PRESERVATIVE	SAMPLE IDENTIFICATION / SITE	CLIENT LAB #	COMP. or GRAB	Organochlorine Pesticides	Pyrethroids Pesticides	Fipronil	Degradates	TOC	SSC					REMARKS
	3-26-14	~~12:10~~ 14:00 (KL)	Strmwtr	2 x 1L AG	<6C	207R00011DS-W-01		Grab	x										
	|	|	Strmwtr	2 x 1L AG	<6C	207R00011DS-W-02		Grab		x	x	x							
	|	|	Strmwtr	3 x 40ml VOA	<6C, HCl	207R00011DS-W-02		Grab					x						
	|	—	Strmwtr	250 ml HDPE	<6C	207R00011DS-W-01		Grab						x					
		~~11:00~~ 12:40 (KL)	Strmwtr	2 x 1L AG	<6C	207R00011US-W-01		Grab	x										
	|	|	Strmwtr	2 x 1L AG	<6C	207R00011US-W-01		Grab		x	x	x							
	|	|	Strmwtr	3 x 40ml VOA	<6C, HCl	207R00011US-W-02		Grab					x						
	—	—	Strmwtr	250 ml HDPE	<6C	207R00011US-W-01		Grab						x					
						1 glass Carboy													

RELINQUISHED BY	DATE/TIME	RECEIVED BY	RELINQUISHED BY	DATE/TIME	RECEIVED BY
[signature]	3/26/1518	[signature]		/	
/	/			/	

FOR LAB USE ONLY

Samples: WC ___ MICRO ___ BIO ___ AA ___ SV ___ VOA ___ pH? Y/N TEMP: ___ SEALED: Y/N INTACT: Y/N

SD: BIO ___ WC ___ AA ___ COMMENTS:

CC: AA ___ SV ___ VOA ___

SIL: HP ___ PT ___ QT ___ VOA ___

W/HNO$_3$ ___ H_2SO_4 ___ NaOH ___

PIL: HNO$_3$ ___ H_2SO_4 ___ NaOH ___ HCL ___

*MATRIX: AQ = Aqueous Nondrinking Water, Digested Metals; FE = Low R.L.s, Aqueous Nondrinking Water, Digested Metals; DW = Drinking Water; SL = Soil Sludge, Solid ; FP =

**CONTAINER TYPES: AL = Amber Liter; AHL = 500 ml Amber; PT = Pint (Plastic); QT = Quart (Plastic); HG = Half Gallon (Plastic); SJ = Soil Jar; B4 = 4oz. BACT; BT = Brass Tube; VOA = 40mL VOA; OTC - Other Type Container

R ___ PR ___ M ___ F ___

WHITE - LABORATORY YELLOW - CLIENT COPY TO ACCOMPANY FINAL REPORT PINK - CLIENT COPY AS RECEIPT

Pacific EcoRisk
2250 Cordelia Rd., Fairfield, CA 94534
(707) 207-7760 FAX (707) 207-7916

CHAIN-OF-CUSTODY RECORD

Client Name:	
Client Address:	ADH 3065 Porter St suite 101
Phone:	FAX:
Project Manager:	
Project Name:	CCCWISSID / 030.001.0202
Project # / P.O. Number:	

#	Client Sample ID	Sample Date	Sample Time	Sample Matrix*	Container Number	Container Type	Chronic *Selenastrum capricornutum*	Chronic *Ceriodaphnia dubia*	Chronic *Pimephales promelas*	10-day Survival *Hyalella azteca* (water)	10-day *Hyalella azteca* (sediment)						
1	207R00011 05-W-02	3-26-14	1300	STRMW	10	1 gall. amber				x							
2	207R00011 05-W-02	3-26-14	1240	STRMW	10	1 gal Amber				^							
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
12																	

Samples collected by:

Comments/Special Instruction:

Note - Fathead minnow testing is to be performed using the standard EPA protocol (i.e., 4 replicates)

RELINQUISHED BY:		RECEIVED BY:	
Signature: [signature]		Signature: [signature]	
Print: LUCAS ALDINGER		Print: Y. Khadiyeva	
Organization: ADH		Organization: PER	
Date: 3-26-14	Time: 16:00	Date: 3/26/14	Time: 1600
RELINQUISHED BY:		**RECEIVED BY:**	
Signature:		Signature:	
Print:		Print:	
Organization:		Organization:	
Date:	Time:	Date:	Time:

*Example Matrix Codes: (FW = Freshwater); (SW = Saltwater); (WW = Wastewater); (STRMW = Stormwater); (SED = Sediment); or other

*New station code 544MSH062

Down stream location near 1007 Crescent Dr., Brentwood

SWAMP Field Data Sheet (Sediment Chemistry) - EventType=WQ		Entered in d-base (initial/date)	Pg 1 of 2 Pgs
* *StationID: 544R00025	*Date (mm/dd/yyyy): 07 / 22 / 2014	*Group: ADH	*Agency: ~~ADH~~ CCCWP
*Funding: CCCWP	ArrivalTime: 9:30 DepartureTime: 11:00	*SampleTime (1st sample): 10:15	*Protocol: RMC
*ProjectCode:	*Personnel: J. Cerruti, C. Smith	*Purpose (circle applicable): (SedChem) (SedTox) Habitat Benthic	*PurposeFailure:

*Location: Bank Thalweg Midchannel OpenWater	*GPS/DGPS	Lat (dd.ddddd)	Long (ddd.ddddd)	OCCUPATION METHOD: (Walk-in) Bridge R/V ____ Other
GPS Device: Verizon Lucid cell phone	Target:	37.92300	-121.71441	STARTING BANK (facing downstream): (LB) / RB / NA
	*Actual:	37.92288	-121.71410	Point of Sample (if Integrated, then -88 in dbase)
Datum: NAD83 Accuracy ((ft) / m): 19	Same as Water/Probe Collection? (YES) NO			DISTANCE FROM BANK (m): 0.5; STREAM WIDTH (m): 1; WATER DEPTH (m): 0.25

Habitat Observations (CollectionMethod = Habitat_generic) *Only complete Sed Observations (bolded) if WQ Observations are already recorded

WADEABILITY: (Y) / N / Unk

BEAUFORT SCALE see Attachment: 2

WIND DIRECTION (from): [arrow drawn pointing S]

SITE ODOR:	(None), Sulfides, Sewage, Petroleum, Smoke, Other ____
SKY CODE:	Clear, (Partly Cloudy), Overcast, Fog, Smoky, Hazy
OTHERPRESENCE:	(Vascular), (Nonvascular), OilySheen, Foam, (Trash), Other ____
DOMINANTSUBSTRATE:	Bedrock, Concrete, Cobble, Boulder, Gravel, (Sand), (Mud), Unk, Other ____
SEDODOR:	(None), (Sulfides), Sewage, Petroleum, Mixed, Other ____
SEDCOLOR:	Colorless, Green, Yellow, Brown, (Black)
SEDCOMPOSITION:	(Silt/Clay), FineSand, CoarseSand, Gravel, Cobble, Mixed, HardPanClay
OBSERVED FLOW:	NA, Dry Waterbody Bed, No Obs Flow, Isolated Pool, (Trickle (<0.1cfs)), 0.1-1cfs, 1-5cfs, 5-20cfs, 20-50cfs, 50-200cfs, >200cfs

HYDROMODIFICATION: None, Bridge, Pipes, ConcreteChannel, GradeControl, (Culvert), AerialZipline, Other

LOCATION (to sample): (US) / DS / WI / NA

PRECIPITATION: None, Fog, Drizzle, (Rain), Snow

PRECIPITATION (last 24 hrs): (Unknown), <1", >1", None

EVIDENCE OF FIRES: (No), <1 years, <5 years

PHOTOS (RB & LB assigned when facing downstream; RENAME to StationCode_yyyy_mm_dd_uniquecode): yes

1: (RB / (LB) / BB / (US) / DS / ##)

2: (RB / (LB) / BB / US / (DS) / ##)

3: (RB / (LB) / (BB) / US / DS / ##)

Samples Taken (# of containers filled) - Method=Sed_Grab

Field Dup YES / (NO) (SampleType = Grab / Integrated; LABEL_ID = FieldQA; create collection record upon data entry

COLLECTION DEVICE: (Scoop) (SS / PC / (PE)), Core (SS / PC / PE), Grab (Van Veen / Eckman / Petite Ponar)

COLLECTION DEVICE AREA (m2): ____

Sample Type:	DepthCollec (cm)	Equipment Used	Sediment Only (Y / N)	Grain Size/TOC	*1 ~~Organics~~	*2 ~~Metals/HgT~~	*3 ~~Selenium~~	Toxicity	SWI	Archive Chemistry	Benthic Infauna	Benthic Coll. Area (m^2)	Sieve Size (mm)
(Integrated) Grab	2			1	2	2	1	3					
Integrated Grab													
Integrated Grab													
Integrated Grab													

COMMENTS:

down stream location for SSID Study

used kynar coated bucket and scoop

Sample taken @ 10:15

*1 Pyrethroids, fipronil and degradates

*2 organochlorine pesticides

*3 percent solids

Modified 06/27/08

* New station code ~~544MSH065~~ 544MSH062

Downstream Location

SWAMP Field Data Sheet (Water Chemistry & Discrete Probe) - EventType=WQ		Entered in d-base (initial/date)	Pg 2 of 2 Pgs
* *StationID: 544R00025	*Date (mm/dd/yyyy): 07 / 22 / 2014	*Group: ADH	*Agency: ~~ADH~~ CCCWP
*Funding: CCCWP	ArrivalTime: 9:30 DepartureTime: 11:00	*SampleTime (1st sample): 10:15 ~~11:45~~	*Protocol: ~~CCCWP~~ RMC
*ProjectCode:	*Personnel: J. Cerruti, C. Sandlin	*Purpose (circle applicable): WaterChem WaterTox Habitat (FieldMeas)	*PurposeFailure: ~~[illegible]~~

*Location: Bank Thalweg (Midchannel) OpenWater	*GPS/DGPS	Lat (dd.ddddd)	Long (ddd.ddddd)	OCCUPATION METHOD: (Walk-in) Bridge R/V ______ Other
GPS Device: Verizon Lucid Cell phone	Target:	37.92300	-121.71441	STARTING BANK (facing downstream): (LB) / RB / NA
Datum: NAD83 Accuracy ((ft)/m): 18	*Actual:	37.92288	-121.71410	Point of Sample (if Integrated, then -88 in dbase)

Habitat Observations (CollectionMethod = Habitat_generic)

- SITE ODOR: (None), Sulfides, Sewage, Petroleum, Smoke, Other
- WADEABILITY: (Y) / N / Unk
- BEAUFORT SCALE (see attachment): 2
- DISTANCE FROM BANK (m): 0.5
- STREAM WIDTH (m): 1
- WATER DEPTH (m): 0.25
- SKY CODE: Clear, (Partly Cloudy), Overcast, Fog, Smoky, Hazy
- WIND DIRECTION (from): [compass marked]
- HYDROMODIFICATION: None, Bridge, Pipes, ConcreteChannel, GradeControl, (Culvert), AerialZipline, Other — LOCATION (to sample): (US) / DS / WI /
- OTHER PRESENCE: (Vascular), (Nonvascular), OilySheen, Foam, (Trash), Other
- PHOTOS (RB & LB assigned when facing downstream; RENAME to StationCode_yyyy_mm_dd_uniquecode): yes
  - 1: (RB / (LB) / BB / (US) / DS / ##)
  - 2: (RB / (LB) / BB / US / (DS) / ##)
  - 3: (RB / (LB) / (BB) / US / DS / ##)
- DOMINANT SUBSTRATE: Bedrock, Concrete, Cobble, Boulder, Gravel, (Sand), (Mud), Unk, Other
- WATERCLARITY: (Clear) (see bottom), Cloudy (>4" vis), Murky (<4" vis)
- PRECIPITATION: None, Fog, Drizzle, (Rain), Snow
- WATERODOR: (None), Sulfides, Sewage, Petroleum, Mixed, Other
- PRECIPITATION (last 24 hrs): (Unknown), <1", >1", None
- WATERCOLOR: (Colorless), Green, Yellow, Brown
- EVIDENCE OF FIRES: (No), <1 year, <5 years
- OVERLAND RUNOFF (Last 24 hrs): (none), light, moderate / heavy, unknown
- OBSERVED FLOW: NA, Dry Waterbody Bed, No Obs Flow, Isolated Pool, (Trickle (<0.1cfs)), 0.1-1cfs, 1-5cfs, 5-20cfs, 20-50cfs, 50-200cfs, >200cfs

Field Measurements (SampleType = FieldMeasure; Method = Field)

	DepthCollec (m)	Velocity (fps)	Air Temp (°C)	Water Temp (°C)	pH	O_2 (mg/L)	O_2 (%)	Specific Conductivity	Salinity (ppt)	Turbidity (ntu)			
SUBSURF/MID/BOTTOM/REP	4 inches	~~.25 fps~~		21.66	7.80	5.28 DO mg/L	60.6	1592	0.86				
SUBSURF/MID/BOTTOM/REP													
SUBSURF/MID/BOTTOM/REP													
Instrument:	YSI 556												
Calib. Date:	07-22-14												

Samples Taken (# of containers filled) - Method=Water_Grab — Field Dup YES / NO: (SampleType = Grab / Integrated; LABEL_ID = FieldQA; create collection record upon data entry

SAMPLE TYPE: Grab / Integrated — COLLECTION DEVICE: Indiv bottle (by hand, by pole, by bucket); Teflon tubing; Kemmer; Pole & Beaker; Other

	DepthCollec (m)	Inorganics	Bacteria	Chl a	TSS / SSC	TOC / DOC	Total Hg	Dissolved Mercury	Total Metals	Dissolved Metals	Organics	Toxicity	VOAs
Sub/Surface													
Sub/Surface													

COMMENTS:
- Sunny and casually raining (very light rain)
- Scattered garbage in the water (aluminium cans, paper)

1.706 mS/cm
1592 uS/cm

YSI Field measurements only

Modified 02/10/11

* New station code 544MSH065

Up stream location Dry Creek at 1380 Arlington Way

SWAMP Field Data Sheet (Sediment Chemistry) - EventType=WQ

*StationID: 544R00025	*Date (mm/dd/yyyy): 07/22/2014	*Group: ADH	Entered in d-base (initial/date) / Pg 1 of 2 Pgs
*Funding: CCCWP	ArrivalTime: 11:10 / DepartureTime: 12:00	*SampleTime (1st sample): 11:45	*Agency: ~~ADH~~ CCCW
*ProjectCode:	*Personnel: J. Cerruti, C. Sandlin	*Purpose (circle applicable): SedChem SedTox Habitat Benthic	*Protocol: RMC / *PurposeFailure:

*Location: Bank Thalweg Midchannel OpenWater	*GPS/DGPS	Lat (dd.ddddd)	Long (ddd.ddddd)	OCCUPATION METHOD: Walk-in Bridge R/V ______ Other
GPS Device: Verizon Lucid cellphone	Target:	37.92157	-121.72174	STARTING BANK (facing downstream): LB / RB / NA
	*Actual:	37.92689	-121.72200	Point of Sample (if Integrated, then -88 in dbase)
Datum: NAD83 Accuracy (ft / m): 18	Same as Water/Probe Collection? YES NO			DISTANCE FROM BANK (m): 0.75 / STREAM WIDTH (m): 1.5 / WATER DEPTH (m): ~~6 inches~~ 15 cm

Habitat Observations (CollectionMethod = Habitat_generic) **Only complete Sed Observations (bolded) if WQ Observations are already recorded

WADEABILITY: Y / N / Unk — Y

BEAUFORT SCALE see Attachment: 2

WIND DIRECTION (from): N

HYDROMODIFICATION: None, Bridge, Pipes, ConcreteChannel, GradeControl, Culvert, AerialZipline, Other — Culvert
LOCATION (to sample): US / DS / WI / NA — US

SITE ODOR: None, Sulfides, Sewage, Petroleum, Smoke, Other ____ — Sulfides

SKY CODE: Clear, Partly Cloudy, Overcast, Fog, Smoky, Hazy — Partly Cloudy

OTHERPRESENCE: Vascular, Nonvascular, OilySheen, Foam, Trash, Other ____ — Vascular, Nonvascular, Trash

DOMINANTSUBSTRATE: Bedrock, Concrete, Cobble, Boulder, Gravel, Sand, Mud, Unk, Other ____ — Mud

PHOTOS (RB & LB assigned when facing downstream; RENAME to StationCode_yyyy_mm_dd_uniquecode):
1: (RB / LB / BB / US / DS / ##) — LB, US
2: (RB / LB / BB / US / DS / ##) — LB, DS
3: (RB / LB / BB / US / DS / ##) — LB, BB

SEDODOR: None, Sulfides, Sewage, Petroleum, Mixed, Other ____ — Sulfides

PRECIPITATION: None, Fog, Drizzle, Rain, Snow — Rain*

SEDCOLOR: Colorless, Green, Yellow, Brown Black — Brown Black

PRECIPITATION (last 24 hrs): Unknown, <1", >1", None — Unknown

SEDCOMPOSITION: Silt/Clay, FineSand, CoarseSand, Gravel, Cobble, Mixed, HardPanClay — Silt/Clay

EVIDENCE OF FIRES: No, <1 years, <5 years — No

OBSERVED FLOW: NA, Dry Waterbody Bed, No Obs Flow, Isolated Pool, Trickle (<0.1cfs), 0.1-1cfs, 1-5cfs, 5-20cfs, 20-50cfs, 50-200cfs, >200cfs — Trickle (<0.1cfs)

Samples Taken (# of containers filled) - Method=Sed_Grab

Field Dup YES / NO: (SampleType = Grab / Integrated; LABEL_ID = FieldQA; create collection record upon data entry) — NO

COLLECTION DEVICE: Scoop (SS / PC / PE), Core (SS / PC / PE), Grab (Van Veen / Eckman / Petite Ponar) — Scoop, PE

COLLECTION DEVICE AREA (m2): ______

Sample Type:	DepthCollec (cm)	Equipment Used	Sediment Only (Y / N)	Grain Size/TOC	*1 ~~Organics~~	*2 ~~Metals/HgT~~	*3 ~~Selenium~~	Toxicity	SWI	Archive Chemistry	Benthic Infauna	Benthic Coll. Area (m^2)	Sieve Size (mm)
Integrated Grab				1	2	2	1	3					
Integrated Grab													
Integrated Grab													
Integrated Grab													

COMMENTS:

Up stream location for SSID Study

used Kynar coated bucket and scoop

* very light shower in morning, dry & hot in afternoon

*1 Pyrethroids, Fipronil, and degradates
*2 organochlorine pesticides
*3 percent solids

Modified 06/27/08

* New station code 544MSH065
upstream location

SWAMP Field Data Sheet (Water Chemistry & Discrete Probe) - EventType=WQ

* *StationID: 544R00025	*Date (mm/dd/yyyy): 07/22/2014	*Group: ADH	Entered in d-base (initial/date) — Pg 2 of 2 Pgs; *Agency: ~~ADH~~ CCCWP
*Funding: CCCWP	ArrivalTime: 11:10 — DepartureTime: 12:00	*SampleTime (1st sample): ~~10:15~~ 11:45	*Protocol: RMC
*ProjectCode:	*Personnel: J. Cerruti, C. Sandlin	*Purpose (circle applicable): WaterChem WaterTox Habitat (FieldMeas)	*PurposeFailure:
*Location: Bank Thalweg Midchannel OpenWater	*GPS/DGPS — Lat (dd.ddddd) / Long (ddd.ddddd)		OCCUPATION METHOD: (Walk-in) Bridge R/V ___ Other
GPS Device:	Target: 37.92157 / -121.72174		STARTING BANK (facing downstream): LB / RB / NA
Datum: NAD83 — Accuracy (ft / m):	*Actual: 37.921689 / -121.72200		Point of Sample (If Integrated, then -88 in dbase)

Habitat Observations (CollectionMethod = Habitat_generic)

- WADEABILITY: (Y) / N / Unk
- BEAUFORT SCALE (see attachment): 2
- DISTANCE FROM BANK (m): 0.75
- STREAM WIDTH (m): 1.5
- WATER DEPTH (m): ~~6 inches~~ 15cm
- SITE ODOR: (None), Sulfides, Sewage, Petroleum, Smoke, Other
- SKY CODE: Clear, (Partly Cloudy), Overcast, Fog, Smoky, Hazy
- WIND DIRECTION (from): N
- HYDROMODIFICATION: None, Bridge, Pipes, ConcreteChannel, GradeControl, (Culvert), AerialZipline, Other — LOCATION (to sample): (US) / DS / WI /
- OTHER PRESENCE: (Vascular), (Nonvascular), OilySheen, Foam, (Trash), Other
- DOMINANT SUBSTRATE: Bedrock, Concrete, Cobble, Boulder, Gravel, Sand, (Mud), Unk, Other
- PHOTOS (RB & LB assigned when facing downstream; RENAME to StationCode_yyyy_mm_dd_uniquecode):
  - 1: (RB / (LB) / BB / (US) / DS / ##)
  - 2: (RB / (LB) / BB / US / (DS) / ##)
  - 3: (RB / (LB) / (BB) / US / DS / ##)
- WATERCLARITY: (Clear (see bottom)), Cloudy (>4" vis), Murky (<4" vis)
- PRECIPITATION: (None), Fog, Drizzle, Rain, Snow
- WATERODOR: (None), Sulfides, Sewage, Petroleum, Mixed, Other
- PRECIPITATION (last 24 hrs): (Unknown), <1", >1", None
- WATERCOLOR: (Colorless), Green, Yellow, Brown
- EVIDENCE OF FIRES: (No), <1 year, <5 years
- OVERLAND RUNOFF (Last 24 hrs): none, light, moderate / heavy, unknown
- OBSERVED FLOW: NA, Dry Waterbody Bed, No Obs Flow, Isolated Pool, (Trickle (<0.1cfs)), 0.1-1cfs, 1-5cfs, 5-20cfs, 20-50cfs, 50-200cfs, >200cfs

Field Measurements (SampleType = FieldMeasure; Method = Field)

	DepthCollec (m)	Velocity (fps)	Air Temp (°C)	Water Temp (°C)	pH	O_2 (mg/L)	O_2 (%)	Specific Conductivity	Salinity (ppt)	Turbidity (ntu)			
SUBSURF/MID/BOTTOM/REP	4 inches	~~[illegible]~~		22.45	7.61	3.7500	44.0	1683	.89				
SUBSURF/MID/BOTTOM/REP													
SUBSURF/MID/BOTTOM/REP													
Instrument:	YSI 556												
Calib. Date:	07-22												

Samples Taken (# of containers filled) - Method=Water_Grab — Field Dup YES / NO: (SampleType = Grab / Integrated; LABEL_ID = FieldQA; create collection record upon data entry

SAMPLE TYPE: Grab / Integrated — COLLECTION DEVICE: Indiv bottle (by hand, by pole, by bucket); Teflon tubing; Kemmer; Pole & Beaker; Other

	DepthCollec (m)	Inorganics	Bacteria	Chl a	TSS / SSC	TOC / DOC	Total Hg	Dissolved Mercury	Total Metals	Dissolved Metals	Organics	Toxicity	VOAs
Sub/Surface													
Sub/Surface													

COMMENTS:

1,770 mS/cm
1683 uS/cm

light rain this morning

Modified 02/10/11

* New station code 207WAL060

downstream East Branch Grayson Creek @ Ardith Lane

SWAMP Field Data Sheet (Sediment Chemistry) - EventType=WQ		Entered in d-base (initial/date)	Pg 1 of 2 Pgs
* *StationID: 207R00011	*Date (mm/dd/yyyy): 07/22/14	*Group: ADH Environmental	*Agency: CCCWP
*Funding: CCCWP	ArrivalTime: 1015 DepartureTime: 12:30	*SampleTime (1st sample): 11:45	*Protocol: RMC
*ProjectCode:	*Personnel: K. Lewis, B. Haeger	*Purpose (circle applicable): (SedChem) (SedTox) Habitat Benthic	*PurposeFailure:

*Location: Bank Thalweg Midchannel OpenWater	*GPS/DGPS	Lat (dd.ddddd)	Long (ddd.ddddd)	OCCUPATION METHOD: (Walk-in) Bridge R/V ____ Other
GPS Device: Garmin eTrex 20	Target:	37.95995	-122.07304	STARTING BANK (facing downstream): (LB) / RB / NA
	*Actual:	37.95850	-122.06634	Point of Sample (if Integrated, then -88 in dbase)
Datum: NAD83 Accuracy ((ft)/ m): ~~39~~ 14	Same as Water/Probe Collection? (YES) NO			DISTANCE FROM BANK (m): 0.8 / STREAM WIDTH (m): 1.6 / WATER DEPTH (~~m~~ cm): 3-

Habitat Observations (CollectionMethod = Habitat_generic) **Only complete Sed Observations (bolded) if WQ Observations are already recorded

SITE ODOR:	(None), Sulfides, Sewage, Petroleum, Smoke, Other____	WADEABILITY: (Y) / N / Unk	BEAUFORT SCALE see Attachment: 1
SKY CODE:	Clear, Partly Cloudy, (Overcast), Fog, Smoky, Hazy	WIND DIRECTION (from): NW	
OTHERPRESENCE:	Vascular, (Nonvascular), OilySheen, Foam, Trash, Other____		
DOMINANTSUBSTRATE:	Bedrock, (Concrete), Cobble, Boulder, Gravel, ~~Sand, Mud~~, Unk, Other____		
SEDODOR:	None, Sulfides, Sewage, Petroleum, Mixed, Other____	PRECIPITATION:	(None), Fog, Drizzle, Rain, Snow
SEDCOLOR:	Colorless, Green, Yellow, (Brown)	PRECIPITATION (last 24 hrs):	(Unknown), <1", >1", None
SEDCOMPOSITION:	Silt/Clay, (FineSand), CoarseSand, Gravel, Cobble, Mixed, HardPanClay	EVIDENCE OF FIRES:	(No), <1 years, <5 years
OBSERVED FLOW:	NA, Dry Waterbody Bed, No Obs Flow, Isolated Pool, Trickle (<0.1cfs), (0.1-1cfs), 1-5cfs, 5-20cfs, 20-50cfs, 50-200cfs, >200cfs		

HYDROMODIFICATION: None, Bridge, Pipes, (ConcreteChannel), GradeControl, Culvert, AerialZipline, Other
LOCATION (to sample): US / DS / WI / NA

PHOTOS (RB & LB assigned when facing downstream; RENAME to StationCode_yyyy_mm_dd_uniquecode):
1: (RB / (LB) BB / (US) DS / ##)
2: (RB / (LB) BB / US / (DS) ##)
3: (RB / (LB) (BB) US / DS / ##)

Samples Taken (# of containers filled) - Method=Sed_Grab Field Dup YES / (NO) (SampleType = Grab / Integrated; LABEL_ID = FieldQA; create collection record upon data entry

COLLECTION DEVICE: (Scoop) (SS / PC / (PE)) Core (SS / PC / PE), Grab (Van Veen / Eckman / Petite Ponar) COLLECTION DEVICE AREA (m2): ____

Sample Type:	DepthCollec (cm)	Equipment Used	Sediment Only (Y / N)	Grain Size/TOC	*1 ~~Organics~~	*2 ~~Metals/HgT~~	*3 ~~Selenium~~	Toxicity	SWI	Archive Chemistry	Benthic Infauna	Benthic Coll. Area (m^2)	Sieve Size (mm)
(Integrated) Grab	2			1	2	2	1	3					
Integrated Grab													
Integrated Grab													
Integrated Grab													

COMMENTS:

down stream location for SSID Study.
used kynar coated scoop and bucket

*1 Pyrethroids, fipronil, and degredates
*2 organochlorine pesticides
*3 Percent solids

Modified 06/27/08

*New station code 207WAL060

down stream East Branch Grayson Creek @ Ardith Lane

SWAMP Field Data Sheet (Water Chemistry & Discrete Probe) - EventType=WQ

Entered in d-base (initial/date)		Pg 2 of 2 Pgs	
* *StationID: 207R00011	*Date (mm/dd/yyyy): 07 / 22 / 2014	*Group: ADH	*Agency: CCCWP
*Funding: CCCWP	ArrivalTime: 10:15 DepartureTime: 12:30	*SampleTime (1st sample): 11:45	*Protocol: RMC
*ProjectCode:	*Personnel: K. Lewis, C. Sandlin	*Purpose (circle applicable): WaterChem WaterTox Habitat (FieldMeas)	*PurposeFailure:

*Location: Bank Thalweg Midchannel OpenWater	*GPS/DGPS	Lat (dd.ddddd)	Long (ddd.ddddd)	OCCUPATION METHOD: (Walk-in) Bridge R/V ______ Other
GPS Device: Garmin etrex 20	Target:	37.95995	-122.07304	STARTING BANK (facing downstream): (LB) / RB / NA
Datum: NAD83 Accuracy ((ft) / m): 14	*Actual:	37.95850	-122.06634	Point of Sample (if Integrated, then -88 in dbase)

Habitat Observations (CollectionMethod = Habitat_generic)

SITE ODOR:	(None), Sulfides, Sewage, Petroleum, Smoke, Other___	WADEABILITY: (Y) / N / Unk	BEAUFORT SCALE (see attachment): 1
DISTANCE FROM BANK (m): 0.4	STREAM WIDTH (m): 1.6	WATER DEPTH (m) cm: 3	
SKY CODE:	Clear, (Partly Cloudy), Overcast, Fog, Smoky, Hazy	WIND DIRECTION (from): NW	
HYDROMODIFICATION: None, Bridge, Pipes, (ConcreteChannel), GradeControl, Culvert, AerialZipline, Other	LOCATION (to sample): US / DS / WI /		
OTHER PRESENCE:	(Vascular), (Nonvascular), OilySheen, Foam, (Trash), Other___		
DOMINANT SUBSTRATE:	Bedrock, Concrete, Cobble, Boulder, Gravel, (Sand), Mud, Unk, Other___		
WATERCLARITY:	(Clear (see bottom)), Cloudy (>4" vis), Murky (<4" vis)	PRECIPITATION:	(None), Fog, Drizzle, Rain, Snow
WATERODOR:	(None), Sulfides, Sewage, Petroleum, Mixed, Other___	PRECIPITATION (last 24 hrs):	(Unknown), <1", >1", None
WATERCOLOR:	(Colorless), Green, Yellow, Brown	EVIDENCE OF FIRES:	(No), <1 year, <5 years
OVERLAND RUNOFF (Last 24 hrs):	(none), light, moderate / heavy, unknown		
OBSERVED FLOW:	NA, Dry Waterbody Bed, No Obs Flow, Isolated Pool, Trickle (<0.1cfs), (0.1-1cfs), 1-5cfs, 5-20cfs, 20-50cfs, 50-200cfs, >200cfs		

PHOTOS (RB & LB assigned when facing downstream; RENAME to StationCode_yyyy_mm_dd_uniquecode):
1: (RB / (LB) / BB / (US) / DS / ##)
2: (RB / (LB) / BB / US / (DS) / ##)
3: (RB / (LB) / (BB) / US / DS / ##)

Field Measurements (SampleType = FieldMeasure; Method = Field)

	DepthCollec (m)	Velocity (fps)	Air Temp (°C)	Water Temp (°C)	pH	O_2 (mg/L)	O_2 (%)	Specific Conductivity	Salinity (ppt)	Turbidity (ntu)			
SUBSURF/MID/BOTTOM/REP	0.02			21.2	8.30	16.6		1219					
SUBSURF/MID/BOTTOM/REP													
SUBSURF/MID/BOTTOM/REP													
Instrument:	YSI 556												
Calib. Date:	07-22-14												

Samples Taken (# of containers filled) - Method=Water_Grab

Field Dup YES / NO: (SampleType = Grab / Integrated; LABEL_ID = FieldQA; create collection record upon data entry

SAMPLE TYPE: Grab / Integrated COLLECTION DEVICE: Indiv bottle (by hand, by pole, by bucket); Teflon tubing; Kemmer; Pole & Beaker; Other ___

	DepthCollec (m)	Inorganics	Bacteria	Chl a	TSS / SSC	TOC / DOC	Total Hg	Dissolved Mercury	Total Metals	Dissolved Metals	Organics	Toxicity	VOAs
Sub/Surface													
Sub/Surface													

COMMENTS:

Sediment chemistry and tox samples only. Stream water field measurements taken

Modified 02/10/11

* New station code 207WAL078

up stream Trib of Grayson @ Footbridge between Mercury Way + Vineyard Ct.

SWAMP Field Data Sheet (Sediment Chemistry) - EventType=WQ

Entered in d-base (initial/date) | Pg 1 of 2 Pgs

* *StationID: 207R00011 | *Date (mm/dd/yyyy): 07 / 22 / 2014 | *Group: AOH | *Agency: CCCWP

*Funding: CCCWP | ArrivalTime: 12:45 | DepartureTime: 15:15 | *SampleTime (1st sample): 14:45 | *Protocol: RMC

*ProjectCode: | *Personnel: K. Lewis, B. Haeger | *Purpose (circle applicable): SedChem SedTox Habitat Benthic | *PurposeFailure:

*Location: Bank Thalweg Midchannel OpenWater

*GPS/DGPS	Lat (dd.ddddd)	Long (ddd.ddddd)
Target:	37.95275	-122.08150
*Actual:	37.95280	-122.08155

GPS Device: Garmin etrex 20

Datum: NAD83 | Accuracy (ft / m): 14

Same as Water/Probe Collection? YES NO

OCCUPATION METHOD: Walk-in Bridge R/V ______ Other

STARTING BANK (facing downstream): LB / RB / NA

Point of Sample (If Integrated, then -88 in dbase)

DISTANCE FROM BANK (m): 0.5 | STREAM WIDTH (m): 1.0 | WATER DEPTH (m): 3 cm

Habitat Observations (CollectionMethod = Habitat_generic) *Only complete Sed Observations (bolded) if WQ Observations are already recorded

WADEABILITY: Y / N / Unk

BEAUFORT SCALE see Attachment: 1

WIND DIRECTION (from): NW

SITE ODOR: None, Sulfides, Sewage, Petroleum, Smoke, Other____

SKY CODE: Clear, Partly Cloudy, Overcast, Fog, Smoky, Hazy

OTHERPRESENCE: Vascular, Nonvascular, OilySheen, Foam, Trash, Other____

DOMINANTSUBSTRATE: Bedrock, Concrete, Cobble, Boulder, Gravel, Sand, Mud, Unk, Other____

HYDROMODIFICATION: None, Bridge, Pipes, ConcreteChannel, GradeControl, Culvert, AerialZipline, Other

LOCATION (to sample): US / DS / WI / NA

PHOTOS (RB & LB assigned when facing downstream; RENAME to StationCode_yyyy_mm_dd_uniquecode):
1: (RB / LB / BB / US / DS / ##)
2: (RB / LB / BB / US / DS / ##)
3: (RB / LB / BB / US / DS / ##)

SEDODOR: None, Sulfides, Sewage, Petroleum, Mixed, Other____

SEDCOLOR: Colorless, Green, Yellow, Brown

SEDCOMPOSITION: Silt/Clay, FineSand, CoarseSand, Gravel, Cobble, Mixed, HardPanClay

PRECIPITATION: None, Fog, Drizzle, Rain, Snow

PRECIPITATION (last 24 hrs): Unknown, <1", >1", None

EVIDENCE OF FIRES: No, <1 years, <5 years

OBSERVED FLOW: NA, Dry Waterbody Bed, No Obs Flow, Isolated Pool, Trickle (<0.1cfs), 0.1-1cfs, 1-5cfs, 5-20cfs, 20-50cfs, 50-200cfs, >200cfs

Samples Taken (# of containers filled) - Method=Sed_Grab

Field Dup YES / NO: (SampleType = Grab / Integrated; LABEL_ID = FieldQA; create collection record upon data entry

COLLECTION DEVICE: Scoop (SS / PC / PE), Core (SS / PC / PE), Grab (Van Veen / Eckman / Petite Ponar)

COLLECTION DEVICE AREA (m2): ______

Sample Type:	DepthCollec (cm)	Equipment Used	Sediment Only (Y / N)	Grain Size/TOC	~~Organics~~ *1	~~Metals/HgT~~ *2	~~Selenium~~ *3	Toxicity	SWI	Archive Chemistry	Benthic Infauna	Benthic Coll. Area (m^2)	Sieve Size (mm)
Integrated Grab	2			1	2	2	1	3					
Integrated Grab													
Integrated Grab													
Integrated Grab													

COMMENTS:

up stream location for SSID Study

used Kynar coated scoop and bucket

*1 Pyrethroids, Fipronil and Degradates

*2 organochlorine pesticides

*3 Percent solids

Modified 06/27/08

* New station code 207WAL078

up stream → Trib of Grayson @ Footbridge between Mercury Way & Vineyard Ct

SWAMP Field Data Sheet (Water Chemistry & Discrete Probe) - EventType=WQ

* *StationID: 207R00011	*Date (mm/dd/yyyy): 07 / 22 / 2014		*Group: ADH	*Agency: CCCWP
*Funding: CCCWP	ArrivalTime: 12:45	DepartureTime: 15:15	*SampleTime (1st sample): 14:45	*Protocol: RMC
*ProjectCode:	*Personnel: K. Lewis, B. Haeger		*Purpose (circle applicable): WaterChem WaterTox Habitat (FieldMeas)	*PurposeFailure:

Entered in d-base (initial/date): | Pg 2 of 2 Pgs

*Location: Bank Thalweg Midchannel OpenWater	*GPS/DGPS	Lat (dd.ddddd)	Long (ddd.ddddd)	OCCUPATION METHOD: (Walk-in) Bridge R/V ____ Other
GPS Device: Garmin etrex 20	Target:	37.95275	-122.08150	STARTING BANK (facing downstream): (LB) / RB / NA
Datum: NAD83 / Accuracy ((ft) / m): 14	*Actual:	37.95280	-122.08155	Point of Sample (if Integrated, then -88 in dbase)

Habitat Observations (CollectionMethod = Habitat_generic)

SITE ODOR:	(None), Sulfides, Sewage, Petroleum, Smoke, Other____	WADEABILITY: (Y) / N / Unk	BEAUFORT SCALE (see attachment): NW
SKY CODE:	Clear, (Partly Cloudy), Overcast, Fog, Smoky, Hazy	WIND DIRECTION (from): NW	
OTHER PRESENCE:	(Vascular), (Nonvascular), OilySheen, Foam, (Trash), Other____		
DOMINANT SUBSTRATE:	Bedrock, Concrete, Cobble, Boulder, Gravel, (Sand), Mud, Unk, Other____		
WATERCLARITY:	(Clear (see bottom)), Cloudy (>4" vis), Murky (<4" vis)	PRECIPITATION:	(None), Fog, Drizzle, Rain, Snow
WATERODOR:	(None), Sulfides, Sewage, Petroleum, Mixed, Other____	PRECIPITATION (last 24 hrs):	(Unknown), <1", >1", None
WATERCOLOR:	(Colorless), Green, Yellow, Brown	EVIDENCE OF FIRES:	(No), <1 year, <5 years
OVERLAND RUNOFF (Last 24 hrs):	(none), light, moderate / heavy, unknown		
OBSERVED FLOW:	NA, Dry Waterbody Bed, No Obs Flow, Isolated Pool, Trickle (<0.1cfs), (0.1-1cfs), 1-5cfs, 5-20cfs, 20-50cfs, 50-200cfs, >200cfs		

DISTANCE FROM BANK (m): 0.5

STREAM WIDTH (m): 1.0

WATER DEPTH (m): cm 3

HYDROMODIFICATION: None, Bridge, Pipes, (ConcreteChannel), GradeControl, Culvert, AerialZipline, Other — LOCATION (to sample): US / DS / WI /

PHOTOS (RB & LB assigned when facing downstream; RENAME to StationCode_yyyy_mm_dd_uniquecode):
1: (RB / (LB) / BB / (US) / DS / ##)
2: (RB / (LB) / BB / US / (DS) / ##)
3: (RB / (LB) / (BB) / US / DS / ##)

Field Measurements (SampleType = FieldMeasure; Method = Field)

	DepthCollec (m) cm	Velocity (fps)	Air Temp (°C)	Water Temp (°C)	pH	O_2 (mg/L)	O_2 (%)	Specific Conductivity	Salinity (ppt)	Turbidity (ntu)			
SUBSURF/MID/BOTTOM/REP	2			25.76	8.46	12.17		1637					
SUBSURF/MID/BOTTOM/REP													
SUBSURF/MID/BOTTOM/REP													
Instrument:	YSI 556												
Calib. Date:	07-22-14												

Samples Taken (# of containers filled) - Method=Water_Grab

Field Dup YES / NO: (SampleType = Grab / Integrated; LABEL_ID = FieldQA; create collection record upon data entry

SAMPLE TYPE: ~~Grab / Integrated~~ | COLLECTION DEVICE: | Indiv bottle (by hand, by pole, by bucket); Teflon tubing; Kemmer; Pole & Beaker; Other ____

	DepthCollec (m)	Inorganics	Bacteria	~~Chl-a~~	TSS / SSC	TOC / DOC	Total Hg	Dissolved Mercury	Total Metals	Dissolved Metals	Organics	Toxicity	VOAs
Sub/Surface													
Sub/Surface													

COMMENTS: water field measurements only -

Modified 02/10/11

Caltest ANALYTICAL LABORATORY

1885 N. KELLY ROAD • NAPA, CA 94558 • (707) 258-4000 • Fax (707) 226-1001 • www.caltestlabs.com

SAMPLE CHAIN OF CUSTODY

PAGE 1 OF 2

LAB ORDER #: P070867

PROJECT # / PROJECT NAME: CCCWP - SSID

P.O. #: 030.001.0202

CLIENT: ADH Environmental

REPORT ATTN: Alessandro Hnatt

ADDRESS: 3065 Porter St Ste. 101 CITY: Soquel STATE: CA ZIP: 95073

BILLING ADDRESS: same as above

PHONE #: 831.477.2003 FAX PHONE: 831.477.0895

SAMPLER (PRINT & SIGN NAME): Kevin Lewis [signature]

ANALYSES REQUESTED: Pyrethroids, Fipronil and degradates; Organochlorine pesticides; Percent solids; Total organic carbon

TURN-AROUND TIME: ☒ STANDARD ☐ RUSH

DUE DATE: ______

CALTEST #	DATE SAMPLED	TIME SAMPLED	MATRIX	CONTAINER AMOUNT/TYPE	PRESERVATIVE	~~SAMPLE IDENTIFICATION SITE~~ * Refer to Remarks	CLIENT LAB #	COMP. or GRAB	Pyrethroids, Fipronil and degradates	Organochlorine pesticides	Percent solids	Total organic carbon			~~New site IDs~~ REMARKS
	7-22-14	11:45	Sed	2x8oz AG	4°C	544R00025US-01		~~grab~~	X						544MSH065
	↓	↓	↓	2x8oz AG	↓	544R00025US-02		↓		X					544MSH065
				1x8oz CG		544R00025US-03					X				544MSH065
				1x8oz CG		544R00025US-04						X			544MSH065
		10:15		2x8oz AG		544R00025DS-01			X						544MSH062
		10:15		2x8oz AG		544R00025DS-02				X					544MSH062
				1x8oz CG		544R00025DS-03					X				544MSH062
	↓	↓	↓	1x8oz CG	↓	544R00025DS-04		↓				X			544MSH062

(KL)

By submittal of sample(s), client agrees to abide by the Terms and Conditions set forth on the reverse of this document.

RELINQUISHED BY	DATE/TIME	RECEIVED BY	RELINQUISHED BY	DATE/TIME	RECEIVED BY
[signature]	7-22-14 17:54	[signature]			

FOR LAB USE ONLY

Samples: WC____ MICRO____ BIO____ MET____ SV____ VOA____ TEMP:____ °C SEALED: Y__ / N__ INTACT: Y__ / N__

BD: BIO____ WC____ MET____

CC: AA____ SV____ VOA____

SIL: HP____ PT____ QT____ VOA____

W/HNO3____ H2SO4____ NaOH____

PIL: HNO3____ H2SO4____ NaOH____ HCL____

COMMENTS

MATRIX: W = Aqueous Nondrinking Water, Digested Metals; ML = Low R.L.s, Aqueous Nondrinking Water, Digested Metals; DW = Drinking Water; SL = Soil, Sludge, Solid; FP = Free Product

CONTAINER TYPES: AL = Amber Liter; AHL = 500 ml Amber; PT = Pint (Plastic); QT=Quart (Plastic); HG = Half Gallon (Plastic); SJ = Soil Jar; B4 = 4 oz. BACT; BT = Brass Tube; VOA = 40 mL.VOA; OTC = Other Type Container

REV. 2/13

WHITE - ORIGINAL TO LABORATORY YELLOW - CLIENT COPY AS RECEIPT

Caltest ANALYTICAL LABORATORY

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SAMPLE CHAIN OF CUSTODY

PAGE 2 OF 2

LAB ORDER #: B070867

PROJECT # / PROJECT NAME: 030.001.0202 / CCCWP-SSID

P.O. #:

CLIENT: ADH Environmental

REPORT ATTN: Alessandro Hnatt

ADDRESS: 3065 Porter St Ste 101 CITY: Soquel STATE: CA ZIP: 95073

BILLING ADDRESS: Same as above

PHONE #: 831-477-2003 FAX PHONE: 831-477-0895

SAMPLER (PRINT & SIGN NAME): Kevin Lewis

ANALYSES REQUESTED: Pyrethroids, Fipronil, Degradates; Organochlorine pesticides; Percent solids; Total organic carbon

TURN-AROUND TIME: [X] STANDARD [ ] RUSH

DUE DATE:

REV. 2/13

CALTEST #	DATE SAMPLED	TIME SAMPLED	MATRIX	CONTAINER AMOUNT/TYPE	PRESERVATIVE	SAMPLE IDENTIFICATION SITE (*Refer to Remarks)	CLIENT LAB #	COMP. or GRAB	Pyrethroids, Fipronil, Degradates	Organochlorine pesticides	Percent solids	Total organic carbon			REMARKS (New site IDs)
	07-22-14	1445	Sed	2x8oz AG	4°C	~~207R00011US-01~~		Comp	X						~~207R00~~ 207WAL078
	↓	1445		2x8oz AG	↓	~~207R00011US-02~~		↓		X					207WAL078
		1445		1x8oz CG		~~207R00011US-03~~					X				207WAL078
		1445		1x8oz CG		~~207R00011US-04~~						X			207WAL078
		1145		2x8oz AG		~~207R00011DS-01~~			X						207WAL060
		1145		2x8oz AG		~~207R00011DS-02~~				X					207WAL060
		1145		1x8oz CG		~~207R00011DS-03~~					X				207WAL060
	↓	1145		1x8oz CG	↓	~~207R00011DS-04~~		↓				X			207WAL060

By submittal of sample(s), client agrees to abide by the Terms and Conditions set forth on the reverse of this document.

RELINQUISHED BY	DATE/TIME	RECEIVED BY	RELINQUISHED BY	DATE/TIME	RECEIVED BY
BRD HAEGER	07-22-14 1755	[signature]			

FOR LAB USE ONLY

Samples: WC____ MICRO____ BIO____ MET____ SV____ VOA____ TEMP:____°C SEALED: Y__ / N__ INTACT: Y__ / N__

BD: BIO____ WC____ MET____

CC: AA____ SV____ VOA____

SIL: HP____ PT____ QT____ VOA____

W/HNO_3____ H_2SO_4____ NaOH____

PIL: HNO_3____ H_2SO_4____ NaOH____ HCL____

COMMENTS

MATRIX: W = Aqueous Nondrinking Water, Digested Metals; ML = Low R.L.s, Aqueous Nondrinking Water, Digested Metals; DW = Drinking Water; SL = Soil, Sludge, Solid; FP = Free Product

CONTAINER TYPES: AL = Amber Liter; AHL = 500 ml Amber; PT = Pint (Plastic); QT=Quart (Plastic); HG = Half Gallon (Plastic); SJ = Soil Jar; B4 = 4 oz. BACT; BT = Brass Tube; VOA = 40 mL.VOA; OTC = Other Type Container

WHITE - ORIGINAL TO LABORATORY YELLOW - CLIENT COPY AS RECEIPT

Pacific EcoRisk
2250 Cordelia Rd., Fairfield, CA 94534
(707) 207-7760 FAX (707) 207-7916

CHAIN-OF-CUSTODY RECORD

Results To:	~~Alessandro Hnatt~~	**Invoice To:**	ADH Environmental
Address:	ADH Environmental 3065 Porter St Ste.101 Soquel, CA 95073	**Address:**	" "
Phone:	831. 477. 2003	**Phone:**	" "
Attn:	Alessandro Hnatt	**Attn:**	" "
E-mail:	adh@adhenvironmental.com	**E-mail:**	" "
Project Name:	CCCWP - SSID		
P.O.#/Ref:	030.001.0202		

REQUESTED ANALYSIS

	Client Sample ID	Sample Date	Sample Time	Sample Matrix*	Grab/ Comp	Container Number	Container ~~3gal~~ Type 1gal×3	TOX - 1 species (10-Day Hyalella Azteca (Sediment))							
1	544R00025US ①	07-22-14	1145	Sed	~~grab~~ Comp	CP	~~1 gal~~ clear glass	X							
2	544R00025DS ②	↓	10:15	↓	↓	CP	~~3gal~~ 1gal×3	X							
3	207R00011US ③	↓	~~1145~~ ~~1015~~ (3,4)	↓	↓	CP	~~3gal~~ 1gal×3	X							
4	207R00011DS ④	↓	~~1015~~ (3,4) 1145	↓	↓	CP	~~3gal~~ 1gal×3	X							
5															
6															
7															
8															
9															
10															

Samples Collected By:

Comments/Special Instruction:

preserved at 4°C

* Please amend sample ID's as follows:
① 544R00025US to 544MSH065
② 544R00025DS to 544MSH062
③ 207R00011US to 207WAL078
④ 207R00011DS to 207WAL060

RELINQUISHED BY:		RECEIVED BY:	
Signature: [signature]		Signature: Molly Alar	
Print: BRAD HAEGER		Print: Molly Alar	
Organization: ADH		Organization: PER	
Date: 07-22-14	Time: 1715	Date: 7/22/14	Time: 1715

RELINQUISHED BY:		RECEIVED BY:	
Signature:		Signature:	
Print:		Print:	
Organization:		Organization:	
Date:	Time:	Date:	Time:

*Example Matrix Codes: (**EFF** - Effluent) (**FW** = Freshwater); (**SW** = Saltwater); (**WW** = Wastewater); (**STRMW** = Stormwater); (**SED** = Sediment); or other

Appendix J. TIE Laboratory Reports

Alessandro D. Hnatt
ADH Environmental
3065 Porter Street, Suite 101
Soquel, CA 95073

April 8, 2014

Alessandro:

I have enclosed one copy of our report "Evaluation of the Chronic Toxicity of Contra Costa Clean Water Program Stormwater Samples" for the samples that were collected February 6, 2014. Briefly, both of the samples collected were toxic to *Hyalella azteca*. There was an 81.3% reduction in survival in the 544R00025US sample and an 87.5% reduction in survival in the 544R00025DS sample.

In response to these observations, a targeted TIE was performed the downstream stormwater sample (544R00025DS) in an attempt to identify suspected cause(s) of toxicity. The results of this testing are presented below:

Effects of TIE treatments on the toxicity of CCCWP stormwater sample to *Hyalella azteca*				
TIE Treatment	Mean % Survival			Effects of TIE Treatment?
	Control/Blank	50% Effluent	100% Effluent	
Baseline	100		16	toxicity present
PBO	100	0	0	*increase* in toxicity
Carboxylesterase	92.5		98	**toxicity removed**
BSA	100		46	partial reduction of toxicity

The following trends (changes in sample toxicity relative to the untreated water sample [Baseline] test) were observed:

- The addition of PBO to the test solutions increased toxicity to *H. azteca* survival (survival decreased from 16% to complete mortality). These results suggest that compounds which are *detoxified* by the cytochrome-P450 system (e.g., pyrethroid insecticides) were contributing to sample toxicity;
- The addition of carboxylesterase decreased the survival toxicity (from 16% survival to 98% survival), suggesting that type I and type II pyrethroids are contributing to the toxicity (Weston and Amweg 2007). However, it should be noted that the esterase control treatment (BSA) also reduced toxicity, suggesting that some of the reduced toxicity was due the presence of large organic molecules. The use of carboxylesterase as a TIE treatment is still experimental and these results need to be used judiciously and in conjunction with other TIE treatment (e.g., PBO); and

- There was partial toxicity removal as a result of BSA addition, since BSA does not cleave the ester bond in type I and type II pyrethroids, evidence of greater reduction in toxicity in the esterase treatment than seen in the BSA treatment is indicative of type I and type II pyrethroids as a the cause of the stormwater toxicity.

The weight of evidence from the TIE performed on the downstream stormwater sample suggests that the toxicity was likely due to pyrethroid insecticides.

If you have any questions regarding the performance and interpretation of these tests, feel free to contact my colleague Eddie Kalombo or myself at (707) 207-7760.

Sincerely,

Stephen L. Clark
Vice President/Special Projects Director

Evaluation of the Chronic Toxicity of Contra Costa Clean Water Program Stormwater Samples

Samples collected February 6, 2014

Prepared For:

ADH Environmental
3065 Porter Street, Suite 101
Soquel, CA 95073

Prepared By:

Pacific EcoRisk
2250 Cordelia Road
Fairfield, CA 94534

April 2014

PACIFIC ECORISK
ENVIRONMENTAL CONSULTING & TESTING

Evaluation of the Chronic Toxicity of Contra Costa Clean Water Program Stormwater Samples

Samples collected February 6, 2014

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Appendices

Appendix A Chain-of-Custody Record for the Collection and Delivery of the CCCWP Stormwater Samples

Appendix B Test Data and Summary of Statistics for the Evaluation of the Chronic Toxicity of CCCWP Stormwater Samples to *Hyalella azteca*

Appendix C Test Data and Summary of Statistics for the Evaluation of the Chronic Toxicity of CCCWP Stormwater to *Hyalella azteca* – Follow-Up Toxicity Identification Evaluation (TIE): 544R00025DS

Appendix D Test Data and Summary of Statistics for the Reference Toxicant Evaluation of the *Hyalella azteca*

1. INTRODUCTION

Under contract to ADH Environmental, and in support of the Bay Area Stormwater Management Agencies Association (BASMAA) Regional Monitoring Coalition ongoing monitoring efforts, Pacific EcoRisk (PER) has been contracted to evaluate the toxicity of stormwater samples collected for the Contra Costa Clean Water Program (CCCWP). This evaluation consist of performing the following US EPA toxicity tests:

- 10-day survival test with the freshwater amphipod *Hyalella azteca.*

These toxicity tests were conducted on stormwater samples collected on February 6, 2014. In order to assess the sensitivity of the test organisms to toxic stress, a reference toxicant test was also performed. As a result of the magnitude of toxicity observed, and at the request of the ADH Environmental, PER conducted a targeted Phase 1 Toxicity Identification Evaluation (TIE). This report describes the performance and results of these tests.

2. CHRONIC TOXICITY TEST PROCEDURES

The methods used in conducting testing with *H. azteca* followed a test protocol that is based on a modification of the US EPA guidelines, “Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates” (EPA/600/R-99/064).

2.1 Sample Receipt and Handling

On February 6, ADH collected stormwater samples into appropriately-cleaned containers, which were transported, on ice and under chain-of-custody, to the PER testing laboratory in Fairfield, CA. Upon receipt at the testing laboratory, aliquots of each sample were collected for analysis of initial water quality characteristics (Table 1), with the remainder of each sample being stored at 0-6˚C except when being used to prepare test solutions.

The chain-of-custody record for the collection and delivery of these stormwater samples is provided as Appendix A.

Table 1. Initial water quality characteristics of the CCCWP stormwater samples.

Date Sample Received	Sample ID	Temp (°C)	pH	D.O. (mg/L)	Alkalinity (mg/L)	Hardness (mg/L)	Conductivity (µS/cm)	Total Ammonia (mg/L N)
2/7/14	544R00025US-W-01	1.9	7.61	8.3	122	424	1836	<1.0
2/7/14	544R00025DS-W-01	1.9	7.66	10.6	118	420	1823	<1.0

2.2 Survival Toxicity Testing of Stormwater Samples with *Hyalella azteca*

This test consists of exposing the amphipods to the stormwater samples for 10 days, after which effects on survival are evaluated. The specific procedures used in this testing are described below.

The *H. azteca* used in this testing were obtained from a commercial supplier (Chesapeake Cultures, VA). Upon receipt at the PER laboratory, the organisms were maintained at 23˚C in aerated aquaria containing Standard Artificial Medium (SAM-5S) water (Borgmann 1996) prior to their use in this test. During this pre-test period, the organisms were fed the alga *Selenastrum capricornutum* and Yeast-Cerophyll®-Trout (YCT) food amended with *Spirulina*.

The Lab Control water for these tests consisted of SAM-5S water. The stormwater samples were tested at the 100% concentration only. "New" water quality characteristics (pH, D.O., and conductivity) were measured on the test solutions prior to use in these tests.

There were 5 replicates for each test treatment, each replicate consisting a 250-mL glass beaker containing 100 mL of test solution. These tests were initiated by allocating ten 8-day old *H. azteca*, into each replicate, followed by the addition of 1.5 mL of *Spirulina* amended YCT. The replicate beakers were placed into a temperature-controlled room at 23˚C, under cool-white fluorescent lighting on a 16L:8D photoperiod.

Each day of the tests, each replicate beaker was examined and the number of surviving organisms determined; 'old' water quality characteristics were measured in one randomly-selected beaker at each test treatment at this time. On Days 2, 4, 6, and 8 of the test, the organisms were fed 1.5 mL of *Spirulina* amended YCT in each test chamber.

On Day 5 of the 10-day tests, fresh test solutions were prepared and characterized, as before. Each replicate was examined, with any dead animals, uneaten food, wastes, and other detritus being removed. The number of live organisms in each replicate was determined and then approximately 80% of the test media in each beaker was carefully poured out and replaced with fresh test solution. "Old" water quality characteristics (pH, D.O., and conductivity) were measured on the old test solution that had been discarded from one randomly-selected replicate at each treatment.

After 10 days of exposure, the tests were terminated and the number of live organisms in each replicate was recorded. The resulting survival data were analyzed to evaluate any impairment due to the stormwater samples; all statistical analyses were performed using CETIS® statistical software.

2.2.1 Reference Toxicant Testing of the *Hyalella azteca*

In order to assess the sensitivity of the *H. azteca* test organisms to toxic stress, a reference toxicant test was performed. The reference toxicant test was performed as a 96-hr waterborne exposure to Control water spiked with KCl at test concentrations of 0, 0.1, 0.2, 0.4, 0.8 and 1.6 g/L. The resulting survival data were statistically analyzed to determine key dose-response point estimates (e.g., EC_{50}); all statistical analyses were made using the CETIS® software. This response endpoint was then compared to the 'typical response' range established by the mean ± 2 SD of the point estimates generated by the 20 most recent previous reference toxicant tests performed by this lab.

2.3 Follow-Up Toxicity Identification Evaluation (TIE) Procedures

At the direction of the client, a Phase I TIE "targeted" was performed to identify if pyrethroid insecticides were the cause of toxicity.

The goal of the Phase I TIE fractionation procedures is to determine the class of compounds (e.g., organics, metals, ammonia, etc.) responsible for sample toxicity. This is achieved by performing physical and chemical manipulations (or treatments) on the sample. Changes in toxicity that result from the TIE treatments help characterize the physical-chemical nature of the compound(s) responsible for the observed toxicity, which in turn can be used to identify the compound(s) responsible for the toxicity. The specific treatments used in this targeted TIE are described below.

2.3.1 TIE Fractionation Method Blanks

As part of the TIE process, a method blank is prepared for each treatment and then tested to determine whether any of the TIE treatment procedures contribute any artifactual toxicity to the manipulated sample. The method blanks consisted of aliquots of Control water subjected to each of the TIE test treatments (discussed below).

2.3.2 Baseline

The Baseline test is simply a re-test of the untreated stormwater sample to confirm the persistence of toxicity during the concurrent TIE testing, and to provide a "benchmark" of toxicity against which to evaluate toxicity removal by the TIE treatments. The Baseline test was performed as described in Section 2.2.

2.3.3 Piperonyl Butoxide (PBO) Addition

This TIE treatment can help identify toxicity caused by toxicants subject to metabolic activation/detoxification by the cytochrome-P450 system:

- an <u>increase in toxicity</u> after PBO treatment is indicative of a contaminant that is typically *detoxified* by the cytochrome-P450 enzyme system (e.g., carbamates, pyrethroids [Amweg and Weston 2007], etc.), whereas

- a decrease in toxicity after PBO treatment is indicative of a contaminant that is *activated* by the cytochrome-P450 system [e.g., organophosphate (OP) pesticides].

The simultaneous presence of compounds that are detoxified *and* compounds that are activated by the cytochrome-P450 system (e.g., the co-occurrence of both OP-pesticides and pyrethroid pesticides) may cancel each other out. The PBO treatment consisted of addition of PBO to the stormwater sample at 50% and 100% dilution (and method blank) at a concentration of 50 µg/L. This test was then performed as described in Section 2.2.

2.3.4 Carboxylesterase Addition

The use of carboxylesterase to hydrolyze pyrethroids (via cleaving of the ester bond) has been proposed as a simple, mechanistic-based method to selectively identify pyrethroid-associated toxicity. Carboxylesterase is an enzyme that degrades type I and type II pyrethroids and has been used in recent studies to help identify pyrethroid-associated toxicity (Wheelock et al. 2004; Weston and Amweg 2007). It should be noted that this treatment is still experimental in nature and should be used in conjunction with other pyrethroid-targeted TIE treatments (e.g., PBO addition and temperature adjustment) via a weight-of-evidence approach.

Carboxylesterase may also alleviate toxicity by acting as dissolved organic matter (DOM) and providing complexation substrate to other hydrophobic compounds thus reducing the bioavailability of the toxicant; to control for the DOM effect, a bovine serum albumin (BSA) test was performed. Since BSA does not cleave the ester bond in type I and type II pyrethroids, pyrethroid-induced toxicity would be evident by a greater reduction in toxicity in the esterase treatment than seen in the BSA treatments. Any reductions in toxicity above and beyond that observed for aeration and/or BSA would be indicative of type I and type II pyrethroids as the cause of the toxicity.

These carboxylesterase treatment consisted of addition of carboxylesterase to the water sample (and method blank) at a carboxylesterase concentration of 73 mg/L (or 1.25 Units/mL); the corresponding BSA test consisted of addition of BSA to the water sample (and method blank) at a concentration of 73 mg/L. The carboxylesterase and BSA tests were performed as described in Section 2.2.

Note – Anomalous mortalities due to hypoxia (low D.O.) occurred in the one carboxylesterase blank replicate. This replicate was removed from statistical analysis.

3. RESULTS

3.1 Effects of the CCCWP Stormwater on *Hyalella azteca*

The results for these tests are summarized below in Table 2. There were significant reductions in *H. azteca* survival in the upstream and downstream 544R00025 stormwater samples. The test data and summary of statistical analyses for these tests are presented in Appendix B.

Table 2. Effects of CCCWP stormwater on *Hyalella azteca*.

Test Initiation Date (Time)	Treatment/Sample ID	10-Day Mean % Survival
3/7/13 (1855)	Lab Control	96
	544R00025US	**18***
	544R00025DS	**12***

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

3.2 Performance of the Follow-Up Targeted TIE

3.2.1 Results of Targeted Phase I TIE of the "544R00025DS" Stormwater Sample

The results for this Phase I TIE are summarized below in Table 3. The following trends (changes in sample toxicity relative to the untreated water sample [Baseline] test) were observed:

- The addition of PBO to the test solutions increased toxicity to *H. azteca* survival (survival decreased from 16% survival to complete mortality). These results suggest that compounds which are *detoxified* by the cytochrome-P450 system (e.g., pyrethroid insecticides) were contributing to sample toxicity;
- The addition of carboxylesterase decreased the survival toxicity (from 16% survival to 98% Survival), suggesting that type I and type II pyrethroids are contributing to the toxicity (Weston and Amweg 2007). However, it should be noted that the esterase control treatment (BSA) also reduced toxicity, suggesting that some of the reduced toxicity was due the presence of large organic molecules. The use of carboxylesterase as a TIE treatment is still experimental and these results need to be used judiciously and in conjunction with other TIE treatment (e.g., PBO); and
- There was partial toxicity removal as a result of BSA addition, since BSA does not cleave the ester bond in type I and type II pyrethroids, evidence of greater reduction in toxicity in the esterase treatment than seen in the BSA treatment is indicative of type I and type II pyrethroids as a the cause of the stormwater toxicity.

The test data and the summary of statistical analyses for these tests are presented in Appendix C.

Table 3. Effects of TIE treatments on the toxicity of CCCWP stormwater sample on *H. azteca* survival

TIE Treatment	Mean % Survival			Effects of TIE Treatment?
	Control/Blank	50% Effluent	100% Effluent	
Baseline	100		**16***	toxicity present
PBO	100	**0***	**0***	*increase* in toxicity
Carboxylesterase	92.5[a]		98	**toxicity removed**
BSA	100		**46***	partial reduction of toxicity

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

a - Anomalous mortalities due to hypoxia (low D.O.) occurred in the one carboxylesterase blank replicate. This replicate was removed from statistical analysis.

4. AQUATIC TOXICITY DATA QUALITY CONTROL

Four QC measures were assessed during the toxicity testing:

- Maintenance of acceptable test conditions;
- Negative Control testing;
- Positive Control (reference toxicant) testing; and
- Concentration Response Relationship assessment.

4.1 Maintenance of Acceptable Test Conditions

All test conditions (e.g., pH, D.O., temperature, etc.) were within acceptable limits for these tests. All analyses were performed according to laboratory Standard Operating Procedures.

4.2 Negative Control Testing

The responses at the Lab Control treatments were acceptable.

4.3 Positive Control Testing

4.3.1 Reference Toxicant Toxicity to *Hyalella azteca*

The results of this test are presented in Table 4. The EC_{50} of 0.57 g/L is slightly above the "typical response" upper threshold value of 0.54 g/L KCl, suggesting that these organisms may have been slightly less sensitive to toxicant stress than is typical and that the survival responses in the accompanying stormwater tests should be interpreted judiciously.

The test data and summary of statistical analyses for this test are presented in Appendix D.

Table 4. Reference toxicant testing: Effects of KCl on *Hyalella azteca* survival.

KCl Treatment (g/L)	Mean% Survival
Control	100
0.1	100
0.2	100
0.4	100
0.8	**0***
1.6	**0***
Summary of Statistics	
EC_{50} =	0.57 g/L KCl
"Typical response" range (mean ±2 SD)	0.26 – 0.54 g/L KCl

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

4.4 Concentration Response Relationships

The concentration-response relationships for the reference toxicant tests were evaluated as per EPA guidelines (EPA-821-B-00-004), and were determined to be acceptable.

5. SUMMARY & CONCLUSIONS

Toxicity of CCCWP Stormwater to *Hyalella azteca*

There were significant reductions in *H. azteca* survival in the upstream (US) and downstream (DS) 544R00025 stormwater samples.

Targeted Phase I TIE of the "544R00025DS" Stormwater Sample

A targeted TIE was performed on the downstream stormwater sample (544R00025DS). The following trends (changes in sample toxicity relative to the untreated water sample [Baseline] test) were observed:

- The addition of PBO to the test solutions increased toxicity to *H. azteca* survival (survival decreased from 16% survival to complete mortality). These results suggest that compounds which are *detoxified* by the cytochrome-P450 system (e.g., pyrethroid insecticides) were contributing to sample toxicity;
- The addition of carboxylesterase decreased the survival toxicity (from 16% survival to 98% Survival), suggesting that type I and type II pyrethroids are contributing to the toxicity (Weston and Amweg 2007). However, it should be noted that the esterase control treatment (BSA) also reduced toxicity, suggesting that some of the reduced toxicity was due the presence of large organic molecules. The use of carboxylesterase as a TIE treatment is still experimental and these results need to be used judiciously and in conjunction with other TIE treatment (e.g., PBO); and
- There was partial toxicity removal as a result of BSA addition, since BSA does not cleave the ester bond in type I and type II pyrethroids, evidence of greater reduction in toxicity in the esterase treatment than seen in the BSA treatment is indicative of type I and type II pyrethroids as a the cause of the stormwater toxicity.

The weight of evidence from the TIE performed on the downstream stormwater sample suggests that the toxicity was likely due to pyrethroid insecticides.

6. LITERATURE CITED

Amweg EL, Weston DP (2007) Whole sediment toxicity identification evaluation tools for pyrethroid insecticides: I. Piperonyl butoxide addition. *Environ. Toxicol. Chem.* 26:2389-2396.

Wheelock CE, Miller JL, Miller MJ, Gee SJ, Shan G, Hammock B (2004) Development of toxicity identification evaluation procedures for pyrethroid detection using esterase activity. *Environ. Toxicol. Chem.* 23:2699–2708.

Weston DP, Amweg EL (2007) Whole sediment toxicity identification evaluation tools for pyrethroid insecticides: II. Esterase addition. *Environ. Toxicol. Chem.* 26:2397-2404.

Weston DP, You J, Harwood AD, Lydy MJ (2009) Whole sediment toxicity identification evaluation tools for pyrethroid insecticides: III. Temperature Manipulation. *Environ. Toxicol. Chem*. 28:173-180.

Weston DP, Lydy MJ (2010) Focused toxicity identification evaluations to rapidly identify the cause of toxicity in environmental samples. *Chemosphere*. 78:368-374.

Appendix A

Chain-of-Custody Record for the Collection and Delivery of the CCCWP Stormwater Samples

Pacific EcoRisk
2250 Cordelia Rd., Fairfield, CA 94534
(707) 207-7760 FAX (707) 207-7916

CHAIN-OF-CUSTODY RECORD

Client Name:	ADH Environmental
Client Address:	3065 Porter St. Suite 101 Soquel CA 95073
Phone:	8314772003
FAX:	8314770895
Project Manager:	Alessandro Hnatt.
Project Name:	CCCWP - SSID
Project # / P.O. Number:	030.001.0202 (task 2G)

REQUESTED ANALYSIS

	Client Sample ID	Sample Date	Sample Time	Sample Matrix*	Container Number	Container Type	~~Chronic Selenastrum capricornutum~~	Chronic ~~Ceriodaphnia dubia~~	~~Chronic Pimephales promelas~~	10-day Hyalella azteca (water)	~~10-day Hyalella azteca (sediment)~~						
1	~~544R00025-W~~			~~STRMW~~		~~1 gall. amber~~	~~x~~	~~x~~	~~x~~	~~x~~							
2	544R00025DS-W-0	2-6-14	20:50		10	gal amber				X							
3	544R00025US-W-0	2-6-14	20:50		10	gal amber				X							
4																	
5																	
6																	
7																	
8																	
9																	
10																	
12																	

Samples collected by:

Comments/Special Instruction:

Note - Fathead minnow testing is to be performed using the standard EPA protocol (i.e., 4 replicates)

Contract # 030.001.0202
SSID Study

RELINQUISHED BY:		RECEIVED BY:	
Signature:	Justin Cerruti (signed)	Signature:	(signed)
Print:	Justin Cerruti	Print:	Marlon Ortiva
Organization:	ADH	Organization:	PER
Date: 2-7-14	Time: ~~5:40~~ 1740	Date: 02.07.14	Time: 1740

RELINQUISHED BY:		RECEIVED BY:	
Signature:		Signature:	
Print:		Print:	
Organization:		Organization:	
Date:	Time:	Date:	Time:

*Example Matrix Codes: (FW = Freshwater); (SW = Saltwater); (WW = Wastewater); (STRMW = Stormwater); (SED = Sediment); or other

Appendix B

Test Data and Summary of Statistics for the Evaluation of the Chronic Toxicity of the CCCWP Stormwater Samples to *Hyalella azteca*

CETIS Summary Report

Hyalella Survival and Growth Test — **Pacific EcoRisk**

Batch ID:	10-6599-0950	**Test Type:**	Survival-Growth (10 day)	**Analyst:**	Eddie Kalombo
Start Date:	07 Feb-14 18:55	**Protocol:**	GCML	**Diluent:**	Not Applicable
Ending Date:	17 Feb-14 09:05	**Species:**	Hyalella azteca	**Brine:**	Not Applicable
Duration:	9d 14h	**Source:**	Chesapeake Cultures, Inc.	**Age:**	8

Sample Code	Sample Notes
544R00025US	Upstream Sample
544R00025DS	Downstream Sample

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
ADH_0207_HA_C1	15-4211-5762	07 Feb-14 18:55	07 Feb-14 18:55	NA (23.3 °C)	ADH Environmental, Inc.	19397
544R00025US	10-7678-2817	06 Feb-14 20:50	07 Feb-14 17:40	22h (1.9 °C)		
544R00025DS	17-0680-4397	06 Feb-14 20:50	07 Feb-14 17:40	22h (1.9 °C)		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
ADH_0207_HA_C1	Sediment	CCCWP	LABQA		
544R00025US	Stormwater	CCCWP	544R00025US-W-01		
544R00025DS	Stormwater	CCCWP	544R00025DS-W-01		

Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
ADH_0207_HA_C1	5	0.96	0.94	0.98	0.9	1	0.0245	0.0548	5.71%	0.0%
544R00025US	5	0.18	0.149	0.211	0.1	0.3	0.0374	0.0837	46.5%	81.3%
544R00025DS	5	0.12	0.0888	0.151	0	0.2	0.0374	0.0837	69.7%	87.5%

Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
ADH_0207_HA_C1	1	0.9	1	1	0.9
544R00025US	0.2	0.3	0.1	0.2	0.1
544R00025DS	0.1	0.2	0.1	0	0.2

Survival Rate Binomials

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5
ADH_0207_HA_C1	10/10	9/10	10/10	10/10	9/10
544R00025US	2/10	3/10	1/10	2/10	1/10
544R00025DS	1/10	2/10	1/10	0/10	2/10

CETIS Analytical Report

Report Date: 02 Mar-14 16:09 (p 1 of 2)
Test Code: ADH_0207_HA_C1 | 08-6541-7375

Hyalella Survival and Growth Test — Pacific EcoRisk

Analysis ID:	17-7335-5517	Endpoint:	Survival Rate	CETIS Version:	CETISv1.8.5
Analyzed:	02 Mar-14 16:09	Analysis:	Parametric-Two Sample	Official Results:	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	7.52%	

Equal Variance t Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
ADH_0207_HA_C1		544R00025US	14.5	1.86	0.118	8	<0.0001	CDF	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	2.101034	2.101034	1	210	<0.0001	Significant Effect
Error	0.07996342	0.009995428	8			
Total	2.180998		9			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Variance Ratio F	1.51	23.2	0.6999	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.845	0.741	0.0510	Normal Distribution

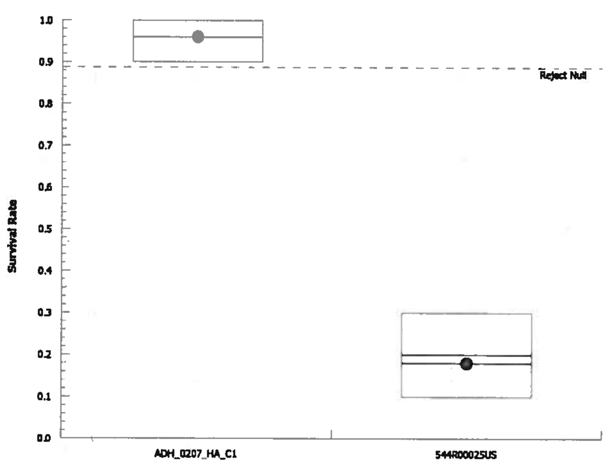
Survival Rate Summary

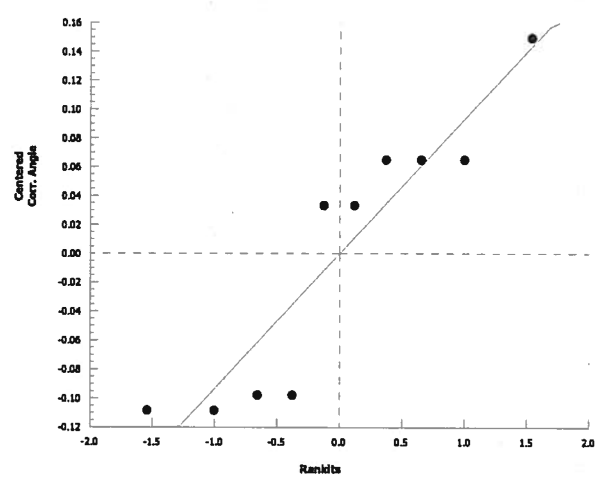
Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
ADH_0207_HA_C1	5	0.96	0.892	1	1	0.9	1	0.0245	5.71%	0.0%
544R00025US	5	0.18	0.0761	0.284	0.2	0.1	0.3	0.0374	46.5%	81.3%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
ADH_0207_HA_C1	5	1.35	1.24	1.46	1.41	1.25	1.41	0.0399	6.63%	0.0%
544R00025US	5	0.43	0.294	0.566	0.464	0.322	0.58	0.049	25.5%	68.1%

Graphics





10 Day Acute *Hyalella azteca* Toxicity Test Data

Client: ADH / CCCWP
Test Material: 544R00025 U/S (up-stream)
Test ID#: 55256 Project #: 19397
Test Date: 2-7-14

Organism Log#: 7930 Age: 8 days
Organism Supplier: Chesapeake
Control/Diluent: SAM-5 Hyalella Water
Control Water Batch: 54

Treatment	Temp (°C)	pH new	pH old	D.O. (mg/L) new	D.O. (mg/L) old	Conductivity (μS/cm)	# Live Organisms A	B	C	D	E	SIGN-OFF
Lab Control	23.3	7.86		9.1		389	10	10	10	10	10	Date: 2-7-14; Sample ID: RS 34018 34017
100%	23.3	7.61		8.1		1835	10	10	10	10	10	Test Solution Prep: [illegible]; New WQ: KB
Meter ID	43A	PH15		RD04		EC04						Initiation Time: 1355; Initiation Signoff: [illegible]
Lab Control	23.2				8.3		10	9	10	10	10	Date: 2/8/14; Count Time: 1140
100%	23.2				7.6		9	10	10	10	10	Count Signoff: KB; Old WQ: MA
Meter ID	43A				RD06							
Lab Control	23.4				5.9		10	9	10	10	9	Date: 2/9/14; Count Time: 1030
100%	23.4				6.1		8	7	6	10	9	Count Signoff: [illegible]; Old WQ: [illegible]
Meter ID	43A				RD04							Feed: [illegible]
Lab Control	23.7				7.0		10	9	10	10	9	Date: 2/10/14; Count Time: 1030
100%	23.7				6.0		7	7	5	8	6	Count Signoff: MK; Old WQ: O.M.S.
Meter ID	43A				RD04							
Lab Control	23.4				7.3		10	9	10	10	9	Date: 2/11/14; Count Time: 1005
100%	23.4				7.3		7	7	5	8	6	Count Signoff: [illegible]; Old WQ: [illegible]
Meter ID	43A				RD05							Feed: [illegible]
Lab Control	23.1	8.11	7.75	8.8	8.1	461	10	9	10	10	9	Date: 2.12.14; Sample ID: 34017
100%	23.1	7.85	7.73	10.1	7.5	1926	6	6	4	7	5	Test Solution Prep: [illegible]; New WQ: AS
Meter ID	43A	PH16	PH16	RD05	RD06	EC04						Renewal Time: 1345; Renewal Signoff: [illegible]; Old WQ: AS
Lab Control	23.1				7.2		10	9	10	10	9	Date: 2.13.14; Count Time: 1015
100%	23.1				6.2		4	4	4	5	5	Count Signoff: [illegible]; Old WQ: [illegible]
Meter ID	43A				RD06							Feed: [illegible]
Lab Control	23.3				4.65 MK		10	9	10	10	9	Date: 2/14/14; Count Time: 915
100%	23.3				4.5		3	4	2	3	3	Count Signoff: [illegible]; Old WQ: MK
Meter ID	43A				RD05							
Lab Control	23.2				5.0		10	9	10	10	9	Date: 2/15/14; Count Time: 900
100%	23.2				4.2		2	4	1	2	1	Count Signoff: [illegible]; Old WQ: LH
Meter ID	43A				RD07							Feed: [illegible]
Lab Control	23.1				5.4		10	9	10	10	9	Date: 2/16/14; Count Time: 1105
100%	23.1				5.1		2	4	1	2	1	Count Signoff: [illegible]; Old WQ: [illegible]
Meter ID	43A				RD07							
Lab Control	23.1		7.50		5.6	441	10	9	10	10	9	Date: 2.17.14; Termination Time: 0905
100%	23.1		7.74		5.6	2000	2	3	1	2	1	Termination Signoff: [illegible]; Old WQ: O.M.S.
Meter ID	43A		pH19		RD04	EC09						

Hyalella Survival and Growth Test — **Pacific EcoRisk**

Analysis ID:	09-0015-3719	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.5
Analyzed:	02 Mar-14 16:09	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	8.26%	

Equal Variance t Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
ADH_0207_HA_C1		544R00025DS	14.5	1.86	0.129	8	<0.0001	CDF	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	2.504565	2.504565	1	209	<0.0001	Significant Effect
Error	0.0957804	0.01197255	8			
Total	2.600346		9			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Variance Ratio F	2.01	23.2	0.5170	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.91	0.741	0.2836	Normal Distribution

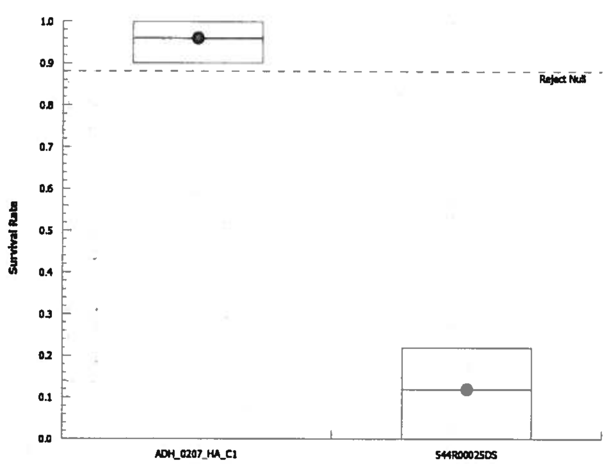
Survival Rate Summary

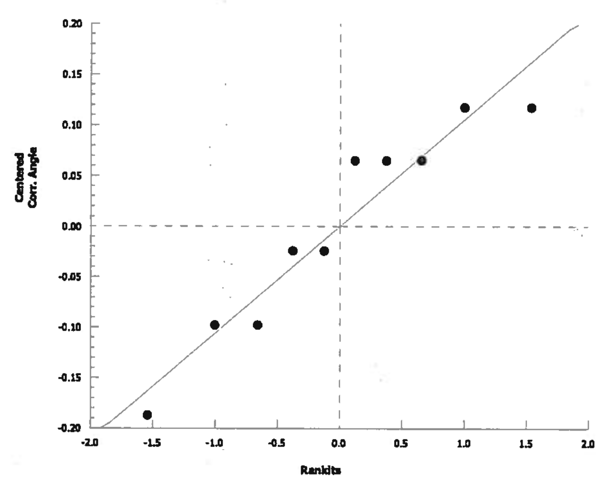
Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
ADH_0207_HA_C1	5	0.96	0.892	1	1	0.9	1	0.0245	5.71%	0.0%
544R00025DS	5	0.12	0.0161	0.224	0.1	0	0.2	0.0374	69.7%	87.5%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
ADH_0207_HA_C1	5	1.35	1.24	1.46	1.41	1.25	1.41	0.0399	6.63%	0.0%
544R00025DS	5	0.346	0.189	0.503	0.322	0.159	0.464	0.0565	36.5%	74.3%

Graphics





10 Day Acute *Hyalella azteca* Toxicity Test Data

Client: ADH / CCCWP
Test Material: 544R00025 D/S (down-stream)
Test ID#: 55260 Project #: 19397
Test Date: 2-7-14

Organism Log#: 7930 Age: 8 days
Organism Supplier: Chesapeake
Control/Diluent: SAM-5 Hyalella Water
Control Water Batch: 54

Treatment	Temp (°C)	pH new	pH old	D.O. (mg/L) new	D.O. (mg/L) old	Conductivity (µS/cm)	# Live Organisms A	B	C	D	E	SIGN-OFF
Lab Control	23.3	7.86		9.1		389	10	10	10	10	10	Date: 2-7-14 Sample ID: 34018
100%	23.3	7.66		10.6		1823	10	10	10	10	10	Test Solution Prep: [illegible] New WQ: AS
Meter ID	43A	PH15		RD04		EC04						Initiation Time: 1855 Initiation Signoff: [illegible]
Lab Control	23.2				8.3		10	9	10	10	10	Date: 2/8/14 Count Time: 1140
100%	23.2				7.9		8	10	10	10	10	Count Signoff: KG Old WQ: MH
Meter ID	43A				RD06							
Lab Control	23.4				5.9		10	9	10	10	9	Date: 2/9/14 Count Time: 1030
100%	23.4				5.8		6	10	10	9	9	Count Signoff: [illegible] Old WQ: ARP
Meter ID	43A				RD04							Feed: [illegible]
Lab Control	23.7				7.0		10	9	10	10	9	Date: 2/10/14 Count Time: 1030
100%	23.7				5.1		5	8	9	7	9	Count Signoff: MK Old WQ: D.M.S.
Meter ID	43A				RD04							
Lab Control	23.4				7.3		10	9	10	10	9	Date: 2/11/14 Count Time: 1205
100%	23.4				5.7		5	8	9	7	9	Count Signoff: [illegible] Old WQ: CA
Meter ID	43A				RD05							Feed: [illegible]
Lab Control	23.1	8.11	7.75	8.8	8.1	461	10	9	10	10	9	Date: 2.12.14 Sample ID: 34018
100%	23.1	7.82	7.79	10.2	7.0	1909	3	7	8	7	7	Test Solution Prep: [illegible] New WQ: AS
Meter ID	43A	PH16	PH16	RD05	RD06	EC04						Renewal Time: 1345 Renewal Signoff: [illegible] Old WQ: AS
Lab Control	23.1				7.2		10	9	10	10	9	Date: 2-13-14 Count Time: 1015
100%	23.1				5.4		2	6	5	4	5	Count Signoff: [illegible] Old WQ: [illegible]
Meter ID	43A				RD07							Feed: [illegible]
Lab Control	23.3				4.6		10	9	10	10	9	Date: 2/14/14 Count Time: 915
100%	23.3				3.6		2	6	4	2	3	Count Signoff: [illegible] Old WQ: MK
Meter ID	43A				RD05							
Lab Control	23.2				5.0		10	9	10	10	9	Date: 2/15/14 Count Time: 900
100%	23.2				3.6		2	4	4	1	3	Count Signoff: [illegible] Old WQ: LH
Meter ID	43A				RD07							Feed: [illegible]
Lab Control	23.1				5.4		10	9	10	10	9	Date: 2/16/14 Count Time: 1105
100%	23.1				6.1		2	3	1	1	2	Count Signoff: [illegible] Old WQ: TM
Meter ID	43A				RD07							
Lab Control	23.1		7.50		5.6	441	10	9	10	10	9	Date: 2.17.14 Termination Time: 0905
100%	23.1		7.89		6.3	2008	1	2	1	0	2	Termination Signoff: [illegible] Old WQ: D.M.S.
Meter ID	43A		PH19		RD04	EC04						

Appendix C

Test Data and Summary of Statistics for the Evaluation of the Chronic Toxicity of the CCCWP Stormwater to *Hyalella azteca* – Follow-Up Toxicity Identification Evaluation (TIE): 544R00025DS

10 Day Acute *Hyalella azteca* Toxicity Test Data

Client: ADH /CCCWP
Test Material: 544R00025DS-W-01
Test ID#: 55383 Project #: 19397
Test Date: 2/15/14

Organism Log#: 7966 Age: 7-8 d.
Organism Supplier: Chesapeak
Control/Diluent: SAM-5 Hyalella Water
Control Water Batch: 81

Treatment	Temp (°C)	pH new	pH old	D.O. (mg/L) new	D.O. (mg/L) old	Conductivity (µS/cm)	# Live A	# Live B	# Live C	# Live D	# Live E	SIGN-OFF
Lab Control	23.2	7.81		8.4		428	10	10	10	10	10	Date 2/15/14; Sample ID 34018
100%	23.2	7.84		8.7		1921	10	10	10	10	10	Test Solution Prep [illegible]; New WQ FOLB
Meter ID	43A	PH18		RD04		EC09						Initiation Time 1630; Initiation Signoff [illegible]
Lab Control	23.1				8.2		10	10	10	10	10	Date 2.16.14; Count Time 1100
100%	23.1				7.0		10	10	9	10	10	Count Signoff [illegible]
Meter ID	43A				RD04							Old WQ [illegible]
Lab Control	23.3				5.6		10	10	10	10	10	Date 2-17-14; Count Time 1210
100%	23.3				5.3		9	10	9	10	10	Count Signoff [illegible]; Old WQ [illegible]
Meter ID	43A				RD05							Feed [illegible]
Lab Control	23.2				5.6		10	10	10	10	10	Date 2/18/14; Count Time 1100
100%	23.2				6.1		8	9	7	10	10	Count Signoff [illegible]; Old WQ CP
Meter ID	43A				RD04							
Lab Control	23.3				7.8		10	10	10	10	10	Date 2/19/14; Count Time 1400
100%	23.3				7.7		8	8	4	8	7	Count Signoff MK; Old WQ AS
Meter ID	43A				RD07							Feed MK
Lab Control	23.2	8.41	7.84	9.0	8.0	430	10	10	10	10	10	Date 2/20/14; Sample ID 34018
100%	23.2	7.91	8.12	9.6	7.5	1904	5	5	4	5	2	Test Solution Prep [illegible]; New WQ AS
Meter ID	43A	PH19	PH15	RD07	RD05	EC04						Renewal Time 1655; Renewal Signoff [illegible]; Old WQ CP
Lab Control	22.9				3.2		10	10	10	10	10	Date 2/21/14; Count Time 1800
100%	22.9				4.5		5	5	2	0	0	Count Signoff [illegible]; Old WQ [illegible]
Meter ID	43A				RD07							Feed [illegible]
Lab Control	23.1				4.5		10	10	10	10	10	Date 2/22/14; Count Time 900
100%	23.1				4.0		5	2	2	—	—	Count Signoff [illegible]; Old WQ MK
Meter ID	43A				RD05							
Lab Control	23.1				6.2		10	10	10	10	10	Date 2/23/14; Count Time 1030
100%	23.4				6.0		4	2	2	—	—	Count Signoff [illegible]; Old WQ [illegible]
Meter ID	43A				RD07							Feed [illegible]
Lab Control	23.1				5.6		10	10	10	10	10	Date 2/24/14; Count Time 1430
100%	23.1				4.7		4	2	2	—	—	Count Signoff CJD; Old WQ CP
Meter ID	43A				RD04							
Lab Control	23.2		7.80		5.7	477	10	10	10	10	10	Date 2/25/14; Termination Time 1100
100%	23.2		7.88		6.0	2177	4	2	2	—	—	Termination Signoff CJD; Old WQ CP
Meter ID	43A		PH16		RD04	EC06						

10 Day Acute *Hyalella azteca* Toxicity Test Data

Client: ADH /CCCWP
Test Material: 544R00025DS-W-01 + PBO
Test ID#: 55383 Project #: 19397
Test Date: 2/15/14

Organism Log#: 7966 Age: 7-8 d
Organism Supplier: Chesapeake
Control/Diluent: SAM-5 Hyalella Water
Control Water Batch: 81

Treatment	Temp (°C)	pH new	pH old	D.O. (mg/L) new	D.O. (mg/L) old	Conductivity (µS/cm)	# Live Organisms A	B	C	D	E	SIGN-OFF
PBO Blank	23.2	7.90		8.6		420	10	10	10	10	10	Date: 2/15/14; Sample ID: 34514
50%	23.2	7.92		8.6		1165	10	10	10	10	10	Test Solution Prep: [illegible]; New WQ: [illegible]
100%	23.2	7.90		8.6		1882	10	10	10	10	10	Initiation Time: 1630; Initiation Signoff: [illegible]
Meter ID	43A	PH18		RDO4		EC09						
PBO Blank	23.1				8.1		10	10	10	10	10	Date: 2.16.14; Count Time: 1200
50%	23.1				7.1		10	10	10	10	10	Count Signoff: [illegible]; Old WQ: [illegible]
100%	23.1				7.0		10	10	10	10	10	
Meter ID	43A				RDO4							
PBO Blank	23.3				5.2		10	10	10	10	10	Date: 2-17-14; Count Time: 1210
50%	23.3				6.0		~~10~~ 7	7	10	7	9	Count Signoff: [illegible]; Old WQ: [illegible]
100%	23.3				6.4		7	5	6	3	5	Feed: [illegible]
Meter ID	43A				RDO5							
PBO Blank	23.2				5.8		10	10	10	10	10	Date: 2/18/14; Count Time: 1100
50%	23.2				6.0		7	6	10	6	9	Count Signoff: [illegible]; Old WQ: CP
100%	23.2				6.2		5	5	6	3	4	
Meter ID	43A				RDO4							
PBO Blank	23.3				7.4		10	10	10	10	10	Date: 2/19/14; Count Time: 1400
50%	23.3				7.2		6	5	7	3	7	Count Signoff: MK; Old WQ: AS
100%	23.3				7.2		3	1	1	0	1	Feed: MK
Meter ID	43A				RDO7							
PBO Blank	23.2	8.12	7.73	9.0	6.7	411	10	10	10	10	10	Date: 2/20/14; Sample ID: 34618
50%	23.2	7.98	7.80	9.1	6.9	1199	~~3~~ 1	0	0	0	1	Test Solution Prep: [illegible]; New WQ: AS
100%	23.2	7.97	7.94	9.1	7.4	1916	0	0	0	0	1	Renewal Time: 1655; Renewal Signoff: [illegible]; Old WQ: CP
Meter ID	43F	PH19	PH15	RDO7	RDO5	EC04						
PBO Blank	22.9				4.5		10	10	10	10	10	Date: 2/21/14; Count Time: 1800
50%	22.9				6.3		0	–	–	–	0	Count Signoff: [illegible]; Old WQ: [illegible]
100%	22.9				6.9		–	–	–	–	0	Feed: [illegible]
Meter ID	43A				RDO7							
PBO Blank	23.1				2.7		10	10	10	10	10	Date: 2/22/14; Count Time: 900
50%	23.1				–		–	–	–	–	–	Count Signoff: [illegible]; Old WQ: MK
100%	23.1				–		–	–	–	–	–	
Meter ID	43A				RDO5							
PBO Blank	23.1				5.9		10	10	10	10	10	Date: 2/23/14; Count Time: 1030
50%	–				–		–	–	–	–	–	Count Signoff: [illegible]; Old WQ: [illegible]
100%	–				–		–	–	–	–	–	Feed: [illegible]
Meter ID	43A				RDO7							
PBO Blank	23.1				5.7		10	10	10	10	10	Date: 2/24/14; Count Time: 1430
50%	–				–		–	–	–	–	–	Count Signoff: [illegible]; Old WQ: CP
100%	–				–		–	–	–	–	–	
Meter ID	43A				RDO4							
PBO Blank	23.2		7.88		5.7	455	10	10	10	10	10	Date: 2/25/14; Termination Time: 1100
50%	23.2		–		–	–	–	–	–	–	–	Termination Signoff: [illegible]; Old WQ: CP
100%	23.2		–		–	–	–	–	–	–	–	
Meter ID	43A		PH16		RDO4	EC06						

10 Day Acute *Hyalella azteca* Toxicity Test Data

Client: ADH /CCCWP
Test Material: 544R00025DS-W-01 + Carboxyl Esterase
Test ID#: 55383 Project #: 19397
Test Date: 2/15/14
Organism Log#: 7966 Age: 7-8 d
Organism Supplier: Chesapeake
Control/Diluent: SAM-5 Hyalella Water
Control Water Batch: 81

Treatment	Temp (°C)	pH new	pH old	D.O. (mg/L) new	D.O. (mg/L) old	Conductivity (µS/cm)	# Live Organisms A	B	C	D	E	SIGN-OFF
Carboxyl esterase Blank	23.2	8.02		8.7		423	10	10	10	10	10	Date 2/15/14; Sample ID 34018
100%	23.2	7.92		8.6		1869	10	10	10	10	10	Test Solution Prep [initials]; New WQ FOUB
Meter ID	43A	PH18		RD04		EC09						Initiation Time 1630; Initiation Signoff [initials]
Carboxyl esterase Blank	23.1				9.6		10	10	10	10	10	Date 2.16.14; Count Time 1100
100%	23.1				2.0		10	10	10	10	10	Count Signoff [initials]; Old WQ [initials]
Meter ID	43A				RD04							
Carboxyl esterase Blank	23.3				3.9		10	10	9	10	10	Date 2/17/14; Count Time 1210
100%	23.3				2.4		9	10	10	10	10	Count Signoff [initials]; Old WQ LH
Meter ID	43A				RD05							Feed [initials]
Carboxyl esterase Blank	23.2				4.6		10	10	9	10	10	Date 2/18/14; Count Time 1100
100%	23.2				5.2		9	10	10	10	10	Count Signoff [initials]; Old WQ CP
Meter ID	43A				RD04							
Carboxyl esterase Blank	23.3				5.1		10	9	9	10	10	Date 2/19/14; Count Time 1400
100%	23.3				7.1		9	10	10	10	10	Count Signoff MK; Old WQ AS
Meter ID	43A				RD07							Feed MK
Carboxyl esterase Blank	23.2	8.07	7.65	9.1	5.5	417	10	9	9	10	10	Date 2/20/14; Sample ID 34018
100%	23.2	7.99	7.81	9.0	5.7	1908	9	10	10	10	10	Test Solution Prep [initials]; New WQ AS
Meter ID	43A	PH19	PH15	RD07	RD05	EC09						Renewal Time 1655; Renewal Signoff [initials]; Old WQ CP
Carboxyl esterase Blank	22.9				3.4		10	9	9	10	10	Date 2/21/14; Count Time 1800
100%	22.9				6.4		9	10	10	10	10	Count Signoff [initials]; Old WQ [initials]
Meter ID	43A				RD07							Feed [initials]
Carboxyl esterase Blank	23.1				1.7		10	9	9	10	10	Date 2/22/14; Count Time 900
100%	23.1				7.6		9	10	10	10	10	Count Signoff [initials]; Old WQ MK
Meter ID	43A				RD05							
Carboxyl esterase Blank	23.1				7.4		1	9	9	10	10	Date 2/23/14; Count Time 1030
100%	23.1				7.7		9	10	10	10	10	Count Signoff [initials]; Old WQ ~~FOUB~~ [initials]
Meter ID	43A				RD07							Feed [initials]
Carboxyl esterase Blank	23.1				7.4		1	9	9	10	10	Date 2/24/14; Count Time 1430
100%	23.1				7.7		9	10	10	10	10	Count Signoff CJD; Old WQ CP
Meter ID	43A				RD04							
Carboxyl esterase Blank	23.2		8.02		6.7	523	1	9	9	9	10	Date 2/25/14; Termination Time 1100
100%	23.2		8.20		7.3	2201	9	10	10	10	10	Termination Signoff CJD; Old WQ CP
Meter ID	43A		PH16		RD04	EC06						

10 Day Acute *Hyalella azteca* Toxicity Test Data

Client: ADH /CCCWP
Test Material: 544R00025DS-W-01 + BSA
Test ID#: 55383 Project #: 19397
Test Date: 2/15/14

Organism Log#: 7966 Age: 7-8 d
Organism Supplier: Chesapeake
Control/Diluent: SAM-5 Hyalella Water
Control Water Batch: 81

Treatment	Temp (°C)	pH new	pH old	D.O. (mg/L) new	D.O. (mg/L) old	Conductivity (µS/cm)	# Live Organisms A	B	C	D	E	SIGN-OFF
BSA Blank	23.2	8.00		8.6		413	10	10	10	10	10	Date: 2/15/14
100%	23.2	7.94		8.6		1890	10	10	10	10	10	Sample ID: 34018; Test Solution Prep: [signature]; New WQ: FOUB
Meter ID	43A	PH18		RD04		EC09						Initiation Time: 1630; Initiation Signoff: [signature]
BSA Blank	23.1				6.1		10	10	10	10	10	Date: 2.16.14; Count Time: 1100
100%	23.1				2.9		10	10	10	10	10	Count Signoff: [signature]; Old WQ: [signature]
Meter ID	43A				RD04							
BSA Blank	23.3				5.0		10	10	10	10	10	Date: 2/17/14; Count Time: 1210
100%	23.3				2.6		10	10	8	10	10	Count Signoff: [signature]; Old WQ: [illegible]
Meter ID	43A				RD05							Feed: [signature]
BSA Blank	23.2				4.4		10	10	10	10	10	Date: 2/18/14; Count Time: 1100
100%	23.2				4.7		10	10	8	10	10	Count Signoff: [signature]; Old WQ: CP
Meter ID	43A				RD04							
BSA Blank	23.3				4.4		10	10	10	10	10	Date: 2/19/14; Count Time: 1400
100%	23.3				6.0		8	6	7	8	8	Count Signoff: MK; Old WQ: AS
Meter ID	43A				RD07							Feed: MK
BSA Blank	23.2	8.15	7.58	9.2	4.3	409	10	10	10	10	10	Date: 2/20/14; Sample ID: 34018
100%	23.2	7.93	7.81	9.1	5.3	1912	~~3~~ 4	6	3	6	8	Test Solution Prep: [signature]; New WQ: AS
Meter ID	43A	PH19	PH15	RD07	RD05	EC04						Renewal Time: 1655; Renewal Signoff: [signature]; Old WQ: CP
BSA Blank	22.9				3.4		10	10	10	10	10	Date: 2/21/14; Count Time: 1800
100%	22.9				6.7		4 ~~5~~	6	3	6	8	Count Signoff: [signature]; Old WQ: [signature]
Meter ID	43A				RD07							Feed: [signature]
BSA Blank	23.1				1.8		10	10	10	10	10	Date: 2/22/14; Count Time: 900
100%	23.1				7.0		4	5	3	6	7	Count Signoff: [signature]; Old WQ: MK
Meter ID	43A				RD05							
BSA Blank	23.1				7.4		10	10	10	10	10	Date: 2/23/14; Count Time: 1030
100%	23.1				7.7		4	5	2	6	7	Count Signoff: [signature]; Old WQ: AS
Meter ID	43A				RD07							Feed: [signature]
BSA Blank	23.1				7.2		10	10	10	10	10	Date: 2/24/14; Count Time: 1430
100%	23.1				7.5		4	5	1	6	7	Count Signoff: CJD; Old WQ: CP
Meter ID	43A				RD04							
BSA Blank	23.2		8.09		6.9	522	10	10	10	10	10	Date: 2/25/14; Termination Time: 1100
100%	23.2		8.18		6.9	2201	4	5	1	6	7	Termination Signoff: CJD; Old WQ: CP
Meter ID	43A		PH16		RD04	EC06						

Appendix D

Test Data and Summary of Statistics for the Reference Toxicant Evaluation of the *Hyalella azteca*

CETIS Summary Report

Report Date: 15 Feb-14 15:46 (p 1 of 1)
Test Code: 55244 | 12-2780-2249

Hyalella 96-h Acute Survival Test — **Pacific EcoRisk**

Batch ID:	19-8480-8516	**Test Type:**	Survival (96h)	**Analyst:**	Cassy Glover
Start Date:	07 Feb-14 17:40	**Protocol:**	EPA-821-R-02-012 (2002)	**Diluent:**	SAM-5S
Ending Date:	11 Feb-14 16:55	**Species:**	Hyalella azteca	**Brine:**	Not Applicable
Duration:	95h	**Source:**	Chesapeake Cultures, Inc.	**Age:**	8

Sample ID:	12-2997-3710	**Code:**	KCl	**Client:**	Reference Toxicant
Sample Date:	07 Feb-14 17:40	**Material:**	Potassium chloride	**Project:**	22049
Receive Date:	07 Feb-14 17:40	**Source:**	Reference Toxicant		
Sample Age:	NA (23.3 °C)	**Station:**	In House		

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
04-8301-8359	96h Survival Rate	0.4	0.8	0.5657	NA		Fisher Exact/Bonferroni-Holm Test

Point Estimate Summary

Analysis ID	Endpoint	Level	g/L	95% LCL	95% UCL	TU	Method
04-4756-7462	96h Survival Rate	EC50	0.566	0.454	0.704		Binomial/Graphical

96h Survival Rate Summary

C-g/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Lab Water Contr	10	1	1	1	1	1	0	0	0.0%	0.0%
0.1		10	1	1	1	1	1	0	0	0.0%	0.0%
0.2		10	1	1	1	1	1	0	0	0.0%	0.0%
0.4		10	1	1	1	1	1	0	0	0.0%	0.0%
0.8		10	0	0	0	0	0	0	0		100.0%
1.6		10	0	0	0	0	0	0	0		100.0%

96h Survival Rate Detail

C-g/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Lab Water Contr	1	1	1	1	1	1	1	1	1	1
0.1		1	1	1	1	1	1	1	1	1	1
0.2		1	1	1	1	1	1	1	1	1	1
0.4		1	1	1	1	1	1	1	1	1	1
0.8		0	0	0	0	0	0	0	0	0	0
1.6		0	0	0	0	0	0	0	0	0	0

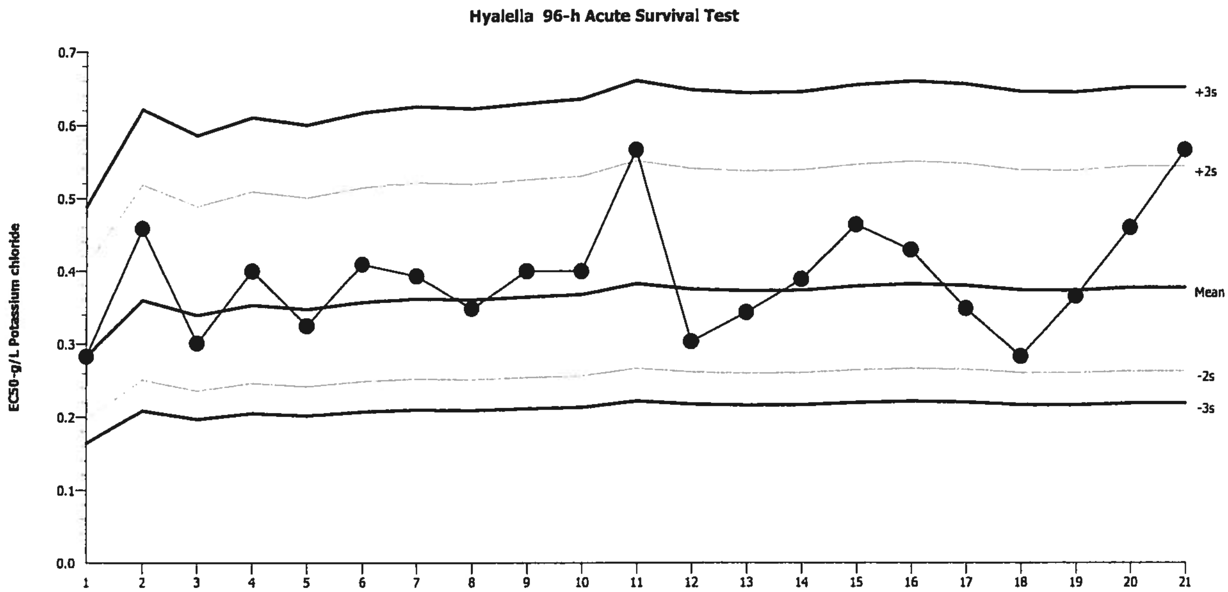
96h Survival Rate Binomials

C-g/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Lab Water Contr	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
0.1		1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
0.2		1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
0.4		1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
0.8		0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1
1.6		0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1

CETIS QC Plot

Hyalella 96-h Acute Survival Test **Pacific EcoRisk**

Test Type: Survival (96h) **Organism:** Hyalella azteca (Freshwater Amphip **Material:** Potassium chloride
Protocol: All Protocols **Endpoint:** 96h Survival Rate **Source:** Reference Toxicant-REF



Mean:	0.3773	**Count:**	20	**-2s Warning Limit:**	0.2621	**-3s Action Limit:**	0.2185
Sigma:	NA	**CV:**	20.00%	**+2s Warning Limit:**	0.5429	**+3s Action Limit:**	0.6513

Quality Control Data

Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID
1	2013	Jul	25	16:30	0.2828	-0.09443	-1.583			00-1823-9671	20-7751-0916
2			26	14:30	0.4583	0.08108	1.07			11-2447-7250	10-1665-7756
3		Aug	15	16:50	0.3009	-0.07641	-1.243			00-1985-9655	15-6499-7663
4			22	15:50	0.4	0.02273	0.3215			03-4648-2331	16-3196-9760
5			23	15:30	0.3249	-0.05237	-0.8211			15-2391-2292	08-1418-9228
6		Sep	12	16:00	0.4092	0.0319	0.446			15-4907-0534	08-4072-9838
7			15	16:05	0.3931	0.01586	0.2263			20-8032-4728	11-2664-4219
8		Oct	10	14:15	0.3482	-0.02905	-0.4402			17-8638-2812	17-1370-8594
9			27	15:00	0.4	0.02273	0.3215			07-6368-8256	01-2718-7046
10		Nov	6	15:40	0.4	0.02273	0.3215			15-7026-7439	19-7036-5835
11			20	17:00	0.5657	0.1884	2.226	(+)		01-7958-1543	09-3590-7589
12			21	16:55	0.3031	-0.07412	-1.202			17-4328-3485	11-7628-5959
13		Dec	11	17:45	0.3429	-0.0344	-0.5254			06-4892-3798	02-7681-8091
14	2014	Jan	22	15:30	0.3887	0.01145	0.1643			15-1323-9580	12-5039-1906
15			23	12:20	0.4634	0.08616	1.13			12-4927-8114	03-4534-5077
16			24	13:50	0.4287	0.05144	0.7023			04-8256-1553	14-6784-2933
17			29	12:45	0.3482	-0.02905	-0.4402			02-0910-9206	20-3009-8021
18			30	13:00	0.2828	-0.09443	-1.583			07-7453-2234	19-6136-6595
19			31	15:00	0.3651	-0.01214	-0.1796			07-3562-2451	09-8419-3354
20		Feb	4	16:00	0.4595	0.08221	1.083			07-2556-9878	06-3437-8862
21			7	17:40	0.5657	0.1884	2.226	(+)		12-2780-2249	04-4756-7462

96 Hour *Hyalella azteca* Reference Toxicant Test Data

Client: **Reference Toxicant**
Test Material: Potassium Chloride
Test ID#: 55244 Project # 22049
Test Date: 2-7-14 Randomization: 10.6.3
Feeding T0 Time: 0800 Initials: DS

Organism Log #: 7930 Age: 8 days
Organism Supplier: Chesapeake
Control/Diluent: SAM-5 *Hyalella* Water
Control Water Batch: 54
Feeding T46 Time: 1100 Initials: [illegible]

Treatment (g/L)	Temp (°C)	pH	D.O. (mg/L)	Conductivity (µS/cm)	# Live Animals A	B	C	D	E	F	G	H	I	J	Sign-Off
Control	23.3	8.01	9.0	443	1	1	1	1	1	1	1	1	1	1	Test Solution Prep: SH
0.1	23.3	7.93	9.0	601	1	1	1	1	1	1	1	1	1	1	New WQ: [illegible]
0.2	23.3	7.91	9.0	761	1	1	1	1	1	1	1	1	1	1	Initiation Date: 2-7-14
0.4	23.3	7.85	9.2	1157	1	1	1	1	1	1	1	1	1	1	Initiation Time: 1740
0.8	23.3	7.81	9.5	1901	1	1	1	1	1	1	1	1	1	1	Initiation Signoff: [illegible]
1.6	23.3	7.76	10.2	3320	1	1	1	1	1	1	1	1	1	1	RT Batch #: 14
Meter ID	43A	pH19	RD07	Ec09											
Control	23.2				1	1	1	1	1	1	1	1	1	1	Count Date: 2/8/14
0.1	23.2				1	1	1	1	1	1	1	1	1	1	Count Time: 1100
0.2	23.2				1	1	1	1	1	1	1	1	1	1	Count Signoff: CJD
0.4	23.2				1	1	1	1	1	1	1	1	1	1	
0.8	23.2				1	1	1	0	0	0	0	0	0	0	
1.6	23.2				0	0	0	0	0	0	0	0	0	0	
Meter ID	43H														
Control	23.3				1	1	1	1	1	1	1	1	1	1	Count Date: 2-9-14
0.1	23.3				1	1	1	1	1	1	1	1	1	1	Count Time: 1055
0.2	23.3				1	1	1	1	1	1	1	1	1	1	Count Signoff: [illegible]
0.4	23.3				1	1	1	1	1	1	1	1	1	1	
0.8	23.3				0	0	0	-	-	-	-	-	-	-	
1.6	-				-	-	-	-	-	-	-	-	-	-	
Meter ID	43A														
Control	23.7				1	1	1	1	1	1	1	1	1	1	Count Date: 2/10/14
0.1	23.7				1	1	1	1	1	1	1	1	1	1	Count Time: 1115
0.2	23.7				1	1	1	1	1	1	1	1	1	1	Count Signoff: MK
0.4	23.7				1	1	1	1	1	1	1	1	1	1	
0.8	-				-	-	-	-	-	-	-	-	-	-	
1.6	-				-	-	-	-	-	-	-	-	-	-	
Meter ID	43A														
Control	23.4	7.86	9.8	445	1	1	1	1	1	1	1	1	1	1	Termination Date: 2/11/14
0.1	23.4	7.87	9.5	613	1	1	1	1	1	1	1	1	1	1	Termination Time: 1655
0.2	23.4	7.86	9.3	769	1	1	1	1	1	1	1	1	1	1	Termination Signoff: [illegible]
0.4	23.4	7.85	9.1	1170	1	1	1	1	1	1	1	1	1	1	Old WQ: AWS
0.8	-	7.85	9.0	1900	-	-	-	-	-	-	-	-	-	-	
1.6	-	7.82	8.7	3330	-	-	-	-	-	-	-	-	-	-	
Meter ID	43A	PH19	RD07	EC04											

Alessandro D. Hnatt
ADH Environmental
3065 Porter Street, Suite 101
Soquel, CA 95073

September 9, 2014

Alessandro:

I have enclosed one copy of our report "Evaluation of the Chronic Toxicity of Contra Costa Clean Water Program Ambient Sediment Samples" for the samples that were collected July 22, 2014. The results of this testing are summarized below:

Toxicity summary for CCCWP-SSID ambient sediment samples to *Hyalella azteca*.		
Sample Station	Toxicity Present Relative to Lab Control treatment?	
	Survival	Growth
207WAL078	**Yes**	**Yes**
207WAL060	**Yes**	no
544MSH065	**Yes**	**Yes**
544MSH062	**Yes**	**Yes**

In response to the observed reduction in survival and growth, a targeted TIE was performed on the upstream stormwater sample (544MSH065) in an attempt to identify suspected cause(s) of toxicity. The results of this testing are presented below:

Effects of TIE treatments on the toxicity of CCCWP-SSID ambient sediment sample to *Hyalella azteca.*					
TIE Treatment	Toxicity Present Relative to Lab Control treatment?				
	Mean % Survival		Weight		Effects of TIE Treatment?
	Control/Blank	100%	Control/Blank	100%	
Baseline	96.7	**6.7***	0.13	**0.03***	toxicity present
Aeration	96.7	**13.3***	0.12	0.08	toxicity present
PBO	96.7	**0***	0.12	N/A	*increase* in toxicity
Carboxylesterase	100	76.7	0.15	**0.09***	reduction of toxicity

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

There was still a statistically significant reduction in *H. azteca* survival and growth in the test of the untreated sediment, indicating that the toxicity that had been observed in the initial testing of this sample was persistent. The following trends (changes in sample toxicity relative to the untreated water sample [Baseline] test) were observed:

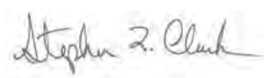
- The addition of PBO to the test solutions increased toxicity to *H. azteca* survival (survival decreased from 6.7% to complete mortality). These results suggest that compounds which are *detoxified* by the cytochrome-P450 system (e.g., pyrethroid insecticides) were contributing to sample toxicity; and

- The addition of carboxylesterase removed the significant reduction in survival (increased from 6.7% survival to 76.7% survival), suggesting that type I and type II pyrethroids are contributing to the toxicity (Weston and Amweg 2007). The use of carboxylesterase as a TIE treatment is still experimental and these results need to be used judiciously and in conjunction with other TIE treatment (e.g., PBO).

The weight of evidence from the TIE performed on the upstream ambient sediment sample suggests that the toxicity was likely due to pyrethroid insecticides.

If you have any questions regarding the performance and interpretation of these tests, feel free to contact my colleague Eddie Kalombo or myself at (707) 207-7760.

Sincerely,



Digitally signed by com.apple.idms.appleid.prd.7573396d6a2f514d2b446864737862394d70787541673d3d
Date: 2014.09.10 09:52:50 -08'00'

Stephen L. Clark
Vice President/Special Projects Director

Pacific EcoRisk is accredited in accordance with NELAP (ORELAP ID 4043). Pacific EcoRisk certifies that the test results reported herein conform to the most current NELAP requirements for parameters for which accreditation is required and available. Any exceptions to NELAP requirements are noted, where applicable, in the body of the report. This report shall not be reproduced, except in full, without the written consent of Pacific EcoRisk. This testing was performed under Lab Order 19397.

Evaluation of the Chronic Toxicity of Contra Costa Clean Water Program Ambient Sediment Samples

Samples collected July 22, 2014

Prepared For:

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September 2014

PACIFIC ECORISK
ENVIRONMENTAL CONSULTING & TESTING

Evaluation of the Chronic Toxicity of Contra Costa Clean Water Program Ambient Sediment Samples

Samples collected July 22, 2014

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Appendix A Chain-of-Custody Record for the Collection and Delivery of the CCCWP Ambient Sediment Samples

Appendix B Test Data and Summary of Statistics for the Evaluation of the Toxicity of the CCCWP Ambient Sediment Samples to *Hyalella azteca*

Appendix C Test Data and Summary of Statistics for the Evaluation of the Toxicity of the CCCWP Ambient Sediment Samples to *Hyalella azteca* – Follow-Up Toxicity Identification Evaluation (TIE): 544MSH065

Appendix D Test Data and Summary of Statistics for the Reference Toxicant Evaluation of the *Hyalella azteca*

1. INTRODUCTION

Under contract to ADH Environmental, and in support of the Bay Area Stormwater Management Agencies Association (BASMAA) Regional Monitoring Coalition ongoing monitoring efforts, Pacific EcoRisk (PER) has been contracted to evaluate the toxicity of stormwater samples collected for the Contra Costa Clean Water Program (CCCWP). This evaluation consist of performing the following US EPA toxicity test:

- 10-day survival and growth sediment toxicity test with the amphipod *Hyalella azteca*.

This toxicity test was conducted on ambient sediment samples collected on July 22, 2014. In order to assess the sensitivity of the test organisms to toxic stress, a reference toxicant test was also performed. As a result of the magnitude of toxicity observed, and at the request of the ADH Environmental, PER conducted a targeted Phase I Toxicity Identification Evaluation (TIE) on one of the samples that exhibited toxicity to *H. azteca*. This report describes the performance and results of these tests.

2. CHRONIC TOXICITY TEST PROCEDURES

The methods used in conducting the chronic toxicity tests followed the guidance established by the following publications and EPA manuals:

- "Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates, Second Edition" (EPA/600/R-99/064);
- Methods for Aquatic Toxicity Identification Evaluations Phase I Toxicity Characterization Procedures (EPA/600/66-91/003);
- Sediment Toxicity Identification Evaluation (TIE) Phases I, II, and III General Document (EPA/600/R-07/080);
- Amweg EL, Weston DP. 2007. Whole Sediment Toxicity Identification Evaluation Tools for Pyrethroid Insecticides: I. Piperonyl Butoxide Addition. *Environmental Toxicology and Chemistry* 26(11): 2389-2396; and
- Weston DP, Amweg EL. 2007. Whole Sediment Toxicity Identification Evaluation Tools for Pyrethroid Insecticides: II. Esterase Addition. *Environmental Toxicology and Chemistry* 26(11): 2397-2404.

2.1 Sample Receipt and Handling

On July 22, ADH collected ambient sediment samples into appropriately-cleaned containers, which were transported, on ice and under chain-of-custody, to the PER testing laboratory in Fairfield, CA. Upon receipt at the testing laboratory, aliquots of each sample were collected for analysis of initial water quality characteristics (Table 1), with the remainder of each sample being stored at 0-6˚C except when being used to prepare test solutions.

The chain-of-custody record for the collection and delivery of these stormwater samples is provided as Appendix A.

Table 1. Collection of the CCCWP-SSID ambient sediment samples.		
Sample ID	Sediment Sample Collection Date	Sample Receipt Date
544MSH065	7/22/14 (1145)	7/22/14 (1715)
544MSH062	7/22/14 (1015)	7/22/14 (1715)
207WAL078	7/22/14 (1445)	7/22/14 (1715)
207WAL060	7/22/14 (1145)	7/22/14 (1715)

2.2 Sediment Toxicity Testing with *Hyalella azteca*

The freshwater sediment toxicity test with *Hyalella azteca* consists of exposing the amphipods to the sediment for 10 days, after which effects on survival and growth are evaluated. The specific procedures used in this testing are described below.

The *Hyalella azteca* used in this testing were obtained from a commercial supplier (Aquatic Biosystems, Fort Collins, CO). Upon receipt at the laboratory, the amphipods were placed into HDPE tanks containing SAM-5S water at 23˚C, and were fed the alga *Selenastrum capricornutum* and Yeast-Cerophyll®-Trout (YCT) food amended with *Spirulina*.

Each site sediment was tested at the 100% concentration only. The Control treatment sediment consisted of a composite of reference site sediments that has been maintained under culture at the PER lab for >3 months. There were 8 replicates for each test treatment. Each replicate container consisted of a 300 mL tall-form glass beaker with a 3 cm ribbon of 540 μm mesh NITEX attached to the top of the beaker with silicone sealant. Each sediment sample was homogenized immediately prior to introduction of the sediments into the test replicates. Approximately 100 mL of sediment was then loaded into each of the test replicate containers. Each of the test replicates was carefully filled with clean overlying SAM-5S water. The test replicates with sediments and clean overlying water were established 24 hrs prior to the introduction of the amphipods.

After this initial 24 hr period, the overlying water in each replicate was flushed with one volume of fresh control water (approximately 150 mL). For each test treatment, a small aliquot of the renewed overlying water was then collected from each of the 8 replicates and composited for measurement of "initial" water quality characteristics (pH, dissolved oxygen [D.O.], conductivity, alkalinity, hardness, and total ammonia). Then, ten 12-13 day-old amphipods were randomly allocated into each replicate, followed by the addition of 1.0 mL of YCT food. The test replicates were then returned to the temperature-controlled rooms. At the time of test initiation for each set of tests, 8 replicates of 10 randomly-selected organisms were collected, dried, and weighed (described below) to determine the mean dry weight of the test organisms at test initiation.

Each day, for the following 9 days, each test replicate was examined for the presence of any dead amphipods. A small aliquot of the overlying water in each of the 8 replicates was then collected and composited as before for measurement of “old” D.O., after which each replicate was flushed with one volume of fresh water. Another small aliquot of the overlying water in each of the 8 replicates was then collected and composited as before for measurement of “new” D.O., after which each replicate was fed 1.0 mL of YCT, and then replaced within the temperature-controlled room.

After 10 days exposure, an aliquot of overlying water was collected from each replicate and composited for analysis of the “final” water quality characteristics. The sediments in each replicate container were then carefully sorted and sieved and the number of surviving amphipods determined. The surviving organisms were euthanized in methanol and transferred to small pre-tared weighing pans, which were placed into a drying oven at 100˚C. After drying for ~24 hrs, the pans were transferred to a desiccator to cool, and then weighed to the nearest 0.01 mg to determine the mean dry weight per surviving organism for each replicate. The resulting survival and growth (mean dry weight) data were then analyzed to evaluate any impairment due to the sediments; all statistical analyses were performed using the CETIS® statistical package (TidePool Scientific, McKinleyville, CA).

2.2.1 Reference Toxicant Testing of the *Hyalella azteca*

In order to assess the sensitivity of the *H. azteca* test organisms to toxic stress, a reference toxicant test was performed. The reference toxicant test was performed as a 96-hr waterborne exposure to Control water spiked with KCl at test concentrations of 0, 0.1, 0.2, 0.4, 0.8 and 1.6 g/L. The resulting survival data were statistically analyzed to determine key dose-response point estimates (e.g., EC_{50}); all statistical analyses were made using the CETIS® software. This response endpoint was then compared to the ‘typical response’ range established by the mean ± 2 SD of the point estimates generated by the 20 most recent previous reference toxicant tests performed by this lab.

2.3 Follow-Up Bulk Sediment Toxicity Identification Evaluation (TIE) Procedures

At the direction of the client, a Phase I TIE "targeted" was performed to identify if pyrethroid insecticides were the cause of toxicity.

The goal of the Phase I TIE fractionation procedures is to determine the class of compounds (e.g., organics, metals, ammonia, etc.) responsible for sample toxicity. This is achieved by performing physical and chemical manipulations (or treatments) on the sediment sample. Changes in toxicity that result from the TIE treatments help characterize the physical-chemical nature of the compound(s) responsible for the observed toxicity, which in turn can be used to identify the compound(s) responsible for the toxicity. The specific treatments used in this targeted TIE are described below.

2.3.1 TIE Fractionation Method Blanks

As part of the TIE process, a method blank is prepared for each treatment and then tested to determine whether any of the TIE treatment procedures contribute any artifactual toxicity to the manipulated sample. The method blanks were prepared by treating aliquots of Control sediment with each of the fractionation test treatments (discussed below).

2.3.2 Baseline

The Baseline test is simply a re-test of the untreated bulk sediment sample to confirm the persistence of toxicity during the concurrent TIE testing, and to provide a "benchmark" of toxicity against which to evaluate toxicity removal by the TIE treatments. The Baseline test and TIE fractionation treatment test sediments were tested with *Hyalella azteca* as described in Section 2.2, with the exception that there were 3 replicates for each test treatment, each replicate consisting a 100-mL glass beaker containing 30 mL of sediment with 10 *Hyalella azteca* per replicate. All statistical analyses were performed using CETIS® statistical software.

2.3.3 Piperonyl Butoxide (PBO) Addition

This TIE treatment can help identify toxicity caused by toxicants subject to metabolic activation/detoxification by the cytochrome-P450 system:

- an <u>increase in toxicity</u> after PBO treatment is indicative of a contaminant that is typically *detoxified* by the cytochrome-P450 enzyme system (e.g., carbamates, pyrethroids [Amweg and Weston 2007], etc.), whereas
- a <u>decrease in toxicity</u> after PBO treatment is indicative of a contaminant that is *activated* by the cytochrome-P450 system [e.g., organophosphate (OP) pesticides].

The simultaneous presence of compounds that are detoxified *and* compounds that are activated by the cytochrome-P450 system (e.g., the co-occurrence of both OP-pesticides and pyrethroid pesticides) may cancel each other out. The PBO treatment consisted of addition of PBO to the bulk sediment overlying water (and method blank) at a concentration of 25 μg/L. This test was then performed as described in Section 2.2.

2.3.4 Carboxylesterase Addition

The use of carboxylesterase to hydrolyze pyrethroids (via cleaving of the ester bond) has been proposed as a simple, mechanistic-based method to selectively identify pyrethroid-associated toxicity. Carboxylesterase is an enzyme that degrades type I and type II pyrethroids and has been used in recent studies to help identify pyrethroid-associated toxicity (Wheelock et al. 2004; Weston and Amweg 2007). It should be noted that this treatment is still experimental in nature and should be used in conjunction with other pyrethroid-targeted TIE treatments (e.g., PBO addition and temperature adjustment) via a weight-of-evidence approach.

The carboxylesterase treatment consisted of addition of carboxylesterase to the sediment test overlying water (and method blank) at a carboxylesterase concentration of 73 mg/L (or 1.25 Units/mL). The carboxylesterase test was performed as described in Section 2.2.

2.3.5 Aeration Treatment

The aeration treatment is designed to characterize effluent toxicity that can be attributed to volatile, sublatable, or oxidizable compounds. Using a pipette connected to an air-delivery system, the sediment test overlying water (and method blank) was for the duration of the test. Aeration also can have the physical effect of removing surface-active agents. Surface-active agent compounds congregate on the liquid/gas interface of the air bubbles and are carried to the surface of the solution where they can adhere to the sides of the container or are released into the atmosphere. A method blank was prepared in a similar fashion. The aeration treatment was included in this TIE since the original toxicity tests had to be aerated due to low dissolved oxygen in the overlying water at test initiation. The aeration treatment toxicity testing was performed as described in Section 2.2.

3. RESULTS

3.1 Effects of the CCCWP Ambient Sediment on *Hyalella azteca*

The results for these tests are summarized below in Table 2. There were significant reductions in *H. azteca* survival in all of the samples, and significant reductions in growth in the 207WAL078, 544MSH065, and 544MSH062 ambient sediment samples. There was no reduction in growth in the 207WAL060 ambient sediment sample.

The test data and summary of statistical analyses for these tests are presented in Appendix B.

Table 2. Effects of CCCWP ambient sediment on *Hyalella azteca*.

Sample Station	Toxicity Present Relative to Lab Control treatment?	
	% Survival	Weight (mg)
Control	100	0.086
207WAL078 (207R00011US)	**97.1*** (2.9% reduction)	**0.070*** (18.5% reduction)
207WAL060 (207R00011DS)	**90*** (10% reduction)	0.088
544MSH065 (544R00025US)	**3.75*** (96.3% reduction)	**0.006*** (92.7% reduction)
544MSH062 (544R00025DS)	**48.8*** (51.2% reduction)	**0.035*** (59% reduction)

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

3.2 Performance of the Follow-Up Targeted TIE

3.2.1 Results of Targeted Phase I TIE of the "544MSH065" Ambient Sediment Sample

The results for this Phase I TIE are summarized below in Table 3. The following trends (changes in sample toxicity relative to the untreated water sample [Baseline] test) were observed:

- There was still a statistically significant reduction in *H. azteca* survival and growth in the test of the untreated sediment, indicating that the toxicity that had been observed in the initial testing of this sample was persistent;
- The addition of PBO to the test solutions increased toxicity to *H. azteca* survival (survival decreased from 6.7% to complete mortality). These results suggest that compounds which are *detoxified* by the cytochrome-P450 system (e.g., pyrethroid insecticides) were contributing to sample toxicity; and
- The addition of carboxylesterase removed the significant reduction in survival (increased from 6.7% survival to 76.7% survival), suggesting that type I and type II pyrethroids are contributing to the toxicity (Weston and Amweg 2007). The use of carboxylesterase as a TIE treatment is still experimental and these results need to be used judiciously and in conjunction with other TIE treatments (e.g., PBO).

The test data and the summary of statistical analyses for these tests are presented in Appendix C.

Table 3. Effects of TIE treatments on the toxicity of the 544MSH065 ambient sediment sample to *Hyalella azteca*.

TIE Treatment	Toxicity Present Relative to Lab Control treatment?				
	Mean % Survival		Weight		Effects of TIE Treatment?
	Control/Blank	100%	Control/Blank	100%	
Baseline	96.7	**6.7***	0.13	**0.03***	toxicity persistent
Aeration	96.7	**13.3***	0.12	0.08	toxicity present
PBO	96.7	**0***	0.12	N/A	*increase* in toxicity
Carboxylesterase	100	76.7	0.15	**0.09***	reduction of toxicity

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

4. AQUATIC TOXICITY DATA QUALITY CONTROL

Four QC measures were assessed during the toxicity testing:

- Maintenance of acceptable test conditions;
- Negative Control testing;
- Positive Control (reference toxicant) testing; and
- Concentration Response Relationship assessment.

4.1 Maintenance of Acceptable Test Conditions

All test conditions (e.g., pH, D.O., temperature, etc.) were within acceptable limits for these tests. As the dissolved oxygen measurements were below 2.5 mg/L immediately prior to test initiation, all of the samples except for the 544MSH062 sample were aerated during testing. All analyses were performed according to laboratory Standard Operating Procedures.

4.2 Negative Control Testing

The responses at the Lab Control treatments were acceptable.

4.3 Positive Control Testing

4.3.1 Reference Toxicant Toxicity to *Hyalella azteca*

The results of this test are presented in Table 4. The EC_{50} for this test was consistent with the "typical response" range established by the reference toxicant test database for this species, indicating that these organisms were responding to toxic stress in a typical fashion. The test data and summary of statistical analyses for this test are presented in Appendix D.

Table 4. Reference toxicant testing: Effects of KCl on *Hyalella azteca* survival.

KCl Treatment (g/L)	Mean% Survival
Control	100
0.1	100
0.2	100
0.4	**40***
0.8	**0***
1.6	**0***
Summary of Statistics	
EC_{50} =	0.37 g/L KCl
"Typical response" range (mean ±2 SD)	0.27 – 0.60 g/L KCl

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

4.4 Concentration Response Relationships

The concentration-response relationships for the reference toxicant tests were evaluated as per EPA guidelines (EPA-821-B-00-004), and were determined to be acceptable.

5. SUMMARY & CONCLUSIONS

There were significant reductions in *H. azteca* survival in all of the samples, and significant reductions in growth in the 207WAL078, 544MSH065, and 544MSH062 ambient sediment samples. There was no reduction in growth in the 207WAL060 ambient sediment sample.

Based on the magnitude of the reduction in survival observed for the 544MSH065 sample, a targeted TIE was performed on the sample. The following trends (changes in sample toxicity relative to the untreated water sample [Baseline] test) were observed:

- There was still a statistically significant reduction in *H. azteca* survival and growth in the test of the untreated sediment, indicating that the toxicity that had been observed in the initial testing of this sample was persistent;
- The addition of PBO to the test solutions increased toxicity to *H. azteca* survival (survival decreased from 6.7% to complete mortality). These results suggest that compounds which are *detoxified* by the cytochrome-P450 system (e.g., pyrethroid insecticides) were contributing to sample toxicity; and
- The addition of carboxylesterase removed the significant reduction in survival (increased from 6.7% survival to 76.7% survival), suggesting that type I and type II pyrethroids are contributing to the toxicity (Weston and Amweg 2007). The use of carboxylesterase as a TIE treatment is still experimental and these results need to be used judiciously and in conjunction with other TIE treatment (e.g., PBO).

The weight of evidence from the TIE performed on the upstream ambient sediment sample suggests that the toxicity was likely due to pyrethroid insecticides.

6. LITERATURE CITED

Amweg EL, Weston DP. 2007. Whole sediment toxicity identification evaluation tools for pyrethroid insecticides: I. Piperonyl butoxide addition. *Environ. Toxicol. Chem.* 26:2389-2396.

Wheelock CE, Miller JL, Miller MJ, Gee SJ, Shan G, Hammock B. 2004. Development of toxicity identification evaluation procedures for pyrethroid detection using esterase activity. *Environ. Toxicol. Chem.* 23:2699–2708.

Weston DP, Amweg EL. 2007. Whole sediment toxicity identification evaluation tools for pyrethroid insecticides: II. Esterase addition. *Environ. Toxicol. Chem.* 26:2397-2404.

Appendix A

Chain-of-Custody Record for the Collection and Delivery of the CCCWP Ambient Sediment Samples

Pacific EcoRisk
2250 Cordelia Rd., Fairfield, CA 94534
(707) 207-7760 FAX (707) 207-7916

CHAIN-OF-CUSTODY RECORD

Results To:	~~Alessandro Hnatt~~	**Invoice To:**	ADH Environmental
Address:	ADH Environmental 3065 Porter St Ste.101 Soquel, CA 95073	**Address:**	" "
Phone:	831. 477. 2003	**Phone:**	" "
Attn:	Alessandro Hnatt	**Attn:**	" "
E-mail:	adh@adhenvironmental.com	**E-mail:**	" "
Project Name:	CCCWP - SSID		
P.O.#/Ref:	030.001.0202		

	Client Sample ID	Sample Date	Sample Time	Sample Matrix*	Grab/ Comp	Container Number	Container Type (~~3gal~~ 1galX3)	REQUESTED ANALYSIS: TOX - 1 species (10-Day Hyalella Azteca (Sediment))
1	544R00025US ①	07-22-14	1145	Sed	~~Grab~~	CP	~~1 gal~~ clear glass	X
2	544R00025DS ②	↓	10:15	↓	↓	CP	~~3gal~~ 1gal X3	X
3	207R00011US ③	↓	~~1145~~ ~~1015~~ (34)	↓	↓	CP	~~3gal~~ 1gal X3	X
4	207R00011DS ④	↓	~~1015~~ (34) 1145	↓	↓	CP	~~3gal~~ 1galX3	X
5								
6								
7								
8								
9								
10								

Samples Collected By:

Comments/Special Instruction:

preserved at 4°C

* Please amend sample ID's as follows:

① 544R00025US to 544MSH065
② 544R00025DS to 544MSH062
③ 207R00011US to 207WAL078
④ 207R00011DS to 207WAL060

RELINQUISHED BY:	RECEIVED BY:
Signature: [signature]	Signature: Molly Alar [signature]
Print: BRAD PREGER	Print: Molly Alar
Organization: ADH	Organization: PER
Date: 07-22-14 Time: 1715	Date: 7/22/14 Time: 1715

RELINQUISHED BY:	RECEIVED BY:
Signature:	Signature:
Print:	Print:
Organization:	Organization:
Date: Time:	Date: Time:

*Example Matrix Codes: (EFF - Effluent) (FW = Freshwater); (SW = Saltwater); (WW = Wastewater); (STRMW = Stormwater); (SED = Sediment); or other

Appendix B

Test Data and Summary of Statistics for the Evaluation of the Toxicity of the CCCWP Ambient Sediment Samples to *Hyalella azteca*

CETIS Summary Report

Report Date: 14 Aug-14 13:27 (p 1 of 2)
Test Code: 544MSH062 | 12-4174-5973

Hyalella Survival and Growth Test — **Pacific EcoRisk**

Batch ID:	09-9010-4697	**Test Type:**	Survival-Growth (10 day)	**Analyst:**	Tamara Luna
Start Date:	27 Jul-14 16:40	**Protocol:**	GCML	**Diluent:**	Not Applicable
Ending Date:	06 Aug-14 12:00	**Species:**	Hyalella azteca	**Brine:**	Not Applicable
Duration:	9d 19h	**Source:**	Chesapeake Cultures, Inc.	**Age:**	12

Sample Code	Sample ID	Sample Date	Receive Date	Sample Age	Client Name	Project
Lab Control	07-2024-9688	27 Jul-14 16:40	27 Jul-14 16:40	NA (23 °C)	ADH Environmental, Inc.	19397
207WAL078	10-3577-9053	22 Jul-14 14:45	22 Jul-14 17:15	5d 2h (0.6 °C)		
207WAL060	14-8088-4311	22 Jul-14 11:45	22 Jul-14 17:15	5d 5h (1 °C)		
544MSH065	12-0131-0279	22 Jul-14 14:45	22 Jul-14 17:15	5d 2h (0.6 °C)		
544MSH062	03-6621-9776	22 Jul-14 10:15	22 Jul-14 17:15	5d 6h (0 °C)		

Sample Code	Material Type	Sample Source	Station Location	Latitude	Longitude
Lab Control	Sediment	ADH Environmental, Inc.	LABQA		
207WAL078	Sediment	ADH Environmental, Inc.	207WAL078		
207WAL060	Sediment	ADH Environmental, Inc.	207WAL060		
544MSH065	Sediment	ADH Environmental, Inc.	544MSH065		
544MSH062	Sediment	ADH Environmental, Inc.	544MSH062		

Mean Dry Weight-mg Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
Lab Control	8	0.0857	0.0705	0.101	0.066	0.113	0.00644	0.0182	21.2%	0.0%
207WAL078	7	0.0699	0.0619	0.0779	0.054	0.0789	0.00326	0.00862	12.3%	18.5%
207WAL060	8	0.0875	0.071	0.104	0.0667	0.12	0.00701	0.0198	22.6%	-2.09%
544MSH065	8	0.00625	-0.00853	0.021	0	0.05	0.00625	0.0177	283.0%	92.7%
544MSH062	8	0.0352	0.0165	0.0538	0	0.055	0.00787	0.0223	63.3%	59.0%

Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
Lab Control	8	1	1	1	1	1	0	0	0.0%	0.0%
207WAL078	7	0.971	0.926	1	0.9	1	0.0184	0.0488	5.02%	2.86%
207WAL060	8	0.9	0.855	0.945	0.8	1	0.0189	0.0535	5.94%	10.0%
544MSH065	8	0.0375	0	0.126	0	0.3	0.0375	0.106	283.0%	96.2%
544MSH062	8	0.488	0.218	0.757	0	0.9	0.114	0.323	66.2%	51.2%

Mean Dry Weight-mg Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
Lab Control	0.066	0.078	0.069	0.091	0.075	0.113	0.112	0.082
207WAL078	0.078	0.07	0.054	0.0644	0.074	0.0789	0.07	
207WAL060	0.0967	0.12	0.089	0.075	0.0667	0.071	0.11	0.072
544MSH065	0	0	0	0.05	0	0	0	0
544MSH062	0.04	0.04	0	0.048	0.055	0	0.0483	0.05

Survival Rate Detail

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
Lab Control	1	1	1	1	1	1	1	1
207WAL078	1	1	0.9	1	1	1	0.9	
207WAL060	0.9	1	0.9	0.9	0.8	0.9	0.9	0.9
544MSH065	0	0	0	0.3	0	0	0	0
544MSH062	0.7	0.6	0	0.5	0.6	0	0.6	0.9

Hyalella Survival and Growth Test — **Pacific EcoRisk**

Survival Rate Binomials

Sample Code	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8
Lab Control	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10
207WAL078	10/10	10/10	9/10	10/10	10/10	10/10	9/10	
207WAL060	9/10	10/10	9/10	9/10	8/10	9/10	9/10	9/10
544MSH065	0/10	0/10	0/10	3/10	0/10	0/10	0/10	0/10
544MSH062	7/10	6/10	0/10	5/10	6/10	0/10	6/10	9/10

10-Day *Hyalella azteca* Sediment Toxicity Test Data

Client: ADH Environmental
Project#: 19397
Test ID#: 58103

Org. Supplier: ABS
Org. Log #: 8379
Org. Age/Size: 12-13 days

Day	Date	Test Material: Control				Water Quality Measurements: Parameter	Value	Meter ID	Sign-off
0	7/27/14	# Live Organisms				pH	7.69	pH21	AM Change: DMS
		A 10	B 10	C 10	D 10	D.O. (mg/L)	7.8	RD04	WQ: DMS
		E 10	F 10	G 10	H 10	Conductivity (µS/cm)	458	EC04	Initiation Time: 1640
						Alkalinity (mg/L)	✓ 46		Initiation Counts: [initials]
						Hardness (mg/L)	✓ 126		Confirmation Counts: [initials]
						Ammonia (mg/L)	<1.00	DR3800	PM Feed: [initials]
						Temp. (°C)	23.0	84A	
1	7/28/14	# of Mortalities				Old D.O. (mg/L)	7.4	RD09	AM Change: VK WQ: VK
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.4	RD09	Mortality Counts: VK
		E KMP 0	F 0	G 0	H 0	Temp. (°C)	23.4	84A	PM Change: KMP PM Feed: KMP
2	7/29/14	# of Mortalities				Old D.O. (mg/L)	7.0	RD05	AM Change: VK WQ: VK
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	8.4	RD05	Mortality Counts: VK
		E 0	F 0	G 0	H 0	Temp. (°C)	~~23.2~~ VK	84A	PM Change: VK PM Feed: VK
3	7/30/14	# of Mortalities				Old D.O. (mg/L)	7.8	RD07	AM Change: VK WQ: VK
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	8.1	RD07	Mortality Counts: VK
		E 0	F 0	G 0	H 0	Temp. (°C)	23.3	84A	PM Change: VK PM Feed: VK
4	7-31-14	# of Mortalities				Old D.O. (mg/L)	6.2	RD04	AM Change: APF WQ: APF
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.3	RD04	Mortality Counts: APF
		E 0	F 0	G 0	H 0	Temp. (°C)	22.6	84A	PM Change: APF PM Feed: APF
5	8/1/14	# of Mortalities				Old D.O. (mg/L)	7.4	RD04	AM Change: KMP WQ: KMP
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.6	RD04	Mortality Counts: KMP
		E 0	F 0	G 0	H 0	Temp. (°C)	23.3	84A	PM Change: VK PM Feed: VK
6	8/2/14	# of Mortalities				Old D.O. (mg/L)	7.4	RD07	AM Change: KMP WQ: KMP
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.5	RD07	Mortality Counts: KMP
		E 0	F 0	G 0	H 0	Temp. (°C)	22.7	84A	PM Change: KMP PM Feed: KMP
7	8/3/14	# of Mortalities				Old D.O. (mg/L)	7.8	RD11	AM Change: DMS WQ: DMS
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	8.1	RD11	Mortality Counts: [initials]
		E 0	F 0	G 0	H 0	Temp. (°C)	23.2	84A	PM Change: DMS PM Feed: SM
8	8/4/14	# of Mortalities				Old D.O. (mg/L)	7.3	RD11	AM Change: TEH WQ: TEH
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.4	RD11	Mortality Counts: TEH
		E 0	F 0	G 0	H 0	Temp. (°C)	22.8	84A	PM Change: CS PM Feed: CS
9	8/5/14	# of Mortalities				Old D.O. (mg/L)	7.0	RD04	AM Change: DMS WQ: DMS
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.8	RD04	Mortality Counts: DMS
		E 0	F 0	G 0	H 0	Temp. (°C)	23.0	84A	PM Change: DMS PM Feed: DMS
10	\	# Alive				pH	7.57	PH16	WQ: FOWB
		A 10	B 10	C 10	D 10	D.O. (mg/L)	7.4	RD04	Termination Counts: [initials]
		E 10	F 10	G 10	H 10	Conductivity (µS/cm)	436	EC06	Termination Time: 1200
						Alkalinity (mg/L)	✓ 53		
						Hardness (mg/L)	✓ 122		
						Ammonia (mg/L)	<1.00	DR3800	
						Temp. (°C)	22.8	84A	

Hyalella azteca Weight Data Sheets

Client: **ADH Environmental** Test Init Date: 7.27.14 Balance ID: BAL01

Sample ID: **Control** Tare Wt Date: 8.2.14 Sign-Off: VK

Test ID: 58103 Final Wt Date: 8.7.14 Sign-Off: BKK

Project #: 19397

Pan	Concentration Replicate	Initial Weight. (mg)	Final Weight. (mg)	# organisms	Ave Weight (mg)
1	A	61.77	62.43	10	0.066
2	B	68.97	69.75	10	0.078
3	C	67.88	68.57	10	0.069
4	D	66.18	67.09	10	0.091
5	E	72.72	73.47	10	0.075
6	F	68.77	69.90	10	0.113
7	G	66.47	67.59	10	0.112
8	H	65.78	66.60	10	0.082
QA 1		59.73	59.73		

Hyalella Survival and Growth Test — **Pacific EcoRisk**

Analysis ID:	03-4183-9143	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	14 Aug-14 13:26	**Analysis:**	Nonparametric-Two Sample	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	4.28%	

Wilcoxon Rank Sum Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
Lab Control		207WAL078	48	NA	1	13	<0.0001	Exact	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.008094273	0.008094273	1	2.77	0.1197	Non-Significant Effect
Error	0.0379419	0.002918608	13			
Total	0.04603618		14			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Variance Ratio F	2.49E+13	9.16	<0.0001	Unequal Variances
Distribution	Shapiro-Wilk W Normality	0.713	0.833	0.0003	Non-normal Distribution

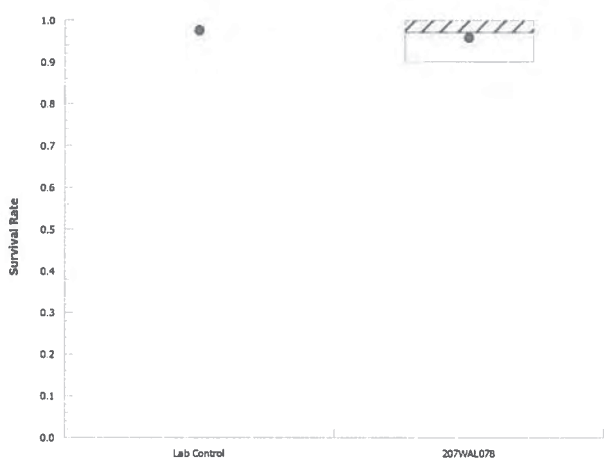
Survival Rate Summary

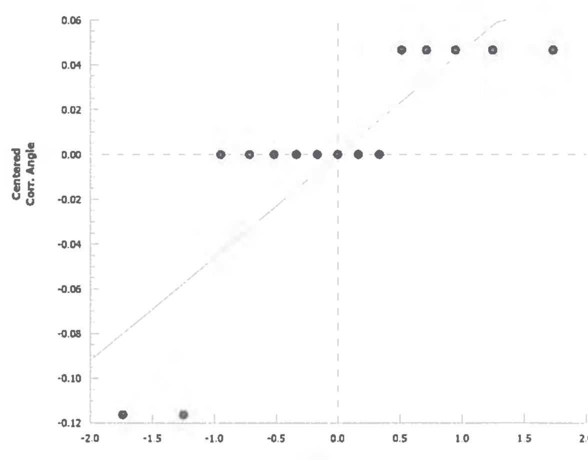
Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Lab Control	8	1	1	1	1	1	1	0	0.0%	0.0%
207WAL078	7	0.971	0.926	1	1	0.9	1	0.0184	5.02%	2.86%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Lab Control	8	1.41	1.41	1.41	1.41	1.41	1.41	0	0.0%	0.0%
207WAL078	7	1.37	1.29	1.44	1.41	1.25	1.41	0.0301	5.82%	3.3%

Graphics





10-Day *Hyalella azteca* Sediment Toxicity Test Data

Client:	ADH Environmental	Org. Supplier:	ABS
Project#:	19397	Org. Log #:	8379
Test ID#:	58110	Org. Age/Size:	12-13 days

Test Material: 207WAL078 ~~207R00011US~~ MF

Day	Date	Test Material	Parameter	Value	Meter ID	Sign-off
0	7/27/14	# Live Organisms	pH	7.57	pH21	AM Change: DMS
		A 10 B 10 C 10 D 10	D.O. (mg/L)	6.3	RD04	WQ: DMS
		E 10 F 10 G 10 H 10	Conductivity (µS/cm)	505	EC04	Initiation Time: 1640
			Alkalinity (mg/L)	✓ 93		Initiation Counts: [initials]
			Hardness (mg/L)	✓ 142		Confirmation Counts: [initials]
			Ammonia (mg/L)	<1.00	DR3800	PM Feed: [initials]
			Temp. (°C)	23.0	84A	
1	7/28/14	# of Mortalities	Old D.O. (mg/L)	~~8.1~~ 8.0	RD09	AM Change: KR WQ: KR
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	7.7	RD07	Mortality Counts: KR
		E ~~6~~ KMP 0 F 0 G 0 ~~6~~ KMP H 0	Temp. (°C)	23.4	84A	PM Change: KMP PM Feed: KMP
2	7/29/14	# of Mortalities	Old D.O. (mg/L)	7.4	RD09	AM Change: VK WQ: VK
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	7.7	RD09	Mortality Counts: VK
		E 0 F 0 G 0 H 0	Temp. (°C)	22.9	84A	PM Change: VK PM Feed: VK
3	7/30/14	# of Mortalities	Old D.O. (mg/L)	7.7	RD07	AM Change: KR WQ: KR
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	8.0	RD07	Mortality Counts: KR
		E 0 F 0 G 0 H 0	Temp. (°C)	23.3	84A	PM Change: VK PM Feed: VK
4	7-31-14	# of Mortalities	Old D.O. (mg/L)	8.4	~~8.2~~ RD04	AM Change: ARF WQ: ARF
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	8.2	RD04	Mortality Counts: ARF
		E 0 F 0 G 0 H 0	Temp. (°C)	22.8	84A	PM Change: ARF PM Feed: ARF
5	8/1/14	# of Mortalities	Old D.O. (mg/L)	7.7	RD04	AM Change: KMP WQ: KMP
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	7.9	RD04	Mortality Counts: KMP
		E 0 F 0 G 0 H 0	Temp. (°C)	23.3	84A	PM Change: VK PM Feed: VK
6	8/2/14	# of Mortalities	Old D.O. (mg/L)	~~7.8~~ 8.0 KMP	RD07	AM Change: KMP WQ: KMP
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	8.3	RD07	Mortality Counts: KMP
		E 0 F 0 G 0 H 0	Temp. (°C)	22.7	84A	PM Change: KMP PM Feed: KMP
7	8/3/14	# of Mortalities	Old D.O. (mg/L)	7.4	RD11	AM Change: DMS WQ: DMS
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	7.8	RD11	Mortality Counts: [initials]
		E 0 F 0 G 0 H 0	Temp. (°C)	23.3	84A	PM Change: DMS PM Feed: SM
8	8/4/14	# of Mortalities	Old D.O. (mg/L)	7.7	RD11	AM Change: [initials] WQ: [initials]
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	7.8	RD11	Mortality Counts: [initials]
		E 0 F 0 G 0 H 0	Temp. (°C)	22.8	84A	PM Change: CS PM Feed: CS
9	8/5/14	# of Mortalities	Old D.O. (mg/L)	7.4	RD04	AM Change: DMS WQ: DMS
		A 0 B 0 C 0 D 0	New D.O. (mg/L)	7.7	RD04	Mortality Counts: DMS
		E 0 F 0 G 0 H 0	Temp. (°C)	23.0	84A	PM Change: DMS PM Feed: DMS
10	8/6/14	# Alive	pH	7.81	PH16	WQ: [initials]
		A 10 B 10 C 9 D 10	D.O. (mg/L)	7.9	RD04	Termination Counts: [initials]
		E 10 F 10 G — H 9	Conductivity (µS/cm)	550	EC06	Termination Time: 1200
			Alkalinity (mg/L)	✓ 123		
			Hardness (mg/L)	✓ 162		
			Ammonia (mg/L)	1.92	DR3800	
			Temp. (°C)	22.8	84A	

Hyalella Survival and Growth Test — Pacific EcoRisk

Analysis ID:	13-5730-6806	Endpoint:	Mean Dry Weight-mg	CETIS Version:	CETISv1.8.7
Analyzed:	14 Aug-14 13:26	Analysis:	Parametric-Two Sample	Official Results:	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Untransformed	NA	C > T	NA	NA	15.6%	

Equal Variance t Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
Lab Control		207WAL078	2.1	1.77	0.013	13	0.0279	CDF	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.0009373499	0.0009373499	1	4.41	0.0559	Non-Significant Effect
Error	0.002765303	0.0002127156	13			
Total	0.003702653		14			

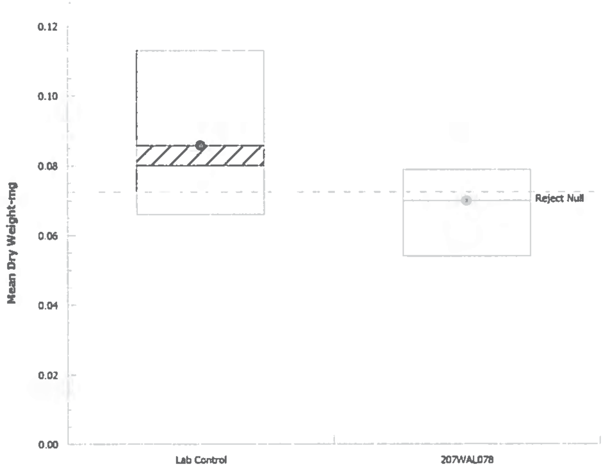
Distributional Tests

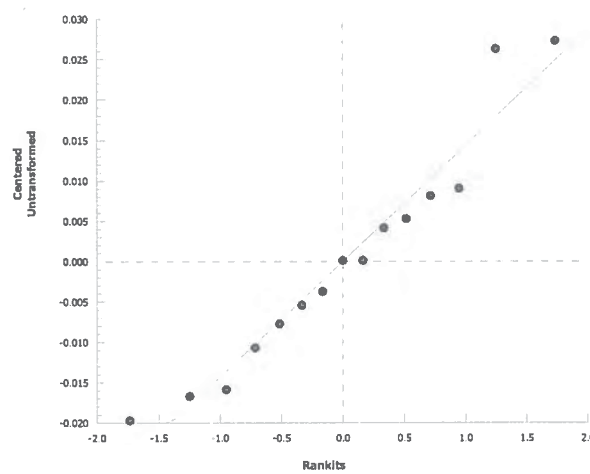
Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Variance Ratio F	4.46	10.8	0.0879	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.938	0.833	0.3628	Normal Distribution

Mean Dry Weight-mg Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Lab Control	8	0.0857	0.0705	0.101	0.08	0.066	0.113	0.00644	21.2%	0.0%
207WAL078	7	0.0699	0.0619	0.0779	0.07	0.054	0.0789	0.00326	12.3%	18.5%

Graphics





Hyalella azteca Weight Data Sheets

Client: **ADH Environmental** Test Init Date: 7.27.14 Balance ID: BAL 01

Sample ID: **207WAL078** Tare Wt Date: 8.2.14 Sign-Off: VK

Test ID: 58110 Final Wt Date: 8.7.14 Sign-Off: [illegible]

Project #: 19397

Pan	Concentration Replicate	Initial Weight. (mg)	Final Weight. (mg)	# organisms	Ave Weight (mg)
17	A	59.83	60.61	10	0.078
18	B	71.48	72.18	10	0.070
19	C	62.62	63.16	9	0.054
20	D	64.66	65.24	10	0.064
21	E	68.57	69.31	10	0.074
22	F	66.31	67.02	10	0.079
23	G	70.98	– ~~71.08~~	—	—
24	H	58.32	59.02	9	0.07
QA 1		59.73	59.74		

Hyalella Survival and Growth Test — **Pacific EcoRisk**

Analysis ID:	12-4833-5624	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	14 Aug-14 13:26	**Analysis:**	Nonparametric-Two Sample	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	4.33%	

Wilcoxon Rank Sum Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
Lab Control		207WAL060	40	NA	1	14	0.0007	Exact	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.1028308	0.1028308	1	30.9	<0.0001	Significant Effect
Error	0.0466386	0.003331328	14			
Total	0.1494694		15			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Variance Ratio F	2.63E+13	8.89	<0.0001	Unequal Variances
Distribution	Shapiro-Wilk W Normality	0.528	0.841	<0.0001	Non-normal Distribution

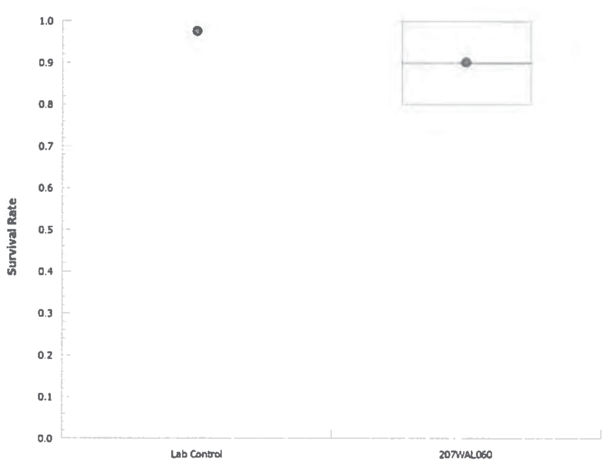
Survival Rate Summary

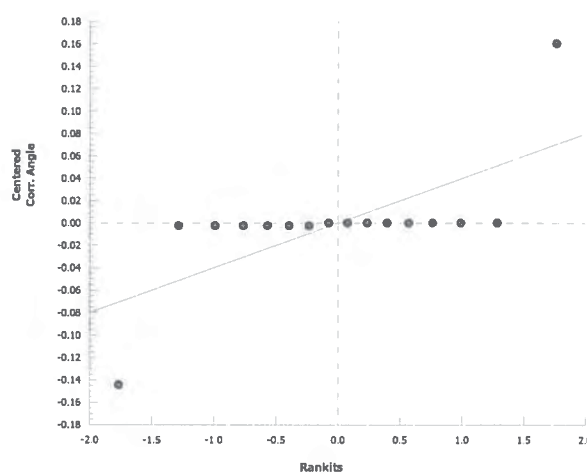
Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Lab Control	8	1	1	1	1	1	1	0	0.0%	0.0%
207WAL060	8	0.9	0.855	0.945	0.9	0.8	1	0.0189	5.94%	10.0%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Lab Control	8	1.41	1.41	1.41	1.41	1.41	1.41	0	0.0%	0.0%
207WAL060	8	1.25	1.18	1.32	1.25	1.11	1.41	0.0289	6.52%	11.4%

Graphics





10-Day *Hyalella azteca* Sediment Toxicity Test Data

Client: ADH Environmental
Project#: 19397
Test ID#: 58112

Org. Supplier: ABS
Org. Log #: 8379
Org. Age/Size: 12-13 days

Day	Date	Test Material: 207WAL060 ~~207R00011DS~~				Water Quality Measurements: Parameter	Value	Meter ID	Sign-off
		# Live Organisms							
0	7/27/14	A 10	B 10	C 10	D 10	pH	7.57	pH21	AM Change: DMS
						D.O. (mg/L)	6.7	RD04	WQ: DMS
		E 10	F 10	G 10	H 10	Conductivity (µS/cm)	479	EC04	Initiation Time: 1640
						Alkalinity (mg/L)	✓ 86		Initiation Counts: [illegible]
						Hardness (mg/L)	✓ 155		Confirmation Counts: [illegible]
						Ammonia (mg/L)	<1.00	DR3800	PM Feed: [illegible]
						Temp. (°C)	23.0	84A	
		# of Mortalities							
1	7/28/14	A 0	B 0	C 0	D 0	Old D.O. (mg/L)	8.1	RD09	AM Change: KR WQ: KR
						New D.O. (mg/L)	7.7	RD09	Mortality Counts: KR
		E 0	F 0	G 0	H 0	Temp. (°C)	23.4	84A	PM Change: KMP PM Feed: KMP
		# of Mortalities							
2	7/29/14	A 0	B 0	C 0	D 0	Old D.O. (mg/L)	8.0	RD05	AM Change: VK WQ: VK
						New D.O. (mg/L)	7.9	RD05	Mortality Counts: VK
		E 0	F 0	G 0	H 0	Temp. (°C)	22.9	84A	PM Change: VK PM Feed: VK
		# of Mortalities							
3	7/30/14	A 0	B 0	C 0	D 0	Old D.O. (mg/L)	7.7	RD07	AM Change: KR WQ: KR
						New D.O. (mg/L)	7.9	RD07	Mortality Counts: KR
		E 0	F 0	G 0	H 0	Temp. (°C)	23.3	84A	PM Change: VK PM Feed: VK
		# of Mortalities							
4	7-31-14	A 0	B 0	C 0	D 0	Old D.O. (mg/L)	4.4	RD09	AM Change: ARF WQ: ARF
						New D.O. (mg/L)	7.9	RD09	Mortality Counts: ARF
		E 0	F 0	G 0	H 0	Temp. (°C)	22.8	84A	PM Change: ARF PM Feed: ARF
		# of Mortalities							
5	8/1/14	A 0	B 0	C 0	D 0	Old D.O. (mg/L)	4.9	RD04	AM Change: KMP WQ: KMP
						New D.O. (mg/L)	6.2	RD04	Mortality Counts: KMP
		E 0	F 0	G 0	H 0	Temp. (°C)	23.3	84A	PM Change: VK PM Feed: VK
		# of Mortalities							
6	8/2/14	A 0	B 0	C 0	D 0	Old D.O. (mg/L)	5.4	RD07	AM Change: KMP WQ: KMP
						New D.O. (mg/L)	6.5 ~~8.0~~ KMP	RD07	Mortality Counts: KMP
		E 0	F 0	G 0	H 0	Temp. (°C)	22.7	84A	PM Change: KMP PM Feed: KMP
		# of Mortalities							
7	8/3/14	A 0	B 0	C 0	D 0	Old D.O. (mg/L)	6.4	RD11	AM Change: DMS WQ: DMS
						New D.O. (mg/L)	6.6	RD11	Mortality Counts: FOWB
		E 0	F 0	G 0	H 0	Temp. (°C)	23.3	84A	PM Change: DMS PM Feed: SM
		# of Mortalities							
8	8/4/14	A 0	B 0	C 0	D 0	Old D.O. (mg/L)	8.0	RD11	AM Change: TEH WQ: TEH
						New D.O. (mg/L)	7.5	RD11	Mortality Counts: TEH
		E 0	F 0	G 0	H 0	Temp. (°C)	22.8	84A	PM Change: CS PM Feed: CS
		# of Mortalities							
9	8/5/14	A 0	B 0	C 0	D 0	Old D.O. (mg/L)	8.0	RD04	AM Change: DMS WQ: DMS
						New D.O. (mg/L)	8.1	RD04	Mortality Counts: DMS
		E 0	F 0	G 0	H 0	Temp. (°C)	23.0	84A	PM Change: DMS PM Feed: DMS
		# Alive							
10	8/6/14	A 9	B 10	C 9	D 9	pH	7.88	PH16	WQ: FOWB
						D.O. (mg/L)	8.1	RD04	Termination Counts: [illegible]
		E 8	F 9	G 9	H 9	Conductivity (µS/cm)	534	EC06	Termination Time: 1200
						Alkalinity (mg/L)	✓ 112		
						Hardness (mg/L)	✓ 183		
						Ammonia (mg/L)	1.17	DR3800	
						Temp. (°C)	22.8	84A	

Hyalella Survival and Growth Test				Pacific EcoRisk
Analysis ID: 17-0742-7162	**Endpoint:** Mean Dry Weight-mg		**CETIS Version:** CETISv1.8.7	
Analyzed: 14 Aug-14 13:26	**Analysis:** Parametric-Two Sample		**Official Results:** Yes	

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Untransformed	NA	C > T	NA	NA	19.5%	

Equal Variance t Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
Lab Control		207WAL060	-0.188	1.76	0.017	14	0.5733	CDF	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	1.283993E-05	1.283993E-05	1	0.0354	0.8534	Non-Significant Effect
Error	0.005071048	0.0003622177	14			
Total	0.005083888		15			

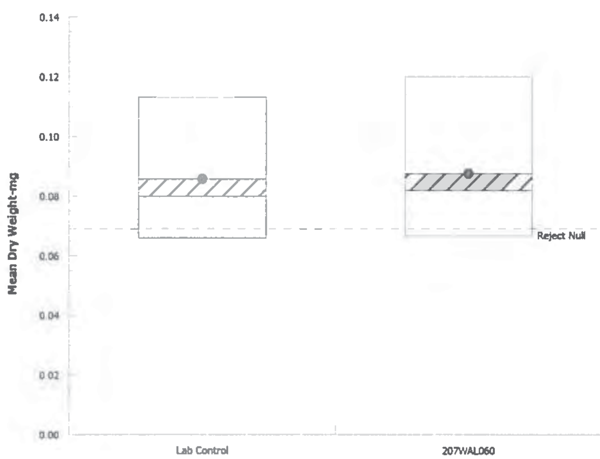
Distributional Tests

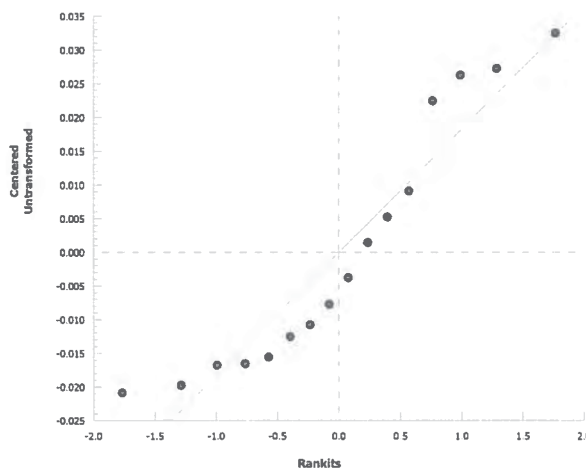
Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Variance Ratio F	1.19	8.89	0.8275	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.885	0.841	0.0464	Normal Distribution

Mean Dry Weight-mg Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Lab Control	8	0.0857	0.0705	0.101	0.08	0.066	0.113	0.00644	21.2%	0.0%
207WAL060	8	0.0875	0.071	0.104	0.082	0.0667	0.12	0.00701	22.6%	-2.09%

Graphics





Hyalella azteca Weight Data Sheets

Client: **ADH Environmental** Test Init Date: 7.27.14 Balance ID: BAL 01

Sample ID: **207WAL060** Tare Wt Date: 8.2.14 Sign-Off: VK

Test ID: 58112 Final Wt Date: 8.7.14 Sign-Off: [illegible]

Project #: 19397

Pan	Concentration Replicate	Initial Weight. (mg)	Final Weight. (mg)	# organisms	Ave Weight (mg)
25	A	78.08	78.95	9	0.0967
26	B	63.53	64.73	10	0.120
27	C	71.21	72.10	9	0.089
28	D	65.25	66.00	9	0.075
29	E	80.44	81.04	8	0.0667
30	F	64.91	65.62	9	0.071
31	G	67.69	68.68	9	0.110
32	H	90.64	91.36	9	0.072
QA 2		71.05	71.05		

Hyalella Survival and Growth Test				Pacific EcoRisk
Analysis ID: 16-9643-3210	Endpoint: Survival Rate		CETIS Version: CETISv1.8.7	
Analyzed: 14 Aug-14 13:26	Analysis: Nonparametric-Two Sample		Official Results: Yes	

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	6.19%	

Wilcoxon Rank Sum Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
Lab Control		544MSH065	36	NA	0	14	<0.0001	Exact	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	5.766035	5.766035	1	521	<0.0001	Significant Effect
Error	0.1549824	0.01107017	14			
Total	5.921017		15			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Variance Ratio F	8.72E+13	8.89	<0.0001	Unequal Variances
Distribution	Shapiro-Wilk W Normality	0.469	0.841	<0.0001	Non-normal Distribution

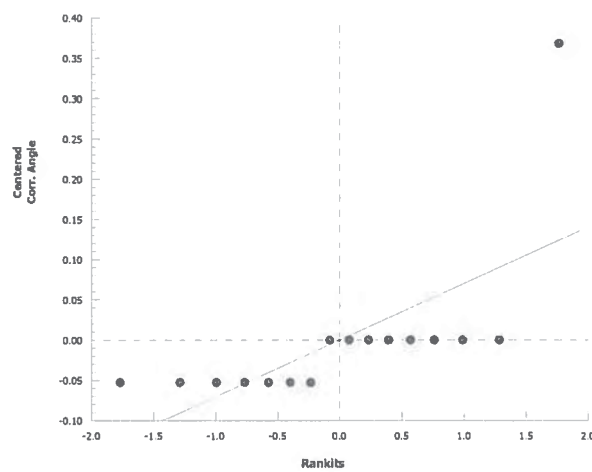
Survival Rate Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Lab Control	8	1	1	1	1	1	1	0	0.0%	0.0%
544MSH065	8	0.0375	0	0.126	0	0	0.3	0.0375	283.0%	96.2%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Lab Control	8	1.41	1.41	1.41	1.41	1.41	1.41	0	0.0%	0.0%
544MSH065	8	0.211	0.087	0.336	0.159	0.159	0.58	0.0526	70.4%	85.0%

Graphics



10-Day *Hyalella azteca* Sediment Toxicity Test Data

Client: ADH Environmental
Project#: 19397
Test ID#: 58114

Org. Supplier: ABS
Org. Log #: 8379
Org. Age/Size: 12-13 days

Day	Date	Test Material: 544MSH065 ~~544R00025US~~ MF				Parameter	Value	Meter ID	Sign-off:
0	7/27/14	# Live Organisms				pH	7.52	pH21	AM Change: DMS
		A 10	B 10	C 10	D 10	D.O. (mg/L)	7.1	RD04	WQ: DMS
		E 10	F 10	G 10	H 10	Conductivity (µS/cm)	495	EC04	Initiation Time: 1640
						Alkalinity (mg/L)	✓ 79		Initiation Counts: [illegible]
						Hardness (mg/L)	✓ 142		Confirmation Counts: [illegible]
						Ammonia (mg/L)	<1.00	DR3800	PM Feed: [illegible]
						Temp. (°C)	23.0	84A	
1	7/28/14	# of Mortalities				Old D.O. (mg/L)	8.1	RD09	AM Change: KR WQ: KR
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	8.2	RD09	Mortality Counts: KR
		E KMP 0	F KMP 0	G KMP 0	H KMP 0	Temp. (°C)	23.4	84A	PM Change: KMP PM Feed: KMP
2	7/29/14	# of Mortalities				Old D.O. (mg/L)	8.2	RD09	AM Change: VK WQ: VK
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	8.1	RD09	Mortality Counts: VK
		E 0	F 0	G 0	H 0	Temp. (°C)	22.9	RD09	PM Change: VK PM Feed: VK
3	7/30/14	# of Mortalities				Old D.O. (mg/L)	7.9	RD07	AM Change: KR WQ: KR
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.8	RD07	Mortality Counts: KR
		E 0	F 0	G 0	H 0	Temp. (°C)	84A	84A	PM Change: VK PM Feed: VK
4	7-31-14	# of Mortalities				Old D.O. (mg/L)	6.7	RD04	AM Change: APF WQ: APF
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	8.1	RD04	Mortality Counts: APF
		E 0	F 0	G 0	H 0	Temp. (°C)	22.8	84A	PM Change: APF PM Feed: APF
5	8/1/14	# of Mortalities				Old D.O. (mg/L)	8.0	RD04	AM Change: KMP WQ: KMP
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	8.1	RD04	Mortality Counts: KMP
		E 0	F 0	G 0	H 0	Temp. (°C)	23.3	84A	PM Change: VK PM Feed: VK
6	8/2/14	# of Mortalities				Old D.O. (mg/L)	7.8	RD07	AM Change: KMP WQ: KMP
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.8	RD07	Mortality Counts: KMP
		E 0	F 0	G 0	H 0	Temp. (°C)	22.7	84A	PM Change: KMP PM Feed: KMP
7	8/3/14	# of Mortalities				Old D.O. (mg/L)	8.1	RD11	AM Change: DMS WQ: DMS
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	8.3	RD11	Mortality Counts: FOVB
		E 0	F 0	G 0	H 0	Temp. (°C)	23.3	84A	PM Change: DMS PM Feed: SM
8	8/4/14	# of Mortalities				Old D.O. (mg/L)	7.7	RD11	AM Change: TEH WQ: TEH
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.4	RD11	Mortality Counts: TEH
		E 0	F 0	G 0	H 0	Temp. (°C)	22.8	84A	PM Change: CS PM Feed: CS
9	8/5/14	# of Mortalities				Old D.O. (mg/L)	8.1	RD04	AM Change: DMS WQ: DMS
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	8.3	RD04	Mortality Counts: DMS
		E 0	F 0	G 0	H 0	Temp. (°C)	23.0	84A	PM Change: DMS PM Feed: DMS
10	8/6/14	# Alive				pH	7.87	PH16	WQ: FOVB
		A 0	B 0	C 0	D 3	D.O. (mg/L)	8.1	RD04	Termination Counts: [illegible]
		E 0	F 0	G 0	H 0	Conductivity (µS/cm)	521	EC06	Termination Time: 1200
						Alkalinity (mg/L)	✓ 93		
						Hardness (mg/L)	✓ 162		
						Ammonia (mg/L)	1.84	DR3800	
						Temp. (°C)	22.8	84A	

Hyalella Survival and Growth Test — **Pacific EcoRisk**

Analysis ID:	19-1115-8945	**Endpoint:**	Mean Dry Weight-mg	**CETIS Version:**	CETISv1.8.7
Analyzed:	14 Aug-14 13:26	**Analysis:**	Nonparametric-Two Sample	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Untransformed	NA	C > T	NA	NA	18.4%	

Wilcoxon Rank Sum Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
Lab Control		544MSH065	36	NA	0	14	<0.0001	Exact	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.02528073	0.02528073	1	78.5	<0.0001	Significant Effect
Error	0.004507259	0.000321947	14			
Total	0.02978799		15			

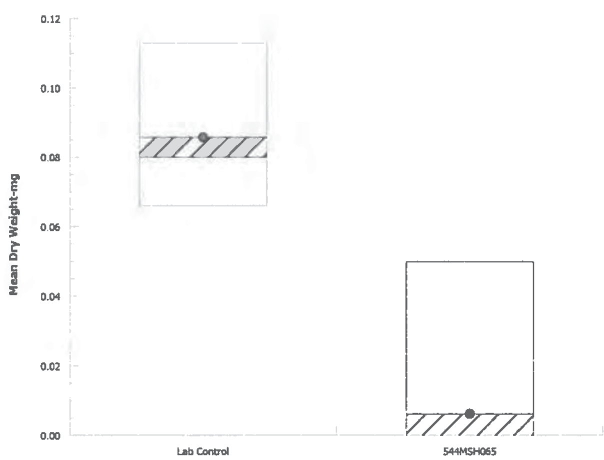
Distributional Tests

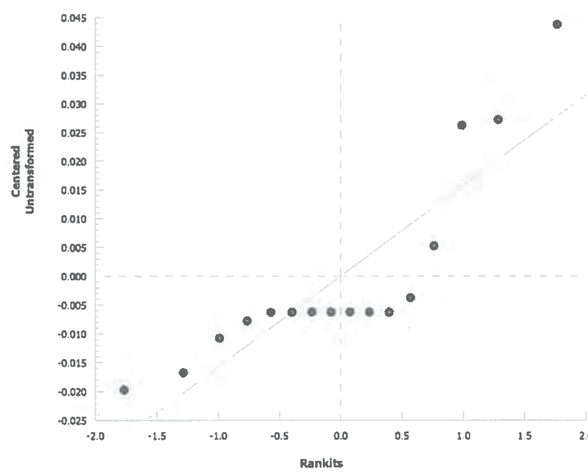
Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Variance Ratio F	1.06	8.89	0.9405	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.767	0.841	0.0010	Non-normal Distribution

Mean Dry Weight-mg Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Lab Control	8	0.0857	0.0705	0.101	0.08	0.066	0.113	0.00644	21.2%	0.0%
544MSH065	8	0.00625	-0.00853	0.021	0	0	0.05	0.00625	283.0%	92.7%

Graphics





Hyalella azteca Weight Data Sheets

Client: **ADH Environmental** Test Init Date: 7.27.14 Balance ID: BAL01

Sample ID: **544MSH065** Tare Wt Date: 8.2.14 Sign-Off: VK

Test ID: 58114 Final Wt Date: 8.7.14 Sign-Off: BKM

Project #: 19397

Pan	Concentration Replicate	Initial Weight. (mg)	Final Weight. (mg)	# organisms	Ave Weight (mg)
33	A	64.92	—	0	—
34	B	67.81	—	0	—
35	C	66.49	—	0	—
36	D	132.81	132.96	3	0.050
37	E	72.82	—	0	—
38	F	67.50	—	0	—
39	G	70.67	—	0	—
40	H	60.03	—	0	—
QA 2		71.05	71.05		

Hyalella Survival and Growth Test — **Pacific EcoRisk**

Analysis ID:	12-1339-0826	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	14 Aug-14 13:26	**Analysis:**	Nonparametric-Two Sample	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	15.3%	

Wilcoxon Rank Sum Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	Ties	DF	P-Value	P-Type	Decision(α:5%)
Lab Control		544MSH062	36	NA	0	14	<0.0001	Exact	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	1.75214	1.75214	1	23.1	0.0003	Significant Effect
Error	1.063089	0.0759349	14			
Total	2.815228		15			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Variance Ratio F	5.98E+14	8.89	<0.0001	Unequal Variances
Distribution	Shapiro-Wilk W Normality	0.778	0.841	0.0014	Non-normal Distribution

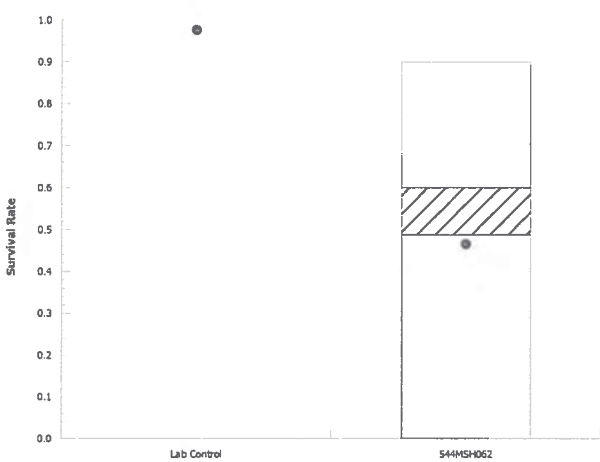
Survival Rate Summary

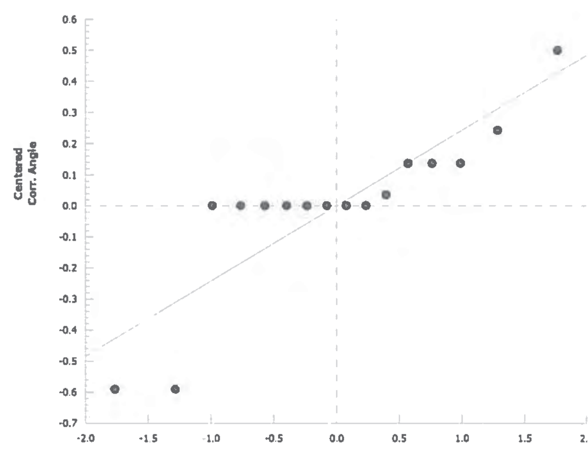
Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Lab Control	8	1	1	1	1	1	1	0	0.0%	0.0%
544MSH062	8	0.488	0.218	0.757	0.6	0	0.9	0.114	66.2%	51.2%

Angular (Corrected) Transformed Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Lab Control	8	1.41	1.41	1.41	1.41	1.41	1.41	0	0.0%	0.0%
544MSH062	8	0.75	0.424	1.08	0.886	0.159	1.25	0.138	51.9%	46.9%

Graphics





10-Day *Hyalella azteca* Sediment Toxicity Test Data

Client: **ADH Environmental**
Project#: **19397**
Test ID#: **58116**

Org. Supplier: **ABS**
Org. Log #: 8379
Org. Age/Size: 12-13 days

Day	Date	Test Material: 544MSH062 ~~544R00025DS~~				Water Quality Measurements: Parameter	Value	Meter ID	Sign-off
0	7/27/14	# Live Organisms				pH	7.65	pH21	AM Change: DMS
		A 10	B 10	C 10	D 10	D.O. (mg/L)	7.6	RD04	WQ: DMS
		E 10	F 10	G 10	H 10	Conductivity (µS/cm)	547	EC04	Initiation Time: 1640
						Alkalinity (mg/L)	✓ 78		Initiation Counts: [initials]
						Hardness (mg/L)	✓ 151		Confirmation Counts: [initials]
						Ammonia (mg/L)	<1.00	DR3800	PM Feed: [initials]
						Temp. (°C)	23.0	84A	
1	7/28/14	# of Mortalities				Old D.O. (mg/L)	7.4	RD09	AM Change: KR WQ: KR
		A 0 ~~8~~ KMP	B 0	C 0	D 0	New D.O. (mg/L)	7.1	RD09	Mortality Counts: KR
		E 0 ~~8~~ KMP	F 0 ~~8~~ KMP	G 0	H 0	Temp. (°C)	23.4	84A	PM Change: KMP PM Feed: KMP
2	7/29/14	# of Mortalities				Old D.O. (mg/L)	7.8	RD05	AM Change: UK WQ: UK
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.9	RD05	Mortality Counts: VK
		E 6	F 0	G 0	H 0	Temp. (°C)	22.9	84A	PM Change: VK PM Feed: VK
3	7/30/14	# of Mortalities				Old D.O. (mg/L)	7.8	RD07	AM Change: KR WQ: KR
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.9	RD07	Mortality Counts: KR
		E 6	F 0	G 0	H 0	Temp. (°C)	23.3	84A	PM Change: VK PM Feed: VK
4	7-31-14	# of Mortalities				Old D.O. (mg/L)	6.6	RD04	AM Change: ARF WQ: ARF
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.5	RD04	Mortality Counts: ARF
		E 0	F 0	G 0	H 0	Temp. (°C)	22.8	84A	PM Change: ARF PM Feed: ARF
5	8/1/14	# of Mortalities				Old D.O. (mg/L)	7.5	RD04	AM Change: KMP WQ: KMP
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.6	RD04	Mortality Counts: KMP
		E 0	F 0	G 0	H 0	Temp. (°C)	23.3	84A	PM Change: VK PM Feed: VK
6	8/2/14	# of Mortalities				Old D.O. (mg/L)	7.4	RD07	AM Change: KMP WQ: KMP
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	KMP ~~7.0~~ 7.5	RD07	Mortality Counts: KMP
		E 0	F 0	G 0	H 0	Temp. (°C)	22.7	84A	PM Change: KMP PM Feed: KMP
7	8/3/14	# of Mortalities				Old D.O. (mg/L)	6.8	RD11	AM Change: DMS WQ: DMS
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.5	RD11	Mortality Counts: FOVB
		E 0	F 0	G 0	H 0	Temp. (°C)	23.3	84A	PM Change: DMS PM Feed: SM
8	8/4/14	# of Mortalities				Old D.O. (mg/L)	6.6	RD11	AM Change: TCM WQ: TCM
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.0	RD11	Mortality Counts: TCM
		E 0	F 0	G 0	H 0	Temp. (°C)	22.8	84A	PM Change: ES PM Feed: ES
9	8/5/14	# of Mortalities				Old D.O. (mg/L)	6.9	RD04	AM Change: DMS WQ: DMS
		A 0	B 0	C 0	D 0	New D.O. (mg/L)	7.5	RD04	Mortality Counts: DMS
		E 0	F 0	G 0	H 0	Temp. (°C)	23.0	84A	PM Change: DMS PM Feed: DMS
10	8/6/14	# Alive				pH	7.67	PH16	WQ: FOVB
		A 7	B 6	C 0	D 5	D.O. (mg/L)	7.2	RD04	Termination Counts: [initials]
		E 6	F 0	G 6	H 9	Conductivity (µS/cm)	457	EC06	Termination Time: 1200
						Alkalinity (mg/L)	✓ 72		
						Hardness (mg/L)	✓ 180		
						Ammonia (mg/L)	<1.00	DR3800	
						Temp. (°C)	22.8	84A	

Hyalella Survival and Growth Test — **Pacific EcoRisk**

Analysis ID:	03-8499-8034	**Endpoint:**	Mean Dry Weight-mg	**CETIS Version:**	CETISv1.8.7
Analyzed:	14 Aug-14 13:26	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Untransformed	NA	C > T	NA	NA	20.9%	

Equal Variance t Two-Sample Test

Sample Code	vs	Sample Code	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
Lab Control		544MSH062	4.97	1.76	0.018	14	0.0001	CDF	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.0102347	0.0102347	1	24.7	0.0002	Significant Effect
Error	0.005791049	0.0004136464	14			
Total	0.01602575		15			

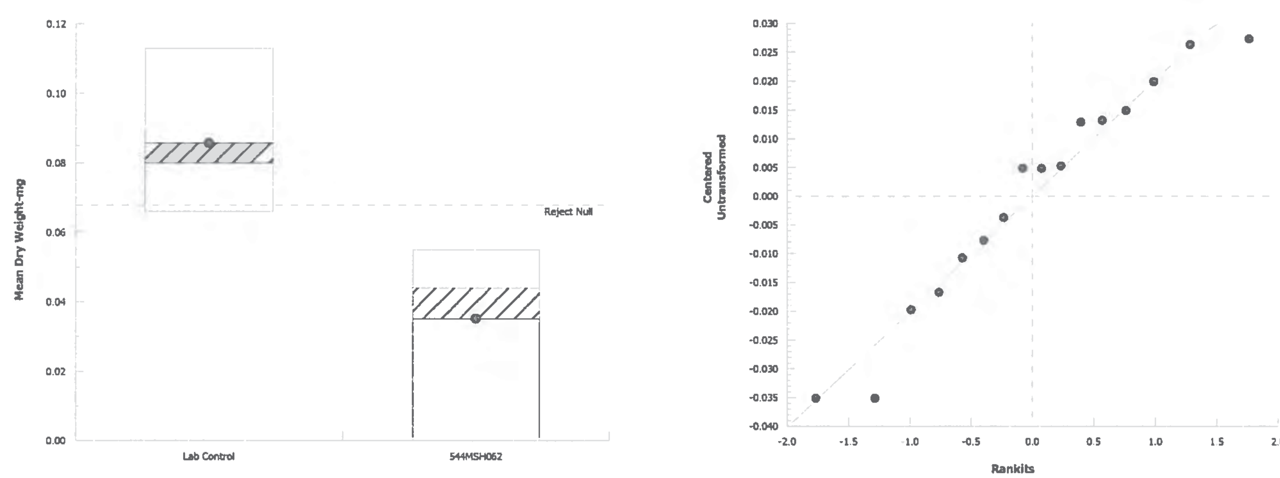
Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Variance Ratio F	1.5	8.89	0.6079	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.944	0.841	0.4013	Normal Distribution

Mean Dry Weight-mg Summary

Sample Code	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
Lab Control	8	0.0857	0.0705	0.101	0.08	0.066	0.113	0.00644	21.2%	0.0%
544MSH062	8	0.0352	0.0165	0.0538	0.044	0	0.055	0.00787	63.3%	59.0%

Graphics



Hyalella azteca Weight Data Sheets

Client: **ADH Environmental** Test Init Date: 7.27.14 Balance ID: BAL01

Sample ID: **544MSH062** Tare Wt Date: 8.2.14 Sign-Off: VK

Test ID: 58116 Final Wt Date: 8.7.14 Sign-Off: BEK

Project #: 19397

Pan	Concentration Replicate	Initial Weight. (mg)	Final Weight. (mg)	# organisms	Ave Weight (mg)
41	A	74.39	74.67	7	0.040
42	B	68.30	68.54	6	0.040
43	C	65.51	—	0	—
44	D	55.86	56.10	5	0.048
45	E	70.15	70.48	6	0.055
46	F	67.76	—	0	—
47	G	71.99	72.28	6	0.0483
48	H	61.70	62.15	9	0.050
QA 2		71.05	71.05		

Appendix C

Test Data and Summary of Statistics for the Evaluation of the Toxicity of the CCCWP Ambient Sediment Samples to *Hyalella azteca* – Follow-Up Toxicity Identification Evaluation (TIE): 544MSH065

CETIS Summary Report

Report Date: 08 Sep-14 14:58 (p 1 of 1)
Test Code: 58801 | 11-1351-5332

Hyalella Survival and Growth Test — **Pacific EcoRisk**

Batch ID:	02-8200-7394	**Test Type:**	Survival-Growth (10 day)	**Analyst:**	Padrick Anderson
Start Date:	09 Aug-14 15:00	**Protocol:**	EPA/600/R-99/064 (2000)	**Diluent:**	Not Applicable
Ending Date:	19 Aug-14 12:00	**Species:**	Hyalella azteca	**Brine:**	Not Applicable
Duration:	9d 21h	**Source:**	Aquatic Biosystems, CO	**Age:**	12

Sample ID:	13-3721-7571	**Code:**	Baseline	**Client:**	ADH Environmental, Inc.
Sample Date:	22 Jul-14 11:45	**Material:**	Sediment	**Project:**	19397
Receive Date:	22 Jul-14 17:15	**Source:**	ADH Environmental, Inc. (ADH ENVIRO)		
Sample Age:	18d 3h (0 °C)	**Station:**	544MSH065		

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
18-3759-4452	Mean Dry Weight-mg	<100	100	NA	45.4%	>1	Equal Variance t Two-Sample Test
10-2182-1396	Survival Rate	<100	100	NA	16.8%	>1	Equal Variance t Two-Sample Test

Mean Dry Weight-mg Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Control Sed	3	0.134	0.0894	0.179	0.116	0.152	0.0105	0.0181	13.5%	0.0%
100		3	0.0267	-0.0881	0.141	0	0.08	0.0267	0.0462	173.0%	80.2%

Survival Rate Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Control Sed	3	0.967	0.823	1	0.9	1	0.0333	0.0577	5.97%	0.0%
100		3	0.0667	0	0.354	0	0.2	0.0667	0.115	173.0%	93.1%

Mean Dry Weight-mg Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3
0	Control Sed	0.116	0.152	0.135
100		0	0	0.08

Survival Rate Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3
0	Control Sed	1	0.9	1
100		0	0	0.2

Survival Rate Binomials

C-%	Control Type	Rep 1	Rep 2	Rep 3
0	Control Sed	10/10	9/10	10/10
100		0/10	0/10	2/10

Hyalella Survival and Growth Test			Pacific EcoRisk
Analysis ID: 10-2182-1396	**Endpoint:** Survival Rate		**CETIS Version:** CETISv1.8.7
Analyzed: 08 Sep-14 8:31	**Analysis:** Parametric-Two Sample		**Official Results:** Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	16.8%	Fails survival rate

Equal Variance t Two-Sample Test

Control	vs	C-%	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
Control Sed		100*	9.52	2.13	0.246	4	0.0003	CDF	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	1.806068	1.806068	1	90.7	0.0007	Significant Effect
Error	0.07966898	0.01991724	4			
Total	1.885737		5			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Variance Ratio F	3.5	199	0.4445	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.836	0.43	0.1207	Normal Distribution

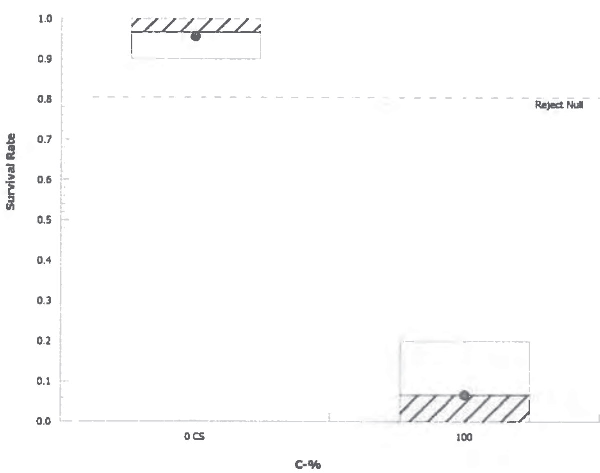
Survival Rate Summary

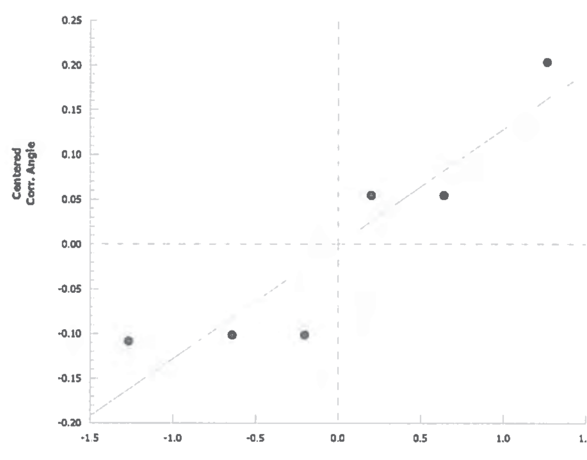
C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Control Sed	3	0.967	0.823	1	1	0.9	1	0.0333	5.97%	0.0%
100		3	0.0667	0	0.354	0	0	0.2	0.0667	173.0%	93.1%

Angular (Corrected) Transformed Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Control Sed	3	1.36	1.12	1.59	1.41	1.25	1.41	0.0543	6.93%	0.0%
100		3	0.26	-0.177	0.698	0.159	0.159	0.464	0.102	67.6%	80.8%

Graphics





CETIS Analytical Report

Report Date: 08 Sep-14 08:31 (p 1 of 2)
Test Code: 58801 | 11-1351-5332

Hyalella Survival and Growth Test					Pacific EcoRisk
Analysis ID:	18-3759-4452	**Endpoint:**	Mean Dry Weight-mg	**CETIS Version:**	CETISv1.8.7
Analyzed:	08 Sep-14 8:31	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Untransformed	NA	C > T	NA	NA	45.4%	Fails mean dry weight-mg

Equal Variance t Two-Sample Test

Control	vs	C-%	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
Control Sed		100*	3.76	2.13	0.061	4	0.0099	CDF	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.01741217	0.01741217	1	14.1	0.0198	Significant Effect
Error	0.004923207	0.001230802	4			
Total	0.02233537		5			

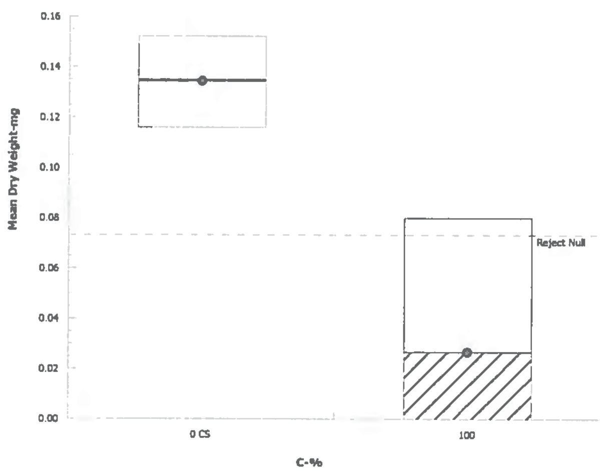
Distributional Tests

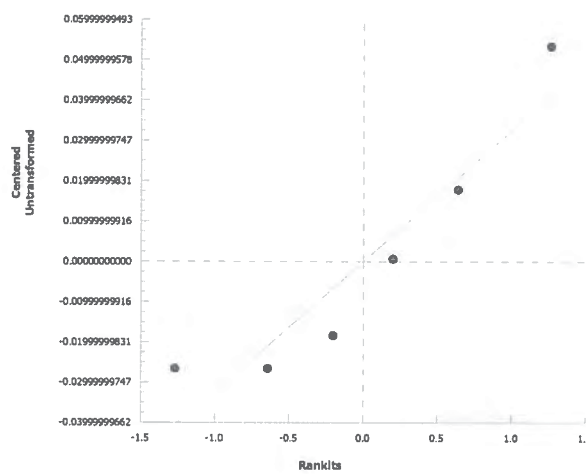
Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Variance Ratio F	6.5	199	0.2667	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.874	0.43	0.2431	Normal Distribution

Mean Dry Weight-mg Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Control Sed	3	0.134	0.0894	0.179	0.135	0.116	0.152	0.0105	13.5%	0.0%
100		3	0.0267	-0.0881	0.141	0	0	0.08	0.0267	173.0%	80.2%

Graphics





10-Day Freshwater Sediment Toxicity Test Data

Client: ADH/RMC Project #: 19397 Organism Supplier/Log Number: ABS/ 8422
Species: *Hyalella azteca* Test ID#: 58801 Organism Age/Size: 12/13 days
Control Water: SAM-5

Treatment =	Control				100% - 544R00025US				Sign-offs:
Day 0		New D.O.	7.9			New D.O.	6.7		Initiation Time: 1500
Date: 8-9-14		Meter ID	R11						WQ: MM
Temp. (°C) = 23.0	A 10	B 10	C 10		A 10	B 10	C 10		Initiation Counts: MM
Feed: MM									Confirmation Counts: MK
Day 1	Old D.O. 7.6		New D.O. 7.6		Old D.O. 7.5		New D.O. 7.5		AM Change: EK
Date: 8.10.14	Meter ID RD11		Meter ID RD11						WQ: EK
Temp. (°C) = 22.8	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: —
Feed: EK									Mortality Counts: EK
Day 2	Old D.O. 8.4		New D.O. 8.4		Old D.O. 8.3		New D.O. 8.5		AM Change: EK
Date: 8.11.14	Meter ID RD07		Meter ID RD07						WQ: EK
Temp. (°C) = 23.0	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: —
Feed: EK	—	—	—		—	—	—		Mortality Counts: EK
Day 3	Old D.O. 8.6		New D.O. 8.7		Old D.O. 8.6		New D.O. 8.7		AM Change: EK
Date: 8.12.14	Meter ID RD09		Meter ID RD09						WQ: EK
Temp. (°C) = 22.9	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: —
Feed: EK									Mortality Counts: EK
Day 4	Old D.O. 8.7		New D.O. 8.7		Old D.O. ~~8.7~~ 8.2		New D.O. 8.7		AM Change: EK
Date: 8.13.14	Meter ID RD11		Meter ID RD11						WQ: EK
Temp. (°C) = 22.9	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: —
Feed: EK									Mortality Counts: EK
Day 5	Old D.O. 8.4		New D.O. 8.5		Old D.O. 8.1		New D.O. 8.5		AM Change: EK
Date: 8.14.14	Meter ID RD07		Meter ID RD07						WQ: EK
Temp. (°C) = 22.8	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: —
Feed: EK									Mortality Counts: EK
Day 6	Old D.O. 8.4		New D.O. 8.4		Old D.O. 8.2		New D.O. 8.3		AM Change: MM
Date: 8-15-14	Meter ID RD09		Meter ID RD09						WQ: MM
Temp. (°C) = 23.1	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: —
Feed: MM									Mortality Counts: MM
Day 7	Old D.O. 8.5		New D.O. 8.5		Old D.O. 8.3		New D.O. 8.3		AM Change: MM
Date: 8-16-14	Meter ID RD11		Meter ID RD11						WQ: MM
Temp. (°C) = 22.7	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: —
Feed: MM									Mortality Counts: MM
Day 8	Old D.O. 8.4		New D.O. 8.6		Old D.O. 8.3		New D.O. 8.6		AM Change: EK
Date: 8.17.14	Meter ID RD11		Meter ID RD11						WQ: EK
Temp. (°C) = 22.8	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: —
Feed: EK									Mortality Counts: EK
Day 9	Old D.O. 8.6		New D.O. 8.8		Old D.O. 8.4		New D.O. 8.8		AM Change: EK
Date: 8.18.14	Meter ID RD11		Meter ID RD11						WQ: EK
Temp. (°C) = 22.9	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: —
Feed: EK									Mortality Counts: EK
Day 10	Old D.O. 8.3				Old D.O. 7.9				Termination Counts: EK
Date: 8.19.14	Meter ID RD07								
Temp. (°C) = 22.9	# Alive/Replicate				# Alive/Replicate				WQ: EK
	A 10	B 9	C 10		A 0	B 0	C 2		

CETIS Summary Report

Report Date: 08 Sep-14 14:56 (p 1 of 1)
Test Code: 58801a | 03-7045-9434

Hyalella Survival and Growth Test — **Pacific EcoRisk**

Batch ID:	01-2600-7207	**Test Type:**	Survival-Growth (10 day)	**Analyst:**	Padrick Anderson
Start Date:	09 Aug-14 15:00	**Protocol:**	EPA/600/R-99/064 (2000)	**Diluent:**	Not Applicable
Ending Date:	19 Aug-14 12:00	**Species:**	Hyalella azteca	**Brine:**	Not Applicable
Duration:	9d 21h	**Source:**	Aquatic Biosystems, CO	**Age:**	12

Sample ID:	08-9875-5755	**Code:**	Aeration	**Client:**	ADH Environmental, Inc.
Sample Date:	22 Jul-14 11:45	**Material:**	Sediment	**Project:**	19397
Receive Date:	22 Jul-14 17:15	**Source:**	ADH Environmental, Inc. (ADH ENVIRO)		
Sample Age:	18d 3h (0 °C)	**Station:**	544MSH065		

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
02-6734-8419	Mean Dry Weight-mg	100	>100	NA	83.5%	1	Equal Variance t Two-Sample Test
01-7668-1575	Survival Rate	<100	100	NA	20.2%	>1	Equal Variance t Two-Sample Test

Mean Dry Weight-mg Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Aeration Blank	3	0.119	0.103	0.134	0.114	0.126	0.00362	0.00627	5.28%	0.0%
100		3	0.0844	-0.115	0.284	0	0.16	0.0464	0.0804	95.2%	28.9%

Survival Rate Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Aeration Blank	3	0.967	0.823	1	0.9	1	0.0333	0.0577	5.97%	0.0%
100		3	0.133	0	0.513	0	0.3	0.0882	0.153	115.0%	86.2%

Mean Dry Weight-mg Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3
0	Aeration Blank	0.126	0.114	0.116
100		0.16	0	0.0933

Survival Rate Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3
0	Aeration Blank	1	0.9	1
100		0.1	0	0.3

Survival Rate Binomials

C-%	Control Type	Rep 1	Rep 2	Rep 3
0	Aeration Blank	10/10	9/10	10/10
100		1/10	0/10	3/10

Hyalella Survival and Growth Test — **Pacific EcoRisk**

Analysis ID:	01-7668-1575	**Endpoint:**	Survival Rate	**CETIS Version:**	CETISv1.8.7
Analyzed:	08 Sep-14 8:36	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	20.2%	Fails survival rate

Equal Variance t Two-Sample Test

Control	vs	C-%	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
Aeration Blank		100*	7.49	2.13	0.286	4	0.0008	CDF	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	1.512935	1.512935	1	56.2	0.0017	Significant Effect
Error	0.1077692	0.0269423	4			
Total	1.620704		5			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Variance Ratio F	5.09	199	0.3286	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.974	0.43	0.9162	Normal Distribution

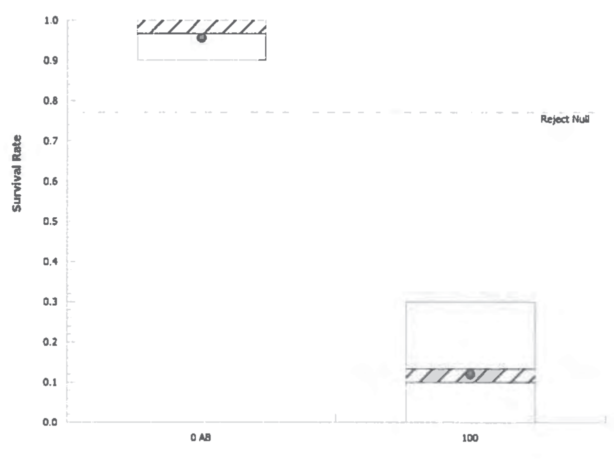
Survival Rate Summary

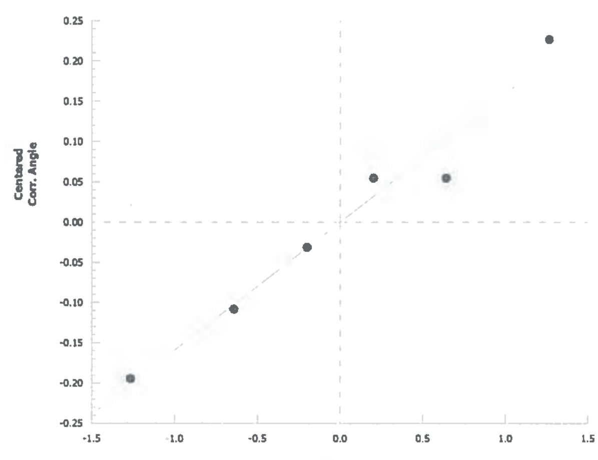
C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Aeration Blank	3	0.967	0.823	1	1	0.9	1	0.0333	5.97%	0.0%
100		3	0.133	0	0.513	0.1	0	0.3	0.0882	115.0%	86.2%

Angular (Corrected) Transformed Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Aeration Blank	3	1.36	1.12	1.59	1.41	1.25	1.41	0.0543	6.93%	0.0%
100		3	0.353	-0.174	0.881	0.322	0.159	0.58	0.123	60.0%	74.0%

Graphics





Hyalella Survival and Growth Test					Pacific EcoRisk
Analysis ID: 02-6734-8419	**Endpoint:**	Mean Dry Weight-mg		**CETIS Version:**	CETISv1.8.7
Analyzed: 08 Sep-14 8:37	**Analysis:**	Parametric-Two Sample		**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Untransformed	NA	C > T	NA	NA	83.5%	Passes mean dry weight-mg

Equal Variance t Two-Sample Test

Control	vs	C-%	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
Aeration Blank		100	0.738	2.13	0.099	4	0.2506	CDF	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.001771875	0.001771875	1	0.545	0.5012	Non-Significant Effect
Error	0.0129977	0.003249426	4			
Total	0.01476958		5			

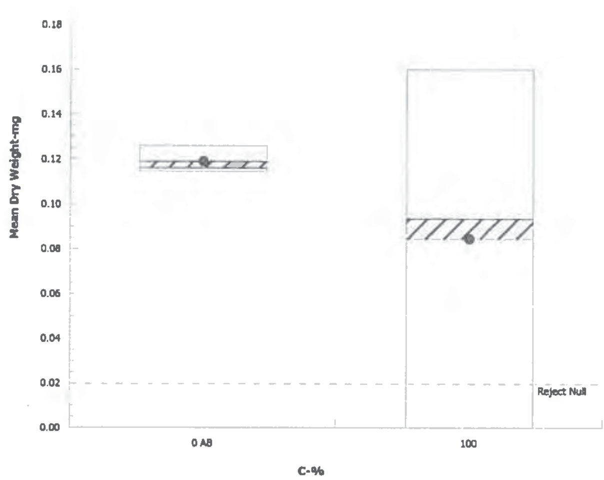
Distributional Tests

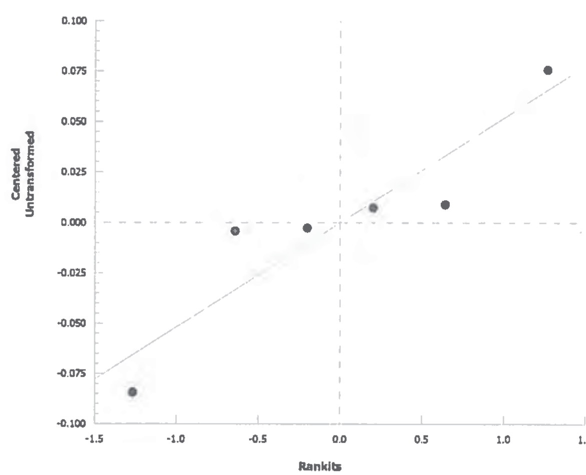
Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Variance Ratio F	164	199	0.0121	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.889	0.43	0.3119	Normal Distribution

Mean Dry Weight-mg Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Aeration Blank	3	0.119	0.103	0.134	0.116	0.114	0.126	0.00362	5.28%	0.0%
100		3	0.0844	-0.115	0.284	0.0933	0	0.16	0.0464	95.2%	28.9%

Graphics





10-Day Freshwater Sediment Toxicity Test Data

Client: ADH/RMC Project #: 19397 Organism Supplier/Log Number: ABS/ 8422

Species: *Hyalella azteca* Test ID#: 58801 Organism Age/Size: 12/13 days

Control Water: SAM-5

Treatment =	Aeration Blank				544R00025US + Aeration				Sign-offs:
Day 0			New D.O. 8.2				New D.O. 7.6		Initiation Time: 1500
Date: 8/9/14			Meter ID RD11						WQ: Mm
Temp. (°C) = 23.0	A 10	B 10	C 10		A 10	B 10	C 10		Initiation Counts: Mm
Feed: Mm									Confirmation Counts: MK
Day 1	Old D.O. 7.4		New D.O. 7.4		Old D.O. 7.4		New D.O. 7.4		AM Change: Eka
Date: 8.10.14	Meter ID RD11		Meter ID RD11						WQ: Eka
Temp. (°C) = 22.8	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: —
Feed: Eka									Mortality Counts: Eka
Day 2	Old D.O. 8.2		New D.O. 8.4		Old D.O. 8.1		New D.O. 8.4		AM Change: Eka
Date: 8.11.14	Meter ID RD07		Meter ID RD07						WQ: Eka
Temp. (°C) = 23.0	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: —
Feed: Eka	—	—	—		—	—	—		Mortality Counts: Eka
Day 3	Old D.O. 8.3		New D.O. 8.7		Old D.O. 8.4		New D.O. 8.7		AM Change: Eka
Date: 8.12.14	Meter ID RD09		Meter ID RD09						WQ: Eka
Temp. (°C) = 22.9	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: —
Feed: Eka									Mortality Counts: Eka
Day 4	Old D.O. 8.3		New D.O. 8.7		Old D.O. 8.1		New D.O. 8.7		AM Change: Eka
Date: 8.13.14	Meter ID RD11		Meter ID RD11						WQ: Eka
Temp. (°C) = 22.9	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: —
Feed: Eka									Mortality Counts: Eka
Day 5	Old D.O. 8.0		New D.O. 8.5		Old D.O. 7.8		New D.O. 8.5		AM Change: Eka
Date: 8.14.14	Meter ID RD07		Meter ID RD07						WQ: Eka
Temp. (°C) = 22.8	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: —
Feed: Eka									Mortality Counts: Eka
Day 6	Old D.O. 8.3		New D.O. 8.3		Old D.O. 7.9		New D.O. 7.7		AM Change: Mm
Date: 8/15/14	Meter ID RD09		Meter ID RD09						WQ: Mm
Temp. (°C) = 23.1	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: —
Feed: Mm									Mortality Counts: Mm
Day 7	Old D.O. 8.3		New D.O. 8.4		Old D.O. 8.1		New D.O. 8.1		AM Change: Mm
Date: 8.16.14	Meter ID RD11		Meter ID RD11						WQ: Mm
Temp. (°C) = 22.7	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: —
Feed: Mm									Mortality Counts: Mm
Day 8	Old D.O. 8.3		New D.O. 8.6		Old D.O. 8.3		New D.O. 8.6		AM Change: Eka
Date: 8.17.14	Meter ID RD11		Meter ID RD11						WQ: Eka
Temp. (°C) = 22.8	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: —
Feed: Eka									Mortality Counts: Eka
Day 9	Old D.O. 8.2		New D.O. 8.8		Old D.O. 8.2		New D.O. 8.8		AM Change: Eka
Date: 8.18.14	Meter ID RD11		Meter ID RD11						WQ: Eka
Temp. (°C) = 22.9	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: —
Feed: Eka									Mortality Counts: Eka
Day 10	Old D.O. 8.3				Old D.O. 7.7				Termination Counts: Eka
Date: 8.19.14	Meter ID RD07								
Temp. (°C) = 22.9	# Alive/Replicate				# Alive/Replicate				WQ: Eka
	A 10	B 9	C 10		A 1	B 0	C 3		

CETIS Summary Report

Report Date: 08 Sep-14 14:57 (p 1 of 1)
Test Code: 58801b | 19-5160-7963

Hyalella Survival and Growth Test — **Pacific EcoRisk**

Batch ID:	01-2914-6876	**Test Type:**	Survival-Growth (10 day)	**Analyst:**	Padrick Anderson
Start Date:	09 Aug-14 15:00	**Protocol:**	EPA/600/R-99/064 (2000)	**Diluent:**	Not Applicable
Ending Date:	19 Aug-14 12:00	**Species:**	Hyalella azteca	**Brine:**	Not Applicable
Duration:	9d 21h	**Source:**	Aquatic Biosystems, CO	**Age:**	12

Sample ID:	15-8148-7129	**Code:**	PBO @ 25 ug/L	**Client:**	ADH Environmental, Inc.
Sample Date:	22 Jul-14 11:45	**Material:**	Sediment	**Project:**	19397
Receive Date:	22 Jul-14 17:15	**Source:**	ADH Environmental, Inc. (ADH ENVIRO)		
Sample Age:	18d 3h (0 °C)	**Station:**	544MSH065		

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
18-4552-3379	Mean Dry Weight-mg	<100	100	NA	15.2%	>1	Equal Variance t Two-Sample Test
17-7973-1725	Survival Rate	<100	100	NA	7.35%	>1	Equal Variance t Two-Sample Test

Mean Dry Weight-mg Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	PBO 25 Blank	3	0.116	0.0802	0.151	0.1	0.128	0.00825	0.0143	12.4%	0.0%
100		3	0	0	0	0	0	0	0		100.0%

Survival Rate Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	PBO 25 Blank	3	0.967	0.823	1	0.9	1	0.0333	0.0577	5.97%	0.0%
100		3	0	0	0	0	0	0	0		100.0%

Mean Dry Weight-mg Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3
0	PBO 25 Blank	0.128	0.1	0.119
100		0	0	0

Survival Rate Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3
0	PBO 25 Blank	1	0.9	1
100		0	0	0

Survival Rate Binomials

C-%	Control Type	Rep 1	Rep 2	Rep 3
0	PBO 25 Blank	10/10	9/10	10/10
100		0/10	0/10	0/10

Hyalella Survival and Growth Test — Pacific EcoRisk

Analysis ID:	17-7973-1725	Endpoint:	Survival Rate	CETIS Version:	CETISv1.8.7
Analyzed:	08 Sep-14 8:42	Analysis:	Parametric-Two Sample	Official Results:	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	7.35%	Fails survival rate

Equal Variance t Two-Sample Test

Control	vs	C-%	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
PBO 25 Blank		100*	22.1	2.13	0.116	4	<0.0001	CDF	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	2.156087	2.156087	1	487	<0.0001	Significant Effect
Error	0.01770622	0.004426555	4			
Total	2.173793		5			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	1	98.5	0.4226	Equal Variances
Variances	Levene Equality of Variance	16	21.2	0.0161	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.814	0.43	0.0778	Normal Distribution

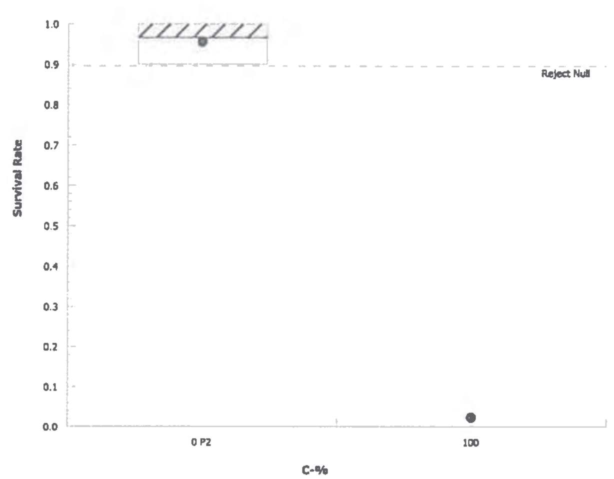
Survival Rate Summary

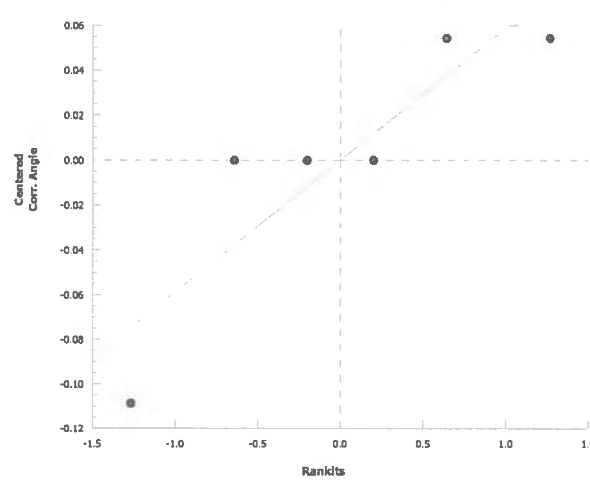
C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	PBO 25 Blank	3	0.967	0.823	1	1	0.9	1	0.0333	5.97%	0.0%
100		3	0	0	0	0	0	0	0		100.0%

Angular (Corrected) Transformed Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	PBO 25 Blank	3	1.36	1.12	1.59	1.41	1.25	1.41	0.0543	6.93%	0.0%
100		3	0.159	0.159	0.159	0.159	0.159	0.159	0	0.0%	88.3%

Graphics





CETIS Analytical Report

Hyalella Survival and Growth Test			Pacific EcoRisk
Analysis ID: 18-4552-3379	Endpoint: Mean Dry Weight-mg	CETIS Version: CETISv1.8.7	
Analyzed: 08 Sep-14 8:44	Analysis: Parametric-Two Sample	Official Results: Yes	

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Untransformed	NA	C > T	NA	NA	15.2%	Fails mean dry weight-mg

Equal Variance t Two-Sample Test

Control	vs	C-%	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
PBO 25 Blank		100*	14	2.13	0.018	4	<0.0001	CDF	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.02006811	0.02006811	1	196	0.0002	Significant Effect
Error	0.0004086705	0.0001021676	4			
Total	0.02047678		5			

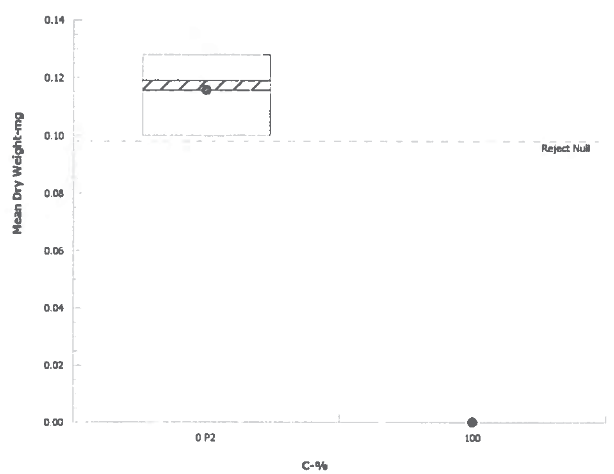
Distributional Tests

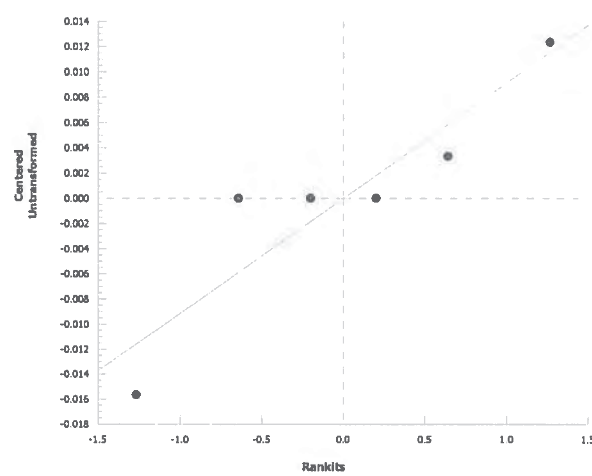
Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	7.84	98.5	0.1074	Equal Variances
Variances	Levene Equality of Variance	8.04	21.2	0.0471	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.878	0.43	0.2586	Normal Distribution

Mean Dry Weight-mg Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	PBO 25 Blank	3	0.116	0.0802	0.151	0.119	0.1	0.128	0.00825	12.4%	0.0%
100		3	0	0	0	0	0	0	0		100.0%

Graphics





10-Day Freshwater Sediment Toxicity Test Data

Client: ADH/RMC Project #: 19397 Organism Supplier/Log Number: ABS/8422

Species: *Hyalella azteca* Test ID#: 58801 Organism Age/Size: 12/13 days

Control Water: SAM-5

Treatment =	25 µg/L PBO Blank				544R00025US + 25 µg/L PBO				Sign-offs:
Day 0			New D.O.	8.1			New D.O.	5.9	Initiation Time: 1500
Date: 8-9-14			Meter ID	RD11					WQ: [illegible]
Temp. (°C) = 23.0	A 10	B 10	C 10		A 10	B 10	C 10		Initiation Counts: [illegible]
Feed: [illegible]									Confirmation Counts: MK
Day 1	Old D.O.	7.2	New D.O.	7.4	Old D.O.	7.1	New D.O.	7.4	AM Change: EKK
Date: 8.10.14	Meter ID	RD11	Meter ID	RD11					WQ: EKK
Temp. (°C) = 22.8	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: —
Feed: EKK									Mortality Counts: EKK
Day 2	Old D.O.	8.1	New D.O.	8.2	Old D.O.	8.1	New D.O.	8.2	AM Change: EKK
Date: 8.11.14	Meter ID		Meter ID						WQ: EKK
Temp. (°C) = 23.0	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: —
Feed: EKK	—	—	—		—	—	—		Mortality Counts: EKK
Day 3	Old D.O.	8.3	New D.O.	8.7	Old D.O.	8.2	New D.O.	8.7	AM Change: EKK
Date: 8.12.14	Meter ID	RD09	Meter ID	RD09					WQ: EKK
Temp. (°C) = 22.9	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: —
Feed: EKK									Mortality Counts: EKK
Day 4	Old D.O.	8.2	New D.O.	8.5	Old D.O.	8.1	New D.O.	8.8	AM Change: EKK
Date: 8.13.14	Meter ID	RD11	Meter ID	RD11					WQ: EKK
Temp. (°C) = 22.9	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: —
Feed: EKK									Mortality Counts: EKK
Day 5	Old D.O.	7.7	New D.O.	8.0	Old D.O.	7.8	New D.O.	8.0	AM Change: EKK
Date: 8.14.14	Meter ID	RD07	Meter ID	RD07					WQ: EKK
Temp. (°C) = 22.8	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: —
Feed: EKK									Mortality Counts: EKK
Day 6	Old D.O.	8.1	New D.O.	8.2	Old D.O.	7.9	New D.O.	7.8	AM Change: [illegible]
Date: 8/15/14	Meter ID	RD09	Meter ID	RD09					WQ: [illegible]
Temp. (°C) = 23.1	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: —
Feed: [illegible]									Mortality Counts: MM
Day 7	Old D.O.	8.3	New D.O.	8.2	Old D.O.	8.2	New D.O.	8.1	AM Change: [illegible]
Date: 8-16-14	Meter ID	RD11	Meter ID	RD11					WQ: [illegible]
Temp. (°C) = 22.7	A 0	B 0	C C		A 0	B 0	C 0		PM Change: —
Feed: [illegible]									Mortality Counts: [illegible]
Day 8	Old D.O.	8.3	New D.O.	8.2	Old D.O.	8.2	New D.O.	8.2	AM Change: EKK
Date: 8.17.14	Meter ID	RD11	Meter ID	RD11					WQ: EKK
Temp. (°C) = 22.8	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: —
Feed: EKK									Mortality Counts: EKK
Day 9	Old D.O.	8.1	New D.O.	8.7	Old D.O.	8.0	New D.O.	8.7	AM Change: EKK
Date: 8.18.14	Meter ID	RD11	Meter ID	RD11					WQ: EKK
Temp. (°C) = 22.9	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: —
Feed: EKK									Mortality Counts: EKK
Day 10	Old D.O.	8.2			Old D.O.	7.6			Termination Counts: EKK
Date: 8.19.14	Meter ID	RD07							
Temp. (°C) = 22.9	**# Alive/Replicate**				**# Alive/Replicate**				WQ: EKK
	A 10	B 9	C 10		A 0	B 0	C 0		

CETIS Summary Report

Hyalella Survival and Growth Test — **Pacific EcoRisk**

Batch ID:	06-0653-7694	**Test Type:**	Survival-Growth (10 day)	**Analyst:**	Padrick Anderson
Start Date:	09 Aug-14 15:00	**Protocol:**	EPA/600/R-99/064 (2000)	**Diluent:**	Not Applicable
Ending Date:	09 Aug-14 12:00	**Species:**	Hyalella azteca	**Brine:**	Not Applicable
Duration:	NA	**Source:**	Aquatic Biosystems, CO	**Age:**	12

Sample ID:	16-4939-1953	**Code:**	Carboxylesteras	**Client:**	ADH Environmental, Inc.
Sample Date:	22 Jul-14 11:45	**Material:**	Sediment	**Project:**	19397
Receive Date:	22 Jul-14 17:15	**Source:**	ADH Environmental, Inc. (ADH ENVIRO)		
Sample Age:	18d 3h (0 °C)	**Station:**	544MSH065		

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
01-6200-3848	Mean Dry Weight-mg	<100	100	NA	18.7%	>1	Equal Variance t Two-Sample Test
16-9849-8596	Survival Rate	100	>100	NA	22.0%	1	Equal Variance t Two-Sample Test

Mean Dry Weight-mg Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Carboxylesteras	3	0.149	0.0966	0.202	0.132	0.173	0.0123	0.0212	14.2%	0.0%
100		3	0.0893	0.0693	0.109	0.08	0.0944	0.00464	0.00804	9.01%	40.2%

Survival Rate Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Carboxylesteras	3	1	1	1	1	1	0	0	0.0%	0.0%
100		3	0.767	0.193	1	0.5	0.9	0.133	0.231	30.1%	23.3%

Mean Dry Weight-mg Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3
0	Carboxylesteras	0.132	0.143	0.173
100		0.08	0.0944	0.0933

Survival Rate Detail

C-%	Control Type	Rep 1	Rep 2	Rep 3
0	Carboxylesteras	1	1	1
100		0.5	0.9	0.9

Survival Rate Binomials

C-%	Control Type	Rep 1	Rep 2	Rep 3
0	Carboxylesteras	10/10	10/10	10/10
100		5/10	9/10	9/10

Hyalella Survival and Growth Test					Pacific EcoRisk
Analysis ID:	16-9849-8596	Endpoint:	Survival Rate	CETIS Version:	CETISv1.8.7
Analyzed:	08 Sep-14 8:49	Analysis:	Parametric-Two Sample	Official Results:	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Angular (Corrected)	NA	C > T	NA	NA	22.0%	Passes survival rate

Equal Variance t Two-Sample Test

Control	vs	C-%	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
Carboxylesterase Bl		100	2.05	2.13	0.329	4	0.0546	CDF	Non-Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.151228	0.151228	1	4.22	0.1091	Non-Significant Effect
Error	0.1433127	0.03582818	4			
Total	0.2945407		5			

Distributional Tests

Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Mod Levene Equality of Variance	1	98.5	0.4226	Equal Variances
Variances	Levene Equality of Variance	16	21.2	0.0161	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.814	0.43	0.0778	Normal Distribution

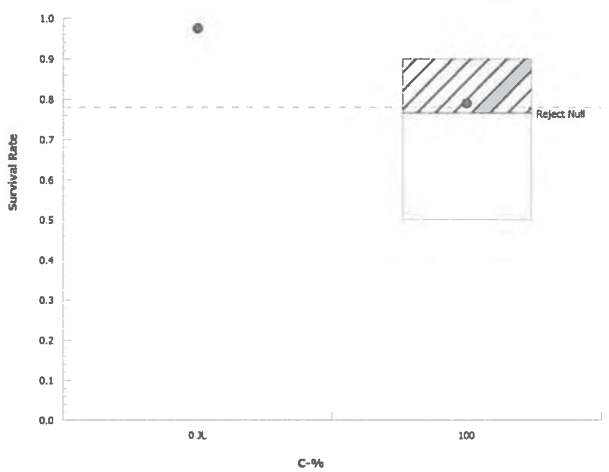
Survival Rate Summary

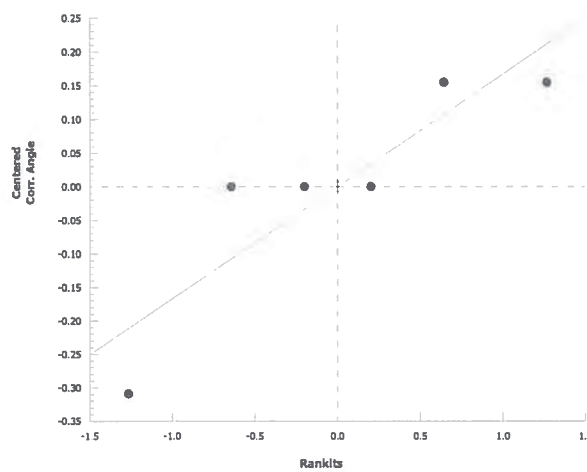
C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Carboxylesteras	3	1	1	1	1	1	1	0	0.0%	0.0%
100		3	0.767	0.193	1	0.9	0.5	0.9	0.133	30.1%	23.3%

Angular (Corrected) Transformed Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Carboxylestera	3	1.41	1.41	1.41	1.41	1.41	1.41	0	0.0%	0.0%
100		3	1.09	0.43	1.76	1.25	0.785	1.25	0.155	24.5%	22.5%

Graphics





Hyalella Survival and Growth Test — **Pacific EcoRisk**

Analysis ID:	01-6200-3848	**Endpoint:**	Mean Dry Weight-mg	**CETIS Version:**	CETISv1.8.7
Analyzed:	08 Sep-14 8:49	**Analysis:**	Parametric-Two Sample	**Official Results:**	Yes

Data Transform	Zeta	Alt Hyp	Trials	Seed	PMSD	Test Result
Untransformed	NA	C > T	NA	NA	18.7%	Fails mean dry weight-mg

Equal Variance t Two-Sample Test

Control	vs	C-%	Test Stat	Critical	MSD	DF	P-Value	P-Type	Decision(α:5%)
Carboxylesterase Bl		100*	4.59	2.13	0.028	4	0.0051	CDF	Significant Effect

ANOVA Table

Source	Sum Squares	Mean Square	DF	F Stat	P-Value	Decision(α:5%)
Between	0.00541335	0.00541335	1	21	0.0101	Significant Effect
Error	0.001029894	0.0002574735	4			
Total	0.006443244		5			

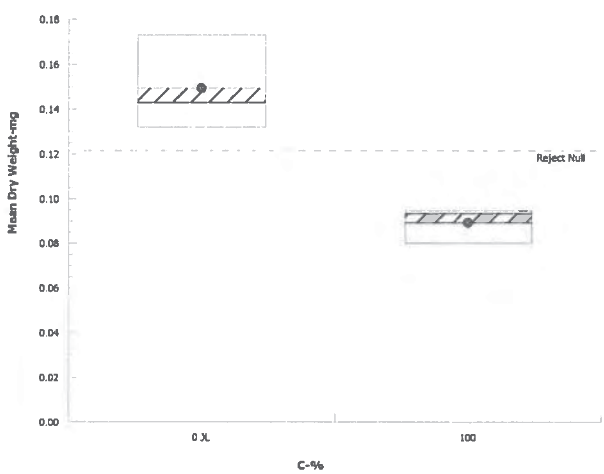
Distributional Tests

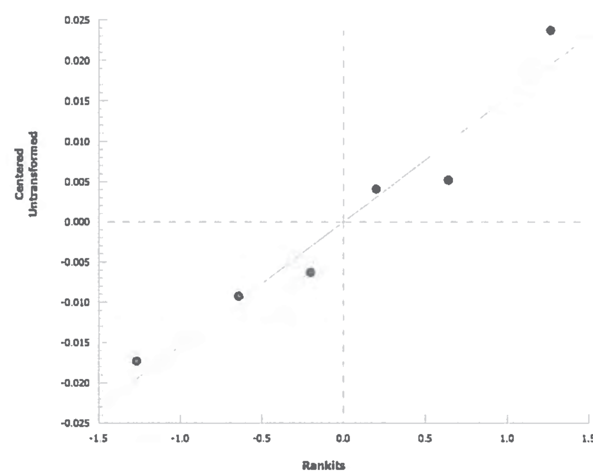
Attribute	Test	Test Stat	Critical	P-Value	Decision(α:1%)
Variances	Variance Ratio F	6.97	199	0.2510	Equal Variances
Distribution	Shapiro-Wilk W Normality	0.953	0.43	0.7677	Normal Distribution

Mean Dry Weight-mg Summary

C-%	Control Type	Count	Mean	95% LCL	95% UCL	Median	Min	Max	Std Err	CV%	%Effect
0	Carboxylesteras	3	0.149	0.0966	0.202	0.143	0.132	0.173	0.0123	14.2%	0.0%
100		3	0.0893	0.0693	0.109	0.0933	0.08	0.0944	0.00464	9.01%	40.2%

Graphics





10-Day Freshwater Sediment Toxicity Test Data

Client: ADH/RMC Project #: 19397 Organism Supplier/Log Number: ABS/8422

Species: *Hyalella azteca* Test ID#: 58801 Organism Age/Size: 12/13 days

Control Water: SAM-5

Treatment =	Carboxylesterase Blank				544R00025US + Carboxylesterase				Sign-offs:
Day 0			New D.O. 8.0				New D.O. 6.9		Initiation Time: 1500
Date: 8/9/14			Meter ID RD11						WQ: [initials]
Temp. (°C) = 23.6	A 10	B 10	C 10		A 10	B 10	C 10		Initiation Counts: [initials]
Feed: [initials]									Confirmation Counts: MK
Day 1	Old D.O. 7.5		New D.O. 7.4		Old D.O. 7.3		New D.O. 7.4		AM Change: [initials]
Date: 8.10.14	Meter ID RD11		Meter ID RD11						WQ: [initials]
Temp. (°C) = 22.8	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: —
Feed: [initials]									Mortality Counts: [initials]
Day 2	Old D.O. 8.2		New D.O. 8.1		Old D.O. 8.3		New D.O. 8.1		AM Change: [initials]
Date: 8.11.14	Meter ID		Meter ID						WQ: [initials]
Temp. (°C) = 23.0	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: —
Feed: [initials]	—	—	—		—	—	—		Mortality Counts: [initials]
Day 3	Old D.O. 8.1		New D.O. 8.6		Old D.O. 8.1		New D.O. 8.6		AM Change: [initials]
Date: 8.12.14	Meter ID RD09		Meter ID RD09						WQ: [initials]
Temp. (°C) = 22.9	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: —
Feed: [initials]									Mortality Counts: [initials]
Day 4	Old D.O. 8.0		New D.O. 8.4		Old D.O. 7.9		New D.O. 8.4		AM Change: [initials]
Date: 8.13.14	Meter ID		Meter ID RD11						WQ: [initials]
Temp. (°C) = 22.9	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: —
Feed: [initials]									Mortality Counts: [initials]
Day 5	Old D.O. 7.8		New D.O. 7.3		Old D.O. 7.8		New D.O. 7.3		AM Change: [initials]
Date: 8.14.14	Meter ID RD07		Meter ID RD07						WQ: [initials]
Temp. (°C) = 22.8	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: —
Feed: [initials]									Mortality Counts: [initials]
Day 6	Old D.O. 7.8		New D.O. 7.9		Old D.O. 7.8		New D.O. 7.8		AM Change: [initials]
Date: 8/15/14	Meter ID RD09		Meter ID RD09						WQ: [initials]
Temp. (°C) = 23.1	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: [initials]
Feed: [initials]									Mortality Counts: [initials]
Day 7	Old D.O. 8.0		New D.O. 7.9		Old D.O. 7.9		New D.O. 7.9		AM Change: [initials]
Date: 8.16.14	Meter ID RD11		Meter ID RD11						WQ: [initials]
Temp. (°C) = 22.7	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: —
Feed: [initials]									Mortality Counts: [initials]
Day 8	Old D.O. 8.1		New D.O. 8.2		Old D.O. 7.9		New D.O. 8.2		AM Change: [initials]
Date: 8.17.14	Meter ID RD11		Meter ID RD11						WQ: [initials]
Temp. (°C) = 22.8	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: —
Feed: [initials]									Mortality Counts: [initials]
Day 9	Old D.O. 8.0		New D.O. 8.5		Old D.O. 7.8		New D.O. 8.5		AM Change: [initials]
Date: 8.18.14	Meter ID RD11		Meter ID RD11						WQ: [initials]
Temp. (°C) = 22.9	A 0	B 0	C 0		A 0	B 0	C 0		PM Change: —
Feed: [initials]									Mortality Counts: [initials]
Day 10	Old D.O. 7.8				Old D.O. 7.3				Termination Counts: [initials]
Date: 8.19.14	Meter ID RD07								
Temp. (°C) = 22.9	# Alive/Replicate				# Alive/Replicate				WQ: [initials]
	A 10	B 10	C 10		A 5	B 9	C 9		

Hyalella azteca Weight Data Sheets

Client:	**ADH/RMC**	Project #:	19397	Balance ID:	BAL01
Sample ID:	**544R00025US**	Tare Wt Date:	8/11/14	Sign-Off:	FOVB
Test ID #:	58801	Final Wt Date:	8/20/14	Sign-Off:	CJG

Pan	Concentration Replicate		Initial Weight. (mg)	Final Weight. (mg)	# organisms	Ave Weight (mg)
1	Control	A	65.27	66.43	10	0.116
2		B	63.46	64.83	9	0.152
3		C	61.79	63.14	10	0.135
4	Aeration Blank	A	65.23	66.49	10	0.126
5		B	63.52	64.55	9	0.114
6		C	64.09	65.25	10	0.116
7	25 µg/L PBO Blank	A	64.29	65.57	10	0.128
8		B	63.34	64.24	9	0.100
9		C	63.69	64.88	10	0.119
10	Carboxylesterase	A	66.79	~~68.17~~ CJG 68.11	10	0.132
11	Blank	B	66.10	67.53	10	0.143
12		C	60.70	62.43	10	0.173
13	100% 544R00025US	A	67.02	—	0	—
14		B	58.19	—	0	—
15		C	63.45	63.61	2	0.080
16	544R00025US + Aeration	A	66.25	66.41	1	0.160
17		B	66.92	—	0	—
18		C	65.50	65.78	3	0.093
19	544R00025US + 25 µg/L PBO	A	59.77	—	0	—
20		B	61.26	—	0	—
21		C	68.48	—	0	—
22	544R00025US + Carboxylesterase	A	63.24	63.64	5	0.080
23		B	63.27	64.12	9	0.094
24		C	61.65	62.49	9	0.093
QA 1			65.74	65.75		—
QA 2			66.66	66.64		—

Freshwater Sediment Test Water Quality Characteristics

Client: ADH/RMC **Species:** *Hyallela azteca*

Initial Water Quality Characteristics for Overlying Water

Date: 8-9-14

Site	pH	D.O. (mg/L)	Conductivity (µS/cm)	Alkalinity	Hardness	Total Ammonia	Test ID #
Control	8.36	7.9	504	65 ✓	138 ✓	<1.00	58801
Aeration Blank	8.33	8.2	574	72 ✓	140 ✓	<1.00	
25 µg/L PBO Blank	8.34	8.1	546	61 ✓	133 ✓	<1.00	
Carboxylesterase Blank	8.31	8.0	567	78 ✓	170 ✓	<1.00	
100% - 544R0025US	7.79	6.7	690	138 ✓	169 ✓	<1.00	
544R0025US + Aeration	8.15	7.6	724	155 ✓	187 ✓	1.02	
544R0025US + 25 µg/L PBO	7.92	5.9	659	144 ✓	164 ✓	1.07	
544R0025US + Carboxylesterase	8.19	6.9	762	179 ✓	197 ✓	2.16	
Meter ID	pH 21	RD11	EC10	— ✓	— ✓	DR3800	
Sign-off	[initials]	[initials]	[initials]	[initials]	[initials]	[initials]	

Final Water Quality Characteristics for Overlying Water

Date: 8.19.14

Site	pH	D.O. (mg/L)	Conductivity (µS/cm)	Alkalinity	Hardness	Total Ammonia
Control	7.73	8.3	437	52 ✓	149 ✓	<1.00
Aeration Blank	7.79	8.3	442	53 ✓	142 ✓	<1.00
25 µg/L PBO Blank	7.83	8.2	438	44 ✓	182 ✓	<1.00
Carboxylesterase Blank	7.82	7.8	502	82 ✓	165 ✓	7.47
100% - 544R0025US	8.06	7.9	561	79 ✓	198 ✓	1.57
544R0025US + Aeration	8.06	7.7	509	81 ✓	160 ✓	1.26
544R0025US + 25 µg/L PBO	8.07	7.6	550	97 ✓	193 ✓	1.18
544R0025US + Carboxylesterase	8.00	7.3	575	109 ✓	295 ✓	8.15
Meter ID	pH 21	RD07	EC04	— ✓	— ✓	DR3800
Sign-off	[initials]	[initials]	[initials]	[initials]	[initials]	[initials]

Appendix D

Test Data and Summary of Statistics for the Reference Toxicant Evaluation of the *Hyalella azteca*

CETIS Summary Report

Hyalella 96-h Acute Survival Test — **Pacific EcoRisk**

Batch ID:	01-9707-2882	**Test Type:**	Survival (96h)	**Analyst:**	Michelle Kawaguchi
Start Date:	27 Jul-14 16:00	**Protocol:**	EPA-821-R-02-012 (2002)	**Diluent:**	SAM-5S
Ending Date:	31 Jul-14 14:35	**Species:**	Hyalella azteca	**Brine:**	Not Applicable
Duration:	95h	**Source:**	Chesapeake Cultures, Inc.	**Age:**	10

Sample ID:	11-9072-4585	**Code:**	KCl	**Client:**	Reference Toxicant
Sample Date:	27 Jul-14 16:00	**Material:**	Potassium chloride	**Project:**	22820
Receive Date:	27 Jul-14 16:00	**Source:**	Reference Toxicant		
Sample Age:	NA (23 °C)	**Station:**	In House		

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
19-6365-8524	96h Survival Rate	0.2	0.4	0.2828	NA		Fisher Exact/Bonferroni-Holm Test

Point Estimate Summary

Analysis ID	Endpoint	Level	g/L	95% LCL	95% UCL	TU	Method
19-9425-5682	96h Survival Rate	EC50	0.373	0.301	0.463		Spearman-Kärber

96h Survival Rate Summary

C-g/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Lab Water Contr	10	1	1	1	1	1	0	0	0.0%	0.0%
0.1		10	1	1	1	1	1	0	0	0.0%	0.0%
0.2		10	1	1	1	1	1	0	0	0.0%	0.0%
0.4		10	0.4	0.207	0.593	0	1	0.163	0.516	129.0%	60.0%
0.8		10	0	0	0	0	0	0	0		100.0%
1.6		10	0	0	0	0	0	0	0		100.0%

96h Survival Rate Detail

C-g/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Lab Water Contr	1	1	1	1	1	1	1	1	1	1
0.1		1	1	1	1	1	1	1	1	1	1
0.2		1	1	1	1	1	1	1	1	1	1
0.4		1	0	1	0	1	0	0	0	1	0
0.8		0	0	0	0	0	0	0	0	0	0
1.6		0	0	0	0	0	0	0	0	0	0

96h Survival Rate Binomials

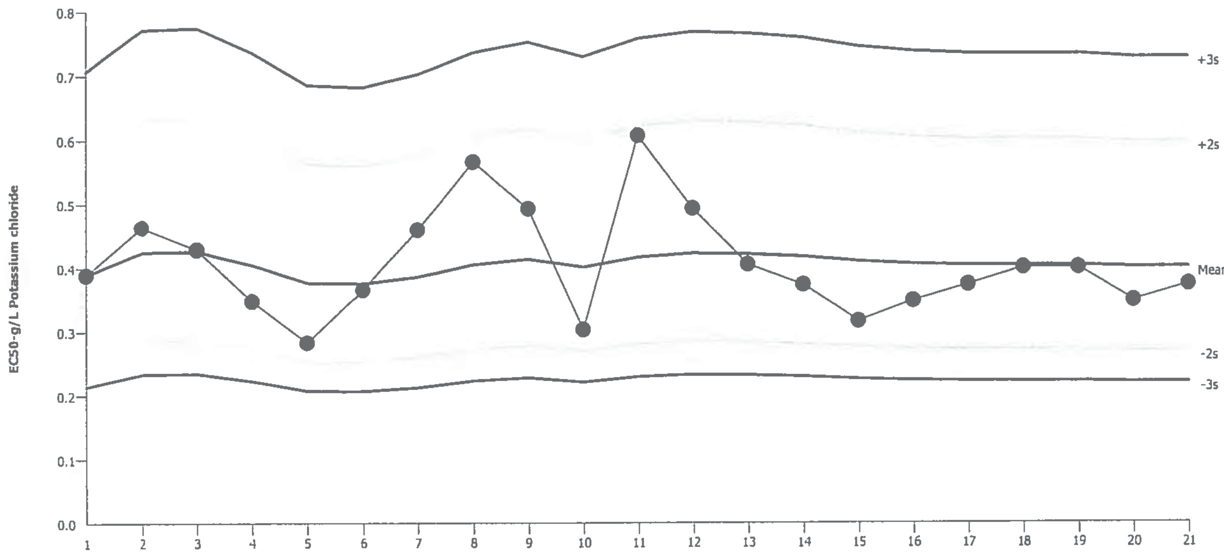
C-g/L	Control Type	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Rep 7	Rep 8	Rep 9	Rep 10
0	Lab Water Contr	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
0.1		1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
0.2		1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
0.4		1/1	0/1	1/1	0/1	1/1	0/1	0/1	0/1	1/1	0/1
0.8		0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1
1.6		0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1

CETIS QC Plot

Report Date: 02 Aug-14 08:10 (1 of 1)

Hyalella 96-h Acute Survival Test — Pacific EcoRisk

Test Type:	Survival (96h)	**Organism:**	Hyalella azteca (Freshwater Amphip	**Material:**	Potassium chloride
Protocol:	EPA-821-R-02-012 (2002)	**Endpoint:**	96h Survival Rate	**Source:**	Reference Toxicant-REF



Mean:	0.4002	**Count:**	20	**-2s Warning Limit:**	0.2687	**-3s Action Limit:**	0.2202
Sigma:	NA	**CV:**	22.00%	**+2s Warning Limit:**	0.5961	**+3s Action Limit:**	0.7275

Quality Control Data

Point	Year	Month	Day	Time	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID
1	2014	Jan	22	15:30	0.3887	-0.01152	-0.1466			15-1323-9580	12-5039-1906
2			23	12:20	0.4634	0.06319	0.7359			12-4927-8114	03-4534-5077
3			24	13:50	0.4287	0.02847	0.345			04-8256-1553	14-6784-2933
4			29	12:45	0.3482	-0.05202	-0.6989			02-0910-9206	20-3009-8021
5			30	13:00	0.2828	-0.1174	-1.743			07-7453-2234	19-6136-6595
6			31	15:00	0.3651	-0.0351	-0.4608			07-3562-2451	09-8419-3354
7		Feb	4	16:00	0.4595	0.05924	0.693			07-2556-9878	06-3437-8862
8			7	17:40	0.5657	0.1654	1.737			12-2780-2249	04-4756-7462
9			15	17:00	0.4925	0.09222	1.041			20-0080-3088	01-2359-2306
10			20	15:45	0.3031	-0.09709	-1.395			05-7047-7703	05-1521-5106
11			27	18:10	0.6063	0.2061	2.085	(+)		00-8786-3488	13-6064-7851
12			28	18:20	0.4925	0.09222	1.041			17-7114-0796	13-7617-1964
13		Mar	1	17:30	0.4048	0.004573	0.05703			13-0688-9437	00-6627-1218
14			27	13:00	0.3732	-0.02702	-0.3509			08-8207-4257	13-7765-3936
15		Apr	19	16:00	0.3162	-0.08406	-1.184			08-9365-8733	12-7246-8879
16		May	17	15:20	0.3482	-0.05202	-0.6989			10-0231-2264	05-8112-0401
17			30	14:30	0.3732	-0.02702	-0.3509			07-8466-6021	10-2686-8051
18		Jun	5	16:40	0.4	-0.00024	-0.00297			21-3469-3919	07-7147-2954
19		Jul	20	16:00	0.4	-0.00024	-0.00297			05-0442-5035	13-8903-6798
20			24	14:15	0.3482	-0.05202	-0.6989			11-0314-5496	07-7675-6316
21			27	16:00	0.3732	-0.02702	-0.3509			10-7064-3733	19-9425-5682

96 Hour *Hyalella azteca* Reference Toxicant Test Data

Client: **Pacific EcoRisk**
Test Material: Potassium Chloride
Test ID#: 58640 Project # 22820
Test Date: 7-27-14 Randomization: 10.6.9
Feeding T0 Time: 0830 Initials: CP

Organism Log #: 8387 Age: ~~1-2~~ 9-10 days
Organism Supplier: Chesapeake Cultures
Control/Diluent: SAM-5
Control Water Batch: 127
Feeding T46 Time: 0950 Initials: MA

Treatment (g/L)	Temp (°C)	pH	D.O. (mg/L)	Conductivity (µS/cm)	A	B	C	D	E	F	G	H	I	J	Sign-Off
					# Live Animals										
Control	23.0	8.02	6.7	403	1	1	1	1	1	1	1	1	1	1	Test Solution Prep: [illegible]
0.1	23.0	7.99	7.0	~~770~~ 649	1	1	1	1	1	1	1	1	1	1	New WQ: JR
0.2	23.0	8.02	7.0	771	1	1	1	1	1	1	1	1	1	1	Initiation Date: 7-27-14
0.4	23.0	7.99	7.3	1177	1	1	1	1	1	1	1	1	1	1	Initiation Time: 1600
0.8	23.0	7.95	7.6	1882	1	1	1	1	1	1	1	1	1	1	Initiation Signoff: MA
1.6	23.0	7.87	8.9	3310	1	1	1	1	1	1	1	1	1	1	RT Batch #: 14
Meter ID	43A	PH15	RD09	EC09											
Control	23.2				1	1	1	1	1	1	1	1	1	1	Count Date: 7/28/14
0.1	23.2				1	1	1	1	1	1	1	1	1	1	Count Time: 0915
0.2	23.2				1	1	1	1	1	1	1	1	1	1	Count Signoff: [illegible]
0.4	23.2				1	1	1	1	1	1	1	1	1	1	
0.8	23.2				0	0	0	0	0	1	0	0	0	0	
1.6	23.2				0	0	0	0	0	0	0	0	0	0	
Meter ID	43A														
Control	23.3				1	1	1	1	1	1	1	1	1	1	Count Date: 7/29/14
0.1	23.3				1	1	1	1	1	1	1	1	1	1	Count Time: 0945
0.2	23.3				1	1	1	1	1	1	1	1	1	1	Count Signoff: MA
0.4	23.3				1	0	1	1	1	1	1	0	1	1	
0.8	—				0	0	0	0	0	0	0	0	0	0	
1.6	—				0	0	0	0	0	0	0	0	0	0	
Meter ID	43A														
Control	23.1				1	1	1	1	1	1	1	1	1	1	Count Date: 7/30/14
0.1	23.1				1	1	1	1	1	1	1	1	1	1	Count Time: 1025
0.2	23.1				1	1	1	1	1	1	1	1	1	1	Count Signoff: MA
0.4	23.1				1	—	1	0	1	0	0	—	1	0	
0.8	—				—	—	—	—	—	—	—	—	—	—	
1.6	—				—	—	—	—	—	—	—	—	—	—	
Meter ID	43A														
Control	23.0	7.59	7.6	556	1	1	1	1	1	1	1	1	1	1	Termination Date: 7/31/14
0.1	23.0	7.53	7.7	779	1	1	1	1	1	1	1	1	1	1	Termination Time: 1435
0.2	23.0	7.58	7.6	788	1	1	1	1	1	1	1	1	1	1	Termination Signoff: AWS
0.4	23.0	7.65	7.4	1338	1	—	1	—	1	—	—	—	1	—	Old WQ: CA
0.8	—	7.81	7.6	2203	—	—	—	—	—	—	—	—	—	—	
1.6	—	7.84	7.7	3860	—	—	—	—	—	—	—	—	—	—	
Meter ID	43A	pH21	RD11	EC08											

Appendix 4

Pollutants of Concern Status Report

Pollutants of concern (POC) loads monitoring progress report, water years (WYs) 2012, 2013, and 2014

Prepared by

Alicia Gilbreath, Jennifer Hunt, Jing Wu, Patrick Kim, and Lester McKee

San Francisco Estuary Institute, Richmond, California

On

January 20, 2015

For

Bay Area Stormwater Management Agencies Association (BASMAA)

And

Regional Monitoring Program for Water Quality in San Francisco Bay (RMP)
Sources Pathways and Loadings Workgroup (SPLWG)
Small Tributaries Loading Strategy (STLS)

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1. Introduction

The San Francisco Regional Water Quality Control Board (Water Board) has determined that San Francisco Bay is impaired by mercury and PCBs due to threats to wildlife and human consumers of fish from the Bay. These contaminants persist in the environment and accumulate in aquatic food webs (SFRWRCB 2006; SFRWRCB, 2008). The Water Board has identified urban runoff from local watersheds as a pathway for pollutants of concern into the Bay, including mercury and PCBs. The Municipal Regional Stormwater Permit (MRP; SFRWRCB, 2009) contains several provisions requiring studies to measure local watershed loads of suspended sediment (SS), total organic carbon (TOC), polychlorinated biphenyl (PCB), total mercury (HgT), total methylmercury (MeHgT), nitrate-N (NO3), phosphate-P (PO4), and total phosphorus (TP) (provision C.8.e), as well as other pollutants covered under provision C.14. (e.g. legacy pesticides, PBDEs, and selenium).

Four Bay Area Stormwater Programs[1], represented by the Bay Area Stormwater Management Agencies Association (BASMAA), collaborated with the San Francisco Bay Regional Monitoring Program (RMP) to develop an alternative strategy allowed by Provision C.8.e of the MRP, known as the Small Tributaries Loading Strategy (STLS) (SFEI, 2009). An early version of the STLS provided an initial outline of the general strategy and activities to address four key management questions (MQs) that are found in MRP provision C.8.e:

> MQ1. Which Bay tributaries (including stormwater conveyances) contribute most to Bay impairment from POCs;
>
> MQ2. What are the annual loads or concentrations of POCs from tributaries to the Bay;
>
> MQ3. What are the decadal-scale loading or concentration trends of POCs from small tributaries to the Bay; and,
>
> MQ4. What are the projected impacts of management actions (including control measures) on tributaries and where should these management actions be implemented to have the greatest beneficial impact.

Since then, a Multi-Year-Plan (MYP) has been written (BASMAA, 2011) and updated twice (BASMAA, 2012; BASMAA, 2013). The MYP provides a comprehensive description of activities that will be implemented over the next 5-10 years to provide information and comply with the MRP. The MYP provides rationale for the methods and locations of proposed activities to answer the four MQs listed above. Activities include modeling using the regional watershed spreadsheet model (RWSM) to estimate regional scale loads (Lent and McKee, 2011; Lent et al., 2012; McKee et al., 2014), and pollutant characterization and loads monitoring in local tributaries beginning Water Year (WY) 2011 (McKee et al.,

[1] Alameda Countywide Clean Water Program, Contra Costa Clean Water Program, San Mateo Clean Water Pollution Prevention Program and Santa Clara Urban Runoff Pollution Prevention Program conduct monitoring and other activities on behalf of MRP Permittees in the four largest Bay Area counties.

2012), that continued in WY 2012 (McKee et al., 2013), WY 2013 (Gilbreath et al., 2014), and was largely completed in WY 2014 (this report).

The purpose of this report is to describe data collected during all three WYs (2012, 2013, and 2014) in compliance with MRP provision C.8.e., following the standard report content described in provision C.8.g.vi. The study design (selected watersheds and sampling locations, analytes, sampling methodologies and frequencies) as outlined in the MYP was developed to assess concentrations and loads in watersheds that are considered to likely be important watersheds in relation to sensitive areas of the Bay margin (MQ1):

- Lower Marsh Creek (Hg);
- North Richmond Pump Station (Hg and PCBs);
- San Leandro Creek below Chabot dam (Hg);
- Guadalupe River (Hg and PCBs);
- Sunnyvale East Channel (PCBs); and
- Pulgas Creek Pump Station South (PCBs).

Loads monitoring provides verification data for the RWSM (MQ2), and is intended to provide baseline data to assess long term loading trends (MQ3) in relation to management actions (MQ4). This report was structured to allow annual updates after each subsequent winter season of data collection. It should be noted that the sampling design described in this report (and modeling design: Lent and McKee, 2011; Lent et al., 2012; McKee et al., 2014) was focused mainly on addressing MQ2. During the next permit term (perhaps beginning in 2015), there will be an increasing focus towards finding high leverage watersheds and source areas within watersheds (MQ 1) for management focus (MQ4). A parallel report (the “POC synthesis report” (SFEI in preparation)) is intended to document progress to date towards addressing management questions and the rationale for changed monitoring design going forward that more carefully addresses MQ1 and MQ4.

2. Field methods

2.1. Watershed physiography, sampling locations, and sampling methods

The San Francisco Bay estuary is surrounded by nine highly urbanized counties with a total population greater than seven million people (US Census Bureau, 2010). Although urban runoff from upwards of 300 small tributaries (note the number is dependent upon how the areas are lumped or split) flowing from the adjacent landscape represents only about 6% of the total freshwater input to the San Francisco Bay, this input has broadly been identified as a significant source of pollutants of concern (POCs) to the estuary (Davis et al., 2007; Oram et al., 2008; Davis et al., 2012; Gilbreath et al., 2012). Four watershed sites were sampled in WY 2012 and two additional watershed sites were added in WY 2013 and WY 2014 (Figure 1; Table 1). The sites were distributed throughout the counties where load monitoring was required by the MRP. The selected watersheds include areas with urban and industrial land uses, watersheds where stormwater programs are planning enhanced management actions to reduce PCB and mercury discharges, and watersheds with historic mercury or PCB occurrences or related management concerns.

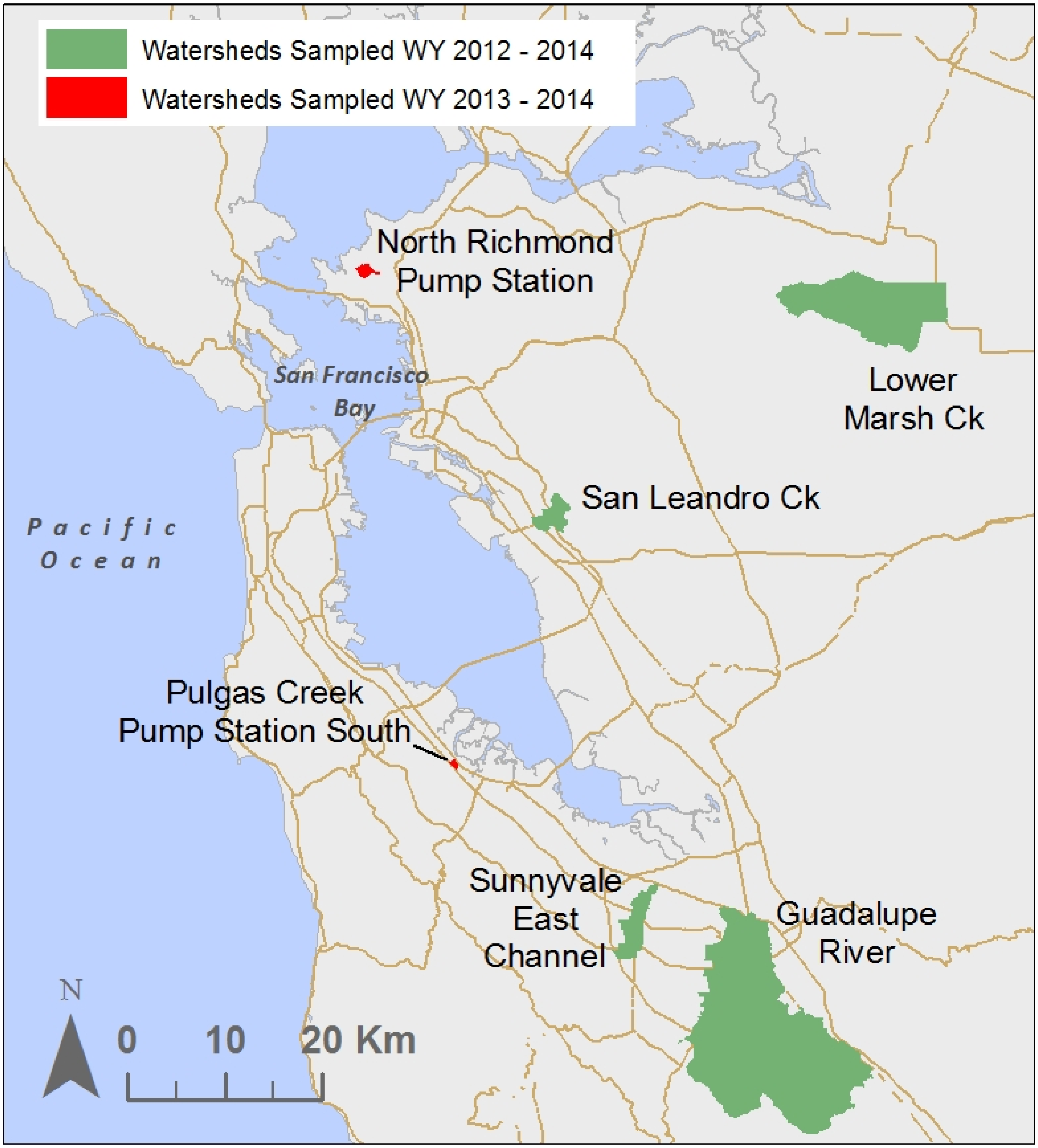

Figure 1. Water year 2012, 2013 and 2014 sampling watersheds.

Table 1. Sampling locations in relation to Countywide stormwater programs and sampling methods at each site.

County program	Watershed name	Water years sampled	Watershed area (km^2)[1]	Sampling location			Operator	Discharge monitoring method	Turbidity	Water sampling for pollutant analysis		
				City	Latitude (WGS1984)	Longitude (WGS1984)				Hg/MeHg collection	Discrete samples excluding Hg species	Composite samples
Contra Costa	Marsh Creek	2012-2014	99	Brentwood	37.990723	-122.16265	ADH	USGS Gauge Number: 11337600[2]; STLS creek stage applied to USGS discharge rating	OBS-500[4]	Manual grab	ISCO auto pump sampler[8]	ISCO auto pump sampler[8]
Contra Costa	North Richmond Pump Station	2013-2014	2.0	Richmond	37.953945	-122.37398	SFEI	Measurement of pump rotations/ interpolation of pump curve	OBS-500[4]	FISP US D95[7]	ISCO auto pump sampler[8]	ISCO auto pump sampler[8]
Alameda	San Leandro Creek	2012-2014	8.9	San Leandro	37.726073	-122.16265	SFEI WY2012 ADH WYs 2013-14	STLS creek stage/ velocity/ discharge rating	OBS-500**[4]	FISP US D95[7] WY 2012 ISCO pump sampler WY 2013-14	ISCO auto pump sampler[8]	ISCO auto pump sampler[8]
Santa Clara	Guadalupe River	2012-2014	236	San Jose	37.373543	-121.69612	SFEI WY2012 Balance WYs 2013-14	USGS Gauge Number: 11169025[3]	DTS-12[5]	FISP US D95[6]	FISP US D95[6]	FISP US D95[6]
Santa Clara	Sunnyvale East Channel	2012-2014	14.8	Sunnyvale	37.394487	-122.01047	SFEI	STLS creek stage applied to SCVWD discharge rating[6]	OBS-500*[4] WY 2012 DTS-12[5] WYs 2013-14	FISP US D95[8]	ISCO auto pump sampler[8]	ISCO auto pump sampler[8]
San Mateo	Pulgas Creek South Pump Station[9]	2013-2014	0.6	San Carlos	37.504583	-122.24901	KLI	ISCO area velocity flow meter with an ISCO 2150 flow module	DTS-12[5]	Pole sampler	ISCO auto pump sampler[8]	ISCO auto pump sampler[8]

[1]Area downstream from reservoirs
[2]USGS 11337600 MARSH C A BRENTWOOD CA
[3]USGS 11169025 GUADALUPE R ABV HWY 101 A SAN JOSE CA
[4]Campbell Scientific OBS-500 Turbidity Probe
[5]Forest Technology Systems DTS-12 Turbidity Sensor
[6]This rating curve was verified with discharge velocity measurements in WY 2012
[7]FISP US D-95 Depth integrating suspended hand line sampler
[8]Teledyne ISCO 6712 Full Size Portable Sampler
[9]Both the northern and southern catchments to the Pulgas Creek Pump Station were sampled in the WY 2011 characterization study (McKee et al., 2012)
*OBS-500 malfunctioned during WY 2012 due to low flow water depth. A DTS-12 was installed during WY 2013
**OBS-500 malfunctioned during some WY2014 events

The monitoring design focused on winter season storms between October 1 and April 30 of each water year; the period when the majority of pollutant transport occurs in the Bay Area (McKee et al., 2003; McKee et al., 2006; Gilbreath et al, 2012). At all six sampling locations, measurement of continuous stage and turbidity at time intervals of 15 min or less was the basis of the chosen monitoring design (Table 1). At free flowing sites, stage was used along with a collection of discrete velocity measurements to generate a rating curve between stage and instantaneous discharge. Subsequently this rating curve was used to estimate a continuous discharge record over the wet season by either the STLS team or USGS depending on the sampling location (Table 1). At Richmond pump station, an optical proximity sensor (Omron, model E3F2) was used along with stage measurements and a pump efficiency curve based on the pump specifications to estimate flow. ISCO flow meters were deployed at the Pulgas Creek Pump Station (Table 1). Turbidity is a measure of the “cloudiness” in water caused by suspension of particles, most of which are less than 62.5 µm in size and, for most creeks in the Bay Area, virtually always less than 250 µm (McKee et al., 2003). In natural flowing rivers and urban creeks or storm drains, turbidity usually correlates with the concentrations of suspended sediments and hydrophobic pollutants. In the creek and channel sampling locations, turbidity probes were mounted in the thalweg of each sampling location on an articulated boom that allowed turbidity sampling at approximately mid-depth under most flow conditions (McKee et al., 2004). At North Richmond Pump Station, the turbidity probe was mounted on a boom that extended into the center of the central well. At Pulgas Creek South Pump Station, the turbidity probe was attached to the catch basin wall at a fixed height, which was selected to ensure the probe remained submerged.

Composite and discrete samples were collected for multiple analytes from the water column over the rising, peak, and falling stages of the hydrograph. The sampling design was developed to support the use of turbidity surrogate regression (TSR) during loads computations. This method is deemed one of the most accurate methods for the computation of loads of pollutants transported dominantly in particulate phase such as suspended sediments, mercury, PCBs and other pollutants (Walling and Webb, 1985; Lewis, 1996; Quémerais et al., 1999; Wall et al., 2005; Ruzycki et al., 2011; Gilbreath et al., 2012; Riscassi and Scanlon, 2013). The method involves logging a continuous turbidity record in a short time interval (15 min or less during the study) and collecting a number of discrete samples to support the development of pollutants specific regressions. In this study, although not always achievable (see discussion later in the report), field crews aimed to collect 16 samples per water year during an early storm, several mid-season storms (ideally including one of the largest storms of the season) and later season storm. The use of turbidity surrogate regression and the other components of this sampling design was recommended over a range of alternative designs (Melwani et al 2010), and was adopted by the STLS (BASMAA, 2011).

Discrete samples for analytes used for loads computations (except water samples collected for mercury, methylmercury and a simultaneously collected sample for suspended sediment analysis) were collected using the ISCO autosampler as a slave pump at all the sites except the Guadalupe River site. At the Guadalupe River location, all discretely collected samples were collected using a Teflon coated Federal Interagency Sediment Program (FISP) D-95 depth-integrating water quality sampler due to the large distance between the overhead structure (a road bridge) and the water surface. Discrete samples for analysis of mercury and methylmercury and a simultaneously collected sample for SSC analysis were collected with the D-95 at Guadalupe, Sunnyvale East Channel, North Richmond Pump Station, and San Leandro Creek (WY 2012 only), using a pole sampler at Pulgas Creek Pump Station, by manually dipping an opened bottle from the side of the channel at Lower Marsh Creek (both WYs), and by ISCO manual pump at San Leandro (in WY 2013-2014) (Table 1).

Tubing for the ISCO autosamplers was installed using the clean hands technique, as was the 1 L Teflon bottle for use with the D-95. Composite samples made up of a number of discrete sub-samples were collected using the ISCO autosampler at all of the sites except Guadalupe River. Composite samples and the timing of each individual sub-sample were collected with the intent of representing the average concentrations during a storm runoff hydrograph for each storm event sampled. The concentration of a particular analyte of interest obtained from laboratory analysis of such a composite sample is usually referred to as an event mean concentration (Stone et al., 2000; Ma et al., 2009). However, as will be discussed later for each of the individual sites, the composites collected during this study rarely captured sub-samples from the entire hydrograph. Additionally, these composites were time-weighted (except at North Richmond Pump Station where collection times were limited to times of pump outs) rather than flow-weighted, chosen to better represent the average conditions that an organism would be exposed to over a period of time, which was advantageous to the interpretation of toxicity. At the Guadalupe site, a FISP D-95 depth integrating water quality sampler was used to collect multiple discrete samples over the hydrograph which were manually composited on-site.

All water samples were collected in pre-labeled appropriately sized and cleaned sample bottles and placed on ice in coolers either during the sampling procedure or as soon as practically possible. Samples were transported back to the office and labels were rechecked as they were logged in prior to and in preparation for shipment to the laboratories.

2.2. Loads computational methods

It has been recognized since the 1980s that different sampling designs and corresponding loads computation techniques generate computed loads of differing magnitude and of varying accuracy and precision (e.g. Walling and Webb, 1985). Therefore, how can we know which methodology generates the most accurate load? In all environmental situations, techniques that maintain high resolution variability in concentration and flow data during the field collection and subsequent computation process result in high-resolution loads estimates that are more accurate no matter which loads computation technique is applied. Less accurate loads are generated by sampling designs that do not account for (or adequately describe) the concentration variability (e.g. a daily or weekly sampling protocol would not work for a semi-arid environment like the Bay Area where storm hydrographs are flashy even in larger watersheds) or that use some kind of mathematical average concentration (e.g. simple mean; geometric mean; flow weighted mean) combined with monthly or annual time interval flows (again would not work in the semi-arid environment since 95% of flow occurs during storms).

Since the objective of any type of environmental data interpretation exercise is to neither over nor under interpret the available data, any loads computation technique that employs extra effort to stratify the data as part of the computation protocol will generate the most accurate loading information.

Stratification can be done in relation to environmental processes such as seasonality, flow regime, or data quality. In a general sense, the more resolved the data are in relation to the processes of concentration or flow variation, the more likely it is that computations will result in loads with high accuracy and precision. The data collection protocol implemented through the Small Tributaries Loading Strategy (STLS) was designed to allow for data stratification in the following manners:

1. Early-season ("1st storm") storm flow sampled for pollutants
2. Mid-season ("largest flood") storm flow sampled for pollutants
3. Later-season storm flow sampled for pollutants
4. Early-, mid-, and later-season storm flow when no pollutant sampling took place
5. Dry weather flow

Loads computation techniques differ for each of these strata in relation to pollutants that are primarily transported in dissolved or particulate phase. As subsequent samples were collected each year at the STLS monitoring sites, our knowledge about how concentrations varied with season and flow (improvements of the definition of the strata) and thus about how best to apply loads computation techniques gradually improved. Therefore, with each additional annual reporting year, the loads were recomputed. This occurred in relation to both improved flow information as well as an improved understanding of concentration variation in relation to seasonal characteristics and flow. The loads and interpretations presented here therefore supersede those reported in previous annual reports for WY 2012 (McKee et al., 2013), WYs 2012 and 2013 (Gilbreath et al., 2014).

During the study, concentrations either measured or estimated were multiplied with the continuous estimates of flow (1-15 minute interval) to compute the load on a 1 to 15 minute basis and summed to monthly and wet season loads. Laboratory measured data were retained in the calculations and assumed real for that moment in time. The techniques for estimating concentrations were applied in the following order of preference (and resulting accuracy of loads) as appropriate for each analyte (see summary in Table 2):

Linear interpolation: Linear interpolation was the primary technique used for interpolating concentrations between measured data points when storms were well sampled. It is the most accurate loads computation method for such storms and retains the maximum amount of information about how concentration and flow varies during the storm of interest (Young and DePinto, 1988; Kronvang and Bruhn, 1996). Two linear interpolation approaches were applied:

> **Linear Interpolation using water concentrations (LI_{WC}):** Linear interpolation using water concentrations is the process by which the interpreter estimates the concentrations mathematically between observed measurements using a linear time step (Kronvang and Bruhn 1996). It was appropriately used for pollutants which occur mainly in dissolved phase because it does not incorporate varying turbidity or SSC (Table 2). It can be used for analytes that are primarily transported in particulate phase; although during this study a superior method using particle ratios was applied to those analytes (Table 2).

Linear Interpolation using particle ratios (LI_{PR}): Linear interpolation using particle ratios can be thought of as locally derived regression in three-dimensional space. It is superior to linear interpolation using water concentrations (see above) for pollutants which occur mainly in particulate form because it ensures that the relationship between the derived concentration and varying turbidity that occurs between the two laboratory pollutant measurements results in particle ratios that, at all times, are reasonable (simpler linear interpolation of concentrations between samples may lead to unreasonable particle ratios for example if samples are collected on either side of a turbidity peak leading to lower particle ratios estimated at the turbidity peak). The use of this method was decided upon in concert with the field sampling design and was only possible because of the collection of continuous turbidity measurements. It was ideal for PCBs and Hg (two of the analytes of most interest) as well as other particulate phase analytes like total phosphorus (Table 2).

Regression Estimators: Regression estimator methods for loads calculations involve developing relationships between limited sample concentration data and an unlimited surrogate measure (e.g. turbidity or flow). These relationships are then applied to the unlimited surrogate measure record (e.g. the short time interval records of flow or turbidity) to calculated short time interval estimates of pollutant concentrations. This loads calculation method has been widely applied to estimating suspended sediment loads throughout the world (e.g., Walling and Webb, 1985; Lewis, 1996), demonstrated by SFEI and others to work well for metals (e.g., Quémerais et al., 1999; Wall et al., 2005; David et al. in press; McKee et al., 2010; Ruzycki et al., 2011; Riscassi and Scanlon, 2013), and more recently been demonstrated by SFEI to work well for organic pollutants (McKee et al., 2006; Gilbreath et al., 2012). This study was designed specifically to apply this method for loads calculations of discretely sampled analytes.

Interpolation using unique POC-flow based regression equations (FSR): The flow based surrogate regression interpolation method was applied for pollutants transported dominantly in the dissolved phase and forming a good relationship with flow, or to the more particle associated pollutants during periods when a turbidity probe failed to deliver quality data (yet the relationship with flow was preferred over resorting to a simple ratio or averaging method.

Interpolation using unique POC-turbidity based regression equations (TSR): Turbidity surrogate regression can be considered the default standard for pollutants of concern that are primarily transported in a particulate form. These types of pollutants (for example PCBs and mercury) form strong linear relationships with either turbidity or SSC. For the particle associated pollutants, turbidity surrogate regression was applied to all unsampled flood flow conditions observed at each monitoring site except under rare circumstances when turbidity data were not available due to probe malfunction. This interpolation method is superior to FSR for particle-associated pollutants because takes into account hysteresis in relation to flow (Walling and Webb, 1985; Lewis, 1996). For example concentrations of suspended sediment and pollutants that are strongly associated with suspended sediment often have greater concentrations during the rising stage of the hydrograph for a given flow as compared with concentrations at the same flow magnitude but on the falling stage of a given hydrograph. This occurs because there is more energy in the water column and typically no transport or source limitation during the rising stages of the hydrograph and earlier phases of a storm. Conversely, water transported during the falling stages is typically less turbulent and sources may have been washed clean by this time or, for the larger watersheds or those that have nonurban land-use in the upstream areas, lower concentrations can occur purely because the origin of the water has evolved to include upstream or less impervious components of the watershed.

Ratios and Averages: During unsampled periods of the record and in cases where pollutants did not form strong relationships with surrogate measures (turbidity, flow and other measured pollutants were all explored), or during periods when the surrogate measure record was unavailable, a simple ratio or average estimator method was applied.

Flow Weighted Mean Concentration (FWMC): In the event that flow or turbidity/SSC does not adequately explain the variation in pollutant concentrations, a flow weighted mean concentration can be calculated and applied to the appropriate flow classes. This is a simple ratio method that averages the concentration data but weighted more heavily towards the greatest flow and thus is an improvement over a simple average (Walling and Web, 1985, Birgand et al., 2010). If warranted, the data may be stratified first with a different FWMC applied to each stratum. Stratification in this manner has been previously applied for Chesapeake Bay tributaries and found to improve the accuracy of loading estimates (Lawson et al., 2001). Using a FWMC is the lowest accuracy method applied in this study for estimating storm flow concentrations.

Interpolation assuming a representative concentration (e.g. "dry weather lab measured" or "lowest measured"): To apply this method, an estimate of average concentrations under certain flow conditions is combined with discharge. This is, in effect, a simple average estimator and is the least accurate and precise of all the loads calculation methods. Because this sampling program focuses on characterizing concentration during storm flows, it may be desirable to use this method in addition to one or more of the previously mentioned methods (e.g. this method may better characterize lower flows alongside use of the FWMC to better characterize storm flows).

3. Continuous data quality assurance

3.1. Continuous data quality assurance methods

Prior to the start of WY 2012, the STLS monitoring teams developed the continuous monitoring protocols for the study collaboratively. Basic quality assurance methods were applied to the WY 2012 dataset. In WY 2013, a better documented method for quality assurance was developed and applied to continuous data (turbidity, stage, and rainfall) collected at the POC loads monitoring stations (McKee et al., 2013). QA was performed on WY 2012 data though not as systematically as later years. Quality of

Table 2. Methods predominantly used for loads computations in relation to each pollutant of concern.

Computation method[a]	SS	TOC	PCBs	HgT	MeHgT	NO3	PO4	TP
Linear interpolation water concentrations (LI_{WC})		✓				✓	✓	
Linear interpolation particle ratios (LI_{PR})	✓		✓	✓	✓			✓
Turbidity surrogate regression (TSR)	✓	✓	✓	✓	✓			✓
Flow surrogate regression (FSR)		✓				✓	✓	
Flow weighted mean concentration (FWMC)		✓				✓	✓	
Assumed representative concentration (for dry weather flow)	✓	✓	✓	✓	✓	✓	✓	✓

[a] Exceptions to the methods listed for each analyte include: FWMCs were used for all analytes at Pulgas Creek Pump Station South. Flow Surrogate Regression was used for most analytes at San Leandro Creek when the turbidity sensor was malfunctioning or had been removed to protect it from vandalism (FWMCs had to be used during these periods for TOC, NO3 and PO4), and at Sunnyvale East Channel to estimate SSC during all of WY 2012 and portions of WY 2013 when the turbidity record was impacted by vegetation collecting at the sensor. The estimated SSC was then used in regressions with particulate associated pollutants.

the continuous data record for each monitoring location for all three years are highlighted in the text below and summarized in Tables 3 and 4.

Throughout the season, field staff were responsible for data verification checks after data were downloaded during site visits. The field staff reviewed the data and completed a data transmission record. During the data validation process, individual records were flagged if they didn't meet the criteria developed in the continuous QA protocol. Datasets were evaluated in relation to the validation criteria, including: accuracy of the instruments through calibration, accuracy of the instruments in relation to comparison with manual measurements, dataset representativeness relative to logging interval and the degree of change from one measurement to the next, completeness of the dataset relative to the target monitoring period (October 1 – April 30) and finally our confidence in the corrections applied to the data records (Table 3 and Table 4). For more information on the quality assurance procedures developed and applied for continuous data, the reader is referred to the current version of the draft "*Quality Assurance Methods for Continuous Rainfall, Run-off, and Turbidity Data"* (McKee et al., 2015).

3.2. Continuous data quality assurance summary

The targeted monitoring period for this study was October 1 through April 30 each wet season (totaling 212 days each season). Especially in the first year of monitoring at each location in which the STLS team installed equipment (this excepts all equipment at Guadalupe as well as stage/flow equipment at Lower Marsh for WYs 2012 and 2013), there were often delays to start the season. The delay to start was the sole reason for missing stage data at all sites except for North Richmond Pump Station in WY 2013 when there was a 7 day period of missing record in October 2012 for unknown reasons. In addition to delayed starts, occasionally the rain gauges clogged, leading to data gaps in the rainfall records, and the expensive turbidity sensor at San Leandro Creek was often removed during periods when no rain was

Table 3. Continuous data quality assurance summary for record completeness and accuracy for each monitoring location. Missing days for all three monitoring years are provided, but quality ratings for accuracy of comparison were only developed for WYs 2013 and 2014. When only one rating is provided, it is relevant for both WYs. "NR" indicates that the QA procedure was not completed and "NA" indicates that the QA procedure was not applicable.

	Missing Days in Period of Record[a]			Accuracy of Comparison[b]		
	Rainfall	Stage	Turbidity	Rainfall	Stage	Turbidity
Lower Marsh	58/ 31/ 61	0 / 0 / 36	58 / 31 / 36	Excellent	NR	NR
Richmond	NA/ 61 / 0	NA / 7 / 17	NA / 0 / 0	Poor[1] / Excellent	NR / Excellent	Good[2] /Excellent
San Leandro	38 / 48 / 30	38 / 42 /23	38 / 42 / 37[3]	Excellent	Excellent	Excellent
Guadalupe	Complete	Complete	5 / 5 / 21	NA	NR / Excellent	Excellent
Sunnyvale	61 / 0 / 1	61 / 0 / 0	61 / 0 / 0	Excellent	Excellent	Excellent
Pulgas	NA / 9 / 21	NA / 41 / 21	NA / 117 / 72	Excellent	NR	Poor[4]

[a] Number of missing days is out of total target of 212 days. Number of missing days is provided for each monitoring year (WY 2012 - 2014)
[b] Accuracy of comparison is provided for WYs 2013 and 2014, the years for which this metric was evaluated systematically.
[1] Rainfall tipping bucket clogged during portions of December and January, leading to a poor relationship between the site record and other nearby rain gauge records.
[2] Regression between sensor and manual measurement data $R^2 = 0.85$.
[3] In total, 158 days of this record were missing turbidity in WY 2014. However, much of that time stages were low enough that no flow occurred. The 37 days noted includes the 23 days at the beginning of the record in which stage was not recorded plus 14 days in which flow did occur yet turbidity was not recorded. This equates to approximately half of the storms in WY 2014 which have no turbidity data.
[4] Manual turbidity measurements against sensor measurements had an $R^2 = 0.25$ in WY 2013 and 0.09 in WY 2014; this record fluctuated dramatically and cyclically (presumably in relation to pump outs); additional review of these data is recommended by BASMAA as they believe application of additional smoothing techniques may improve correlation between manual and sensor turbidity readings.

expected in order to prevent vandalism. A complete review of the number of days missing (out of 212) for each continuous record is provided in Table 3.

Overall the continuous rainfall data were acceptable. Rain data were collected at all the sites except for Guadalupe (Note, SCVWD collects high quality rainfall data throughout the Guadalupe River watershed), and the data were collected on the same time interval as stage and turbidity (except at North Richmond and Pulgas pump stations where rainfall data were collected on the 5 minute interval but stage and turbidity intervals were variable). Rain gauges were cleaned before and periodically during the season, but not calibrated. All sites except for the North Richmond Pump Station and Lower Marsh Creek compared well to nearby rain gauges. Clogging of the tipping buckets at these two sites led to discrepancies in the record compared with nearby gauges. The daily data of the site gage was regressed with the daily data of a nearby gage during periods when the site gage was working, and the regression was used to correct the site gage record. The regression was strong for North Richmond ($R^2 = 0.91$) but poor for San Leandro Creek ($R^2 = 0.61$). All sites had rainfall totals during 5-, 10- and 60-minute intervals that aligned with 1-, 2- and 5-year rainfall returns in their respective regions.

Overall the continuous stage data were acceptable. When collected, manual stage measurements compared well with the corresponding record from the pressure transducer ($R^2 > 0.99$ at all sites all years where it was measured). Percent differences between consecutive records were reasonable at all

Table 4. Continuous data quality assurance summary for representativeness and confidence in corrections for each monitoring location. Quality ratings were only developed for WYs 2013 and 2014. When only one rating is provided, it is relevant for both WYs. "NA" indicates that the QA procedure was not applicable.

	Representativeness of the Population[c]			Confidence in Corrections[c]		
	Rainfall	**Stage**	**Turbidity**	**Rainfall**	**Stage**	**Turbidity**
Lower Marsh	Excellent	Excellent	Excellent	Excellent / Poor[1]	Excellent	Excellent
Richmond	Excellent	Excellent	Poor / Good[2]	Good[3] / Excellent	Excellent	Excellent
San Leandro	Excellent	Excellent	Excellent	Excellent	Excellent	Poor[4]
Guadalupe	NA	Excellent	Excellent	NA	USGS maintained	Excellent
Sunnyvale	Excellent	Good[5] / Excellent	Excellent	Excellent	Excellent	Poor/Good[6]
Pulgas	Excellent	Excellent / Poor[7]	Good[8]	Excellent	Poor/Good[9]	Poor[10]

[c] Representativeness of the Population and Confidence in Corrections metrics are provided for WYs 2013 and 2014, the years for which this metric was evaluated systematically

[1] During WY 2014, data from 59% of the actual rain days were rejected due to clogging of the tipping bucket. The data were substituted with records from nearby local stations (Weather Underground). The regression of daily total rainfall between one of these substituted gages and the site gage for days when the tipping bucket was working had a coefficient of variation of 0.61; the other site has since been decommissioned and the relationship could not be evaluated.

[2] In WY 2013, 4.2% of the population (251 records) had > 20 NTU absolute value change and ≥15% relative change from the preceding record; 2.9% (171 records) had > 20 NTU absolute value change and >50% relative change from the preceding record. In WY 2014, 3.7% of the population had >20 NTU absolute value change and ≥15% relative change from the preceding record; 2.1% had >20 NTU absolute value change and >50% relative change from the preceding record.

[3] Data missing due to clogging was corrected with the nearby Richmond City Hall gage; the regression of daily total rainfall between the Richmond City Hall gage and the site gage for days when the tipping bucket was working had an $R^2 = 0.91$.

[4] Turbidity could not be measured at flows <0.4 ft. Generally, however, these were likely periods of very low turbidity anyway. However, during WY 2013, 23% of records for stages > 1ft were missing turbidity, and in WY 2014, several entire storms were missed due to the sensor not being installed to prevent vandalism or malfunctioning. For WY 2014, 43% of record for which there was flow did not have corresponding turbidity records.

[5] 4.7% of records at Sunnyvale in WY 2013 showed a >15% change between consecutive readings.

[6] The sensor installed during WY 2012 was not adequate for measuring turbidity at lower flows and the entire record was rejected (noted here but not reflected in the Table 4 rating since only WYs 2013 and 2014 are rated. During the subsequent water years, vegetation frequently got caught on the boom structure within the channel and fouled the turbidity record. During WY 2013, 8.3% of the record was rejected and could not be corrected. In WY 2014, 7% of records required correction but this time there was relatively clear evidence for the method used to fill data gaps.

[7] 14% of the records at Pulgas showed a >15% change between consecutive readings, 7% were >25% change, and 1.3% were >100%change.

[8] In WY 2013, 1.9% of the population (483 records) had > 20 NTU absolute value change and ≥15% relative change from the preceding record; 1.3% (328 records) had > 20 NTU absolute value change and >50% relative change from the preceding record. Recommended action for improvement is to shorten the recording interval from 5 minutes to 1 minute. In WY 2014, 1.6% of the population had > 20 NTU absolute value change and ≥15% relative change from the preceding record; 1.0% had > 20 NTU absolute value change and >50% relative change from the preceding record.

[9] During WY 2013, a large portion of the record was on intervals > 15 minutes and we often had no confidence in a method to correct the data. Equipment issues were improved in WY 2014 and the recording interval was set to 15 min except during times of flow, when it switched to logging on the 1 min interval. However, back-ups into the stormdrain led to zero-flow conditions prompting the measurement interval back to 15 minute intervals. It is unknown what the flow was between these occurrences. In total, this scenario appeared to have happened between 15-25 times and back-of-the-envelope calculations suggest that 2-4 % of the total flow volume was likely not recorded as a result.

[10] The turbidity sensor was placed in a catchbasin near the pump station and the runoff in the catchbasin was vigorously pumped out when the pump station turned on. This led to cyclical large variations in the turbidity record, and BASMAA is currently investigating the pump station on/off times to determine if spikes due to pumping can be identified and discerned from erroneous spikes. Pending additional review, the current comparison to the manual turbidity measurements was poor, and we have little confidence in the corrections that were applied to the dataset. Furthermore, the recording interval for WY 2013 was set to 5 min. This was also the case for WY 2014, except during times of flow, when it logged on the 1 min interval consistent with the stage record. However, back-ups into the stormdrain led to zero-flow conditions prompting the measurement interval back to 5 minutes. It is unknown what the flow and turbidity was between these occurrences.

sites with the exceptions of Sunnyvale in WY 2013 and Pulgas in WY 2014 when there were nearly 5 and 14% of the records at each station in which consecutive records showed greater than a 15% difference in stage measurement. Manual stage measurements were not collected at Pulgas Creek Pump Station at all during the study, and could not be used to verify the accuracy or precision of those stage records.

At the creek and channel sites, flow was calculated from the continuous stage record and therefore the accuracy of the estimated flows was dependent on a quality stage record as well as a quality discharge rating curve. At Lower Marsh Creek and Guadalupe River, the USGS had already developed discharge rating curves. The Santa Clara Valley Water District (SCVWD) provided a discharge rating curve for Sunnyvale Channel, and through measurements over a broad stage range, the STLS team verified the quality of the SCVWD curve. The San Leandro location was a challenging cross section to rate given no bed control, seasonally variable vegetation on the banks, variation in the cross-section morphology within and just upstream of the measurement point under the bridge and a near-field side channel entry just upstream. Given these issues, a flow rating for the site would likely take many years under a very wide variety of storms to verify with certainty. With these challenges in mind, the STLS team began development of a discharge rating curve at San Leandro Creek, which was well-measured in WY 2012 and 2014 at stages <2 feet and with three measurements in WY 2012 at approximately 3.5 feet of stage. Due to the large gap in measurements between 2 and 3.5 feet of stage, as well as no measurements for flows between 3.5 and 4 feet of stage (the maximum stage recorded during that study on 12/23/2012), we could have at best moderate confidence in the flow estimates for this site. Compounding this uncertainty, flow volumes estimated during storms of similar sizes between monitoring years were substantially different from year to year perhaps associated with morphological changes that were not documented. Therefore, despite excellent QA ratings for the continuous stage record at San Leandro, our overall confidence in the flow record for this site is low.

The pump station sampling locations employed alternate methods of flow estimation and therefore additional QA procedures were applied to the flow records. The stage records were evaluated for these sites in the same manner as for the creek and channel locations. Additionally, at North Richmond Pump Station, the optical proximity sensor record was reviewed for consistency of the pump shaft rates during times of operation. At both North Richmond and Pulgas Creek Pump Stations, the storms during each water year monitored were isolated and total flow and precipitation volumes were calculated. Relationships between these metrics were evaluated and used to identify eight storms at Pulgas from WY 2013 when the flow meter was malfunctioning. After censorship of these storms, the rainfall-runoff relation at each site was excellent (r^2=0.96 and r^2=0.98 for North Richmond and Pulgas, respectively).

Continuous turbidity data were rated excellent at Lower Marsh Creek and Guadalupe River throughout the monitoring periods. The San Leandro Creek dataset was relatively free from spikes requiring censorship or correction but had a large portion of missing records due to failure to install the sensor prior to some storm events and delays in correcting sensor loss or malfunction. Sunnyvale East Channel's entire WY 2012 record was censored because the numerous spikes that resulted from the OBS-500 reading the bottom of the channel during low flows could not be corrected. The turbidity record for Sunnyvale East Channel also had numerous spikes in the subsequent two years of monitoring due to vegetation catching on the boom structure and interfering with the turbidity measurement; this record could not be corrected for small portions of WY 2013 but because more frequent maintenance was implemented in WY 2014 to address this problem, the entire record could be used after correction of some records. The two pump station monitoring sites were the most dynamic in terms of turbidity magnitude changes from record to record and presented the most challenging logistics for turbidity measurement, which resulted in diminished quality. At North Richmond Pump Station, for example, the regression between sensor and manual measurements in WY 2013 was slightly less than ideal (r^2 = 0.85) and despite the frequent 1-minute logging interval, 4.2% of the WY 2013 records during pump outs had relative changes in turbidity magnitudes from record to record greater than 15% and 20 NTU, leading to a quality ranking of "Poor" for WY 2013. Field staff noted throughout the season large amounts of trash in the pump station well where monitoring occurred, and this could be the cause of the turbidity fluctuations, though it is also conceivable that the small urban system and unique monitoring configuration could have been so dynamic as to result in these relative changes. At Pulgas Creek South Pump Station the turbidity sensor was placed in a catchbasin near the inlet to the pump station and the runoff in the catchbasin was vigorously pumped out when the pumps turned on. This led to cyclical large variations in the turbidity record, and it was not always possible to discern erroneous spikes in the data record as opposed to the cyclical spikes resulting from the pump outs. BASMAA is undertaking further review of the pump on/off times to determine if spikes due to pumping can be identified and if somehow this information will be useful to estimating loads. Furthermore, the recording interval for WY 2013 was set to 5 min, which was long in duration relative to the dynamically changing system. The logging interval was improved in WY 2014, such that during times of flow turbidity was recorded on the 1 min interval consistent with the stage record. However, the programming logic set to accomplish this changing interval created some periods in which flow and turbidity were likely not recorded on the shorter intervals. The current comparison to the manual turbidity measurements at Pulgas Creek was poor in both water years, and we have little confidence in the corrections that were applied to the dataset. Ultimately, the turbidity record was not used to estimate continuous loads at Pulgas Creek, and a flow-based or flow-weighted mean concentration approach was adopted instead. BASMAA has suggested they may undertake further review of this dataset, including application of smoothing functions to better fit the pollutant data to the turbidity record and potentially improve the usability of these data.

4. Laboratory analysis and quality assurance

4.1. Sample preservation and laboratory analysis methods

All samples were labeled, placed on ice, transferred back to the respective site operator's headquarters, and refrigerated at 4 °C until transport to the laboratory for analysis. Laboratory methods were chosen to ensure the highest practical ratio between method detection limits, accuracy and precision, and costs (BASMAA, 2011; 2012). No changes were made between WYs 2013 and 2014 in laboratories conducting the chemical analyses (Table 5).

An inter-comparison study, started in WY 2013 and continued in WY 2014, was designed to assess any impacts of laboratory change during the study. A subset of samples were collected in replicate in the

Table 5. Laboratory analysis methods for WY 2014 samples.

Water Year	Analyte	Method	Field Filtration	Field Acidification	Laboratory
WY2012	Carbaryl	EPA 632M	No	No	DFG WPCL
WY2013	Carbaryl	EPA 632M	No	No	DFG WPCL
WY2014	Carbaryl	EPA 632M	No	No	DFG WPCL
WY2012	Copper[1]	EPA 1638M	No	No	Brooks Rand Labs LLC
WY2013	Copper[1]	EPA 1638M	No	No	Caltest Analytical Laboratory
WY2014	Copper[1]	EPA 1638M	No	No	Caltest Analytical Laboratory
WY2012	Dissolved OrthoPhosphate	EPA 300.1	Yes	No	EBMUD
WY2013	Dissolved OrthoPhosphate	SM20 4500-P E	Yes	No	Caltest Analytical Laboratory
WY2014	Dissolved OrthoPhosphate	SM20 4500-P E	Yes	No	Caltest Analytical Laboratory
WY2012	Fipronil	EPA 619M	No	No	DFG WPCL
WY2013	Fipronil	EPA 619M	No	No	DFG WPCL
WY2014	Fipronil	EPA 619M	No	No	DFG WPCL
WY2012	Nitrate	EPA 300.1	Yes	No	EBMUD
WY2013	Nitrate	EPA 353.2/SM20 4500-NO3 F	Yes	Yes	Caltest Analytical Laboratory
WY2014	Nitrate	EPA 353.2/SM20 4500-NO3 F	Yes	No	Caltest Analytical Laboratory
WY2012	PAHs	AXYS MLA-021 Rev 10	No	No	AXYS Analytical Services Ltd.
WY2013	PAHs	AXYS MLA-021 Rev 10	No	No	AXYS Analytical Services Ltd.
WY2014	PAHs	AXYS MLA-021 Rev 10	No	No	AXYS Analytical Services Ltd.
WY2012	PBDEs	AXYS MLA-033 Rev 06	No	No	AXYS Analytical Services Ltd.

Water Year	Analyte	Method	Field Filtration	Field Acidification	Laboratory
WY2013	PBDEs	AXYS MLA-033 Rev 06	No	No	AXYS Analytical Services Ltd.
WY2014	PBDEs	AXYS MLA-033 Rev 06	No	No	AXYS Analytical Services Ltd.
WY2012	PCBs	AXYS MLA-010 Rev 11	No	No	AXYS Analytical Services Ltd.
WY2013	PCBs	AXYS MLA-010 Rev 11	No	No	AXYS Analytical Services Ltd.
WY2014	PCBs	AXYS MLA-010 Rev 11	No	No	AXYS Analytical Services Ltd.
WY2012	Pyrethroids	AXYS MLA-046 Rev 04	No	No	AXYS Analytical Services Ltd.
WY2013	Pyrethroids	EPA 8270Mod (NCI-SIM)	No	No	Caltest Analytical Laboratory
WY2014	Pyrethroids	EPA 8270Mod (NCI-SIM)	No	No	Caltest Analytical Laboratory
WY2012	Selenium[1]	EPA 1638M	No	No	Brooks Rand Labs LLC
WY2013	Selenium[1]	EPA 1638M	No	No	Caltest Analytical Laboratory
WY2014	Selenium1	EPA 1638M	No	No	Caltest Analytical Laboratory
WY2012	Suspended Sediment Concentration	ASTM D3977	No	No	EBMUD
WY2013	Suspended Sediment Concentration	ASTM D3977-97B	No	No	Caltest Analytical Laboratory
WY2014	Suspended Sediment Concentration	ASTM D3977-97B	No	No	Caltest Analytical Laboratory
WY2012	Total Hardness	EPA 1638M	No	Yes	Brooks Rand Labs LLC
WY2013	Total Hardness	SM 2340	No	Yes	Caltest Analytical Laboratory
WY2014	Total Hardness	SM 2340 C	No	Yes	Caltest Analytical Laboratory

Water Year	Analyte	Method	Field Filtration	Field Acidification	Laboratory
WY2012	Total Mercury	EPA 1631EM	No	Yes	Moss Landing Marine Laboratories
WY2013	Total Mercury	EPA 1631EM Rev 11	No	Yes	Caltest Analytical Laboratory
WY2014	Total Mercury	EPA 1631EM Rev 11	No	Yes	Caltest Analytical Laboratory
WY2012	Total Methylmercury	EPA 1630M	No	Yes	Moss Landing Marine Laboratories
WY2013	Total Methylmercury	EPA 1630M Rev 8	No	Yes	Caltest Analytical Laboratory
WY2014	Total Methylmercury	EPA 1630M Rev 8	No	Yes	Caltest Analytical Laboratory
WY2012	Total Organic Carbon	SM 5310 C	No	Yes	Delta Environmental Lab LLC
WY2013	Total Organic Carbon	SM20 5310B	No	Yes	Caltest Analytical Laboratory
WY2014	Total Organic Carbon	SM20 5310B	No	Yes	Caltest Analytical Laboratory
WY2012	Total Phosphorus	EBMUD 488 Phosphorus	No	Yes	EBMUD
WY2013	Total Phosphorus	SM20 4500-P E	No	Yes	Caltest Analytical Laboratory
WY2014	Total Phosphorus	SM20 4500-P E/SM 4500-P F	No	Yes	Caltest Analytical Laboratory
WY2012	Toxicity[2]	See Table note 3 below	No	No	Pacific Eco-Risk Labs
WY2013	Toxicity2	See Table note 3 below	No	No	Pacific Eco-Risk Labs
WY2014	Toxicity2	See Table note 3 below	No	No	Pacific Eco-Risk Labs

[1] Dissolved selenium and dissolved copper samples were field filtered and field acidified (HNO_3) at the Lower Marsh Creek (WY 2012, 2013, 2014) and San Leandro Creek stations (WY 2013, 2014).

[2] Toxicity testing includes: chronic algal growth test with *Selenastrum capricornutum* (EPA 821/R-02-013), chronic survival & reproduction test with *Ceriodaphnia dubia* (EPA 821/R-02-013), chronic survival and growth test with fathead minnows, *Pimephales promelas* (EPA 821/R-02-013), and 10-day survival test with *Hyalella azteca* (EPA 600/R-99-064M).

field and sent to the previous and replacement laboratories for analysis. Nutrients, copper, mercury, methylmercury, selenium and pyrethroid samples were analyzed as part of the inter-comparison study. Individual laboratory QA summaries for the WY 2014 inter-comparison analyses are presented in section 5.2 of this report. A review of the inter-comparison study results and laboratory QA can be found in Attachment 2.

4.2. Quality assurance methods for pollutants of concern concentration data

The data quality was reviewed using protocols applied to samples collected for the SF Bay Regional Monitoring Program for Water Quality. Data handling procedures and acceptance criteria may differ among programs. However, underlying data are never discarded; results even for "censored" data are maintained, so impacts of applying different protocols can be assessed if desired.

4.2.1. Holding Times

Holding times are the length of time a sample can be stored after collection and prior to analysis without significantly affecting the analytical results. Holding times vary with the analyte, sample matrix, and analytical methodology used to quantify concentration. Holding times can be extended if preservation techniques are employed to reduce biodegradation, volatilization, oxidation, sorption, precipitation, and other physical and chemical processes.

4.2.2 Sensitivity

The sensitivity review evaluated the percentage of field samples that were non-detects (NDs) as a way to evaluate if the analytical methods employed were sensitive enough to detect expected environmental concentrations of the targeted parameters. In general, if more than 50% of the samples were ND, then the method may not be sensitive enough to detect ambient concentrations. However, review of historical data from the same project/matrix/region (or a similar one) helped to put this evaluation into perspective; in most cases the lab was already using a method that is as sensitive as is possible.

4.2.3 Blank Contamination

Blank contamination was assessed to quantify the amount of targeted analyte in a sample from external contamination in the lab or field. This metric was performed on a lab-batch basis. Lab blanks within a batch were averaged. When the average blank concentration was greater than the method detection limit (MDL), the field samples within each batch were qualified as blank contaminated. If the field sample result (including any reported as ND) was less than 3 times the average blank concentration those results were "censored" and not reported or used for any data analyses. All censored data are made available but are qualified as exceeding QAQC thresholds.

4.2.4 Precision

Rather than evaluation by lab batch, precision was reviewed on a project or dataset level (e.g., a year or season's data) so that the review took into account variation across batches. Only results that were greater than 3 times the MDL were evaluated, as results near MDL were expected to be highly variable. The overarching goal was to review precision using sample results that were most similar in characteristics and concentrations to field sample results. Therefore the priority of sample types used in this review was as follows: lab-replicates from field samples or field replicates (but only if the field replicates are fairly homogeneous which is unlikely for wet-season runoff event samples unless collected simultaneously from a location). Replicates from Certified Reference Materials (CRMs), matrix spikes, or spiked blank samples were reviewed next with preference to select the samples that most resembled the targeted ambient samples in matrix characteristics and concentrations. Results outside of the project management quality objective (MQO) but less than 2 times the MQO (e.g., ≤50% if the MQO is ≤25% relative percent difference (RPD) or relative standard deviation (RSD)) were qualified; those outside of 2 times the MQO were censored. All censored data are made available but are qualified as exceeding QAQC thresholds.

4.2.5. Accuracy

Accuracy was also reviewed on a project or dataset level (rather than a batch basis) so that the review takes into account variation across batches. Only results that were greater than 3 times the MDL were evaluated. Again, the preference was for samples most similar in characteristics and concentrations to field samples. Thus the priority of sample types used in this review was as follows: CRMs, then Matrix Spikes (MS), then Blank Spikes. If CRMs and MS were both reported in the same concentration range, CRMs were preferred because of external validation/certification of expected concentrations, as well as better integration into the sample matrix (MS samples were often spiked just before extraction). If both MS and blank spike samples were reported for an analyte, the MS was preferred due to its more similar and complex matrix. Blank spikes were used only when preferred recovery sample types were not available (e.g., no CRMs, and insufficient or unsplittable material for creating an MS). Results outside the MQO were qualified, and those outside 2 times the MQO (e.g., >50% deviation from the target concentration, when the MQO is ≤25% deviation) were censored for poor recovery. All censored data are made available in all public data displays but are qualified as exceeding QAQC thresholds.

4.2.6. Comparison of dissolved and total phases

This review was only conducted on water samples that reported dissolved and total fractions. In most cases the dissolved fraction was less than the particulate or total fraction. Some allowance is granted for variation in individual measurements, e.g. with a precision MQO of RPD or RSD<25%, a dissolved sample result might easily be higher than a total result by that amount.

4.2.7. Average and range of field sample versus previous years

Comparing the average range of the field sample results to comparable data from previous years (either from the same program or other projects) provided confidence that the reported data do not contain egregious errors in calculation or reporting (errors in correction factors and/or reporting units). Comparing the average, standard deviation, minimum and maximum concentrations from the past several years of data aided in exploring data, for example if a higher average was driven largely by a single higher maximum concentration.

4.2.8. Fingerprinting summary

The fingerprinting review evaluated the ratios or relative concentrations of analytes within an analysis. For this review, we looked at the reported compounds to find out if there are unusual ratios for individual samples compared to expected patterns from historic datasets or within the given dataset.

Since analyses of organic contaminants at trace levels are often susceptible to biases that may not be detected by conventional QA measures, additional QA review helps ensure the integrity of the reported data. Based on knowledge of the chemical characteristics and typical relative concentrations of organic contaminants in environmental samples, concentrations of the target contaminants are compared to results for related compounds to identify potentially erroneous data. Compounds that are more abundant in the original technical mixtures and are more stable and recalcitrant in the environment are expected to exist in higher concentrations than the less abundant or less stable isomers. For example, PCB congener concentrations follow general patterns of distribution based on the original concentrations in Aroclor mixtures. If an individual congener occurs at concentrations much higher than usual relative to more abundant congeners, the result warrants further investigation.

Furthermore, several contaminants chemically transform into other toxic compounds and are usually measured within predicted ranges of concentrations compared to their metabolites (e.g. heptachlor epoxide/heptachlor), so deviations from such expectations are also further investigated. However, great care should be exercised in using information on congener ratios of common Aroclor mixtures and other such heuristic methods, for some of the same reasons that interpreting environmental PCBs only as mixtures of Aroclors has limitations. Over-reliance on such patterns in data interpretation may lead to inadvertent censoring of data, e.g., for contributions from unknown or unaccounted sources.

When results are reported outside the range of expected relative concentrations, and the laboratory cannot identify the source of variability, values are qualified to indicate uncertainty in the results. If the reported values do not deviate much from the expected range, they are generally allowed to stand and are included in calculations of “sums” for their respective compound classes. However, if the reported concentrations deviate greatly from the expected range and are clearly higher than observed in past analyses or current sample splits, it can be reasonably concluded that the results are erroneous. Again, even “censored” data records are maintained, so any impact of censoring can be reviewed or reversed.

5 Results

The following sections present results from the six monitored tributaries. In the first sub-section, a summary of data quality is initially presented. This is then followed by sub-sections that synthesize climate and flow across the six locations, concentrations of POCs across the six locations, loads across six locations, and a graphical summary of particle concentrations across the six locations.

5.2 Project Quality Assurance Summary

The section below reports on WY 2014 data; for the WY 2012 and 2013 quality assurance summaries refer to previous reports.

Nutrients

Overall the nutrient data were acceptable. Methods were sufficiently sensitive to detect ambient environmental concentrations. Analytes were not detected in any lab blanks, so field samples did not need qualifying for blank contamination. Some analytes (orthophosphate and phosphorus) were detected in field blanks, with the lowest field samples usually at least about 3x higher than the maximum field blank, except for phosphorus, where the field blank (.057) was only ~20% less than the lowest field sample (.067), and only 6x lower than the average field result. Field blank samples with analyte detection were qualified, but field blanks were not included in all field sample batches so were not used for flagging field results on a batch or whole project basis. However, field blanks should be considered in the interpretation of low concentration samples even if not included in all analytical batches.

Precision on field replicates (generally blind) was good, with RSDs on field replicate samples averaging 15% or better for all the nitrogen analytes and <10% for the phosphorus analytes. Results for matrix spikes and blank spikes were consistent, averaging <10% RSD for all analytes. Recoveries were also good, averaging within 10% of expected values or better for all analytes on matrix spikes, and within ~5% or better for all analytes on laboratory control samples (LCS).

Nutrients - Inter-comparison Study

Overall the data were marginal, with moderate to large deviations for some analytes. Method detection limits were acceptable with no NDs reported. Data were reported not blank corrected. No contamination was measured in any of the method blanks. QC sample types were evaluated according to the preferences noted previously (with greatest preference to sample types most similar in matrix and concentration range as reported field samples, if results for those QC sample types were available in a reportable quantitative range). Lab replicates of field samples were used to evaluate precision for nutrients other than total phosphorus. Average RSDs were good, all less than their respective target MQOs (Nitrate 15%; orthophosphate, and total phosphorus 10%). LCS replicates were used to evaluate the precision of Total Phosphorus results, with average RSD of <1% well within the target MQO (10%). LCS recovery RSDs were examined for nitrate as N and orthophosphate as P but not used for qualifying precision on these analytes, since unspiked lab replicates were quantified for those. Orthophosphate (mean RSD 4.28%) was less than the target MQO (10%), but nitrate as N (mean RSD 22.31%) exceeded 15%, with much of the variation due to different spiking levels on different LCS.

Matrix spikes were used to evaluate the accuracy of total phosphorus results. Recoveries were good with the average recovery errors all within their target MQOs (nitrate 15%, orthophosphate, and total phosphorus 10%). LCS samples were used to assess the accuracy of Nitrate as N and orthophosphate, since these analytes were not in matrix spikes. Recoveries were fair for nitrate (mean error 23.25%, qualified with the non-censoring qualifier of “VIU”) and poor for orthophosphate (mean error 33.95% qualified with the censoring qualifier of “VRIU”). LCS samples were examined for total phosphorus, but not used for qualifying. Total phosphorus (mean error 9.74%) was less than the target MQO (10%).

Suspended Sediment Concentration

Overall the data were acceptable. Method detection limits (MDLs) were sufficient for estimation or quantitation of most samples, with only ~3% of the results reported as NDs. Data were reported not blank corrected. No blank contamination was found in the field or method blanks. LCS replicates were used to evaluate precision, with the average RSD (3.62%) being well below the target method quality objective (MQO) of 10%. The average RSD for field replicates was not used in the evaluation, but was examined and found to be 7.5%. No qualifiers were added. LCS were used to assess accuracy as they were the only spiked samples analyzed. Recoveries measured were good with the average recovery error of 2.93% being well below the target 10% MQO. No qualifiers were needed.

Suspended Sediment Concentration - Inter-comparison Study

Method detection limits were acceptable with no NDs reported. Data were reported not blank corrected. No contamination was measured in the method blanks. Lacking other sample types analyzed in replicate, CRM recoveries were used to evaluate the precision of Suspended Sediment Concentration results, and had an average RSD of 23.6%. Although this was more than double the target MQO of 10%, they were qualified with the non-censoring qualifier of "VIL" since the CRMs were certified at different target values and thus might not be expected to show similar recoveries. CRMs were used to assess the accuracy of the suspended sediment concentration results. Recoveries measured were fair with the average recovery error of 16.23% being greater than the target MQO of 10%, but less than 20%, so were qualified with the non-censoring qualifier of "VIU".

Total Organic Carbon

The TOC data were acceptable. MDLs were sufficient with zero NDs reported. Data were reported not blank corrected. Blank contamination was not measured in the method blanks. Equipment and field blanks were examined, but not used in qualifying field sample results in the database. Blank contamination was found in one of the seven equipment blanks at a level ~3% of those found in the field samples (equipment blank contamination 0.51 mg/L compared to mean field sample concentration 15.74 mg/L). No blank contamination was measured in the field blank.

Precision was evaluated using matrix spike replicates. The RSD was good averaging 0.47%; less than the MQO of 10%. No qualifiers were needed. LCS replicates and blind field replicates had an average RSD of 3.87% and 2.97%, respectively. Matrix spike samples were used to assess accuracy as no CRMs were analyzed. Recoveries measured were good with the average recovery error of 6.88% being less than the target MQO of 10%. No qualifiers were needed. LCS recoveries were good with an average recovery error of 2.22%.

Copper, Selenium, and Total Hardness

The copper, selenium, and total hardness data were acceptable. Samples were either field filtered, or lab filtered within 24 hours except for 1 field blank and one sample, qualified for being slightly over (25-26 hours) the target filtering hold time. MDLs were sufficient with zero NDs reported. Data were reported not blank corrected. Blank contamination was not measured in the method blanks.

Equipment and field blanks were examined, but not used in the qualifying of field samples. Blank contamination was found in several of the field blanks for copper (dissolved and total) at a level ~20% of those found in the field samples for dissolved copper (mean field blank contamination 1.4 ug/L compared to mean field sample concentration 7 ug/L), and at a level ~2% of those found in the field samples for total copper (mean field blank contamination 0.6 ug/L compared to mean field sample concentration of 28 ug/L). No blank contamination was measured in the equipment blanks.

Precision was evaluated using the matrix spike replicates, with the average RSDs being well less than the target MQOs (selenium 35%, copper 25%, and hardness 5%); all <2%. Average RSDs for LCS replicates were also less than the target MQOs; all <5%. The average RSDs for field replicates were not used in qualified, but were examined and found to be less than the target MQOs; all <5%. No precision qualifiers were added. Matrix spike samples were used to assess accuracy as no CRMs were analyzed. Recoveries measured were good with average recovery errors less than the target MQOs (selenium 35%, copper 25%, and hardness 5%). LCS recoveries were also good with average recovery errors all less than the target MQOs. No recovery qualifiers were needed. Dissolved and total fractions were reported for copper and selenium. Dissolved/Total ratios were all < 1.35, within the propagated accepted error for precision and accuracy on individual results.

Copper, Selenium, and Total Hardness - Inter-comparison Study

Overall the data were acceptable. MDLs were sufficient with zero NDs reported. One batch had selenium detected in blanks slightly over the MDL, but still well below most field sample concentrations. The data were blank corrected and the blank standard deviation was less than the MDL so no blank qualifiers were added. Lab replicates were used to evaluate precision, with the average RSDs being all <4%, well below the target MQOs (selenium 35%; calcium, copper, and magnesium 25%). Average RSDs for matrix spike/matrix spike replicate samples were all <4%, also less than the target MQOs. No precision qualifiers were added. CRMs were used to assess accuracy. Recoveries measured were good with average recovery errors less than the target MQOs (selenium 35%; calcium, copper, and magnesium 25%); the highest recovery error was 12% for calcium (to calculate hardness). Matrix spike and LCS recoveries were good with average recovery errors all less than the target MQOs. No added qualifiers were needed. Dissolved and total fractions were reported for copper and selenium. Dissolved/Total ratios were all < 1.35, within precision expected propagated error.

Mercury and Methylmercury

The total mercury (Hg) and methylmercury (MeHg) data overall are acceptable. All were analyzed within the recommended 28 day hold time aside from one mercury sample analyzed slightly beyond (35 days) that was qualified for hold time. The methods were sufficiently sensitive to detect MeHg or Hg in nearly all samples, with only 2 MeHg analyses reported not detected. Blank concentrations of MeHg and total Hg were below detection limits for all blank sample types (field, equipment, and lab), so no blank qualifiers were needed.

Precision on field replicates was acceptable, averaging 16% RSD for both total and methyl mercury. Matrix spike/MSD precision averaged 2% RSD, and LCS (spiked blank) precision was similarly good, averaging 4% and 12% for total and methyl mercury, respectively. No CRMs were analyzed, so matrix spikes were the best indicators of recovery available. Although a few individual sample recoveries were outside of the target range (due to spiking less than 2x native concentrations), recovery errors averaged 11% or better for MeHg and total Hg matrix spikes and spike duplicates spiked higher than 2x, and averaged 9% or better for blank spikes, well within target errors of +/-35%. No added qualifiers were needed. The ratios of methyl to total mercury were within an expected reasonable range, with methyl mercury (around 0.2 ng/L) near 1% or less of total mercury (0.05 ug/L = 50 ng/L, around 250x higher).

Mercury and Methylmercury – Inter-comparison Study

Overall the data were quite good. MDLs were sufficient that there were no NDs for field samples. Methylmercury (MeHg) and mercury (Hg) were not detected in most blanks, except 1 just at its MDL, although the blank average for that batch was still <MDL. Precision on an un-spiked lab replicate was good, with an RSD <3%. Precision on repeated measures of CRMs, MS and LCS were similarly good, all averaging <3%, well within the target 35% MQO for Hg and MeHg. Recoveries on CRMs, MSs, and LCS were all good, with average errors <5% for Hg, and <15% for MeHg, well within the target <35%. The ratios of mercury and methylmercury were pretty typical, with methylmercury <1% of total mercury (although they weren't necessarily reported as pairs for a given site and event in the IC samples).

Carbaryl and Fipronil

Overall the carbaryl and fipronil data were acceptable. Methods were sufficient to detect at least some target analytes in most samples. Fipronil was always detected. None of the target analytes were detected in blanks. Precision on field replicates was generally good, with RSDs <35% target for all analytes. Carbaryl had the highest variation (30%) due to concentrations near the MDL. Precision on MS/MSD and LCS replicates was better yet, <20% RSD for all analytes. Recovery errors on all reported analytes averaged less than the 35% target so no added qualifiers were needed

PAHs

Overall the PAH data were marginally acceptable. MDLs were sufficient with 5 of the 44 reported PAHs having NDs (ranging from 6 to 53% ND per PAH congener), with only 1, Benz(a)anthracene having >=50% ND. Blank contamination was measured in at least one of the seven method blanks for many analytes with blank contamination high enough (>1/3 of the field sample result) to qualify many results (88% of Biphenyl, but 29% or less for other PAHs and alkylated PAHs) with the censoring contamination qualifier of "VRIP". Many of these censored results were the alkylated PAHs, not used in generating sums of PAHs; the other censored LPAH and HPAH results typically account for about 10% of total PAHs.

Field blanks were examined, but not used in qualifying field samples in the database. Contamination in the field blanks was found at concentrations mostly 1-4 times that found in the lab blanks, except for 2,6-Dimethylnaphthalene, 2-Methylnaphthalene, 1-Methylnaphthalene, C1-Naphthalenes, and Naphthalene, which were respectively 5, 6, 7, 8 and 8 times greater in the field blanks than the lab blanks. Average field blank contaminant concentrations were generally less than 10% of the average concentrations found in the field samples, notable exceptions were 1-Methylnaphthalene, C1-Naphthalenes, 2-Methylnaphthalene, Biphenyl, and Naphthalene, which were 22%, 24%, 26%, 27% and 58% of the average field sample concentrations, respectively.

Replicates on field samples were used to evaluate precision and were good, less than the target 35% average RSD. LCS replicates were examined and were also all less than the target 35% average RSD (all <10%). The average RSD combining field and lab duplicates were not used in qualifying, but were less than the target MQO of 35%. No precision qualifiers were added. LCS were used to assess the accuracy of PAHs as no CRMs or matrix spikes were reported. Recoveries measured in the LCS were good with recovery errors less than the target 35% for all 44 PAHs measured (all <20%). No recovery qualifiers were added. Alkyalted PAHs were not included in the LCS or other recovery samples so were qualified with the QA code of "VBS" and batch verification code of "VQI" for partial/unknown recovery QA.

PBDEs

The PBDE data were overall acceptable. MDLs were sufficient with 29 of the 49 reported total fraction PBDE congeners having NDs (ranging from 6 to 100% ND), and 27% (13 out of 49) having >=50% ND. PBDE congeners 28, 47, 49, 71, 85, 99, 100, 116, 119, 126, 140, 153, 154, 155, 183, 190, 197, 205, 206, 208, and 209 had some contamination in at least one method blank, but the blank contamination was only bad enough to qualify 58% of PBDE 190 and 205, 41% of PBDE 126, 29% of PBDE 116, 24% of PBDE 140, 12% of PBDE 155, and 6% of PBDE 71 and 199 results with the censoring contamination qualifier of "VRIP" (results with reported concentrations <3x the blank results (by batch) being censored for contamination).

Field blanks were examined, but not used in qualifying. Blank contamination was found in at least one field blank for PBDE congeners 17, 28, 47, 49, 85, 99, 100, 119, 140, 153, 154, 155, 203, 206, 207, and 209. Field blank contamination was found at concentrations mostly 1-4 times that found in the lab blanks, except for PBDE 049 and 085, which were respectively 13 and 10 times greater in the field blanks than the lab blanks. However, this was still well below the concentrations found in the field samples; average field blank contaminant concentrations at most were 2.3% (PBDE 049) of the average concentrations found in the field samples.

Lab replicates on field samples were used to evaluate precision and were generally good, less than the target 35% average RSD (PBDE 008 was just below at 34.9%). Replicates of the eight usable LCS were examined and were all <35% average RSD (all <16%). The average RSD combining all field and lab duplicates were not used in qualifying (since lab replicates alone are more representative of purely analytical issues) but were examined and found to be less than the target MQO of 35%, except for PBDE 138 (RSD 35.6%). No precision qualifiers were added. LCS results were used to assess the accuracy of PBDEs as no CRMs or matrix spikes were reported. Recoveries for the eight PBDEs measured in the LCS were good with recovery errors less than the target 35% for all reported analytes (all <15%). LCS results for PBDE 33 were unusable. No additional qualifiers were needed.

PCBs

Overall the PCB data were acceptable. MDLs were sufficient with NDs being reported for 15.5% (11 out of 71) PCB congeners ranging from 1% to 3.5% ND; none were extensive (>=50% ND). Blank contamination was measured in at least one method blank for many PCBs (8, 18, 28, 31, 33, 44, 49, 52, 56, 60, 66, 70, 87, 95, 99, 101, 105, 110, 118, 128, 132, 138, 149, 151, 153, 156, 158, 170, 174, 177, 180, 183, and 187). Contamination was over 1/3 of the field sample result in 1% to 11% of PCB 8, 18, 28, 31, 33, 44, 49, 52, 56, 60, 66, 70, 87, 95, 99, 101, 105, 110, 118, 151, and 177 samples and qualified with the censoring qualifier of "VRIP".

Field blanks were examined, but not used in qualifying results in the database. Blank contamination was found in the field blanks at levels generally less than in the method blanks and at levels well below those found in the field samples (< 1%). Lab replicates of field samples were used to evaluate precision, with the average RSD being less than the target MQO (35%); all <30%. Average RSD for LCS replicates were examined, and were less than the target MQO of 35%; all <10%. The average RSD for field replicates were not used in qualifying, but were examined and found to be less than the target MQO; all <22%. No precision qualifiers were added. LCS results were used to assess accuracy as no CRMs, or matrix spikes were analyzed. Recoveries measured were good with recovery errors less than the target MQO (35%); all <8%. No additional recovery qualifiers were needed.

Pyrethroids

Overall the pesticide data were acceptable. NDs were reported for all 11 pyrethroids ranging from 7% to 100% ND; NDs for Allethrin, Total Esfenvalerate/Fenvalerate, Fenpropathrin, Tetramethrin, and T-Fluvalinate were extensive (>=50% ND). Data were reported not blank corrected. Blank contamination was measured in at least one method blank for Total lambda-Cyhalothrin. Contamination was extensive enough so that 20% of Total lambda-Cyhalothrin results were qualified with the censoring qualifier of "VRIP" (results with reported concentrations <3x the blank results (by batch) being censored for contamination). Field blanks were examined, but not used in qualifying. Blank contamination was found in the field blank for Total lambda-Cyhalothrin at levels ~40% of those found in the method blanks (0.11 ng/L compared to 0.26 and 0.28 ng/L), and at a level below those found in the field samples (average field sample concentration 0.62 ng/L, field blank contamination 0.11 ng/L).

Matrix spike replicates were used to evaluate precision, with the average RSD being well less than the target MQO (35%); all <12%. Average RSD for LCS replicates were examined, and were less than the target MQO of 35%; all <14%. The average RSD for field replicates were not used in qualifying, but were examined and found to be less than the target MQO (35%); all <30%. No precision qualifiers were added. Accuracy was assessed using the matrix spike samples as no CRMs were analyzed. Recoveries measured were generally good with average recovery errors less than the target MQO (35%); except for Total lambda-Cyhalothrin (42%) and T-Fluvalinate (41%) which were qualified with the non-censoring qualifier of "VIU". LCS recoveries were good with average recovery errors all less than 30%.

Pyrethroids – Inter-comparison Study

Overall the data were acceptable. Most pyrethroids were 100% ND, except for Bifenthrin, Deltamethrin/Tralomethrin, and Total Permethrin (Tetramethrin was qualified by the laboratory as an unreportable estimate). Data were reported not blank corrected. No contamination was measured in the one method blank. No replicates of any kind were analyzed so precision could not be evaluated; results were qualified with the QA code of "VBS" for incomplete QC. The LCS was used to assess accuracy as no CRMs or matrix spikes were analyzed. Recoveries measured were generally good with average recovery errors less than the target MQO (35%); all were <24%.

Toxicity

The 36 hour recommended hold times were exceeded for some sets of *Hyalella azteca* (up to 53 hour hold time) and *Pimephales promelas* (up to 74 hours), and up to 1-2 hour slight exceedances for the other species. Results exceeding the recommended 36 hour hold time were qualified. Control survival was acceptable with a minimum 80% survival just meeting the 80% requirement in one batch. Other batches had higher survival up to 100%. Water quality limits for the test species were not exceeded in any tests. Reference toxicant control EC50/IC50 were within the mean+/-2stdev of previous control results ("typical response" range).

5.3 Climate and flow at the sampling locations during water years 2012, 2013, and 2014

The climatic conditions under which observations are made of pollutant concentrations in flowing river systems have a large bearing on concentrations and loads observed. It has been argued that a 30 year period is needed in California to capture the majority of climate related variability of a single site (Inman and Jenkins, 1999; McKee et al., 2003). Given monitoring programs for concentrations or loads do not normally continue for such a long period (except for rare occasions for turbidity and suspended sediment (e.g. Santa Anna River, Southern California: Warrick and Rubin 2007; Casper Creek, northern California: Keppeler, 2012; Alameda Creek at Niles (data for WYs 1957-73 and 2000-present (30 years)), the objective of sampling is usually to try to capture sufficient components of the full spectrum of variability to make inferences from a smaller dataset. When such data are available, they usually reveal complex patterns in relation to rare large events or several periods of rare drought and decadal scale changes to climate and land use or water management (Inman and Jenkins, 1999; McKee et al., 2003; Warrick and Rubin 2007; Keppeler, 2012; Warrick et al., 2013). However, for pollutant data sets in general, data sets are rarely longer than a few years and high magnitude (high intensity or long duration) events occur infrequently and thus are usually poorly represented. Unfortunately, these types of events usually transport the majority of a decadal scale loads (Inman and Jenkins, 1999; Warrick and Rubin 2007). This occurs because the discharge-load relation spans 2-3 orders of magnitude on the discharge axis and often 3-4 orders of magnitude on the sediment load axis and is described best by a power function ($Q_s=aQ_w^b$) where a and b are constants that describe pollutant sources and the erosive power of water. Therefore storms and wet years with larger discharge, if measured, have a profound influence on the estimate of mean annual load for a given site and would likely confound any comparisons of loads between sites unless adequately characterized. However, if it is assumed that this is consistently true for all sites, or loads measured during dry years can be "climatically adjusted", the validity of loads comparisons between sites will be increased.

Conceptually, watersheds that are more impervious, or smaller in area, or have lower pollutant production variability (or sources) should exhibit lower inter-annual variability (lower slope of the power function) and therefore require less sampling to adequately quantify pollutant source-release-transport processes (an example in this group is Marsh Creek which has rural and recent urbanization land uses and few suspected source areas for PCBs). In contrast, a longer sampling period spanning a wider climatic variability would be more ideal to adequately describe pollutant source-release-transport processes in watersheds that are larger, or less impervious, or have large and known pollutant sources. The quintessential example of this category within this study is Guadalupe River in relation to Hg sources, release mechanisms, and loads but San Leandro Creek (both Hg and PCBs) and Sunnyvale East channel and Pulgas Creek (PCBs) also appear to be in this category. Marsh Creek also appears to be in this category in relation to suspended sediment. Concentration variability relative to first flush and storm magnitude-frequency-duration will probably remain unexplainable for these analytes, even after three years of sampling. This will be one factor that may lead to lower confidence in annual loads computations and average annual loads estimates.

Unfortunately, during the three year study, winter seasons have been very dry relative to average annual conditions with all observations to-date made during years of between 38-85% mean annual precipitation and 22-82% mean annual flow (Table 6). For example, San Leandro Creek experienced 75% of mean annual runoff (MAR) in WY 2012, 67% MAR in WY 2013, and 52% MAR in WY 2014. However, there have been some notable storms, particularly those occurring during late November and December of WY 2013, an intense first flush in November 2013 (WY 2014) and another relatively intense storm in late February 2014 (WY 2014). For example, approximately 52% of the total wet season rainfall fell at the Sunnyvale East Channel rain gauge over 11 days during November and December of WY 2013 and 13% on February 28, 2014 (WY2014). Loads of pollutants were disproportionately transported during such events; at Sunnyvale East Channel, 96%, 91% and 84% of the WY 2013 total wet season sediment, PCBs and mercury loads were transported during those larger November and December storms and 30%, 58% and 24% of the total wet season sediment, PCBs, and mercury loads were transported in a single day on February 28 in WY 2014. However, despite these larger individual storm events, the overall drought conditions during the study may result in estimated long-term averages for each site that are biased low due relatively benign flow production, sediment erosion, and transport conditions in all six watersheds. The bias may not be as severe in those watersheds that received slightly wetter conditions and/or that are more impervious.

Table 6. Climate and flow during sampling years at each sampling location.

Water Year (WY)		Marsh Creek[2]	North Richmond Pump Station[3]	San Leandro Creek[4]	Guadalupe River[5]	Sunnyvale East Channel[6]	Pulgas Creek South Pump Station[7]
Rainfall (mm) (% mean annual)	2012	320 (71%)	NA	486 (75%)	179 (47%)	224 (60%)	NA
	2013	344 (76%)	493 (85%)	437 (67%)	223 (59%)	307 (82%)	378 (78%)
	2014	260 (58%)	327 (57%)	338 (52%)	161 (43%)	207 (55%)	183 (38%)
	Mean Annual	457	578	627	378	387	484
Runoff (Mm^3) (% mean annual)	2012	1.87 (22%)	NA	7.30	38.0 (68%)	1.07	NA
	2013	6.23 (73%)	0.74	7.21	45.45 (82%)	1.51	0.22
	2014	1.17* (15%)	0.50	0.24	16.75* (30%)	1.01	0.08
	Mean Annual	8.0	No long term data	No long term data	55.6	No long term data	No long term data

[1] Unless otherwise stated, averages are for the period Climate Year (CY) (Jul-Jun) (rainfall) or Water Year (WY) (Oct-Sep) (runoff) 1971-2010.

[2] Rainfall gauge: Concord Wastewater treatment plant (NOAA gauge number 041967) (CY 1991-2013); Runoff gauge: Marsh Creek at Brentwood (gauge number 11337600) (WY 2001-2013).

[3] Rainfall gauge: This study with mean annual from modeled PRISM data; Runoff gauge: This study.

[4] Rainfall gauge: Upper San Leandro Filter (gauge number 049185); Runoff gauge: This study.

[5] Rainfall gauge: San Jose (NOAA gauge number 047821); Runoff gauge: Guadalupe River at San Jose (gauge number 11169000) and at Hwy 101 (gauge number 11169025).

[6] Rainfall gauge: Palo Alto (NOAA gauge number 046646); Runoff gauge: This study

[7] Rainfall gauge: Redwood City NCDC (gauge number 047339-4); Runoff gauge: This study.

* indicates data missing for the latter few months of the season

5.4 Concentrations of pollutants of concern during sampling to-date

Understanding the concentrations of pollutants in the watersheds is important to both directly answering one of the Small Tributary Loading Strategy management questions (MQ2) as well as forming the basis from which to answer all of the other key management questions identified by the Strategy. The three year sampling program has provided data that, in some cases, indicate surprisingly high concentrations (e.g. Hg in San Leandro Creek; PCBs in Sunnyvale East Channel; PBDEs in North Richmond Pump Station); other cases indicate surprisingly low concentrations (Hg in Marsh Creek). While in other case, sampling has somewhat verified what was expected (North Richmond (PCBs and Hg), Guadalupe (PCBs and Hg) and Pulgas Creek South Pump Station (PCBs)). In some cases NDs and quality assurance issues confound robust interpretations. This section explores these issues through synthesis of data collected across all six sampling locations over the three years.

Concentrations of pollutants typically vary over the course of a storm and between storms of varying magnitudes, and are dependent on antecedent rainfall, soil moisture conditions, related discharge, sediment supply and transport, and pollutant source-release-transport processes. Although these can be fully understood over a long period of sampling that covers a wide range of conditions, shorter sampling programs will fail to capture this variability and therefore concentrations may appear complex or even chaotic and interpretation may remain difficult. Thus, it is important, even during shorter sampling programs, to try sample over a wide range flow conditions both within a storm and over a wide range of storm magnitudes to adequately characterize concentrations of pollutants in a watershed.

The monitoring design for this project aimed to collect pollutant concentration data from 12 storms over the span of three years (except for North Richmond Pump Station and Pulgas Creek South Pump Station with a target of 8 storm events), with priority pollutants sampled at an average of four samples per storm for a total of 48 discrete samples collected during the monitoring term. In order to capture as much variability as possible, the program aimed to sample earlier season storms, several larger (preferably) or "mid-season" storms, and a later season storm each year for each site (Melwani et al 2010; BASMAA, 2011), However, due to dry conditions, these aims were not easily met. Sampling at the six locations over the three water years has included sampling between 7-10 storm events at each location (Table 7). North Richmond Pump Station was the only site that completed the full allotment of storm events (n=8). Given the small sample size and varying sample sizes between sites, and the failure in some cases to collect a full sample set across the desired storm conditions, the following synthesis represents the best available knowledge about these sites; and areas where gaps in knowledge remain are identified.

Overall, detections of concentrations in the priority pollutants (suspended sediment, total PCBs, total mercury, total methylmercury, total organic carbon, total phosphorous, nitrate, and phosphate) were all 90 or higher, as were detections of several of the "tier II" pollutants (total and dissolved copper and selenium, PAHs and PBDEs) (Table 8). Numerous pyrethroids were not detected at any of the sites; whereas, Delta/Tralomethrin, Cypermethrin, Cyhalothrin lambda, Permethrin, Bifenthrin as well as Carbaryl and Fipronil were all detected in one or more samples at each sampling location.

The two highly urban and impervious sampling locations added in WY 2013 and also sampled in WY 2014 (North Richmond and Pulgas Creek South Pump Stations), have the lowest mean SSC; whereas, pollutant concentrations are relatively high for these watersheds (e.g. PCBs at Pulgas Creek South Pump Station). In contrast, Sunnyvale East Channel has high PCB concentrations but also relatively high SSC. As a result, the particle ratio (turbidity or SSC to pollutant; discussed further in section 5.5) rank shows a differing order to the water concentration ranking. Given the high imperviousness and small size of the North Richmond and Pulgas Creek South Pump Station watersheds, although fewer storms have been sampled at these locations, it is unlikely greater variation in SSC would be observed even if they were to be sampled again in the future.

The maximum PCB concentration observed during the three year program (6,669 ng/L) was collected in Pulgas Creek Pump Station, which also has the greatest mean PCB concentration of the six locations; consistent with the high ranking assigned to Pulgas Creek South Pump Station based on the WY 2011 reconnaissance study of 17 watersheds distributed across four Bay Area counties (McKee et al., 2012). This result was an order of magnitude higher than results from any other storm sampled at the station and it is unclear why this storm in particular mobilized such high concentrations given that the storm was relatively small in magnitude (0.42 inches), intensity (maximum 1 hour rainfall 0.11 inches) and the resulting flow peak (8.6 cfs relative to other PCB samples collected at flows as high as 17 cfs). However, sampling at Pulgas Creek South Pump Station during WYs 2013 and 2014 has captured relatively small storm events (one during WY 2013) and the rest during WY 2014 which recorded 38% MAP; given that PCBs are dominantly associated with particles and that particle transport is correlated with rainfall magnitude and intensity (as seen at Zone 4 Line A[2] (Gilbreath et al., 2012)) it is possible that additional sampling during more, and more intense, storm events could reveal even greater concentrations. Guadalupe River had mercury mines in the upper watershed and is a known mercury source to the San Francisco Bay, explaining the relatively high mercury and, possibly, methylmercury concentrations in this watershed (Thomas et al., 2002; Conaway et al., 2003; Davis et al., 2012). Less well understood is San Leandro Creek, which has mercury and methylmercury concentrations nearly as high as Guadalupe River. If sampling in San Leandro Creek were to continue at some point in the future, under more variable storm and climatic conditions, an improved understanding of source-release-transport processes of mercury in this watershed could be generated that would help to isolate natural or anthropogenic mercury sources and also improve our understanding of pollution levels relative to other watersheds and the accuracy of loads estimates. It is also worth noting (with regard to the tier I priority analytes) that phosphorus concentrations in most of the six watersheds appear greater than elsewhere in the world under similar land use scenarios, perhaps attributable to geological sources (Dillon and Kirchner, 1975; McKee and Krottje, 2005). For example, Dillon and Kirchner (1975) found that watersheds of differing geology under the same land use could exhibit loads differing by an order of

[2] Zone 4 Line A is a 4.2 km^2 100% urban tributary located in Hayward, CA. This creek was monitored extensively by the RMP between WYs 2007-2010 using a similar study approach to estimate loads as the one reported here. The creek was discretely sampled during storm events for SSC, Hg species, metals and other trace elements including selenium, organic carbon, PCBs, PBDEs, pyrethroids, OC pesticides, dioxins and furans and nutrients. It presents one of the most robust datasets available in the Bay Area.

Table 7. Number of storms sampled and number of discrete samples collected at each location relative to the program objectives as recommended (Melwani et al 2010) and codified in the multi-year-plan (e.g. BASMAA, 2011).

Water Year	Storm category	Marsh Creek	North Richmond Pump Station	San Leandro Creek	Guadalupe River	Sunnyvale East Channel	Pulgas Creek South Pump Station
2012	Early season or "first flush	No	Study not yet begun	No	No	No	Study not yet begun
	Larger or mid-season	Yes		Yes	Yes	Yes	
	Later season	Yes		Yes	Yes	Yes	
2013	Early season or "first flush	Yes	Yes	Yes	Yes	Yes	No
	Larger or mid-season	Yes	Yes	Yes	Yes	Yes	No
	Later season	Yes	Yes	Yes	Yes	No	Yes
2014	Early season or "first flush	No	Yes	No	Yes	No	Yes
	Larger or mid-season	Yes	Yes	Yes	Yes	Yes	Yes
	Later season	No	No	No	Yes	Yes	Yes
	Total number of discrete samples	31 out of 48	32 out of 32	44 out of 48	39 out of 48	40 out of 48	28 out of 32

magnitude. Bay Area watersheds with geological sources of phosphorus such as appetite minerals may naturally release greater amounts of phosphorus.

Selenium and PBDE concentrations, two analytes being collected at a lesser frequency in this study (intended only for characterization) are particularly notable. In the Guadalupe River, mean selenium concentrations were 2 to 6-fold greater than the other five locations; elevated groundwater concentrations have been observed in Santa Clara County previously (Anderson, 1998). Across all six sites, Se concentrations averaged 0.6 µg/L. If these concentrations are representative and combined with average annual flow entering the Bay from the nine-county Bay Area (1.5 km^3 based on the RWSM: Lent et al., 2012), the total average annual Se load would be estimated to be 900 kg. Although this is less than the estimated average annual load entering the Bay from the Central Valley Rivers (16,000 kg/yr; David et al., in press), it is still a large component of the Se mass balance for the Bay. Maximum PBDE concentrations in North Richmond Pump Station were 33 to 60-fold greater than the PBDE maxima observed in the five other locations of this current study. These are the highest PBDE concentrations measured in Bay Area stormwater to-date (see section 8.2 for details). Additional investigation into the

Table 8. Synthesis of concentrations of pollutants of concern based on all quality assured data collected over the three sampling years at each location.

Analyte Name	Unit	Number (% detect)	Mean (std.error)	Number (% detect)	Mean (std.error)	Number (% detect)	Mean (std.error)	Number (% detect)	Mean (std.error)	Number (% detect)	Mean (std.error)	Number (% detect)	Mean (std.error)
SSC	mg/L	101 (94%)	108 (97%)	117 (95%)	136 (100%)	137 (98%)	96 (99%)	204 (23.5)	56.8 (5.57)	115 (13.8)	157 (12.3)	232 (31.4)	56.5 (6.27)
ΣPCB	ng/L	22 (100%)	32 (100%)	44 (100%)	39 (100%)	40 (100%)	29 (100%)	1.25 (0.258)	13.8 (1.57)	8.01 (1.16)	14.3 (2.4)	104 (27.5)	505 (261)
Total Hg	ng/L	31 (100%)	32 (100%)	44 (100%)	39 (100%)	40 (100%)	31 (100%)	38.4 (9.62)	39.6 (7.8)	106 (24.2)	212 (35.9)	47.6 (6.68)	18.2 (2.39)
Total MeHg	ng/L	20 (90%)	16 (100%)	30 (100%)	27 (100%)	27 (93%)	20 (100%)	0.291 (0.0741)	0.208 (0.0633)	0.397 (0.0663)	0.504 (0.0677)	0.295 (0.0376)	0.189 (0.033)
TOC	mg/L	30 (100%)	32 (100%)	44 (100%)	40 (100%)	40 (100%)	28 (100%)	7.13 (0.34)	11.2 (1.82)	8.24 (0.462)	12.2 (1.96)	10.1 (1.1)	20.5 (5.54)
NO3	mg/L	28 (96%)	32 (100%)	45 (100%)	36 (100%)	41 (100%)	28 (100%)	0.569 (0.0402)	0.976 (0.143)	0.425 (0.0659)	0.917 (0.099)	0.472 (0.0872)	0.466 (0.0864)
Total P	mg/L	30 (100%)	32 (100%)	44 (100%)	40 (100%)	41 (100%)	28 (100%)	0.415 (0.0441)	0.384 (0.0256)	0.288 (0.024)	0.414 (0.0376)	0.411 (0.0429)	0.29 (0.047)
PO4	mg/L	30 (100%)	31 (100%)	45 (100%)	40 (100%)	41 (100%)	28 (100%)	0.0987 (0.0074)	0.218 (0.0141)	0.1 (0.00412)	0.15 (0.0156)	0.128 (0.00905)	0.124 (0.0189)
Hardness	mg/L	4 (100%)	5 (100%)	8 (100%)	7 (100%)	8 (100%)	6 (100%)	176 (19.3)	129 (38.6)	56.5 (4.94)	138 (12.7)	124 (32.6)	69.8 (12)
Total Cu	ug/L	8 (100%)	8 (100%)	11 (100%)	10 (100%)	10 (100%)	7 (100%)	13.7 (3.59)	22.5 (4.49)	16.2 (3.07)	21.6 (2.87)	17.9 (1.88)	43.9 (10.1)
Dissolved Cu	ug/L	8 (100%)	8 (100%)	11 (100%)	10 (100%)	10 (100%)	7 (100%)	2.74 (0.588)	8.45 (1.53)	5.98 (0.682)	5 (0.939)	5.5 (1.09)	18.6 (3.91)
Total Se	ug/L	8 (100%)	8 (100%)	11 (100%)	10 (100%)	10 (100%)	7 (100%)	0.742 (0.103)	0.409 (0.0638)	0.223 (0.019)	1.31 (0.252)	0.606 (0.147)	0.292 (0.0632)
Dissolved Se	ug/L	8 (100%)	8 (100%)	11 (100%)	10 (100%)	10 (100%)	7 (100%)	0.647 (0.0886)	0.366 (0.0586)	0.166 (0.0149)	1.07 (0.266)	0.519 (0.146)	0.244 (0.0526)
Carbaryl	ng/L	8 (25%)	8 (88%)	12 (50%)	10 (90%)	10 (40%)	7 (100%)	3.63 (2.39)	21.6 (4.72)	5.82 (2.11)	29.5 (6.87)	6.5 (2.78)	105 (26.3)
Fipronil	ng/L	8 (100%)	8 (75%)	11 (91%)	10 (100%)	10 (90%)	7 (86%)	12.2 (1.19)	6.31 (1.92)	10.1 (1.89)	11.3 (1.56)	6.5 (1.13)	3.29 (0.68)
ΣPAH	ng/L	4 (100%)	4 (100%)	5 (100%)	11 (100%)	6 (100%)	6 (100%)	140 (46.5)	527 (279)	1260 (494)	416 (116)	1350 (455)	1660 (1070)
ΣPBDE	ng/L	4 (100%)	5 (100%)	5 (100%)	5 (100%)	6 (100%)	6 (100%)	27 (10.1)	789 (644)	28.5 (11.7)	60.8 (18.3)	47 (16)	45.6 (13.1)
Delta/ Tralomethrin	ng/L	8 (75%)	8 (75%)	10 (40%)	10 (50%)	9 (89%)	7 (43%)	1.5 (0.637)	2.29 (0.818)	0.391 (0.207)	0.852 (0.328)	1.77 (0.469)	0.386 (0.205)
Cypermethrin	ng/L	8 (88%)	8 (100%)	11 (55%)	10 (70%)	10 (80%)	7 (100%)	11.7 (8.24)	4.84 (1.38)	0.368 (0.115)	1.49 (0.512)	3.29 (0.63)	2.42 (0.663)
Cyhalothrin lambda	ng/L	7 (86%)	7 (100%)	9 (56%)	10 (70%)	8 (75%)	6 (83%)	1.23 (0.486)	1.1 (0.228)	0.616 (0.376)	0.556 (0.174)	0.656 (0.296)	0.35 (0.12)
Permethrin	ng/L	8 (75%)	8 (100%)	11 (55%)	10 (80%)	10 (100%)	7 (86%)	6.08 (2.29)	17.7 (5.91)	3.59 (1.24)	10.5 (2.34)	21.8 (3.61)	10.7 (3.03)
Bifenthrin	ng/L	8 (100%)	8 (100%)	11 (91%)	10 (90%)	10 (90%)	7 (100%)	75.2 (29.9)	5.88 (0.796)	8.08 (2.69)	5.29 (1.18)	8.01 (1.95)	5.14 (1.81)

Analyzed but not now I had somedetected: Fenpropathrin, Esfenvalerate/Fenvalerate, Cyfluthrin, Allethrin, Prallethrin, Phenothrin, Resmethrin. All Hardness results in WY 2013 were censored.

source-release processes of PBDE that are specific to Richmond, and lacking in the other watersheds, would be needed to better understand this result.

Concentration sampling during the three water years at the six locations has in part confirmed previously known or suspected high leverage watersheds (i.e. mercury in Guadalupe, PCBs in Sunnyvale East Channel and Pulgas Creek South). Concentration results have also raised some questions about certain pollutants in other watersheds (e.g. upper versus lower watershed Hg concentrations in San Leandro Creek, PBDE concentrations in North Richmond Pump Station). More sampling under a broader range of storm events (early season and first flush, larger storms during the mid-season and later season storms) would improve characterization of pollutants in those watersheds and increase confidence in the relative magnitude between watersheds and average annual loads estimates (baseline concentrations) that might form the basis for assessing trends (MQ3) at some future time. Although not the subject of this report, the RMP has provided funding to support the development of a POC loadings synthesis document (McKee et al. in preparation) and a trends strategy document (slated for preparation in summer 2015). A more thorough evaluation of existing data as a baseline for the trends management questions will be completed through those efforts.

5.5 Loads of pollutants of concern computed for each sampling location

One of the primary goals of this project and a key management question of the Small Tributary Loading Strategy was to estimate the annual loads of POCs from tributaries to the Bay (MQ2). In particular, large loads of POCs entering sensitive Bay margins are likely to have a disproportionate impact on beneficial uses (Greenfield and Allen, 2013). As described in the climatic section (5.2), given that the relationship between climate (manifested as either rainfall or resulting discharge) and watershed loads follows a power function, estimates of long-term average loads for a given watershed are highly influenced by samples collected during wetter than average conditions and rare high magnitude storm events. Comparing loads estimates between the sites was confounded by relatively small sample datasets collected during climatically dry years. However, based on data collected, average annual loads estimates for each sampling location have now been computed. Accepting these caveats, the following observations are made on the total wet season loads estimates at the six locations.

The magnitude of the total loads between watersheds is largely driven by drainage area of each watershed. In terms of total wet season loads from each of the six watersheds, the largest watershed sampled is the Guadalupe River, which also has the largest load for every pollutant estimated in this study. Conversely, Pulgas Creek South Pump Station is the smallest watershed in the study and has the lowest total wet season load (except for PCBs). As another example, methylmercury in San Leandro Creek (8.9 km^2) and Guadalupe River (236 km^2) have similar concentrations but Guadalupe River discharges more than 10x the total mass of methylmercury given the much greater overall discharge of runoff volume and sediments. There is one significant exception. As mentioned, Pulgas Creek Pump Station South exports a disproportionately large PCB load, greater than Lower Marsh Creek (160x larger), North Richmond Pump Station (3.3x larger), San Leandro Creek (15x larger), and Sunnyvale Channel (WY 2013 only, 25x larger) (Table 9).

Table 9. Loads of pollutants of concern during the sampling years at each sampling location.

Site	Water Year	Discharge (Mm^3)	SS (t)	TOC (kg)	PCBs (g)	HgT (g)	MeHgT (g)	NO3 (kg)	PO4 (kg)	Total P (kg)	Loads Confidence	Loads Quality
Marsh Creek[a]	2012	1.61	233	11,380	1.34	64.0	0.262	956	175	578	Moderate (PCBs) Low (Hg)	Lack of sample data during storms that cause runoff and sediment transport through the upper watershed reservoir and data during a wet year.
	2013	5.82	2,703	39,500	16.0	408	2.78	3,474	666	4,212		
	2014	1.34	202	9,257	1.20	30.7	0.217	786	148	479		
North Richmond Pump Station[b]	2012	-	-	-	-	-	-	-	-	-	Moderate	Lack of data during wet year.
	2013	0.795	35.7	6,353	8.14	16.0	0.200	761	161	215		
	2014	0.499	20.4	6,197	4.76	15.8	0.117	478	101	186		
San Leandro Creek[c]	2012	7.30	158	40,483	16.4	221	1.57	1,973	571	1,404	Low	Lack of a robust discharge rating curve for higher flows; lack of data during reservoir release and during a wet year.
	2013	7.21	223	52,274	15.0	213	1.58	2,801	674	1,334		
	2014	0.243	28.0	1,840	1.93	25.4	2.89	97.1	23.4	70.6		
Guadalupe River	2012	25.8	2,106[1]	154,379	123	2,039	6.13	20,879	2,498	6,023	High (PCBs) Low (Hg)	Lack of long duration and high intensity storms sampled for Hg release from upper watershed. Confidence in PCB data supported by previous studies.
	2013	35.5	4,464[1]	238,208	309	5,476	13.6	25,775	3,771	10,829		
	2014	16.75	1,094	106,141	97.2	1,519	4.29	13,182	1,723	4,172		
Sunnyvale East Channel[d]	2012	1.31	56.4	8,227	50.9	25.9	0.382	335	139	395	Moderate	Lack of data during wet year. High variability in PCB concentrations between storm events.
	2013	1.51	508	8,685	87.9	87.6	3.26	369	159	689		
	2014	1.01	89.0	12,040	74.4	27.9	0.669	336	135	343		
Pulgas Creek Pump Station[e]	2012	-	-	-	-	-	-	-	-	-	Low	A lower quality (FWMC) approach applied to loads calculations. Lack of data during a wet year. High variability in PCB concentrations between storm events.
	2013	0.165	10.9	1,539	21.8	3.07	0.0291	41.1	12.8	33.0		
	2014	0.08	5.31	764	11.8	1.48	0.0141	20.1	6.31	16.1		

[a] Marsh Creek wet season loads are reported for the period of record 12/01/11 – 4/26/12, 10/19/12 – 4/18/13 and 11/06/13 – 4/30/14.

[b] North Richmond Pump Station wet season loads are reported for the period of record 11/01/12 – 4/30/13 and 10/16/13 – 4/30/14.

[c] San Leandro Creek wet season loads are reported for the period of record 12/01/11 – 4/30/12, 11/01/12 – 4/18/13 and 11/01/13 – 4/30/14.

[d] Sunnyvale East Channel wet season loads are reported for the period of record 12/01/11 – 4/30/12, 10/01/12 – 4/30/13 and 10/01/13 – 4/30/14.

[e] Pulgas Creek South Pump Station loads are estimates provided for the entire wet seasons (10/01/12 – 4/30/13 and 10/01/13 – 4/30/14) however monitoring only occurred during the period 12/17/2012 – 3/15/2012 and 10/22/13 – 4/30/14. Monthly loads for the non-monitored period were extrapolated using regression equations developed for the monthly rainfall and corresponding monthly (or partial month) contaminant load.

Comparison of total wet season loads between water years at the sites highlighted show how loads estimates can be highly variable even during three drier than average years. Additionally, the size and intensity of the storm events in the different regions where the sampling sites were located greatly impacted the load variation from year-to-year and between sampling locations. For example, PCB loads in Guadalupe River and San Leandro Creek were approximately 3- and 7-fold greater in WY 2012 than in WY 2014, whereas loads of PCBs were 13- and 8-fold larger in WY 2013 relative to WY2012 in Lower Marsh Creek and Sunnyvale East Channel, where the late November and December 2012 (WY2013) storms were comparatively larger events. Even when normalized to total discharge (in other words, the flow-weighted mean concentration [FWMC]), Sunnyvale East Channel transported 7-fold as much sediment in WY 2013 than WY 2012, whereas the FWMC of suspended sediment in San Leandro Creek was the same in WYs 2012 and 2013 and 5-fold greater in WY 2014 despite much lower flow. The relationship between FWMC and discharge (either at the annual or individual flood scale) can be used as an indicator of when enough data have been collected to characterize the site adequately to answer our management questions. FWMC should continue to increase relative to storm magnitude until watershed sources are exhausted; locations and analytes that reach that maximum will have sufficient data to compute reliable long term average annual loads. With the data currently in hand, attempts to estimate average annual loads will be biased low.

In light of these climatic considerations as well as the known data quality considerations and challenges at each of the sampling locations, the two far-right columns in Table 9 note the remaining level of confidence in the annual loads estimates as well as the main issues at each site which warrant the confidence level rating. Any future sampling at each of these locations should seek to alleviate these issues and to raise the quality of the data in relation to answering management questions.

5.6. Comparison of regression slopes and normalized loads estimates between watersheds

One of our key activities in relation to the Small Tributary Loading Strategy is improving our understanding of which Bay tributaries (including stormwater conveyances) contribute most to Bay impairment from pollutants of concern (MQ1) and therefore potentially represent watersheds where management actions should be implemented to have the greatest beneficial impact (MQ4). Multiple factors influence the treatability of pollutant loads in relation to impacts to San Francisco Bay. Conceptually, a large load of pollutant transported on a relatively small mass of sediment is more treatable than less polluted sediment. Therefore, the graphical function between either sediment concentration or turbidity provides a first order mechanism for ranking relative treatability of watersheds (Figure 2A). This method is valid for pollutants that are dominantly transported in a particulate form (total mercury and the sum of PCBs are good examples but pyrethroid pesticides and PBDEs may also be considered in this group) and when there is relatively little variation in the particle ratios between water years or storms or at least less variation than seen between watersheds. Note data presented at the October 2013 SPLWG meeting demonstrated that this assumption is sometimes violated and influences our perception of relative ranking.

These issues accepted, based on the ratios between turbidity and Hg, runoff derived from less urbanized upper portions of San Leandro Creek watershed and runoff from the Guadalupe River watershed exhibit the greatest particle ratios for total mercury (Figure 2). Sunnyvale East Channel, Marsh Creek and Pulgas Creek South Pump Station appear to have relatively low particle ratios for total mercury, although, Marsh Creek has not been observed under wet conditions when the possibility of mercury release from historic mining sources exists. The relative nature of these rankings has not changed in relation to the previous reports (McKee et al., 2013; Gilbreath et al., 2014).

In contrast, for the sum of PCBs, Pulgas Creek South Pump Station and Sunnyvale East Channel exhibit the highest particle ratios among these six watersheds, with urban sourced runoff from Guadalupe River and North Richmond Pump Station ranked 3rd and 4th as indicated by the turbidity-PCB graphical relation (Figure 2). Marsh Creek exhibits very low particle ratios for PCBs, an observation that is unlikely to change with additional samples given the likelihood of relatively low pollutant sources and relatively low variability of release-transport processes. Unlike for Hg, new data collected during WYs 2013 and 2014 alters the relative PCB rankings based on this graphical analysis providing an example of the influence of either low sample numbers or the random nature of sample capture on the resulting interpretation of particle ratios (as discussed in the October 2013 SPLWG meeting). Given the relatively wide confidence intervals around these lines (not shown) and the collection during relatively dry years, the relative nature of these regression equations may change if there are any future samples completed.

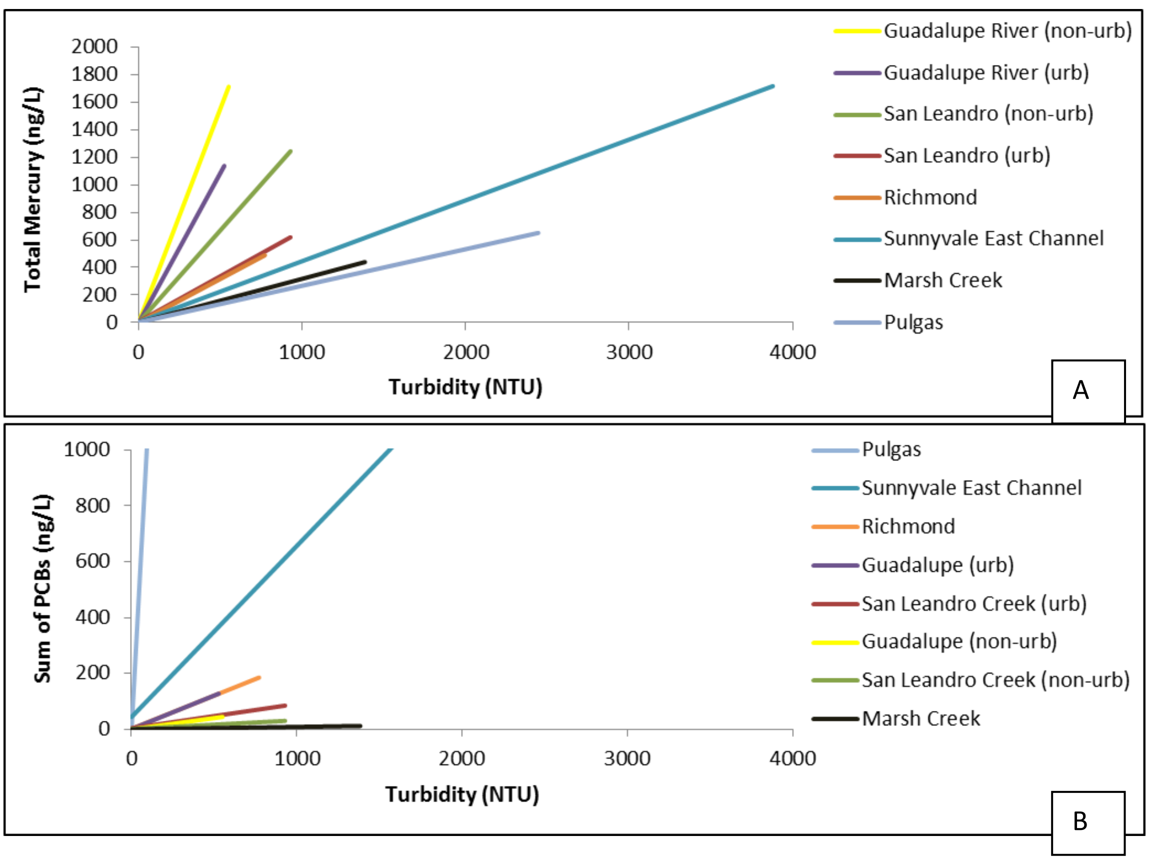

Figure 2. Comparison of regression slopes between watersheds based on data collected during sampling for A) Total Mercury and B) PCBs. Turbidity range shown on graphs represents minimum and maximum turbidities for entire sampling period

Another influence on potential treatability is the size of the watershed. Conceptually, a large load that is transported from a relatively small watershed and therefore in association with a relatively small volume of water is more manageable. Efforts to manage flows from the North Richmond Pump Station watershed exemplify this type of opportunity. Thus, area normalized loads (yields) provide another useful mechanism for first order ranking of watersheds (Table 10) in relation to ease of management. This method is more highly subject to climatic variation than the turbidity function/particle ratio method for ranking and therefore was done on climatically averaged loads. Despite these challenges, in a general sense, the relative rankings for PCBs exhibit a similar ranking to the particle ratio method; Pulgas Creek South Pump Station watershed ranked highest and Marsh Creek watershed ranked lowest. However the relative ranking of the other watersheds is not similar. In the case of mercury, Guadalupe River and San Leandro Creek exhibit the highest currently estimated yields corroborating the evidence from the particle ratio method. Similar to PCBs, the relative ranking of the other four watersheds is not similar to the particle ratio method. Given all our observations were during relatively dry years, it is difficult to know the certainty of the relative nature of the area-normalized estimates. For example, the relative rankings for suspended sediment loads normalized by unit area would likely change substantially with the addition of data from a water year that exceeds the climatic normal for each watershed; total phosphorus unit loads would also respond in a similar manner. For pollutants such as PCBs and total Hg that are found in specific source areas such as industrial and mining areas (Hg only) of these watersheds, release processes will likely be influenced by both climatic factors and sediment transport off impervious surfaces; also factors that are not likely well captured by the sampling that has occurred under relatively dry conditions.

6. Conclusions and next steps

6.1. Current and future uses of the data

The monitoring program implemented during the study was designed primarily to improve estimates of watershed-specific and regional loads to the Bay (MQ2) and secondly, to provide baseline data to support evaluation of trends towards concentration or loads reductions in the future (conceptually one or two decades hence) (MQ3) (see introduction section) in compliance with MRP provision C.8.e. (SFRWRCB, 2009). Multiple metrics have been developed and presented in this report to support these management questions:

- Pollutant loads: Pollutant loading estimates can help measure relative delivery of pollutants to sensitive Bay margin habitats and support calibration and verification of the Regional Watershed Spreadsheet Model and resulting regional scale loading estimates.
- Flow Weighted Mean Concentrations: FWMC can help to identify when sufficient data has been collected to adequately characterize watershed processes in relation to a specific pollutant in the context of management questions.
- Sediment-pollutant particle ratios: Particle ratios can help identify relative watershed pollution levels on a particle basis and relates to treatment potential.
- Pollutant area yields: Pollutant yields can help identify pollutant sources and relates to treatment potential.

Table 10. Climatically averaged area normalized loads (yields) ranked in relation to PCBs based on free flowing areas downstream from reservoirs (See Table 1 for areas used in the computations).

	Unit runoff (m)	SS (t/km^2)	TOC (mg/m^2)	PCBs (µg/m^2)	HgT (µg/m^2)	MeHgT (µg/m^2)	NO3 (mg/m^2)	PO4 (mg/m^2)	Total P (mg/m^2)
Marsh Creek	0.13	80.0	916	0.474	13.8	0.0423	79.7	15.1	76.6
North Richmond Pump Station	0.52	26.1	4,684	5.84	13.7	0.143	497	105	157
San Leandro Creek	0.95	53.3	5,957	3.36	55.4	0.260	317	81.9	216
Guadalupe River	0.24	272	1,926	20.3	282	0.196	169	28.1	116
Sunnyvale East Channel	0.17	33.6	1,220	9.44	5.95	0.116	45.8	19.3	63.9
Pulgas Creek Pump Station	0.63	41.8	5,907	84.6	11.8	0.111	158	49.2	127

- Correlation of pollutants: Finding co-related pollutants helps identify those watersheds with multiple sources and provides additional cost/benefit for management actions.

As discussed briefly in the introduction (section 1), as management effort focuses more and more on locating high leverage watersheds and patches within watersheds, the monitoring (and modeling) design is evolving.

6.2. What data gaps remain at current loads stations?

With regard to addressing the main management endpoints (single watershed and regional watershed loads and baseline data for trends) that influenced the monitoring design recommended by Melwani et al 2010 and described in each iteration of the MYP (BASMAA, 2011; BASMAA, 2012; BASMAA, 2013), an important question that managers are asking is how to determine when sufficient data have been collected. Several sub-questions are important when trying to make this determination. Are the data representative of climatic variability; have storms and years been sampled well enough relative to expected climatic variation? Are the data representative of the source-release-transport processes of the pollutant of interest? In reality, these factors tend to juxtapose and after three years of monitoring during relatively dry climatic conditions, some data gaps remain for each of the monitoring locations.

- Marsh Creek watershed has been sampled for three WYs. Continuous turbidity data were rated excellent at Lower Marsh Creek. Ample lower watershed stormwater runoff data are now available at Lower Marsh Creek, but this site is lacking information on high intensity upper watershed rain events where sediment mobilization from the historic mercury mining area could occur. Any future sampling would ideally be focused on Hg and for storms of greater intensity preferably when spillage is occurring from the upstream reservoir. No further PCB data are recommended. The sampling design to achieve these goals could be revisited with the objective of increased cost efficiency for data gathering to support remaining unanswered management questions.

- North Richmond Pump Station watershed has been sampled for two WYs (although data exist from a previous study [Hunt et al., 2012]). Additional data in relation to early season (seasonal 1st flush or early season storms) would help improve estimates of loads that could be averted from diversion of early season storms to wastewater treatment. Further data collection in relation to high concentrations of PBDEs would increase our understanding of PBDE source(s) in this watershed.
- San Leandro Creek watershed has been sampled for three WYs. San Leandro Creek received poor ratings on the quality of discharge information and completeness of turbidity data. The largest weakness is the scarcity of velocity measurements to adequately describe the stage-discharge rating curve for stages >2 feet and generate a continuous flow record. Additional velocity measurements are necessary to increase the accuracy and precision of discharge data for the site and support the computation of loads. There is currently no information on pollutant concentrations during reservoir releases, yet volumetrically, reservoir releases during WYs 2012 and 2013 were proportionally large but may have been atypical. Sample collection during release would help elucidate pollutant load contributions from the reservoir. Data collection during more intense rainstorms are also desirable for this site given the complex sources of PCBs and mercury in the watershed and the existence of areas of less intense land use and open space lending to likely relatively high inter-annual variability of water and sediment production.
- Guadalupe River watershed has been sampled at the Hwy 101 location during nine water years (WY 2003-2006, 2010-2014) to-date, but data are still lacking to adequately describe high intensity upper watershed rain events when mercury may still be released from sources in relation to historic mining activities. This type of information could help estimate the upper range of mercury loads from the mercury mining district and continue to help focus management attention. Further data collection in Guadalupe River watershed should focus on Hg sampling during high intensity storms. Further sampling of relatively frequent smaller runoff events is unnecessary and transport processes for PCBs are well supported by currently available data. The current sampling design is not cost-effective for gathering improved information to support management decisions in this watershed.
- Sunnyvale East Channel initially received poor quality data ratings for turbidity but this improved substantially in WYs 2013 and 2014. However, more storm event POC data are needed for establishing higher confidence in particle ratios, pollutant loads, FWMCs, and yields. A PCB source was apparently mobilized during the February 28, 2014 storm which had very high PCB concentrations, and this source seemed to continue to flush through the system in subsequent events. Because of this, our PCB regression with turbidity is not strong, creating uncertainty around the accuracy of the total PCB load estimate (e.g. what PCB sources might have moved through the system when we were not sampling?). Further data are needed in this watershed to better understand source-release-transport processes for PCBs.
- Based on the current review of the data, Pulgas Creek South Pump Station received a poor data quality rating for turbidity. Monitoring at this site was complicated by the logistical limitations of monitoring in a highly dynamic storm drain system. The challenging logistics of this site led to delays in the initiation of monitoring in WY 2013 as BASMAA/KLI worked to establish a

monitoring plan and functional instrumentation configuration (e.g., during WY 2013, turbidity data were only collected during three of the seven wet season months due to these challenges). In addition, because this site was located within a storm drain and vault adjacent to a pump station, the periodic operation of the pumps likely contributed to turbidity spikes and generally noisy nature of the data. Following review of WY 2014 observations, it was decided to reject the whole turbidity data set from this site. Although not feasible under the scope of this project, BASMAA has suggested they may undertake further review of this dataset, including application of smoothing functions to better fit the pollutant data to the turbidity record and potentially improve the usability of these data. KLI collected a robust manual turbidity sample set in combination with the pollutant sampling. Although they did not accurately record the times of this sample collection and therefore a relationship between manual turbidity and the sensor turbidity record for discrete times cannot be developed, a relationship between manual collection and smoothed sensor data (e.g. smoothed over 15-30 minutes) could potentially be developed. This could then validate the data quality of the smoothed turbidity data, and allow future use of these data for the development of the turbidity-pollutant regressions. However, because of the dynamic nature of this system (e.g. the sensor record showed changes >500 NTU in a 15 minute period), the likelihood of forming acceptable regressions between pollutant data and smoothed turbidity data seems low. More importantly, the cyclical spiking of the turbidity record suggests resuspension of settled sediments during pump outs. If the turbidity sensor was measuring resuspension of sediment in the vault, the turbidity sensor was measuring the turbidity caused by that sediment when it initially entered the vault, as well as when it was resuspended; in other words, the sensor record includes in some portions twice-measured sediment/turbidity. Therefore, the continuous turbidity record likely does not accurately represent the turbidity within the system, and consequently an accurate, continuous record for any pollutant likely cannot be established using the turbidity surrogate regression method even in the event that a pollutant-turbidity regression could be developed through smoothing. The sampling program began at this location (and North Richmond Pump Station) in WY 2013 as compared to WY 2012 at the other sites, and so despite being one of the most logistically challenging sites to set up for monitoring, BASMAA/KLI also had the least amount of time to execute it (arguably North Richmond Pump Station was also logistically challenging but SFEI had already completed two years of sampling at this location for another project, during which some of the instrumentation set-up challenges had been worked through). Due to both the delay in monitoring initiation at Pulgas combined with the very low rainfall in WY 2013, only a single storm was monitored and therefore very little data was available from WY 2013 in which to assess these issues. In short, although this has been a three-year project, this is really the first year that a substantial dataset has been available to evaluate for the Pulgas Ck Pump Station site. On the positive side, there are nearly two full wet seasons of flow data as well as seven storms worth of pollutant data, including the highest PCB concentrations observed to-date in the Bay Area. Despite challenges with the continuous turbidity record, these other data are valuable and less robust estimates of load are possible based on the FWMC approach. Additionally, because KLI also collected manual turbidity samples during pollutant sample collection, the pollutant data could potentially still be used to estimate loads using turbidity surrogate regression if a high quality relationship between the manually collected turbidity record and a continuous record could be established. Now that the monitoring challenges for this site are better understood, additional effort to improve the continuous turbidity monitoring at this location would be desirable to increase confidence in particle ratios, pollutant loads, FWMCs, and yields.

6.3. Next Steps

Recent discussions between BASMAA and the Region 2 Regional Water Quality Control Board in relation to reissuing the MRP (and discussion at the October 2013 and May 2014 SPLWG meetings) have highlighted the increasing focus towards finding watersheds and land areas within watersheds for management focus (MQ4). The monitoring design described in this report is not appropriate for this increasing management focus. There are various alternative monitoring designs that are more cost-effective for addressing the increasing focus in the second MRP permit term towards finding watersheds and land areas within watersheds for management attention while still supporting the other STLS management questions in a programmatic manner. The challenge for the STLS and SPWLG is finding the right balance between the different alternatives within budget constraints. Sampling during WY 2015 is using the following reconnaissance characterization design:

- Collaboration with stormwater Countywide programs to identify locations with possible PCB and/or mercury sources (based on a GIS based analysis)
- Focused sampling in older industrial drainages (some of which are tidally influenced)
- Composite sampling: 1 composite per storm/per analyte for PCB, total mercury, total metals, SSC, grain size, TOC/DOC; 5-15 aliquots per composite sample
- Pilot testing passive sediment samplers

The advantage of the reconnaissance sampling design is flexibility and given recent advances on the development of the RWSM (SFEI in preparation) have indicated the value of the data collected previously using the reconnaissance design (McKee et al., 2012), it seems likely that the reconnaissance design may end up being the most cost-effective going forward over the next three or more years. Data and information gathered over the last 10+ years guided by the SPLWG and STLS will continue to help guide the development of a cost effective monitoring design to adapt to changing management needs.

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8. Detailed information for each sampling location

8.1. Marsh Creek

8.1.1. Marsh Creek flow

The US geological survey has maintained a flow record on Marsh Creek (gauge number 11337600) since October 1, 2000 (13 WYs). Data collection at this site was discontinued after September 30, 2013 due to budget reductions. Flow for WY 2014 was based on a continuous stage record generated by the STLS sampling team combined with the flow rating curve provided by the USGS. Peak annual flows for the 14 years have ranged between 168 cfs (1/22/2009) and 1770 cfs (1/2/2006). For the same period, annual runoff has ranged between 3.03 Mm^3 (WY 2009) and 26.8 Mm^3 (WY 2006). In the Bay Area, at least 30 years of observations are needed at a particular site to get a reasonable understanding of climatic variability (McKee et al., 2003). Since, at this time, Marsh Creek has a relatively short history of gauging, flow record on Marsh Creek were compared with a reasonably long record at an adjacent monitoring station near San Ramon. Based on this comparison, WY 2006 may be considered representative of very rare wet conditions (upper 10th percentile) and WY 2009 is perhaps representative of moderately rare dry conditions (lower 20th percentile) based on records that began in WY 1953 at San Ramon Creek near San Ramon (USGS gauge number 11182500).

A number of relatively minor storms occurred during WYs 2012, 2013, and 2014 (Figure 3). In WY 2012, flow peaked at 174 cfs on 1/21/2012 at 1:30 am and then again 51 ½ hours later at 143 cfs on 1/23/2012 at 5:00 am. Total runoff during the whole of WY 2012 (October 1st to September 30th) was 1.87 Mm^3. During WY 2013, flow peaked at 1300 cfs at 10:00 am on 11/30/2012; total run-off for the water year was 6.26 Mm^3. During WY 2014, flow peaked at 441 cfs on 2/28/2014 at 6:20 am and total runoff was 1.31 Mm^3, the lowest of the 3 years of observations during the study and the lowest in the 14 year record for the site. Although the peak discharge for WY 2013 was the second highest since records began in WY 2001, total annual flow ranked eighth in the last 13 years. Thus, discharge of these magnitudes for all three water years are likely exceeded most years in this watershed. Rainfall data corroborates this assertion; rainfall during WYs 2012, 2013, and 2014 respectively were 70%, 71%, and 61% of mean annual precipitation (MAP) based on a long-term record at Concord Wastewater treatment plant (NOAA gauge number 041967) for the period Climate Year (CY) 1992-2014. Marsh Creek has a history of mercury mining in the upper part of the watershed. The Marsh Creek Reservoir is downstream from the historic mining area but upstream of the current gauging location. During WYs 2012 to 2014, discharge through the reservoir occurred on March, November, and December 2012. It is possible that in the future when larger releases occur, additional Hg loads may be transported down the Creek system but for these dry years, this was not a big component of the flow-source-transport process.

8.1.2. Marsh Creek turbidity and suspended sediment concentration

Turbidity generally responded to rainfall events in a similar manner to runoff. During WY 2012, turbidity peaked at 532 NTU during a late season storm on 4/13/12 at 7 pm. Relative to flow magnitude, turbidity remained elevated during all storms and was the greatest during the last storm despite lower flow. During WY 2013, turbidity peaked at 1384 NTU during the December storm series on 12/02/12 at 7:05

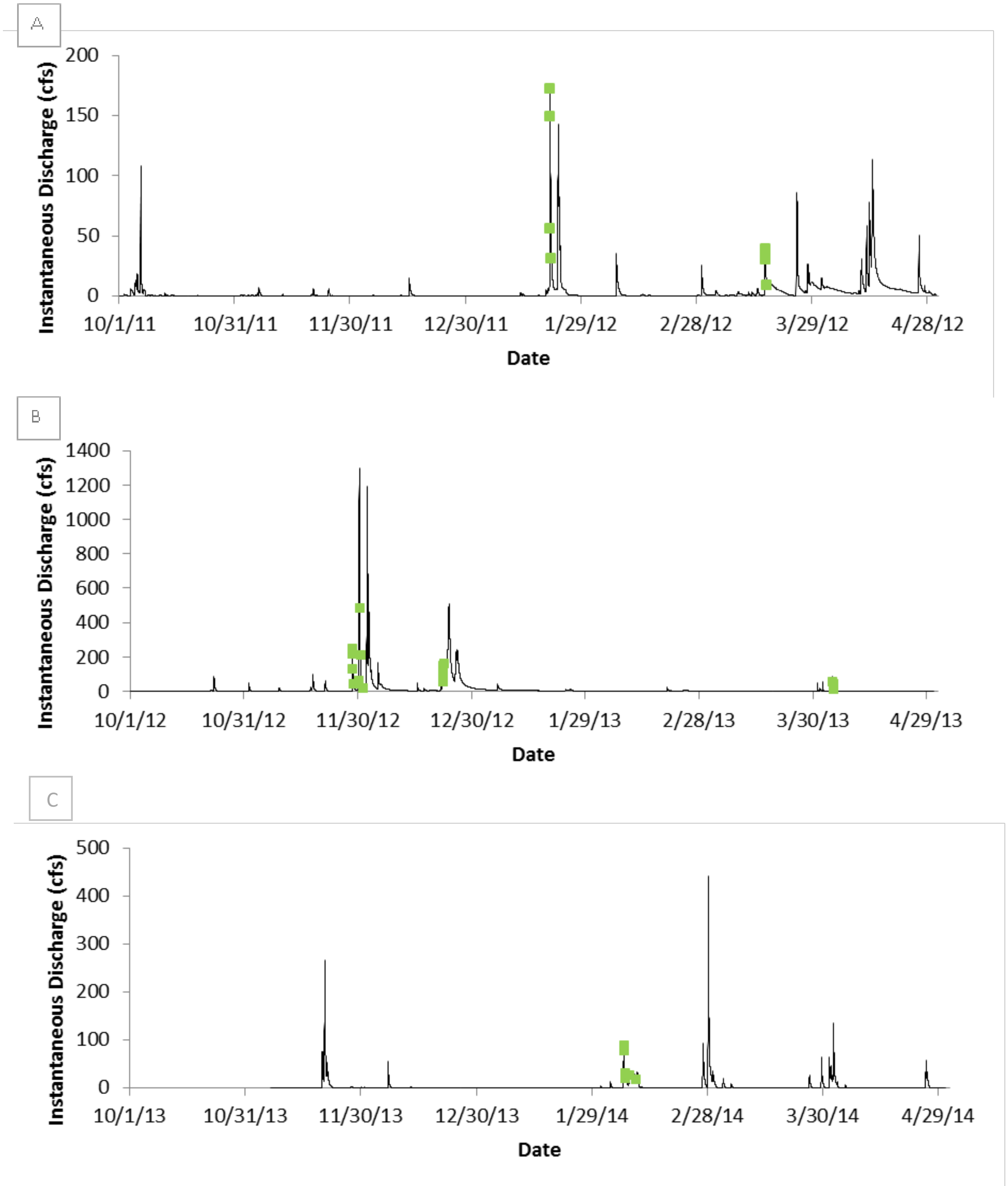

Figure 3. Flow characteristics in Marsh Creek during Water Year 2012 (A) and Water Year 2013 (B) based on published 15 minute data provided by the United States Geological Survey, gauge number 11337600) with sampling events plotted in green. Flow for WY 2014 (C) was based on stage measurements taken by the STLS study team combined with the USGS rating curve for the site.

pm. This occurred during a period when the Marsh Creek Reservoir was overflowing. During WY 2014, turbidity peaked at 458 NTU during the November storm on 11/20/2013 at 2:30 pm, very similar to the peak turbidity (432 NTU) observed later in the year during the storm that yielded the peak flow for the year. These observations, and observations made previously during the RMP reconnaissance study (maximum 3211 NTU; McKee et al., 2012), provide evidence that during larger storms and wetter years, the Marsh Creek watershed is capable of much greater sediment erosion and transport than occurred during observations in the three WYs reported here, resulting in greater turbidity and concentrations of suspended sediment. The OBS-500 instrument utilized at this sampling location with a range of 0-4000 NTU will likely be exceeded during larger storms if such storms are observed during some future sampling effort.

Suspended sediment concentration, since it was computed from the continuous turbidity data, follows the same patterns as turbidity in relation to discharge. Computed SSC peaked at 1312 mg/L during the 4/13/12 late season storm, at 1849 mg/L on 12/02/12, and at 682 mg/L on 11/20/2013 at 2:30 pm at the same times as the peaks in turbidity. During WY 2012, relative to flow magnitude, SSC remained elevated during all storms and was the greatest during the last storm despite lower flow. A similar pattern was also observed during WY 2013. Turbidity and computed SSC peaked during a smaller storm in December rather than the largest storm which occurred in late November. Turbidity remained relatively elevated from an even smaller storm that occurred on December 24th. This pattern was not observed in WY 2014 perhaps because storms were minor and few. Observations of increased sediment transport as the season progresses relative to flow in addition to the maximum SSC observed during the RMP reconnaissance study of 4139 mg/L (McKee et al., 2012), suggest that in wetter years, greater SSC can be expected.

8.1.3. Marsh Creek POC concentrations summary (summary statistics)

In relation to the other five monitoring locations, Marsh Creek is representative of a relatively rural watershed with lower urbanization but potentially impacted by mercury residues from historic mining upstream. Summary statistics (Table 11) were used to provide useful information to compare Marsh Creek water quality to other Bay Area streams. The comparison of summary statistics to knowledge from other watersheds and conceptual models of pollutant sources and transport processes provided a further check on data quality.

The maximum PCB concentration (4.32 ng/L) was similar to background concentrations normally found in relatively nonurban areas (Lent and McKee, 2011). For example, maximum concentrations in watersheds with little to no urbanization dominated by agriculture and open space exhibit average concentrations <5 ng/l (David et al., in press; Foster et al., 2000a; Howell et al. 2011; McKee et al., 2012). In instances where urbanization and industrial sources are highly diluted by >75% developed agricultural land concentrations averaging 8.9 ng/L can be observed (Gómez-Gutiérrez et al., 2006). Marsh Creek, at the sampling point, has the lowest percentage imperviousness (10%) of any Bay Area watershed measured to-date for PCBs and exhibits the lowest measured particle ratio of 5 pg/mg. If this is taken to be background for the Bay Area, any rural watershed with little urban land use that has suspended sediment concentrations during flood periods exceeding 1000 mg/L could be expected to exhibit PCB concentrations exceeding 5 ng/L. Of the 23 Bay Area watersheds reviewed by McKee et al. (2003), rural dominated areas including Cull Creek above Cull Creek Reservoir, San Lorenzo Creek above Don Castro Reservoir, Wildcat Creek near the park entrance, and Crow Creek exhibited FWMC > 1000 mg/L and could, if measured, show similar PCB concentrations to those observed in Marsh Creek.

Maximum total mercury concentrations (252 ng/L) were similar to concentrations found in mixed land use watersheds with some urban related influence such as atmospheric burden (McKee et al., 2004; Lent and McKee, 2011). Given global Hg cycling has a large atmospheric component (Fitzgerald et al., 1998; Lamborg et al., 2002; Steding and Flegal, 2002) and background soil concentrations in California are typically on the order of 0.1 mg/kg (equivalent to ng/mg) (Bradford et al., 1996), concentrations of this magnitude in a watershed with higher sediment erosion and higher average suspended sediment concentrations can occur when associated with the transport of low concentration particles (McKee et al., 2012). Thus Bay Area watersheds that exhibit suspended sediment concentrations in excess of 2,000 mg/L during floods should exhibit total Hg concentrations during floods in excess of 200 ng/L, even when no urban or mining sources are present. The particle ratio of Hg in Marsh Creek averaged 0.21 mg/kg for the three years of study, only 3-fold background CA soils concentrations, and was the 5th lowest observed in Bay Area watersheds to-date.

Maximum MeHg concentrations (0.407 ng/L during WY 2012, 1.2 ng/L during WY 2013, and ND during WY 2014 for the single sample collected at low flow) were greater during the first two years of observations than the proposed implementation goal of 0.06 ng/l for methylmercury in ambient water for watersheds tributary to the Central Delta (Wood et al., 2010: Table 4.1, page 40), however concentrations of this magnitude or greater have been observed in a number of Bay Area watersheds (Guadalupe River: McKee et al., 2006; McKee et al., 2010; Zone 4 Line A: Gilbreath et al., 2012; Glen Echo Creek and Zone 5 Line M: McKee et al., 2012). Indeed, concentrations of methylmercury of this magnitude have commonly been observed in rural watersheds (Domagalski, 2001; Balogh et al., 2002) and production has been related to organic carbon transport, riparian processes and percentage of watershed with wetlands (Balogh et al., 2002; Balogh et al., 2004; Barringer et al., 2010; Zheng et al., 2010; Bradely et al., 2011). Although local Hg sources can be a factor in helping to elevate MeHg production and food-web impacts, it is generally agreed that Hg sources are not a primary limiting factor in MeHg production.

Nutrient concentrations appear to be reasonably typical of other Bay Area rural watersheds (McKee and Krottje, 2005; Pearce et al., 2005) but perhaps a little greater for PO4 and TP than concentrations found in watersheds in grazing land use from other parts of the country and world (e.g. three rural dominated watersheds North Carolina: Line, 2013; comprehensive Australian literature review for concentrations bay land use class: Bartley et al., 2012). This appears typical in the Bay Area; phosphorus concentrations appear greater than elsewhere in the world under similar land use scenarios, an observation perhaps attributable to geological sources (Dillon and Kirchner, 1975; McKee and Krottje, 2005; Pearce et al., 2005).

Organic carbon concentrations observed in Marsh Creek were lesser than observed in Z4LA (max = 23 mg/L; FWMC = 12 mg/L: Gilbreath et al., 2012) but compared more closely to Belmont, Borel, Calabazas, San Tomas, and Walnut Creeks (McKee et al., 2012). Indeed, TOC concentrations of 4-12 mg/L have been observed elsewhere in California (Sacramento River: Sickman et al., 2007).

For pollutants sampled at a sufficient frequency for loads analysis (suspended sediments, PCBs, mercury, organic carbon, and nutrients), concentrations exhibited the typical pattern of median < mean with the exception of organic carbon. A similar style of first order quality assurance based on comparisons to observations in other studies is also possible for analytes measured at a lower frequency. Pollutants sampled at a lesser frequency using composite sampling design (see methods section) and appropriate for characterization only (copper, selenium, PAHs, carbaryl, fipronil, and PBDEs) were quite low and similar to concentrations found in watersheds with limited or no urban influences. Carbaryl and fipronil (not measured previously by RMP studies) were on the lower side of the range of peak concentrations reported in studies across the US and California (fipronil: 70 – 1300 ng/L: Moran, 2007) (Carbaryl: DL - 700 ng/L: Ensiminger et al., 2012). The Carbaryl concentrations we observed were more similar to those observed in tributaries to Salton Sea, Southern CA (geometric mean ~2-10 ng/L: LeBlanc and Kuivila, 2008). Pyrethroid concentrations of Delta/ Tralomethrin were similar to those observed in Zone 4 Line A, a small 100% urban tributary in Hayward, whereas concentrations of Permethrin and Cyhalothrin lambda were about 10-fold and 2-fold lower and concentrations of Bifenthrin were about 5-fold higher; cypermethrin was not detected in Z4LA (Gilbreath et al., 2012). In summary, the statistics indicate pollutant concentrations typical of a Bay Area non-urban stream and there is no reason to suspect data quality issues.

8.1.2. Marsh Creek toxicity

Composite water samples were collected at the Marsh Creek station during two storm events in WY 2012, four storm events in WY 2013 and two events in WY 2014. No significant reductions in the survival, reproduction and growth of three of four test species were observed during WY 2012 – WY 2014 except two occurrences of fathead minnow testing with 17% mortality rate (WY 2014 sample) and 42% mortality rate (WY 2013). Significant reductions in the survival of the amphipod Hyalella azteca was observed during both WY 2012 storm events while WY 2013 and 2014 had complete mortality of Hyalella Azteca between 5 and 10 days of exposure to storm water during all storm events.

Table 11. Summary of laboratory measured pollutant concentrations in Marsh Creek during WY 2012, 2013, and 2014.

		2012							2013							2014						
Analyte	Unit	Samples Taken (n)	Proportion Detected (%)	Min	Max	Median	Mean	Standard Deviation	Samples Taken (n)	Proportion Detected (%)	Min	Max	Median	Mean	Standard Deviation	Samples Taken (n)	Proportion Detected (%)	Min	Max	Median	Mean	Standard Deviation
SSC	mg/L	27	96%	0	930	180	297	276	54	100%	3.3	1040	167	217	230	20	75%	0	161	12	41.9	57
ΣPCB	ng/L	7	100%	0.354	4.32	1.27	1.95	1.61	15	100%	0.24	3.46	0.676	0.927	0.856							
Total Hg	ng/L	8	100%	8.31	252	34.5	74.3	85.2	17	100%	1.9	120	19	32.5	33.9	6	100%	2.4	18	4.55	7.35	6.02
Total MeHg	ng/L	5	100%	0.085	0.406	0.185	0.218	0.12	14	93%	0	1.2	0.185	0.337	0.381	1	0%	0	0	0	0	
TOC	mg/L	8	100%	4.6	12.4	8.55	8.34	2.37	16	100%	4.3	9.5	6.55	6.52	1.6	6	100%	6	8.7	7.05	7.17	1.04
NO3	mg/L	8	100%	0.47	1.1	0.635	0.676	0.202	16	94%	0	1	0.525	0.531	0.222	4	100%	0.28	0.59	0.575	0.505	0.15
Total P	mg/L	8	100%	0.295	1.1	0.545	0.576	0.285	16	100%	0.14	0.95	0.34	0.395	0.21	6	100%	0.097	0.5	0.22	0.255	0.137
PO4	mg/L	8	100%	0.022	0.12	0.0563	0.0654	0.0298	16	100%	0.046	0.18	0.11	0.114	0.0365	6	100%	0.046	0.15	0.108	0.101	0.0415
Hardness	mg/L	2	100%	200	203	202	202	2.12								2	100%	120	180	150	150	42.4
Total Cu	ug/L	2	100%	13.8	27.5	20.6	20.6	9.7	4	100%	3.8	30	12.5	14.7	11	2	100%	4.5	4.7	4.6	4.6	0.141
Dissolved Cu	ug/L	2	100%	4.99	5.62	5.3	5.3	0.445	4	100%	1.3	2.4	1.45	1.65	0.52	2	100%	2.1	2.6	2.35	2.35	0.354
Total Se	ug/L	2	100%	0.647	0.784	0.716	0.716	0.0969	4	100%	0.525	1.4	0.67	0.816	0.395	2	100%	0.44	0.8	0.62	0.62	0.255
Dissolved Se	ug/L	2	100%	0.483	0.802	0.643	0.643	0.226	4	100%	0.51	1.2	0.585	0.72	0.323	2	100%	0.42	0.59	0.505	0.505	0.12
Carbaryl	ng/L	2	50%	0	16	8	8	11.3	4	25%	0	13	0	3.25	6.5	2	0%	0	0	0	0	0
Fipronil	ng/L	2	100%	7	18	12.5	12.5	7.78	4	100%	10	13	10.8	11.1	1.44	2	100%	13	15	14	14	1.41
ΣPAH	ng/L	1	100%	216	216	216	216		2	100%	85.7	222	154	154	96.4	1	100%	37.8	37.8	37.8	37.8	
ΣPBDE	ng/L	1	100%	20	20	20	20		2	100%	11.2	56.4	33.8	33.8	32	1	100%	20.3	20.3	20.3	20.3	
Delta/ Tralomethrin	ng/L	2	100%	0.954	5.52	3.23	3.23	3.23	4	75%	0	2.2	0.75	0.925	0.943	2	50%	0	1.8	0.9	0.9	1.27
Cypermethrin	ng/L	2	50%	0	68.5	34.2	34.2	48.4	4	100%	1.8	13	2.15	4.78	5.49	2	100%	0.6	5.3	2.95	2.95	3.32
Cyhalothrin lambda	ng/L	2	50%	0	2.92	1.46	1.46	2.06	4	100%	0.5	3.2	0.8	1.33	1.27	1	100%	0.4	0.4	0.4	0.4	
Permethrin	ng/L	2	100%	3.81	17.3	10.6	10.6	9.54	4	75%	0	12	6.55	6.28	6.11	2	50%	0	2.4	1.2	1.2	1.7
Bifenthrin	ng/L	2	100%	25.3	257	141	141	163	4	100%	27	150	45	66.8	56.2	2	100%	20	33	26.5	26.5	9.19

Analyzed but not detected: Fenpropathrin, Esfenvalerate/ Fenvalerate, Cyfluthrin, Allethrin, Prallethrin, Phenothrin, and Resmethrin
Zeroes were used in the place of non-detects when calculating means, medians, and standard deviations.
The minimum number of samples used to calculate standard deviation at Marsh Creek was two.
All Hardness results in WY 2013 were censored.

8.1.3. Marsh Creek loading estimates

Site-specific methods were developed for computed loads (Table 12). Methylmercury data was flow-stratified for improved relationships between turbidity and the pollutant under different flow conditions. Preliminary loads estimates generated for WY 2012 and reported by McKee et al. (2013) have now been revised based on additional data collected in WY 2013 and 2014 and an improving understanding of pollutant transport processes for the site. Monthly loading estimates correlate well with monthly discharge (Table 13). There are no data available for October and November 2011 and October 2013 because monitoring equipment was not installed. Monthly discharge was greatest in December 2012 as were the monthly loads for each of the pollutants regardless of transport mode (dominantly particulate or dissolved). The discharge was relatively high for December given the rainfall, an indicator that the watershed was reasonably saturated by this time. The sediment loads are well-aligned with the total discharge and the very high December 2012 sediment load appears real; the watershed became saturated after late November rains such that early December and Christmas time storms transported a lot of sediment. Monthly loads of total Hg appear to correlate with discharge for all months; this would not be the case if there was variable release of mercury from historic mining sources upstream associated with climatic and reservoir discharge conditions. Importantly, if data were to be collected to capture periods when saturated and high rainfall conditions occur along with reservoir releases, new information may emerge about the influence, if any, of Hg pollution associated with historic mining. If these conditions were to result in significant Hg releases, then any estimate of long term average load might be elevated above what can be computed now. Given the very dry flow conditions of WYs 2012, 2013, and 2014 (see discussion on flow above), loads presented here are considered representative of dry conditions.

Table 12. Regression equations used for loads computations for Marsh Creek during water years 2012, 2013 and 2014.

Analyte	Origin of runoff	Slope	Intercept	Correlation coefficient (r^2)	Notes
Suspended Sediment (mg/L/NTU)	Mainly urban	1.49		0.63	Regression with turbidity
Total PCBs (ng/L/NTU)	Mainly urban	0.00878		0.86	Regression with turbidity
Total Mercury (ng/L/NTU)	Mainly urban	0.3174		0.68	Regression with turbidity
Total Methylmercury (ng/L/NTU) - Storm Flows	Mainly urban	0.00136	0.0199	0.86	Regression with turbidity
Total Methylmercury (ng/L/NTU) - Low Flow[a]	Mainly urban	0.0067	0.039	0.94	Regression with turbidity
Total Organic Carbon (mg/L)	Mainly urban	6.9			Flow weighted mean concentration
Total Phosphorous (mg/L/NTU)	Mainly urban	0.00174	0.176	0.71	Regression with turbidity
Nitrate (mg/L)	Mainly urban	0.594			Flow weighted mean concentration
Phosphate (mg/L)	Mainly urban	0.111			Flow weighted mean concentration

[a] Includes small storms after extended dry periods.

Table 13. Monthly loads for Lower Marsh Creek during water years 2012 - 2014. Italicized loads are estimated based on monthly rainfall-load relationships.

Water Year	Month	Rainfall (mm)	Discharge (Mm^3)	SS (t)	TOC (kg)	PCBs (g)	HgT (g)	MeHgT (g)	NO3 (kg)	PO4 (kg)	Total P (kg)
2012	11-Oct	33	*0.153*	*9.59*	*1,057*	*0.056*	*1.73*	*0.0224*	*91.0*	*17.0*	*44.2*
	11-Nov	26	*0.0717*	*2.72*	*495*	*0.0159*	*0.50*	*0.0087*	*42.6*	*7.96*	*17.5*
	11-Dec	6	0.0252	0.819	174	0.00483	0.247	0.00466	14.8	2.77	5.38
	12-Jan	51	0.318	77.5	2,443	0.414	19.1	0.0687	190	33.1	158
	12-Feb	22	0.0780	4.56	538	0.0269	1.377	0.00704	46.0	8.58	19.0
	12-Mar	60	0.361	23.5	2,485	0.148	6.64	0.0321	213	38.8	93.8
	12-Apr	59	0.607	114	4,188	0.673	34.5	0.118	358	66.8	240
	Wet season total	257	1.61	233	11,380	1.34	64.0	0.262	956	175	578
2013	12-Oct	23	0.0875	7.98	603	0.0470	1.22	0.0393	51.6	9.62	24.7
	12-Nov	96	0.989	237	6,309	1.42	32.2	0.331	625	132	457
	12-Dec	75	4.00	2,435	27,474	14.4	372	2.32	2,363	444	3,573
	13-Jan	15	0.428	11.1	2,955	0.0655	1.69	0.0256	253	47.1	88.3
	13-Feb	6	0.142	1.39	981	0.00819	0.212	0.0118	83.9	15.6	26.7
	13-Mar	9	0.0721	1.57	497	0.00925	0.239	0.00987	42.5	7.93	14.5
	13-Apr	19	0.0978	8.75	680	0.0476	1.34	0.0412	54.8	10.5	28.0
	Wet season total	243	5.82	2,703	39,500	16.0	408	2.78	3,474	666	4,212
2014	13-Oct	1	*0.0252*	*0.48*	*174*	*0.00280*	*0.0885*	*0.00237*	*15.0*	*2.80*	*4.91*
	13-Nov	41	0.261	49.1	1,800	0.289	7.48	0.0504	154	28.7	103
	13-Dec	6	0.005	0.0185	36.5	0.000109	0.00282	0.000256	3.12	0.582	0.953
	14-Jan	4	0.032	1.39	224	0.00821	0.212	0.00225	19.1	3.56	7.33
	14-Feb	79	0.618	122	4308	0.729	18.5	0.126	363	69.1	259
	14-Mar	24	0.179	9.17	1232	0.0540	1.40	0.0128	105	19.6	42.1
	14-Apr	29	0.215	20.2	1483	0.119	3.07	0.0231	127	23.6	61.4
	Wet season total	184	1.34	202	9,257	1.20	30.7	0.217	786	148	479

[a] April 2012 monthly loads are reported for only the period April 01-26. In the 4 days missing from the record, <0.03 inches of rain fell in the lower watershed.

[b] October 2012 monthly loads are reported for only the period October 19-31. In the 18 days missing from the record, <0.05 inches of rain fell in the lower watershed.

[c] April 2013 monthly loads are reported for only the period April 01-18. In the 12 days missing from the record, no rain fell in the lower watershed.

[d] November 2013 are reported for only the period November 6-30. No rain fell during the missing period.

8.2. North Richmond Pump Station

8.2.1. North Richmond Pump Station flow

Richmond discharge estimates were calculated during periods of active pumping at the station during WYs 2013 and 2014. Discharge estimates include all data collected when the pump rate was operating at greater than 330 RPM, the rate which marks the low end of the pump curve provided by the pump station. This rate is generally reached 30 seconds after pump ignition. For the purposes of this study, flows at less than 330 RPM were considered negligible due to limitations of the pump efficiency curve. This assumption may have resulted in slight underestimation of active flow from the station particularly during shorter duration pump outs but this under estimate was minor relative to storm and annual flows. The annual estimated discharge from the station was 0.74 Mm^3 for WY 2013 and 0.50 Mm^3 for WY 2014 (Table 16). A discharge estimate at the station for WY 2011 was 1.1 Mm^3 (Hunt et al., 2012). The rainfall to runoff ratios between the two studies was similar supporting the hypothesis that the flows and resulting load estimates from the previous study remain valid.

Precipitation in WY 2013 was 89% mean annual precipitation (MAP) based on a long-term record PRISM data record (modeled PRISM data) for the period Climate Year (CY) 1970-2000. Thus it appears WY 2013 was slightly drier than average. Of the total annual rainfall, 74% fell during a series of larger events in the period late November to December. Otherwise, WY 2013 had a number of very small events, three of which were sampled for water quality (Figure 4). The pumps at this pump station operate at a single speed, and therefor flow rates at this location are governed by the number of pumps operating at a given time. Most pump-outs during these storms had one operating pump except for a few storm events where two pumps were in operation. Flow "peaked" during one of these times when two pumps were in operation simultaneously. The peak rate was 210 cfs and occurred on December 2, 2013 after approximately 3.8 inches of rain fell over a 63 hour period.

WY 2014 was even drier than the previous year, with only 62% MAP (12.8 inches of rain). In total, five events were sampled for water quality, including the intense early season first flush on November 19 and 20, 2013, and multiple events in February 2014. Similar to WY 2013, a single pump operated for the majority of pump outs, with only a couple of occasions when two pumps were simultaneously operating. Flow peaked at 191 cfs on March 29th, 2014 after 0.84 inches fell in the previous three hours.

8.2.2. North Richmond Pump Station turbidity and suspended sediment concentration

Maximum turbidity during the study was measured at 772 NTU and which occurred during a dry flow pump out on January 24, 2013 following a low magnitude storm event of 0.22 inches on January 23rd. Maximum turbidity during other storm events ranged up to 428 NTU in WY 2013 and 466 NTU in WY 2014. Storms typically peaked in turbidity between 150 and 500 NTU. The pattern of turbidity variation over the wet season was remarkably similar to that observed during WY 2011 in the previous study (Hunt et al., 2012). The turbidity dataset collected by Hunt et al. (2012) was noisy and contained unexplainable turbidity spikes that were censored. The similarities between the WY 2011 and 2013 datasets suggest that the WY 2011 data set was not over-censored and therefore that pollutant loads based on both flow and turbidity computed by Hunt et al. (2012) remain valid. Suspended sediment concentration was computed from the continuous turbidity data. Computed SSC peaked at 1010 mg/L

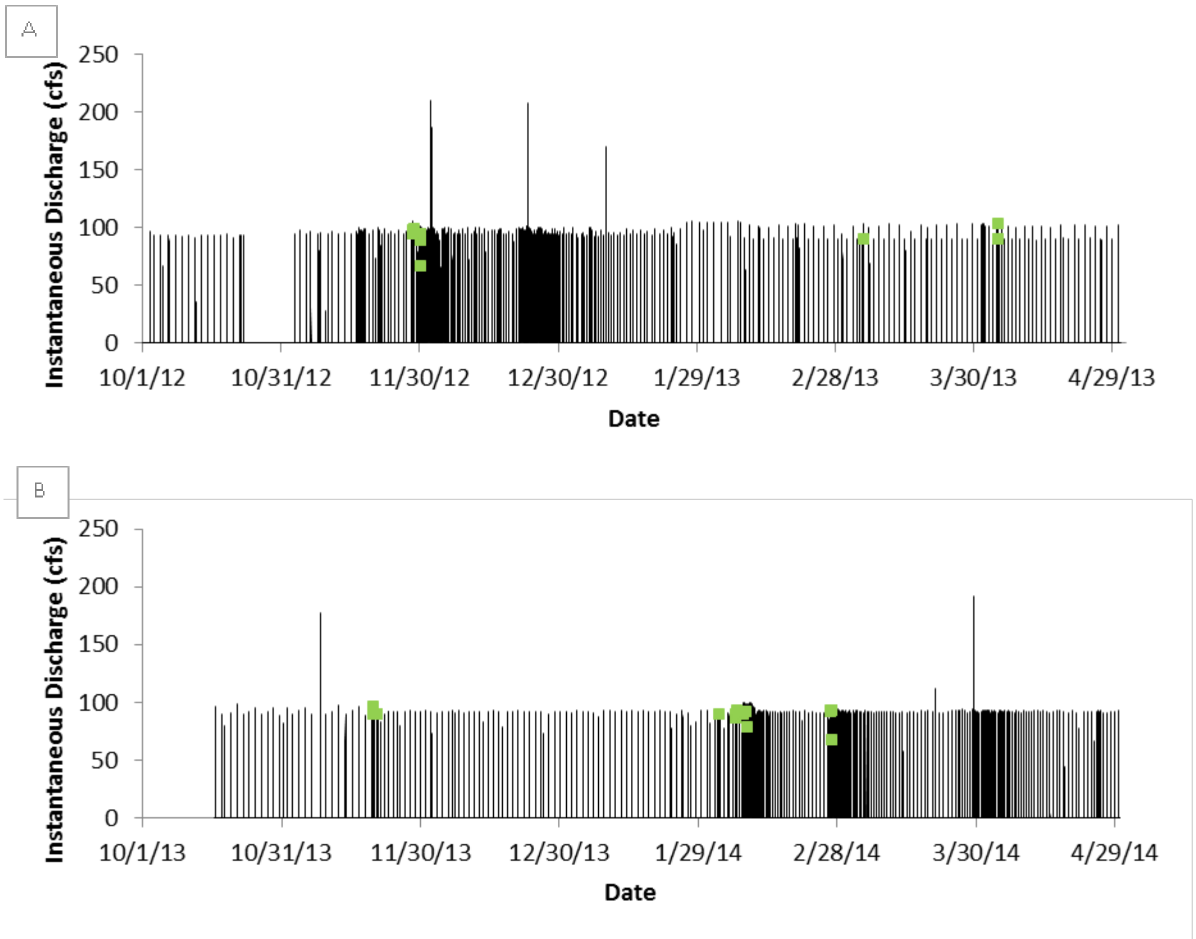

Figure 4. Flow characteristics at North Richmond Pump Station during Water Year 2013 and 2014 with sampling events plotted in green.

during the 1/24/13 low flow pump out when turbidity also peaked. In WY 2014, the peak computed SSC was 579 mg/L during the 3/26/14 event; SSC in most storms peaked between 200 and 600 mg/L.

8.2.3. North Richmond Pump Station POC concentrations (summary statistics)

The North Richmond Pump Station is a 1.6 km watershed primarily comprised of industrial, transportation, and residential land uses. The watershed has a long history of industrial land use and is downwind from the Richmond Chevron Oil Refinery and the Port of Richmond. The land-use configuration results in a watershed that is approximately 62% covered by impervious surface and these land use and history factors help to contribute to potentially high concentrations loads of PCB and Hg. Summary statistics (Table 14) were used to provide useful information to compare Richmond pump station water quality to other Bay Area monitoring locations. The comparison of summary statistics to knowledge from other watersheds and conceptual models of pollutant sources and transport processes provided a further check on data quality.

The maximum PCB concentration measured during the project study period was 38 ng/L. In WY2011, the maximum concentration measured was 82 ng/L (Hunt et al., 2012). PCB concentrations were in the range of other findings for urban locations (range 0.1-1120 ng/L) (Lent and McKee, 2011). Although highly impervious with an industrial history, the North Richmond Pump Station Watershed contains no known PCB sources of specific focus at this time; PCB transport in this watershed could be more generally representative of older mixed urban and industrial land use areas. In contrast, watersheds with known specific industrial sources appear to exhibit average concentrations in excess of about 100 ng/l (Marsalek and Ng, 1989; Hwang and Foster, 2008; Zgheib et al., 2011; Zgheib et al., 2012; McKee et al., 2012) and watersheds with little to no urbanization dominated by agriculture and open space exhibit average concentrations <5 ng/l (David et al., in press; Foster et al., 2000a; Howell et al. 2011; McKee et al., 2012). In instances where urbanization and industrial sources are highly diluted by >75% developed agricultural land concentrations averaging 8.9 ng/L can be observed (Gómez-Gutiérrez et al., 2006). The North Richmond Pump Station Watershed has an imperviousness of 62% and exhibits a PCB particle ratio of 267 pg/mg; the sixth highest observed so far in the Bay Area and well above the background of rural areas (indicated by Marsh Creek in the Bay Area).

Maximum total mercury concentrations (230 ng/L) during WYs 2013 and 2014 were of a similar magnitude with maximum observed concentrations during previous monitoring efforts (200 ng/L) (Hunt et al., 2012). This sample was collected during the February 26, 2014 storm event where approximately 1 inch of rain fell in the watershed. This event followed a 17 day dry period. Mercury concentrations were higher than in the range found in Zone 4 Line-A, another small urban impervious watershed (Gilbreath et al., 2012). Concentrations were also much greater than those observed in three urban Wisconsin watersheds (Hurley et al., 1995), urban influenced watersheds of the Chesapeake Bay region (Lawson et al., 2001), and two sub-watersheds of mostly urban land use in the Toronto area (Eckley and Branfirheun, 2008). Unlike, Marsh Creek, where the maximum Hg concentrations for the most part are attributed to the erosion of high masses of relatively low concentration soils, North Richmond Pump Station Watershed transports relatively low concentrations and mass of suspended sediment (maximum observed from grab samples was just 347 mg/L). Hg sources and transport in this watershed are more likely attributed to local atmospheric re-deposition from historical and ongoing oil refining and shipping and from within-watershed land use and sources. The source-release-transport processes are more likely similar to those of other urbanized and industrial watersheds (Barringer et al., 2010; Rowland et al., 2010; Lin et al., 2012) but not of very highly contaminated watersheds with direct local point source discharge (e.g. 1600-4300 ng/L: Ullrich et al., 2007; 100-5000 ng/L: Picado and Bengtsson, 2012; Kocman et al., 2012; 78-1500 ng/L: Rimondi et al., 2014).

The MeHg concentrations during the two-year study ranged from 0.03-1.1 ng/L compared with WY 2011 maximum concentrations of 0.6 ng/L (Hunt et al., 2012). Concentrations of this magnitude or greater have been observed in a number of Bay Area urban influenced watersheds (Guadalupe River: McKee et al., 2006; McKee et al., 2010; Zone 4 Line A: Gilbreath et al., 2012; Glen Echo Creek and Zone 5 Line M: McKee et al., 2012). However, concentrations of methylmercury of this magnitude have not been observed in urbanized watersheds (Mason and Sullivan, 1998; Naik and Hammerschmidt, 2011; Chalmers et al., 2014). Although local Hg sources can be a factor in helping to elevate MeHg production and food-web impacts, it is generally agreed, at least for agricultural and forested systems with lesser urban influences, that Hg sources are not a primary limiting factor in MeHg production (Balogh et al., 2002; Balogh et al., 2004; Barringer et al., 2010; Zheng et al., 2010; Bradely et al., 2011).

Nutrient concentrations in the North Richmond Pump Station appear to be reasonably typical of other Bay Area more rural watersheds (McKee and Krottje, 2005; Pearce et al., 2005) and compare closely to those observed in Guadalupe River during this study. North Richmond had the highest nitrate concentrations (equivalent to Guadalupe River) and orthophosphate concentrations of the six POC locations in this study. Concentrations also appear typical or slightly greater than for PO4 and TP of found in urban watersheds in other parts of the country and world (e.g. Hudak and Banks, 2006; comprehensive Australian literature review for concentrations by land use class: Bartley et al., 2012). Phosphorus concentrations appear greater here than elsewhere in the world under similar land use scenarios, an observation perhaps attributable to geological sources (Dillon and Kirchner, 1975; McKee and Krottje, 2005; Pearce et al., 2005).

Organic carbon concentrations observed in North Richmond Pump Station were similar to those observed in Z4LA (max = 23 mg/L; FWMC = 12 mg/L: Gilbreath et al., 2012) were similar to Belmont, Borel, Calabazas, and Walnut Creeks (McKee et al., 2012) and Guadalupe and Sunnyvale East Channel. They were much lower than observed in Pulgas Green Pump Station. Indeed, TOC concentrations of 4-12 mg/L have been observed elsewhere in California (Sacramento River: Sickman et al., 2007).

For pollutants sampled at a sufficient frequency for loads analysis (suspended sediments, PCBs, mercury, organic carbon, and nutrients), concentrations exhibited an unexpected pattern of median < mean except for PAH, PBDE, total copper, and hardness. This is perhaps indicative of some kind of point source for these pollutants in this watershed that is diluted during higher flows. Maximum PBDE concentrations at Richmond were 4200 ng/L which is 85-fold greater than the highest average observed in the five other locations of this current study and 50-fold greater than previously reported for Zone 4 Line A (Gilbreath et al., 2012). These are the highest PBDE concentrations measured in Bay Area stormwater to-date of any study. The North Richmond watershed currently contains an auto dismantling yard and a junk/wrecking yard; possible source areas. Only two peer reviewed articles have previously described PBDE concentrations in runoff, one for the Pearl River Delta, China (Guan et al., 2007), and the other for the San Francisco Bay (Oram et al., 2008) based, in part, on concentrations observed in Guadalupe River and Coyote Creek. Maximum total PBDE concentrations measured by Guan et al. (2007) were 68 ng/L, a somewhat surprising result given that the Pearl River Delta is a known global electronic-waste recycling hot spot. However, the Guan et al. study was based on monthly collection as opposed to storm-based sampling as was completed in a larger river system where dilution of point source may have occurred.

Copper, selenium, carbaryl, fipronil, and pyrethroids were sampled at a lesser frequency using a composite sampling design (see methods section) and were used to characterize pollutant concentrations to help support management questions possible causes of toxicity (in the case of the pesticides). Similar to the other sites, carbaryl and fipronil (not measured previously by RMP studies) were on the lower side of the range of peak concentrations reported in studies across the US and California (fipronil: 70 – 1300 ng/L: Moran, 2007) (Carbaryl: DL - 700 ng/L: Ensiminger et al., 2012; tributaries to Salton Sea, Southern CA geometric mean ~2-10 ng/L: LeBlanc and Kuivila, 2008).

Table 14. Summary of laboratory measured pollutant concentrations in North Richmond Pump Station during water year 2013 and 2014.

		2013							2014						
Analyte	**Unit**	**Samples Taken (n)**	**Proportion Detected (%)**	**Min**	**Max**	**Median**	**Mean**	**Standard Deviation**	**Samples Taken (n)**	**Proportion Detected (%)**	**Min**	**Max**	**Median**	**Mean**	**Standard Deviation**
SSC	mg/L	41	95%	0	213	26.5	45.7	54.3	67	99%	0	325	52	63.9	58.1
ΣPCB	ng/L	12	100%	4.85	31.6	10.1	12	7.09	20	100%	2.23	38.5	13.7	15	9.83
Total Hg	ng/L	12	100%	13	98	18.5	27.7	24.6	20	100%	11.5	230	28.5	46.7	51.8
Total MeHg	ng/L	6	100%	0.03	0.19	0.145	0.118	0.0705	10	100%	0.03	1.1	0.16	0.261	0.309
TOC	mg/L	12	100%	3.5	13.5	6.6	7.46	3.36	20	100%	5.2	60	9.85	13.4	12.4
NO3	mg/L	12	100%	0.21	3.1	0.855	1.13	0.848	20	100%	0.32	3.9	0.688	0.882	0.792
Total P	mg/L	12	100%	0.18	0.35	0.27	0.276	0.0449	20	100%	0.3	0.75	0.405	0.448	0.146
PO4	mg/L	11	100%	0.11	0.24	0.16	0.168	0.0424	20	100%	0.15	0.44	0.23	0.245	0.0809
Hardness	mg/L								5	100%	46	260	120	129	86.4
Total Cu	ug/L	3	100%	9.9	20	16	15.3	5.09	5	100%	11	46	30	26.8	14.4
Dissolved Cu	ug/L	3	100%	4.4	10	4.7	6.37	3.15	5	100%	4.7	15.5	7.3	9.7	4.75
Total Se	ug/L	3	100%	0.27	0.59	0.33	0.397	0.17	5	100%	0.24	0.74	0.4	0.416	0.206
Dissolved Se	ug/L	3	100%	0.26	0.56	0.27	0.363	0.17	5	100%	0.16	0.61	0.415	0.367	0.183
Carbaryl	ng/L	3	100%	12	40	19	23.7	14.6	5	80%	0	37	25.5	20.3	14.2
Fipronil	ng/L	3	33%	0	4	0	1.33	2.31	5	100%	5	14	7	9.3	4.35
ΣPAH	ng/L	2	100%	160	1350	754	754	840	2	100%	195	405	300	300	148
ΣPBDE	ng/L	2	100%	153	3360	1760	1760	2270	3	100%	18	241	170	143	114
Delta/ Tralomethrin	ng/L	3	100%	1	3.5	3.05	2.52	1.33	5	60%	0	6.2	0.3	2.16	2.9
Cypermethrin	ng/L	3	100%	2.1	4.35	3.1	3.18	1.13	5	100%	2.1	13	3.4	5.84	4.75
Cyhalothrin lambda	ng/L	3	100%	0.4	1.3	0.6	0.767	0.473	4	100%	0.5	1.9	1.5	1.35	0.619
Permethrin	ng/L	3	100%	6.4	16	13.5	12	4.98	5	100%	7.2	55	7.9	21.1	20.9
Bifenthrin	ng/L	3	100%	3.8	8.05	6.1	5.98	2.13	5	100%	3.4	8.6	5	5.82	2.57

Zeroes were used in the place of non-detects when calculating means, medians, and standard deviations.
The minimum number of samples used to calculate standard deviation at the North Richmond Pump Station was two.

Pyrethroid concentrations of Delta/ Tralomethrin were similar to those observed in Zone 4 Line A, Cypermethryn was not detected in Z4LA, whereas concentrations of Permethrin and Bifenthrin were about 2-fold lower (Gilbreath et al., 2012). In summary, the statistics indicate pollutant concentrations typical of a Bay Area urban stream and there is no reason to suspect data quality issues.

8.2.4. North Richmond Pump Station toxicity

At North Richmond Pump Station, no significant effects were observed for the crustacean Ceriodaphnia dubia, the algae Selenastrum capricornutum, or fathead minnows during any tests for either year of monitoring. Two of three WY 2013 samples had a significant decrease in Hyalella Azteca survival. One sample showed an 88% survival rate compared to a 98% lab survival rate. The other sample showed a 12% survival rate compared to a 100% lab survival rate. In the five storm WY 2014 storm events, mortality of Hyalella azteca ranged from 8% to 80%.

8.2.5. North Richmond Pump Station loading estimates

The following methods were applied for calculating loading estimates (Table 15). Given that there were no flows out of the pump station when the pumps were not on, loads were only calculated for periods during active pumping conditions. Regression equations between turbidity and the particle-associated pollutants (SSC, PCBs, total mercury, methylmercury, total organic carbon and total phosphorous) were used to estimate loads (Table 16). Because there was no relation or trend in the concentrations of nitrate and phosphate in relation to flow or turbidity, flow weighted mean concentrations were applied. Monthly loading estimates correlate very well with monthly discharge (Table 16). Monthly discharge was greatest in December 2012 as were the monthly loads for suspended sediment and pollutants. Although there were slight climatic differences that have not been adjusted for, WY 2013 suspended sediment (35.7 t) and PCB (8.14 g) load estimates were comparable to the WY 2011 estimates (29 t and 8.0 g, respectively) even thought it was a wetter year (134% MAP) (Hunt., 2012) providing further support and confidence that the computed loads are reasonable. Due to lessons learned from the previous study, there is much higher confidence in the WY 2013 and 2014 loads estimates due to improvements in both the measurements of turbidity and flow rate using optical sensor equipment. Given the below average rainfall conditions experienced during WY 2013 and 2014, loads from the present study may be considered representative of somewhat dry conditions.

Table 15. Regression equations used for loads computations for North Richmond Pump Station during water year 2013 and 2014.

Analyte	Origin of runoff	Slope	Intercept	Correlation coefficient (r^2)	Notes
Suspended Sediment (mg/L/NTU)	Mainly urban	1.31		0.58	Regression with turbidity
Total PCBs (ng/L/NTU)	Mainly urban	0.237	2.12	0.76	Regression with turbidity
Total Mercury (ng/L/NTU) WY 2013	Mainly urban	0.442		0.89	Regression with turbidity
Total Mercury (ng/L/NTU) WY 2014	Mainly urban	0.733		0.71	Regression with turbidity
Total Methylmercury (ng/L/NTU)	Mainly urban	0.0044	0.0542	0.47	Regression with turbidity
Total Organic Carbon (mg/L/NTU) WY 2013	Mainly urban	-0.0295	8.84	0.09	Regression with turbidity
Total Organic Carbon (mg/L/NTU) WY 2014	Mainly urban	0.0326	11.4	0.01	Regression with turbidity
Total Phosphorous (mg/L/NTU) WY 2013	Mainly urban	0.000754	0.241	0.34	Regression with turbidity
Total Phosphorous (mg/L/NTU) WY 2014	Mainly urban	0.00255	0.293	0.42	Regression with turbidity
Nitrate (mg/L)	Mainly urban	0.958			Flow weighted mean concentration
Phosphate (mg/L)	Mainly urban	0.206			Flow weighted mean concentration

Table 16. Monthly loads for North Richmond Pump Station. Italicized loads are estimated based on monthly rainfall-load relationships.

Water Year	Month	Rainfall (mm)	Discharge (Mm^3)	SS (t)	TOC (kg)	PCBs (g)	HgT (g)	MeHgT (g)	NO3 (kg)	PO4 (kg)	Total P (kg)
2013	12-Oct	33	*0.0590*	*2.36*	*604*	*0.525*	*1.28*	*0.0129*	*56*	*11.9*	*18.5*
	12-Nov	156	0.152	7.88	1167	1.75	3.48	0.0429	146	30.9	41.2
	12-Dec	232	0.374	20.8	2834	4.56	9.19	0.112	358	75.8	102
	13-Jan	18	0.0640	1.31	537	0.373	0.578	0.00923	61.4	13.0	16.2
	13-Feb	18	0.0438	1.28	358	0.324	0.564	0.00799	42.0	8.89	11.3
	13-Mar	19	0.0418	0.414	360	0.164	0.183	0.00408	40.0	8.48	10.3
	13-Apr	26	0.0602	1.72	493	0.440	0.761	0.0108	57.6	12.2	15.5
	Wet season total	502	0.795	35.7	6353	8.14	16.0	0.200	761	161	215
2014	13-Oct	0	0.0113	0.0184	129	0.0272	0.0142	0.000691	10.8	2.28	3.33
	13-Nov	36	0.0509	2.09	632	0.487	1.61	0.0119	48.7	10.3	19.0
	13-Dec	8	0.0271	0.393	319	0.129	0.304	0.00320	26.0	5.50	8.7
	14-Jan	1	0.0216	0.0739	248	0.0592	0.0571	0.00149	20.6	4.38	6.46
	14-Feb	176	0.224	9.87	2798	2.27	7.63	0.0556	214	45.4	84.8
	14-Mar	74	0.0967	5.64	1243	1.23	4.36	0.0301	92.6	19.6	39.3
	14-Apr	32	0.0676	2.31	829	0.563	1.79	0.0138	64.8	13.7	24.3
	Wet season total	326	0.499	20.4	6,197	4.76	15.77	0.1168	478	101	186

8.3. San Leandro Creek

8.3.1. San Leandro Creek flow

Rainfall at San Leandro Creek during the study was below average all three years. During WY 2012, total rainfall was 19.14 inches, or 75% of mean annual precipitation (MAP = 25.7 in) based on a long-term record at Upper San Leandro Filter (gauge number 049185) for the period 1971-2010 (WY). In WYs 2013 and 2014, rainfall totaled 17.2 and 13.3 inches, respectively, for MAPs of just 67% and 52% in each of those years. Since 1971, 2012-14 were the 14th, 11th, and 3rd driest years on record, respectively, and together had the second lowest 3-year cumulative rainfall, excepting the record dry 1975-1977 drought.

There is no historic flow record on San Leandro Creek. The challenges of developing a rating curve for this site have already been described (see "Continuous data quality assurance summary"). During WY 2012 monitoring, a preliminary rating curve was developed for stages up to 3.65 feet based on discharge sampling. This rating was augmented in WY 2014 with additional discharge measurement at wadeable stages, though gaps in the rating exist between 2 and 3.5 feet of stage as well for stages greater than

3.65 feet. As such, the estimated discharge at this site is of marginal quality. Additionally, the rainfall to runoff relationship during individual storms[3] between WY 2012 and WYs 2013-14 shifts down significantly from 0.38 in WY 2012 to 0.22 in WY 2013 and to 0.12 in WY 2014. We cannot explain this shift, adding further uncertainty to discharge quality.

Total estimated runoff for the monitoring years was 7.3 Mm^3, 7.2 Mm^3, and 0.24 Mm^3 for WYs 2012, 2013 and 2014, respectively. This larger total annual discharge during WYs 2012 and 2013 was mostly a result of reservoir discharge from the upstream Lake Chabot, indicated by the square and sustained nature of the hydrographs during those water years, which may have been atypical[4]. Additionally, a series of relatively minor storms occurred throughout each WY (Figure 5). Flows peaked at 313 cfs in WY 2012, at 344 cfs in WY 2013, and at 152 cfs in WY 2014. San Lorenzo Creek to the south has been gauged by the USGS in the town of San Lorenzo (gauge number 11181040) from WY 1968-78 and again from WY 1988-present. Based on these records, annual peak flow has ranged between 300 cfs (1971) and 10300 cfs (1998). During WY 2012, flow peaked on San Lorenzo Creek at San Lorenzo at 2150 cfs on 1/20/2012 at 23:00; a flow that has been exceeded 54% of the years on record. During, WY 2013, flow in San Lorenzo peaked at 3080 cfs on 12/2/2012 at 11:15 am; a flow of this magnitude has been exceeded 38% of the years on record. And during WY 2014, flow peaked at 1320 cfs, a magnitude which has historically been exceeded 72% of the monitored years. Annual flow for San Lorenzo Creek at San Lorenzo (gauge number 11181040) for WY 2012 - 2014 respectively was 57%, 65% and 27% of normal. Based on this evidence alone, we suggest that storm driven flows in San Leandro Creek were likely much lower than average during this study.

8.3.2. San Leandro Creek turbidity and suspended sediment concentration

Turbidity generally responded to rainfall events in a similar manner to runoff. During the reservoir release period in the early part of WY 2012, turbidity remained relatively low indicating very little sediment was eroded from within San Leandro Creek at this magnitude and consistency of stream power. A similar phenomenon occurred in January of WY 2013 when again little rainfall occurred and relatively clean runoff devoid of sediment and pollutants was associated with the reservoir release.

Turbidity peaked at 929 NTU during a late season storm on 4/13/12 at 5:15 am. In contrast, during WY 2013, saturated watershed conditions began to occur in late November and sediment began to be released from the upper watershed much earlier in the season. A peak turbidity of 495 NTU occurred on 11/30/12 at 9:45 am. The post new year period was relatively dry and the latter season storm in April was relatively minor. Turbidity in WY 2014 was not well-characterized for a large portion of the season, but the late February through to early April period was measured with a peak of 347 NTU. These observations provide evidence that during larger storms and wetter years, the urbanized lower San

[3] Storms with flow that was augmented with reservoir release were removed from this analysis.

[4] Lake Chabot provides emergency water storage and recreation downstream of the East Bay Municipal Utility District's main Upper San Leandro Reservoir. Downstream releases are episodic and in WYs 2012 and 2013 included lake drawdowns for studies associated with preparation of the December 2013 Environmental Impact Report for planned seismic upgrades of Chabot Dam. http://www.ebmud.com/water-and-wastewater/project-updates/chabot-dam-upgrade

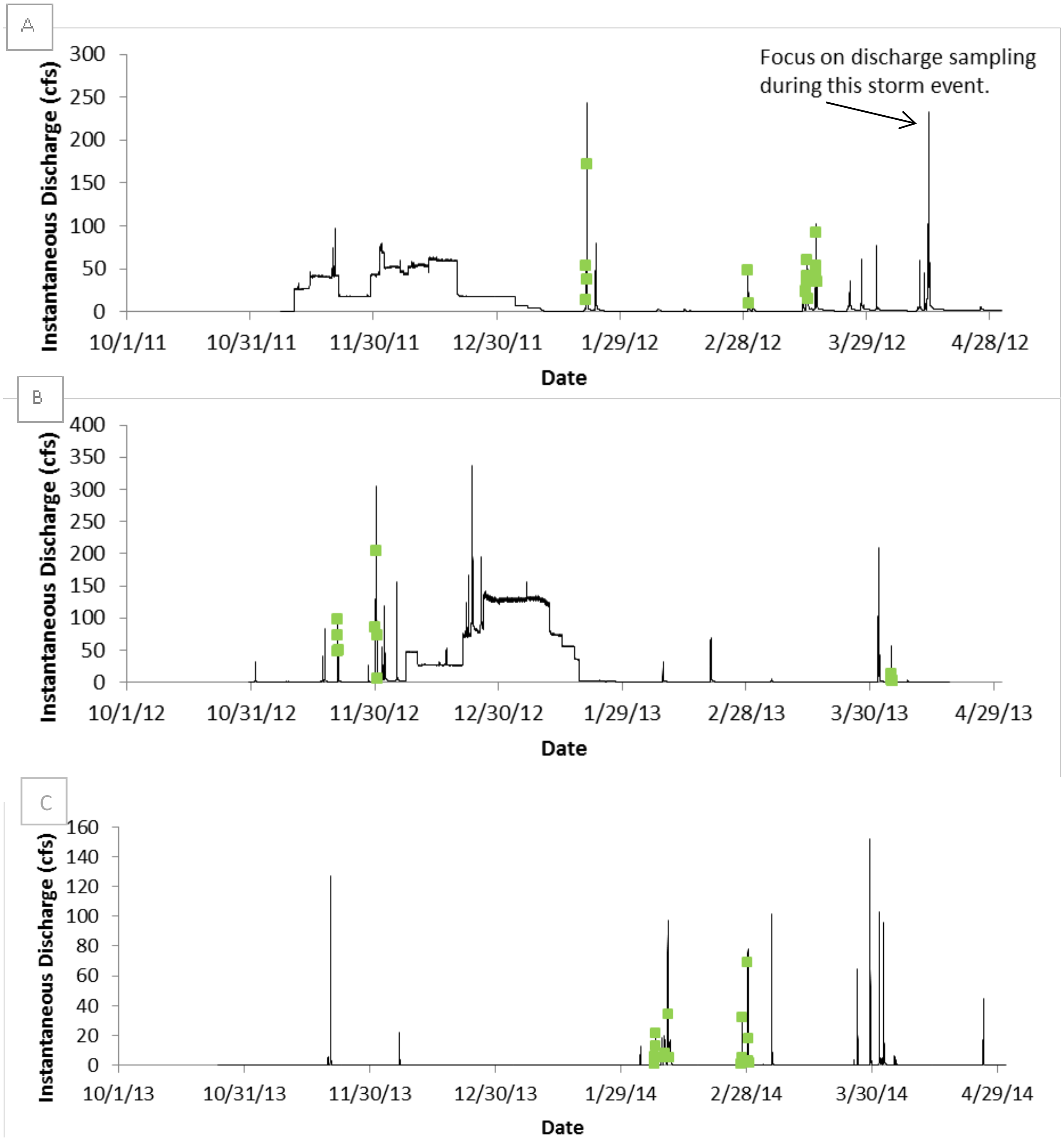

Figure 5. Flow characteristics in San Leandro Creek at San Leandro Boulevard during Water Year 2012 (A), WY 2013 (B) and WY 2014 (C) with sampling events plotted in green. Note, flow information could be updated in the future if additional discharge data are collected.

Leandro Creek watershed is likely capable of much greater sediment erosion and transport resulting in greater turbidity and concentrations of suspended sediment.

Suspended sediment concentration, since it was computed from the continuous turbidity data, follows the same patterns as turbidity. Suspended sediment concentration during WY 2012 peaked at 1106 mg/L during the late season storm on 4/13/12 at 5:15 am; a peak SSC of 898 mg/L occurred on 11/30/12 at 9:45 am for WY 2013; and a peak SSC of 413 mg/L was measured on 2/28/14 at 8:35. The maximum concentration observed during the RMP reconnaissance study (McKee et al., 2012) was 965 mg/L but at this time we have not evaluated the relative storm magnitude between WY 2011 and the current study to determine if the relative concentrations are logical.

8.3.3. San Leandro Creek POC concentrations (summary statistics)

Summary statistics of pollutant concentrations measured in San Leandro Creek during the project provide a basic understanding of general water quality and also allow a first order judgment of quality assurance (Table 17). For pollutants sampled at a sufficient frequency for loads analysis (suspended sediments, PCBs, mercury, organic carbon, and nutrients), concentrations followed the typical pattern of median < mean for most analytes.

The range of PCB concentrations (0.73-29.4 ng/L) were in the lower range of findings for urban locations (range 0.1-1120 ng/L) (Lent and McKee, 2011). PCB processes are complex in this watershed and appear to be greater in runoff derived from the urban landscape and lower in upper watershed runoff. In contrast, watersheds with known specific industrial sources appear to exhibit average concentrations in excess of about 100 ng/l (Marsalek and Ng, 1989; Hwang and Foster, 2008; Zgheib et al., 2011; Zgheib et al., 2012; McKee et al., 2012) and watersheds with little to no urbanization dominated by agriculture and open space exhibit average concentrations <5 ng/l (David et al., in press; Foster et al., 2000a; Howell et al. 2011; McKee et al., 2012). In instances where urbanization and industrial sources are highly diluted by >75% developed agricultural land concentrations averaging 8.9 ng/L can be observed (Gómez-Gutiérrez et al., 2006). The San Leandro Creek watershed has an average imperviousness of only 38% yet it may be an oversimplification to compare it to less urbanized watersheds since it has a very urban and impervious lower watershed. Indeed, it exhibits a particle ratio for PCBs of 101 pg/mg; the ninth highest observed so far in the Bay Area out of 24 locations and well above the background of rural areas (indicated by Marsh Creek in the Bay Area).

Maximum mercury concentrations (590 ng/L) were greater than observed in Zone 4 Line A in Hayward (Gilbreath et al., 2012) and of a similar magnitude to those observed in the San Pedro stormdrain draining an older urban residential area of San Jose (SFEI, unpublished). Concentrations were also much greater than those observed in three urban Wisconsin watersheds (Hurley et al., 1995), urban influenced watersheds of the Chesapeake Bay region (Lawson et al., 2001), and two sub-watersheds of mostly urban land use in the Toronto area (Eckley and Branfirheun, 2008). Unlike fully urban systems, San Leandro Creek appears to exhibit Hg transport processes in relation to both the erosion of soils and urban processes such as atmospheric deposition and within-watershed urban legacy Hg sources. The source-release-transport processes are not likely similar to those of very highly contaminated watersheds with direct local point source discharge (e.g. 1600-4300 ng/L: Ullrich et al., 2007; 100-5000 ng/L: Picado and Bengtsson, 2012; Kocman et al., 2012; 78-1500 ng/L: Rimondi et al., 2014).

The MeHg concentrations during the three-year study ranged from 0.1-1.48 ng/L. Concentrations of this magnitude or greater have been observed in a number of Bay Area urban influenced watersheds (Guadalupe River: McKee et al., 2006; McKee et al., 2010; Zone 4 Line A: Gilbreath et al., 2012; Glen

Echo Creek and Zone 5 Line M: McKee et al., 2012). However, concentrations of methylmercury of this magnitude have not been observed in urbanized watersheds from other parts of the world (Mason and Sullivan, 1998; Naik and Hammerschmidt, 2011; Chalmers et al., 2014). Although local Hg sources can be a factor in helping to elevate MeHg production and food-web impacts, it is generally agreed, at least for agricultural and forested systems with lesser urban influences, that Hg sources are not a primary limiting factor in MeHg production (Balogh et al., 2002; Balogh et al., 2004; Barringer et al., 2010; Zheng et al., 2010; Bradely et al., 2011).

Nutrient concentrations in the San Leandro Creek watershed appear to be reasonably typical of Bay Area more rural watersheds (McKee and Krottje, 2005; Pearce et al., 2005). Nitrate concentrations appear strikingly similar between San Leandro Creek, Lower Marsh Creek, Sunnyvale East Channel, and Pulgas Creek Pump Station. In contrast, nitrate concentrations were about 2-fold greater in North Richmond and Guadalupe River. Orthophosphate concentrations were similar between San Leandro Creek and Lower Marsh Creek and 1-5-2-fold lower than the other locations in this study. Total P concentrations were similar across the six sites. Concentrations appear typical or slightly greater than for PO4 and TP of found in urban watersheds in other parts of the country and world (e.g. Hudak and Banks, 2006; comprehensive Australian literature review for concentrations by land use class: Bartley et al., 2012). Slightly higher phosphorus concentrations may perhaps be attributable to geological sources (Dillon and Kirchner, 1975; McKee and Krottje, 2005; Pearce et al., 2005).

Organic carbon concentrations observed in San Leandro Creek (4-17 mg/L) were similar to those observed in Z4LA (max = 23 mg/L; FWMC = 12 mg/L: Gilbreath et al., 2012) were similar to Belmont, Borel, Calabazas, and Walnut Creeks (McKee et al., 2012). They were much lower than observed in Pulgas Green Pump Station. TOC concentrations of 4-12 mg/L have been observed elsewhere in California (Sacramento River: Sickman et al., 2007).

A similar style of first order quality assurance is also possible for analytes measured at a lesser frequency using composite sampling design (see methods section) (copper, selenium, PAHs, carbaryl, fipronil, and PBDEs) and appropriate for water quality characterization only. The maximum concentration of PBDEs (65 ng/L) was considerably lower than the other sites with the exception of Lower Marsh Creek where observed maximum concentrations were similar. This is possibly due to differences in the randomness of the representativeness of sub-samples of the composites or due to dilution from cleaner water and sediment loads from upstream. Only two peer reviewed articles have previously described PBDE concentrations in runoff, one for the Pearl River Delta, China (Guan et al., 2007), and the other for the San Francisco Bay (Oram et al., 2008) based, in part, on concentration data from Guadalupe River and Coyote Creek. Maximum total PBDE concentrations measured by Guan et al. (2007) were 68 ng/L, a somewhat surprising result given that the Pearl River Delta is a known global electronic-waste recycling hot spot. However, the Guan et al. study was based on monthly interval collection as opposed to storm event-based sampling, and was conducted in a very large river system where dilution of point source was likely to have occurred.

Similar to the other sites, carbaryl and fipronil (not measured previously by RMP studies) were on the lower side of the range of peak concentrations reported in studies across the US and California (fipronil:

70 – 1300 ng/L: Moran, 2007) (Carbaryl: DL - 700 ng/L: Ensiminger et al., 2012; tributaries to Salton Sea, Southern CA geometric mean ~2-10 ng/L: LeBlanc and Kuivila, 2008). The total selenium concentrations in San Leandro Creek appear to be about half those observed in Z4LA (Gilbreath et al., 2012). Pyrethroid concentrations of Delta/ Tralomethrin and Bifenthrin were similar to those observed in Z4LA whereas concentrations of Cyhalothrin lambda and Permethrin were about 3x and 11x lower, respectively (Gilbreath et al., 2012). In summary, mercury concentrations in San Leandro are on the high end of typical Bay Area urban watersheds, whereas concentrations of other POCs are either within the range of or below those measured in other typical Bay Area urban watersheds and appear consistent with or explainable in relation to studies from elsewhere. There do not appear to be any data quality issues.

8.3.4. San Leandro Creek toxicity

Composite water samples were collected at the San Leandro Creek station during four storm events in WY 2012, three storm events during WY 2013, and four storm events during WY 2014. The survival of the freshwater fish species Pimephales promelas was significantly reduced during one of the four WY 2012 and one of the three WY 2013 events. Similar to the results for other POC monitoring stations, significant reductions in the survival of the amphipod Hyalella azteca were observed, in this case in three of the four WY 2012 storm events sampled. In WY 2014 Hyalella azteca had mortality rates ranging from 16% to 98%. No significant reductions in the survival, reproduction and growth of the crustacean Ceriodaphnia dubia or the algae Selenastrum capricornutum were observed during any of these storms.

8.3.5. San Leandro Creek loading estimates

Site specific methods were developed for computed loads (Table 18). This watershed is among the most complex in terms of data interpretation. There were challenges with missing turbidity data, a poorly defined discharge rating, a side channel coming in at the site, reservoir releases potentially including imported water, and complexities associated with urban runoff and non-urban runoff origins of runoff. Loads estimates generated for WYs 2012 and 2013 and reported by Gilbreath et al. (2014) have now been revised based on revisions to the discharge estimates, additional pollutant concentration data collected in WY 2014 and a changing understanding of pollutant transport processes for the site. Monthly loading estimates correlate well with monthly discharge (Table 19). There are no data available for October of each water year because monitoring equipment was not installed. Discharge and rainfall were not aligned due to reservoir release. Monthly discharge was greatest in January 2013 when large releases were occurring from the upstream reservoir. The greatest monthly loads for each of the pollutants regardless of transport mode (dominantly particulate or dissolved) occurred in December 2012 when rainfall induced run-off caused high turbidity and elevated concentrations of suspended sediments and pollutants. The sediment and pollutant loads were less well correlated with the total discharge than for other sampling sites due to reservoir releases and complex sources. When discharge was dominated by upstream flows induced by rainfall, relatively high loads of mercury occurred; conversely, PCB loads were greater relative to rainfall during smaller rainfall events when less runoff occurred from the upper watershed. Given the very dry flow conditions of WY 2012, 2013, and 2014 (see discussion on flow above), loads presented here may be considered representative of dry conditions. Any future sampling should be focus on larger rain storms during wetter years and improving the discharge rating for the site.

Table 17. Summary of laboratory measured pollutant concentrations in San Leandro Creek during water years 2012, 2013, and 2014.

		2012							2013							2014						
Analyte	Unit	Samples Taken (n)	Proportion Detected (%)	Min	Max	Median	Mean	Standard Deviation	Samples Taken (n)	Proportion Detected (%)	Min	Max	Median	Mean	Standard Deviation	Samples Taken (n)	Proportion Detected (%)	Min	Max	Median	Mean	Standard Deviation
SSC	mg/L	53	98%	0	590	100	162	144	28	86%	0	904	48	114	202	36	97%	0	178	17.5	46.2	55.1
ΣPCB	ng/L	16	100%	2.91	29.4	10.5	12.3	8.74	12	100%	0.73	15.7	4.15	5.59	4.65	16	100%	1.6	26	2.73	5.48	6.8
Total Hg	ng/L	16	100%	11.9	577	89.4	184	203	12	100%	7.5	590	44	92.8	162	16	100%	4.9	170	17.5	37.4	44.4
Total MeHg	ng/L	9	100%	0.164	1.48	0.22	0.499	0.456	9	100%	0.15	1.4	0.2	0.377	0.397	12	100%	0.1	1	0.24	0.335	0.261
TOC	mg/L	16	100%	4.5	12.7	7.95	7.79	2.12	12	100%	4	14	5.65	6.25	2.55	16	100%	5.75	17	9.53	10.2	3.22
NO3	mg/L	16	100%	0.14	0.83	0.34	0.356	0.194	13	100%	0.13	2.8	0.235	0.546	0.758	16	100%	0.17	0.9	0.27	0.405	0.266
Total P	mg/L	16	100%	0.2	0.76	0.355	0.393	0.176	12	100%	0.0915	0.61	0.205	0.212	0.138	16	100%	0.11	0.495	0.21	0.241	0.094
PO4	mg/L	16	100%	0.057	0.16	0.0725	0.0866	0.0282	13	100%	0.069	0.13	0.0965	0.0962	0.0189	16	100%	0.073	0.17	0.115	0.117	0.0239
Hardness	mg/L	4	100%	33.8	72.5	56.5	54.8	18.5								4	100%	46	69	59	58.3	10.3
Total Cu	ug/L	4	100%	12.3	39.5	20.1	23	11.8	3	100%	5.9	28	11	15	11.6	4	100%	8	14	9.75	10.4	2.75
Dissolved Cu	ug/L	4	100%	6.04	10	8.34	8.18	1.99	3	100%	3.5	4.9	4.1	4.17	0.702	4	100%	3.8	7.2	4.8	5.15	1.47
Total Se	ug/L	4	100%	0.104	0.291	0.216	0.207	0.0885	3	100%	0.18	0.29	0.19	0.22	0.0608	4	100%	0.19	0.29	0.24	0.24	0.0476
Dissolved Se	ug/L	4	100%	0.068	0.195	0.131	0.131	0.0572	3	100%	0.16	0.19	0.17	0.173	0.0153	4	100%	0.16	0.26	0.18	0.195	0.0443
Carbaryl	ng/L	4	50%	0	14	5	6	7.12	3	0%	0	0	0	0	0	5	80%	0	18	11	10	7.44
Fipronil	ng/L	4	100%	6	10	8	8	1.63	3	67%	0	9	2	3.67	4.73	4	100%	15	19	17	17	1.83
ΣPAH	ng/L	2	100%	1530	2890	2210	2210	966	1	100%	1400	1400	1400	1400		2	100%	162	299	231	231	96.6
ΣPBDE	ng/L	2	100%	41	64.9	53	53	16.9	2	100%	1.61	29.7	15.7	15.7	19.9	1	100%	5.19	5.19	5.19	5.19	
Delta/ Tralomethrin	ng/L	3	100%	0.163	1.74	1.41	1.1	0.832	3	33%	0	0.6	0	0.2	0.346	4	0%	0	0	0	0	0
Cypermethrin	ng/L	4	0%	0	0	0	0	0	3	67%	0	0.8	0.7	0.5	0.436	4	100%	0.4	0.9	0.625	0.638	0.25
Cyhalothrin lambda	ng/L	3	33%	0	3.86	0	1.29	2.23	3	33%	0	0.3	0	0.1	0.173	3	100%	0.1	1.1	0.4	0.5	0.424
Permethrin	ng/L	4	100%	3.34	13.1	5.77	7	4.45	3	33%	0	6	0	2	3.46	4	25%	0	4.2	0.675	1.39	1.98
Bifenthrin	ng/L	4	75%	0	32.4	12.1	14.1	13.5	3	100%	2.8	7.1	5.5	5.13	2.17	4	100%	2.85	6.5	3.8	4.24	1.58

Zeroes were used in the place of non-detects when calculating means, medians, and standard deviations.
The minimum number of samples used to calculate standard deviation at San Leandro Creek was two.

Table 18. Regression equations used for loads computations for San Leandro Creek during water years 2012-14.

Analyte	Origin of runoff	Slope	Intercept	Correlation coefficient (r^2)	Notes
Suspended Sediment (mg/L/NTU)	Mainly urban	1.35		0.9	Regression with turbidity
Suspended Sediment (mg/L/NTU)	Mainly non-urban	1.14		0.82	Regression with turbidity
Suspended Sediment (mg/L)	Mainly baseflow	3.39			Avg of 4/4/13 storm (all collected at base flow) and low flow samples
Suspended Sediment (mg/L/CFS)	Mainly urban	3.58	2.57	0.66	Regression with Flow
Suspended Sediment (mg/L/CFS)	Mainly non-urban	2.04		0.8	Regression with Flow
Total PCBs (ng/L/NTU)	Mainly urban	0.0935	3.95	0.58	Regression with turbidity
Total PCBs (ng/L/NTU)	Mainly non-urban	0.0322	0.957	0.87	Regression with turbidity
Total PCBs (ng/L)	Mainly baseflow	1.32			Avg of 4/4/13 storm (all collected at base flow)
Total PCBs (ng/L/CFS)	Mixed	0.121	2.89	0.54	Regression with Flow
Total Mercury (ng/L/NTU)	Mixed	1.13		0.79	Regression with turbidity
Total Mercury (ng/L)	Mainly baseflow	8.9			Avg of 4/4/13 storm (all collected at base flow)
Total Mercury (ng/L/CFS)	Mainly urban	1.8		0.67	Regression with Flow
Total Mercury (ng/L/CFS)	Mainly non-urban	3.13	44.1	0.43	Regression with Flow
Total Methylmercury (ng/L/NTU)	Mixed	0.00257	0.147	0.81	Regression with turbidity
Total Methylmercury (ng/L)	Mainly baseflow	0.217			Avg of 4/4/13 storm (all collected at base flow) and low flow samples
Total Methylmercury (ng/L/CFS)	Mainly urban	0.00225	0.171	0.14	Regression with Flow
Total Methylmercury (ng/L/CFS)	Mainly non-urban	0.00988	0.27	0.81	Regression with Flow
Total Organic Carbon (mg/L)	Mixed	7.28			Flow weighted mean concentration
Total Organic Carbon (mg/L)	Mainly baseflow	5.3625			Avg of 4/4/13 storm (all collected at base flow)
Total Phosphorous (mg/L/NTU)	Mixed	0.00128	0.158	0.67	Regression with turbidity

Analyte	**Origin of runoff**	**Slope**	**Intercept**	**Correlation coefficient (r^2)**	**Notes**
Total Phosphorous (mg/L)	Mainly baseflow	0.105			Avg of 4/4/13 storm (all collected at base flow)
Total Phosphorous (mg/L/CFS)	Mixed	0.00252	0.188	0.45	Regression with Flow
Nitrate (mg/L)	Mixed	0.384			Flow weighted mean concentration
Nitrate (mg/L)	Mainly baseflow	0.26			Avg of 4/4/13 storm (all collected at base flow)
Phosphate (mg/L)	Mixed	0.0932			Flow weighted mean concentration
Phosphate (mg/L)	Mainly baseflow	0.0768			Avg of 4/4/13 storm (all collected at base flow)

Table 19. Monthly loads for San Leandro Creek for water years 2012-14. Italicized loads are estimated based on monthly rainfall-load relationships.

Water Year	Month	Rainfall (mm)	Discharge (Mm^3)	SS (t)	TOC (kg)	PCBs (g)	HgT (g)	MeHgT (g)	NO3 (kg)	PO4 (kg)	Total P (kg)
2012	11-Oct	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	11-Nov	*3*	*0.00067*	*0.032*	*5.0*	*0.0045*	*0.042*	*0.0045*	*0.24*	*0.061*	*0.15*
	11-Dec	0	4.67	15.8	25,026	6.16	37.6	0.771	1,213	358	780
	12-Jan	73	0.845	33.3	4,959	3.24	34.7	0.192	244	68.4	170
	12-Feb	22	0.101	1.98	621	0.271	2.56	0.0217	30.5	8.20	17.4
	12-Mar	151	0.734	31.2	4,393	2.59	54.5	0.233	213	59.4	182
	12-Apr	85	0.956	76.1	5,484	4.12	92	0.349	272	76.5	255
	Wet season total	334	7.30	158	40,488	16.4	221	1.57	1,974	571	1,405
2013	12-Oct	*25*	*0.035*	*2.3*	*244*	*0.20*	*2.5*	*0.053*	*13*	*3.2*	*8.5*
	12-Nov	121	0.198	38.6	1,263	1.59	29.7	0.105	110	20.6	57.9
	12-Dec	127	3.29	124	23,951	7.92	124	0.796	1,263	307	621
	13-Jan	7	3.63	52.4	26,430	4.95	51.9	0.652	1,394	338	632
	13-Feb	19	0.0290	1.36	211	0.109	1.26	0.00712	11.1	2.70	6.00
	13-Mar	11	0.00752	0.791	54.7	0.0758	0.666	0.00262	2.89	0.701	1.94
	13-Apr[a]	41	0.0505	5.74	364	0.346	5.41	0.0197	19.1	4.68	14.0
	Wet season total	351	7.24	225	52,517	15.2	215	1.64	2,813	677	1,342
2014	13-Oct	*16*	*0.015*	*0.92*	*107*	*0.088*	*1.1*	*0.031*	*5.5*	*1.4*	*3.6*
	13-Nov	24	0.0276	5.19	199	0.311	5.68	0.908	10.4	2.55	10.0
	13-Dec	8	0.00350	0.104	24.9	0.0146	0.203	0.0880	1.30	0	0.746
	14-Jan	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	14-Feb	93	0.103	9.65	839	0.803	6.65	1.52	44.6	10.6	28.2
	14-Mar	78	0.0756	9.83	543	0.586	9.45	0.0326	28.6	6.98	22.6
	14-Apr	36	0.0332	3.24	234	0.212	3.41	0.340	12.2	3.03	9.02
	Wet season total	256	0.258	28.9	1,946	2.02	26.5	2.92	103	24.8	74.3

[a] April 2013 monthly loads are reported for only the period April 01-18. In the 12 days missing from the record, no rain fell in the San Leandro Creek watershed.

8.3. Guadalupe River

8.3.1. Guadalupe River flow

The US Geological Survey has maintained a flow record on lower Guadalupe River (gauge number 11169000; 11169025) since October 1, 1930 (83 WYs; note 1931 is missing). Peak annual flows for the period have ranged between 125 cfs (WY 1960) and 11000 cfs (WY 1995). Annual runoff from Guadalupe River has ranged between 0.422 (WY 1933) and 241 Mm^3 (WY 1983).

During WY 2012, a series of relatively minor storms[5] occurred (Figure 6). A storm that caused flow to escape the low flow channel and inundate the in-channel bars did not occur until 1/21/12, very late in the season compared to what has generally occurred over the past years of sampling and analysis for this system (McKee et al., 2004; McKee et al., 2005; McKee et al., 2006; McKee et al., 2010; Owens et al., 2011). The flow during this January storm was 1220 cfs; flows of this magnitude are common in most years. Flow peaked in WY 2012 at 1290 cfs on 4/13/2012 at 07:15 and total runoff during WY 2012 based on USGS data was 38.0 Mm^3; discharge of this magnitude is about 85% mean annual runoff (MAR) based on 83 years of record and 68% MAR if we consider the period WY1971-2010 (perhaps more representative of current climatic conditions given climate change). Rainfall data corroborates this assertion; rainfall during WY 2012 was 7.09 inches, or 49% of mean annual precipitation (MAP = 15.07 in) based on a long-term record at San Jose (NOAA gauge No: 047821) for the period 1971-2010 (CY). CY 2012 was the driest year in the past 42 years and the 7th driest for the 138 year record beginning 1875.

Water year 2013 was only slightly wetter, raining 9.43 inches at the San Jose gauge (65% MAP for the period 1971-2010 [CY]). Three moderate sized storms occurred in late November and December which led to three peak flows above 1500 cfs within a span of one month (Figure 6). Flow peaked on the third of these storms at 3160 cfs on 12/23/12 at 18:45, a peak flow which has been exceeded in half of all years monitored (83 years). Total runoff during WY 2013 based on USGS data was 45.8 Mm^3; discharge of this magnitude is about 82% MAR based on 83 years of record and equivalent to the MAR for the period WY1971-2010.

Water year 2014 was drier than the two previous, raining only 6.32 inches (43 % MAP for the period 1971-2010 [CY]). One moderately sized storm occurred in late February 2014, but otherwise only minor storms occurred during the year. Flow peaked on February 28th, 2014 at 07:30 at 2310 cfs, which has historically been exceeded in 59% of all monitored years. Total flow for the water year has not been published by the USGS[6]. However, when just comparing the October-April time period for each water year monitored in this study, WY 2014 was less than the previous two at only 16.7 Mm^3 compared with 25.8 and 35.5 Mm^3 for WYs 2012 and 2013, respectively.

[5] A storm was defined as rainfall that resulted in flow that exceeds bankfull, which, at this location, is 200 cfs, and is separated by non-storm flow for a minimum of two days.

[6] The USGS normally publishes finalized data for the permanent record in the spring following the end of each Water Year.

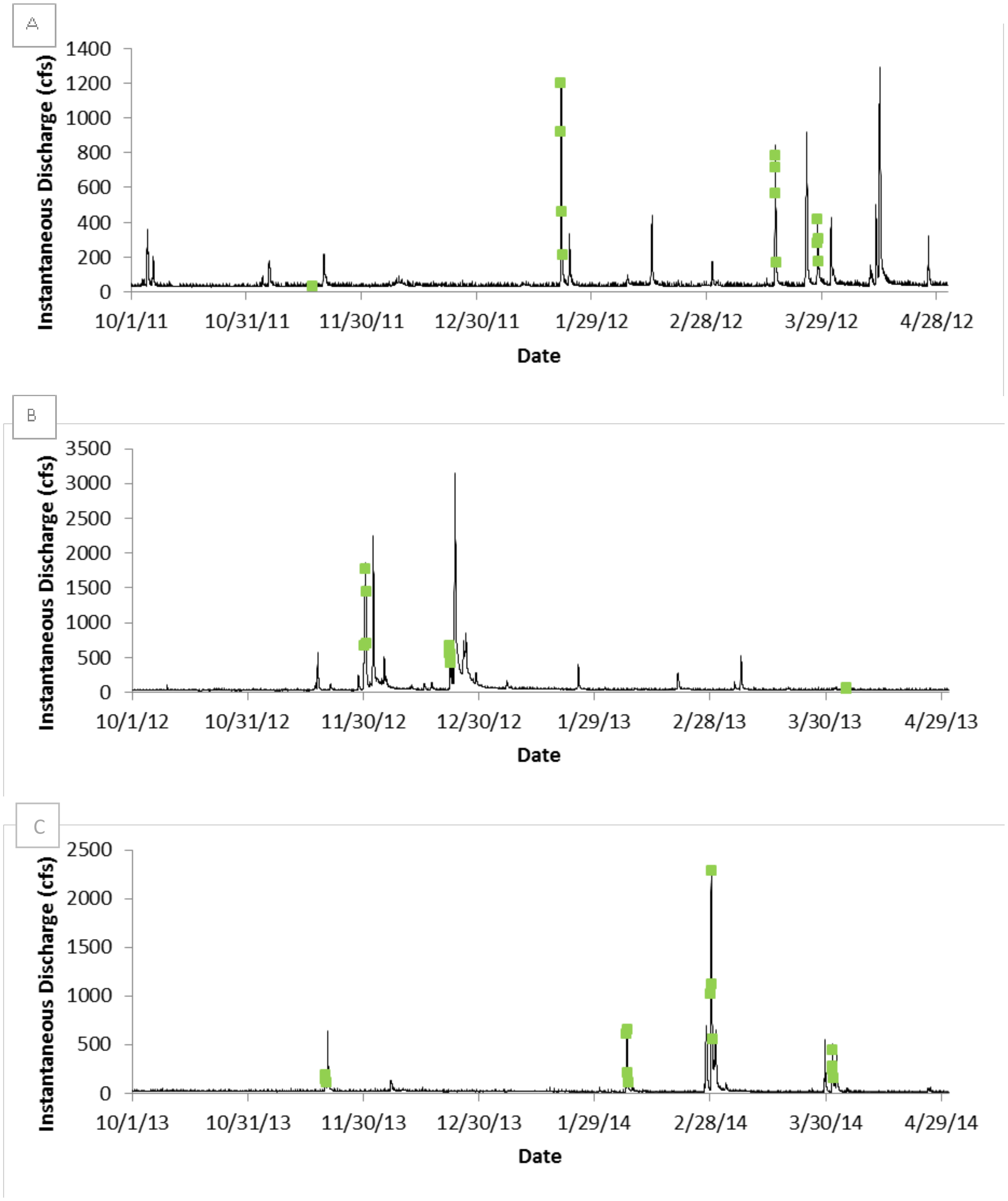

Figure 6. Flow characteristics in Guadalupe River during water year 2012 (A), 2013 (B) and 2014 (C) based on published 15-minute data provided by the USGS (gauge number 11169025), with sampling events plotted in green. The fuzzy nature of the low flow data are caused by baseflow discharge fluctuations likely caused by pump station discharges near the gauge.

8.3.2. Guadalupe River turbidity and suspended sediment concentration

The US Geological Survey also maintains the turbidity sensor at this location. Turbidity generally responded to rainfall events in a similar manner to runoff. Generally, peak turbidities fluctuated throughout the storm season between 150 – 600 FNU for each storm. Based on past years of record, turbidity can exceed 1000 FNU at the sampling location (e.g. McKee et al., 2004), so these monitored years produced turbidity conditions that were generally much lower than the system is capable of. In WY 2012, Guadalupe River exhibited a pronounced first flush during a very minor early season storm when, relative to flow, turbidity was elevated and reached 260 FNU. In contrast, the storm that produced the greatest flow for the season that occurred on 4/13/2012 had lower peak turbidity (185 FNU). A similar pattern occurred in WY 2013, except that the third large storm event on 12/23/12 raised turbidity to its peak for the season (551 FNU). Peak turbidity for WY 2012 was 388 FNU during a storm on 1/21/12 at 3:15 am. Despite higher peak flow in WY 2014 than 2012, turbidity peak only reached 273 FNU during in the intense first flush on 11/20/13 at 15:45.

A continuous record of SSC was computed by SFEI using the POC monitoring SSC data, the USGS turbidity record, and a linear regression model between instantaneous turbidity and SSC for each water year. Based on USGS sampling in Guadalupe River in past years, >90% of particles in this system are <62.5 µm in size (e.g. McKee et al., 2004). Because of these consistently fine particle sizes, turbidity correlates well with the concentrations of suspended sediments and hydrophobic pollutants (e.g. McKee et al., 2004). Suspended sediment concentration, since it was computed from the continuous turbidity data, follows the same patterns as turbidity in relation to discharge. It is estimated that SSC peaked in WY 2012 at 728 mg/L during the 1/21/12 storm event at 3:15, in WY 2013 at 957 mg/L on 12/23/12 at 19:00, and in WY 2014 at 474 mg/L on 11/20/13 at 15:45. The maximum SSC observed during previous monitoring years was 1180 mg/L in 2002. Rainfall intensity was much greater during WY 2003 than any other year since, leading to the hypothesis that concentrations of this magnitude will likely occur in the future during wetter years with greater and more intense rainfall (McKee et al., 2006).

8.3.3. Guadalupe River POC concentrations (summary statistics)

A summary of concentrations is useful for providing comparisons to other systems and also for doing a first order quality assurance check. Concentrations measured in Guadalupe River during the project are summarized (Table 20). Guadalupe River is unique among the sampling location in that it has been sampled for POCs on and off since November 2002. The results from previous work (McKee et al., 2004; McKee et al., 2005; McKee et al., 2006; McKee et al., 2010; Owens et al., 2011) are not included in the summary statistics provided here. The interested reader will need to refer to those reports

The range of PCB concentrations are typical of mixed urban land use watersheds (Lent and McKee, 2011) and mean concentrations in this watershed were the 3rd highest measured of the six locations (Pulgas Creek PS > Sunnyvale Channel > Guadalupe River = North Richmond PS > San Leandro Creek >Lower Marsh Creek). However, maximum concentrations measured in Guadalupe River in the past were ~2-fold greater (e.g. McKee et al., 2006). PCB processes are complex in this watershed and are known to be greater in runoff derived from the urban landscape and lower in runoff derived from the upper less urban watershed (McKee et al., 2006). Concentrations in Guadalupe River watershed at the Hwy 101 sampling location appear to be similar to watersheds with industrial sources where concentrations in excess of about 100 ng/L are common (Marsalek and Ng, 1989; Hwang and Foster, 2008; Zgheib et al., 2011; Zgheib et al., 2012; McKee et al., 2012). In contrast, watersheds with little to no urbanization dominated by agriculture and open space exhibit average concentrations <5 ng/l (David et al., in press; Foster et al., 2000a; Howell et al. 2011; McKee et al., 2012). In instances where urbanization and industrial sources are highly diluted by >75% developed agricultural land concentrations averaging 8.9 ng/L can be observed (Gómez-Gutiérrez et al., 2006). The Guadalupe River watershed has an imperviousness of 39% and exhibits a particle ratio of 84 pg/mg (based on all sampling to-date including previous studies); the 10th highest observed so far in the Bay Area out of 24 locations and well above the background of rural areas (indicated by Marsh Creek in the Bay Area).

Maximum mercury concentrations (1000 ng/L measured in WY 2012) are greater than observed in Z4LA (Gilbreath et al., 2012) and the San Pedro stormdrain (SFEI unpublished data), which drains an older urban residential area of San Jose. This maximum concentration was higher than the average mercury concentration (690 ng/L) but much less than the maximum concentration (~18,700 ng/L) observed over the period of record at this location (2002-2010) (McKee et al., 2010). Concentrations were orders of magnitude greater than those observed in three urban Wisconsin watersheds (Hurley et al., 1995), urban influenced watersheds of the Chesapeake Bay region (Lawson et al., 2001), and two sub-watersheds of mostly urban land use in the Toronto area (Eckley and Branfirheun, 2008). The concentrations in Guadalupe River are similar to those of very highly contaminated watersheds with direct local point source discharge or mining influences (e.g. 1600-4300 ng/L: Ullrich et al., 2007; 100-5000 ng/L: Picado and Bengtsson, 2012; Kocman et al., 2012; 78-1500 ng/L: Rimondi et al., 2014).

The MeHg concentrations during the three-year study ranged from 0.04-1.2 ng/L and were lower than maximum concentrations (2.51 ng/L) observed previously for this sampling location (McKee et al., 2010). Concentrations of this magnitude or greater have been observed in a number of Bay Area urban influenced watersheds (Zone 4 Line A: Gilbreath et al., 2012; Glen Echo Creek and Zone 5 Line M: McKee et al., 2012). However, concentrations of methylmercury of this magnitude have not been observed in urbanized watersheds from other parts of the world (Mason and Sullivan, 1998; Naik and Hammerschmidt, 2011; Chalmers et al., 2014). Although local Hg sources can be a factor in helping to elevate MeHg production and food-web impacts, it is generally agreed, at least for agricultural and forested systems with lesser urban influences, that Hg sources are not a primary limiting factor in MeHg production (Balogh et al., 2002; Balogh et al., 2004; Barringer et al., 2010; Zheng et al., 2010; Bradely et al., 2011). Based on previous sampling experience in the system (McKee et al., 2004; McKee et al., 2005; McKee et al., 2006; McKee et al., 2010; Owens et al., 2011) and these simple comparisons to other studies, there are no reasons to suspect any data quality issues.

Nutrient concentrations were in the same range as measured in in Z4LA (Gilbreath et al., 2012), and typical for the Bay Area, phosphorus concentrations appear greater than elsewhere in the world under similar land use scenarios, perhaps attributable to geological sources (McKee and Krottje, 2005). Nitrate concentrations were highest in Guadalupe River and North Richmond pump station during this study. Nitrate concentrations appear similar between San Leandro Creek, Lower Marsh Creek, Sunnyvale East Channel, and Pulgas Creek Pump Station. In contrast, nitrate concentrations were about 2-fold greater in Guadalupe River and North Richmond Pump Station. Mean orthophosphate concentrations (0.15 mg/L)

Table 20. Summary of laboratory measured pollutant concentrations in Guadalupe River for water years 2012, 2013, and 2014.

		2012							2013							2014						
Analyte	Unit	Samples Taken (n)	Proportion Detected (%)	Min	Max	Median	Mean	Standard Deviation	Samples Taken (n)	Proportion Detected (%)	Min	Max	Median	Mean	Standard Deviation	Samples Taken (n)	Proportion Detected (%)	Min	Max	Median	Mean	Standard Deviation
SSC	mg/L	41	100%	8.6	730	82	198	205	41	100%	5.9	342	128	124	104	54	100%	5.8	358	110	150	102
ΣPCB	ng/L	11	100%	2.7	59.1	7.17	17.7	21.5	12	100%	2.04	47.4	6.29	10.6	12.7	16	100%	3.1	33.1	11.4	14.6	11.1
Total Hg	ng/L	12	100%	36.6	1000	125	268	324	12	100%	14.5	360	155	153	119	15	100%	45	740	130	215	193
Total MeHg	ng/L	10	100%	0.086	1.15	0.381	0.445	0.352	7	100%	0.04	0.94	0.49	0.428	0.34	10	100%	0.09	1.2	0.575	0.616	0.366
TOC	mg/L	12	100%	4.9	18	7.45	8.73	4.03	12	100%	5.3	11	6.05	6.36	1.55	16	100%	5.3	56	12.1	19.3	17.1
NO3	mg/L	12	100%	0.56	1.9	0.815	0.917	0.38	8	100%	0.45	2.3	1.43	1.38	0.905	16	100%	0.32	1.8	0.54	0.685	0.403
Total P	mg/L	12	100%	0.19	0.81	0.315	0.453	0.247	12	100%	0.098	0.61	0.355	0.31	0.159	16	100%	0.11	1	0.485	0.464	0.268
PO4	mg/L	12	100%	0.06	0.16	0.101	0.101	0.0321	12	100%	0.061	0.18	0.12	0.109	0.0339	16	100%	0.11	0.5	0.17	0.218	0.125
Hardness	mg/L	3	100%	133	157	140	143	12.3								4	100%	94	200	120	134	46
Total Cu	ug/L	3	100%	10.7	26.3	24.7	20.6	8.58	3	100%	5.9	28	23	19	11.6	4	100%	12	34	25.5	24.3	9.54
Dissolved Cu	ug/L	3	100%	5.07	7.91	5.51	6.16	1.53	3	100%	2.5	3.6	2.5	2.87	0.635	4	100%	2.9	12	4	5.72	4.24
Total Se	ug/L	3	100%	1.16	1.63	1.21	1.33	0.258	3	100%	0.7	3.3	0.78	1.59	1.48	4	100%	0.6	1.8	0.98	1.09	0.506
Dissolved Se	ug/L	3	100%	0.772	1.32	1.04	1.04	0.274	3	100%	0.4	3.2	0.54	1.38	1.58	4	100%	0.34	1.5	0.775	0.847	0.502
Carbaryl	ng/L	3	100%	13	57	54.3	41.4	24.7	3	67%	0	21	17	12.7	11.2	4	100%	12	64	28.5	33.3	21.9
Fipronil	ng/L	3	100%	6.5	20	11	12.5	6.87	3	100%	3	11	9	7.67	4.16	4	100%	8	15	14.5	13	3.37
ΣPAH	ng/L	1	100%	611	611	611	611		8	100%	40.7	736	174	251	245	2	100%	692	1260	978	978	405
ΣPBDE	ng/L	1	100%	23	23	23	23		2	100%	13.1	69.8	41.4	41.4	40.1	2	100%	96.7	101	99	99	3.18
Delta/ Tralomethrin	ng/L	3	100%	0.704	1.9	1.81	1.47	0.667	3	0%	0	0	0	0	0	4	50%	0	2.8	0.65	1.02	1.33
Cypermethrin	ng/L	3	0%	0	0	0	0		3	100%	0.5	3.3	1.7	1.83	1.4	4	100%	1.1	5	1.65	2.35	1.8
Cyhalothrin lambda	ng/L	3	33%	0	0.6	0	0.2	0.346	3	100%	0.3	1.5	0.5	0.767	0.643	4	75%	0	1.46	0.6	0.665	0.606
Permethrin	ng/L	3	100%	16.8	20.5	19.5	18.9	1.91	3	33%	0	5.4	0	1.8	3.12	4	100%	7.2	14	10.6	10.6	3
Bifenthrin	ng/L	3	67%	0	13.3	6.16	6.47	6.63	3	100%	0.9	7.6	5.9	4.8	3.48	4	100%	3.5	6.1	4.75	4.78	1.47

Zeroes were used in the place of non-detects when calculating means, medians, and standard deviations.
The minimum number of samples used to calculate standard deviation at Guadalupe River was two.

were slightly lower than observed in the Richmond Pump Station but 20-50% above the other four sample sites. The maximum total P concentration (1 mg/L) was very high in this study relative to the other watersheds; however, average total P concentrations were similar across the six sites. Concentrations appear typical or slightly greater than for PO4 and total P found in urban watersheds in other parts of the country and world (e.g. Hudak and Banks, 2006; comprehensive Australian literature review for concentrations by land use class: Bartley et al., 2012). These elevated phosphorus concentrations, especially the peak concentration observed in Guadalupe River, may perhaps be attributable to geological sources (Dillon and Kirchner, 1975; McKee and Krottje, 2005; Pearce et al., 2005).

Organic carbon concentrations observed in Guadalupe River during WYs 2012-2014 (4-56 mg/L) were higher than those observed in Z4LA (max = 23 mg/L; FWMC = 12 mg/L: Gilbreath et al., 2012). They were greater than but more similar to maximum concentrations observed in Sunnyvale East Channel (30 mg/L) but less than Pulgas Creek South Pump Station (140 mg/L). Although we have not done an extensive literature review of TOC concentrations in the worlds river systems, our general knowledge of the literature would have us hypothesize that concentrations of these magnitudes are very high. These may be contributing to the apparent high methylation rates in the Bay Area.

A similar style of first order quality assurance is also possible for analytes measured at a lesser frequency using composite sampling design (see methods section) (copper, selenium, PAHs, carbaryl, fipronil, and PBDEs) and appropriate for water quality characterization only. The maximum concentration of PBDEs (101.2 ng/L) was similar to Sunnyvale East Channel, lesser by 15-fold than North Richmond Pump Station and greater by about 2-fold than the other locations. Only two peer reviewed articles describing PBDE concentrations in runoff have been located, one for the Pearl River Delta, China (Guan et al., 2007), and the other for the San Francisco Bay (Oram et al., 2008) based, in part, on concentration data from Guadalupe River and Coyote Creek taken during WYs 2003-2006. Maximum total PBDE concentrations measured by Guan et al. (2007) were 68 ng/L, a somewhat surprising result given that the Pearl River Delta is a known global electronic-waste recycling hot spot. However, the Guan et al. study was based on monthly interval collection as opposed to storm event-based sampling and was completed in a larger river system where dilution of point source may have occurred.

Copper, which was sampled at a lesser frequency for characterization only, was similar to concentrations previously observed (McKee et al., 2004; McKee et al., 2005; McKee et al., 2006) and similar to those observed in Z4LA (Gilbreath et al., 2012). Maximum selenium concentrations were generally 2-10 fold greater than the other five locations and were generally higher than Z4LA; elevated groundwater concentrations have been observed in Santa Clara County previously (Anderson, 1998). Similar to the other sites, carbaryl and fipronil (not measured previously by RMP studies) were on the lower side of the range of peak concentrations reported in studies across the US and California (fipronil: 70 – 1300 ng/L: Moran, 2007) (Carbaryl: DL - 700 ng/L: Ensiminger et al., 2012; tributaries to Salton Sea, Southern CA geometric mean ~2-10 ng/L: LeBlanc and Kuivila, 2008). Pyrethroid concentrations of Delta/ Tralomethrin and Bifenthrin were about 2.5-fold less than those observed in Z4LA whereas concentrations of Cyhalothrin lambda and Permethrin were about 8-fold lower (Gilbreath et al., 2012). In summary, mercury concentrations are elevated in the Guadalupe Giver relative to typical Bay Area and other urban watersheds and are more akin to concentrations observed in mining and point source contaminated systems. Concentrations of other POCs are either within the range of or below those measured in other typical Bay Area urban watersheds and appear consistent with or explainable in relation to studies from elsewhere. There do not appear to be any data quality issues.

8.3.4. Guadalupe River toxicity

Composite water samples were collected at the Guadalupe River station during three storm events in WY 2012, three storm events in WY 2013, and four storm events in WY 2014. Similar to the results for other POC monitoring stations, no significant reductions in the survival, reproduction and growth of three of four test species were observed during storms except for fathead minnow growth reductions in two WY 2014 samples and a reduction in fathead minnow survival in one WY 2014 sample. Significant reductions in the survival of the amphipod *Hyalella azteca* were observed during two of the three WY 2012 events sampled and three of the four WY 2014 samples.

8.3.5. Guadalupe River loading estimates

The following methods were applied to estimate loads for the Guadalupe River in WYs 2012, 2013, and 2014. Suspended sediment loads for WY 2012 and 2013 were downloaded from USGS. Since the WY 2014 suspended sediment record has not yet been published, concentrations were estimated from the turbidity record using a linear relation (Table 21). Once the official USGS flow and SSC record is published for WY 2014, the suspended sediment load will be updated. Concentrations during storm flows were estimated using regression equations between the POCs and turbidity, except for nitrate and phosphate, in which a flow-surrogate regression was used (Table 21). As found during other drier periods (McKee et al., 2006), a separation of the data for PCBs to form regression relations based on origin of flow was possible. On the other hand, there was virtually no mining runoff during these very dry years and although a separation was made for Hg in addition to PCBs, very few data points populated the regression between Hg and turbidity for the upper watershed as the source of flow.

Monthly discharge was greatest in December 2012 as were loads of most pollutants. This single wet month transported approximately 50% of the PCB and mercury load of the two wet seasons combined. WY 2013 loads were approximately 3-fold higher than WY 2012 and 4-fold greater than WY 2014. However, compared to previous sampling years (McKee et al., 2004; McKee et al., 2005; McKee et al., 2006; McKee et al., 2010; Owens et al., 2011 [Hg only]), loads of total mercury and PCBs were lower than any previously observed years (Table 22). At this time, all loads estimates for WY 2014 should be considered preliminary. Once available, USGS official records for flow, turbidity, and SSC can be substituted for the preliminary data presented here. Overall, WY 2012, 2013, and 2014 loads may be considered representative of loads during dry conditions in this watershed.

Table 21. Regression equations used for loads computations for Guadalupe River during water year 2012, 2013, and 2014.

Analyte	Origin of runoff	Slope	Intercept	Correlation coefficient (r^2)	Notes
Suspended Sediment (mg/L/NTU)	Mixed	1.69	0.93	0.92	Regression with turbidity
Total PCBs (ng/L/NTU)	Mainly urban	0.236	1.42	0.71	Regression with turbidity
Total PCBs (ng/L/NTU)	Mainly non-urban & baseflow	0.081		0.81	Regression with turbidity
Total Mercury (ng/L/NTU)	Mixed	2.21		0.82	Regression with turbidity
Total Methylmercury (ng/L/NTU)	Mixed	0.00352	0.181	0.6	Regression with turbidity
Total Methylmercury (ng/L)	Baseflow	0.0994			Average
Total Organic Carbon (mg/L/NTU)	Mixed	0.0245	4.9715	0.49	Regression with turbidity
Total Phosphorous (mg/L/NTU)	Mixed	0.00213	0.153	0.72	Regression with turbidity
Nitrate (mg/L/CFS)	Mainly urban	-0.00133	1.99	0.64	Regression with flow
Nitrate (mg/L/CFS)	Mainly non-urban & baseflow	-0.000161	0.732	0.17	Regression with flow
Phosphate (mg/L/CFS)	Mixed	0.0000336	0.0906	0.36	Regression with flow

Table 22. Monthly loads for Guadalupe River for water year 2012, 2013 and 2014.

Water Year	Month	Rainfall (mm)	Discharge (Mm^3)	SS (t)	TOC (kg)	PCBs (g)	HgT (g)	MeHgT (g)	NO3 (kg)	PO4 (kg)	Total P (kg)
2012	11-Oct	19	2.91	167	16,565	9.63	190	0.556	2449	270	628
	11-Nov	15	2.88	104	15,552	6.01	111	0.441	2300	266	548
	11-Dec	1	2.73	76.3	14,016	1.42	38.7	0.272	1984	251	455
	12-Jan	18	3.85	564	28,348	30.9	570	1.33	3077	396	1128
	12-Feb	14	3.15	305	18,361	10.4	243	0.613	2451	294	716
	12-Mar	50	5.08	403	30,542	35.1	433	1.50	4238	495	1314
	12-Apr	44	5.22	486	30,994	29.8	452	1.41	4381	527	1235
	Wet season total	161	25.8	2,106	154,379	123	2,039	6.13	20,879	2,498	6,023
2013	12-Oct	8	2.26	60.5	11,988	3.67	68.5	0.258	1810	207	411
	12-Nov	48	5.23	1092	38,487	53.1	999	2.68	4148	592	1862
	12-Dec	92	14.8	2768	117,823	230	4034	8.90	9301	1745	6174
	13-Jan	15	4.14	204	21,988	8.35	129	0.58	3237	385	756
	13-Feb	11	3.05	85.7	15,999	4.69	76.3	0.398	2355	282	539
	13-Mar	21	3.47	123.4	18,604	7.45	122	0.546	2837	325	648
	13-Apr	5	2.57	130.2	13,319	2.37	47.7	0.279	2087	235	439
	Wet season total	201	35.5	4,464	238,208	309	5,476	13.6	25,775	3,771	10,829
2014	13-Oct	0	1.72	25.5	8,902	1.22	33.2	0.171	1250	157	294
	13-Nov	21	2.25	132	17,545	16.2	169	0.510	2021	246	551
	13-Dec	4	1.96	24.7	10,106	2.23	32.2	0.225	1582	180	331
	14-Jan	3	1.53	15.6	7,837	0.748	20.4	0.152	1115	140	254
	14-Feb	64	4.55	696	34,750	57.6	1009	2.28	3076	538	1797
	14-Mar	35	3.07	148	17,982	13.7	188	0.673	2571	306	627
	14-Apr	17	1.67	50.8	9,020	5.51	66.2	0.274	1566	156	319
	Wet season total	144	16.7	1,094	106,141	97.2	1,519	4.29	13,182	1,723	4,172

8.3. Sunnyvale East Channel

8.3.1. Sunnyvale East Channel flow

Santa Clara Valley Water District (SCVWD) has maintained a flow gauge on Sunnyvale East Channel from WY 1983 to present. Unfortunately, the record is known to be of poor quality (pers. comm., Ken Stumpf, SCVWD), which was apparent when the record was regressed against rainfall ($R^2 = 0.58$) (Lent et al., 2012). The gauge is presently scheduled for improvement by SCVWD. Despite the poor historical flow record, velocity measurement conducted in WY 2013 confirmed the good quality of the SCVWD discharge-rating curve up to stages of 2.9 ft (corresponding to flows of 190 cfs) for this site. Consequently, flow could be calculated using that curve and the continuous stage record collected during this study.

All three monitored water years were relatively dry years and discharge was likely lower than average. Rainfall during WYs 2012-2014 was 8.82, 12.1 and 8.1 inches, respectively, at Palo Alto (NOAA gauge number 046646). Relative to mean annual precipitation (MAP = 15.5 in) based on a long-term record for the period 1971-2010 (CY), WY 2012 was only 57% MAP, WY 2013 was 78% MAP, and WY 2014 was 52% MAP.

A series of relatively minor storms occurred during WY 2012 (Figure 7). Flow peaked at 492 cfs overnight on 4/12/12- 4/13/12 at midnight. Total runoff during WY 2012 for the period 12/1/11 to 4/30/12 was 1.07 Mm^3 based on our stage record and the SCVWD rating curve. Total annual runoff WY 2013 for the period between 10/01/12 and 4/30/13 was 1.51 Mm^3 and likely below average based on below average rainfall. However, unlike WY 2012 in which the rainfall was spread over several smaller events, the majority of WY 2013 rainfall occurred during three large storm events in late November and December, each of which was of 1-2 year recurrence based on NOAA Atlas 14 partial duration series data for the area. Flow peaked during the third event of this series at 727 cfs on 12/23/12 at 15:15. Given that SCVWD maintains the channel to support a peak discharge of 800 cfs, the December 2012 storms resulted in significant flows for the system. Field observations during sampling of the early December storms corroborate this assertion; stages neared the top of bank and the banks of the channel for the observable reach at and upstream from the sampling location showed evidence of erosion. This is yet another vivid example of why peak discharge often correlates with total wet season load better than total wet season flow (Lewicki and McKee, 2009). The WY 2014 wet season was very similar to the WY 2012 season, both in terms of total annual flow (1.01 Mm3) as well as the relative size of the storms, peaking at 439 cfs on February 28th, 2014 at 3:45 am.

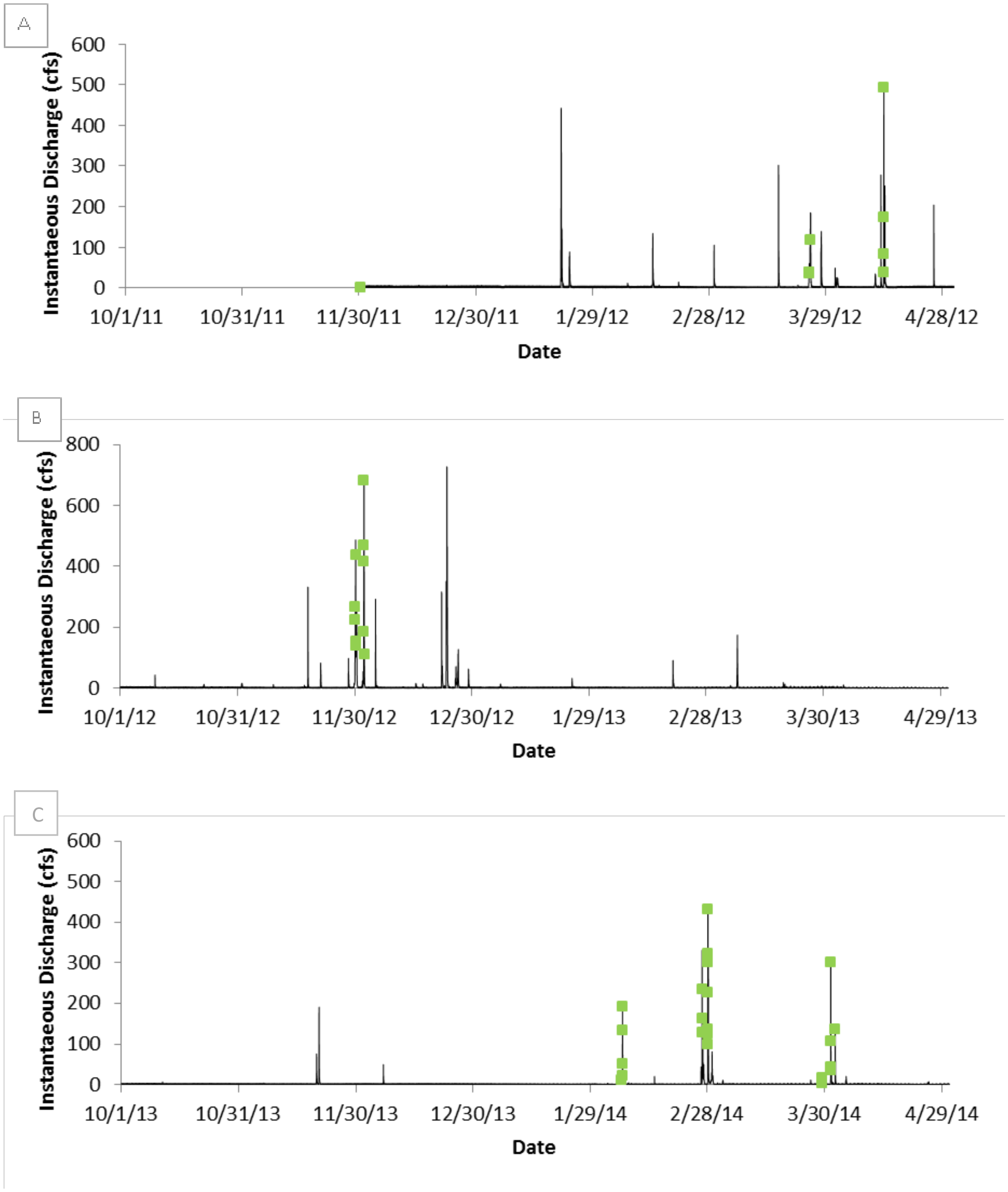

Figure 7. Flow characteristics in Sunnyvale East Channel at East Ahwanee Avenue during WY 2012 (A), WY 2013 (B) and WY 2014 (C) with sampling events marked in green. The flow record is based on the District rating curve for this station as verified by velocity sampling completed during the study in WY 2013.

8.3.2. Sunnyvale East Channel turbidity and suspended sediment concentration

The entire turbidity record for WY 2012 was censored due to problems believed to be with the installation design and the OBS-500 instrument reading the bottom of the channel. In WY 2013, the OBS-500 instrument was replaced with an FTS DTS-12 turbidity probe (0-1,600 NTU range). This instrument performed well through to the first large storm on 11/30/12 and then the turbidity record experienced numerous spikes through the rest of the season. Our observations during maintenance suggested that the three large storm events in late November and December uprooted and dislodged a lot of vegetation and some trash, which slowly passed through the system throughout the season and caught on the boom structure where turbidity was monitored. After field visits to download data and perform maintenance on site including removing the vegetation from the boom, the turbidity record cleared until the next elevated flow. Consequently, 8.3% of the turbidity record was censored due to fouling. In WY 2014, the FTS DTS-12 sensor was used again with more regular field maintenance. Vegetation continued to be a problem throughout the season, fouling the record at times. More regular maintenance and attempts at structural modifications to help deflect vegetation improved the completeness of the record from the previous year, this time with 7% of the record censored and corrected by interpolation.

Given the challenges with the turbidity sensor installation during the first year and vegetation disruptions in the subsequent years, multiple approaches were used for the estimation of SSC. For the portions of the record that were of good quality or deemed to be good quality after correction, turbidity surrogate regression could be used ($R^2 = 0.87$). For the entire WY 2012 and the portions of the WY 2013 record for which turbidity was not usable, SSC was alternatively computed as a function of flow (with much lower confidence due to the loss of hysteresis in the computational scheme). The relationship was strong in WY 2012 ($R^2 = 0.97$) and moderately strong in WY 2013 ($R^2=0.82$).

Turbidity in Sunnyvale East Channel in WY 2013 and 2014 remained low (<40 NTU) during base flows and increased to between 200 and 1000 NTU during storms. Interestingly, turbidity season peaks in both water years occurred during the seasonal first flush, which also happened to corresponded in both years with storms that were short-lived but relatively intense. Turbidity peaked at 1014 NTU early in the season on 10/9/12 in response to a small but intense rainfall in which 0.19 inches fell in 20 minutes. In WY 2014 and turbidity peaked for the season at 424 NTU on the 11/20/13 storm when 0.25 inches fell in one hour. Three large events in November and December 2012 resulted in turbidities in the 600-900 NTU range, and otherwise turbidity for most other events peaked between 200 and 400 NTU.

Computed suspended sediment concentration in WY 2012 peaked at 362 mg/L on 4/13/12 just after midnight, at 3879 mg/L on 10/9/12, and 1148 mg/L on 11/20/13, all in response to the measured peak flow (in WY 2012) or peak turbidity (WY 2013 and 2014) for the given wet season. Although these concentrations are an order of magnitude different, lab measured samples from storm monitoring events in each WY corroborated these results; the maximum sampled lab measured SSC in WY 2012 was 370 mg/L (collected on 4/13/12), 3120 mg/L in WY 2013 (collected on 12/2/12; the 10/9/12 estimated peak SSC occurred during a non-sampled storm event), and 514 mg/L in WY 2014 (collected on 2/26/2014; the 11/20/13 estimated peak SSC also occurred during a non-sampled storm event).

8.3.3. Sunnyvale East Channel POC concentrations (summary statistics)

A summary of concentrations is useful for providing comparisons to other systems and also for doing a first order quality assurance check on the data generated; data that differs from that reported elsewhere may indicate errors or provide evidence for source characteristics. A wide range of pollutants were measured in Sunnyvale East Channel during the three-year project (Table 233). Concentrations for pollutants sampled at a sufficient frequency for loads analysis (suspended sediments, PCBs, mercury, organic carbon, and nutrients) exhibited the typical pattern of median < mean except for some cases where organic carbon, nitrate, phosphate, and PAH where the mean and median were similar.

The range of PCB concentrations were elevated relative to other mixed urban land use watersheds (range 0.1-1120 ng/L: Lent and McKee, 2011) with maximum concentrations observed at 980 ng/L. Highest PCB concentrations were measured during the February 28, 2014 storm event where an estimated 1.3 inches of rain fell in this watershed. This event followed a 0.9 inch rain event 2 days prior. These concentrations were amongst the highest PCB concentration measured to-date in the Bay Area with project site mean PCB concentrations ranking only behind Pulgas Creek South and Santa Fe Channel. PCB concentrations remained elevated throughout other monitored storms during WY 2014 helping to support a hypothesis that there is a large PCB source in this watershed. Concentrations in the Sunnyvale East Channel watershed appear to be similar to watersheds with industrial sources where concentrations in excess of about 100 ng/L are common (Marsalek and Ng, 1989; Hwang and Foster, 2008; Zgheib et al., 2011; Zgheib et al., 2012; McKee et al., 2012). In contrast, watersheds with little to no urbanization dominated by agriculture and open space exhibit average concentrations <5 ng/l (David et al., in press; Foster et al., 2000a; Howell et al. 2011; McKee et al., 2012). In instances where urbanization and industrial sources are highly diluted by >75% developed agricultural land concentrations averaging 8.9 ng/L can be observed (Gómez-Gutiérrez et al., 2006). The Sunnyvale East Channel watershed has an imperviousness of 69% and exhibits a particle ratio of 869 pg/mg (based on all sampling to-date including WY 2011 data); the fourth highest observed so far in the Bay Area out of 24 locations and well above the background of rural areas (indicated by Marsh Creek in the Bay Area).

The range of mercury concentrations were comparable to those observed in Z4LA (Gilbreath et al., 2012) while the maximum total mercury concentration in Sunnyvale East Channel (220 ng/L) was greater than sampled in Z4LA (150 ng/L). Concentrations were also much greater than those observed in three urban Wisconsin watersheds (Hurley et al., 1995), urban influenced watersheds of the Chesapeake Bay region (Lawson et al., 2001), and two sub-watersheds of mostly urban land use in the Toronto area (Eckley and Branfirheun, 2008). Similar to Marsh Creek and San Leandro Creek, where the maximum Hg concentrations are somewhat attributed to the erosion of soils, Sunnyvale East Channel watershed also transports high concentrations of suspended sediment (maximum observed from grab samples was 3120 mg/L). Given the relatively low particle ratio (0.22 mg/kg) not greatly elevated about what might be considered background for CA soils (0.1 mg/kg equivalent to ng/mg: Bradford et al., 1996), Hg sources and transport in this watershed are more likely attributed to local atmospheric deposition or perhaps redeposition from historical and ongoing Lehigh Hanson Permanente Cement Plant (Rothenberg et al., 2010a; Rothenberg et al., 2010b). The source-release-transport processes for Hg in

Table 23. Summary of laboratory measured pollutant concentrations in Sunnyvale East Channel during water years 2012, 2013, and 2014.

		2012							2013							2014						
Analyte	Unit	Samples Taken (n)	Proportion Detected (%)	Min	Max	Median	Mean	Standard Deviation	Samples Taken (n)	Proportion Detected (%)	Min	Max	Median	Mean	Standard Deviation	Samples Taken (n)	Proportion Detected (%)	Min	Max	Median	Mean	Standard Deviation
SSC	mg/L	28	96%	0	370	49.5	81.6	100	34	97%	0	3120	301	485	645	75	99%	0	514	125	173	134
ΣPCB	ng/L	8	100%	3.27	119	33.6	41.3	41.5	10	100%	9.16	176	31.3	59.3	64.3	22	100%	2.86	983	90.7	147	223
Total Hg	ng/L	8	100%	6.3	64.1	21.7	27.7	21.7	10	100%	13	220	55.5	72.9	65.2	22	100%	14	120	37	43.1	27
Total MeHg	ng/L	6	83%	0	0.558	0.226	0.25	0.22	6	100%	0.02	0.54	0.22	0.252	0.22	15	93%	0	0.7	0.33	0.332	0.173
TOC	mg/L	8	100%	4.91	8.6	5.94	6.41	1.4	10	100%	4.1	10	5.85	5.85	1.71	22	100%	4.5	30	10.5	13.4	7.94
NO3	mg/L	8	100%	0.2	0.56	0.28	0.309	0.119	10	100%	0.15	0.37	0.28	0.269	0.069	23	100%	0.13	2.6	0.28	0.618	0.714
Total P	mg/L	8	100%	0.19	0.5	0.25	0.277	0.0975	10	100%	0.23	1.7	0.385	0.522	0.434	23	100%	0.11	0.92	0.36	0.408	0.212
PO4	mg/L	8	100%	0.067	0.11	0.079	0.0847	0.0191	10	100%	0.094	0.13	0.12	0.115	0.0098	23	100%	0.006	0.285	0.13	0.148	0.069
Hardness	mg/L	2	100%	51.4	61.2	56.3	56.3	6.93								6	100%	92	340	100	146	97.5
Total Cu	ug/L	2	100%	10.8	19	14.9	14.9	5.79	2	100%	19	31	25	25	8.49	6	100%	11	21	18	16.5	4.09
Dissolved Cu	ug/L	2	100%	4.36	14.8	9.58	9.58	7.38	2	100%	3.1	4.9	4	4	1.27	6	100%	2.8	6.1	4.32	4.63	1.24
Total Se	ug/L	2	100%	0.327	0.494	0.41	0.41	0.118	2	100%	0.49	0.49	0.49	0.49	0	6	100%	0.33	1.9	0.545	0.71	0.593
Dissolved Se	ug/L	2	100%	0.308	0.325	0.317	0.317	0.012	2	100%	0.35	0.39	0.37	0.37	0.0283	6	100%	0.24	1.8	0.47	0.637	0.583
Carbaryl	ng/L	2	100%	11	21	16	16	7.07	2	50%	0	19	9.5	9.5	13.4	6	17%	0	14	0	2.33	5.72
Fipronil	ng/L	2	100%	6	12	9	9	4.24	2	50%	0	6	3	3	4.24	6	100%	3	11	6.5	6.83	2.86
ΣPAH	ng/L	1	100%	289	289	289	289		1	100%	1350	1350	1350	1350		4	100%	382	2770	1660	1620	1260
ΣPBDE	ng/L	1	100%	4.83	4.83	4.83	4.83		1	100%	34.9	34.9	34.9	34.9		4	100%	15.7	103	62	60.6	40.7
Delta/ Tralomethrin	ng/L	1	0%	0	0	0	0		2	100%	3.6	3.8	3.7	3.7	0.141	6	100%	0.6	3.25	1.13	1.42	0.947
Cypermethrin	ng/L	2	0%	0	0	0	0		2	100%	3.2	5.2	4.2	4.2	1.41	6	100%	2.6	6	4.13	4.08	1.16
Cyhalothrin lambda	ng/L	1	0%	0	0	0	0		2	100%	1.2	2.5	1.85	1.85	0.919	5	80%	0	0.6	0.3	0.31	0.213
Permethrin	ng/L	2	100%	5.7	20.9	13.3	13.3	10.8	2	100%	22	48	35	35	18.4	6	100%	11	29	18.8	20.2	6.45
Bifenthrin	ng/L	2	50%	0	8	4	4	5.66	2	100%	8.7	18	13.3	13.3	6.58	6	100%	2	18	5.3	7.56	5.94

Zeroes were used in the place of non-detects when calculating means, medians, and standard deviations.
The minimum number of samples used to calculate standard deviation at Sunnyvale East Channel was two.

this watershed do not appear to be similar to those of very industrial watersheds with direct local point source discharge (e.g. 1600-4300 ng/L: Ullrich et al., 2007; 100-5000 ng/L: Picado and Bengtsson, 2012; Kocman et al., 2012; 78-1500 ng/L: Rimondi et al., 2014).

The MeHg concentrations during the three-year study ranged from DL-0.7 ng/L. Concentrations of this magnitude or greater have been observed in a number of Bay Area urban influenced watersheds (Zone 4 Line A: Gilbreath et al., 2012; Glen Echo Creek Santa Fe Channel, San Leandro Creek, and Zone 5 Line M: McKee et al., 2012). However, concentrations of methylmercury of this magnitude have not been observed in urbanized watersheds from other parts of the world (Mason and Sullivan, 1998; Naik and Hammerschmidt, 2011; Chalmers et al., 2014). Although local Hg sources can be a factor in helping to elevate MeHg production and food-web impacts, it is generally agreed, at least for agricultural and forested systems with lesser urban influences, that Hg sources are not a primary limiting factor in MeHg production (Balogh et al., 2002; Balogh et al., 2004; Barringer et al., 2010; Zheng et al., 2010; Bradely et al., 2011). Based on plenty of previous sampling experience in numerous Bay Area watershed systems there are no reasons to suspect any data quality issues. Bay Area methylmercury concentrations appear to be elevated, perhaps associated with arid climate seasonal wetting and drying and high vegetation productivity in riparian areas of channels systems with abundant supply of organic carbon each fall and winter.

Nutrient concentrations were also in the same range as measured in Z4LA (Gilbreath et al., 2012) and like the other watersheds reported from the current study, phosphorus concentrations appear to be greater than elsewhere in the world under similar land use scenarios perhaps attributable to geological sources (McKee and Krottje, 2005). Nitrate concentrations appear strikingly similar between Sunnyvale East Channel and San Leandro Creek, Lower Marsh Creek, and Pulgas Creek Pump Station. In contrast, nitrate concentrations were about 2-fold greater in Guadalupe River and North Richmond Pump Station. Mean orthophosphate concentrations (0.128 mg/L) were similar to Pulgas Creek Pump Station but much lower than observed in the Richmond Pump Station and about 30% elevated above Lower Marsh and San Leandro Creeks. The maximum total P concentration (1.7 mg/L) should be considered very high for an urban watershed however average total P concentrations were similar across the six sites. Concentrations appear typical or slightly greater than for PO4 and TP of found in urban watersheds in other parts of the country and world (e.g. Hudak and Banks, 2006; comprehensive Australian literature review for concentrations by land use class: Bartley et al., 2012). Higher phosphorus concentrations especially the peak concentration observed in Sunnyvale East Channel may perhaps be attributable to geological sources (Dillon and Kirchner, 1975; McKee and Krottje, 2005; Pearce et al., 2005).

Organic carbon concentrations observed in Sunnyvale East Channel during WYs 2012-2014 (4.1-30 mg/L) were higher than those observed in Z4LA (max = 23 mg/L; FWMC = 12 mg/L: Gilbreath et al., 2012). It turned out that these were the 3rd greatest observed in the Bay Area to-date. They were greater than but more similar to maximum concentrations observed in Guadalupe River (56 mg/L) but less than Pulgas Green Pump Station (140 mg/L). Although we have not done an extensive literature review of TOC concentrations in the worlds river systems, our general knowledge of the literature would have us hypothesize that concentrations of these magnitudes are very high. These may be contributing to the apparently high methylation rates in the Bay Area.

Of the pollutants sampled at a lesser frequency using a composite sampling design (see methods section) appropriate for characterization only, copper and selenium were similar to concentrations observed in Z4LA (Gilbreath et al., 2012) while PAHs and PBDEs were on the lower end of the range observed in Z4LA.

The maximum concentration of PBDEs (102.7 ng/L) was similar to Guadalupe River during this study (note greater concentrations have been observed in Guadalupe River at Hwy 101 previously: McKee et al., 2006) but lesser by 15-fold than North Richmond Pump Station and greater by about 2-fold than the other locations. Only two peer reviewed articles have previously described PBDE concentrations in runoff, one for the Pearl River Delta, China (Guan et al., 2007), and the other for the San Francisco Bay (Oram et al., 2008) based, in part, on concentration data from Guadalupe River and Coyote Creek taken during WYs 2003-2006. Maximum total PBDE concentrations measured by Guan et al. (2007) were 68 ng/L, a somewhat surprising result given that the Pearl River Delta is a known global electronic-waste recycling hot spot. However, the Guan et al. study was based on monthly interval collection as opposed to storm event-based sampling as was completed in a larger river system where dilution of point source may have occurred.

Similar to the other sites, carbaryl and fipronil (not measured previously by RMP studies) were on the lower side of the range of peak concentrations reported in studies across the US and California (fipronil: 70 – 1300 ng/L: Moran, 2007) (Carbaryl: DL - 700 ng/L: Ensiminger et al., 2012; tributaries to Salton Sea, Southern CA geometric mean ~2-10 ng/L: LeBlanc and Kuivila, 2008). Project mean Permethrin concentrations at Sunnyvale East Channel were amongst the highest measured to-date ranking only behind Zone 4 Line A. Concentrations of Delta/ Tralomethrin were similar to observed in Lower Marsh Creek and Richmond Pump Station. Bifenthrin were similar to all the other locations except Lower Marsh Creek where they were about 10-fold greater. Concentrations of Cyhalothrin lambda were similar in across San Leandro Creek, Guadalupe River, Sunnyvale East Channel, and Pulgas Creek Pump Station and about 2-fold greater in Marsh Creek and Richmond Pump Station. In general, the mix of pyrethriods used in each watershed appears to differ remarkably and is perhaps associated with local applicator and commercially available product preferences in home garden stores.

In summary, PCB concentrations are elevated in the Sunnyvale East Channel relative to typical Bay Area and other urban watersheds, Hg appears to be relatively low, whereas concentrations of other POCs are either within the range of or below those measured in other typical Bay Area urban watersheds and appear consistent with or explainable in relation to studies from elsewhere. Based on these first order comparisons, we see no quality issues with the data.

8.3.4. Sunnyvale East Channel toxicity

Composite water samples were collected in the Sunnyvale East Channel during two storm events in WY 2012, two storm events in WY 2013, and six storm events in WY 2014. No significant reductions in the survival, reproduction and growth of three of four test species were observed during storms. Significant reductions in the survival of the amphipod Hyalella azteca were observed during all WY 2012, WY 2013, and WY 2014 storm events.

8.3.5. Sunnyvale East Channel loading estimates

Given that the turbidity record in WY 2012 was unreliable due to optical interference from bottom substrate (a problem rectified in 2013), and gaps that existed in the WY 2013 record due to vegetation interference throughout the season, continuous suspended sediment concentration was estimated from the discharge record using a linear relation for the period of record in which turbidity was censored, and otherwise using the power relation with turbidity during the period in which the turbidity record was acceptable (Table 24). Concentrations of other POCs were estimated using regression equations between the pollutant and either flow or estimated SSC, whichever relation was stronger. Total organic carbon and the dissolved nutrients did not have a strong relation with either suspended sediment or flow and therefore a flow weighted mean concentration was applied to estimate the loads reported in Table 25. This table highlights how monthly loads can be dominated by a few large storm events. Relative to discharge, suspended sediment load showed quite high variability relative to some of the other sampling locations in the study. Although just one month (December 2012) discharged 17% of the total volume for WYs 2012, 2013, and 2014 combined, 62% of the suspended sediment load was transported during this month as well as approximately 22% of the PCB and 45% of the mercury loads. Given the context that WYs 2012, 2013, and 2014 were relatively dry years, we may be likely to see an even broader range of rainfall-runoff-pollutant transport processes in Sunnyvale East Channel if wetter seasons are sampled in the future – this could be something to consider also if this station were to be chosen as a trend indicator station.

Table 24. Regression equations used for loads computations for Sunnyvale East Channel during water year 2012-2014. Note that regression equations will be reformulated upon future wet season storm sampling.

Analyte	Origin of runoff	Slope	Intercept	Correlation coefficient (r^2)	Notes
Suspended Sediment (WY2012) (mg/L/CFS)	Mainly urban	0.97		0.97	Regression with flow
Suspended Sediment (WY2013) (mg/L/CFS)	Mainly urban	$0.129x^{1.485}$		0.82	Regression with flow
Suspended Sediment (WY2013&14) (mg/L/NTU)	Mainly urban	$0.24x^{1.40}$		0.87	Regression with turbidity
Total PCBs (ng/mg) prior to Feb 28, 2014	Mainly urban	0.0704	34.4079	0.413	Regression with estimated SSC
Total PCBs (ng/mg) post Feb 28, 2014	Mainly urban	1.05	12.91	0.23	Regression with estimated SSC
Total PCBs (ng/L) Fows < 40 CFS	Mainly urban	15.6			Average Low Flow Concentration
Total Mercury (ng/mg)	Mainly urban	0.149	12.49	0.92	Regression with estimated SSC
Total Methylmercury (ng/mg)	Mainly urban	0.000911	0.144	0.69	Regression with estimated SSC
Total Organic Carbon (WYs 2012-13) (mg/L)	Mainly urban	5.7917568			Flow weighted mean concentration
Total Organic Carbon (WY 2014) (mg/L)	Mainly urban	11.870684			Flow weighted mean concentration
Total Phosphorous (mg/mg)	Mainly urban	0.000503	0.277	0.75	Regression with estimated SSC
Nitrate (WYs 2012-13) (mg/L)	Mainly urban	0.245			Flow weighted mean concentration
Nitrate (WY 2014) (mg/L)	Mainly urban	0.323			Flow weighted mean concentration
Phosphate (WYs 2012-13) (mg/L)	Mainly urban	0.104			Flow weighted mean concentration
Phosphate (WY 2014) (mg/L)	Mainly urban	0.133			Flow weighted mean concentration

Table 25. Monthly loads for Sunnyvale East Channel during water years 2012, 2013 and 2014. Italicized loads are estimated based on monthly rainfall-load relationships.

Water Year	Month	Rainfall (mm)	Discharge (Mm^3)	SS (t)	TOC (kg)	PCBs (g)	HgT (g)	MeHgT (g)	NO3 (kg)	PO4 (kg)	Total P (kg)
2012	11-Oct	14	*0.128*	*4.10*	*1053*	*5.20*	*2.65*	*0.0965*	*37.4*	*15.1*	*39.9*
	11-Nov	9	*0.110*	*2.80*	*939*	*4.40*	*2.01*	*0.0865*	*33.6*	*13.4*	*33.7*
	11-Dec	2	0.148	0.383	855	5.110	1.90	0.0210	36.2	15.4	41.1
	12-Jan	37	0.254	18.2	1473	10.03	5.90	0.0516	62.3	26.5	79.6
	12-Feb	22	0.151	1.85	875	5.333	2.17	0.0228	37.0	15.7	42.8
	12-Mar	69	0.260	10.78	1528	9.14	4.76	0.0442	65.1	26.9	76.4
	12-Apr	39	0.260	18.2	1503	11.65	6.55	0.0594	63.2	26.2	81.8
	Wet season total	192	1.31	56.4	8,227	50.87	25.9	0.382	335	139	395
2013	12-Oct	13	0.122	5.29	709	4.584	2.32	0.4595	30.0	12.7	36.6
	12-Nov	61	0.357	89	2020	20.5	15.1	0.541	92	38.5	146
	12-Dec	101	0.610	402	3541	47.7	63.2	1.979	144	63.9	385
	13-Jan	8	0.114	1.82	660	4.052	1.70	0.0853	27.9	11.9	32.5
	13-Feb	10	0.100	4.46	582	3.770	1.92	0.0809	24.6	10.4	30.1
	13-Mar	20	0.138	5.13	799	5.11	2.49	0.1040	33.8	14.3	40.8
	13-Apr	6	0.065	0.129	376	2.241	0.830	0.013	15.9	6.75	18.0
	Wet season total	219	1.51	508	8,685	87.9	87.6	3.263	369	159	689
2014	13-Oct	0	0.115	0.519	1374	4.008	1.52	0.0425	37.3	15.4	32.2
	13-Nov	14	0.141	21.1	1683	6.35	4.91	0.2039	45.7	18.8	49.8
	13-Dec	4	0.096	1.55	1140	3.406	1.43	0.0514	31.0	12.7	27.3
	14-Jan	2	0.072	0.253	861	2.507	0.94	0.0355	23.4	9.62	20.2
	14-Feb	65	0.315	50.9	3771	44.7	13.3	0.2055	90.9	42.9	137
	14-Mar	38	0.164	12.5	1942	9.7	4.16	0.0818	55.7	22.4	47.9
	14-Apr	12	0.107	2.18	1269	3.62	1.66	0.0481	52.0	13.5	29.4
	Wet season total	136	1.01	89.0	12,040	74.4	27.9	0.669	336	135	343

8.6. Pulgas Creek South Pump Station

8.6.1. Pulgas Creek South Pump Station flow

Flow from the southern catchment of the Pulgas Creek Pump Station was monitored for two wet seasons. An ISCO area velocity flow meter situated in the incoming pipe (draining to the catch basin prior to entering the pump station) was used to measure stage and flow in WY 2013 and 2014. A monthly (or partial monthly for December 2012 and March 2013) rainfall to runoff regression (R^2 = 0.97) was applied to estimate total discharge during the missing period of the record. Based on this regression estimator method, coarse estimates of total runoff during WYs 2013 and 2014 were 0.22 Mm^3 and 0.08 Mm^3, respectively.

Runoff from the Pulgas Creek South Pump Station watershed is highly correlated with rainfall due to its small drainage area and high imperviousness. Mean Annual Precipitation (MAP) for the nearby Redwood City NCDC meteorologic gauge (gauge number 047339-4) was 78% and 35% of normal in WYs 2013 and 2014, respectively. Total runoff for both years at Pulgas Creek was also likely below normal, and probably more so than the rainfall since total annual discharge generally varies more widely than total annual rainfall. Indeed, the total annual discharge in the nearby USGS-gauged Saratoga Creek was 48% and 9% of normal in WYs 2013 and 2014, respectively.

During the two years of recorded data at Pulgas Creek South Pump Station, the largest storm series, and subsequently the largest discharge period, occurred in December 2012. Flow peaked during this storm at 50 cfs, while the peak flow in WY 2014 was 33 cfs and occurred during a short but relatively intense storm on 11/20/2013 (Figure 8). December 2012 was only partially monitored (record began on Dec 17, 2012), though by estimating total monthly discharge based on the rainfall-runoff regression, estimated discharge for December 2012 was higher than the entire WY 2014 season's estimated discharge. San Francisquito Creek to the south has been gauged by the USGS at the campus of Stanford University (gauge number 11164500) from WY 1930-41 and again from 1950-present. Annual peak flows in San Francisquito over the long term record have ranged between 12 cfs (WY 1961) and 7200 cfs (WY1998). During WY 2013, flow at San Francisquito Creek peaked at 5400 cfs on 12/23/12 at 18:45, a flow that has been exceeded in only two previous years on record. On the other extreme, during WY 2014 flow peaked at 100 cfs on 4/1/2014 at 22:00. Flow peaks at San Francisquito Creek during these two water years show the contrast in precipitation events between the two years monitored at this site. It is noted, however, that the December 23, 2012 event at Pulgas Creek South Pump Station was likely not equivalent in magnitude as that which occurred at San Francisquito since the smaller, highly impervious Pulgas Creek South Pump Station watershed would be less affected by antecedent saturation conditions than San Francisquito Creek and more by hourly and sub-hourly rainfall intensities. The maximum 1-hour rainfall intensity at Pulgas Creek in WY 2013 was 0.43 inches per hour on 12/23/12 and 0.28 inches per hour on 11/20/2013 in WY 2014, both concurrent with the peak flow for the respective year. Relative to the Redwood City NCDC meteorological gauge and based on the partial duration series, the maximum WY 2013 1-hour rainfall intensity at Pulgas has approximately a 1-year recurrence interval, and therefore much less than a 1-year recurrence for the most intense WY 2014 storm. Based on this rainfall intensity recurrence, we suggest peak flows in Pulgas Creek South Pump Station watershed were approximately average for WY 2013 and below average in WY 2014.

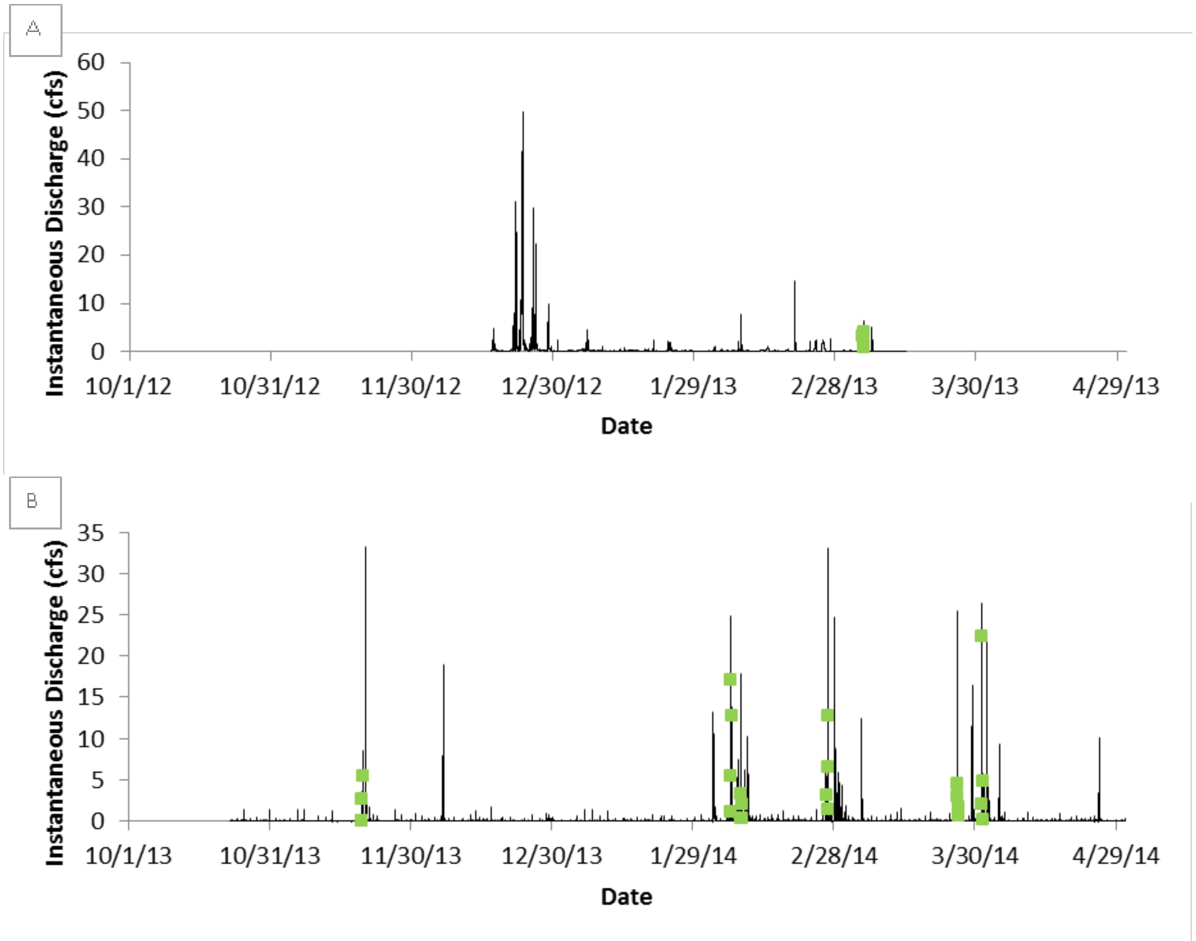

Figure 8. Flow characteristics at Pulgas Creek South Pump Station during Water Year 2013 and 2014 with sampling events plotted in green.

8.6.2. Pulgas Creek South Pump Station turbidity and suspended sediment concentration

Turbidity in Pulgas Creek South Pump Station watershed generally responded to rainfall events in a similar manner to runoff. During non-storm periods, turbidity generally fluctuated between 2 and 20 NTU, whereas during storms, maximum turbidity for each event reached between 100 and 600 NTU. Near midnight on 12/30/12, during flow conditions slightly elevated above base flows but not associated with rainfall, turbidity spiked above the sensor maximum[7] and did not return to readings below 20 NTU for 18 hours. After the first year of sampling, we noted that during all storm events after the 12/30/12 spike, storm maximum turbidities were all greater than maximum turbidities in the large storm series

[7] Note the reported DTS-12 turbidity sensor maximum is 1600 NTU. Maximum sensor reading during this spike was 2440 NTU. Given this is beyond the accurate range of the sensor, we do not suggest this reading is accurate but rather reflects that a significant spike in turbidity occurred in the system at this time.

around 12/23/12. We proposed two hypotheses to explain these observations: a) during larger storm events such as the 12/23/12 storm, turbidity becomes diluted, or b) that the signal of particles released into the watershed and measured on 12/30/12 continued to present at lower magnitudes through the remainder of the season. It remains challenging to tease out which of these hypotheses is more likely correct; turbidity in WY 2014 ranged up to 596 NTU and did peak in most storms higher that the large event on 12/23/12. This would suggest that these turbidities are typical in this watershed. However, WY 2014 was also a very dry year and so it remains possible that the particles released into the watershed and measured on 12/30/12 were still flushing through the system throughout WY 2014.

Turbidity measurements during storms were very spiky, possibly due to the combined factors of the location of the sensor in the catch basin vault and the cyclical pump out from the adjacent pump station. The turbidity record could not be used in regression with manually collected SSC to estimate SSC continuously and therefore it is not possible to estimate the peak SSC during the monitoring period. The highest manually collected SSC was 333mg/L and sampled on 11/19/13 at 16:12. This occurred during a sampled storm in which the continuous turbidity sensor was malfunctioning.

8.6.3. Pulgas Creek South Pump Station POC concentrations (summary statistics)

A summary of concentrations is useful for providing comparisons to other systems and also for doing a first order quality assurance check. Summary statistics of pollutant concentrations measured in Pulgas Creek South Pump Station in WY 2013 and 2014 are presented in Table 26. Samples were collected during one storm event in WY 2013 and 6 storm events in WY 2014 (except for dry weather methylmercury sample collection).

The range of WY 2013 PCB concentrations measured during one storm event were generally typical of mixed urban land use watersheds previously monitored in the San Francisco Bay Area (i.e. Guadalupe River, Zone 4 Line A, Coyote Creek, summarized by Lent and McKee, 2011). However, concentrations in WY 2014 were indicative of PCB watershed sources and were the highest concentrations measured in Bay Area stormwater. Maximum concentrations were measured during the storm event on 11/19/2013 and were quantified at 6669 ng/L. Approximately 0.5 inches of rain fell during this storm event and it was one of the earliest events of the WY 2014 season. The previous highest concentration measured (Santa Fe Channel in WY 2011 at 470 ng/L: McKee et al., 2012) was one order of magnitude lower. For the three-year project, mean PCB concentrations were highest at Pulgas Creek South (Pulgas Creek South > East Sunnyvale Channel > Guadalupe River = Richmond Pump Station > San Leandro Creek > Lower Marsh Creek). Concentrations in the Pulgas Creek Pump Station watershed appear to be similar to watersheds with industrial sources where concentrations in excess of about 100 ng/L are common (Marsalek and Ng, 1989; Hwang and Foster, 2008; Zgheib et al., 2011; Zgheib et al., 2012; McKee et al., 2012) and in fact are amongst the highest reported in peer-reviewed literature for urban systems. In contrast, watersheds with little to no urbanization dominated by agriculture and open space exhibit average concentrations <5 ng/l (David et al., in press; Foster et al., 2000a; Howell et al. 2011; McKee et al., 2012). In instances where urbanization and industrial sources are highly diluted by >75% developed agricultural land concentrations averaging 8.9 ng/L can be observed (Gómez-Gutiérrez et al., 2006). The Pulgas Creek South Pump Station watershed has an imperviousness of 87% and exhibits a particle ratio of 1079 pg/mg, the second highest

Table 26. Summary of laboratory measured pollutant concentrations in Pulgas Creek South Pump Station during water year 2013 and 2014.

		2013							2014						
Analyte	Unit	Samples Taken (n)	Proportion Detected (%)	Min	Max	Median	Mean	Standard Deviation	Samples Taken (n)	Proportion Detected (%)	Min	Max	Median	Mean	Standard Deviation
SSC	mg/L	15	100%	4.3	110	24	33.3	33.1	81	99%	0	333	37	60.8	64.5
ΣPCB	ng/L	4	100%	15.1	62.7	30.5	34.7	20.1	25	100%	16.9	6670	69.5	581	1500
Total Hg	ng/L	6	100%	4.2	23	7.45	10.5	6.9	25	100%	4.2	69	16	20	13.9
Total MeHg	ng/L	6	100%	0.04	0.28	0.215	0.178	0.1	14	100%	0.02	0.66	0.155	0.193	0.167
TOC	mg/L	4	100%	7.3	17	8.35	10.3	4.53	24	100%	4.1	140	11	22.2	31.4
NO3	mg/L	4	100%	0.24	0.49	0.35	0.357	0.102	24	100%	0.1	2.3	0.3	0.484	0.491
Total P	mg/L	4	100%	0.1	0.25	0.125	0.15	0.0707	24	100%	0.067	1.2	0.23	0.313	0.261
PO4	mg/L	4	100%	0.0505	0.0935	0.059	0.0655	0.0195	24	100%	0.056	0.47	0.092	0.133	0.105
Hardness	mg/L								6	100%	40	110	63.5	69.8	29.4
Total Cu	ug/L	1	100%	30	30	30	30		6	100%	22.5	99	36.5	46.3	28.5
Dissolved Cu	ug/L	1	100%	20	20	20	20		6	100%	12	41	13.5	18.3	11.3
Total Se	ug/L	1	100%	0.18	0.18	0.18	0.18		6	100%	0.14	0.6	0.242	0.311	0.175
Dissolved Se	ug/L	1	100%	0.17	0.17	0.17	0.17		6	100%	0.1	0.48	0.19	0.257	0.148
Carbaryl	ng/L	1	100%	204	204	204	204		6	100%	41	189	65.5	88.5	59.4
Fipronil	ng/L	1	0%	0	0	0	0		6	100%	3	6	3.5	3.83	1.17
ΣPAH	ng/L	4	100%	211	1140	552	614	389	2	100%	552	6970	3760	3760	4540
ΣPBDE	ng/L	4	100%	5.18	89.8	32.5	40	39.7	2	100%	52.1	61.4	56.7	56.7	6.59
Delta/ Tralomethrin	ng/L	1	0%	0	0	0	0		6	50%	0	1.2	0.2	0.45	0.565
Cypermethrin	ng/L	1	100%	0.9	0.9	0.9	0.9		6	100%	0.8	5.65	2.7	2.68	1.78
Cyhalothrin lambda	ng/L	1	0%	0	0	0	0		5	100%	0.2	0.8	0.3	0.42	0.268
Permethrin	ng/L	1	100%	2.9	2.9	2.9	2.9		6	83%	0	20	14.3	12	7.94
Bifenthrin	ng/L	1	100%	1.3	1.3	1.3	1.3		6	100%	1.4	15	4.7	5.78	4.92

Zeroes were used in the place of non-detects when calculating means, medians, and standard deviations.
The minimum number of samples used to calculate standard deviation Pulgas Creek South Pump Station was four.

observed so far in the Bay Area out of 24 locations (Only Pulgas Creek North is higher) and well above the background of rural areas (indicated by Marsh Creek in the Bay Area).

The range of total mercury concentrations (4-69 ng/L; mean = 15 ng/L) were lower than observed in any of the other watersheds in this study and on the very low end of concentrations sampled in Z4LA (Gilbreath et al., 2012). Pulgas Creek South Pump Station watershed also exhibits relatively low SSC compared to the other six locations. Of the six POC loads stations monitored during this study, total Hg concentrations in Pulgas Creek were most similar to those observed in three urban Wisconsin watersheds (Hurley et al., 1995), urban influenced watersheds of the Chesapeake Bay region (Lawson et al., 2001), and two sub-watersheds of mostly urban land use in the Toronto area (Eckley and Branfirheun, 2008). Unlike Marsh Creek, San Leandro Creek, or Sunnyvale East Channel where the maximum Hg concentrations could be either mostly or somewhat attributed to the erosion of upper watershed soils, Pulgas Creek South Pump Station Watershed transports relatively low Hg concentrations that are most likely attributable to local atmospheric deposition and minor within-watershed sources areas associated with industrial and commercial land uses. Despite low Hg concentrations in water, the particle ratio for total Hg relative to suspended sediment in this watershed (0.8 mg/kg) is the same as observed in Richmond Pump Station watershed and the 3rd highest behind San Leandro Creek and Ettie St. Pump Station watersheds (discounting Guadalupe River and its mining impacted tributaries which all rank higher still). The source-release-transport processes are likely similar to those of other urbanized and industrial watersheds (Barringer et al., 2010; Rowland et al., 2010; Lin et al., 2012) but not likely similar to very highly contaminated watersheds with direct local point source discharge (e.g. 1600-4300 ng/L: Ullrich et al., 2007; 100-5000 ng/L: Picado and Bengtsson, 2012; Kocman et al., 2012; 78-1500 ng/L: Rimondi et al., 2014).

The MeHg concentrations during the two-year study ranged from 0.04-0.66 ng/L. Concentrations of this magnitude or greater have been observed in a number of Bay Area urban influenced watersheds (Zone 4 Line A: Gilbreath et al., 2012; Glen Echo Creek Santa Fe Channel, San Leandro Creek, Zone 5 Line M, Borel Creek, and Pulgas Creek North: McKee et al., 2012). However, concentrations of methylmercury of this magnitude have not been observed in urbanized watersheds from other parts of the world (Mason and Sullivan, 1998; Naik and Hammerschmidt, 2011; Chalmers et al., 2014). Although local Hg sources can be a factor in helping to elevate MeHg production and food-web impacts, it is generally agreed, at least for agricultural and forested systems with lesser urban influences, that Hg sources are not a primary limiting factor in MeHg production (Balogh et al., 2002; Balogh et al., 2004; Barringer et al., 2010; Zheng et al., 2010; Bradely et al., 2011). Based on plenty of previous sampling experience in numerous Bay Area watershed systems, there are no reasons to suspect any data quality issues. Bay Area methylmercury concentrations appear to be elevated perhaps associated with arid climate seasonal wetting and drying and high vegetation productivity in riparian areas of channels systems with abundant supply of organic carbon each fall and winter. Although there is no riparian corridor in the Pulgas Creek South Pump Station catchment, the pipes nearly always contain water-logged sediment that is deep enough in some areas to create anoxic conditions.

Nutrient concentrations in Pulgas Creek South Pump Station watershed were also generally in the same range as measured in Z4LA (Gilbreath et al., 2012) and like the other watersheds reported from the current study, phosphorus concentrations appear to be greater than elsewhere in the world under similar land use scenarios perhaps attributable to geological sources (McKee and Krottje, 2005). Nitrate concentrations appear lower in Pulgas Creek Pump Station compared to Guadalupe River and Richmond Pump Station but similar Sunnyvale East Channel, San Leandro Creek, and Lower Marsh Creek. Mean orthophosphate concentrations (0.124 mg/L) were similar to Sunnyvale East Channel but much lower than observed in the Richmond Pump Station and about 30% elevated above Lower Marsh and San Leandro Creeks. The maximum total P concentration (1.2 mg/L) should be considered very high for an urban watershed, however average total P concentrations were similar across the six sites. Concentrations of PO4 and TP appear typical or slightly greater than observations in urban watersheds in other parts of the country and world (e.g. Hudak and Banks, 2006; comprehensive Australian literature review for concentrations by land use class: Bartley et al., 2012). Higher phosphorus concentrations, especially the peak concentration observed in Pulgas Creek may perhaps be attributable to geological sources (Dillon and Kirchner, 1975; McKee and Krottje, 2005; Pearce et al., 2005).

Organic carbon concentrations observed in Pulgas Creek Pump Station during WYs 2013-2014 (4.1-140 mg/L) were much greater than those observed in Z4LA (max = 23 mg/L; FWMC = 12 mg/L: Gilbreath et al., 2012). It turned out that these were the greatest concentrations observed in the Bay Area to-date. They were greater than but more similar to maximum concentrations observed in Guadalupe River and Sunnyvale East Channel (56 and 30 mg/L respectively). Although we have not done an extensive literature review of TOC concentrations in the worlds river systems, our general knowledge of the literature would have us hypothesize that concentrations of these magnitudes are very high. High organic carbon concentrations may be contributing to the apparent high methylation rates in Bay Area urban storm drains, creeks, and rivers.

Pollutants sampled at a lesser frequency using a composite sampling design (see methods section) and appropriate for water quality characterization only (copper, selenium, PAHs, carbaryl, fipronil, and PBDEs) were similar to concentrations observed in Z4LA (Gilbreath et al., 2012). PAH concentrations at Pulgas Creek South were almost 2 times higher than the next highest concentration (San Leandro Creek) and were more similar to the previous highest PAH concentration measured (Santa Fe Channel) (McKee et al., 2012). The maximum PBDE concentration (89.9 ng/L) was lower than the other 5 locations in this study with the exception of Lower Marsh Creek. It is possible that low sample numbers and very dry conditions (38% MAP in WY 2014) for this watershed biased the concentrations low; only a future sampling effort would verify the relatively low concentration in comparison to the other highly urban and impervious watersheds in this study. Only two peer reviewed articles have previously described PBDE concentrations in runoff, one for the Pearl River Delta, China (Guan et al., 2007), and the other for the San Francisco Bay (Oram et al., 2008) based, in part, on concentration data from Guadalupe River and Coyote Creek taken during WYs 2003-2006. Maximum total PBDE concentrations measured by Guan et al. (2007) were 68 ng/L, a somewhat surprising result given that the Pearl River Delta is a known global electronic-waste recycling hot spot. However, the Guan et al. study was based on monthly interval collection as opposed to storm event-based sampling as was completed in a larger river system where dilution of point source may have occurred.

Similar to the other sites, carbaryl and fipronil (not measured previously by RMP studies) were on the lower side of the range of peak concentrations reported in studies across the US and California (fipronil: 70 – 1300 ng/L: Moran, 2007) (Carbaryl: DL - 700 ng/L: Ensiminger et al., 2012; tributaries to Salton Sea, Southern CA geometric mean ~2-10 ng/L: LeBlanc and Kuivila, 2008). However, carbaryl concentrations at Pulgas Creek South, although still very low, were 5 to 15 times higher than other POC sites. Concentrations of Cypermethrin were similar to those observed in Z4LA whereas concentrations of Permethrin and Bifenthrin were about 5x and 2x lower, respectively (Gilbreath et al., 2012). In general, the mix of pyrethroids used in each watershed appears to differ remarkably and is perhaps associated with local applicator and commercially available product preferences in home garden stores. For example, concentrations of Cyhalothrin lambda were similar across the Pulgas Creek Pump Station, San Leandro Creek, Guadalupe River, and Sunnyvale East Channel sampling sites and about 2-fold greater in Marsh Creek and Richmond Pump Station. Bifenthrin was similar across all six sites with the exception of Lower Marsh Creek where concentrations were observed to be 10-fold greater.

In summary, PCB concentrations are extremely elevated in the Pulgas Creek South Pump Station relative to other Bay Area watersheds and urban watersheds in other parts of the world. Hg appears to be relatively low when considering water concentrations alone but elevated in relation to the amount of sediment transported. Whereas concentrations of other POCs are either within range or below those measured in other typical Bay Area urban watersheds and appear consistent with or explainable in relation to studies from elsewhere. Based on these first order comparisons, we see no quality issues with the data.

8.6.4. Pulgas Creek South Pump Station toxicity

The Pulgas Creek South site was sampled over one storm event in WY 2013 and six discrete storm events in WY 2014. There was no observed toxicity in the WY 2013 event. In WY 2014, Hyalella azteca had reduced survival in all the events sampled. The reductions ranged from 6% to 88%. Additionally the first storm sampled in WY 2014, on November 19, 2013, had a significant reduction in the growth of both S. capricornutum and the fathead minnow by 96% and 45%, respectively. The second WY 2014 storm sampled on February 2, 2014 had a reduction in growth of the fathead minnow by 18% while S. capricornutum was unaffected. No other significant reductions in survival or growth were reported in any of the species for any other samples.

8.6.5. Pulgas Creek South Pump Station loading estimates

Continuous concentrations of suspended sediment, PCBs, total mercury and methylmercury, and total phosphorous were computed using a simple FWMC estimator (Table 27). This method differs from the previous report (Gilbreath et al., 2014) when a regression estimator method was used. This occurred because more information revealed complex patterns that could not be explained using regression. If the dataset for this site were to improve in the future, these estimates could be recalculated and improved. With these caveats, preliminary monthly loading estimates are dominated by the three wet months (November and December, 2012 and February 2014) during which time 62% of the total discharge volume and load passed through the system. Pulgas Creek exhibited the highest concentrations and unit area normalized loads of the six loading stations for PCBs (Table 28).

Table 27. Regression equations used for loads computations for Pulgas Creek South during water years 2013-2014.

Analyte	Origin of runoff	Slope	Intercept	Correlation coefficient (r^2)	Notes
Suspended Sediment (mg/L)	Mainly urban	66.1			Flow weighted mean concentration
Total PCBs (ng/L)	Mainly urban	132			Flow weighted mean concentration
Total Mercury (ng/L)	Mainly urban	18.6			Flow weighted mean concentration
Total Methylmercury (ng/L)	Mainly urban	0.1761756			Flow weighted mean concentration
Total Organic Carbon (mg/L)	Mainly urban	9.32			Flow weighted mean concentration
Total Phosphorous (mg/L)	Mainly urban	0.2			Flow weighted mean concentration
Nitrate (mg/L)	Mainly urban	0.249			Flow weighted mean concentration
Phosphate (mg/L)	Mainly urban	0.0776			Flow weighted mean concentration

Table 28. Monthly loads estimated for Pulgas Creek South Pump Station during water year 2013-2014.

Water Year	Month	Rainfall (mm)	Discharge (Mm^3)	SS (t)	TOC (kg)	PCBs (g)	HgT (g)	MeHgT (g)	NO3 (kg)	PO4 (kg)	Total P (kg)
2013	12-Oct	25	0.0100	0.659	92.9	1.32	0.185	0.00176	2.48	0.774	1.99
	12-Nov	121	0.0515	3.41	480	6.80	0.959	0.00908	12.8	4.00	10.3
	12-Dec	183	0.0829	5.48	773	10.94	1.54	0.0146	20.6	6.43	16.6
	13-Jan	8	0.0034	0.227	32.0	0.453	0.0639	0.000605	0.855	0.266	0.687
	13-Feb	10	0.0039	0.256	36.1	0.512	0.0721	0.000683	0.965	0.301	0.775
	13-Mar	20	0.0073	0.480	67.7	0.959	0.135	0.00128	1.81	0.564	1.45
	13-Apr	18	0.0062	0.407	57.5	0.814	0.115	0.00109	1.53	0.478	1.23
	Wet season total	386	0.165	10.9	1539	21.8	3.07	0.0291	41.1	12.8	33.0
2014	13-Oct	0	0.0004	0.0283	4.00	0.0566	0.00798	0.0000756	0.107	0.0333	0.0858
	13-Nov	24	0.0085	0.611	108	2.69	0.164	0.00160	2.55	0.770	1.96
	13-Dec	8	0.0047	0.309	43.6	0.617	0.0870	0.000824	1.16	0.363	0.935
	14-Jan	0	0.0008	0.0541	7.63	0.108	0.0152	0.000144	0.204	0.0635	0.164
	14-Feb	90	0.0400	2.61	364	5.09	0.745	0.00701	9.79	3.10	8.10
	14-Mar	41	0.0160	1.09	152	2.00	0.290	0.00283	4.06	1.26	3.03
	14-Apr	21	0.0092	0.605	85.3	1.21	0.170	0.00161	2.28	0.711	1.83
	Wet season total	185	0.0796	5.31	764	11.8	1.48	0.0141	20.1	6.31	16.1

Attachment 1. Quality Assurance information

Table A1: Summary of QA data at all sites. This table includes the top eight PAHs found commonly at all sites , the PBDE congeners that account for 75% of the sum of all PBDE congeners, the top nine PCB congeners found at all sites, and the pyrethroids that were detected at any site.

Analyte	Unit	AverageLabBlank	Detection Limit (MDL) (range; mean)	Average Reporting Limit (RL)	RSD of Lab Duplicates (% range; % mean)	RSD of Field Duplicates (% range; % mean)	Percent Recovery of CRM (% range; % mean)	Percent Recovery of Matrix Spike (% range; % mean)
Carbaryl	ng/L	0	9.9-10; 10	20	75.71-75.71; 75.71	1.39-83.55; 42.47	NA	66.64-120.25; 94.99
Fipronil	ng/L	0	0.5-5; 0.945	4.34	NA	0.00-141.42; 28.84	NA	51.52-150.00; 86.24
NH4	mg/L	0	0.015-0.04; 0.024	0.0486	NA	0.00-11.79; 4.47	NA	80.00-120.00; 102.41
NO3	mg/L	0	0.002-0.05; 0.0113	0.0488	0.00-0.00; 0.00	0.00-42.43; 2.51	NA	90.00-105.00; 98.98
PO4	mg/L	0	0.0035-0.06; 0.00599	0.0112	0.00-1.61; 0.90	0.00-5.29; 1.51	NA	83.50-126.06; 97.94
Total P	mg/L	0	0.007-0.1; 0.016	0.01	0.00-2.40; 0.79	0.00-33.17; 3.90	NA	86.00-113.00; 97.30
SSC	mg/L	0	0.23-6.8; 2.28	3	NA	0.00-85.48; 12.61	80.99-114.49; 100.72	NA
Benz(a)anthracenes/Chrysenes, C1-	ng/L	0.245	0.0364-75.5; 2.64	NA	NA	NA	NA	NA
Benz(a)anthracenes/Chrysenes, C2-	ng/L	0.177	0.046-	NA	NA	NA	NA	NA

Analyte	Unit	AverageLabBlank	Detection Limit (MDL) (range; mean)	Average Reporting Limit (RL)	RSD of Lab Duplicates (% range; % mean)	RSD of Field Duplicates (% range; % mean)	Percent Recovery of CRM (% range; % mean)	Percent Recovery of Matrix Spike (% range; % mean)
			43.1; 1.98					
Fluoranthene	ng/L	0.152	0.0382-2.58; 0.446	NA	NA	NA	NA	NA
Fluoranthene/Pyrenes, C1-	ng/L	0.531	0.103-25.4; 2.08	NA	NA	NA	NA	NA
Fluorenes, C3-	ng/L	1.42	0.0451-29.4; 1.47	NA	NA	NA	NA	NA
Naphthalenes, C4-	ng/L	1.86	0.0461-3.54; 0.751	NA	NA	NA	NA	NA
Phenanthrene/Anthracene, C4-	ng/L	1.44	0.0891-27.1; 2.72	NA	NA	NA	NA	NA
Pyrene	ng/L	0.133	0.0376-5.96; 0.562	NA	NA	NA	NA	NA
PBDE 047	ng/L	0.0363	0.000368-0.000872; 0.000414	NA	NA	NA	NA	NA
PBDE 099	ng/L	0.0379	0.000472-0.0124; 0.00366	NA	NA	NA	NA	NA
PBDE 209	ng/L	0.101	0.0127-0.24; 0.0771	NA	NA	NA	NA	NA
PCB 087	ng/L	0.00147	0.000184-0.0337; 0.00142	NA	NA	NA	NA	NA

Analyte	Unit	AverageLabBlank	Detection Limit (MDL) (range; mean)	Average Reporting Limit (RL)	RSD of Lab Duplicates (% range; % mean)	RSD of Field Duplicates (% range; % mean)	Percent Recovery of CRM (% range; % mean)	Percent Recovery of Matrix Spike (% range; % mean)
PCB 095	ng/L	0.0013	0.000184-0.0372; 0.0016	NA	NA	NA	NA	NA
PCB 110	ng/L	0.00184	0.000184-0.029; 0.00122	NA	NA	NA	NA	NA
PCB 138	ng/L	0.0018	0.000214-0.149; 0.00441	NA	NA	NA	NA	NA
PCB 149	ng/L	0.00101	0.00022-0.151; 0.00469	NA	NA	NA	NA	NA
PCB 151	ng/L	0.000445	0.000184-0.0195; 0.00115	NA	NA	NA	NA	NA
PCB 153	ng/L	0.00178	0.000209-0.132; 0.00392	NA	NA	NA	NA	NA
PCB 174	ng/L	0.0000338	0.000184-0.0118; 0.00106	NA	NA	NA	NA	NA
PCB 180	ng/L	0.000603	0.000184-0.00952; 0.000908	NA	NA	NA	NA	NA
Bifenthrin	ng/L	0.0457	0.05-5.52; 0.761	1.53	NA	NA	NA	NA
Cypermethrin	ng/L	0	0.1-5.29; 0.815	1.53	NA	NA	NA	NA

Analyte	Unit	AverageLabBlank	Detection Limit (MDL) (range; mean)	Average Reporting Limit (RL)	RSD of Lab Duplicates (% range; % mean)	RSD of Field Duplicates (% range; % mean)	Percent Recovery of CRM (% range; % mean)	Percent Recovery of Matrix Spike (% range; % mean)
Delta/Tralomethrin	ng/L	0.155	0.1-1; 0.258	3.05	NA	NA	NA	NA
Total Cu	ug/L	0	0.042-0.421; 0.114	0.527	0.20-2.68; 0.88	0.00-3.72; 1.06	100.66-106.15; 102.50	80.00-200.00; 97.76
Dissolved Cu	ug/L	0	0.042-0.421; 0.096	0.5	NA	0.00-12.65; 3.92	NA	85.50-98.00; 92.24
Total Hg	ng/L	0	0.2-2; 0.234	0.526	2.12-2.12; 2.12	0.00-63.15; 13.84	91.93-106.84; 99.17	92.99-119.87; 104.34
Total MeHg	ng/L	0.00354	0.01-0.02; 0.0177	0.0401	0.97-5.87; 3.35	0.00-37.52; 8.84	NA	58.99-137.27; 95.64
Total Se	ug/L	0.0094	0.024-0.06; 0.0503	0.0925	0.29-26.96; 5.76	0.00-33.12; 6.97	92.56-103.84; 100.00	80.78-121.22; 95.67
Dissolved Se	ug/L	0	0.024-0.06; 0.0523	0.124	6.18-6.18; 6.18	0.00-6.18; 3.03	NA	87.20-96.22; 91.35
TOC	mg/L	0.0197	0.035-0.3; 0.249	0.481	NA	0.00-15.71; 3.49	NA	0.03-123.00; 96.59

Table A2: Field blank data from all sites.

Analyte	Unit	Average MDL	RL	Minimum Field Blank	Maximum Field Blank	Average Field Blank
Carbaryl	ng/L	10	20	ND	ND	ND
Fipronil	ng/L	0.714	3.14	ND	ND	ND
NO3	mg/L	0.0123	0.047	ND	0.039	0.00279
PO4	mg/L	0.00583	0.01	ND	0.008	0.001
Total P	mg/L	0.00719	0.01	ND	0.057	0.00519
SSC	mg/L	2	3	ND	ND	ND
Acenaphthene	ng/L	0.31	-	ND	ND	ND
Acenaphthylene	ng/L	0.0803	-	ND	0.0663	0.0133
Anthracene	ng/L	0.143	-	ND	ND	ND
Benz(a)anthracene	ng/L	0.0394	-	ND	0.0406	0.00812
Benz(a)anthracenes/Chrysenes, C1-	ng/L	0.0293	-	ND	0.173	0.0814
Benz(a)anthracenes/Chrysenes, C2-	ng/L	0.0515	-	ND	0.393	0.186
Benz(a)anthracenes/Chrysenes, C3-	ng/L	0.0457	-	ND	0.389	0.174
Benz(a)anthracenes/Chrysenes, C4-	ng/L	0.0478	-	ND	1.03	0.329
Benzo(a)pyrene	ng/L	0.111	-	ND	ND	ND
Benzo(b)fluoranthene	ng/L	0.0509	-	ND	0.121	0.0407
Benzo(e)pyrene	ng/L	0.102	-	ND	0.0695	0.0139
Benzo(g,h,i)perylene	ng/L	0.0671	-	ND	ND	ND
Benzo(k)fluoranthene	ng/L	0.11	-	ND	ND	ND
Chrysene	ng/L	0.0407	-	ND	0.151	0.0704
Dibenz(a,h)anthracene	ng/L	0.0693	-	ND	ND	ND
Dibenzothiophene	ng/L	0.0688	-	ND	0.289	0.0974
Dibenzothiophenes, C1-	ng/L	0.089	-	ND	ND	ND
Dibenzothiophenes, C2-	ng/L	0.052	-	0.266	0.71	0.486
Dibenzothiophenes, C3-	ng/L	0.0524	-	0.484	0.782	0.637
Dimethylnaphthalene, 2,6-	ng/L	0.247	-	ND	0.854	0.327

Analyte	Unit	Average MDL	RL	Minimum Field Blank	Maximum Field Blank	Average Field Blank
Fluoranthene	ng/L	0.0333	-	0.104	0.343	0.238
Fluoranthene/Pyrenes, C1-	ng/L	0.113	-	0.0828	0.716	0.387
Fluorene	ng/L	0.103	-	ND	0.229	0.098
Fluorenes, C2-	ng/L	0.122	-	1.39	3.5	2.37
Fluorenes, C3-	ng/L	0.133	-	2.95	4.13	3.58
Indeno(1,2,3-c,d)pyrene	ng/L	0.0417	-	ND	ND	ND
Methylnaphthalene, 2-	ng/L	0.233	-	ND	5.56	1.7
Methylphenanthrene, 1-	ng/L	0.119	-	ND	0.12	0.0419
Naphthalene	ng/L	0.145	-	1.7	22.4	10.5
Naphthalenes, C1-	ng/L	0.093	-	ND	8.71	2.69
Naphthalenes, C3-	ng/L	0.167	-	0.601	3.94	2.15
Perylene	ng/L	0.116	-	ND	ND	ND
Phenanthrene	ng/L	0.0885	-	0.436	0.717	0.543
Phenanthrene/Anthracene, C1-	ng/L	0.119	-	ND	0.533	0.256
Phenanthrene/Anthracene, C2-	ng/L	0.068	-	0.0581	0.843	0.485
Pyrene	ng/L	0.0323	-	0.0763	0.229	0.164
Trimethylnaphthalene, 2,3,5-	ng/L	0.11	-	ND	0.385	0.176
PBDE 007	ng/L	0.000474	-	ND	0.00164	0.000328
PBDE 008	ng/L	0.000434	-	ND	0.0013	0.00026
PBDE 010	ng/L	0.000561	-	ND	ND	ND
PBDE 011	ng/L	-	-	-	-	-
PBDE 012	ng/L	0.000417	-	ND	0.000793	0.000159
PBDE 013	ng/L	-	-	-	-	-
PBDE 015	ng/L	0.000401	-	ND	0.00416	0.000832
PBDE 017	ng/L	0.000483	-	ND	0.0236	0.00503
PBDE 025	ng/L	-	-	-	-	-
PBDE 028	ng/L	0.000772	-	ND	0.029	0.00609
PBDE 030	ng/L	0.000457	-	ND	ND	ND

Analyte	Unit	Average MDL	RL	Minimum Field Blank	Maximum Field Blank	Average Field Blank
PBDE 032	ng/L	0.00042	-	ND	ND	ND
PBDE 033	ng/L	-	-	-	-	-
PBDE 035	ng/L	0.000939	-	ND	ND	ND
PBDE 047	ng/L	0.000478	-	0.0156	1.04	0.266
PBDE 049	ng/L	0.0009	-	ND	0.0863	0.0187
PBDE 051	ng/L	0.000521	-	ND	0.00865	0.00173
PBDE 066	ng/L	0.00136	-	ND	0.0494	0.00988
PBDE 071	ng/L	0.000579	-	ND	0.0143	0.00286
PBDE 075	ng/L	0.00102	-	ND	ND	ND
PBDE 077	ng/L	0.000537	-	ND	ND	ND
PBDE 079	ng/L	0.000484	-	ND	ND	ND
PBDE 085	ng/L	0.00151	-	ND	0.0578	0.0137
PBDE 099	ng/L	0.000743	-	0.0295	1.2	0.308
PBDE 100	ng/L	0.000564	-	0.00597	0.281	0.0726
PBDE 105	ng/L	0.0012	-	ND	ND	ND
PBDE 116	ng/L	0.00189	-	ND	0.0113	0.00226
PBDE 119	ng/L	0.00109	-	ND	0.00686	0.00149
PBDE 120	ng/L	-	-	-	-	-
PBDE 126	ng/L	0.000751	-	ND	0.00121	0.000242
PBDE 128	ng/L	0.00495	-	ND	ND	ND
PBDE 140	ng/L	0.000817	-	ND	0.00677	0.00154
PBDE 153	ng/L	0.000892	-	0.00334	0.135	0.0316
PBDE 155	ng/L	0.000608	-	ND	0.00943	0.00207
PBDE 166	ng/L	-	-	-	-	-
PBDE 181	ng/L	0.00218	-	ND	ND	ND
PBDE 183	ng/L	0.00253	-	ND	0.0437	0.00874
PBDE 190	ng/L	0.00454	-	ND	ND	ND
PBDE 197	ng/L	0.00387	-	0.00236	0.0973	0.0498

Analyte	Unit	Average MDL	RL	Minimum Field Blank	Maximum Field Blank	Average Field Blank
PBDE 203	ng/L	0.00308	-	ND	0.123	0.0266
PBDE 204	ng/L	-	-	-	-	-
PBDE 205	ng/L	0.00563	-	ND	ND	ND
PBDE 206	ng/L	0.0222	-	ND	1.4	0.287
PBDE 207	ng/L	0.0177	-	ND	2.33	0.488
PBDE 208	ng/L	0.0265	-	ND	1.69	0.338
PBDE 209	ng/L	0.0512	-	ND	22.9	4.99
PCB 008	ng/L	0.00134	-	ND	0.0204	0.00303
PCB 018	ng/L	0.000722	-	ND	0.109	0.0112
PCB 020	ng/L	-	-	-	-	-
PCB 021	ng/L	-	-	-	-	-
PCB 028	ng/L	0.000465	-	0.00121	0.065	0.00967
PCB 030	ng/L	-	-	-	-	-
PCB 031	ng/L	0.000515	-	ND	0.0477	0.00667
PCB 033	ng/L	0.000523	-	ND	0.0115	0.00202
PCB 044	ng/L	0.000904	-	ND	0.0494	0.00645
PCB 047	ng/L	-	-	-	-	-
PCB 049	ng/L	0.00102	-	ND	0.0245	0.00277
PCB 052	ng/L	0.000668	-	ND	0.0431	0.0062
PCB 056	ng/L	0.00056	-	ND	0.00776	0.00112
PCB 060	ng/L	0.000608	-	ND	0.0013	0.000306
PCB 061	ng/L	-	-	-	-	-
PCB 065	ng/L	-	-	-	-	-
PCB 066	ng/L	0.000699	-	ND	0.00817	0.00176
PCB 069	ng/L	-	-	-	-	-
PCB 070	ng/L	0.000534	-	0.00121	0.02	0.00467
PCB 074	ng/L	-	-	-	-	-
PCB 076	ng/L	-	-	-	-	-

Analyte	Unit	Average MDL	RL	Minimum Field Blank	Maximum Field Blank	Average Field Blank
PCB 083	ng/L	-	-	-	-	-
PCB 086	ng/L	-	-	-	-	-
PCB 087	ng/L	0.000815	-	ND	0.00809	0.00283
PCB 090	ng/L	-	-	-	-	-
PCB 093	ng/L	-	-	-	-	-
PCB 095	ng/L	0.000997	-	ND	0.0115	0.00335
PCB 097	ng/L	-	-	-	-	-
PCB 098	ng/L	-	-	-	-	-
PCB 099	ng/L	0.000777	-	ND	0.00753	0.00189
PCB 100	ng/L	-	-	-	-	-
PCB 101	ng/L	0.00155	-	ND	0.00392	0.00246
PCB 102	ng/L	-	-	-	-	-
PCB 105	ng/L	0.000877	-	ND	0.0033	0.000927
PCB 108	ng/L	-	-	-	-	-
PCB 110	ng/L	0.00099	-	ND	0.0113	0.00416
PCB 113	ng/L	-	-	-	-	-
PCB 115	ng/L	-	-	-	-	-
PCB 118	ng/L	0.000824	-	ND	0.00796	0.00237
PCB 119	ng/L	-	-	-	-	-
PCB 125	ng/L	-	-	-	-	-
PCB 128	ng/L	0.000753	-	ND	0.00127	0.000397
PCB 129	ng/L	-	-	-	-	-
PCB 132	ng/L	0.00104	-	ND	0.00272	0.00113
PCB 135	ng/L	-	-	-	-	-
PCB 138	ng/L	0.00124	-	ND	0.012	0.00353
PCB 141	ng/L	0.000792	-	ND	0.00096	0.000246
PCB 147	ng/L	-	-	-	-	-
PCB 149	ng/L	0.00126	-	ND	0.00828	0.00237

Analyte	Unit	Average MDL	RL	Minimum Field Blank	Maximum Field Blank	Average Field Blank
PCB 151	ng/L	0.000754	-	ND	0.00463	0.00103
PCB 153	ng/L	0.00193	-	ND	0.00341	0.00154
PCB 154	ng/L	-	-	-	-	-
PCB 156	ng/L	0.000731	-	ND	0.000581	0.000132
PCB 157	ng/L	-	-	-	-	-
PCB 158	ng/L	0.000607	-	ND	0.000602	0.000117
PCB 160	ng/L	-	-	-	-	-
PCB 163	ng/L	-	-	-	-	-
PCB 166	ng/L	-	-	-	-	-
PCB 168	ng/L	-	-	-	-	-
PCB 170	ng/L	0.000802	-	ND	0.00131	0.000401
PCB 174	ng/L	0.000818	-	ND	0.00139	0.000347
PCB 177	ng/L	0.000731	-	ND	0.000988	0.000278
PCB 180	ng/L	0.00137	-	ND	0.00274	0.000713
PCB 183	ng/L	0.000725	-	ND	0.00208	0.000442
PCB 185	ng/L	-	-	-	-	-
PCB 187	ng/L	0.00096	-	ND	0.00509	0.000853
PCB 193	ng/L	-	-	-	-	-
PCB 194	ng/L	0.000832	-	ND	0.000731	0.0000522
PCB 195	ng/L	0.000803	-	ND	0.000261	0.0000186
PCB 201	ng/L	0.000633	-	ND	ND	ND
PCB 203	ng/L	0.000903	-	ND	ND	ND
Allethrin	ng/L	0.465	1.5	ND	ND	ND
Bifenthrin	ng/L	0.202	1.5	ND	ND	ND
Cyfluthrin, total	ng/L	1.14	1.5	ND	ND	ND
Cyhalothrin,lambda, total	ng/L	0.24	1.5	ND	0.11	0.0157
Cypermethrin, total	ng/L	0.276	1.5	ND	ND	ND
Delta/Tralomethrin	ng/L	0.21	3	ND	ND	ND

Analyte	Unit	Average MDL	RL	Minimum Field Blank	Maximum Field Blank	Average Field Blank
Esfenvalerate/Fenvalerate, total	ng/L	0.254	3	ND	ND	ND
Fenpropathrin	ng/L	0.386	1.5	ND	ND	ND
Permethrin, total	ng/L	1.37	15	ND	ND	ND
Phenothrin	ng/L	0.525	-	ND	ND	ND
Prallethrin	ng/L	7.02	-	ND	ND	ND
Resmethrin	ng/L	0.653	-	ND	ND	ND
Total Cu	ug/L	0.066	0.444	ND	1.4	0.45
Dissolved Cu	ug/L	0.066	0.444	ND	1.4	0.297
Total Hg	ng/L	0.199	0.482	ND	4.4	0.271
Total MeHg	ng/L	0.0192	0.04	ND	0.021	0.00162
Dissolved Se	ug/L	0.0549	0.096	ND	ND	ND
Total Se	ug/L	0.0549	0.096	ND	ND	ND
Total Hardness (calc)	mg/L	1.46	4.3	ND	ND	ND
TOC	mg/L	0.3	0.5	ND	ND	ND

Table A3: Average RSD of field and lab duplicates at each site.

	San Leandro Creek		East Sunnyvale Channel		Lower Marsh Creek		Guadalupe River		Richmond Pump Station		Pulgas Creek	
Analyte	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD
Carbaryl	-	-	-	-	-	-	83.50%	75.70%	-	-	1.40%	-
Fipronil	53.00%	-	31.40%	-	9.20%	-	10.90%	-	10.90%	-	-	-
NO3	0.00%	0.00%	9.90%	0.00%	0.50%	-	0.00%	0.00%	1.80%	-	0.40%	-
PO4	0.50%	0.80%	1.90%	0.90%	0.30%	-	1.40%	1.10%	1.50%	-	3.70%	-
Total P	3.60%	0.00%	0.90%	0.00%	3.00%	2.40%	12.40%	0.00%	1.70%	-	2.70%	-
SSC	11.00%	-	6.20%	-	11.90%	-	36.20%	-	12.40%	-	10.00%	-
Acenaphthene	20.10%	-	6.30%	3.70%	-	-	10.00%	0.40%	2.10%	1.50%	-	-
Acenaphthylene	10.70%	-	8.50%	5.00%	-	-	31.80%	18.10%	5.70%	5.50%	-	-
Anthracene	14.20%	-	14.10%	5.00%	43.40%	-	39.10%	23.40%	5.60%	4.10%	-	-
Benz(a)anthracene	15.30%	-	18.70%	11.40%	-	-	-	-	-	-	-	-
Benz(a)anthracenes/Chrysenes, C1-	5.70%	-	6.70%	2.30%	2.90%	-	17.30%	6.80%	1.30%	1.30%	-	-

	San Leandro Creek		East Sunnyvale Channel		Lower Marsh Creek		Guadalupe River		Richmond Pump Station		Pulgas Creek	
Analyte	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD
Benz(a)anthracenes/Chrysenes, C2-	4.30%	-	7.80%	7.70%	6.00%	-	19.00%	16.40%	2.80%	1.70%	-	-
Benz(a)anthracenes/Chrysenes, C3-	23.60%	-	15.80%	13.50%	11.10%	-	40.20%	8.90%	2.50%	3.40%	-	-
Benz(a)anthracenes/Chrysenes, C4-	5.90%	-	23.90%	26.40%	10.60%	-	16.70%	7.00%	4.00%	0.40%	-	-
Benzo(a)pyrene	16.70%	-	11.80%	5.10%	20.80%	-	23.60%	6.50%	3.60%	4.80%	-	-
Benzo(b)fluoranthene	9.30%	-	9.70%	6.70%	26.60%	-	17.50%	5.20%	4.60%	4.70%	-	-
Benzo(e)pyrene	13.50%	-	7.50%	7.20%	9.90%	-	28.40%	5.90%	2.00%	1.00%	-	-
Benzo(g,h,i)perylene	16.60%	-	5.50%	0.60%	4.60%	-	14.20%	5.30%	3.50%	3.20%	-	-
Benzo(k)fluoranthene	36.40%	-	20.60%	1.80%	-	-	33.00%	2.80%	-	-	-	-
Chrysene	8.40%	-	8.90%	3.50%	9.50%	-	19.00%	7.50%	4.00%	5.00%	-	-
Dibenz(a,h)anthracene	39.90%	-	25.20%	10.90%	-	-	-	-	2.00%	1.20%	-	-
Dibenzothiophene	-	-	7.20%	5.20%	-	-	15.90%	13.00%	-	-	-	-
Dibenzothiophenes, C1-	8.90%	-	5.90%	3.90%	5.10%	-	24.60%	2.90%	7.00%	2.60%	-	-

	San Leandro Creek		East Sunnyvale Channel		Lower Marsh Creek		Guadalupe River		Richmond Pump Station		Pulgas Creek	
Analyte	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD
Dibenzothiophenes, C2-	4.50%	-	7.20%	5.70%	10.20%	-	12.20%	2.90%	4.40%	4.90%	-	-
Dibenzothiophenes, C3-	4.80%	-	8.90%	2.30%	8.00%	-	14.70%	0.80%	3.70%	3.80%	-	-
Dimethylnaphthalene, 2,6-	22.20%	-	5.10%	3.70%	0.40%	-	12.20%	13.80%	4.20%	3.90%	-	-
Fluoranthene	16.00%	-	10.60%	3.30%	33.20%	-	17.20%	16.00%	5.50%	3.50%	-	-
Fluoranthene/Pyrenes, C1-	16.30%	-	9.90%	2.80%	8.70%	-	17.40%	2.90%	2.00%	2.30%	-	-
Fluorene	15.30%	-	15.00%	4.00%	-	-	15.80%	9.10%	2.70%	2.90%	-	-
Fluorenes, C2-	14.00%	-	7.30%	8.90%	0.80%	-	9.40%	1.20%	3.30%	4.30%	-	-
Fluorenes, C3-	7.00%	-	11.30%	2.80%	9.00%	-	12.30%	0.10%	2.00%	2.50%	-	-
Indeno(1,2,3-c,d)pyrene	21.90%	-	8.80%	2.30%	14.90%	-	18.10%	5.30%	6.70%	6.70%	-	-
Methylnaphthalene, 2-	9.30%	-	4.10%	2.60%	2.10%	-	10.60%	6.30%	2.40%	1.90%	-	-
Methylphenanthrene, 1-	16.70%	-	14.40%	9.50%	11.60%	-	14.60%	10.70%	0.80%	0.80%	-	-
Naphthalene	10.30%	-	5.20%	1.90%	3.20%	-	2.10%	3.80%	2.40%	0.50%	-	-
Naphthalenes, C1-	14.50%	-	6.40%	3.70%	0.50%	-	7.50%	5.70%	2.30%	1.70%	-	-
Naphthalenes, C3-	17.20%	-	7.80%	7.90%	0.60%	-	8.90%	11.20%	5.30%	5.80%	-	-

	San Leandro Creek		East Sunnyvale Channel		Lower Marsh Creek		Guadalupe River		Richmond Pump Station		Pulgas Creek	
Analyte	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD
Perylene	17.60%	-	13.70%	5.80%	5.00%	-	25.60%	8.60%	3.50%	4.30%	-	-
Phenanthrene	5.80%	-	20.20%	5.30%	29.00%	-	21.30%	26.50%	2.50%	2.10%	-	-
Phenanthrene/Anthracene, C1-	28.70%	-	10.30%	3.00%	13.70%	-	13.00%	0.20%	2.60%	2.00%	-	-
Phenanthrene/Anthracene, C2-	15.60%	-	9.10%	7.30%	7.10%	-	12.90%	8.10%	2.80%	2.80%	-	-
Pyrene	16.70%	-	9.00%	3.00%	19.50%	-	19.20%	14.40%	4.60%	3.90%	-	-
Trimethylnaphthalene, 2,3,5-	22.10%	-	7.80%	3.40%	2.30%	-	17.60%	9.00%	3.30%	4.50%	-	-
PBDE 007	-	-	-	-	-	-	-	11.20%	15.40%	15.60%	2.00%	2.00%
PBDE 008	-	-	-	-	-	-	-	-	-	-	-	-
PBDE 010	-	-	-	-	-	-	-	-	-	-	-	-
PBDE 012	-	-	-	-	-	-	-	-	-	-	-	-
PBDE 015	11.20%	9.50%	0.70%	-	-	-	3.20%	4.30%	12.30%	15.40%	7.50%	7.50%
PBDE 017	-	-	-	-	-	-	-	-	-	-	-	-
PBDE 028	-	-	-	-	-	-	-	-	-	-	-	-
PBDE 030	-	-	-	-	-	-	-	-	-	-	-	-

	San Leandro Creek		East Sunnyvale Channel		Lower Marsh Creek		Guadalupe River		Richmond Pump Station		Pulgas Creek	
Analyte	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD
PBDE 032	-	-	-	-	-	-	-	-	-	-	-	-
PBDE 035	-	-	-	-	-	-	-	-	-	-	-	-
PBDE 047	8.30%	1.20%	4.40%	-	-	-	13.80%	18.20%	6.40%	0.70%	4.60%	4.60%
PBDE 049	4.10%	0.70%	1.50%	-	-	-	10.20%	8.60%	5.40%	3.20%	12.40%	12.40%
PBDE 051	5.70%	5.70%	0.70%	-	-	-	-	-	10.50%	6.70%	15.30%	15.30%
PBDE 066	2.00%	0.50%	1.10%	-	-	-	13.80%	14.10%	6.30%	2.80%	8.40%	8.40%
PBDE 071	1.90%	1.90%	2.30%	-	-	-	-	-	18.20%	19.60%	32.70%	32.70%
PBDE 075	0.70%	0.70%	9.80%	-	-	-	-	-	0.80%	0.60%	22.00%	22.00%
PBDE 077	15.80%	15.80%	-	-	-	-	-	-	-	-	-	-
PBDE 079	16.40%	16.40%	-	-	-	-	-	-	21.80%	15.60%	-	-
PBDE 085	12.50%	5.20%	5.00%	-	-	-	4.60%	5.70%	12.40%	3.70%	2.90%	2.90%
PBDE 099	8.90%	3.90%	3.30%	-	-	-	8.10%	9.90%	9.30%	2.40%	4.80%	4.80%
PBDE 100	5.20%	0.30%	3.80%	-	-	-	9.20%	11.70%	8.90%	1.10%	6.00%	6.00%
PBDE 105	-	-	-	-	-	-	-	-	-	-	-	-

	San Leandro Creek		East Sunnyvale Channel		Lower Marsh Creek		Guadalupe River		Richmond Pump Station		Pulgas Creek	
Analyte	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD
PBDE 116	-	-	-	-	-	-	-	-	-	-	-	-
PBDE 119	-	-	-	-	-	-	-	-	-	-	-	-
PBDE 126	-	-	-	-	-	-	-	-	-	-	-	-
PBDE 128	-	-	-	-	-	-	-	-	-	-	-	-
PBDE 140	-	-	30.00%	-	-	-	12.10%	12.50%	15.70%	2.70%	9.80%	9.80%
PBDE 153	11.20%	6.60%	9.90%	-	-	-	6.20%	7.10%	9.50%	3.80%	3.50%	3.50%
PBDE 155	9.20%	12.50%	-	-	-	-	6.40%	7.80%	17.60%	3.70%	6.00%	6.00%
PBDE 181	-	-	-	-	-	-	-	-	-	-	-	-
PBDE 183	16.40%	1.50%	18.50%	-	-	-	27.40%	32.60%	15.40%	6.10%	11.00%	11.00%
PBDE 190	-	-	-	-	-	-	-	-	-	-	1.70%	1.70%
PBDE 197	34.70%	12.30%	15.80%	-	-	-	-	-	-	-	-	-
PBDE 203	25.10%	17.60%	14.80%	-	-	-	-	3.30%	22.40%	12.70%	4.60%	4.60%
PBDE 205	-	-	-	-	-	-	-	-	-	-	-	-
PBDE 206	18.40%	23.90%	10.60%	-	-	-	6.10%	7.60%	21.90%	10.50%	37.30%	37.30%

	San Leandro Creek		East Sunnyvale Channel		Lower Marsh Creek		Guadalupe River		Richmond Pump Station		Pulgas Creek	
Analyte	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD
PBDE 207	24.20%	25.50%	8.30%	-	-	-	2.00%	2.10%	24.70%	14.30%	28.20%	28.20%
PBDE 208	23.50%	23.70%	11.30%	-	-	-	3.50%	4.10%	24.60%	14.50%	30.50%	30.50%
PBDE 209	21.60%	19.40%	1.60%	-	-	-	2.10%	2.20%	19.90%	5.10%	42.30%	42.30%
PCB 008	14.40%	10.40%	13.70%	13.60%	20.00%	-	5.00%	0.30%	23.50%	9.70%	6.90%	11.90%
PCB 018	-	-	-	-	-	-	-	-	26.60%	5.20%	4.70%	-
PCB 028	-	-	-	-	-	-	-	-	20.30%	3.60%	5.10%	-
PCB 031	10.80%	9.10%	8.80%	7.50%	8.50%	-	4.70%	0.70%	17.10%	2.60%	4.90%	0.80%
PCB 033	-	-	-	-	-	-	-	-	24.40%	7.00%	6.50%	-
PCB 044	-	-	-	-	-	-	-	-	13.10%	8.60%	-	-
PCB 049	-	-	-	-	-	-	-	-	15.50%	12.80%	-	-
PCB 052	8.90%	13.80%	12.30%	10.40%	9.90%	-	7.00%	14.40%	18.60%	15.60%	11.40%	6.60%
PCB 056	6.20%	5.10%	13.90%	7.30%	2.20%	-	5.50%	12.00%	13.40%	1.70%	16.20%	3.80%
PCB 060	5.60%	4.30%	14.50%	7.80%	2.00%	-	6.10%	13.60%	11.30%	1.70%	14.60%	3.20%
PCB 066	7.00%	8.00%	11.40%	8.90%	1.50%	-	8.20%	15.00%	11.20%	2.80%	16.00%	1.60%

Analyte	San Leandro Creek		East Sunnyvale Channel		Lower Marsh Creek		Guadalupe River		Richmond Pump Station		Pulgas Creek	
	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD
PCB 070	-	-	-	-	-	-	-	-	6.00%	9.90%	-	-
PCB 087	-	-	-	-	-	-	-	-	18.40%	22.40%	9.30%	-
PCB 095	-	-	-	-	-	-	-	-	21.10%	29.80%	16.10%	-
PCB 099	-	-	-	-	-	-	-	-	20.60%	24.70%	22.30%	-
PCB 101	-	-	-	-	-	-	-	-	17.10%	23.90%	20.10%	-
PCB 105	7.40%	7.90%	19.30%	11.00%	13.40%	-	7.70%	19.20%	14.90%	11.40%	17.30%	22.50%
PCB 110	-	-	-	-	-	-	-	-	16.60%	20.90%	11.00%	-
PCB 118	7.70%	8.60%	21.00%	8.70%	15.00%	-	8.10%	20.80%	15.20%	13.60%	16.30%	27.90%
PCB 128	19.80%	19.80%	-	-	-	-	-	-	7.20%	15.00%	3.30%	-
PCB 132	9.70%	9.20%	20.00%	4.70%	18.50%	-	11.80%	25.80%	13.20%	18.40%	5.30%	11.40%
PCB 138	-	-	-	-	-	-	-	-	6.60%	10.80%	1.40%	-
PCB 141	9.40%	10.30%	19.40%	3.50%	14.80%	-	14.00%	22.90%	15.50%	15.60%	7.70%	15.90%
PCB 149	-	-	-	-	-	-	-	-	4.80%	10.40%	3.90%	-
PCB 151	-	-	-	-	-	-	-	-	3.00%	5.90%	3.50%	-

	San Leandro Creek		East Sunnyvale Channel		Lower Marsh Creek		Guadalupe River		Richmond Pump Station		Pulgas Creek	
Analyte	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD
PCB 153	-	-	-	-	-	-	-	-	6.40%	7.60%	2.70%	-
PCB 156	-	-	-	-	-	-	-	-	8.00%	18.60%	-	-
PCB 158	8.90%	11.00%	18.50%	3.80%	16.70%	-	11.10%	24.80%	15.60%	16.00%	9.40%	16.70%
PCB 170	7.30%	4.70%	15.90%	1.40%	11.30%	-	13.20%	24.70%	20.80%	7.90%	5.30%	7.70%
PCB 174	5.60%	1.70%	14.20%	2.20%	11.50%	-	21.80%	36.30%	13.80%	1.50%	6.30%	7.20%
PCB 177	6.00%	3.70%	13.30%	3.40%	18.90%	-	20.10%	-	16.60%	4.30%	4.90%	6.00%
PCB 180	-	-	-	-	-	-	23.70%	29.50%	15.00%	4.40%	-	-
PCB 183	-	-	-	-	-	-	33.10%	31.60%	13.40%	5.50%	-	-
PCB 187	5.20%	3.80%	11.00%	3.90%	6.40%	-	23.80%	34.90%	15.00%	5.00%	8.60%	10.50%
PCB 194	7.40%	3.30%	19.00%	5.60%	14.40%	-	16.10%	38.70%	22.70%	12.20%	5.90%	8.20%
PCB 195	5.50%	2.00%	18.10%	3.40%	29.70%	-	15.30%	26.90%	24.80%	12.70%	4.30%	3.80%
PCB 201	8.80%	2.40%	13.20%	1.10%	10.10%	-	23.30%	-	13.20%	6.80%	8.00%	8.20%
PCB 203	7.70%	6.70%	15.50%	5.40%	14.30%	-	18.20%	44.10%	17.80%	17.10%	9.60%	12.90%
Allethrin	-	-	-	-	-	-	-	-	-	-	-	-

	San Leandro Creek		East Sunnyvale Channel		Lower Marsh Creek		Guadalupe River		Richmond Pump Station		Pulgas Creek	
Analyte	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD
Bifenthrin	18.70%	-	11.10%	-	8.50%	-	4.80%	-	9.70%	-	0.00%	-
Cyfluthrin, total	14.60%	-	17.90%	-	-	-	-	-	4.30%	-	6.60%	-
Cyhalothrin,lambda, total	-	-	-	-	-	-	-	-	-	-	0.00%	-
Cypermethrin, total	-	-	30.40%	-	27.60%	-	-	-	1.60%	-	1.30%	-
Delta/Tralomethrin	-	-	39.50%	-	32.40%	-	23.00%	-	58.00%	-	12.90%	-
Esfenvalerate/Fenvalerate, total	-	-	10.10%	-	-	-	-	-	24.40%	-	-	-
Fenpropathrin	-	-	-	-	-	-	-	-	-	-	-	-
Permethrin, total	12.90%	-	10.90%	-	10.60%	-	2.10%	-	5.20%	-	4.00%	-
Phenothrin	-	-	-	-	-	-	-	-	-	-	-	-
Prallethrin	-	-	-	-	-	-	-	-	-	-	-	-
Resmethrin	-	-	-	-	-	-	-	-	-	-	-	-
Total Cu	0.90%	1.10%	0.10%	0.20%	0.40%	0.80%	-	-	0.00%	-	3.40%	-
Dissolved Cu	6.30%	-	1.60%	-	-	-	-	-	3.80%	-	-	-

Analyte	San Leandro Creek		East Sunnyvale Channel		Lower Marsh Creek		Guadalupe River		Richmond Pump Station		Pulgas Creek	
	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD
Total Hg	18.70%	2.10%	11.80%	-	4.50%	-	12.30%	-	9.70%	-	16.90%	-
Total MeHg	10.00%	4.10%	11.90%	-	2.70%	-	10.60%	2.60%	10.70%	-	1.40%	-
Dissolved Se	3.10%	6.20%	1.60%	-	-	-	-	-	5.20%	-	-	-
Total Se	11.60%	10.10%	0.00%	-	4.10%	1.50%	1.40%	1.40%	0.00%	-	6.40%	-
Total Hardness (calc)	1.20%	-	8.30%	-	-	-	-	-	0.00%	-	6.30%	-
TOC	1.50%	-	3.00%	-	3.80%	-	6.10%	-	6.40%	-	1.50%	-

Attachment 2. Intercomparison Studies

Due to the change in analytical labs for 2013 and 2014 from those used previously in loading studies, a limited number of split samples were analyzed for intercomparison with results from laboratories contracted in previous years.

In general, the intra-lab variation from replicate analyses performed on these samples for both the current and previous contract labs, was much smaller than the inter-lab variation. This is to be expected; analytical biases (e.g., from mis-calibration, incomplete extraction, matrix interferences, etc.) will tend to recur and be more consistent within a lab than among labs. Even if both labs perform within typical acceptance limits for CRMs or other performance tests, the net difference between labs can sometimes be exacerbated by biases in opposite directions, or interferences present in specific field matrices but not reference materials, and in limited studies, it may be possible only to estimate a typical difference, not establish which lab's results are more accurate. Differences in results between years and between sites analyzed by different labs that are smaller than or similar to the inter-lab measurement differences may not be real or significant and may only reflect measurement differences between labs.

Even in larger intercomparison exercises with multiple labs, there is no assurance provided that the certified or consensus value is absolutely accurate, only a weight of evidence that more or most labs get a similar result. Such a consensus may in part reflect a common bias among labs encountering a similar interference or bias of choosing a particular extraction or analytical method.

The following section will discuss results on split samples analyzed for this project in 2013 and 2014 for various analytes. In most cases the differences among labs were within common precision acceptance limits (e.g., 25% RPD for intra-lab replicates for trace metals in RMP or SWAMP) or within the expected combined (propagated) error for separate measurements of recovery (e.g. within 25% of target values for 2 independent labs for reference materials or matrix spikes for trace elements; propagated error = square root $((25\%)^{\wedge 2} + (25\%)^{\wedge 2})$ = ~35%). In cases where the results between labs show a consistent bias, it may be possible to adjust for the bias in evaluating interannual or inter-site differences, but in cases where the inter-lab differences appear more randomly distributed, smaller interannual or inter-site differences may not be distinguishable from measurement uncertainty.

In cases where more random or less systematic differences were found between the labs' results, it is often difficult to diagnose the cause without extensive investigation. Causes of the discrepancies may be particular to specific samples, or sporadic and hard to reproduce. However, because the data in this study are compiled to develop overall pictures of concentrations and loads from the various watersheds, the impact of measurement errors or variations in any individual samples is lessened; random errors will partially offset and the aggregate statistics will reasonably allow estimation of the central tendency of the data. For many of the analytes, the results were often in good agreement (near a 1:1 line) for all but 1 of the split sample pairs, so the data can, in many cases, be compared with acknowledgement of measurement uncertainty but without requiring adjustment, which is suitable only for cases of systematic bias. Results for specific analytes are discussed below.

Trace Elements

Copper

Copper was measured by Caltest (the "Target Lab") in 2013 and 2014, and by Brooks Rand (the "IC Lab") in previous years. Three samples each of dissolved and total copper were split and analyzed by both labs in the course of the study. For both labs, the within lab RPDs were within 5% or better for these split samples, suggesting that individually, neither of the labs had noticeable issues with subsampling the provided samples uniformly for replicate analysis. In general, the IC lab reported concentrations higher than the target lab for any given sample (Figure 9). For dissolved copper, the average difference in slope (fitting a linear regression through the origin, vs. an "ideal" 1:1 line) was 28%, and for total copper, the average difference in slope was 15%. For individual result pairs, the target lab result was always lower, ranging 65% to 89% (average 74%) of the IC lab result for dissolved samples and 83% to 95% (average 87%) for total samples; average RPD was 31% for dissolved copper, and 14% for total copper. These data hint at a systematic bias, but because of the small number of samples in the comparison and differences between labs within or nearly within common acceptance limits for within lab variation (e.g., 25% RPD for metals) more evidence of a systematic bias would be recommended before attempting to develop an adjustment factor between labs.

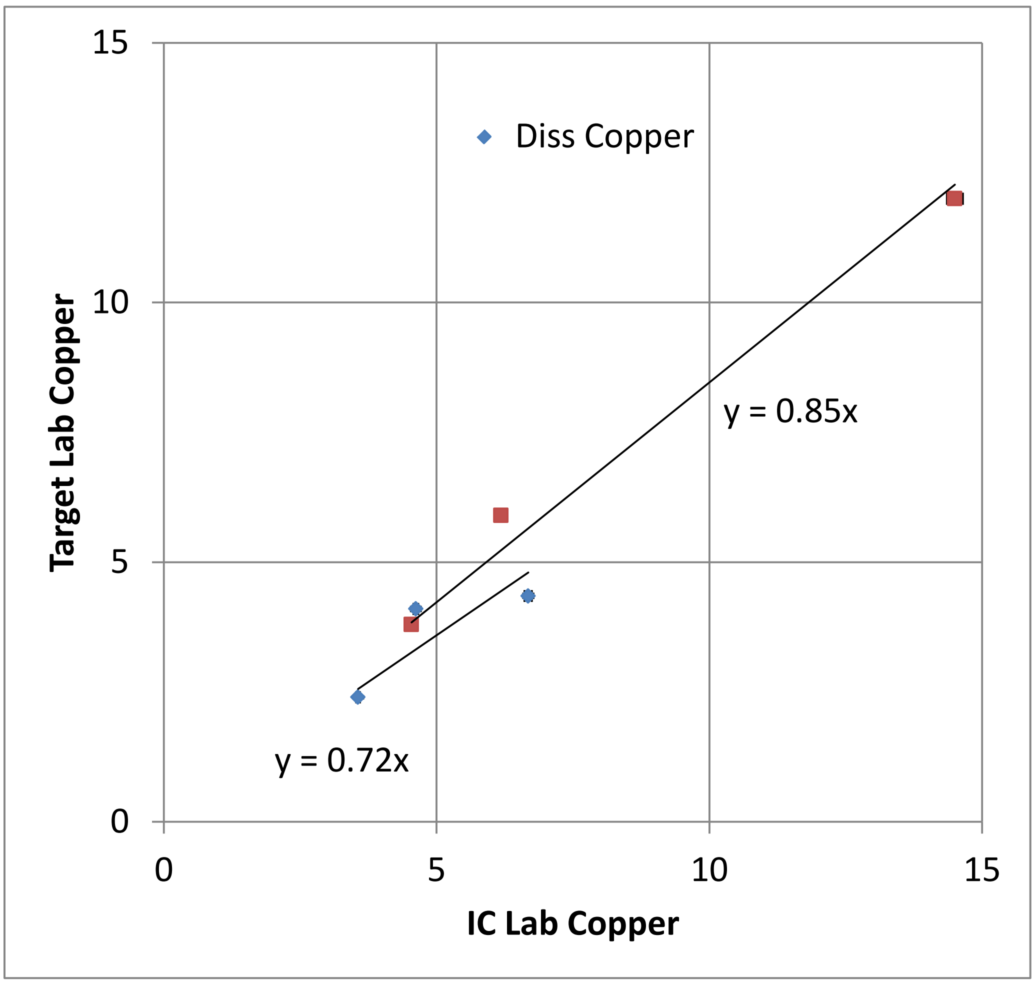

Figure 9 Target versus IC lab dissolved and total copper in split water samples for 2013 to 2014.

Total Mercury

Total mercury was measured by Caltest (the “Target Lab”) in 2013 and 2014, and by Moss Landing Marine Labs (the “IC Lab”) in previous years. Seven total (unfiltered) water samples were split and analyzed for total mercury by both labs in the course of the study. For both labs, none of these split samples were analyzed as lab replicates, but precision on lab replicate analyses averaged 16% RSD in 2014 for the target lab and 3% in 2014 for the IC lab. Similar to copper, the IC lab generally reported concentrations higher than the target lab for any given sample (Figure 10), although the bias is less consistent. For total mercury, the target lab result ranged 51% to 105% (average 82%) of the IC lab result; the average RPD was 25%. Much of this difference was driven by a single result pair in 2014, where the IC lab result was nearly double that of the target laboratory; without that pair, the slope would have been near 1:1 (1.03), so correction is not warranted given the overall deviation depending largely on that one sample pair.

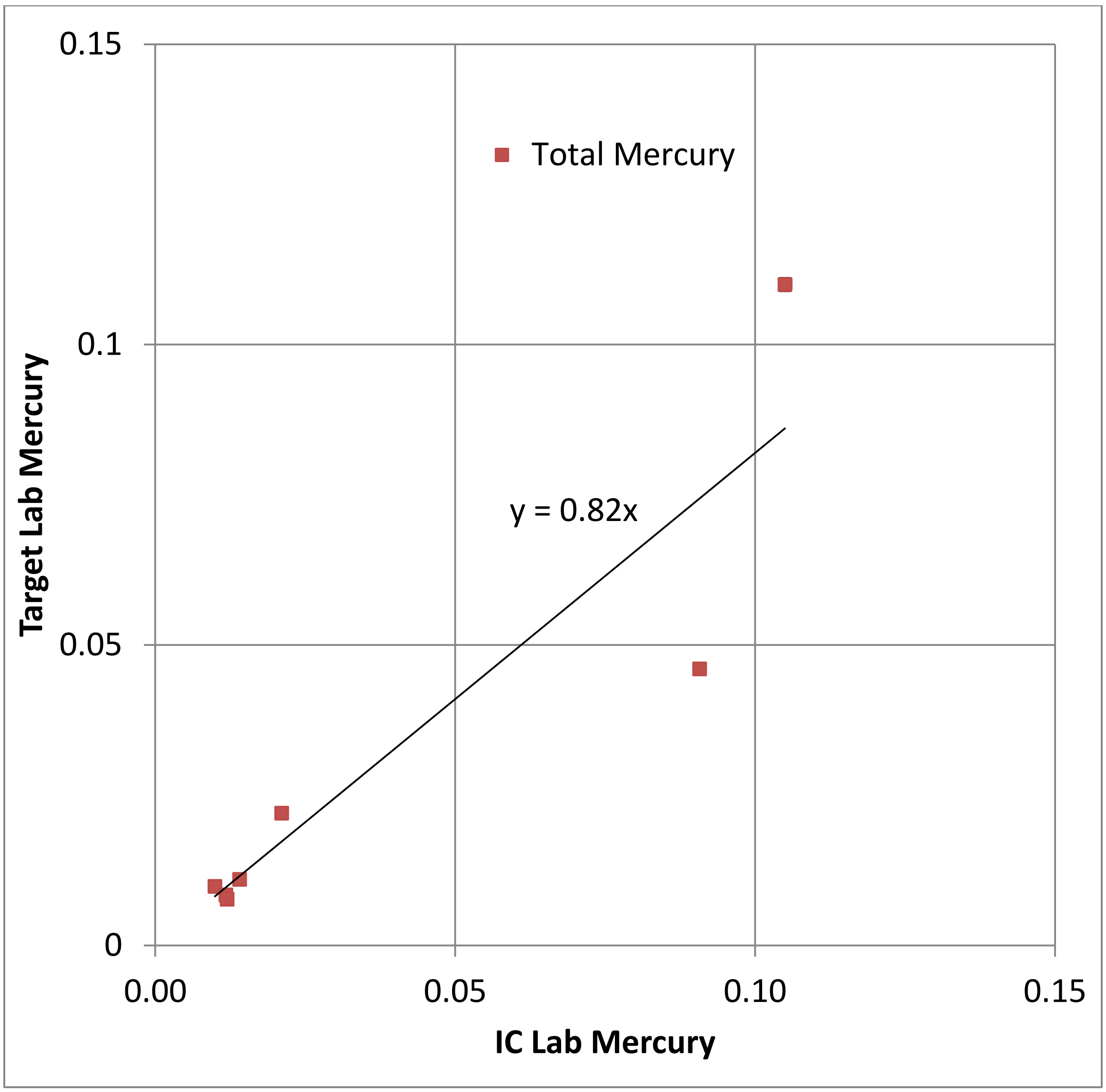

Figure 10 Target versus IC lab total mercury in split water samples for 2013 to 2014.

Methylmercury

Methyl mercury was measured by Caltest (the "Target Lab") in 2013 and 2014, and by Moss Landing Marine Labs (the "IC Lab") in previous years. Four total (unfiltered) water samples were split and analyzed for methylmercury by both labs in the course of the study. Only the IC lab analyzed one of these split samples directly in lab replicates, with <1% RSD, but the target lab also had acceptable precision with average 16% RSD in 2014 for other samples in the project. Unlike the other metals, the results for the IC lab averaged slightly lower than the target lab (Figure 11). For methylmercury, the target lab ranged 90% to 132% (average 105%) of the IC lab result. The average RPD was 12%, with some points both above and below the 1:1 line. Similar to copper, the differences are neither large enough nor consistent enough to warrant a correction factor.

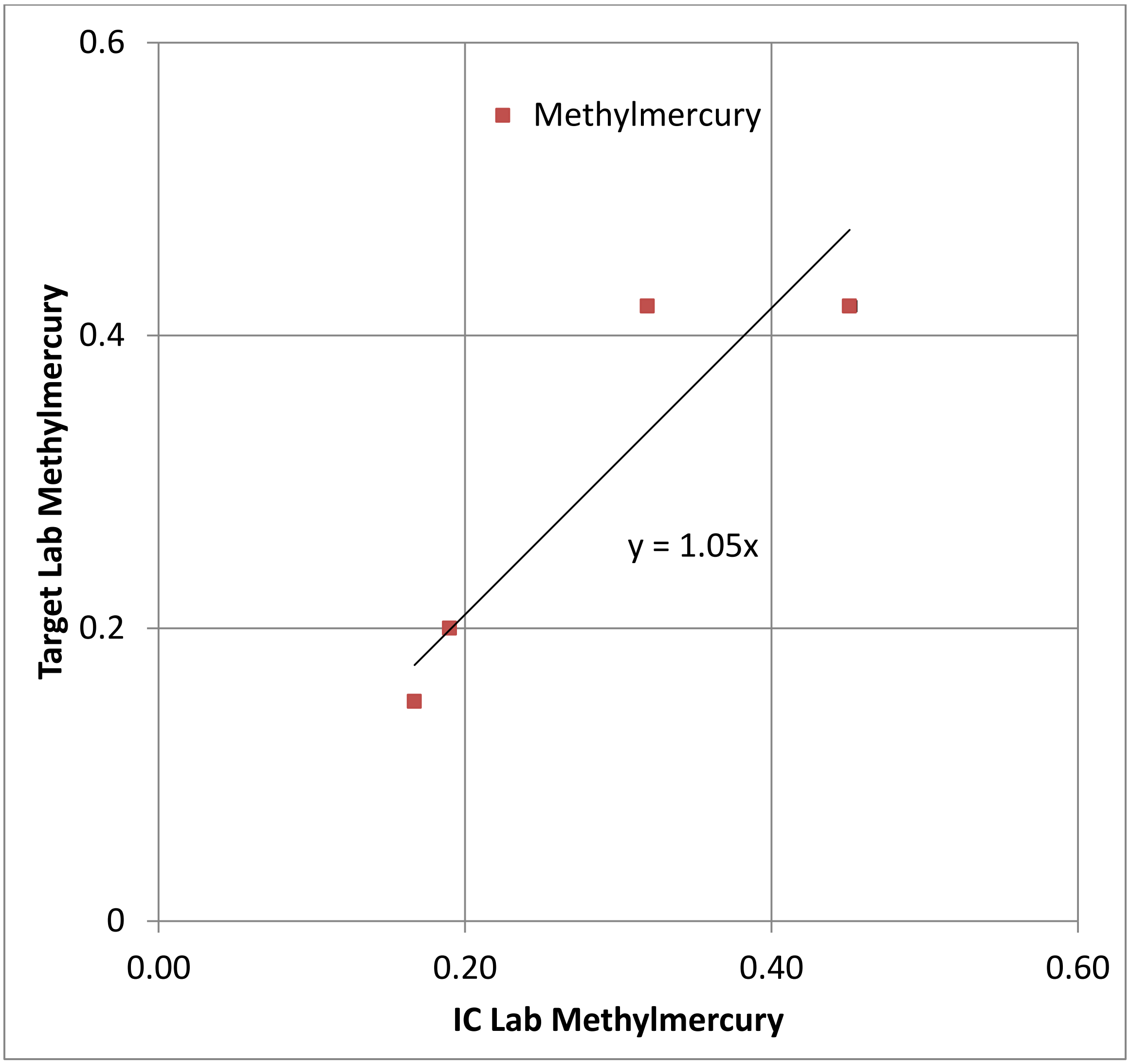

Figure 11 Target versus IC lab methylmercury in split water samples for 2013 to 2014.

Selenium

Selenium was measured by Caltest (the "Target Lab") in 2013 and 2014, and by Brooks Rand (the "IC Lab") in previous years. Two samples each of dissolved and total selenium were split and analyzed by both labs in the course of the study. For both labs, the within lab replicate RPDs were good, within 10% or better for these split samples. In general, the IC lab reported concentrations very slightly higher than the target lab for any given sample (Figure 12), but results were nearly identical among labs, and very similar between dissolved and total phase for any given sampling event. For dissolved selenium, the target lab results were 89% to 97% (average 92%) of the IC lab, and for total selenium 88% to 98% (average 95%). Averages of individual result pair RPDs were 9% for dissolved selenium, and 5% for total selenium. Corrections for selenium are clearly not warranted given the very good agreement.

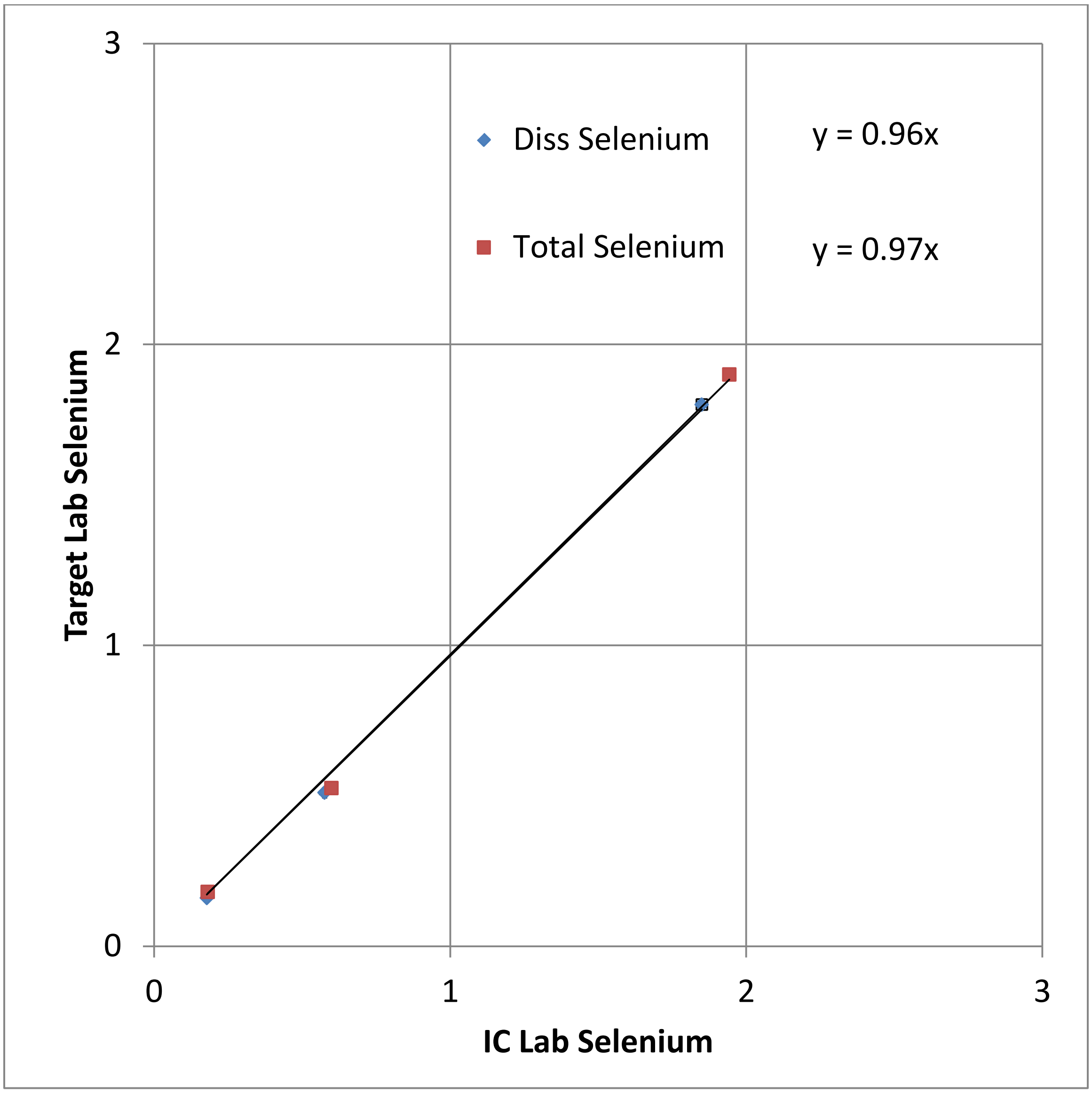

Figure 12 Target versus IC lab dissolved and total selenium in split water samples for 2013 to 2014.

Hardness

Hardness was measured by Caltest (the "Target Lab") in 2013 and 2014, and by Brooks Rand (the "IC Lab") in previous years by a calculation from Ca and Mg concentrations. Three samples were split for analysis by both labs in the course of the study. For the target lab, the within lab replicate RPDs or RSDs were 6% to 12% for these split samples, and for the IC lab 3% on the one sample they analyzed in replicate. There was no consistent bias, with the target lab reporting 85% to 116% (average 100%) of the IC lab result. Although recovery errors in lab control samples (a clean lab matrix) by the target lab were generally within 10% or better of the target value, for field sample matrix spikes, recoveries were highly variable, as low as 30% recovery (70% error), averaging over 20% error. The moderately large average recovery error and sporadic large excursions suggest uncertainties in the target lab hardness data, leading 2013 results to be censored (although raw results remain in the database, and are plotted in Figure 13 here). The IC lab did not report recovery on hardness directly, but recovery was good on Ca and Mg, with modest errors (from 8% to 12%). Given a lack of consistent bias, a correction factor is not warranted for hardness measurements.

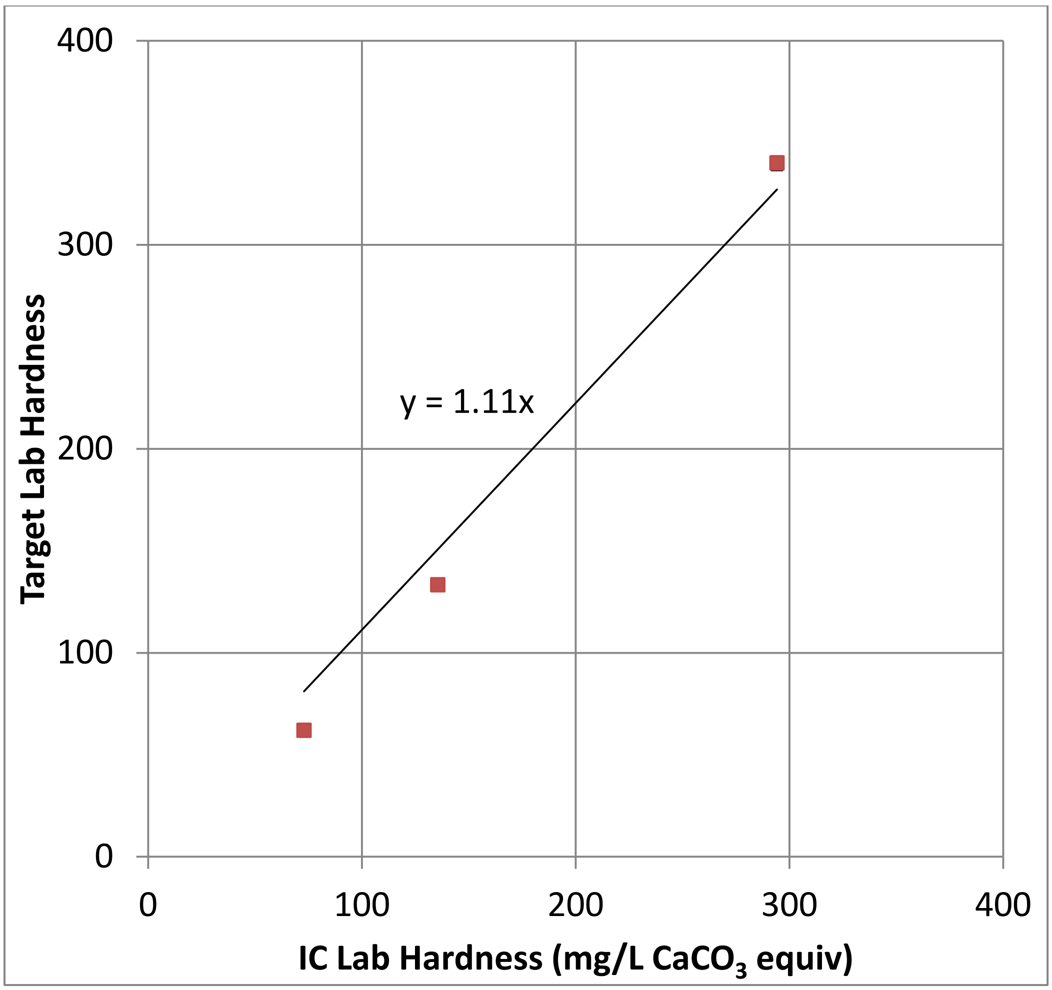

Figure 13 Target versus IC lab hardness in split water samples for 2013 to 2014.

Suspended Sediment Concentration

Suspended sediment concentration (SSC) was measured by Caltest (the "Target Lab") in 2013 and 2014, and by EBMUD (the "IC Lab") in previous years. Three samples were split for analysis by both labs in the course of the study. For the target lab, the lab replicate RSDs were 6% to 12% for these split samples, and for the IC lab 3% on the one sample they analyzed in replicate. There was no consistent bias between labs (Figure 14). The target lab reported results 41% to 150% (average 101%) those of the IC lab, with the largest relative differences on the lower concentration samples. Recoveries on LCS samples by the target lab were within 10% of the expected values. The IC lab reported recovery on performance testing reference materials, with recovery errors for different materials of 1% to 19%. Despite the large variations in the comparison of results between labs, the differences were not consistently biased and thus would not justify application of a correction factor.

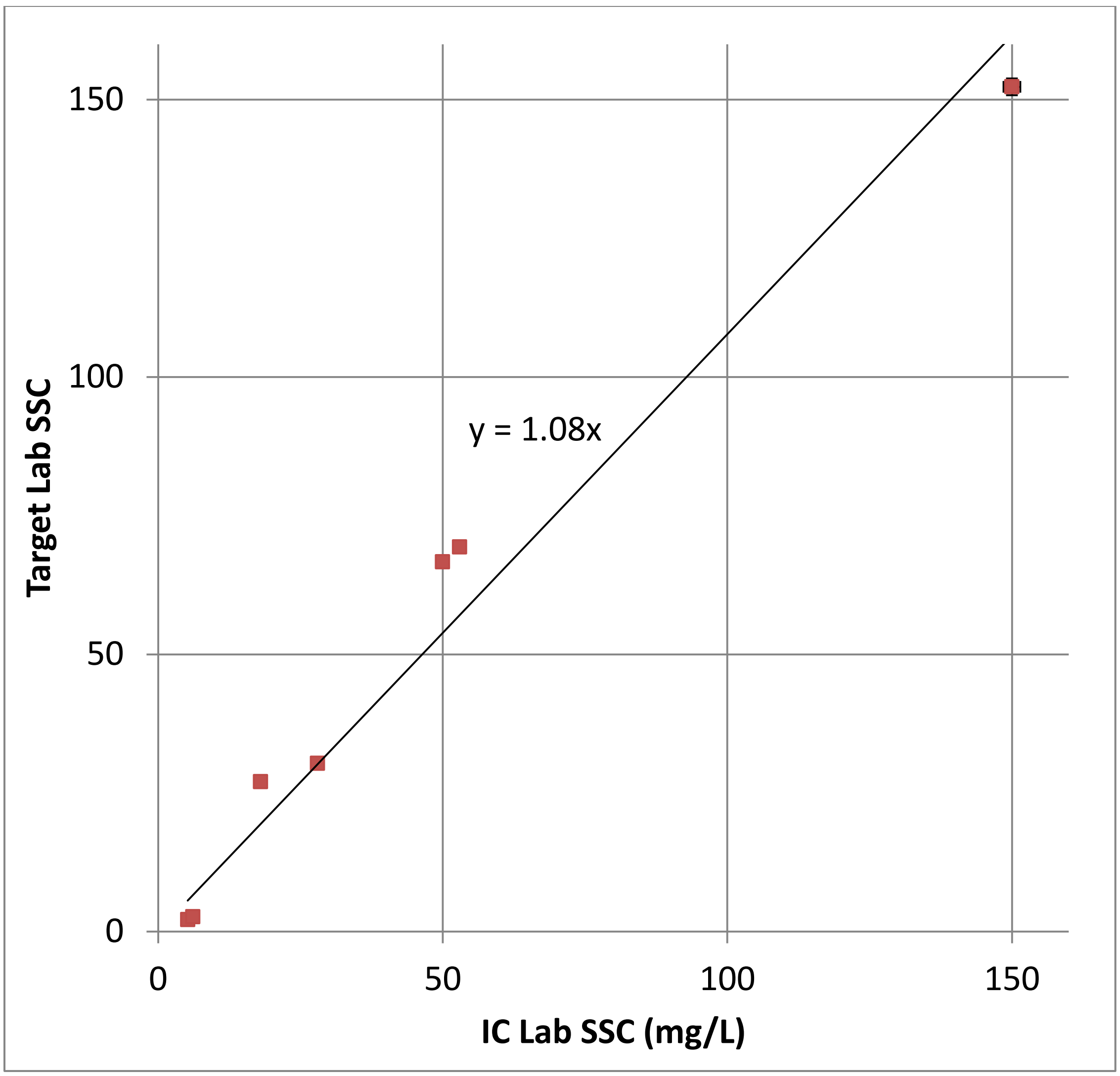

Figure 14 Target versus IC lab SSC in split water samples for 2013 to 2014.

Nutrients

Nutrients were measured by Caltest (the "Target Lab") in 2013 and 2014, and by EBMUD (the "IC Lab") in previous years. Seven samples were split for analysis of nitrate by both labs. For the IC lab, the lab replicate RSDs were 1% or better for these split samples. The target lab did not analyze any of these split samples in replicate, but RSDs for lab replicates on other field samples averaged 5%. The target lab generally reported lower concentrations except for the highest sample (Figure 14), ranging 76% to 108% (average 90%) of those from the IC lab, with the largest relative differences mostly on the lowest concentration samples (RPDs on paired splits of 2% to 28%, averaging 15%). Recoveries on LCS samples by the target lab averaged within 3% of the expected values, while the IC lab LCS sample recovery errors averaged 24%. The IC lab spiked at much lower levels however (around 0.05 mg/L vs ~4 for the target lab) which may in large part explain the seemingly poorer recoveries. Differences among the labs results were not systematic and do not warrant a correction factor for comparison.

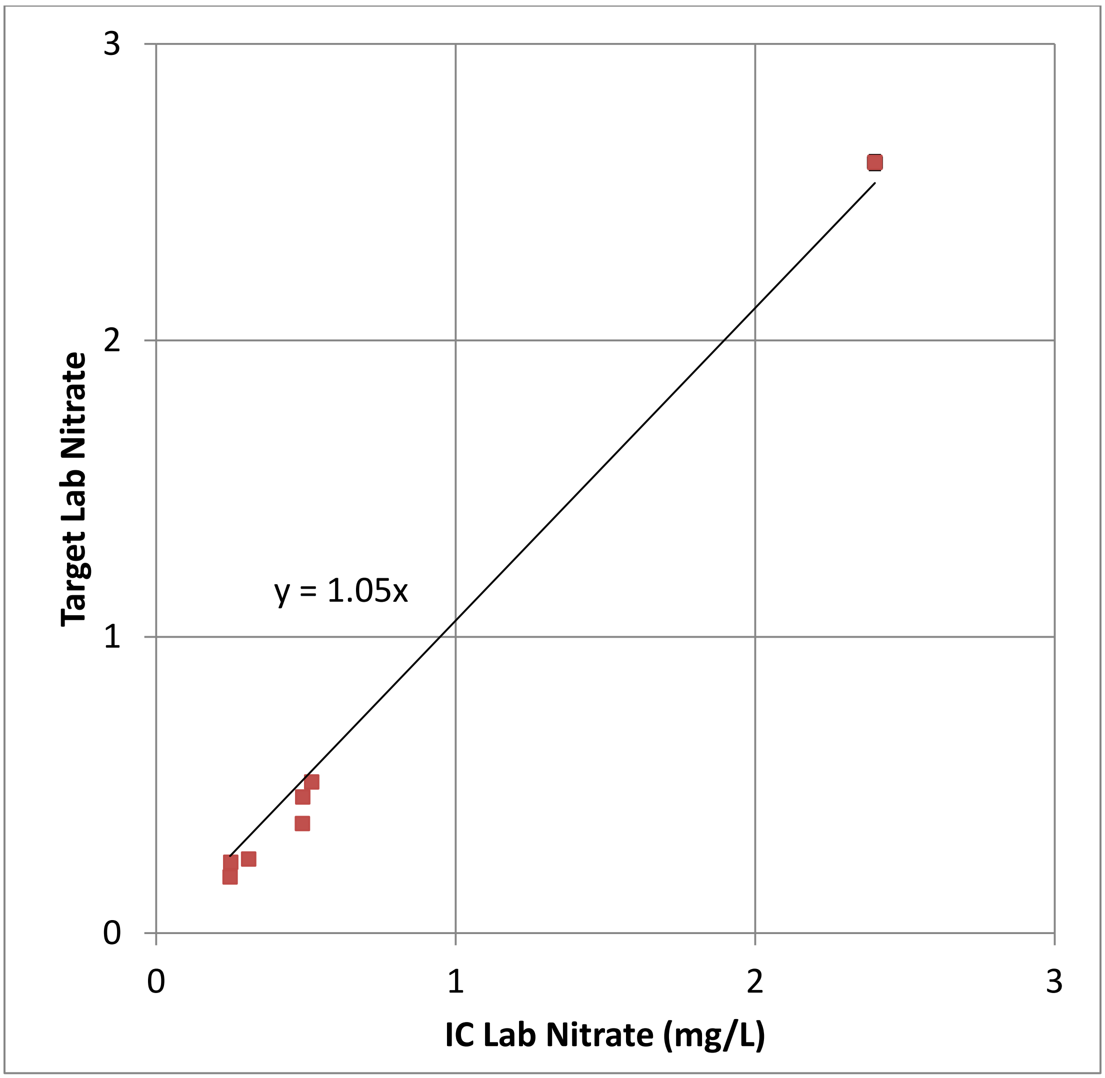

Figure 15 Target versus IC lab nitrate in split water samples for 2013 to 2014.

Orthophosphate was measured in seven split samples by both labs. For both labs, lab replicate RSDs were <1% for these split samples. The target lab reported a much lower concentration (69% of the IC lab result on one sample), but otherwise had similar results (Figure 16), around 92% to 101% of those from the IC lab (average 93% including all samples). Reported as RPDs on paired splits, the differences ranged from 0% to 37%, averaging 8%. Recoveries on IC lab LCS samples were biased high an average 14%, which may explain in part the differences among labs, but without the one sample with the target lab at 69% of the IC results, results would be near 1:1 between the labs.

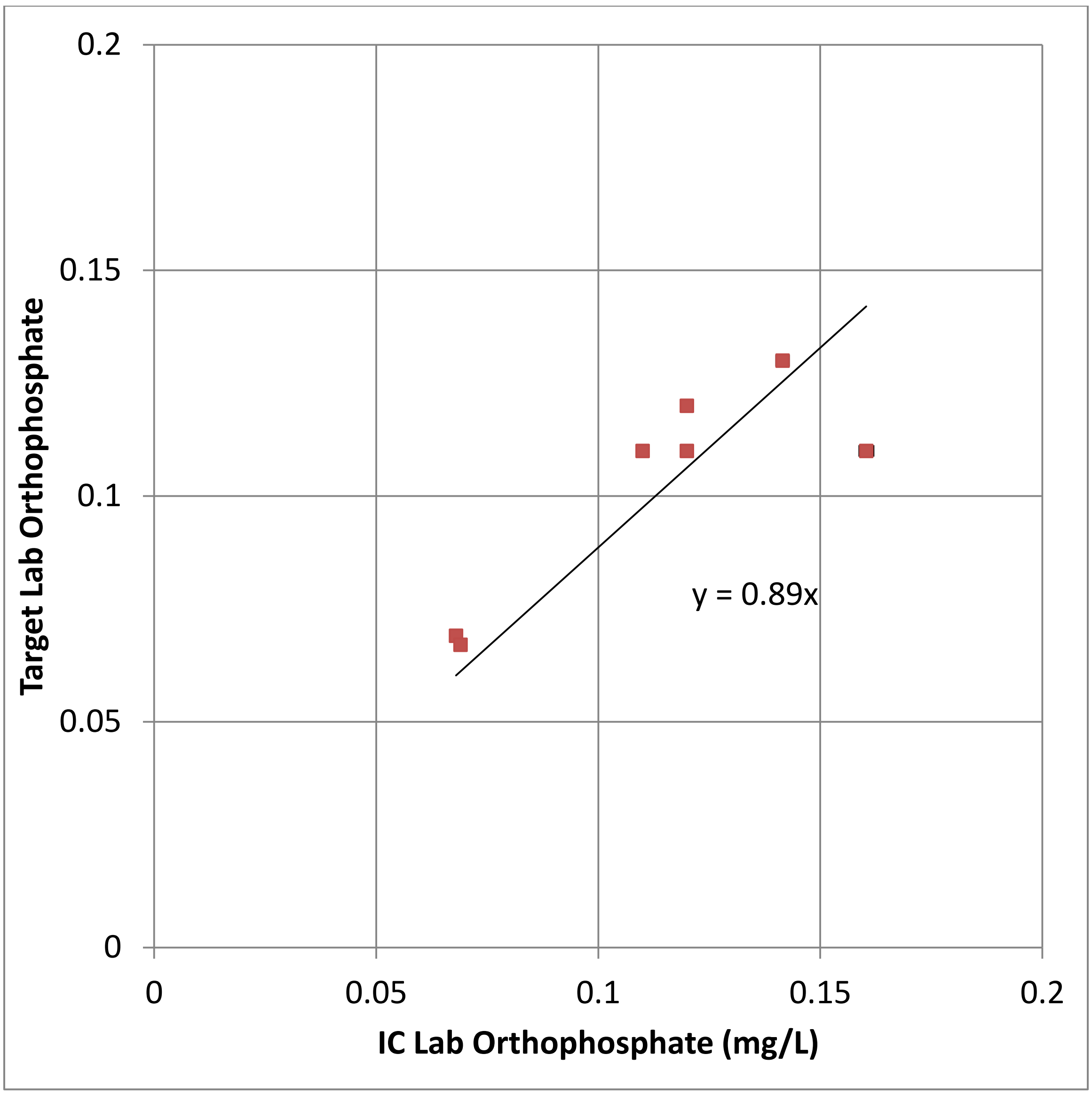

Figure 16 Target versus IC lab orthophosphate in split water samples for 2013 to 2014.

Phosphorus was reported for four split samples. For 3 of the 4 samples results generally agreed (target lab results 70% to 96% of the IC lab's), but for one, the concentration for the target lab was 4x lower (Figure 17). RPDs ranged from 140% for the latter sample pair, to 4% for the best paired results. Although the IC lab 2013 sample batch was flagged for low recovery (86%), below the target MQO of 10% error (90% recovery), that would not explain the discrepancy between the labs since the IC lab result was biased high relative to the target lab. The lab replicate precision was good for both the target and IC labs for these split samples (RSDs <5%), so measurement variation also seems unlikely to explain the difference, but the specific pair with the largest difference was not analyzed in replicate by either lab. Field sampling variation (more likely with total phase samples) might also contribute to differences in inter-lab splits, which are taken sequentially in the field rather than by truly splitting a larger sample. Again, aside from the poor agreement on one pair, the results show no clear bias among labs and do not require any adjustment.

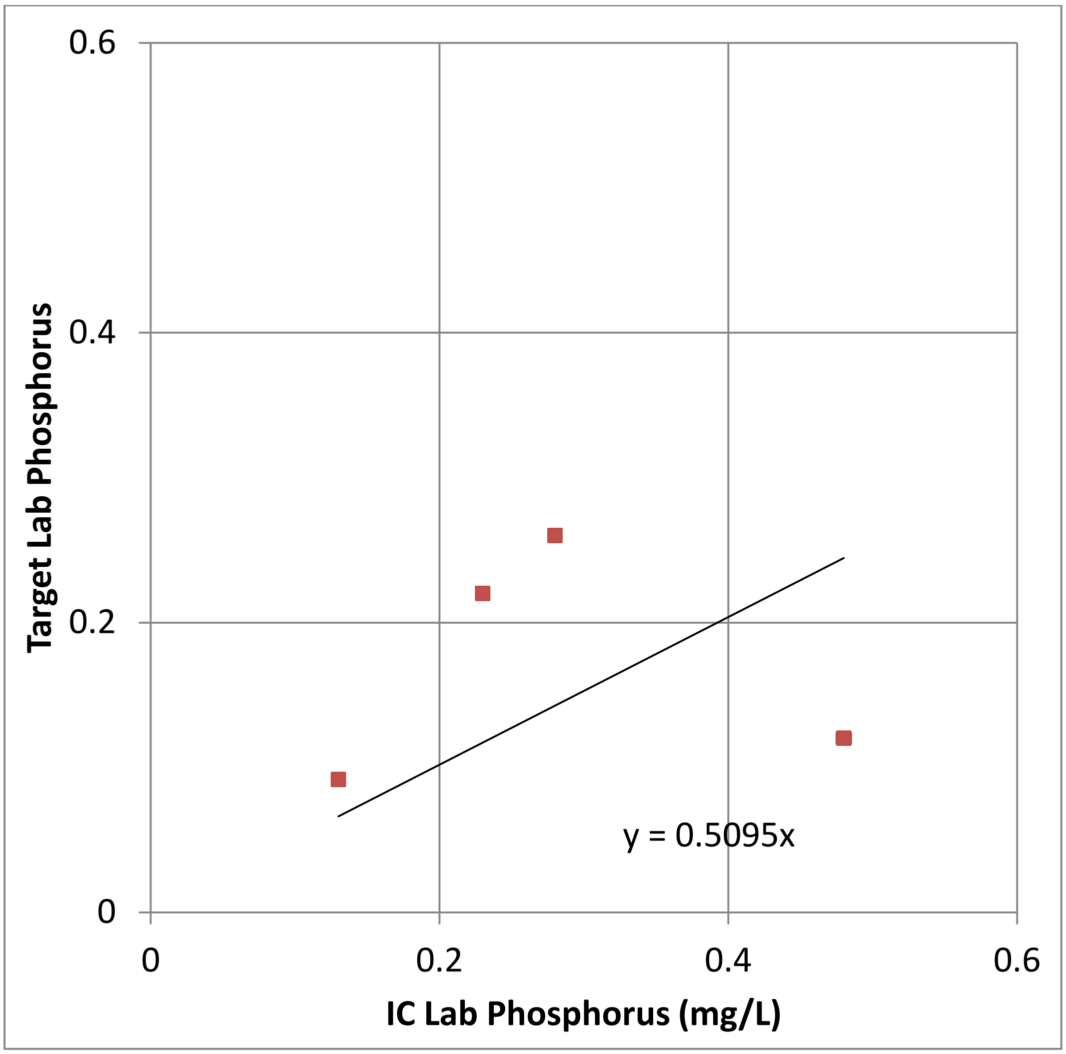

Figure 17 Target versus IC lab orthophosphate in split water samples for 2013 to 2014.

Pyrethroids

Pyrethroids were measured by Caltest (the "Target Lab") in 2013 and 2014, and by Axys Analytical (the "IC Lab") in previous years. Three water samples were split and analyzed for pyrethroids by both labs in the course of the study. For both labs, none of these split samples were analyzed as lab replicates. Some field replicates were analyzed by the target lab with RSDs 31% or better for analytes detected over 3x the MDL; the IC lab reports an ongoing precision and recovery (LCS) sample replicated across batches, with recovery errors 23% or less in 2014 samples. Only three analytes were detected in at least two of the split samples: bifenthrin, deltamethrin/tralomethrin, and total cypermethrin (Figure 18). The target lab reported higher concentrations slightly over half the time, but the ratio of target to IC lab concentrations was highly variable between samples for any given analyte; 54% to 120% for bifenthrin, 38% and 86% for deltamethrin/tralomethrin, and 105% and 149% for total permethrin. These differences are equivalent to an RPD range of 5% to 90%; as would be expected, the worst correspondence occurred in lower concentration samples where the relative impact of a nominal difference is larger. A larger number of samples would be needed to state with certainty, but within this small set of samples there does not appear to be any consistent bias, with the few results with concentrations above 10,000 pg/L (10 ng/L) being generally very similar between labs.

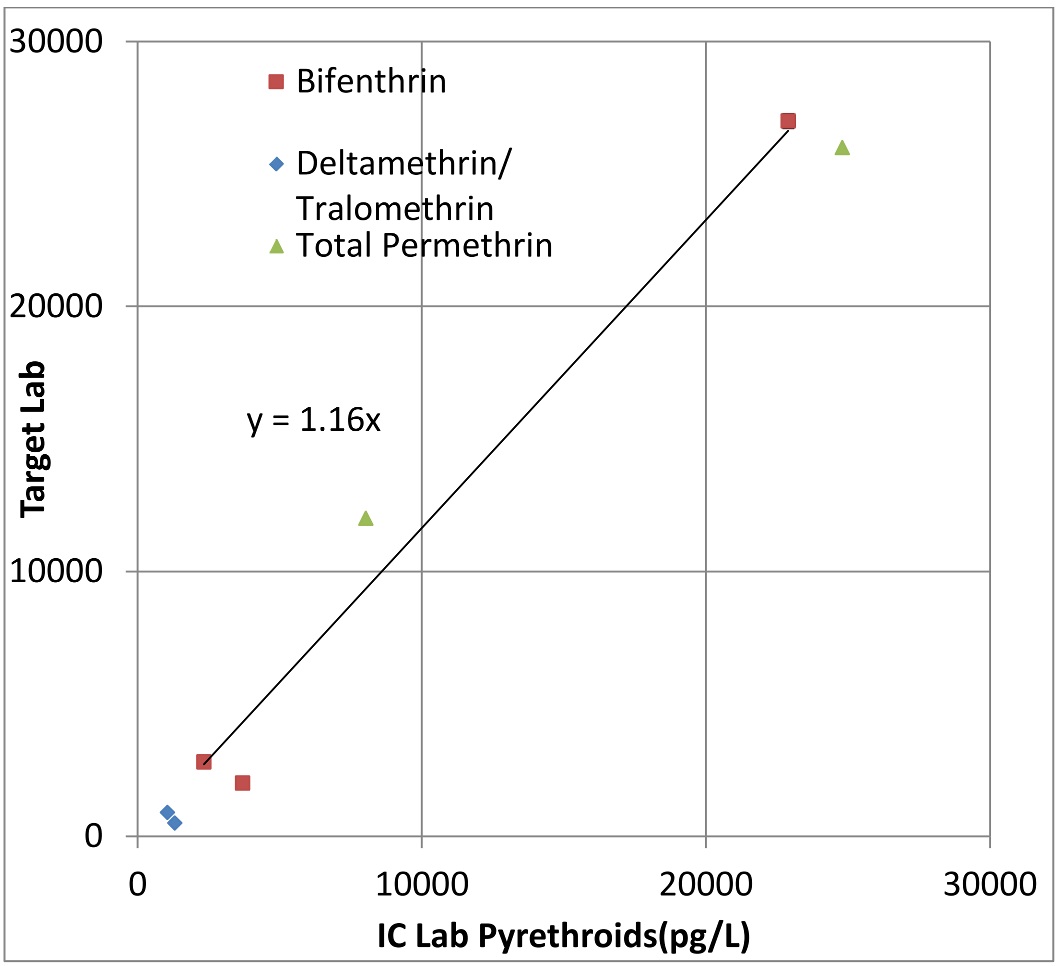

Figure 18 Target versus IC lab pyrethroids in split water samples for 2013 to 2014.

Overall the results of these intercomparison samples show general agreement between labs. For most analytes, there was not consistent bias between the labs; even where there seemed to be some bias, many of the results still showed nearly a 1:1 correspondence, so with the small number of split samples reported for most analytes, one or two random measurement errors could create the appearance of a net bias. If there are needs to more definitively quantify differences in sites or among events reported by different labs in different years, a greater number of split samples would be needed to assure a lack of bias from changing labs, but the current data suggest other than for sporadic excursions for individual samples, the data generally agree between labs, within the usual intra-lab acceptance ranges for precision and recovery for the various analytes. As noted before, most of the field sample data for this study will be considered in aggregated statistics, so even in cases where sporadic large differences appeared, the net impact will be small so long as these excursions are not the rule rather than the exception. Data subsampling techniques (e.g., including and excluding subsets of the best or worst data) can be used to further explore the need to reduce uncertainty of inter-lab differences for decision-making, before devoting time and resources to more rigorously quantify these differences.

Appendix 5

Proposed Alternative Approach to Pollutants of Concern
and Long Term Trends Monitoring, July 23, 2014

CONTRA COSTA
CLEAN WATER
PROGRAM

Thomas E. Dalziel
Program Manager

July 23, 2014

Mr. Bruce Wolfe, Executive Officer
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California Regional Water Quality Control Board
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Subject: Proposed Alternative Approach to Pollutants of Concern and Long Term Trends Monitoring

Dear Mr. Wolfe and Ms. Creedon:

The Contra Costa Clean Water Program (CCCWP) respectfully submits this letter to formally request approval of an alternative approach to Pollutants of Concern and Long Term Trends Monitoring. This monitoring program is required under Provision C.8.e of the National Pollutant Discharge Elimination System (NPDES) permits for urban stormwater discharges issued to CCCWP Permittees by the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB) and the Central Valley Regional Water Quality Control Board (CVRWQCB) in Order No. R2-2009-0074 and Order No. R5-2010-0102, respectively. Our proposal is to:

1) Sample no more than two more storms at the existing Marsh Creek POC loads station for mercury, methylmercury, and SSC only. The sampling would be timed to capture upper watershed flow (i.e., flow from the Marsh Creek Reservoir).
2) Conduct PCB source identification studies, following the approach proposed in the Integrated Monitoring Report, Part C.
3) Increase the number of LID effectiveness evaluation samples collected and analyzed as part of the approved methylmercury control study plan.

Resources saved under item #1 above, would be used to identify source areas of polychlorinated biphenyls (PCBs) in response to SFBRWQCB information needs (#2 above), and to collect and analyze additional Low Impact Development (LID) effectiveness evaluation samples (#3 above) in response to CVRWQCB information needs.

Details on the background and rationale for this proposal appear below.

Background on the Current C.8.e Monitoring Approach

Contra Costa County is divided between the jurisdictions of the SFBRWQCB and the CVRWQCB. Historically, the NPDES stormwater permits issued by each Regional Board to CCCWP Permittees within their respective jurisdictions have had nearly identical provisions, to promote a coordinated countywide program of water quality management. Subsequent to the issuance of the Municipal Regional Permit (MRP, Order No. R2-2009-0074) by the SFBRWQCB in 2009, additional coordination between CCCWP, SFBRWQCB, and CVRWQCB staff helped develop coordinated permit language for Eastern Contra Costa County Permittees (East County Permit, Order No. R5-2010-0102). The coordination promoted efficient use of countywide resources for water quality monitoring addressing the needs of both Regional Boards.

Provision C.8.e in both the MRP and the East County Permit requires monitoring to quantify annual loads and long term trends for pollutants of concern (POCs) in tributaries that flow to San Francisco Bay (the Bay) and the Sacramento San Joaquin River Delta (the Delta). POCs are constituents that are known or suspected to cause or contribute to impairment of receiving water quality, including constituents with established Total Maximum Daily Loads (TMDLs).

TMDLs have been established for mercury and polychlorinated biphenyls (PCBs) in San Francisco Bay. A TMDL for mercury and methylmercury has been established for the Delta. The SFBRWQCB has adopted a TMDL for pesticides in urban creeks that has been approved by the United States Environmental Protection Agency (USEPA). The CVRWQCB is developing a TMDL for diazinon and chlorpyrifos in the Central Valley, as well as a separate TMDL for pyrethroid pesticides in the Central Valley. Thus, the primary POCs as defined by TMDLs adopted or under development are mercury (including methylmercury), PCBs, and pesticides (including, but not limited to diazinon, chlorpyrifos, and pyrethroids).

In addition to POCs with existing or pending TMDLs, the SFBRWQCB and the CVRWQCB have required through Provision C.8.e monitoring information for Total and Dissolved Copper; Suspended Sediments Concentrations (SSC); Total Organic Carbon; Water Column Toxicity; Nitrate; Phosphorous; Hardness; Total and Dissolved Selenium; Total Polybrominated Diphenyl Ethers (PBDEs); Total Poly-Aromatic Hydrocarbons (PAHs); Bedded Sediment Toxicity; and, Pollutants in fine-grained bedded sediments.

Both the MRP and the East County Permit include the following language allowing an alternative approach to the specific details proposed in Provision C.8.e:

Permittees shall implement the following POC monitoring components or pursue an alternative approach that addresses each of the aforementioned management information needs. An alternative approach may be pursued by Permittees provided that: either similar data types, data quality, data quantity are collected with an equivalent level of effort described; or an equivalent level of monitoring effort is employed to answer the management information needs. The alternative approach may be an inter-regional effort designed to improve measurement and estimation of pollutant loads to the Bay/Delta from small tributaries.

During the first term of the MRP, CCCWP joined with other members of the Bay Area Stormwater Management Agencies Association (BASMAA) in a regional collaboration to develop and implement an alternative approach to Provision C.8.e, with buy-in from SFBRWQCB staff[1]. The forum for discussing and managing the alternative approach to C.8.e monitoring is referred to as the Small Tributaries Loading Strategy (STLS) Workgroup, which is a subcommittee of the RMP's Sources, Pathways and Loadings Workgroup. Stakeholders involved in the STLS include BASMAA representatives, staff of the San Francisco Estuary Institute, and staff of the SFBRWQCB.

Marsh Creek was one of two locations selected by the STLS for monitoring in fulfillment of Provision C.8.e. Marsh Creek drains over 60,000 acres. It is comprised of an upper and lower watershed, because of the Marsh Creek Reservoir, which is designed to provide stormwater detention for flood protection of downstream areas. Flows from the upper watershed only reach the lower watershed intermittently, after late season storms saturate ground levels and fill the reservoir sufficiently to initiate flows from the primary spillway. When only the lower watershed is sampled during lighter, more frequent storm events, the flows are dominated by urban runoff from the surrounding communities. Marsh Creek was selected based on the following rationale:

- The Mount Diablo Mercury mine site is located in the upper watershed of Marsh Creek. Mercury and methylmercury have been previously monitored in the upper watershed by other parties, with support from Contra Costa County Department of Public Works (Slotton et al, 1998); however, prior to the implementation of C.8.e monitoring under the MRP and the East County Permit, no data have been available on mercury loads into lower Marsh Creek.
- Mercury loads discharged from Marsh Creek affect both the Delta and the Bay because the Bay is downstream of the Delta; therefore, mercury loads monitoring at Marsh Creek is responsive to TMDLs established for both the Bay and for the Delta.
- The urbanized areas of the lower Marsh Creek watershed are predominantly new residential and commercial areas; PCBs monitoring at this location was expected to verify the working hypothesis that newer urban areas have lower PCB yields per unit area compared to older urban or older industrial areas.

[1] The Alternative Approach agreed to by the BASMAA regional collaboration included monitoring at Marsh Creek, which is located in the Central Valley Region, to count towards one of the required locations in the San Francisco Bay Region. Since this was not a change from the original East County Permit requirements, buy-in from CVRWQCB staff was not needed.

- Marsh Creek is the second largest watershed in Contra Costa County, after Walnut Creek.

The second location monitored in Contra Costa County in fulfillment of Provision C.8.e. is the North Richmond Stormwater Pumping Station (NRSPS). The NRSPS provides flood protection for a 900 acre watershed. That location was monitored as a special study of the San Francisco Bay Regional Monitoring Program (RMP). The rationale for monitoring at the NRSPS was:

- The NRSPS is also the location where an MRP-required pilot study is being conducted to evaluate the feasibility and potential benefits of diverting urban stormwater into sanitary sewers. Establishing current POC loads in the watershed is helpful to putting the results of the pilot study into context.
- The watershed served by the NRSPS is a mixture of older urban and older industrial areas; therefore, the PCB yields per unit area would be expected to be higher as compared to newer urban areas such as lower Marsh Creek Watershed.

Rationale for a New C.8.e Monitoring Approach

The rationale for a new monitoring approach in response to Provision C.8.e is based on a review of lessons learned from the monitoring performed to date. Those lessons learned are framed in the context of the following four priority management information needs identified in both the MRP and the East County Permit:

1) Identifying which Bay and Delta tributaries (including stormwater conveyances) contribute most to Bay and Delta impairment from pollutants of concern;
2) Quantifying annual loads or concentrations of pollutants of concern from tributaries to the Bay and Delta;
3) Quantifying the decadal-scale loading or concentration trends of pollutants of concern from small tributaries to the Bay and Delta; and
4) Quantifying the projected impacts of management actions (including control measures) on tributaries and identifying where these management actions should be implemented to have the greatest beneficial impact.

The state of knowledge regarding each management question is summarized below. Detailed results are available in CCCWP's Integrated Monitoring Report, Part A, Appendix A-7 (Pollutants of Concern Loads Monitoring Data Progress Report, Water Years 2012 and 2013), and CCCWP's Integrated Monitoring Report, Part C (Pollutants of Concern Implementation Plan). Both of these documents were submitted to the SFBRWQCB and the CVRWQCB in March, 2014, in fulfillment of Provisions C.8.g of the MRP and the East County Permit.

Question 1: Which tributaries contribute the most to impairment from POCs?

Tributaries draining watersheds with large areas of old industrial and old urban land uses have the greatest contribution of PCBs per unit area, as compared to new urban and open space land uses. This has been well-documented by the monitoring results that were outcomes of the C.8.e monitoring approach agreed to by the STLS. As expected, the older urban and older industrial land use of the NRSPS watershed has a higher PCB annual load per unit area (yield) as compared to the lower Marsh Creek watershed.

In contrast to PCBs, mercury yields are more consistent regionally among different land use types. Older industrial areas still have somewhat higher yields compared to new urban and open spaces; however, the difference among land uses for mercury yields is two-fold or three-fold, rather than orders of magnitude, as with PCBs. Legacy mercury mines are known to have a direct impact on mercury yields; this has been shown in the case of the New Almaden Mercury Mine in the Guadalupe River watershed.

We don't have enough information yet about upper Marsh Creek watershed flows to characterize whether or not the Mount Diablo Mercury Mine site significantly affects mercury and methylmercury yields in that watershed. Due to very dry conditions over the past several years, upper watershed flows were only sampled once for mercury, methylmercury and SSC (out of thirty grab samples for total mercury and sixteen grab samples for methylmercury). CCCWP recommends waiting for upper watershed flow before collecting any more stormwater grab samples from Marsh Creek for mercury or methylmercury.

The MRP and the East County Permit require an average of four storms per year. A numeric requirement for storms per year sampled promotes sampling smaller, more high frequency storms. The rationale for revising the numeric requirement for storms sampled is that we have enough information on lower watershed flows that are dominated by urban runoff. It is a better use of CCCWP monitoring resources, and more responsive to this management question, to wait for upper watershed flows that have much longer recurrence intervals.

Question 2: What are annual POC loads?

Annual POC loads are estimated using a Regional Watershed Spreadsheet Model (RWSM). The model uses POC yields based on land use to estimate loads. That modeling effort has been under way for several years, and an initial draft report on model results has been reviewed by the STLS. The POC loads monitoring approach implemented by the STLS was aimed at improving estimates derived from the RWSM. Findings of the initial modeling report suggest that further refinement and improvement of the model may not be warranted – we have enough information about source areas of POCs to cease the base of watershed tributary monitoring approach and move monitoring closer to source areas.

Question 3: What is the decadal scale loading trend for POCs?

To characterize the change in POC loads over time, it is not necessary or appropriate to monitor tributaries annually. Decadal scale changes will be best detected after one to two decades of focused implementation on POC load reduction projects. A key lesson learned during the past four years of implementing pilot projects required by the MRP is that attaining aggressive TMDL goals for POCs, such as the mandated ninety percent reduction in PCB loadings required by the San Francisco Bay TMDL would require implementation of widespread stormwater treatment retrofits in developed areas. Such a massive scale of stormwater treatment is beyond the existing engineering and economic capacity of Permittees. Attainment of such far-reaching load reductions would require development of new revenue programs to fund stormwater quality improvement. This represents a significant undertaking that Permittees are currently exploring through negotiation of the reissuance of the MRP.

Rather than monitoring annually in tributaries to detect change, CCCWP proposes that it is better to measure progress by assessing the amount of urban stormwater that was treated prior to adoption of TMDLs, and modeling the benefits of new stormwater treatment based on effectiveness assessments at a limited number of representative treatment systems. Over time, as stormwater treatment is implemented and more areas of urban hardscape are disconnected from direct, untreated discharges to receiving waters, the cumulative POC load reduction benefit can be quantified based on the measured effectiveness at representative stormwater treatment systems and the amount of stormwater treated.

Question 4: What is the projected impact of control measures and where should control measures be implemented?

Results reported in the Integrated Monitoring Report, Part A, document some good news related to this question for pesticides, which is that source control works. Diazinon and chlorpyrifos were re-registered to restrict use to registered professional applicators. Diazinon and chlorpyrifos are now consistently below water quality objectives in Marsh Creek, and acute toxicity to the water flea *daphnia magna* (an organism highly sensitive to diazinon and chlorpyrifos) has been essentially eliminated.

We have detected toxicity to the benthic amphipod *hyalella azteca* at a number of locations. CCCWP is currently conducting a Stressor-Source Identification Study (SSID) to determine the causes of toxicity. Preliminary results confirm the working hypothesis that pyrethroid pesticides cause the observed toxicity. Following the model of diazinon and chlorpyrifos, the answer to "where should control measures be implemented?" is "at the source – producers." Consequently, CCCWP will work with BASMAA and members of the California Association of Stormwater Agencies (CASQA) to lobby for re-registration of pyrethroid pesticides, building on lessons learned from diazinon and chlorpyrifos. This approach is responsive to TMDLs for pesticides established by the SFBRWQCB and the CVRWQCB.

For PCBs, CCCWP has proposed in our Integrated Monitoring Report, Part C an approach to identifying PCB source areas where source control is expected to yield PCB load reduction benefits. Some "high opportunity areas" have already been identified in old industrial areas of Richmond; additional areas may be identified through this source identification approach. CCCWP recommends that this source-oriented approach is the most productive path forward to address goals established by the San Francisco Bay PCBs TMDL.

Stormwater treatment retrofits applied to older urban areas to attain PCB load reduction goals will also address mercury load reduction goals. The preferred approach to stormwater treatment in Contra Costa County is Low Impact Development (LID). However, the benefits of LID for reducing methylmercury loads have not been evaluated, either in Contra Costa County or in any scientific literature.

CCCWP has proposed to evaluate the benefits of LID for methylmercury load reduction through the Methylmercury Control Study Plan submitted to the CVRWQCB. Comments received from CVRWQCB staff indicate that an increased level of LID effectiveness evaluation is desirable; therefore, CCCWP proposes to increase the level of monitoring effort for LID effectiveness in the methylmercury control study, to better quantify the projected impact of control measures.

Summary

In conclusion, CCCWP's recommended alternative approach to C.8.e monitoring in the MRP and the East County Permit are as follows:

1) Sample no more than two more storms at the existing Marsh Creek POC loads station for mercury, methylmercury, and SSC only. The sampling would be timed to capture upper watershed flow (i.e., flow from the Marsh Creek Reservoir).
2) Conduct PCB source identification studies, following the approach proposed in the Integrated Monitoring Report, Part C.
3) Increase the number of LID effectiveness evaluation samples collected and analyzed for the approved Methylmercury Control Study Plan.

If you have any questions or concerns, please don't hesitate to contact me at (925) 313-2392, tdalz@pw.cccounty.us.

Sincerely,

Thomas E. Dalziel
Program Manager
Contra Costa Clean Water Program

cc: Selina Louie, Richard Looker, Thomas Mumley (SFBRWQCB)
Genevieve Sparks, Janice Cooke (CVRWQCB)

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