Contra Costa Clean Water Program

Pesticides and Toxicity Monitoring Report for Water Year 2025 and Comprehensive Analysis of Data Collected in Water Years 2020-2025

Submitted to the San Francisco Bay and Central Valley Regional Water Quality Control Boards

In Compliance with NPDES Permit Provision C.8.h.v Municipal Regional Stormwater Permit (Order No. R2-2022-0018)

March 31, 2026

CONTRA COSTA CLEAN WATER PROGRAM

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Prepared for

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Acronyms and Abbreviations

BAMSC	Bay Area Municipal Stormwater Collaborative
BASMAA	Bay Area Stormwater Management Agencies
CCCWP	Contra Costa Clean Water Program
CGU	concentration goal unit
CVRWQCB	California Regional Water Quality Control Board, Central Valley Region
DOC	dissolved organic carbon
DPR	California Department of Pesticide Regulations
IMR	integrated monitoring report
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
MDL	method detection limit
MRP	Municipal Regional Stormwater Permit
MS4	Municipal Separate Storm Sewer System
MS	matrix spike
MSD	matrix spike duplicate
NorCal	Northern California
NPDES	National Pollutant Discharge Elimination System
PAH	polycyclic aromatic hydrocarbons
PEC	probable effects concentrations
QA/QC	quality assurance/quality control
QAPP	quality assurance project plan
RL	reporting limit
RMC	Regional Monitoring Coalition
RPD	relative percent difference
SFBRWQCB	California Regional Water Quality Control Board, San Francisco Bay
SoCal	Southern California
SOP	standard operating procedures
SWAMP	Surface Water Ambient Monitoring Program
TEC	threshold effects concentration
TMDL	Total Maximum Daily Load
TOC	total organic carbon
TU	toxic unit
USEPA	U.S. Environmental Protection Agency
WY	water year

Executive Summary

The Municipal Regional Stormwater National Pollutant Discharge Elimination System (NPDES) Permit (MRP) contains requirements for pesticides and toxicity monitoring in urban creeks (SFBRWQCB 2022). This report documents monitoring and reporting conducted by the Contra Costa Clean Water Program (CCCWP) in compliance with those requirements.

MRP Provision C.8.g. (Pesticides and Toxicity Monitoring) contains the following elements designed to assess potential pesticides contamination and associated toxicity in urban creeks:

- Water column pesticides and toxicity monitoring – wet weather
- Toxicity in water column – dry weather
- Toxicity, pesticides, and other pollutants in sediment – dry weather

The monitoring described in this report is responsive to the monitoring requirements of MRP Provision C.8.g, as well as the follow-up notification requirements specified in MRP Provision C.8.g.iv and the Integrated Monitoring Report (IMR) requirements specified in MRP Provision C.8.h. This includes analysis of the results of the annual pesticides and toxicity monitoring for water year (WY) 2025, as well as a comprehensive analysis of the pesticides and toxicity monitoring performed during WYs 2020–2025.

Dry Weather Chemistry and Toxicity Testing, WY 2025

Dry weather water and sediment samples were collected from a site on lower Marsh Creek (site ID 544R02505) on July 22, 2025, and tested for toxicological and chemical parameters, as required by the MRP. Quality assurance/quality control (QA/QC) procedures were implemented as specified in the Regional Monitoring Coalition (RMC) Quality Assurance Project Plan (QAPP; BASMAA 2020), and monitoring was performed per protocols specified in the RMC standard operating procedures (SOPs; BASMAA 2016) and in conformity with California's Surface Water Ambient Monitoring Program (SWAMP) protocols, as required by the MRP.

During WY 2025 dry weather monitoring, the water samples were toxic to both the algae *Selenastrum capricornutum* (95% effect) and the invertebrate crustacean *Ceriodaphnia dubia* (20.5% effect). Because the *Selenastrum* percent effect exceeded 50%, resampling and retesting at the Marsh Creek site were required for this species. The retest sample, collected on September 16, 2025, was not toxic. Toxicity to *Selenastrum* is highly unusual in Contra Costa County urban creeks; this is the only such occurrence in the past six years of creek status monitoring by CCCWP. The observed toxicity hypothetically could have been caused by elevated levels of one or more herbicides in the creek. The lack of toxicity in the retest sample indicates the toxic condition was transitory and does not represent a chronic or persistent condition.

The sediment sample was toxic for the aquatic invertebrate *Hyalella azteca* with a 36% effect. Toxicity to *Hyalella* has been a common occurrence in urban creeks throughout the Bay Area and California over the past 20 years (see, e.g., Ruby 2013).

In the chemical analysis of the sediments, all seven heavy metals were detected, as is typical for urban creek sediments. However, no PAH compounds were detected in the WY 2025 Marsh Creek

sediment sample. Although this is atypical for Bay Area urban creek sediments in general, there were also no detected PAH compounds in the WY 2024 testing of the same site.

Also uncharacteristically, no pyrethroid pesticides were detected in the WY 2025 Marsh Creek sediments, and no fipronil compounds were detected. Organic carbon (as sediment total organic carbon [TOC]) was relatively low at 0.56% dry weight.

Comprehensive Analysis of Monitoring Data, WYs 2020-2025

Per MRP Provision C.8.h.v, the Permittees are required to submit an integrated monitoring report that includes a comprehensive analysis of all data collected since the previous integrated monitoring report, which covered the period through and including WY 2019. However, as specified in MRP footnote #48, the integrated monitoring report is to exclude creek status monitoring conducted after the submittal of the prior integrated monitoring report. This comprehensive analysis therefore does not cover the bioassessment and associated water quality monitoring conducted during WYs 2020-2022 at 10 sites annually within Contra Costa County.

The period encompassing WYs 2020-2025 spanned MRP 2.0 and MRP 3.0, which was adopted in 2022. During that period, CCCWP undertook the following monitoring related to pesticides and toxicity, in accordance with Provision C.8.g under first MRP 2.0 and then MRP 3.0:

- Wet weather water column pesticides chemistry and aquatic toxicity monitoring at two urban creek sites during WY 2023
- Dry weather water column toxicity and sediment chemistry and toxicity at one urban creek site annually, WY 2020-2025

Wet weather water samples were collected from urban creeks in the MRP region during an early season storm event on November 8, 2022 (WY 2023). In Contra Costa County, wet weather samples were collected from Walnut Creek at Concord Avenue (site ID 207R02615) and from Pinole Creek (site ID 206PNL010). The samples were tested for toxicity to several different aquatic species and analyzed for a suite of pesticide compounds, as required by the MRP.

Both the Walnut Creek (site ID 207R02615) and Pinole Creek (site ID 206PNL010) November 8, 2022 stormwater samples were toxic to *Hyalella azteca*. The toxic effect in the Walnut Creek sample was equal to 50% of the lab control; therefore, the *Hyalella azteca* test required retesting with sample water collected during wet weather from the Walnut Creek site.

Samples for the retest were collected at the Walnut Creek site during a storm event on January 10, 2023. In the retest, the sample was again toxic to *Hyalella azteca*, but the toxic effect was less than 50%.

The measured pyrethroid concentrations in the wet weather samples were sufficient to cause the toxicity observed in both the Walnut Creek (site ID 207R02615) and Pinole Creek (site ID 206PNL010) November 8, 2022 stormwater samples, as well as in the Walnut Creek January 10, 2023 retest sample, due principally to elevated concentrations of bifenthrin, cyhalothrin/lambda, and deltamethrin. The pyrethroid sediment concentrations in the November 8, 2022 stormwater samples were particularly high, with pyrethroid toxic unit equivalents (TUs) measuring 23.5 at the Walnut Creek site and 17.3 at the Pinole Creek site. Toxicity is likely when the calculated TU exceeds 1.0.

In dry weather, the CCCWP Permittees annually collect water and sediment samples from one urban creek site, perform toxicity tests on water and sediment samples, and conduct chemical analysis of sediment samples, as required by the MRP.

Toxicity in dry weather water samples occurred to *Ceriodaphnia dubia* in WYs 2021 and 2025. In both cases, the acute test (survival) passed, but the chronic test (reproduction) failed. Water samples also were toxic to *Hyalella azteca* (WY 2021), *Chironomus dilutus* (WY 2023), and *Selenastrum capricornutum* (WY 2025).

All seven metals were detected in every dry weather sediment sample analyzed from WY 2020-2025. Detections of PAHs were highly variable, ranging from 10 PAHs detected at Grayson Creek (site 207R01547) in WY 2020 and 11 detected at Walnut Creek (site 207R02615) in WY 2023 to zero detections at Marsh Creek (site 544R02505) in both WY 2024 and 2025.

Pyrethroid pesticides were commonly detected in sediment samples at the rate of three to five pyrethroids per sample every year except WY 2025, during which no pyrethroids were detected. Analysis of the sediment grain size distributions indicated a preponderance of larger particles may have influenced the WY 2025 pyrethroid sediment chemistry results. Neither carbaryl nor fipronil nor its degradates were detected in any sediment samples collected during WYs 2020-2025.

The only toxic sediment test results occurred in WYs 2024 and 2025, in both cases to *Hyalella azteca*. Pyrethroid TUs calculated from dry weather sediment chemistry data exceeded 1.0 only in the Marsh Creek sample during WY 2024, coinciding with sediment toxicity to *Hyalella azteca*. Sediment samples collected from the same site in WY 2025 were also toxic to *Hyalella azteca*, but no pyrethroid pesticides were detected in the sediment analysis.

Interpretation: Prior Conditions, Beneficial Uses, Standards, and Impairments

The findings presented in this report reflect prior conditions in urban creeks within Contra Costa County, the San Francisco Bay Area, and throughout California generally, as contamination of urban creeks by current-use pesticides and associated toxicity to aquatic organisms has been and continues to be a common occurrence. The designated beneficial uses of the urban creeks, therefore, are not supported by continued contamination by current-use pesticides and associated pesticide-caused toxicity, as documented in this and prior reports and studies.

The determinations of toxicity to aquatic organisms documented in this report represent apparent violations of the narrative toxicity water quality standard in the San Francisco Bay Basin Plan (SFBRWQCB 2023), as well as the narrative sediment objective and the narrative population and community ecology objective.

The findings of water and sediment toxicity documented in this report, taken together with the water and sediment chemistry data showing elevated levels of pyrethroid pesticides, also arguably represent an exceedance of the Diazinon and Pesticide-Related Toxicity in Urban Creeks TMDL's numeric target for pesticide-related toxicity (SFBRWQCB 2005), as it is clear from the chemistry data that in most cases pesticides likely "cause or contribute to the toxicity."

The instances of water column and sediment toxicity presented in this report indicate ongoing water quality impairments, and the likely sources of the impairments are applications of pyrethroid and other pesticides within Contra Costa County urban watersheds.

However, the exceedances of the narrative Basin Plan objective and the TMDL numeric target do not trigger notification to the San Francisco Bay Regional Water Quality Control Board per MRP Provision C.8.h.i, because they are “continuing or recurring exceedances of water quality standards previously reported to the Water Board" and “exceedances of pollutants that are addressed pursuant to Provisions C.9 (et al.)…”

Continued implementation of CCCWP’s Pesticides Toxicity Control Program, as defined in MRP Provision C.9, is recommended, along with a simplified level of annual reporting.

1 Introduction

1.1 Overview

Pesticides are widely used for pest control in urban areas. They can be transported in urban runoff from their application sites via urban storm drainage systems (municipal separate storm sewer systems, or MS4s) to urban creeks and other receiving waters, where they may cause toxicity to aquatic life (see e.g., Ensminger et al. 2013, Ruby 2013, USEPA 2016).

Both the San Francisco Bay and Central Valley Regional Water Quality Control Boards (SFBRWQCB and CBRWQCB, respectively) have adopted total maximum daily load (TMDL) regulations to address pesticides pollution (SFBRWQCB 2005, CVRWQCB 2017). Both TMDLs have been adopted as Basin Plan Amendments within their respective Basin Plans (Water Quality Control Plans) for the San Francisco Bay Basin (SFBRWQCB 2023) and the Sacramento and San Joaquin River Basins (CVRWQCB 2019).

Responding to the ongoing issue of pesticide-related pollution in Bay Area receiving waters and related TMDL implementation requirements, the Municipal Regional Stormwater National Pollutant Discharge Elimination System (NPDES) Permit (MRP) contains requirements for pesticides and toxicity monitoring in urban creeks (SFBRWQCB 2022). This report documents monitoring and reporting conducted by the Contra Costa Clean Water Program (CCCWP) in compliance with those requirements.

1.2 Regulatory Context and Report Organization

MRP Provision C.8.g. (Pesticides and Toxicity Monitoring) contains the following elements designed to assess potential pesticides contamination and associated toxicity in urban creeks:

- Wet weather pesticides and toxicity monitoring (water column)
- Toxicity in water column – dry weather
- Toxicity, pesticides, and other pollutants in sediment – dry weather

The monitoring described in this report is responsive to the monitoring requirements of MRP Provision C.8.g., as well as follow-up notification requirements specified in MRP Provision C.8.g.iv and reporting requirements specified in Provision C.8.h.

The following MRP reporting requirements, specific to pesticides and toxicity monitoring per Provision C.8.h.iii.(3), are addressed within this report:

- A complete water year summary table that lists the monitoring sites and location information, with a row for each site, showing the parameters monitored at that site (Section 2.1);
- For the WY 2025 monitoring, a statement of the data quality (Section 3.1) and an analysis of the data (Section 3.2);
- A comprehensive analysis of pesticides and toxicity monitoring conducted during WYs 2020-2025 (Sections 4.1-4.3);

- Discussion of non-permittee monitoring data (Section 4.4), monitoring data relative to prior conditions and trends (Section 4.5), beneficial uses (Section 4.6), and applicable water quality standards (Section 4.7), as described in the Basin Plan, Ocean Plan, California Toxics Rule, and other applicable water quality control plans;
- Where appropriate, development of hypotheses to investigate pollutant sources, trends, and BMP effectiveness (Section 4.8);
- Identification and prioritization of water quality impairments (Section 4.8);
- Identification and discussion of potential sources (and actual, if known) of water quality impairments, and provide sufficient justification for those potential sources (Section 4.8); and
- Description of follow-up actions (Section 4.8).

MRP Provision C.8.g.iv. also requires the following:

- Follow-up – Permittees shall provide notification in the next urban creeks monitoring report when analytical results indicate any of the following:
  - (1) A toxicity test of growth, reproduction, or survival of any test organism is reported as "fail" in both the initial sampling and a second, follow-up sampling, and both have ≥50% effect;
  - (2) A pollutant is present at a concentration exceeding its water quality objective in the Basin Plan; or
  - (3) For pollutants without water quality objectives, results exceed probable effects concentrations (PEC) or threshold effects concentrations (TEC) [as defined per MacDonald et al. 2000].

The monitoring results are analyzed and interpreted according to those qualifications (Sections 3.2 and 4.2–4.8).

The standard reporting requirements defined in Provision C.8.h.vii are also addressed as follows:

1. The purpose of the monitoring and a brief description of the study design rationale (Sections 1.1 and 1.2);
2. Quality assurance/quality control summaries for sample collection and analytical methods, including a discussion of any limitations of the data (Section 3.1);
3. Brief descriptions of sampling protocols and analytical methods (Section 2.2);
4. Sample location description, including water body name, segment, and latitude and longitude coordinates (Section 2.1);
5. Sample ID, collection date (and time, if relevant), media (e.g., water, filtered water, bed sediment, tissue) (Section 2.1);
6. Concentrations detected, measurement units, and detection limits (Section 3.2);
7. Assessment, analysis, and interpretation of the data for each monitoring program component (Sections 3.2 and 4.2-4.8);

8. A listing of volunteer and other non-Permittee entities whose data are included in the report (Section 4.6); and
9. Assessment of compliance with applicable water quality standards (Section 4.7).

2 Methods

2.1 Site Selection

A site on Lower Marsh Creek (site ID 544R02505) was selected as the WY 2025 dry weather monitoring site for pesticides and toxicity monitoring, matching the WY 2024 dry weather monitoring site. This monitoring location was selected in compliance with MRP Provision C.8.g.i.(2) as a location where toxicity could be likely, and to resample a location where toxicity has been found in the past. This same site was monitored during dry weather in 2024, and found to be toxic to *Hyalella azteca*. As a large, urbanized watershed, Marsh Creek has been monitored on a number of occasions since initial adoption of the MRP in 2012, and is considered representative of urban creeks in Contra Costa County. Additional data gathered in this watershed can assist in the interpretation and analysis of trends. The location of the selected site is specified in Table 1.

Table 1 Contra Costa County Pesticides and Toxicity Monitoring Location, WY 2025

Site ID	Creek Name	Latitude	Longitude	Permittee Jurisdiction	Dry Weather Water Column Toxicity (Acute and Chronic)	Dry Weather Sediment Toxicity (Acute and Chronic)	Dry Weather Sediment Chemistry	Wet Weather Water Column Toxicity (Acute and Chronic)	Wet Weather Water Chemistry
544R02505	Marsh Creek	37.99310	-121.69575	Oakley	X	X	X		

2.2 Monitoring Methods

The monitoring performed by CCCWP for compliance with MRP Provision C.8.g requirements conforms with the standard monitoring provisions (MRP Attachment D) and SWAMP protocols (SWRCB 2022). Provision C.8.g requires the following monitoring elements:

- Water column: pesticides chemistry and toxicity testing – wet weather
- Water column: toxicity testing – dry weather
- Sediments: pesticides/other pollutants chemistry and toxicity testing – dry weather

These elements are designed to assess potential pesticides contamination and associated toxicity in urban creeks by allowing comparisons of dry weather and stormwater (wet weather) conditions, and to a somewhat limited degree, interpretation of the toxicity testing results with associated water and sediment chemistry data.

The Bay Area Stormwater Management Agencies Association (BASMAA) Regional Monitoring Coalition (RMC), the predecessor to the Bay Area Municipal Stormwater Collaborative (BAMSC) workgroup, developed detailed SOPs and a state-approved quality assurance project plan (QAPP) to address similar monitoring requirements in previous versions of the MRP. Those protocols and procedures remain relevant for monitoring performed under the current MRP.

2.2.1 Field Sampling and Data Collection Methods

Water samples for dry weather toxicity testing and sediment samples for chemical analysis and toxicity testing were collected on July 22, 2025, and delivered to the laboratories that same day.

Following receipt of test results indicating toxicity to *Selenastrum capricornutum* at an effect level greater than 50%, a second water sample was collected from the same site on September 16, 2025, and delivered to the laboratory for toxicity testing that same day.

Water and sediment samples were collected in accordance with existing SWAMP-comparable methods and procedures, as described in the RMC QAPP (BASMAA 2020) and the associated SOPs (BASMAA 2016). The SOPs were developed using a standard format describing health and safety cautions and considerations, relevant training, site selection, and sampling methods and procedures.

The sampling methods and procedures described in the RMC SOPs include pre-fieldwork mobilization activities, equipment preparation, field sample collection, sample preservation and transport, and demobilization activities, including procedures to prevent the transport of invasive species between creeks. The SOPs relevant to the monitoring discussed in this report are listed in Table 2.

Table 2 RMC Standard Operating Procedures Pertaining to Pesticides and Toxicity Monitoring

SOP	Procedure
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	Quality assurance and quality control (QA/QC) data review

Water Toxicity Sample Collection

Samples were collected for water toxicity using the standard grab sample collection method referenced above. Labeled 3.7-liter amber glass bottles were filled with ambient water, put on ice to cool to 4 °C ± 2 °C, and delivered to the laboratory within the required holding time. The laboratory was notified of the impending sample delivery to ensure meeting the 24-hour sample delivery time requirement. Procedures used for sample collection and transport are described in SOP FS-2 (BASMAA 2016).

Sediment Chemistry and Sediment Toxicity Sample Collection

Sediment samples were collected after water samples were collected. Before conducting sediment sampling, field personnel surveyed the proposed sampling area to identify appropriate fine-sediment depositional areas and to avoid disturbing potential sediment collection sub-sites. Personnel carefully entered the stream and began 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 aliquoted into separate jars for chemical and toxicological analysis using standard clean sampling techniques (see SOP FS-6, BASMAA 2016). Sample containers were submitted to the respective laboratories per SOP FS-9 (BASMAA 2016).

2.2.2 Laboratory Analysis

In dry weather, the CCCWP Permittees are collectively required to collect water and sediment samples from one site annually, and perform the following tests and analyses, per MRP Provision C.8.g.ii.:

- Water sample toxicity testing for the same set of test species as required for the wet weather monitoring, as listed in MRP Table 8.4
- Sediment sample toxicity testing for *Hyalella azteca* and *Chironomus dilutus* (survival endpoints)
- Sediment chemical analysis for pyrethroid pesticides, fipronil and degradates, PAHs, metals, TOC, and grain size, with comparisons of results to water quality objectives or other comparative metrics, including PEC or TEC from MacDonald et al. (2000), as has been done for previous MRP monitoring

BAMSC participants agreed to use the same set of analytical laboratories for pesticides analysis and toxicity testing, developed standards for contracting with the labs, and coordinated quality assurance issues. All samples collected by BAMSC participants and sent to laboratories for analysis were analyzed and reported by SWAMP-comparable methods, as described in the RMC QAPP (BASMAA 2020).

The following analytical laboratory contractors performed the required chemical and toxicological analyses.

Pacific EcoRisk, Inc. – Water and sediment toxicity

Water and sediment samples were tested per species-specific protocols published by U.S. Environmental Protection Agency (USEPA), in accordance with the methods specified in MRP Table 8.4.

Caltest Analytical Laboratory, Inc. – Water and sediment chemistry

Upon receipt at the laboratory, samples were immediately logged and preserved, as necessary. USEPA-approved testing protocols were then applied to analyze water and sediment samples, per the methods specified in MRP Table 8.5.

2.3 Quality Assurance/Quality Control (QA/QC)

Pesticides and toxicity monitoring is coordinated among the responsible MRP permittees through BASMC. Data QA/QC procedures are described in detail in the BASMAA RMC QAPP (BASMAA 2020) and RMC SOP FS-13 (QA/QC Data Review; BASMAA 2016). Implementation of these procedures ensures SWAMP comparability for the monitoring data and allows for the use of the data for regulatory purposes.

Data quality objectives were established to ensure the data collected are of sufficient quality for the intended use. Data quality objectives include both quantitative and qualitative assessments 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. Pre-monitoring field training and in situ field assessments were conducted to ensure consistent and comparable field techniques.

Data were collected per the procedures described in the relevant SOPs (BASMAA 2016), 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. Data were checked for conformance with QAPP requirements, and field procedures were reviewed to check for compliance with the methods specified in the relevant SOPs. Data review was performed per protocols defined in RMC SOP FS13 (QA/QC Data Review; BASMAA 2016). Data quality was assessed and qualifiers were assigned as necessary, in accordance with SWAMP requirements.

2.4 Data Analysis

As a measure of the potential toxicity associated with pesticides chemistry data, TU equivalents are computed from the lab results for the individual pesticides detected in each sample. The TU calculations are based on published literature acute toxicity (LC_{50}) values for freshwater invertebrates (LC_{50} is the concentration of a chemical which is lethal on average to 50% of test organisms), where available. The results for the individual pesticides are then summed to produce a TU equivalent value for the sample. The chemistry results are indicative of potential pesticide-caused toxicity in samples where TU >1.

Because organic carbon mitigates the toxicity of pyrethroid pesticides in sediments, sediment LC_{50} values were derived based on organic carbon-normalized pyrethroid concentrations (Weston et al. 2013). Therefore, the RMC pyrethroid concentrations reported by the lab also were divided by the measured TOC concentration at each site (as a percentage), and the TOC-normalized concentrations (as µg/g organic carbon) were then used to compute TU equivalents for each pyrethroid.

As noted in MRP Provision C.8.g.iv.(3), for sediment chemistry data, in the absence of applicable water quality standards, comparisons to TECs and PECs are calculated as defined in MacDonald et al. (2000). For each constituent for which there is a published TEC or PEC value, the ratio of the measured concentration to the respective TEC or PEC value was computed as the TEC or PEC quotient, respectively. All results with a TEC ratio equal to or greater than 1.0 were identified. For each site, the mean PEC quotient was then computed, and any sites where mean PEC quotient was equal to or greater than 0.5 were identified.

3 Water Year 2025 Results and Data Analysis

3.1 Statement of Data Quality

CCCWP implemented a comprehensive QA/QC program for the WY 2025 monitoring. In general, QA/QC procedures were implemented as specified in the RMC QAPP (BASMAA 2020), and monitoring was performed per protocols specified in the RMC SOPs (BASMAA 2016) and in conformity with SWAMP protocols, as required by the MRP. QA/QC data were reviewed against measurement quality objectives (MQOs) specified in the QAPP. The QA/QC review resulted in a high degree of confidence in the quality of the data produced during the WY 2025 monitoring. QA/QC issues noted by the laboratories and/or field crews or discovered during data review are summarized below.

3.1.1 Toxicity QA/QC – Water and Sediment Samples

No QA/QC issues were reported by the toxicology laboratory for the specified testing, for either the tests conducted on Marsh Creek samples collected on July 22, 2025, or the retest for *Selenastrum capricornutum* from a second water sample collected from the same site on September 16, 2025.

3.1.2 Chemistry QA/QC – Sediment Sample

The laboratory diluted the sediment samples for the analysis of pesticides and PAHs to reduce matrix interference, which raised the method detection limits (MDLs) and reporting limits (RLs) for those constituents.

The laboratory used batch quality assurance data from another project for the matrix spike/matrix spike duplicate (MS/MSD) analyses for metals, pesticides, and PAHs.

For chromium, nickel, and zinc, the MS/MSD recoveries were not calculated due to the high native concentration in the sample selected for MS/MSD versus the laboratory spike concentration. Those analyses were assigned a “GB” QA code indicating “Matrix spike recovery not within control limits.”

The surrogate recovery result for Esfenvalerate-d6, a pyrethroid surrogate compound, was 3%, outside of the lab’s QC limits of 50–150%, due to apparent matrix interference in the sample. The sample was confirmed on re-analysis.

The laboratory reported low laboratory control sample/laboratory control sample duplicate (LCS/LCSD) spike recoveries for acenaphthene, acenaphthylene, and 2-methylnaphthalene, outside of Caltest acceptance criteria. The QC batch was accepted based on results of other internal accuracy measures (MS/MSD recoveries and associated relative percent difference [RPD]).

The laboratory reported slightly low LCS spike recovery for deltamethrin:tralomethrin, outside of Caltest acceptance criteria. The QC batch was accepted based on results of LCSD and MS/MSD recoveries and associated RPD. The laboratory reported low matrix spike recoveries for the four fipronil compounds due to possible matrix interferences in the QC sample. The QC batch was accepted based on LCS and RPD results.

Field duplicate sediment chemistry samples were collected from Alameda County site 204Z7G010 on the same date (July 22, 2025), and RPDs were calculated for the duplicate samples for use by the other cooperating BAMSC programs. The field duplicate RPDs generally met the MQO of <25%,

with exceptions for one PAH compound (naphthalene, RPD 48%), two pesticides (cyhalothrin, RPS 109%; fipronil sulfone, RPD 52%), and one grain size (pebbles, small 4 to <8 mm, RPD 53%).

3.2 Dry Weather Sediment Chemistry and Water and Sediment Toxicity

Dry weather water and sediment samples were collected from a site on lower Marsh Creek (site ID 544R02505) on July 22, 2025, and tested for toxicological and chemical parameters as described above. The analytical results are presented below.

3.2.1 Toxicity Testing Results, WY 2025

The dry weather toxicity testing results are presented in Table 3. The initial (July 22, 2025) water samples were toxic to both the algae *Selenastrum capricornutum* (95% effect) and the invertebrate crustacean *Ceriodaphnia dubia* (20.5% effect). Because the *Selenastrum* percent effect was greater than 50%, resampling and retesting of the Marsh Creek site was required for this species. The retest sample, collected on September 16, 2025, was not toxic.

Toxicity to *Selenastrum* is highly unusual in Contra Costa County urban creeks; this is the only such occurrence in the past six years of creek status monitoring by CCCWP. The lack of toxicity in the retest sample indicates that the toxic condition was transitory and does not represent a chronic or persistent condition.

Similarly, while toxicity to *Ceriodaphnia* was common during the 1990s and early 2000s, prior to USEPA's effective banning of urban uses of the organophosphate pesticides diazinon and chlorpyrifos, such occurrences have been rare in the past 20 years.

The sediment sample was toxic for the aquatic invertebrate *Hyalella azteca*, with a 24% effect. This effect level was less than 50% and therefore did not require a retest. Toxicity to *Hyalella* has been a common occurrence in urban creeks throughout the Bay Area and California over the past 20 years (see, e.g., Ruby 2013).

Table 3 Dry Weather Toxicity Testing Results

Sample Type/Date	Matrix/Test Species	Test Endpoint(s)	Lab Control	Marsh Creek Site 544R02505	% Effect	TST Pass/Fail
Water Samples (07/22/2025)	*Selenastrum capricornutum* (Green Algae)	Growth (cells/mL x 106)	2.18	0.115	**95%****	**Fail***
Water Samples (07/22/2025)	*Ceriodaphnia dubia* (Freshwater Crustacean)	Survival (%)	90.0	100	-11%	Pass
Water Samples (07/22/2025)	*Ceriodaphnia dubia* (Freshwater Crustacean)	Reproduction (#neonates/female)	30.2	24.0	20.5%	**Fail***
Water Samples (07/22/2025)	*Chironomus dilutus* (Midge)	Survival (%)	100	100	0%	Pass
Water Samples (07/22/2025)	*Hyalella azteca* (Freshwater Amphipod)	Survival (%)	94.0	100	-6.4%	Pass
Water Samples (07/22/2025)	*Pimephales promelas* (Fathead Minnow)	Larval Survival (%)	95.0	100	-5.3%	Pass
Water Samples (07/22/2025)	*Pimephales promelas* (Fathead Minnow)	Growth (biomass, mg)	0.45	0.41	9.0%	Pass
Water Sample Retest (09/16/2025)	*Selenastrum capricornutum* (Green Algae)	Growth (cells/mL x 106)	2.24	6.31	-181%	Pass
Sediment Samples (07/22/2025)	*Chironomus dilutus* (Midge)	Survival (%)	86.2	70.0	18.8%	Pass
Sediment Samples (07/22/2025)	*Hyalella azteca* (Freshwater Amphipod)	Survival (%)	95.0	72.5	24%	**Fail***

* Sample test result was significantly less than the lab control treatment; sample was determined to be toxic
** % Effect was >50%; retest required

3.2.2 Sediment Chemistry Results, WY 2025

The dry weather sediment chemistry analytical results are presented in Table 4.

All seven heavy metals were detected, as is typical for urban creek sediments.

However, no PAH compounds were detected in the WY 2025 Marsh Creek sediment sample. Although this is atypical for Bay Area urban creek sediments in general, there were also no detected PAH compounds in the WY 2024 testing of the same site (site ID 544R02505).

Also uncharacteristically, no pyrethroid pesticides were detected in the WY 2025 Marsh Creek sediments, and no fipronil compounds were detected. Organic carbon (as sediment TOC) was relatively low, at 0.56% dry weight.

Table 4 Dry Weater Sediment Chemistry Monitoring Results, WY 2025 Marsh Creek Site 544R02505

Analyte	Units [1]	Result	MDL	RL
Arsenic	mg/Kg	1.7	0.12	0.31
Cadmium	mg/Kg	0.061	0.0041	0.041
Chromium	mg/Kg	24	0.40	0.51
Copper	mg/Kg	15	0.060	0.21
Lead	mg/Kg	5.2	0.038	0.041
Nickel	mg/Kg	21	0.062	0.082
Zinc	mg/Kg	86	1.8	2.1
Acenaphthene	ng/g	ND	6.2	18
Acenaphthylene	ng/g	ND	5.7	18
Anthracene	ng/g	ND	4.7	18
Benz(a)anthracene	ng/g	ND	4.2	18
Benzo(a)pyrene	ng/g	ND	6.2	18
Benzo(b)fluoranthene	ng/g	ND	7.2	18
Benzo(e)pyrene	ng/g	ND	6.2	18
Benzo(g,h,i)perylene	ng/g	ND	5.7	18
Benzo(k)fluoranthene	ng/g	ND	6.7	18
Biphenyl	ng/g	ND	5.7	18
Chrysene	ng/g	ND	5.7	18
Dibenz(a,h)anthracene	ng/g	ND	4.7	18
Dibenzothiophene	ng/g	ND	6.2	18
Dimethylnaphthalene, 2,6-	ng/g	ND	6.2	18
Fluoranthene	ng/g	ND	5.7	18
Fluorene	ng/g	ND	5.7	18
Indeno(1,2,3-c,d)pyrene	ng/g	ND	5.7	18
Methylnaphthalene, 1-	ng/g	ND	6.2	18
Methylnaphthalene, 2-	ng/g	ND	4.9	18
Methylphenanthrene, 1-	ng/g	ND	4.8	18
Naphthalene	ng/g	ND	5.7	18
Perylene	ng/g	ND	7.7	18
Phenanthrene	ng/g	ND	4.8	18
Pyrene	ng/g	ND	4.0	18
Trimethylnaphthalene, 2,3,5-	ng/g	ND	7.2	18
Bifenthrin	ng/g	ND	1.0	5.1
Cyfluthrin	ng/g	ND	0.41	5.1
Cyhalothrin, Total lambda-	ng/g	ND	0.41	5.1
Cypermethrin	ng/g	ND	0.62	5.1
Deltamethrin/Tralomethrin	ng/g	ND	1.0	5.1
Esfenvalerate/Fenvalerate	ng/g	ND	1.6	5.1
Permethrin	ng/g	ND	3.7	5.1
Fipronil	ng/g	ND	0.62	5.1
Fipronil Desulfinyl	ng/g	ND	0.62	5.1
Fipronil Sulfide	ng/g	ND	0.82	5.1

Analyte	Units [1]	Result	MDL	RL
Fipronil Sulfone	ng/g	ND	2.1	5.1
Total Organic Carbon	%	0.56	0.037	0.037

1 All measurements reported as dry weight

2 J-flagged results, reported by the laboratory as below the reporting limit (RL) but above the method detection limit (MDL), are considered estimated

ND not detected

The analytical results for metals and selected PAHs were compared to PECs and TECs from MacDonald et al. (2000); TEC and PEC ratios were calculated as specified per MRP Provision C.8.g.iv.(3). The results of the TEC and PEC comparisons are shown in Table 5.

None of the constituents registered a TEC ratio greater than 1.0, which would indicate a potential water quality effect, with nickel being closest at 0.93. In previous years, only nickel typically exhibited a TEC ratio greater than 1.0 in dry weather sediment monitoring. The average PEC ratio of 0.13 was also well below the threshold of 0.5, which would indicate a probable water quality effect.

Unusually, no pyrethroid pesticides were detected in the Marsh Creek sediments in the WY 2025 dry weather monitoring. Sediment TU equivalents therefore were not calculated for the pyrethroid pesticides (Table 6).

Typically, several pyrethroid pesticides are detected in Bay Area urban creek sediment samples, at levels cumulatively sufficient to cause toxicity (sample TU equivalent >1.0), with bifenthrin alone often found at concentrations sufficient to cause toxicity to *Hyalella azteca* in sediment samples.

Four pyrethroids were detected in the chemical analysis of the July 9, 2024 sediment samples collected at the same Marsh Creek site (site ID 544R02505), producing a summed TU equivalent value of 3.34 for the sample, and bifenthrin individually was measured at a TU equivalent of 2.54.

Table 5 TEC and PEC Quotients for Sediment Chemistry Constituents, WY 2025 Marsh Creek Site 544R02505

Analytes	Sample Units [1]	Sample	TEC Ratio	PEC Ratio
Arsenic	mg/Kg	1.7	0.17	0.05
Cadmium	mg/Kg	0.061	0.06	0.01
Chromium	mg/Kg	24	0.55	0.22
Copper	mg/Kg	15	0.47	0.10
Lead	mg/Kg	5.2	0.15	0.04
Nickel	mg/Kg	21	0.93	0.43
Zinc	mg/Kg	86	0.71	0.19
Anthracene	ng/g	ND		
Fluorene	ng/g	ND		
Naphthalene	ng/g	ND		
Phenanthrene	ng/g	ND		
Benz(a)anthracene	ng/g	ND		
Benzo(a)pyrene	ng/g	ND		
Chrysene	ng/g	ND		
Fluoranthene	ng/g	ND		
Pyrene	ng/g	ND		
Total PAHs[1]	ng/g	72	0.045	0.0032
		Number with TEC > 1.0	0	
		Combined TEC Ratio	3.09	
		Average TEC Ratio	0.39	
		Combined PEC Ratio		1.04
		Average PEC Ratio		0.13

Note: All measurements are reported as dry weight. TECs and PECs per MacDonald et al. (2000).
ND not detected
TEC and PEC ratios are not calculated when the sample result for individual constituents is ND
1 Total PAHs include 25 individual PAH compounds; NDs were substituted at 1/2 MDL to compute total PAHs

Table 6 Calculated Pyrethroid Toxic Unit Equivalents for Sediment Chemistry Data, WY 2025 Marsh Creek Site 544R02505

Pyrethroid Pesticides	LC50 (µg/g organic carbon)	Sample (ng/g)	Sample (µg/g organic carbon)	TU Equivalents[1]
Bifenthrin	0.52	ND		
Cyfluthrin	1.08	ND		
Cyhalothrin, lambda	0.45	ND		
Cypermethrin	0.38	ND		
Deltamethrin/Tralomethrin	0.79	ND		
Esfenvalerate/Fenvalerate	1.54	ND		
Permethrin	10.8	ND		

Note: All sample measurements are reported as dry weight.

ND not detected

1 Toxic unit equivalents (TU) are calculated as ratios of organic carbon-normalized pyrethroid sample concentrations to published *Hyalella azteca* LC_{50} values (Weston et al. 2013). TU equivalents are not calculated when the sample result is ND

4 Comprehensive Analysis, WYs 2020-2025

4.1 Overview, WYs 2020-2025

Per MRP Provision C.8.h.v, the Permittees are required to submit an integrated monitoring report that includes a comprehensive analysis of all the data collected since the previous integrated monitoring report, which covered the period through and including WY 2019. However, as specified in MRP footnote #48, the IMR is to exclude creek status monitoring conducted subsequent to the submittal of the prior integrated monitoring report. This comprehensive analysis therefore does not cover the bioassessment monitoring and associated water quality monitoring conducted during WYs 2020-2022 at 10 sites annually within Contra Costa County.

The period encompassing WYs 2020-2025 spanned MRP 2.0 and MRP 3.0, which was adopted in 2022. During that period, CCCWP undertook the following monitoring related to pesticides and toxicity, in accordance with Provision C.8.g under first MRP 2.0 and then MRP 3.0:

- Wet weather water column pesticides chemistry and aquatic toxicity monitoring at two urban creek sites during WY 2023
- Dry weather water column toxicity and sediment chemistry and toxicity at one urban creek site annually, WYs 2020-2025

The methods and results of prior-year monitoring programs are detailed in the respective annual urban creeks monitoring reports, and methods and results for WY 2025 are included in Section 3 of this IMR.

The relevant results are further summarized below.

The site locations monitored during WYs 2020-2025 for wet weather water column pesticides chemistry and aquatic toxicity, dry weather water column toxicity, and sediment chemistry and toxicity are shown below in Figure 1.

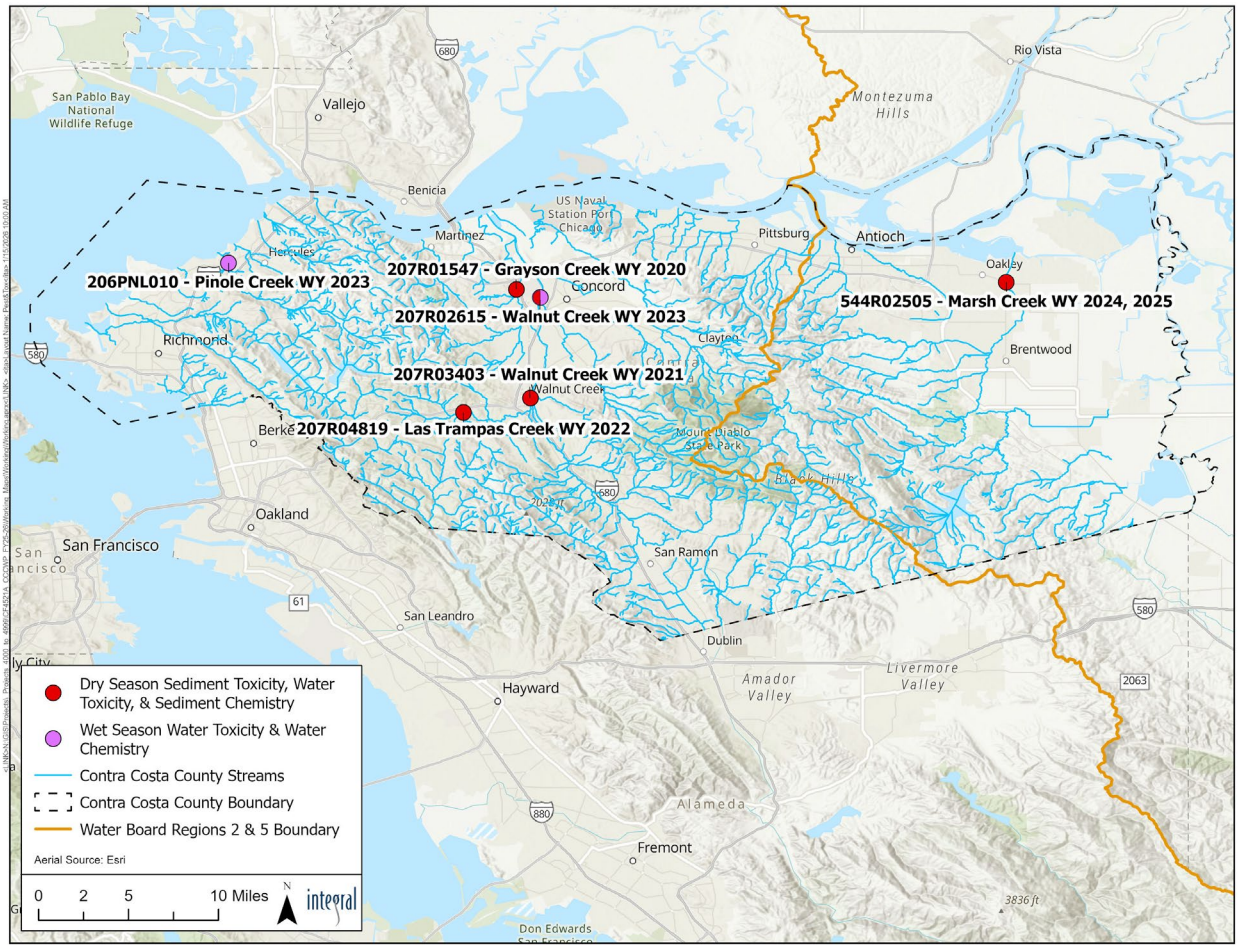

Figure 1. Wet and Dry Weather Chemistry and Toxicity Monitoring Sites, WYs 2020-2025

4.2 Wet Weather Water Column Chemistry and Toxicity Monitoring

Wet weather water samples were collected from urban creeks in the MRP region during an early season storm event on November 8, 2022 (WY 2023). Per MRP Provision C.8.g.iii.(3), if the wet weather monitoring "is conducted by the RMC on behalf of all Permittees, a total of ten (10) samples shall be collected over the Permit term." The BAMSC Workgroup coordinated sample collection during the November 8 storm event and testing and analysis of 10 samples regionwide, thereby fulfilling the MRP 3.0 wet weather monitoring requirement. By agreement of the BAMSC workgroup, the regional distribution of wet weather samples included three samples each from the Alameda and Santa Clara countywide programs, and two samples each from the Contra Costa and San Mateo countywide programs.

In Contra Costa County, wet weather samples were collected from Pinole Creek (site ID 206PNL010) and from Walnut Creek at Concord Avenue (site ID 207R02615). The samples were tested for toxicity to several different aquatic species and analyzed for a suite of pesticide compounds, as required by the MRP.

Both the Pinole Creek (site ID 206PNL010) and Walnut Creek (site ID 207R02615) November 8, 2022 stormwater samples were toxic to *Hyalella azteca*. The toxic effect in the Walnut Creek

sample was equal to 50% of the lab control; therefore, the *Hyalella azteca* test required retesting with sample water collected during wet weather from the Walnut Creek site.

Samples were collected for the retest from the Walnut Creek site during a storm event on January 10, 2023. In the retest, the sample was again toxic to *Hyalella azteca*, but with a toxic effect less than 50%.

The wet weather water toxicity test results are shown in Table 7.

Table 7 Wet Weather Toxicity Testing Results, WY 2023

Sample Date	Test Species	Test Endpoint(s)	Lab Control	Pinole Creek Site 206PNL010	Walnut Creek Site 207R02615
Stormwater Samples (11/08/2022)	*Selenastrum capricornutum* (Green Algae)	Growth (cells/mL x 106)	3.18	7.25	6.81
Stormwater Samples (11/08/2022)	*Ceriodaphnia dubia* (Freshwater Crustacean)	Survival (%)	100	100	100
Stormwater Samples (11/08/2022)	*Ceriodaphnia dubia* (Freshwater Crustacean)	Reproduction (#neonates/female)	44.6	39.9	46.7
Stormwater Samples (11/08/2022)	*Chironomus dilutus* (Midge)	Survival (%)	100	100	92.5
Stormwater Samples (11/08/2022)	*Hyalella azteca* (Freshwater Amphipod)	Survival (%)	96	**74***	**48****
Stormwater Samples (11/08/2022)	*Pimephales promelas* (Fathead Minnow)	Larval Survival (%)	97.5	95	100
Stormwater Samples (11/08/2022)	*Pimephales promelas* (Fathead Minnow)	Growth (biomass, mg)	0.86	0.84	0.91
Stormwater Sample Retest (01/10/2023)	*Hyalella azteca* (Freshwater Amphipod)	Survival (%)	100		**82***

* Sample test result was significantly less than the lab control treatment; the sample was determined to be toxic

** Sample test result was significantly less than the lab control treatment; sample was determined to be toxic, and the test result met the MRP aquatic toxicity threshold for follow-up testing (≥ 50 percent effect)

Stormwater sample retest on 01/10/2023 was for the Walnut Creek site, *Hyalella azteca* test only

In addition to TU equivalents, when possible, pyrethroid concentration goal units (CGUs) also are calculated for water samples, as specified in the Central Valley Pyrethroid Pesticides TMDL (CVRWQCB 2017). The CGU calculations involve an estimate of the fraction of the pesticide concentration present in the freely dissolved (and most biologically available) form and require TOC and dissolved organic carbon (DOC) data in addition to pyrethroids pesticides concentrations. The calculated dissolved-phase pyrethroid pesticide concentrations are compared to acute and chronic criteria established in the TMDL to produce acute and chronic CGU values for each pesticide. The individual pesticide CGUs are then summed to produce an additive CGU for the sample. CGU values >1.0 indicate an exceedance of the TMDL for water bodies regulated by the TMDL in Central Valley Region 5.

TOC and DOC data were available for the January 10, 2023 retest of the Walnut Creek (site ID 207R02615) sample, so CGUs also were calculated for that sample from the pyrethroids concentration data.

Chemistry analytical results and associated metrics are shown in Table 8 for the November 8, 2022 storm event and Table 9 for the January 10, 2023 retest.

As shown in Tables 8 and 9, the measured pyrethroid concentrations were sufficient to cause the toxicity observed in both the Walnut Creek (site ID 207R02615) and Pinole Creek (site ID 206PNL010) November 8, 2022 stormwater samples, as well as in the Walnut Creek January 10, 2023 retest sample, due principally to elevated concentrations of bifenthrin, cyhalothrin/lambda, and deltamethrin. The pyrethroid concentrations in the November 8, 2022 stormwater samples were particularly high, with pyrethroid TUs measuring 23.5 at the Walnut Creek site and 17.3 at the Pinole Creek site. Toxicity is likely when the calculated TU is greater than 1.0.

At 0.9, the chronic CGU value also nearly exceeded the Central Valley TMDL's chronic numeric trigger for the freely dissolved pyrethroids fraction in the January 10, 2023 retest (Table 9).

Table 8 Wet Weather Chemistry Monitoring Results – Stormwater Samples Collected 11/08/2022

Pesticides	Toxic Reference Levels	Pinole Creek Site 206PNL010	Pinole Creek Site 206PNL010	Walnut Creek Site 207R02615	Walnut Creek Site 207R02615
Pyrethroid Pesticides	**LC_{50} (ng/L)**	**Sample (ng/L)**	**TU Equivalent**	**Sample (ng/L)**	**TU Equivalent**
Bifenthrin	0.493	4.1	**8.32**	5.3	**10.75**
Cyfluthrin	25	0.4	0.02	0.6	0.02
Cyhalothrin, lambda	0.08	ND		0.6	**7.50**
Cypermethrin	0.56	ND		0.4	0.71
Deltamethrin*	0.2	1.8	**9.00**	0.9	**4.50**
Esfenvalerate**	0.8	ND		ND	
Permethrin	6.6	ND		ND	
	Sum (Pyrethroid TUs)		**17.3**		**23.5**
Fipronil and Degradates, etc.	**EPA Acute Benchmark (ng/L)**	**Sample (ng/L)**	**TU Equivalent**	**Sample (ng/L)**	**TU Equivalent**
Fipronil	110	6.7	0.06	7.7	0.07
Fipronil Desulfinyl	177500	2.2	0.000	2.8	0.000
Fipronil Sulfide	50000	0.5	0.00	0.6	0.00
Fipronil Sulfone	14500	4.9	0.00	5.9	0.00
Imidacloprid	385	ND		ND	
	Sum (Fipronil etc. TUs)		0.1		0.1
	Sample TU		**17.4**		**23.6**

* Analyzed as deltamethrin + tralomethrin

** Analyzed as esfenvalerate + fenvalerate

ND not detected

Bold TU Equivalent value exceeds 1.0

TU equivalents are not calculated when the sample result is ND

Table 9 Wet Weather Chemistry Monitoring Results – Stormwater Samples Collected 01/10/2023 Walnut Creek Site 207R02615

Pyrethroid Pesticides	Toxic Refernce Level LC_{50} (ng/L)	Sample (ng/L)	TU Equivalent	Acute CGU	Chronic CGU
Bifenthrin	0.493	1.3	**2.64**	0.11	0.90
Cyfluthrin	25	ND		0.0	0.0
Cyhalothrin, lambda	0.08	ND		0.0	0.0
Cypermethrin	0.56	ND		0.0	0.0
Deltamethrin*	0.2	0.9	**4.50**		
Esfenvalerate**	0.8	ND		0.0	0.0
Permethrin	6.6	ND		0.0	0.0
)	***(Pyrethroid TUs/CGUs Sum***		**7.1**	0.11	0.90
Fipronil and Degradates, etc.	**EPA Benchmark**	**Sample (ng/L)**	**TU Equivalent**		
Fipronil	110	7.1	0.06		
Fipronil Desulfinyl	177500	0.5	0.000		
Fipronil Sulfide	50000	0.5	0.00		
Fipronil Sulfone	14500	2.8	0.00		
Imidacloprid	385	ND			
	Sum (Fipronil etc. TUs)		0.1		
	Sample TU		**7.2**		

* Analyzed as deltamethrin + tralomethrin

** Analyzed as esfenvalerate + fenvalerate

ND not detected

Bold TU Equivalent value exceeds 1.0

TU equivalents and CGUs are not calculated when sample result is ND

CGU equations are not available for deltamethrin or other, non-pyrethroid pesticides

4.3 Dry Weather Chemistry and Toxicity

In dry weather, the CCCWP Permittees annually collect water and sediment samples from one urban creek site, and perform the following tests and analyses as required by the MRP:

- Water sample toxicity testing for the same set of test species as were required for the wet weather monitoring, as listed in MRP Table 8.4
- Sediment sample toxicity testing for *Hyalella azteca* and *Chironomus dilutus* (survival endpoints)
- Sediment chemical analysis for pyrethroid pesticides, fipronil and degradates, PAHs, metals, TOC, and grain size, with comparisons of results to water quality objectives or other comparative metrics, including TEC or PEC (per MacDonald et al. 2000), as has been done for previous MRP monitoring

In addition to the required TEC and PEC calculations, TU equivalents are calculated as noted above for the pesticides in sediment samples, as an indication of potential causes of sediment toxicity.

The complete dry weather and sediment toxicity testing results from WYs 2020-2025 are presented in the table in Attachment A. The results indicating statistically significant toxicity to test organisms are summarized in Table 10.

There were no toxicity test results indicating toxicity in WYs 2020 or 2022. The only toxic sediment test results occurred in WYs 2024 and 2025, in both cases to *Hyalella azteca*.

Toxicity in water samples occurred to *Ceriodaphnia dubia* in WYs 2021 and 2025; in both cases the acute test (survival) passed but the chronic test (reproduction) failed. Water samples also were toxic to *Hyalella azteca* (WY 2021), *Chironomus dilutus* (WY 2023), and *Selenastrum capricornutum* (WY 2025).

Table 10 Summary of Toxic Test Results, Dry Weather Toxicity Testing, WYs 2020-2025

Sample Site	SampleType/Date	Matrix/Test Species	Test Endpoint(s)	Lab Control	CCCWP Site	% Effect	TST Pass/Fail
WY 2021: Walnut Creek Site 207R03403	Water Samples (06/23/2021)	*Ceriodaphnia dubia* (Freshwater Crustacean)	Survival (%)	100	100	0%	Pass
WY 2021: Walnut Creek Site 207R03403	Water Samples (06/23/2021)	*Ceriodaphnia dubia* (Freshwater Crustacean)	Reproduction (#neonates/female)	**46.6**	**31.2**	**33%**	**Fail***
WY 2021: Walnut Creek Site 207R03403	Water Samples (06/23/2021)	*Hyalella azteca* (Freshwater Amphipod)	Survival (%)	**100**	**66.0**	**34%**	**Fail***
WY 2023: Walnut Creek Site 207R02615	Water Samples (07/18/2023)	*Chironomus dilutus* (Midge)	Survival (%)	**97.5**	**82.5**	**15%**	**Fail***
WY 2024: Marsh Creek Site 544R02505	Sediment Samples (07/9/2024)	*Hyalella azteca* (Freshwater Amphipod)	Survival (%)	92.5	**58.8**	**36%**	**Fail***
WY 2025: Marsh Creek Site 544R02505	Water Samples (07/22/2025)	*Selenastrum capricornutum* (Green Algae)	Growth (cells/mL x 106)	**2.18**	**0.115**	**95%****	**Fail***
WY 2025: Marsh Creek Site 544R02505	Water Samples (07/22/2025)	*Ceriodaphnia dubia* (Freshwater Crustacean)	Survival (%)	90.0	100	-11%	Pass
WY 2025: Marsh Creek Site 544R02505	Water Samples (07/22/2025)	*Ceriodaphnia dubia* (Freshwater Crustacean)	Reproduction (#neonates/female)	**30.2**	**24.0**	**20.5%**	**Fail***
WY 2025: Marsh Creek Site 544R02505	Sediment Samples (07/22/2025)	*Hyalella azteca* (Freshwater Amphipod)	Survival (%)	**95.0**	**72.5**	**24%**	**Fail***

* Sample test result was significantly less than the lab control treatment; sample was determined to be toxic
** % effect was >50%; retest required

The dry weather sediment chemistry results are summarized for WYs 2020-2025 in Table 11 (chemical analyses are not required under the MRP for dry weather samples).

Table 11 Dry Weather Sediment Chemistry Monitoring Results, WYs 2020-2025

Analyte	Units [1]	WY 2020 Grayson Creek Site 207R01547	WY 2021 Walnut Creek Site 207R03403	WY 2022 Las Trampas Creek Site 207R04819	WY 2023 [3] Walnut Creek Site 207R02615	WY 2024 Marsh Creek Site 544R02505	WY 2025 Marsh Creek Site 544R02505
Arsenic	mg/Kg	3.3	3.4	4	3.4	3.2	1.7
Cadmium	mg/Kg	0.2	0.29	0.21	0.30	0.05	0.061
Chromium	mg/Kg	15	24	33	26	22	24
Copper	mg/Kg	14	30	18	20	12	15
Lead	mg/Kg	11	14	14	11	4.2	5.2
Nickel	mg/Kg	15	26	39	31	21	21
Zinc	mg/Kg	95	91	61	73	40	86
Acenaphthene[2]	ng/g	ND	ND	ND	ND	ND	ND
Acenaphthylene[2]	ng/g	ND	ND	ND	ND	ND	ND
Anthracene[2]	ng/g	ND	ND	ND	ND	ND	ND
Benz(a)anthracene[2]	ng/g	82	ND	ND	[17.5]	ND	ND
Benzo(a)pyrene[2]	ng/g	100	ND	ND	[17.6]	ND	ND
Benzo(b)fluoranthene[2]	ng/g	200	ND	ND	27.8	ND	ND
Benzo(e)pyrene[2]	ng/g	100	ND	ND	[17.1]	ND	ND
Benzo(g,h,i)perylene[2]	ng/g	ND	ND	ND	ND	ND	ND
Benzo(k)fluoranthene[2]	ng/g	61	ND	ND	[11.7]	ND	ND
Biphenyl[2]	ng/g	ND	ND	ND	ND	ND	ND
Chrysene[2]	ng/g	100	ND	ND	36	ND	ND
Dibenz(a,h)anthracene[2]	ng/g	ND	ND	ND	ND	ND	ND
Dibenzothiophene[2]	ng/g	ND	ND	ND	ND	ND	ND
Dimethylnaphthalene, 2,6[2]-	ng/g	ND	ND	J3.1	ND	ND	ND
Fluoranthene[2]	ng/g	200	83	31	44	ND	ND
Fluorene[2]	ng/g	ND	ND	ND	ND	ND	ND
Indeno(1,2,3-c,d)pyrene[2]	ng/g	61	ND	ND	[16.4]	ND	ND
Methylnaphthalene, 1[2]	ng/g	ND	ND	ND	ND	ND	ND
Methylnaphthalene, 2[2]	ng/g	ND	ND	ND	ND	ND	ND
Methylphenanthrene, 1[2]	ng/g	ND	ND	ND	ND	ND	ND
Naphthalene[2]	ng/g	ND	ND	ND	ND	ND	ND
Perylene[2]	ng/g	ND	ND	ND	[7.9]	ND	ND
Phenanthrene[2]	ng/g	51	31	10	27	ND	ND
Pyrene[2]	ng/g	200	83	21	43	ND	ND
Trimethylnaphthalene, 2,3,5[2]	ng/g	NA	NA	NA	ND	ND	ND
Bifenthrin[2]	ng/g	6.5	3.7	2.8	1.6	3.3	ND
Cyfluthrin[2]	ng/g	0.93	0.75	J0.31	J 0.16	J0.39	ND
Cyhalothrin, Total lambda-[2]	ng/g	0.73	ND	J0.22	J 0.22	J0.38	ND
Cypermethrin[2]	ng/g	ND	0.79	J0.12	J 0.25	J0.3	ND
Deltamethrin/Tralomethrin[2]	ng/g	0.67	0.64	1.7	J 0.46	ND	ND
Esfenvalerate/Fenvalerate[2]	ng/g	ND	ND	ND	ND	ND	ND
Permethrin[2]	ng/g	2.6	1.8	1.3	ND	ND	ND

Analyte	Units [1]	WY 2020 Grayson Creek Site 207R01547	WY 2021 Walnut Creek Site 207R03403	WY 2022 Las Trampas Creek Site 207R04819	WY 2023 [3] Walnut Creek Site 207R02615	WY 2024 Marsh Creek Site 544R02505	WY 2025 Marsh Creek Site 544R02505
Carbaryl	ng/g	ND	ND	ND	NA	NA	NA
Fipronil	ng/g	ND	ND	ND	ND	ND	ND
Fipronil Desulfinyl	ng/g	ND	ND	ND	ND	ND	ND
Fipronil Sulfide	ng/g	ND	ND	ND	ND	ND	ND
Fipronil Sulfone	ng/g	ND	ND	ND	ND	ND	ND
Total Organic Carbon	%	2.9	1.3	1.7	0.99	0.25	0.56

1 All measurements reported as dry weight
2 J-flagged results, reported by the laboratory as below the reporting limit (RL) but above the method detection limit (MDL), are considered estimated
3 For WY 2023 PAHs, detected concentrations were calculated as the average of primary and duplicate sample results due to issues with field duplicate sample RPDs. This resulted in some calculated results lower than the RL; those results are marked with [brackets].
NA not analyzed
ND not detected

As shown in Table 12, all seven metals were detected in every dry weather sediment sample analyzed from WY 2020-2025.

Detections of PAHs were highly variable, ranging from 10 PAHs detected at Grayson Creek (site 207R01547) in WY 2020, and 11 detected at Walnut Creek (site 207R02615) in WY 2023, to zero detections at Marsh Creek (site 544R02505) in both WY 2024 and 2025.

Pyrethroid pesticides were commonly detected in sediment samples at the rate of three to five pyrethroids per sample every year except WY 2025, during which no pyrethroids were detected. Neither carbaryl nor fipronil nor its degradates were detected in any sediment samples collected during WYs 2020-2025.

TEC and PEC ratios were computed as required by the MRP (per MacDonald et al. 2000), and TU equivalents for pesticides also were computed; the results for WYs 2020-2025 are shown in Tables 12 and 13, respectively. Because no PEC ratios exceeded the MRP thresholds during WYs 2020-2025, only TEC ratios are presented in Table 12.

Very few constituents exceeded the MRP threshold of >1.0 for the calculated TEC ratio. The PAH pyrene exhibited a TEC ratio >1.0 in WY 2020, and nickel TECs were >1.0 in WYs 2021-2023. The source of nickel in Contra Costa watersheds is likely from natural erosion of substrate minerals.

Table 12 Threshold Effect Concentration (TEC) Quotients for Sediment Chemistry Constituents, WYs 2020-2025

Constituent	Sample Units [1]	WY 2020 Grayson Creek Site 207R01547	WY 2021 Walnut Creek Site 207R03403	WY 2022 Las Trampas Creek Site 207R04819	WY 2023 Walnut Creek Site 207R02615	WY 2024 Marsh Creek Site 544R02505	WY 2025 Marsh Creek Site 544R02505
Arsenic	TEC Ratio	0.34	0.35	0.41	0.35	0.33	0.17
Cadmium	TEC Ratio	0.20	0.29	0.21	0.30	0.05	0.06
Chromium	TEC Ratio	0.35	0.55	0.76	0.60	0.51	0.55
Copper	TEC Ratio	0.44	0.95	0.57	0.63	0.38	0.47

Constituent	Sample Units [1]	WY 2020 Grayson Creek Site 207R01547	WY 2021 Walnut Creek Site 207R03403	WY 2022 Las Trampas Creek Site 207R04819	WY 2023 Walnut Creek Site 207R02615	WY 2024 Marsh Creek Site 544R02505	WY 2025 Marsh Creek Site 544R02505
Lead	TEC Ratio	0.31	0.39	0.39	0.31	0.12	0.15
Nickel	TEC Ratio	0.66	**1.15**	**1.72**	**1.37**	0.93	0.93
Zinc	TEC Ratio	0.79	0.75	0.50	0.60	0.33	0.71
Anthracene	TEC Ratio						
Fluorene	TEC Ratio						
Naphthalene	TEC Ratio						
Phenanthrene	TEC Ratio	0.250	0.152	0.049	0.132		
Benz(a)anthracene	TEC Ratio	0.759			0.162		
Benzo(a)pyrene	TEC Ratio	0.667					
Chrysene	TEC Ratio	0.602			0.217		
Fluoranthene	TEC Ratio	0.473	0.196	0.073	0.104		
Pyrene	TEC Ratio	**1.026**	0.426	0.108	0.221		
Total PAHs[2]	TEC Ratio	0.783	0.160	0.055	0.190	0.044	0.045
Results	***Number with TEC > 1.0***	**1**	1	1	1	0	0
Results	***Combined TEC Ratio***	**7.64**	5.37	4.85	5.18	2.68	3.09
Results	***Average TEC Ratio***	**0.55**	0.49	0.44	0.47	0.34	0.39

1 TEC ratios are computed per MacDonald et al. (2000) for the listed constituents. All concentration measurements were reported as dry weight. TEC ratios are not calculated when the sample result for individual constituents is ND

2 "Total PAHs" include 25 individual PAH compounds; NDs were substituted at 1/2 MDL to compute total PAHs

Bold TEC ratio exceeds 1.0

Pyrethroid TUs calculated from dry weather sediment chemistry data exceeded 1.0 only in the Marsh Creek sample during WY 2024, coinciding with sediment toxicity to *Hyalella azteca*. Sediment samples collected from the same site in WY 2025 were also toxic to *Hyalella azteca*, but no pyrethroid pesticides were detected in the sediment analysis.

Table 13 Calculated Pyrethroid Toxic Unit Equivalents for Sediment Chemistry Data, WYs 2020-2025

Pyrethroid Pesticides	Sample Units [1]	WY 2020 Grayson Creek Site 207R01547	WY 2021 Walnut Creek Site 207R03403	WY 2022 Las Trampas Creek Site 207R04819	WY 2023 Walnut Creek Site 207R02615	WY 2024 Marsh Creek Site 544R02505	WY 2025 Marsh Creek Site 544R02505
Bifenthrin	TU Equiv.	0.43	0.55	0.32	0.31	2.54	
Cyfluthrin	TU Equiv.	0.03	0.05	0.02	0.01	0.14	
Cyhalothrin, lambda	TU Equiv.	0.06		0.03	0.05	0.34	
Cypermethrin	TU Equiv.		0.16	0.02	0.07	0.32	
Deltamethrin/Tralomethrin	TU Equiv.	0.03	0.06	0.13	0.06		
Esfenvalerate/Fenvalerate	TU Equiv.						
Permethrin	TU Equiv.	0.01	0.01	0.01			
Sum (Pyrethroid TUs)	TU Equiv.	0.55	0.83	0.53	0.50	3.34	

1 TU equivalents are calculated as ratios of organic carbon-normalized pyrethroid sample concentrations to published *Hyalella azteca* LC_{50} values (Weston et al. 2013). The laboratory reported all sample concentration measurements as dry weight. TU equivalents are not calculated when the sample result is ND

Under MRP Provision C.8.g.ii, the MRP permittees have continued to analyze grain size distribution in the annual dry weather sediment samples, even after discontinuation of the bioassessment monitoring. The MRP requires that sediment samples be collected from fine-grained depositional locations, as pollutants tend to attach to smaller particles in sediments. The results of the sediment grain size analysis for samples collected during WYs 2020-2025 are shown in Table 14. The grain size distribution results confirm that the sediment samples were generally comprised primarily of finer-grained particles (medium-to-fine sand, silt, clay). An exception is the WY 2024 Marsh Creek sample, which contained the highest percentage of clay particles (16%), but also contained notable amounts of larger particles (coarse sand to pebbles). The WY 2025 Marsh Creek grain size distribution also contained lower percentages of particles in the smallest categories (silt and clay) than in prior years (before WY 2024). It is possible that this grain size distribution affected the WY 2025 pyrethroids sediment chemistry analysis, by providing fewer favorable sites for adsorption of pesticides.

Table 14 Sediment Grain Size Distribution Results, WYs 2020-2025

Grain Size Category	Units	WY 2020 Grayson Creek Site 207R01547	WY 2021 Walnut Creek Site 207R03403	WY 2022 Las Trampas Creek Site 207R04819	WY 2023 Walnut Creek Site 207R02615	WY 2024 Marsh Creek Site 544R02505	WY 2025 Marsh Creek Site 544R02505
Clay: <0.0039 mm	%	12.25	11.4	14.05	9.3	16	6.3
Silt: 0.0039 to <0.0625 mm	%	18.57	16.65	24.67	11.1	0.9	5.7
Sand: V. Fine 0.0625 to <0.125 mm	%	9.69	4.49	16.44	21.4	0	8.7
Sand: Fine 0.125 to <0.25 mm	%	16.41	30.43	19.86	51.6	0	27.8
Sand: Medium 0.25 to <0.5 mm	%	20.27	18.99	18.19	5.8	1.8	39.3
Sand: Coarse 0.5 to <1.0 mm	%	10.58	1.68	5.62	0.5	0	9.8
Sand: V. Coarse 1.0 to <2.0 mm	%	12.23	16.35	1.16	0.3	13.1	2.5
Granule: 2.0 to <4.0 mm	%	6.97	1.06	0.44	0.3	21.2	2.0
Pebble: Small 4 to <8 mm	%	4.81	0	0	0	31.8	0.8
Pebble: Medium 8 to <16 mm	%	0.16	0	0	0	0.2	2.5
Pebble: Large 16 to <32 mm	%	0	0.28	0	0	8.8	0
Pebble: V. Large 32 to <64 mm	%	0	0	0	0	9.0	0

ND" results are shown as "0

4.4 Non-Permittee Monitoring Data

Relevant data have been generated in recent years by other statewide and regional monitoring programs. These include:

- California Department of Pesticide Regulation Study 329. Pesticide monitoring in urban areas of Northern California, FY2022/2023 (Alvarado and McClanahan 2024)
- California Department of Pesticide Regulation Study 320, Ambient Surface Water and Mitigation Monitoring in Urban Areas in Southern California, WY2022/2023 (Nepal 2024)
- U.S. Geological Survey, California Stream Quality Assessment (Sandstrom et al. 2022)
- San Francisco Estuary Institute, San Francisco Bay Margins Study (Heberger et al. 2020)

The California Department of Pesticide Regulation (DPR) Northern California (NorCal) and Southern California (SoCal) studies listed above are ongoing, with monitoring and reporting occurring approximately annually. The NorCal studies include sites located within Contra Costa County, and once published the data are available from DPR's SURF database.[1]

Pyrethroid pesticides, fipronil, and imidacloprid have been commonly detected in urban surface water samples in all these programs, with some concentrations exceeding corresponding aquatic life benchmarks.

CCCWP collected creek samples for DPR from Walnut Creek (site ID 207R02615) during the November 8, 2022 storm event, alongside the required MRP samples. This sample was collected to support DPR's NorCal urban surface water monitoring program, per DPR's request via outreach to BAMSC.

[1] See: https://www.cdpr.ca.gov/docs/emon/surfwtr/surfcont.htm

4.5 Prior Conditions and Trends

The findings presented in this report reflect prior conditions in urban creeks within Contra Costa County, the San Francisco Bay Area, and throughout California generally. As documented in numerous monitoring studies and reports over the past three decades (see e.g., SFBRWQCB 2005, Ensminger et al. 2013, Ruby 2013, CCCWP 2020), contamination of urban creeks by current-use pesticides–and associated toxicity to aquatic invertebrates–has been and continues to be a common occurrence.

Throughout the 1990s and continuing through the early 2000s, Bay Area urban creeks were frequently found to be contaminated with the organophosphate pesticides diazinon and chlorpyrifos, as documented in the Diazinon and Pesticide-Related Toxicity in Urban Creeks TMDL (SFBRWQCB 2005).

After the USEPA imposed substantial restrictions on the use of those pesticides in urban areas, manufacturers replaced the organophosphates with other insecticide active ingredients for urban use, notably pyrethroids, and bifenthrin in particular. Those current-use insecticides were then often detected in monitoring of urban creeks, in both sediment and water-column samples (Ensminger et al. 2013). As studies accumulated documenting contamination of urban creeks by pyrethroids, manufacturers began to release products containing other insecticide active ingredients, such as fipronil and imidacloprid.

As early as the mid-to-late 2000s, pyrethroids and fipronil–and associated toxicity to aquatic invertebrates–were widely found in California urban creeks, including in the Bay Area generally and Contra Costa County specifically (Ruby 2013). Similar findings have continued to accrue annually in limited monitoring by CCCWP under the MRP (CCCWP 2020). During this period the observed toxicity has been most commonly attributed to the widespread use of pyrethroid pesticides (Ruby 2013; CVRWQCB 2017; CCCWP 2022).

Six sediment samples were tested previously from sites within the Marsh Creek watershed (including Marsh Creek and Dry Creek sites), spanning the period from water WY 2012 to WY 2019[2]. The results were similar to the WY 2024 results presented above. All six prior samples were found to be toxic to *Hyalella azteca*, with pyrethroid pesticides detected in the sediments at levels sufficient to cause the toxic response (CCCWP 2022).

4.6 Beneficial Uses

Beneficial uses designated within the San Francisco Bay Basin Plan (SFBRWQCB 2023) for Marsh Creek include commercial and sport fishing (COMM), preservation of rare and endangered species (RARE), warm freshwater habitat (WARM), wildlife habitat (WILD), water contact recreation (REC1), and noncontact water recreation (REC2).

While these designations are generally aimed at protecting fish and fishing opportunities, the aquatic invertebrates most directly affected by pesticide-caused toxicity form essential links in the aquatic food web, and lower trophic levels provide necessary resources to support fish-related beneficial uses. The designated beneficial uses, therefore, are not supported by the continued

[2] In the cited Pyrethroid Control Program Baseline Monitoring Report (CCCWP 2022), Tables 1 and 5, the 2019 Marsh Creek site ID is misidentified as 5440R02505; the correct site ID code is 544MSH045. This misidentification also appears previously in the CCCWP Probabilistic Creek Status Monitoring Report: Water Year 2019 (October 2018-September 2019), February 26, 2020, (CCCWP 2020) in section 4.3.5 Water Column Toxicity (Dry Weather), Table 4.13, section 4.3.6 Sediment Toxicity and Sediment Chemistry, Tables 4.14, 4.15 and 4.16, and section 5.2.3 Sediment Triad Analysis, Table 5.11.

contamination of urban creeks by current-use pesticides and associated pesticide-caused toxicity, as documented in this and prior reports and studies.

4.7 Comparisons to Water Quality Standards

The determinations of water column and sediment toxicity to aquatic organisms documented in this report represent apparent violations of the narrative toxicity water quality objective in the San Francisco Bay Basin Plan (SFBRWQCB 2023), which states:

> "All waters shall be maintained free of toxic substances in concentrations that are lethal to or that produce other detrimental responses in aquatic organisms."

This is supported by the language of the Basin Plan Amendment implementing the "Water Quality Attainment Strategy and TMDL for Diazinon and Pesticide-Related Toxicity in Urban Creeks":

> "When pesticide-related toxicity occurs in urban creek water, creeks do not meet the narrative toxicity objective. When pesticide-related toxicity occurs in sediment, the creeks also do not meet the narrative sediment objective. Likewise, when creek water or sediment is toxic, creeks do not meet the narrative population and community ecology objective. Urban creek waters that fail to meet these objectives are not protective of cold and warm freshwater habitats." (Basin Plan Ch. 7, SFRWQCB 2023)

The Diazinon and Pesticide-Related Toxicity in Urban Creeks TMDL aims to protect aquatic organisms generally and "ensure that urban creeks meet applicable water quality standards established to protect and support beneficial uses" (SFBRWQCB 2005).

In cases where a statistically significant finding of toxicity is accompanied by water or sediment chemistry data showing elevated levels of pesticides, the monitoring results also arguably represent an exceedance of the Diazinon and Pesticide-Related Toxicity in Urban Creeks TMDL's *numeric target* for pesticide-related toxicity, as in those cases the chemistry data clearly show that pesticides likely "cause or contribute to the toxicity."

For WY 2020-2025, the monitoring that included toxic test results in either water or sediment testing is summarized in Table 15, along with the associated test species and calculated TU equivalents for detected pyrethroid pesticides in the toxic samples, where available.

During the WY 2020–2025 monitoring, where associated chemistry data were available, toxicity generally was accompanied by elevated concentrations of pyrethroid pesticides, as indicated by TU equivalent values >1.0 in Table 15. Such samples represent apparent exceedances of both the narrative Basin Plan objective and the TMDL numeric target. The one exception is the Marsh Creek WY 2025 toxic sediment sample, in which the lower percentages of finer grained sediments may have limited the presence of sediment-based pesticides.

Table 15 Monitoring Years with Toxic Test Results and Pyrethroid Pesticides Toxic Unit Equivalents, WY 2020-2025

Water Year	Wet/Dry Weather	Water Toxicity	Pyrethroids TU Equivalent [Water]	Sediment Toxicity	Pyrethroids TU Equivalent [Sediment]
2020	Dry	*Ceridaphnia*/Chronic	[NA]	[ND]	[ND]
2020	Dry	*Hyalella*/Acute	[NA]	[ND]	[ND]
2023	Wet (event 1; Pinole Creek)	*Hyalella*/Acute	17.3	[ND]	[ND]
2023	Wet (event 1; Walnut Creek)	*Hyalella*/Acute	23.5	[ND]	[ND]
2023	Wet (event 2; Walnut Creek)	*Hyalella*/Acute	7.1	[ND]	[ND]
2023	Dry	*Chironomus*/Acute	[NA]	[ND]	[ND]
2024	Dry	[ND]	[ND]	*Hyalella*/Acute	3.34
2025	Dry	*Selenastrum*/Chronic	[NA]	*Hyalella*/Acute	[NC]
2020	Dry	*Ceridaphnia*/Chronic	[NA]	[ND]	[ND]

ND no data
NA not analyzed; MRP does not require chemical analysis for dry weather water samples
NC not calculated; no pyrethroid pesticides detected by laboratory

The noted exceedances of the narrative Basin Plan objective and the TMDL numeric target do not, however, trigger notification to the SFBRWQCB per MRP Provision C.8.h.i, because they are "continuing or recurring exceedances of water quality standards previously reported to the Water Board" and "exceedances of pollutants that are addressed pursuant to Provisions C.9 (et al.)…" In prior dry weather monitoring, as noted in Section 4.5 above, pyrethroid pesticides were detected in the sediments of all toxic sediment samples at levels sufficient to have caused the toxic response (i.e., with calculated TU approximately equal to or greater than 1.0). Similarly, all prior MRP wet weather samples were toxic to Hyalella, and the associated water chemistry results included pyrethroid pesticides present at TU>1.0. (CCCWP 2022).

CCCWP will continue to address the issues of pesticide contamination in urban creeks and pesticide-caused toxicity to aquatic organisms through the ongoing implementation of the Pesticides Toxicity Control Program per MRP Provision C.9.

4.8 Impairments, Sources, and Follow-up

Water quality impairment of urban creeks resulting from pesticide contamination and pesticide-caused toxicity is a systemic problem in Contra Costa County and throughout the Bay Area (SFBRWQCB 2005, Ruby 2013). The instances of water column and sediment toxicity presented in this report indicate ongoing impairment of water quality.

The sources of these impairments are generally applications of legally registered pesticides by certified professional pest control operators and the use of over-the-counter products by individual residents and business proprietors. As noted in the Diazinon and Pesticide-Related Toxicity in Urban Creeks TMDL:

> "Urban runoff contains pesticides as a result of pesticides being manufactured, formulated into products, and sold through distributors and retailers to businesses and individuals who apply them for structural pest control, landscape maintenance, agricultural, and other pest management purposes." (SFBRWQCB 2005)

As shown in Table 15, the toxic effects observed in the pesticides and toxicity monitoring required by the MRP have typically occurred in testing of aquatic invertebrates, including *Ceriodaphnia dubia* in WY 2021 and 2025, *Hyalella azteca* in WY 2021, and *Chironomus dilutus* in WY 2023. As noted previously, in recent years such toxicity has been commonly associated with the presence of insecticides, particularly pyrethroids, in water or sediment samples.

The significant toxicity to the algae test species (*Selenastrum capricornutum*) that occurred in the WY 2025 dry weather water sample is an anomaly. The MRP does not require chemical analysis of dry weather water samples, and because herbicide-related toxicity is so rare in urban creeks, even the MRP wet weather monitoring does not include analysis for herbicides. However, given the high degree of toxicity observed (95% effect in the initial sample, collected from Marsh Creek on July 9, 2025) and the well-known susceptibility of algae and other aquatic plants to herbicides, it can be hypothesized that the observed toxicity may have been caused by a high concentration of one or more herbicides. Common herbicides such as simazine, diuron, and glyphosate are all highly toxic to algae and are widely used in Bay Area urban settings. An elevated herbicide concentration also could have caused or contributed to the relatively mild toxicity observed in *Ceriodaphnia dubia* in the same sample (20.5% toxic effect), as these invertebrates can be sensitive to higher concentrations of herbicides.

The retest sample collected on September 8, 2025 from the same Marsh Creek site was not toxic to *Selenastrum*, indicating that the prior toxicity was likely due to a transient incident.

Because toxicity to test species in dry weather water samples is fairly common, as shown in Table 15, a broad chemistry analytical scan for pesticides, to include herbicides as well as insecticides, would be routinely helpful in interpretation of the toxicity testing results.

The process of addressing the known water quality impairments and sources of pesticide contamination is ongoing through the implementation of the Pesticides Toxicity Control Program per MRP Provision C.9; that program represents the essential ongoing follow-up to the findings presented in this and prior reports.

5 Conclusions and Recommendations

5.1 Compliance Findings - Pesticides and Toxicity Monitoring

5.1.1 Wet Weather

Wet weather water samples were collected from urban creeks in the MRP region during an early season storm event on November 8, 2022 (WY 2023). In Contra Costa County, wet weather samples were collected from Walnut Creek at Concord Avenue (site ID 207R02615) and from Pinole Creek (site ID 206PNL010). The samples were tested for toxicity to several different aquatic species and analyzed for a suite of pesticide compounds, as required by the MRP.

Both the Walnut Creek (site ID 207R02615) and Pinole Creek (site ID 206PNL010) November 8, 2022 stormwater samples were toxic to *Hyalella azteca*. The toxic effect in the Walnut Creek sample was equal to 50% of the lab control; therefore, the *Hyalella azteca* test required retesting with sample water collected during wet weather at the Walnut Creek site.

Samples for the retest were collected at the Walnut Creek site during a storm event on January 10, 2023. In the retest, the sample was again toxic to *Hyalella azteca*, but the toxic effect was less than 50%.

The measured pyrethroid concentrations in the wet weather samples were sufficient to cause the toxicity observed in both the Walnut Creek (site ID 207R02615) and Pinole Creek (site ID 206PNL010) November 8, 2022 stormwater samples, as well as in the Walnut Creek January 10, 2023 retest sample, due principally to elevated concentrations of bifenthrin, cyhalothrin/lambda, and deltamethrin. The pyrethroid sediment concentrations in the November 8, 2022 stormwater samples were particularly high, with pyrethroid toxic unit equivalents (TUs) measuring 23.5 at the Walnut Creek site and 17.3 at the Pinole Creek site. Toxicity is likely when the calculated TU exceeds 1.0.

5.1.2 Dry Weather

Dry weather water and sediment samples were collected annually during WY 2020-2025 at one urban creek site within Contra Costa County.

Toxicity in dry weather water samples occurred to *Ceriodaphnia dubia* in WYs 2021 and 2025; in both cases, the acute test (survival) passed, but the chronic test (reproduction) failed. Water samples also were toxic to *Hyalella azteca* (WY 2021), *Chironomus dilutus* (WY 2023), and *Selenastrum capricornutum* (WY 2025). The MRP requires no water chemistry testing for dry weather water samples.

All seven metals were detected in every dry weather sediment sample analyzed from WY 2020–2025.

Detections of PAHs were highly variable, ranging from 10 PAHs detected at Grayson Creek (site 207R01547) in WY 2020 and 11 detected at Walnut Creek (site 207R02615) in WY 2023 to zero detections at Marsh Creek (site 544R02505) in both WY 2024 and WY 2025.

Pyrethroid pesticides were commonly detected in sediment samples at the rate of three to five pyrethroids per sample every year except WY 2025, during which no pyrethroids were detected. Analysis of sediment grain size distributions indicated that a preponderance of larger particles may have influenced the WY 2025 pyrethroid sediment chemistry results. Neither carbaryl nor fipronil nor its degradates were detected in any sediment samples collected during WYs 2020-2025.

The only toxic sediment test results occurred in WYs 2024 and 2025, in both cases to *Hyalella azteca*. Pyrethroid TUs calculated from dry weather sediment chemistry data exceeded 1.0 only in the Marsh Creek sample during WY 2024, coinciding with the observed sediment toxicity to *Hyalella azteca*. Sediment samples collected from the same site in WY 2025 were also toxic to *Hyalella azteca*, but no pyrethroid pesticides were detected in the sediment analysis.

5.1.3 Comparisons to Water Quality Standards

The determinations of toxicity to aquatic organisms documented in this report represent apparent violations of the narrative toxicity water quality standard in the San Francisco Bay Basin Plan (SFBRWQCB 2023), as well as the narrative sediment objective and the narrative population and community ecology objective.

The Diazinon and Pesticide-Related Toxicity in Urban Creeks TMDL aims to protect aquatic organisms generally and "ensure that urban creeks meet applicable water quality standards established to protect and support beneficial uses" (SFBRWQCB 2005). The statistically significant findings of water and sediment toxicity documented in this report, taken together with the water and sediment chemistry data showing elevated levels of pyrethroid pesticides, also arguably represent an exceedance of the TMDL's numeric target for pesticide-related toxicity, as it is clear from the chemistry data that in most cases pesticides likely "cause or contribute to the toxicity." As stated in the TMDL, "Urban creek waters that fail to meet these objectives are not protective of cold and warm freshwater habitats" (Basin Plan Ch. 7, SFRWQCB 2023).

5.2 Scientific Interpretation

5.2.1 Comparisons to Prior Conditions

The urban creek monitoring results indicating toxicity to aquatic organisms, particularly aquatic invertebrates, with accompanying chemistry data showing elevated concentrations of current-use pesticides, continue a long-standing trend in Bay Area urban creeks, as documented by past CCCWP monitoring reports (see e.g., CCCWP 2020), regional and statewide studies (Ruby 2013), and the Bay Area Diazinon and Pesticide-Related Toxicity in Urban Creeks TMDL (SFBRWQCB 2005).

5.2.2 Impairments and Sources

The instances of water column and sediment toxicity presented in this report indicate ongoing examples of such water quality impairments, and the likely sources of the impairment are applications of pyrethroid and other pesticides within the Marsh Creek watershed. The unusual toxicity to the algae *Selenastrum capricornutum* observed during the WY 2025 dry weather monitoring may have been caused by elevated concentrations of one or more herbicides.

5.3 Recommendations for Follow-up Actions

Continued implementation of CCCWP's Pesticides Toxicity Control Program, as defined in MRP Provision C.9, including the planned activities for fiscal year 2025/2026 as listed in the CCCWP Annual Report for Fiscal Year 2024/2025 (CCCWP 2025), is recommended.

The current approach to annual reporting under the MRP requires detailed, resource-intensive submissions that may not always yield significant year-to-year changes in findings, particularly for established monitoring programs such as Pesticides and Toxicity monitoring. The annual UCMRs have provided in-depth analyses and interpretations, but more meaningful trends and effectiveness analyses emerge over multi-year periods. For the next permit term, CCCWP recommends simplifying annual reporting by providing a brief summary via monitoring progress reports to accompany the annual data submittals to CEDEN. Comprehensive data analysis and interpretation would remain as-is in the IMR. This approach would reduce the annual reporting burden and focus resources on data collection and program management.

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Attachment A Dry Weather Toxicity Testing Results, Water Years 2020-2025

Table A -1 Dry Weather Toxicity Testing Results, WYs 2020-2025

Creek/Site	SampleType/Date	Matrix/Test Species	Test Endpoint(s)	Lab Control	CCCWP Site	% Effect	TST Pass/Fail
WY 2020: Grayson Creek Site 207R01547	Water Samples (07/22/2020)	*Selenastrum capricornutum* (Green Algae)	Growth (cells/mL x 106)	0.891	1.73	-94%	Pass
WY 2020: Grayson Creek Site 207R01547	Water Samples (07/22/2020)	*Ceriodaphnia dubia* (Freshwater Crustacean)	Survival (%)	100	100	0%	Pass
WY 2020: Grayson Creek Site 207R01547	Water Samples (07/22/2020)	*Ceriodaphnia dubia (Freshwater Crustacean)*	Reproduction (#neonates/female)	34.4	33.7	2%	Pass
WY 2020: Grayson Creek Site 207R01547	Water Samples (07/22/2020)	*Chironomus dilutus* (Midge)	Survival (%)	90.0	95.0	-6%	Pass
WY 2020: Grayson Creek Site 207R01547	Water Samples (07/22/2020)	*Hyalella azteca* (Freshwater Amphipod)	Survival (%)	96	96.0	0%	Pass
WY 2020: Grayson Creek Site 207R01547	Water Samples (07/22/2020)	*Pimephales promelas* (Fathead Minnow)	Larval Survival (%)	97.5	100	-3%	Pass
WY 2020: Grayson Creek Site 207R01547	Water Samples (07/22/2020)	*Pimephales promelas (Fathead Minnow)*	Growth (biomass, mg)	0.72	0.94	-31%	Pass
WY 2020: Grayson Creek Site 207R01547	Sediment Samples (07/22/2020)	*Chironomus dilutus* (Midge)	Survival (%)	96.3	96.2	0%	Pass
WY 2020: Grayson Creek Site 207R01547	Sediment Samples (07/22/2020)	*Hyalella azteca* (Freshwater Amphipod)	Survival (%)	93.8	97.5	-4%	Pass
WY 2021: Walnut Creek Site 207R03403	Water Samples (06/23/2021)	*Selenastrum capricornutum* (Green Algae)	Growth (cells/mL x 106)	2.09	7.90	-278%	Pass
WY 2021: Walnut Creek Site 207R03403	Water Samples (06/23/2021)	*Ceriodaphnia dubia* (Freshwater Crustacean)	Survival (%)	100	100	0%	Pass
WY 2021: Walnut Creek Site 207R03403	Water Samples (06/23/2021)	*Ceriodaphnia dubia (Freshwater Crustacean)*	Reproduction (#neonates/female)	**46.6**	**31.2**	**33%**	**Fail***
WY 2021: Walnut Creek Site 207R03403	Water Samples (06/23/2021)	*Chironomus dilutus* (Midge)	Survival (%)	100	92.5	8%	Pass
WY 2021: Walnut Creek Site 207R03403	Water Samples (06/23/2021)	*Hyalella azteca* (Freshwater Amphipod)	Survival (%)	**100**	**66.0**	**34%**	**Fail***
WY 2021: Walnut Creek Site 207R03403	Water Samples (06/23/2021)	*Pimephales promelas* (Fathead Minnow)	Larval Survival (%)	95.0	100	-5%	Pass

Creek/Site	SampleType/Date	Matrix/Test Species	Test Endpoint(s)	Lab Control	CCCWP Site	% Effect	TST Pass/Fail
WY 2021: Walnut Creek Site 207R03403	Water Samples (06/23/2021)	*Pimephales promelas (Fathead Minnow)*	Growth (biomass, mg)	0.53	0.88	-66%	Pass
WY 2021: Walnut Creek Site 207R03403	Sediment Samples (06/23/2021)	*Chironomus dilutus* (Midge)	Survival (%)	100	96.2	4%	Pass
WY 2021: Walnut Creek Site 207R03403	Sediment Samples (06/23/2021)	*Hyalella azteca* (Freshwater Amphipod)	Survival (%)	92.5	86.2	7%	Pass
WY 2022: Las Trampas Creek Site 207R04819	Water Samples (07/12/2022)	*Selenastrum capricornutum* (Green Algae)	Growth (cells/mL x 106)	3.42	7.48	-119%	Pass
WY 2022: Las Trampas Creek Site 207R04819	Water Samples (07/12/2022)	*Ceriodaphnia dubia* (Freshwater Crustacean)	Survival (%)	100	100	0%	Pass
WY 2022: Las Trampas Creek Site 207R04819	Water Samples (07/12/2022)	*Ceriodaphnia dubia (Freshwater Crustacean)*	Reproduction (#neonates/female)	42.0	36.3	14%	Pass
WY 2022: Las Trampas Creek Site 207R04819	Water Samples (07/12/2022)	*Chironomus dilutus* (Midge)	Survival (%)	100	100	0%	Pass
WY 2022: Las Trampas Creek Site 207R04819	Water Samples (07/12/2022)	*Hyalella azteca* (Freshwater Amphipod)	Survival (%)	100	98.0	2%	Pass
WY 2022: Las Trampas Creek Site 207R04819	Water Samples (07/12/2022)	*Pimephales promelas* (Fathead Minnow)	Larval Survival (%)	95.0	95.0	0%	Pass
WY 2022: Las Trampas Creek Site 207R04819	Water Samples (07/12/2022)	*Pimephales promelas* (Fathead Minnow)	Growth (biomass, mg)	0.85	1.02	-20%	Pass
WY 2022: Las Trampas Creek Site 207R04819	Sediment Samples (07/12/2022)	*Chironomus dilutus* (Midge)	Survival (%)	97.5	96.2	1%	Pass
WY 2022: Las Trampas Creek Site 207R04819	Sediment Samples (07/12/2022)	*Hyalella azteca* (Freshwater Amphipod)	Survival (%)	96.2	91.2	5%	Pass
WY 2023: Walnut Creek Site 207R02615	Water Samples (07/18/2023)	*Selenastrum capricornutum* (Green Algae)	Growth (cells/mL x 106)	2.50	5.50	-120%	Pass
WY 2023: Walnut Creek Site 207R02615	Water Samples (07/18/2023)	*Ceriodaphnia dubia* (Freshwater Crustacean)	Survival (%)	90.0	100	-11%	Pass
WY 2023: Walnut Creek Site 207R02615	Water Samples (07/18/2023)	*Ceriodaphnia dubia* (Freshwater Crustacean)	Reproduction (#neonates/female)	32.0	40.1	-25%	Pass
WY 2023: Walnut Creek Site 207R02615	Water Samples (07/18/2023)	*Chironomus dilutus* (Midge)	Survival (%)	**97.5**	**82.5**	**15%**	**Fail***
WY 2023: Walnut Creek Site 207R02615	Water Samples (07/18/2023)	*Hyalella azteca* (Freshwater Amphipod)	Survival (%)	98.0	100	-2%	Pass

Creek/Site	SampleType/Date	Matrix/Test Species	Test Endpoint(s)	Lab Control	CCCWP Site	% Effect	TST Pass/Fail
WY 2023: Walnut Creek Site 207R02615	Water Samples (07/18/2023)	Pimephales promelas (Fathead Minnow)	Larval Survival (%)	95.0	97.5	-3%	Pass
WY 2023: Walnut Creek Site 207R02615	Water Samples (07/18/2023)	Pimephales promelas (Fathead Minnow)	Growth (biomass, mg)	0.82	0.77	6%	Pass
WY 2023: Walnut Creek Site 207R02615	Sediment Samples (07/18/2023)	*Chironomus dilutus* (Midge)	Survival (%)	72.5	77.5	-7%	Pass
WY 2023: Walnut Creek Site 207R02615	Sediment Samples (07/18/2023)	*Hyalella azteca* (Freshwater Amphipod)	Survival (%)	93.8	95.0	-1%	Pass
WY 2024: Marsh Creek Site 544R02505	Water Samples (07/9/2024)	*Selenastrum capricornutum* (Green Algae)	Growth (cells/mL x 106)	2.9	6.1	-110%	Pass
WY 2024: Marsh Creek Site 544R02505	Water Samples (07/9/2024)	*Ceriodaphnia dubia* (Freshwater Crustacean)	Survival (%)	100	90	10%	Pass
WY 2024: Marsh Creek Site 544R02505	Water Samples (07/9/2024)	*Ceriodaphnia dubia* (Freshwater Crustacean)	Reproduction (#neonates/female)	34.7	33.4	3.8%	Pass
WY 2024: Marsh Creek Site 544R02505	Water Samples (07/9/2024)	*Hyalella azteca* (Freshwater Amphipod)	Survival (%)	96	100	-4.2%	Pass
WY 2024: Marsh Creek Site 544R02505	Water Samples (07/9/2024)	*Pimephales promelas* (Fathead Minnow)	Larval Survival (%)	87.5	97.5	-11%	Pass
WY 2024: Marsh Creek Site 544R02505	Water Samples (07/9/2024)	*Pimephales promelas* (Fathead Minnow)	Growth (biomass, mg)	0.74	0.86	-16%	Pass
WY 2024: Marsh Creek Site 544R02505	Water Re-Sampled (07/22/2024)	*Chironomus dilutus* (Midge)	Survival (%)	97.5	97.5	0%	Pass
WY 2024: Marsh Creek Site 544R02505	Sediment Samples (07/9/2024)	*Chironomus dilutus* (Midge)	Survival (%)	85	90	-5.9%	Pass
WY 2024: Marsh Creek Site 544R02505	Sediment Samples (07/9/2024)	*Hyalella azteca* (Freshwater Amphipod)	Survival (%)	92.5	**58.8**	**36%**	**Fail***
WY 2025: Marsh Creek Site 544R02505	Water Samples (07/22/2025)	*Selenastrum capricornutum* (Green Algae)	Growth (cells/mL x 106)	**2.18**	**0.115**	**95%****	**Fail***
WY 2025: Marsh Creek Site 544R02505	Water Samples (07/22/2025)	*Ceriodaphnia dubia* (Freshwater Crustacean)	Survival (%)	90.0	100	-11%	Pass
WY 2025: Marsh Creek Site 544R02505	Water Samples (07/22/2025)	*Ceriodaphnia dubia* (Freshwater Crustacean)	Reproduction (#neonates/female)	**30.2**	**24.0**	**20.5%**	**Fail***
WY 2025: Marsh Creek Site 544R02505	Water Samples (07/22/2025)	*Chironomus dilutus* (Midge)	Survival (%)	100	100	0%	Pass

Creek/Site	SampleType/Date	Matrix/Test Species	Test Endpoint(s)	Lab Control	CCCWP Site	% Effect	TST Pass/Fail
WY 2025: Marsh Creek Site 544R02505	Water Samples (07/22/2025)	*Hyalella azteca* (Freshwater Amphipod)	Survival (%)	94.0	100	-6.4%	Pass
WY 2025: Marsh Creek Site 544R02505	Water Samples (07/22/2025)	*Pimephales promelas* (Fathead Minnow)	Larval Survival (%)	95.0	100	-5.3%	Pass
WY 2025: Marsh Creek Site 544R02505	Water Samples (07/22/2025)	*Pimephales promelas* (Fathead Minnow)	Growth (biomass, mg)	0.45	0.41	9.0%	Pass
WY 2025: Marsh Creek Site 544R02505	Water Sample Retest (09/16/2025)	*Selenastrum capricornutum* (Green Algae)	Growth (cells/mL x 106)	2.24	6.31	-181%	Pass
WY 2025: Marsh Creek Site 544R02505	Sediment Samples (07/22/2025)	*Chironomus dilutus* (Midge)	Survival (%)	86.2	70.0	18.8%	Pass
WY 2025: Marsh Creek Site 544R02505	Sediment Samples (07/22/2025)	*Hyalella azteca* (Freshwater Amphipod)	Survival (%)	**95.0**	**72.5**	**24%**	**Fail***

* Sample test result was significantly less than the lab control treatment; the sample was determined to be toxic
** % Effect was >50%; retest required