Department of Pesticide Regulation
Environmental Monitoring Branch
1001 I Street
Sacramento, California 95812

Study 321. Surface Water Monitoring for Pesticides in Agricultural Areas in the Central Coast and Southern California, 2022

Xin Deng, Ph.D.
March 2022

1. INTRODUCTION

Surface water monitoring in agricultural areas is a priority for the California Department of Pesticide Regulation (CDPR) to assess potential impacts of pesticides from agricultural runoff on California's aquatic environments. Initiated in 2008, collection of agricultural runoff within the Central Coast and Southern regions of California represents one of CDPR's long-term environmental monitoring efforts. Annual surface water monitoring data help guide CDPR in the development and implementation of regulatory and non-regulatory mitigation activities. This project's current monitoring efforts are focused in two major agricultural regions of California: the Central Coast and the Imperial Valley. Because a wide variety of commodities are grown in both regions, a wide range of pesticide active ingredients (AI) are used across the landscape. The 2022 monitoring areas include major watersheds in Monterey, Santa Barbara, San Luis Obispo and Imperial counties (Deng 2018a; Main 2019, 2020a; Deng 2021).

The monitoring results for the Central Coast and Southern California in previous years are summarized in annual project reports (e.g., Main 2020b; Deng 2021, 2022). In 2020, due to the impact of COVID-19 pandemic, monitoring was only performed at 10 sites in the Central Coast and not conducted in Imperial Valley. Excluding metabolites, there were 67 pesticides monitored including 32 insecticides, 22 herbicides, and 13 fungicides (Deng 2022). The most frequently detected insecticides included imidacloprid, methoxyfenozide, chlorantraniliprole, methomyl, clothianidin, bifenthrin, and permethrin. Detection frequencies varied from 50% (permethrin) to 97% (imidacloprid). The frequencies of their concentrations exceeding the associated lowest (chronic or acute) U.S. Environmental Protection Agency (US EPA) aquatic life benchmark values ranged from 31% (permethrin) to 97% (imidacloprid; Deng 2022). Those specific insecticides can be highly toxic to sensitive aquatic organisms. Many of the insecticidal active ingredients were commonly detected in individual site or multiple sampling locations from the same watershed. The frequent co-occurrence of insecticides in a given watershed and frequent exceedance of acute aquatic life benchmarks indicate that insecticide uses in the monitored watershed drainages have the potential to cause adverse impacts to non-target aquatic organisms and communities. Herbicides and fungicides that were frequently detected included boscalid, propiconazole, bensulide, prometryn, bromacil, and azoxystrobin (range: 50 to 100%). By comparison, the frequency of US EPA acute aquatic life benchmark exceedances for herbicides and fungicides were low (< 13%). In these focal regions, review/analysis of annual surface water monitoring results and Pesticide Use Report (PUR) data indicate that several pesticides continue to increase in use (e.g., neonicotinoids) compared to older chemistries such as organophosphates (e.g., chlorpyrifos, diazinon).

In 2020, CDPR collected sediment samples at 10 monitoring sites in the Central Coast. The samples were analyzed for the presence of seven pyrethroids: bifenthrin, cyfluthrin, cypermethrin, fenpropathrin, fenvalerate/esfenvalerate, λ-cyhalothrin, and permethrin. Detection frequencies from the highest to the lowest were: bifenthrin (90%), permethrin (90%), λ-cyhalothrin (60%), cyfluthrin (50%), esfenvalerate (40%), cypermethrin (20%), and fenpropathrin (10%).

Study 321 began in 2019 and is a continuation of CDPR's long-term agricultural monitoring efforts in the Central Coast and Southern California initiated in 2008 (*see Study 304*). Monitoring sites have been established in previous years (Deng 2017). Two additional sites in the northern part of Salinas were monitored in 2021 and will continue to be monitored in 2022. In previous years, the watershed-based prioritization approach was applied to help refine the pesticide priority list for monitoring using CDPR's Prioritization Model (Luo et al. 2013, 2014, 2015). In 2022, the priority lists of pesticides recommended for monitoring were utilized to determine whether the current analytical screens have included all the AIs of potential concerns, and which analytical methods require development to include those AIs in the future. Monitoring frequency in the Central Coast will be four times during the irrigation season from March to September, and two times in the winter from November to January to capture storm runoff. Monitoring in Southern California will be conducted twice a year in March and October.

2. OBJECTIVES

The goals of the project are to assess short-term changes and long-term trends of pesticide occurrence in surface water resulting from agricultural runoff and their potential impact to the surrounding aquatic environments. Monitoring results can be used to assess the efficacy of mitigation efforts and provide information to CDPR managers to determine whether mitigation responses are necessary to address pesticide contamination. Objectives of the project are as follows:

- Determine occurrences and measure chemical concentrations of high-priority pesticides in aqueous and sediment samples;

- Determine toxicity of water samples using lab surrogate species;
- Analyze chemistry data to evaluate potential impacts on aquatic environments by comparing environmental concentrations with current US EPA aquatic life benchmarks;
- Analyze spatial correlations between observed pesticide concentrations/detection frequencies and region-specific pesticide use;
- Assess multiple years of data to characterize patterns and trends in detection frequencies and potential impacts to aquatic organisms;
- Evaluate storm runoff on pesticide transport from agricultural fields.

3. PERSONNEL

This study will be conducted by staff from the Environmental Monitoring Branch, Surface Water Protection Program, under the general direction of Dr. Jennifer Teerlink, Environmental Program Manager I (Supervisory). Key personnel are listed below:

Project Leader:	Xin Deng, Ph.D.
Field Coordinator:	Pedro Lima, Ph.D.
Review Scientist:	Robert Budd, Ph.D.
Statistician:	Xuyang Zhang Ph.D.
Laboratory Liaison:	Joshua Alvarado
Analytical Chemistry:	Center for Analytical Chemistry, California Department of Food and Agriculture (CDFA)

Questions concerning this monitoring project should be directed to Dr. Xin Deng, Senior Environmental Scientist, at (916) 445-2506 or by email at Xin.Deng@cdpr.ca.gov.

4. PESTICIDES FOR MONITORING

Pesticides of potential concerns were prioritized following the procedures described in the Monitoring Prioritization Model (MPM, Luo et al. 2013, 2014, 2015). The 12-digit hydrologic units (HUC12) on the U.S. Geological Survey (USGS) Watershed Boundary Database tool (USGS 2018) is used to define the watershed boundary as an input to the MPM. The watershed boundary identifies the areas that contribute to the specific HUC12 where the monitoring site is located. The MPM aggregates the total use of each pesticide within each upstream HUC12 by utilizing their use amounts reported on the pesticide use reporting (PUR) database and adjusts the total use by factoring in pesticide aquatic dissipation as a function of travel time between each upstream HUC12 and the HUC12 where the monitoring site is located. Pesticide aquatic dissipation was calculated based on water-sediment DT_{50} (half-life) of each pesticide of interest. This study applied the MPM to generate a ranked list of pesticides for the watershed contributing to each sampling site. The final *rank score* of a pesticide is the product of the rank in use amount and the rank of toxicity of that pesticide among all pesticides used upstream. Pesticides were then analyzed to produce final monitoring lists for individual watershed following the general criteria below:

1) Pesticides with a use score ≥ 2 and a final ranking scores ≥ 8 in a priority list for a watershed of interest will be monitored;
2) Pesticides with a use score < 2 and final scores < 8 in a priority list are considered low priority but may be monitored as part of a large analytical screen;
3) Historical monitoring data and current availability of analytical methods at the CDFA lab are additional factors to help decide a final list for monitoring recommendation.
4) Pesticides that are identified as high priority for monitoring that are not included in current analytical screens will be noted for requiring method development.

5. STUDY PLAN

Monitoring will be conducted in Monterey, Santa Barbara and San Luis Obispo counties in the Central Coast, and Imperial County in Southern California. Monitoring plans for each county or counties are described below.

5.1. Imperial County

Ambient monitoring will be conducted in Imperial County twice a year at six established sites. Whole water samples will be collected during the two sampling events, and sediment samples will be collected once a year. Sediment samples will be analyzed for seven pyrethroids. Monitoring locations are located in the Alamo River and New River watersheds (Table 1, Figure 1). Monitoring will be conducted in March and October to capture runoff during the periods of higher pesticide uses in the spring and fall in Imperial County.

The chemical lists for monitoring recommendation in the New River and Alamo River were generated by the monitoring priority model using the average yearly pesticide use from 2018–2020 (Tables 2-3). The chemical lists recommended by the model are similar to those in 2021. 2,4-D is ranked higher on the list due to increasing uses in recent years and will be monitored in 2022. Linuron and 4-(2,4-DB), dimethylamine salt are recommended for monitoring by the priority model, but will not be monitored in 2022 because the analytical method for the two AIs are not currently developed.

5.2. Monterey County

Ambient monitoring will be conducted in Monterey County six times a year at eight sites including four times during the growing season (May, July and September), and two times during storm events in the winter. Whole water samples will be collected during each sampling event for chemical analysis and a subset of water samples from six to eight selected sites will be collected during each sampling event for toxicity testing. Sediment samples from all eight sites will be collected only in September for pyrethroid analysis. Monitoring sites are located in the Salinas River and Tembladero Slough watersheds (Table 4, 5; Figure 2). Two additional sites (Sal_Blanco and Sal_Tembl) that were monitored in 2021 will continue to be monitored in 2022. Both sites represent the agricultural runoff through tile drainage systems that remove excess water from soil below surface in the northern part of Salinas.

The chemical lists for monitoring in each watershed were generated using the average yearly pesticide use data from 2018 to 2020 (Table 4, 5). The chemical lists recommended by the priority model are similar to those in 2021 with changes in rankings of a few chemicals due to changes of their use scores from 2018 to 2020. Notably, the use amounts of chlorpyrifos and diazinon had significantly reduced and so did their ranking scores on the priority list in recent years. The monitoring results indicated no detections in 2020 for chlorpyrifos and diazinon (Deng 2022). Although glufosinate-ammonium, linuron, PCNB and propyzamide are listed as priority for the Salinas River and Tembladero Watersheds, they will not be monitored as analytical methods are not currently developed (Table 4, 5).

5.3. Santa Barbara and San Luis Obispo Counties

Ambient monitoring will be conducted in Santa Barbara and San Luis Obispo counties four times a year in March, May, July, and September at four established sites. Whole water samples will be collected during each sampling event for chemical analysis and a subset of water samples from the four sites will be collected during each sampling period for toxicity testing. Sediment samples will only be collected in September for pyrethroid analysis. Monitoring sites are located in Orcutt Creek and Oso Flaco Creek watersheds (Table 1, Figure 3).

The chemical lists for monitoring in each watershed were generated by the priority model using the average yearly use data from 2018 to 2020 (Table 6, 7). The chemicals recommended by the model for monitoring in the Orcutt Creek Watershed are similar to those in 2021. Chlorpyrifos did not appear to be the priority for monitoring on the chemical lists for both watersheds but will be kept on the monitoring list in 2022 as part of the multi-analyte screen. Propyzamide and linuron appear on the priority list for monitoring at Orcutt Creek (score = 8), however, it will not be included for monitoring as the analytical method is not developed for the two AIs at the chemistry lab.

5.4. Modifications from 2021

There are no additional modifications from 2021 on monitoring timeline and sampling sites in 2022. As for the monitoring chemical lists, 2,4-D will be added for Imperial County along with other three AIs (dicamba, MCPA and triclopry) in the phenoxy screen (Table 8). In addition, the entire LC-Screen that includes 54 pesticides and 5 fipronil degradates will be applied to analyze all water samples in 2022 (Table 9). All pesticides identified as high priority by the Monitoring Prioritization Model are included in current analytical screens except for the following five pesticides: linuron, glufosinate-ammonium, 4-(2,4-DB), dimethylamine salt, PCNB and propyzamide. Analytical methods will need to be developed for the aforementioned pesticides before their inclusion for monitoring.

6. SAMPLING METHOD

6.1. Water and Sediment Sampling

Water samples will be collected as grab samples directly into 1-liter amber glass bottles by hand or using a pole and then sealed with Teflon-lined lids (Deng and Ensminger 2021). Auto samplers (Teledyne Isco, Inc., Lincoln, NE) will be used to collect storm runoff over the course of a storm event (time-weighted) where possible. Sediment samples will be collected into half-pint Mason Jars using stainless steel scoops from the top 2-cm bed layer. Sediments will be sieved through a 2-mm sieve to remove gravel and plant materials, and homogenized (Deng and Ensminger 2021; Ensminger 2017). Samples will be stored and transported on wet ice or refrigerated at 4ºC until analyzed.

6.2. Sample Transport

The CDPR staff will transport water and sediment samples to the Center for Analytical Chemistry at CDFA for chemical analysis and to the UC Davis Marine Pollution Studies Laboratory following the procedures outlined in CDPR SOP QAQC004.01 (Jones 1999). A chain-of-custody record will be completed and will accompany each sample.

6.3. Field Measurements

Dissolved oxygen, pH, specific conductivity, TDS, salinity and water temperature will be measured *in situ* during each sampling event with an YSI EXO1 multi-parameter water quality Sonde (Edgerton 2020).

7. LABORATORY ANALYSES

7.1. Chemical Analysis

Chemical analyses will be performed by the Center for Analytical Chemistry at CDFA. A total of 71 pesticides will be analyzed in each water sample collected from the sampling sites in 2022. Tables 8 presents 54 pesticides and their associated analytical method reporting limits and method detection limits in a single liquid chromatograph multi-analyte screen (LC-screen). Six dinitroanilines, four phenoxies, and seven pyrethroids will also be analyzed (Table 9, 10 and 11). Sediment samples will be analyzed for seven pyrethroids (Table 12). Quality Assurance/Quality control (QA/QC) will be conducted in accordance with the Standard Operating Procedure QAQC001.00 (Peoples, 2019). Approximately 10% of all samples collected during the 2021 monitoring year will be included for QC. Laboratory QA/QC will follow CDPR guidelines and will consist of laboratory blanks, matrix spikes, matrix spike duplicates, surrogate spikes, and blind spikes (Peoples 2019). Laboratory blanks and matrix spikes will be included in each extraction set.

7.2. Organic Carbon and Suspended Solid Analyses

Total organic carbon (TOC) and dissolved organic carbon (DOC) in water samples will be analyzed by CDPR staff using a TOC-V CSH/CNS analyzer (Shimadzu Corporation, Kyoto, Japan) (Ensminger 2013a). Before analysis of each sample set, lab blanks and calibration standards will be run to ensure the quality of the TOC and DOC data. Water samples will also be analyzed for suspended sediment (Ensminger 2013b). Similarly, sediment samples collected during September (Central Coast) and October (Imperial Valley) will be analyzed for TOC using the TOC-V CSH/CNS analyzer following the protocol by Goodell (2016).

7.3. Toxicity Analysis

Toxicity analyses will be conducted in collaboration with the Central Coast Regional Water Quality Control Board and the UC Davis Marine Pollution Studies Laboratory (MPSL). Grab water samples collected from a set of selected sampling sites in the Central Coast and Southern California regions will be tested for mortality and growth by the MPSL using *Hyalella azteca* and *Chironomus dilutus* as surrogate species.

8. DATA ANALYSIS

All data generated by this project will be entered in a Microsoft Office Access database that holds field information, field measurements, and laboratory analytical data. All ambient monitoring analytical data will also be uploaded into the CDPR Surface Water Database (CDPR 2021).

Resulting data will be analyzed and reported potentially including the following:

- Comparison of pesticide concentrations to aquatic toxicity benchmarks, water quality limits, and other toxicity data (CCVRWQCB 2012, US EPA 2021).
- Spatial analysis of data to identify correlations between observed pesticide concentrations and region-specific pesticide uses and geographical features.
- Assessment of multiple years of data to characterize patterns and trends in detection frequencies and exceedances of current aquatic benchmarks.
- Assessment of results to determine potential additional monitoring in regions with similar pesticide use patterns.

9. ESTIMATED TIMETABLE

Field Sampling:	January 2022–December 2022
Chemical Analysis:	January 2022–February 2023
Draft Report:	May 2023
Data Entry into SURF:	August 2023

10. SAMPLING EVENTS

The sampling schedule for each county is provided in Table 13.

11. REFERENCES

CCVRWQCB (California Central Valley Regional Water Quality Control Board). 2012. Criteria reports.

CDPR (California Department of Pesticide Regulation). 2021. Surface Water Database (SURF).

Deng, X. 2017. Study 304. Surface Water Monitoring for Pesticides in Agricultural Areas in Central Coast and Southern California, 2017. Study 304 Protocol, 2017

Deng, X. 2018a. Study 304. Ambient Monitoring Report: Surface Water Monitoring for Pesticides in Agricultural Areas of California, 2017. Study 304 Report, 2018

Deng, X. 2018b. Study 304. Surface Water Monitoring for Pesticides in Agricultural Areas in the Central Coast and Southern California, 2018. Online access currently unavailable.

Deng, X. 2021. Study 321. Surface Water Monitoring for Pesticides in Agricultural Areas of California, 2021. Study 321 Protocol, 2021

Deng, X. 2022. Study 321. Ambient Monitoring Report: Surface Water Monitoring for Pesticides in Agricultural Areas of California, 2020. Online access currently unavailable.

Deng, X. and M. Ensminger. 2021. CDPR SOP FSWA017.00: Procedures for Collecting Water and Sediment Samples for Pesticide Analysis. SOP FSWA017.00

Edgerton, E. 2020. CDPR SOP (Standard Operating Procedures) EQWA012.00: Calibration, Field Measurement, Cleaning, and Storage of the YSI EXO1 Multi-parameter Sonde. SOP EQWA012.

Ensminger, M. 2013a. CDPR SOP METH011.00: Water TOC analysis using the Shimadzu TOC-VCSN and ASI-V autosampler. Online access currently unavailable.

Ensminger, M. 2013b. CDPR SOP METH010.01: Analysis of whole sample suspended sediments in water. SOP METH0.10.01

Ensminger, M. 2017. Study 299. Ambient and mitigation monitoring in urban areas in Northern California FY 2017/18. Online access currently unavailable.

Goodell, K.L. 2016. SOP MET013.00: Sediment TOC analysis using Shimadzu TOC-Vcsn and SSM-5000A. California Department of Pesticide Regulation. SOP MET013.00

Jones, D. 1999. SOP QAQC004.01: Transporting, packaging, and shipping samples from the field to the warehouse or laboratory. California Department of Pesticide Regulation, Sacramento, CA. SOP QAQC004.01

Luo, Y., X. Deng, R. Budd, K. Starner and M. Ensminger. 2013. Methodology for Prioritizing Pesticides for Surface Water Monitoring in Agricultural and Urban Areas. May 2013. Prioritization Model I

Luo, Y., M. Ensminger, R. Budd, X. Deng and A. DaSilva . 2014. Methodology for Prioritizing Pesticides for Surface Water Monitoring in Agricultural and Urban Areas II: Refined Priority List. July 2014. Prioritization Model II

Luo, Y and X. Deng. 2015. Methodology for Prioritizing Pesticides for Surface Water Monitoring in Agricultural and Urban Areas III: Watershed-Based Prioritization. February 2015. Prioritization Model III

Main, A. 2019. Study 321. Surface Water Monitoring for Pesticides in Agricultural Areas in the Central Coast and Southern California, 2020. Study 321 Protocol, 2019

Main, A. 2020a. Study 321. Surface Water Monitoring for Pesticides in Agricultural Areas in the Central Coast and Southern California, 2020. Study 321 Protocol, 2020

Main, A. 2020b. Study 321. Ambient Monitoring Report: Surface Water Monitoring for Pesticides in Agricultural Areas of California, 2019. Study 321 Report, 2019

Peoples, S. 2019. SOP QAQC001.01: Chemistry Laboratory Quality Control. Department of Pesticide Regulation, Sacramento, CA. SOP QAQC001.01

US EPA. 2021. Aquatic Life Benchmarks and Ecological Risk Assessments for Registered Pesticides. Benchmarks

U.S. Geological Survey (USGS). 2018. The National Map

12. TABLES

Table 1. Sampling Site Information for Study 321 in 2021.

County	Site ID	Location	Watershed	Latitude	Longitude	Site Type
Imperial	Imp_Newriv27	New River at HWY S27/Keystone Road	New River	32.9136	-115.60646	Waterway
Imperial	Imp_Lack	New River at Lack Road	New River	33.0999	-115.64876	Waterway
Imperial	Imp_Rice3	Rice Drain III at Weinert Road	New River	32.8691	-115.651	Ag Ditch
Imperial	Imp_Rutherford	Alamo River at Rutherford Road	Alamo River	33.0447	-115.48829	Waterway
Imperial	Imp_Garst	Alamo River at Garst Road	Alamo River	33.199	-115.59696	Waterway
Imperial	Imp_Holtville	Holtville Main Drain at HWY 115	Alamo River	32.9309	-115.40611	Ag Ditch
Monterey	Sal_Quail	Quail Creek at HWY 101; Spence and Potter Roads	Salinas River	36.6092	-121.56269	Waterway
Monterey	Sal_Chualar	Chualar Creek at Chualar River Road	Salinas River	36.5584	-121.52964	Ag Ditch
Monterey	Sal_Davis	Salinas River at Davis Road	Salinas River	36.647	-121.70219	Waterway
Monterey	Sal_Blanco	Blanco Drain at Cooper Road	Salinas River	36.6987	-121.73516	Ag Ditch
Monterey	Sal_Hartnell	Alisal Creek at Hartnell Road	Tembladero Slough	36.6435	-121.57836	Ag Ditch
Monterey	Sal_SanJon	Rec Ditch at San Jon Road	Tembladero Slough	36.7049	-121.70506	Ag Ditch
Monterey	Sal_Tembl	Tembladero Slough at HWY 183	Tembladero Slough	36.75166	-121.74186	Waterway
Monterey	Sal_Haro	Tembladero Slough at Haro Street	Tembladero Slough	36.7596	-121.75433	Waterway
San Luis Obispo	SM_OFC	Oso Flaco Creek at Oso Flaco Creek Road	Oso Flaco Creek	35.0164	-120.58755	Waterway
Santa Barbara	SM_Solomon	Solomon Creek at HWY 1	Orcutt Creek	34.9414	-120.5742	Waterway
Santa Barbara	SM_Orcutt	Orcutt Creek at West Main Street	Orcutt Creek	34.9576	-120.63244	Waterway
Santa Barbara	SM_Main	Main Ditch at HWY 166	Main Ditch	34.95474	-120.48501	Ag Ditch

Table 2. Pesticide Prioritization for Surface Water Monitoring in Alamo River in Imperial County.

Chemical	Use Score	Tox Score	Final Score	Monitoring Inclusion
Permethrin	3	7	21	Yes
Pendimethalin	5	4	20	Yes
Trifluralin	5	4	20	Yes
Imidacloprid	4	5	20	Yes
Malathion	3	6	18	Yes
Chlorpyrifos	3	6	18	Yes
Methomyl	4	4	16	Yes
λ-cyhalothrin	2	8	16	Yes
Cypermethrin	2	8	16	Yes
Esfenvalerate	2	8	16	Yes
Atrazine	3	5	15	Yes
Carbaryl	3	5	15	Yes
4-(2,4-DB), dimethylamine salt	4	3	12	No[1]
Oxyfluorfen	2	5	10	Yes
Dimethoate	3	3	9	Yes
Methoxyfenozide	3	3	9	Yes
Bensulide	4	2	8	Yes
2,4-D	4	2	8	Yes
Linuron	2	4	8	No[1]
Chlorantraniliprole	2	4	8	Yes

Alamo River drainage area = 1,264 km^2

[1]Analytical method not currently available.

Table 3. Pesticide Prioritization for Surface Water Monitoring in New River in Imperial County.

Chemical	Use Score	Tox Score	Final Score	Monitoring Inclusion
Pendimethalin	5	4	20	Yes
Trifluralin	5	4	20	Yes
Imidacloprid	4	5	20	Yes
Malathion	3	6	18	Yes
λ-cyhalothrin	2	8	16	Yes
Esfenvalerate	2	8	16	Yes
Carbaryl	3	5	15	Yes
Permethrin	2	7	14	Yes
4-(2,4-DB), dimethylamine salt	4	3	12	No[1]
Methomyl	3	4	12	Yes
Chlorpyrifos	2	6	12	Yes
Bensulide	5	2	10	Yes
Atrazine	2	5	10	Yes

Chemical	Use Score	Tox Score	Final Score	Monitoring Inclusion
Oxyfluorfen	2	5	10	Yes
Dimethoate	3	3	9	Yes
Methoxyfenozide	3	3	9	Yes
2,4-D	4	2	8	Yes
Linuron	2	4	8	No[1]

New River drainage area = 1,729 km^2

[1]Analytical method not currently available in LC screen.

Table 4. Pesticide Monitoring Prioritization in Salinas River in Monterey County.

Chemical	Use Score	Tox Score	Final Score	Monitoring Inclusion
Permethrin	3	7	21	Yes
Methomyl	5	4	20	Yes
Malathion	3	6	18	Yes
λ-cyhalothrin	2	8	16	Yes
Oxyfluorfen	3	5	15	Yes
Imidacloprid	3	5	15	Yes
Glufosinate-ammonium	4	3	12	No[1]
PCNB	4	3	12	No[1]
Pendimethalin	3	4	12	Yes
Pyraclostrobin	3	4	12	Yes
Prometryn	3	4	12	Yes
Bensulide	5	2	10	Yes
Carbaryl	2	5	10	Yes
Spinetoram	3	3	9	No[1]
Cyprodinil	3	3	9	Yes
Propyzamide	4	2	8	No[1]
Chlorantraniliprole	2	4	8	Yes
Trifloxystrobin	2	4	8	Yes
Linuron	2	4	8	No[1]

Salinas River drainage area = 11,082 km^2

[1]Analytical method not currently available in LC screen.

Table 5. Pesticide Monitoring Prioritization in Tembladero Slough in Monterey County.

Chemical	Use Score	Tox Score	Final Score	Monitoring Inclusion
Malathion	4	6	24	Yes
Permethrin	3	7	21	Yes
Methomyl	4	4	16	Yes
Bifenthrin	2	8	16	Yes
λ-cyhalothrin	2	8	16	Yes
PCNB	4	3	12	No[1]
Pyraclostrobin	3	4	12	Yes

Chemical	Use Score	Tox Score	Final Score	Monitoring Inclusion
Oxyfluorfen	2	5	10	Yes
Carbaryl	2	5	10	Yes
Imidacloprid	2	5	10	Yes
Fenamidone	3	3	9	Yes
Propyzamide	4	2	8	No[1]
Trifloxystrobin	2	4	8	Yes
Prometryn	2	4	8	Yes

Tembladero Slough drainage area = 291 km^2
[1]Analytical method not currently available in LC screen.

Table 6. Pesticide Monitoring Prioritization in Orcutt Creek in Santa Barbara County.

Chemical	Use Score	Tox Score	Final Score	Monitoring Inclusion
Malathion	5	6	30	Yes
Imidacloprid	4	5	20	Yes
Oxyfluorfen	4	5	20	Yes
Bifenthrin	2	8	16	Yes
Permethrin	2	7	14	Yes
Fenpropathrin	2	7	14	Yes
Methomyl	3	4	12	Yes
Prometryn	3	4	12	Yes
Pyraclostrobin	3	4	12	Yes
Cyprodinil	3	3	9	Yes
Propyzamide	4	2	8	No[1]
Linuron	2	4	8	No[1]
Chlorantraniliprole	2	4	8	Yes
Trifluralin	2	4	8	Yes
Trifloxystrobin	2	4	8	Yes
Pendimethalin	2	4	8	Yes

Orcutt Creek drainage area = 301 km^2
[1]Analytical method not currently available in LC screen.

Table 7. Pesticide Monitoring Prioritization in Oso Flaco Creek in San Luis Obispo County.

Chemical	Use Score	Tox Score	Final Score	Monitoring Inclusion
Malathion	5	6	30	Yes
Imidacloprid	4	5	20	Yes
Oxyfluorfen	4	5	20	Yes
Bifenthrin	2	8	16	Yes
Permethrin	2	7	14	Yes
Fenpropathrin	2	7	14	Yes
Cyprodinil	4	3	12	Yes

Chemical	Use Score	Tox Score	Final Score	Monitoring Inclusion
Pyraclostrobin	3	4	12	Yes
Prometryn	2	4	8	Yes
Methomyl	2	4	8	Yes
Trifloxystrobin	2	4	8	Yes
Chlorantraniliprole	2	4	8	Yes
Pendimethalin	2	4	8	Yes

Oso Flaco Creek drainage area = 51 km^2

Table 8. Reporting Limits and Method Detection Limits for Pesticides in LC* Multi-Analyte Screen.

Analytic Screen	Pesticide	Method Detection Limit (ng/L)	Reporting Limit (ng/L)
LC	Abamectin	4	20
LC	Acetamiprid	4	20
LC	Atrazine	4	20
LC	Azoxystrobin	4	20
LC	Bensulide	4	20
LC	Boscalid	4	20
LC	Bromacil	4	20
LC	Carbaryl	4	20
LC	Chlorantraniliprole	4	20
LC	Chlorpyrifos	4	20
LC	Clothianidin	4	20
LC	Cyprodinil	4	20
LC	Diazinon	4	20
LC	Diflubenzuron	4	20
LC	Dimethoate	4	20
LC	Diuron	4	20
LC	Ethoprop	4	20
LC	Etofenprox	4	20
LC	Fenamidone	4	20
LC	Fenhexamid	5	20
LC	Fludioxonil	4	20
LC	Hexazinone	4	20
LC	Imidacloprid	4	20
LC	Indoxacarb	4	20
LC	Isoxaben	4	20
LC	Kresoxim-methyl	4	20
LC	Malathion	4	20
LC	Mefenoxam	4	20
LC	Methidathion	4	20
LC	Methomyl	4	20
LC	Methoxyfenozide	4	20

Analytic Screen	Pesticide	Method Detection Limit (ng/L)	Reporting Limit (ng/L)
LC	Metribuzin	4	20
LC	Norflurazon	4	20
LC	Oryzalin	4	20
LC	Oxadiazon	4	20
LC	Prometon	4	20
LC	Prometryn	4	20
LC	Propanil	4	20
LC	Propargite	4	20
LC	Propiconazole	4	20
LC	Pyraclostrobin	4	20
LC	Pyriproxyfen	4	15
LC	Quinoxyfen	4	20
LC	Simazine	4	20
LC	S-Metolachlor	4	20
LC	Tebuconazole	4	20
LC	Tebufenozide	4	20
LC	Tebuthiuron	4	20
LC	Thiabendazole	4	20
LC	Thiacloprid	4	20
LC	Thiamethoxam	4	20
LC	Thiobencarb	4	20
LC	Trifloxystrobin	4	20
LC	Fipronil	4	10
LC	Fipronil Amide	4	10
LC	Fipronil Sulfide	4	10
LC	Fipronil Sulfone	4	10
LC	Desulfinyl Fipronil	4	10
LC	Desulfinyl Fipronil Amide	4	10

*LC = Liquid chromatograph multi-analyte screen (54 AIs).

Table 9. Reporting Limits and Method Detection Limits for Dinitroanilines and Oxyfluorfen (DN/OX) in Whole Water.

Analytic Screen	Pesticide	Method Detection Limit (ng/L)	Reporting Limit (ng/L)
DN/OX	Benfluralin (*Benefin*)	14	50
DN/OX	Ethalfluralin	15	50
DN/OX	Oxyfluorfen	10	50
DN/OX	Pendimethalin	12	50
DN/OX	Prodiamine	12	50
DN/OX	Trifluralin	14	50

Table 10. Reporting Limits and Method Detection Limits for Phenoxy in Whole Water.

Analytic Screen	Pesticide	Method Detection Limit (ng/L)	Reporting Limit (ng/L)
Phenoxy	2,4-D	15	50
Benzoic acide	Dicamba	17	50
Phenoxy	MCPA	22	50
Pyridine	Triclopyr	20	50

Table 11. Reporting Limits and Method Detection Limits for Pyrethroids in Whole Water.

Analytic Screen	Pesticide	Method Detection Limit (ng/L)	Reporting Limit (ng/L)
Pyrethroid	Bifenthrin	0.91	1
Pyrethroid	λ-cyhalothrin	1.74	2
Pyrethroid	Permethrin	1.05	2
Pyrethroid	Cyfluthrin	1.46	2
Pyrethroid	Cypermethrin	1.54	5
Pyrethroid	Fenpropathrin	1.32	5
Pyrethroid	Fenvalerate/esfenvalerate	1.66	5

*DN/OX = dinitroanilines and oxyfluorfen.

Table 12. Reporting Limits and Method Detection Limits for Pyrethroids in Sediment.

Analytic Screen	Pesticide	Method Detection Limit (ng/g dry wt)	Reporting Limit (ng/g dry wt)
Pyrethroids	Bifenthrin	0.1083	1
Pyrethroids	λ-cyhalothrin	0.1154	1
Pyrethroids	Permethrin	0.1159	1
Pyrethroids	Cyfluthrin	0.1830	1
Pyrethroids	Cypermethrin	0.1070	1
Pyrethroids	Fenpropathrin	0.1094	1
Pyrethroids	Esfenvalerate/fenvalerate	0.1430	1

Table 13. Number of Samples for Pesticide Analyses by Counties from January to December 2022*.

Analyte Group**	Location[1]	1st Storm	Mar	May	July	Sept	Oct	2nd Storm	Total samples[2]
LC-Full	Imperial		6				6		12
DN/OX	Imperial		6				6		12
Phenoxy	Imperial		6				6		12
PY-Water	Imperial		6				6		12
PY-Sediment	Imperial						6		6
LC-Full	CC	8	12	12	12	12		8	64
DN/OX	CC	8	12	12	12	12		8	64
PY-Water	CC	8	12	12	12	12		8	64
PY-Sediment	CC					12			12
Overall		**24**	**60**	**36**	**36**	**48**	**30**	**24**	**258**

*Numbers under each month represent the total number of samples collected for each analyte or analyte group. One grab sample for each analyte or analyte group will be collected from one site.
**LC = Liquid chromatograph multi-analyte screen (54 AIs); DN/OX = Dinitroaniline & Oxyfluorfen; PY = Pyrethroid.
[1]CC = Central Coast = Monterey, Santa Barbara and San Luis Obispo counties.
[2]10% of the equivalent total samples collected will be used for QA/QC.

13. FIGURES

Figure 1. Monitoring Sites in Alamo River and New River in Imperial County.

Figure 2. Monitoring Sites in Salinas River and Tembladero Slough in Monterey County

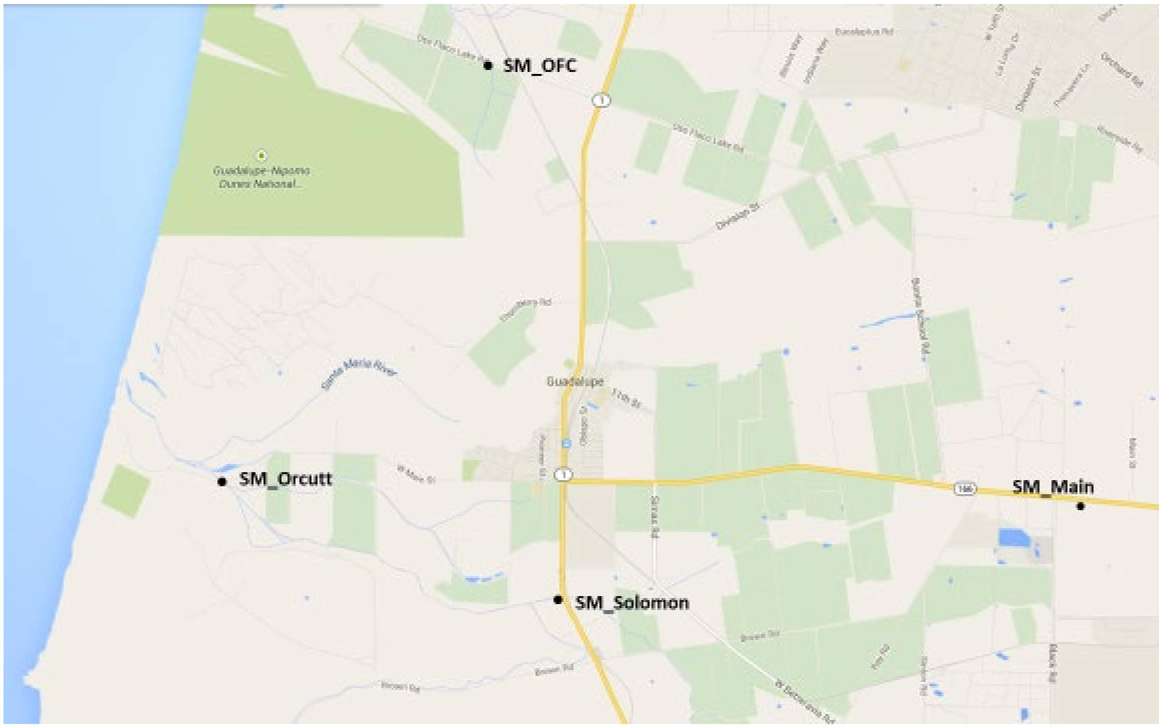

Figure 3. Monitoring Sites in Orcutt Creek and Oso Flaco Creek in San Luis Obispo and Santa Barbara Counties.