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Study 321. Surface Water Monitoring for Pesticides in Agricultural Areas in the Central Coast and Southern California, 2021

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July 2021

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 aquatic environments. Initiated in 2008, surface waters of the Central Coast and Southern California represent one of CDPR's long-term environmental monitoring efforts. Annual monitoring data help guide CDPR in the development and implementation of regulatory and non-regulatory mitigation activities. The current project's 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 2021 monitoring areas include major watersheds in Monterey, Santa Barbara, San Luis Obispo and Imperial counties (Deng 2018a; Main 2019, 2020).

Previous monitoring results for the Central Coast and Southern California are summarized in annual project reports (e.g., Deng 2019; Main 2020). Over 55 pesticides including 26 insecticides, 22 herbicides and 7 fungicides were monitored 2018 (Deng 2018b). In 2019, excluding metabolites, there were 67 pesticides monitored including 32 insecticides, 22 herbicides, and 13 fungicides. The most frequently detected insecticides included imidacloprid, methoxyfenozide, chlorantraniliprole, methomyl, bifenthrin, and λ-cyhalothrin. Detection frequencies varied from 30% (λ-cyhalothrin) to 98% (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 30% (methomyl) to 98% (imidacloprid; Main 2020). Those specific insecticides can be highly toxic to sensitive aquatic organisms. Many of the insecticidal active ingredients were commonly detected in individual samples 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, azoxystrobin, pyraclostrobin, oxyfluorfen, fenamidone, fludioxonil, and pendimethalin (range: 19 to 80%). By comparison, the frequency of US EPA acute aquatic life benchmark exceedances for herbicides and fungicides were low (<9%). In 2019, CDPR collected sediment samples at all 16 monitoring sites that were analyzed for the presence of seven pyrethroids: bifenthrin, cyfluthrin, cypermethrin, fenpropathrin, fenvalerate/esfenvalerate, lambda-cyhalothrin, and permethrin. Detection frequencies were highest for bifenthrin (44%) and lambda-cyhalothrin (44%), and lowest for cyfluthrin (6%). Five samples surpassed concentrations >1 toxicity unit (TU) and individual pesticide TUs in all samples with reported concentrations ranged from 0.01 to 3.94. In these focal regions, annual surface water monitoring results in tandem with 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).

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). In 2021, two additional sites in the northern part of Salinas will be monitored. 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 2021, priority lists of pesticides recommended for monitoring were utilized to check 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 once in 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 the potential impact to aquatic environments. 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;
- Identify the factors that influence pesticide sources in agricultural regions such as agricultural practices (e.g., crop type, irrigation type) or mitigation strategies (e.g., use of structural best management practices (BMPs));

- Test 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

The 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:	Mason Zoerner
Review Scientist:	Robert Budd, Ph.D.
Statistician:	Xuyang Zhang Ph.D.
Laboratory Liaison:	Aniela Burant, Ph.D.
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 (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 prioritization model. The watershed boundary identifies the areas that contribute to the specific HUC12 where the monitoring site is located. The model utilizes pesticide use reporting database to aggregate the total use of each pesticide within each upstream HUC12 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. The model uses the water-sediment DT_{50} (half-life) to account for persistence and/or potential mobility of each pesticide of interest. The model was used 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 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 once in October at six established sites. Water and sediment samples will be collected in the event. Sediment samples will be analyzed for seven pyrethroids. Monitoring locations are located in the Alamo River and New River watersheds (Table 1, Figure 1). In previous years, monitoring was usually conducted in March and October to capture runoff during the period of high pesticide uses in Imperial County. Due to the covid-19 pandemic and CDPR's Health and Safety procedures, monitoring in March was suspended in 2021.

The priority lists for monitoring recommendation in the New River and Alamo River were generated using the average yearly pesticide use from 2016–2018 (Tables 2-3). The chemical lists recommended by the model are similar to those in 2020. Linuron is the only pesticide that is recommended for monitoring by the priority model, but will not be monitored in 2021 because the analytical method for this AI is 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 (March, May, July and September), and two times during storm events in the winter. Water samples will be collected during each sampling event for chemical analysis and a subset of water samples from four to six 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 not monitored in 2020 will be monitored in 2021. Sal_Blanco is a historical site that has not been sampled since 2015, and Sal_Tembl is a new site to CDPR's agricultural monitoring program. 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 priority lists for monitoring in each watershed were generated using the average yearly pesticide use data from 2016 to 2018 (Table 4, 5). The chemical lists recommended by the priority model are similar to those in 2020 with changes on rankings of a few chemicals due to changes of their use scores from 2016 to 2018. Notably, the use amounts of chlorpyrifos and diazinon had significantly reduced and so did their ranking scores on the priority list in recent years. Nevertheless, the monitoring results indicated about 11% and 22% detections in 2019 for chlorpyrifos and diazinon, respectively (Main 2020). Although acephate, glufosinate-ammonium, PCNB and propyzamide are on the priority list in 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. 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 site on Main Ditch at HWY166 was monitored in previous years and was re-added for monitoring in 2019 to replace the 2018 site at Bradley Channel as it dried out during monitoring events in 2018.

The priority lists for monitoring in each watershed were generated using the average yearly use data from 2016 to 2018 (Table 6, 7). The chemicals recommended by the model for monitoring in the Orcutt Creek Watershed are similar to those in 2019. Chlorpyrifos dropped out of the lists for both watersheds but will be kept on the monitoring list in 2021 as part of the multi-analyte screen. Propyzamide and linuron appear as a low or medium priority for monitoring at Oso Flaco Creek (score = 8). However, it will not be included for monitoring as the analytical method is not developed for the AI at the chemistry lab.

5.4. Modifications from 2020

There will be a few modifications on monitoring timeline, sampling sites and chemical analysis in 2021. Monitoring will be conducted four times (March, May, July and September) in the Central Coast in 2021 to capture pesticide runoff during the irrigation season. In previous years, monitoring was conducted three times (May, July and September). Efforts will be made to conduct storm sampling in Monterey County to capture storm runoff, including the first event of the season that generates sufficient runoff. Maintaining the same sampling schedule in both areas in the Central Coast will further help facilitate comparative analyses between the two areas (including data from previous years) by reducing the potential bias introduced by different sampling schedules. Two additional sites will be added in 2021. Both sites are located in the northern part of Salinas, representing surface water runoff from tile drainage systems. In addition, the entire LC-Screen that includes 54 pesticides and 5 fipronil degradates will be applied to analyze all water samples in 2021 (Table 9). All pesticides identified as high priority by the SWPP model are included in current analytical screens except for the following five pesticides: acephate, linuron, glufosinate-ammonium, PCNB and propyzamide. Analytical methods will need to be developed to include those pesticides 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 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

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 (Doo and He 2008).

7. LABORATORY ANALYSES

7.1. Chemical Analysis

Chemical analyses will be performed by the Center for Analytical Chemistry at CDFA A total of 67 pesticides will be analyzed in each water sample collected from all of the sampling sites in 2021. Tables 9 presents 54 pesticides and their associated analytical method reporting limits and method detection limits in a single liquid chromatograph multi-analyte screen (LC-screen). Seven pyrethroids and six dinitroanilines will also be analyzed (Table 8). Quality control (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 every 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 as appropriate, 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 2021–November 2021
Chemical Analysis:	January 2021–December 2021
Draft Report:	August 2022
Data Entry into SURF:	Fall 2022

10. SAMPLING EVENTS

The sampling schedule for each county is provided in Table 11.

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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
Chlorpyrifos	4	6	24	Yes
Pendimethalin	5	4	20	Yes
Imidacloprid	4	5	20	Yes
Permethrin	3	6	18	Yes
Trifluralin	4	4	16	Yes
Atrazine	3	5	15	Yes
λ-cyhalothrin	2	7	14	Yes
Methomyl	3	4	12	Yes
Malathion	2	6	12	Yes
Cypermethrin	2	5	10	Yes
Oxyfluorfen	2	5	10	Yes
Dimethoate	3	3	9	Yes
Bensulide	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
Imidacloprid	4	5	20	Yes
Chlorpyrifos	3	6	18	Yes
Trifluralin	4	4	16	Yes
λ-cyhalothrin	2	7	14	Yes
Methomyl	3	4	12	Yes
Malathion	2	6	12	Yes
Permethrin	3	6	18	Yes
Atrazine	3	5	15	Yes
Praquat dichloride	2	5	10	No[2]
Oxyfluorfen	2	5	10	Yes
Dimethoate	3	3	9	Yes
Bensulide	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.

[2]No longer prioritized for monitoring due to frequently low detections in previous years.

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

Chemical	Use Score	Tox Score	Final Score	Monitoring Inclusion
Permethrin	3	6	18	Yes
Methomyl	4	4	16	Yes
Paraquat dichloride	3	5	15	No[2]
Oxyfluorfen	3	5	15	Yes
Imidacloprid	3	5	15	Yes
λ-cyhalothrin	2	7	14	Yes
Glufosinate-ammonium	4	3	12	No[1]
Pendimethalin	3	4	12	Yes
Pyraclostrobin	3	4	12	Yes
Malathion	2	6	12	Yes
Bensulide	5	2	10	Yes
PCNB	3	3	9	No[1]
Propyzamide	4	2	8	No[1]
Prometryn	2	4	8	Yes
Simazine	2	4	8	Yes
Chlorantraniliprole	2	4	8	Yes

Salinas River drainage area = 11,082 km^2

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

[2]No longer prioritized for monitoring due to frequently low detections in previous years.

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	6	18	Yes
Methomyl	4	4	16	Yes
PCNB	4	3	12	No[1]
Pyraclostrobin	3	4	12	Yes
Bifenthrin	2	6	12	Yes
Carbaryl	2	5	10	Yes
Imidacloprid	2	5	10	Yes
Oxyfluorfen	2	5	10	Yes
Paraquat dichloride	2	5	10	No[2]
Acephate	4	2	8	No[1]
Pendimethalin	2	4	8	Yes

Tembladero Slough drainage area = 291 km^2

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

[2]No longer prioritized for monitoring due to frequently low detections in previous years.

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	3	5	15	Yes
Pyraclostrobin	3	4	12	Yes
Permethrin	2	6	12	Yes
Fenpropathrin	2	5	10	Yes
Cyprodinil	3	3	9	Yes
Methomyl	2	4	8	Yes
Chlorantraniliprole	2	4	8	Yes
Trifloxystrobin	2	4	8	Yes

Orcutt Creek drainage area = 301 km^2

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	3	5	15	Yes
Methomyl	3	4	12	Yes
Pyraclostrobin	3	4	12	Yes
Permethrin	2	6	12	Yes
Fenpropathrin	2	5	10	Yes
Propyzamide	4	2	8	No[1]
Prometryn	2	4	8	Yes
Linuron	2	4	8	No[1]
Trifluralin	2	4	8	Yes
Chlorantraniliprole	2	4	8	Yes

Oso Flaco Creek drainage area = 51 km^2

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

Table 8. Reporting Limits and Method Detection Limits for DN/OX* and Pyrethroids in Whole Water.

Analytic Screen	Pesticide	Method Detection Limit (µg/L)	Reporting Limit (µg/L)
DN/OX	Benfluralin (*Benefin*)	0.014	0.05
DN/OX	Ethalfluralin	0.015	0.05
DN/OX	Oxyfluorfen	0.010	0.05
DN/OX	Pendimethalin	0.012	0.05
DN/OX	Prodiamine	0.012	0.05
DN/OX	Trifluralin	0.014	0.05
Pyrethroid	Bifenthrin	0.00091	0.001
Pyrethroid	λ-cyhalothrin	0.00174	0.002
Pyrethroid	Permethrin	0.00105	0.002
Pyrethroid	Cyfluthrin	0.00146	0.002
Pyrethroid	Cypermethrin	0.00154	0.005
Pyrethroid	Fenpropathrin	0.00132	0.005
Pyrethroid	Fenvalerate/esfenvalerate	0.00166	0.005

*DN/OX = dinitroanilines and oxyfluorfen.

Table 9. Reporting Limits and Method Detection Limits for Pesticides in LC* Multi-Analyte Screen.

Analytic Screen	Pesticide	Method Detection Limit (µg/L)	Reporting Limit (µg/L)
LC	Abamectin	0.004	0.02
LC	Acetamiprid	0.004	0.02
LC	Atrazine	0.004	0.02
LC	Azoxystrobin	0.004	0.02
LC	Bensulide	0.004	0.02
LC	Boscalid	0.004	0.02
LC	Bromacil	0.004	0.02
LC	Carbaryl	0.004	0.02
LC	Chlorantraniliprole	0.004	0.02
LC	Chlorpyrifos	0.004	0.02
LC	Clothianidin	0.004	0.02
LC	Cyprodinil	0.004	0.02
LC	Diazinon	0.004	0.02
LC	Diflubenzuron	0.004	0.02
LC	Dimethoate	0.004	0.02
LC	Diuron	0.004	0.02
LC	Ethoprop	0.004	0.02
LC	Etofenprox	0.004	0.02
LC	Fenamidone	0.004	0.02
LC	Fenhexamid	0.005	0.02
LC	Fludioxonil	0.004	0.02

Analytic Screen	Pesticide	Method Detection Limit (µg/L)	Reporting Limit (µg/L)
LC	Hexazinone	0.004	0.02
LC	Imidacloprid	0.004	0.01
LC	Indoxacarb	0.004	0.02
LC	Isoxaben	0.004	0.02
LC	Kresoxim-methyl	0.004	0.02
LC	Malathion	0.004	0.02
LC	Mefenoxam	0.004	0.02
LC	Methidathion	0.004	0.02
LC	Methomyl	0.004	0.02
LC	Methoxyfenozide	0.004	0.02
LC	Metribuzin	0.004	0.02
LC	Norflurazon	0.004	0.02
LC	Oryzalin	0.004	0.02
LC	Oxadiazon	0.004	0.02
LC	Prometon	0.004	0.02
LC	Prometryn	0.004	0.02
LC	Propanil	0.004	0.02
LC	Propargite	0.004	0.02
LC	Propiconazole	0.004	0.02
LC	Pyraclostrobin	0.004	0.02
LC	Pyriproxyfen	0.004	0.015
LC	Quinoxyfen	0.004	0.02
LC	Simazine	0.004	0.02
LC	S-Metolachlor	0.004	0.02
LC	Tebuconazole	0.004	0.02
LC	Tebufenozide	0.004	0.02
LC	Tebuthiuron	0.004	0.02
LC	Thiabendazole	0.004	0.02
LC	Thiacloprid	0.004	0.02
LC	Thiamethoxam	0.004	0.02
LC	Thiobencarb	0.004	0.02
LC	Trifloxystrobin	0.004	0.02
LC	Fipronil	0.004	0.01
LC	Fipronil Amide	0.004	0.01
LC	Fipronil Sulfide	0.004	0.01
LC	Fipronil Sulfone	0.004	0.01
LC	Desulfinyl Fipronil	0.004	0.01
LC	Desulfinyl Fipronil Amide	0.004	0.01

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

Table 10. 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 11. Number of Samples for Pesticide Analyses by Counties from January to November, 2021*.

Analyte Group**	Location[1]	1st Storm	Mar	May	July	Sept	Oct	2nd Storm	Total samples[2]
LC-Full	Imperial						6		6
DN/OX	Imperial						6		6
PY-Water	Imperial						6		6
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**	**36**	**36**	**36**	**48**	**24**	**24**	**228**

*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

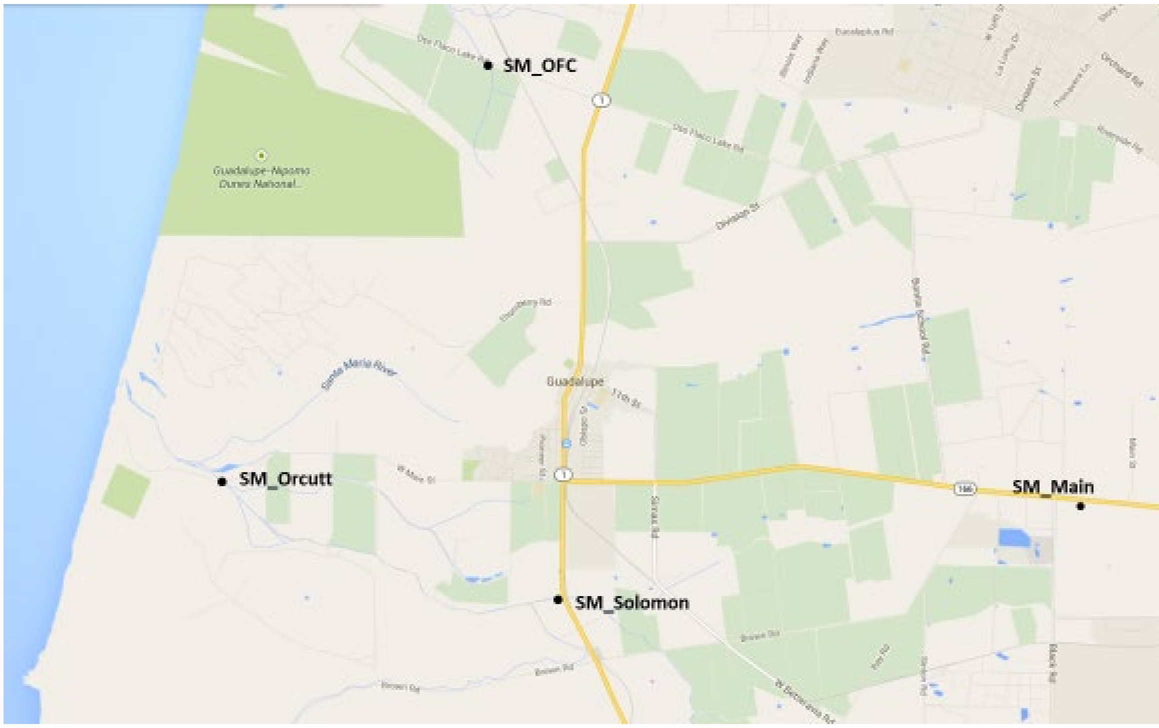

Figure 3. Monitoring Sites in Orcutt Creek and Oso Flaco Creek in San Luis Obispo and Santa Barbara Counties.