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Study 304. Surface Water Monitoring for Pesticides in Agricultural Areas in the Central Coast and Southern California, 2018

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1. INTRODUCTION

Surface water monitoring for pesticides in agricultural areas of California is one of the California Department of Pesticide Regulation's (CDPR's) long-term environmental monitoring projects. The project was initiated in 2008 with a primary goal of collecting data to assess potential impacts of pesticides from agricultural runoff on California aquatic environments. Project findings help guide CDPR in the development and implementation of regulatory and non-regulatory mitigation activities. This project focuses its monitoring on major agricultural areas in the Central Coast and Southern California where pesticide uses are heavy and irrigation practices have high runoff potentials. The monitoring areas include major watershed drainages in Monterey, Santa Barbara, San Luis Obispo and Imperial counties (Starner 2010, 2013; Deng 2016, 2017a).

Preliminary monitoring results in the Central Coast and Southern California in previous years were summarized in project annual reports (accessible via http://www.cdpr.ca.gov/docs/emon/pubs/ehapreps.htm?filter=surfwater). Over 24 pesticides in 8 chemical groups were monitored each year. In 2016, malathion, dimethoate, methomyl, methoxyfenozide, bifenthrin, λ-cyhalothrin, permethrin and imidacloprid were the insecticides detected at high frequencies (20–89%). The frequencies of their concentrations exceeding the associated lowest U.S. Environmental Protection Agency (US EPA) aquatic life benchmark values ranged from 9 to 46% (Deng 2017b). Those insecticides can be highly toxic to sensitive aquatic organisms. Many of them were commonly detected in single or multiple samples from the same watershed. Their frequent co-occurrence in a given watershed and frequent exceedances for their benchmarks indicate that the insecticide uses in the monitored watershed drainages have the potential to cause adverse impacts to non-targeted aquatic organisms and aquatic communities. Herbicides and fungicides that were frequently detected included atrazine, bensulide, oxyfluorfen, pendimethalin, azoxystrobin and pyraclostrobin (14–67%). However, the benchmark exceedances for herbicides and fungicides were low in frequency.

Study 304 is a continuation of CDPR's agricultural monitoring efforts in the Central Coast and Southern California. Monitoring sites were selected from those established in previous years with no changes from 2017 (Deng 2017a). Priority lists of pesticides recommended for monitoring in each watershed were identified using CDPR's Prioritization Model (Luo et al. 2013, 2014, 2015). The watershed-based prioritization approach was applied to help refine the pesticide priority list for monitoring in 2018. In 2018, monitoring frequency in the Central Coast has been modified based on the monitoring results from previous years (see Section 5.4).

2. OBJECTIVE

The goal of the project is to assess short-term changes and long-term trends of pesticide contamination in agricultural runoff and the potential impacts of the runoff to aquatic environments. Results of the assessment will provide information to CDPR managers to determine whether mitigation responses are necessary to address environmental risks of pesticide contamination. Objectives of the project are as follows:

1) Prioritize pesticide monitoring candidates based on current pesticide use at the watershed level;
2) Determine occurrences and measure chemical concentrations of high-priority pesticides in aqueous and sediment samples;
3) Test acute toxicity of water samples using lab surrogate species;
4) Analyze chemistry data to evaluate potential impacts on aquatic environments by comparing environmental concentrations with US EPA aquatic life benchmarks;
5) Analyze spatial correlations between observed pesticide concentrations/detection frequencies and region-specific pesticide use;
6) Assess multiple years of data to characterize patterns and trends in detection frequencies and benchmark exceedances.

3. PERSONNEL

The study will be conducted by staff from the Environmental Monitoring Branch, Surface Water Protection Program, under the general direction of Nan Singhasemanon, Environmental Program Manager I. Key personnel are listed below:

Project Leader:	Xin Deng, Ph.D.
Field Coordinator:	Kevin Kelley
Review Scientist:	Yuzhou Luo, Ph.D.
Statistician:	Dan Wang, Ph.D.
Laboratory Liaison:	Sue Peoples
Analytical Chemistry:	Center for Analytical Chemistry, California Department of Food and Agriculture (CDFA)

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

4. SELECTION OF PESTICIDES FOR MONITORING

The pesticides were prioritized following the procedures described in the Monitoring Prioritization Model (Luo et al. 2013, 2014, 2015). The watershed-based prioritization model uses 12-digit hydrologic units on the U.S. Geological Survey (USGS) Watershed Boundary Database (http://viewer.nationalmap.gov/viewer/nhd.html?p=nhd) to define the watershed boundary. It then aggregates the total use of each pesticide within the watershed and adjusts the total use by factoring in pesticide dissipation as a function of travel time. The model was applied to generate a ranked list of pesticides for each watershed. Pesticides were then screened to produce final monitoring lists following the general criteria below:

1) Pesticides with final ranking scores ≥ 9 in a priority list for a watershed of interest will be monitored as pesticides with this ranking have higher use (use scores ≥ 2) and toxicity (tox scores ≥ 3, the lowest benchmark values ≤ 100 ppb), and thus have higher potential risks to aquatic communities.
2) Pesticides with final scores ≤ 8 and use scores ≥ 2 in a priority list will be considered for monitoring. The use criterion includes the top 30% pesticides with the highest use amounts among all the pesticides reported to PUR from 2013–2015 for a watershed of interest. Pesticides that are not in the priority lists or have use scores < 2 may be reported when they are concurrently analyzed with other prioritized pesticides in an analytical group.
3) Historical monitoring data, current use trends, availability of analytical methods and budget constraints are additional factors to help decide a final list for monitoring.

5. STUDY PLAN

5.1. Imperial County

Ambient monitoring will be conducted in Imperial County twice a year in March and October. Water samples will be collected in both events and sediment samples will be collected only in October for pyrethroid analysis. Six sites that had been monitored within the watersheds of Alamo and New rivers in 2017 will be monitored in 2018 (Table 1, Figure 1).

The priority lists for monitoring in New River and Alamo River in March and October were generated using the average use data from January to March and from August to October from 2013–2015, respectively (Tables 2 and 3). The chemical lists recommended by the model are similar to those in 2017. Chlorantraniliprole will be monitored in March despite its low priority score (final score = 4) because the compound was detected frequently in the two watersheds in 2017.

5.2. Monterey County

Ambient monitoring will be conducted in Monterey County four times a year in May, July, September and November. Water samples will be collected during each sampling event for chemical analysis and a subset of water samples will be collected in July for toxicity test. Sediment samples will be collected only in September for pyrethroid analysis. Six sites that were monitored within the watersheds of Salinas River and Tembladero Slough in 2017 will be monitored in 2018 (Table 1, Figure 2).

The priority lists for monitoring in each watershed were generated using the average pesticide use data from May to November from 2013–2015 (Table 4). The chemical lists recommended by the model are similar to those in 2017 with changes on rankings of a few chemicals due to changes of their use scores from 2013–2015. 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 2–3% detections for chlorpyrifos and 0–11% detections for diazinon in the last three years. We will keep monitoring the two chemicals in 2017. Chlorantraniliprole with a final score of 8 will be monitored in the Salinas River Watershed in 2018 due to its frequent detections in 2017 and their increasing use in recent years. Paraquat dichloride, glufosinate-ammonium, fenamidone, spinetoram and fludioxonil are on the priority list in the Salinas River Watershed but will not be monitored in 2018 due to either the low detection frequency statewide in previous years or unavailability of analytical methods (Table 4).

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 May, July, September and November. Water samples will be collected during each sampling event for chemical analysis and a subset of water samples will be collected in July for toxicity test. Sediment samples will be collected only in September for pyrethroid analysis. Four monitoring sites that had been monitored within the watersheds of Orcutt Creek and Oso Flaco Creek in 2017 will be monitored in 2018 (Table 1, Figure 3).

The priority lists for monitoring in each watershed were generated using the average use data from May to November from 2013–15 (Table 5). The chemicals recommended by the model for monitoring in the Orcutt Creek Watershed are similar to those in 2017. Chlorpyrifos dropped out of the lists for both watersheds but will be kept on the monitoring list in 2017 as part of the multi-analyte screen. Fenhexamid fungicide is on the priority list for the Oso Flaco Creek Watershed (Table 5) but will not be monitored because the analytical method is not currently available.

5.4. Modifications from 2017

The major modification in 2018 was the change of the sampling events from 6 to 4 times in the Salinas Valley. Sampling events in Salinas were traditionally conducted on a monthly basis during irrigation season from April to September. Preliminary statistical analyses on monitoring results in Salinas from 2011–2016 indicate that pesticide detection frequencies among the sampling months had no significant differences (Chi-square test, $p>0.4978$) except in July when the frequency was significant higher than the other months (Chi-square test, $p<0.0133$). Pesticide concentrations among all the detected pesticides showed significant differences across the sampling months (Maximum likelihood estimation test with censored data, $p<0.0352$). When monitoring results were pooled into two groups with Group A including April, June and August and Group B including May, July and September, Group B showed a significantly higher detection frequency (Chi-square test, $p<0.0298$), but no difference was observed in concentrations between the two groups (Maximum likelihood estimation test with censored data, $p=1$). The analyses suggest that the bimonthly sampling schedule in May, July and September would capture the worst case scenario during the irrigation season. In addition, the change would allow CDPR to use analytical resources to extend the sampling event into the post-irrigation season in November in both Salinas and Santa Maria areas. The same sampling schedule in both areas in the Central Coast will help simplify comparative analyses between the two areas and reduce potential bias that were introduced by the sampling design in future data analysis. Moreover, the modified sampling schedule will give us flexibility to extend the sampling event to the non-irrigation season in January and March when resources are available in the future.

6. SAMPLING METHOD

6.1. Water and Sediment Sampling

Water samples will be collected as grab samples directly into 1-liter amber glass bottles sealed with Teflon-lined lids by hand or using a pole (Bennett, 1997). Sediment samples will be collected into 1-quart 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 (Mamola, 2005; Ensminger, 2017). Samples will be stored and transported on wet ice or refrigerated at $4^{o}C$ until analyzed.

6.2. Sample Transport

CDPR staff will transport water and sediment samples to the Center for Analytical Chemistry at California Department of Food and Agriculture for chemical analysis and to the Aquatic Health Program at the University of California-Davis 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, turbidity 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, California Department of Food and Agriculture, Sacramento, CA. A total of 31 pesticides that include all the chemicals on the priority list of each watershed will be analyzed in all of the water samples collected from all of the sampling sites in 2018. Table 6 presents the pesticides and their associated analytical method reporting limits and method detection limits. Eighteen of the pesticides in the screening groups will be selected from a single liquid chromatograph multi-analyte screen (LC-screen). Seven pyrethroids and six dinitroanilines will be analyzed. Quality control will be conducted in accordance with the Standard Operating Procedure QAQC001.00 (Segawa 1995). Laboratory QA/QC will follow CDPR guidelines and will consist of laboratory blanks, matrix spikes, matrix spike duplicates, surrogate spikes, and blind spikes (Segawa 1995). Laboratory blanks and matrix spikes will be included in each extraction set.

7.2. Organic Carbon and Suspended Solid Analysis

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). Water samples will also be analyzed for suspended sediment (Ensminger 2013b). Lab blanks and calibration standards will be ran before every sample set to ensure the quality of the data.

7.3. Toxicity Analysis

Toxicity analyses will be conducted for water samples collected from sampling sites in the Central Coast region by the Aquatic Health Program at the University of California, Davis. Grab water samples will be tested for mortality using *Hyalella azteca, Chironomus dilutus or Ceriodaphnia dubia* 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 (SURF) (http://cdpr.ca.gov/docs/emon/surfwtr/surfdata.htm).

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 2018); spatial analysis of data in order 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; assessment of results to determine potential additional monitoring in regions with similar pesticide use patterns.

9. TIMETABLE

Field Sampling:	March 2018–November 2018
Chemical Analysis:	March 2018–December 2018
Draft Report:	March 2019
Data Entry into SURF:	April 2019

10. SAMPLING EVENTS AND BUDGET

The sampling schedule for each county and the estimated total cost for chemical analyses are provided in Table 7.

11. REFERENCES

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Table 1. Sampling Site Information for Study 304 in 2018

Site ID	Site Location	County	Watershed	Latitude	Longitude	Site Type
Imp_NewRiv27	New River at HWY S27/Keystone Road	Imperial	New River	32.9136	-115.60646	Main Stream
Imp_Lack	New River at Lack Road			33.0999	-115.64876	Main Stream
Imp_Rice3	Rice Drain III at Weinert Road			32.8691	-115.651	Ag Drain
Imp_Rutherford	Alamo River at Rutherford Rd (upstream of Imperial State Wildlife Area)		Alamo River	33.0447	-115.48829	Main Stream
Imp_Garst	Alamo River at Garst Road			33.199	-115.59696	Main stream
Imp_Holtville	Holtville Main Drain at HWY115			32.9309	-115.40611	Ag Drain
Sal_Quail	Quail Creek at HWY 101, btwn Spence and Potter Roads	Monterey	Salinas River	36.6092	-121.56269	Tributary
Sal_Chualar	Chualar Creek at Chualar River Rd., ca. 1.2 mi. from HWY 101			36.5584	-121.52964	Tributary
Sal_Davis	Salinas River at Davis Road			36.647	-121.70219	Main Stream
Sal_Hartnell	Alisal Creek at Hartnell Rd		Tembladero Slough	36.6435	-121.57836	Tributary
Sal_SanJon	Rec Ditch at San Jon Road			36.7049	-121.70506	Tributary
Sal_Haro	Tembladero Slough at Haro Street			36.7596	-121.75433	Main Stream
SM_OFC	Oso Flaco Creek @ OFL Road	San Luis Obispo	Oso Flaco Creek	35.0164	-120.58755	Tributary
SM_Solomon	Solomon Creek @ HWY 1	Santa Barbara	Orcutt Creek	34.9414	-120.5742	Main Stream
SM_Orcutt	Orcutt Creek @ Main Street			34.9576	-120.63244	Main Stream
SM_Bradley	Bradley Channel @ River Oaks		Bradley Channel	34.9742	-120.4245	Ag drain

Table 2. Pesticide Prioritization for Surface Water Monitoring in Alamo River and New River in Imperial County. Ranking of Pesticides Based on Average Use Data from January through March of 2013–2015

Alamo River, Drainage Area = 1264 km^2				
Chemical	**Use score**	**Tox score**	**Final score**	**Monitoring inclusion**
CHLORPYRIFOS	5	6	30	Yes
MALATHION	4	6	24	Yes
PENDIMETHALIN	5	4	20	Yes
TRIFLURALIN	5	4	20	Yes
PERMETHRIN	3	6	18	Yes
ATRAZINE	3	5	15	Yes
λ-CYHALOTHRIN	2	7	14	Yes
DIMETHOATE	4	3	12	Yes
METHOMYL	3	4	12	Yes
CYPERMETHRIN	2	5	10	Yes
IMIDACLOPRID	2	5	10	Yes
OXYFLUORFEN	2	5	10	Yes
New River, Drainage Area = 1729 km^2				
Chemical	**Use score**	**Tox score**	**Final score**	**Monitoring inclusion**
CHLORPYRIFOS	5	6	30	Yes
MALATHION	4	6	24	Yes
PENDIMETHALIN	5	4	20	Yes
PERMETHRIN	3	6	18	Yes
TRIFLURALIN	4	4	16	Yes
DIMETHOATE	5	3	15	Yes
ATRAZINE	3	5	15	Yes
λ-CYHALOTHRIN	2	7	14	Yes
METHOMYL	3	4	12	Yes
CYPERMETHRIN	2	5	10	Yes
OXYFLUORFEN	2	5	10	Yes

Table 3. Pesticide Prioritization for Surface Water Monitoring in Alamo River and New River in Imperial County. Ranking of Pesticides Based on Average Use Data from August through October of 2013–2015

Alamo River, Drainage Area = 1264 km^2				
Pesticide	**Use score**	**Tox score**	**Final score**	**Monitoring inclusion**
CHLORPYRIFOS	4	6	24	Yes
IMIDACLOPRID	3	5	15	Yes
PENDIMETHALIN	3	4	12	Yes
TRIFLURALIN	3	4	12	Yes
PERMETHRIN	2	6	12	Yes
ESFENVALERATE	2	6	12	Yes
BENSULIDE	5	2	10	Yes
CYPERMETHRIN	2	5	10	Yes
OXYFLUORFEN	2	5	10	Yes
METHOXYFENOZIDE	3	3	9	Yes
METHOMYL	2	4	8	Yes
CHLORANTRANILIPROLE	2	4	8	Yes
New River, Drainage Area = 1729 km^2				
Pesticide	**Use score**	**Tox score**	**Final score**	**Monitoring inclusion**
CHLORPYRIFOS	4	6	24	Yes
IMIDACLOPRID	3	5	15	Yes
λ-CYHALOTHRIN	2	7	14	Yes
TRIFLURALIN	3	4	12	Yes
PENDIMETHALIN	3	4	12	Yes
PERMETHRIN	2	6	12	Yes
MALATHION	2	6	12	Yes
BENSULIDE	5	2	10	Yes
CYPERMETHRIN	2	5	10	Yes
METHOMYL	2	4	8	Yes
CHLORANTRANILIPROLE	2	4	8	Yes

Table 4. Pesticide Prioritization for Surface Water Monitoring in Salinas River and Tembladero Slough in Monterey County. Ranking of Pesticides Based on Average Use Data from May through November of 2013–2015

Salinas River, Drainage Area = 11082 km^2				
Pesticide	**Use score**	**Tox score**	**Final score**	**Monitoring inclusion**
PERMETHRIN	4	6	24	Yes
MALATHION	4	6	24	Yes
METHOMYL	5	4	20	Yes
IMIDACLOPRID	3	5	15	Yes
PARAQUAT DICHLORIDE	3	5	15	No[1]
OXYFLUORFEN	3	5	15	Yes
λ-CYHALOTHRIN	2	7	14	Yes
PYRACLOSTROBIN	3	4	12	Yes
CHLORPYRIFOS	2	6	12	Yes
BENSULIDE	5	2	10	Yes
CYPRODINIL	3	3	9	Yes
GLUFOSINATE-AMMONIUM	3	3	9	No[2]
FENAMIDONE	3	3	9	No[2]
SPINETORAM	3	3	9	No[2]
QUINOXYFEN	3	3	9	Yes
PROMETRYN	2	4	8	Yes
CHLORANTRANILIPROLE	2	4	8	Yes
PENDIMETHALIN	2	4	8	Yes
LINURON	2	4	8	No[2]
TRIFLOXYSTROBIN	2	4	8	Yes
S-METOLACHLOR	2	4	8	Yes
Tembladero Slough, Drainage Area = 291 km^2				
Pesticide	**Use score**	**Tox score**	**Final score**	**Monitoring inclusion**
MALATHION	5	6	30	Yes
PERMETHRIN	3	6	18	Yes
DIFLUBENZURON	2	7	14	Yes
METHOMYL	3	4	12	Yes
BIFENTHRIN	2	6	12	Yes
IMIDACLOPRID	2	5	10	Yes
OXYFLUORFEN	2	5	10	Yes
CYPRODINIL	3	3	9	Yes
FENAMIDONE	3	3	9	No[2]
FLUDIOXONIL	3	3	9	No[2]

Notes for exclusion:

1) Low detection frequencies statewide (less than 1 % detection in 1828 samples; SURF database, 2016) from monitoring results in previous years.
2) Analytical method not currently available.

Table 5. Pesticide Prioritization for Surface Water Monitoring in Orcutt Creek and Oso Flaco Creek in Santa Barbara and San Luis Obispo Counties. Ranking of Pesticides Based on Average Use Data from May through November of 2013–2015

Orcutt Creek, Drainage Area = 301 km^2				
Pesticide	**Use score**	**Tox score**	**Final score**	**Monitoring inclusion**
MALATHION	5	6	30	Yes
IMIDACLOPRID	4	5	20	Yes
OXYFLUORFEN	3	5	15	Yes
PROMETRYN	3	4	12	Yes
METHOMYL	3	4	12	Yes
PERMETHRIN	2	6	12	Yes
BIFENTHRIN	2	6	12	Yes
FENPROPATHRIN	2	5	10	Yes
CYPRODINIL	3	3	9	Yes
PYRACLOSTROBIN	2	4	8	Yes
TRIFLURALIN	2	4	8	Yes
Oso Flaco Creek, Drainage Area = 51 km^2				
Pesticide	**Use score**	**Tox score**	**Final score**	**Monitoring inclusion**
MALATHION	5	6	30	Yes
IMIDACLOPRID	4	5	20	Yes
OXYFLUORFEN	3	5	15	Yes
BIFENTHRIN	2	6	12	Yes
PERMETHRIN	2	6	12	Yes
NOVALURON	2	6	12	No[1]
FENPROPATHRIN	2	5	10	Yes
CYPRODINIL	3	3	9	Yes
FENHEXAMID	4	2	8	No[1]
PYRACLOSTROBIN	2	4	8	Yes
TRIFLURALIN	2	4	8	Yes
CHLORANTRANILIPROLE	2	4	8	Yes

Notes for exclusion:

1) Analytical method not currently available.

Table 6. Reporting Limit and Method Detection Limit for Pesticides Monitored in 2018

Analytic Screen	**Pesticide**	**Method Detection Limit (µg/L)**	**Reporting Limit (µg/L)**
Liquid chromatograph multi-analyte screen (LC)	Atrazine	0.004	0.02
	Azoxystrobin	0.004	0.02
	Bensulide	0.004	0.02
	Chlorantraniliprole	0.004	0.02
	Chlorpyrifos	0.004	0.02
	Cyprodinil	0.004	0.02
	Diazinon	0.004	0.02
	Diflubenzuron	0.004	0.02
	Dimethoate	0.004	0.02
	Imidacloprid	0.004	0.01
	Malathion	0.004	0.02
	Methomyl	0.004	0.02
	Methoxyfenozide	0.004	0.02
	Oryzalin	0.004	0.02
	Prometryn	0.004	0.02
	Pyraclostrobin	0.004	0.02
	Quinoxyfen	0.004	0.02
	S-Metolachlor	0.004	0.02
Dinitroanilines and Oxyfluorfen (DN/OX)	Benfluralin	0.014	0.05
	Ethalfluralin	0.015	0.05
	Oxyfluorfen	0.01	0.05
	Pendimethalin	0.012	0.05
	Prodiamine	0.012	0.05
	Trifluralin	0.014	0.05
Pyrethroids (PY) in Water	Bifenthrin	0.00091	0.001
	Lambda-cyhalothrin	0.00174	0.002
	Permethrin	0.00105	0.002
	Cyfluthrin	0.00146	0.002
	Cypermethrin	0.00154	0.005
	Fenpropathrin	0.00132	0.005
	Fenvalerate/esfenvalerate	0.00166	0.005
		Method Detection Limit (ng/g dry wt)	**Reporting Limit (ng/g dry wt)**
Pyrethroids (PY) in Sediment	Bifenthrin	0.1083	1.0
	Lambda-cyhalothrin	0.1154	1.0
	Permethrin	0.1159	1.0
	Cyfluthrin	0.183	1.0
	Cypermethrin	0.107	1.0
	Fenpropathrin	0.1094	1.0
	Esfenvalerate/fenvalerate	0.143	1.0

Table 7. Number of Samples Collected for Pesticide Analyses for the County or Counties and Associated Budget from March – November, 2018

Analyte Group*	**March**	**May**	**July**	**September**	**October**	**November**	**Total Number of Samples**	**QC Samples**	**Cost Per Sample**	**Total Cost Per Analyte Group**
	Imperial	**Central Coast*** **	**Central Coast**	**Central Coast**	**Imperial**	**Central Coast**				
LC-Screen	6	10	10	10	6	10	56	6	1,700	105,400
DN/OX	6	10	10	10	6	10	52	6	840	48,720
PY_water	6	10	10	10	6	10	52	6	600	34,800
PY-sediment				10	6		16	2	600	10,800
Grand Total	**18**	**30**	**30**	**40**	**24**	**30**	**160**	**20**	**3,740**	**199,720**

* LC-screen = Liquid chromatograph multi-analyte screen; DN/OX = Dinitroaniline & Oxyfluorfen; MA-A = Malathion acidified; PY = Pyrethroid
** The number represents 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
***Central Coast = Monterey, Santa Barbara and San Luis Obispo counties

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

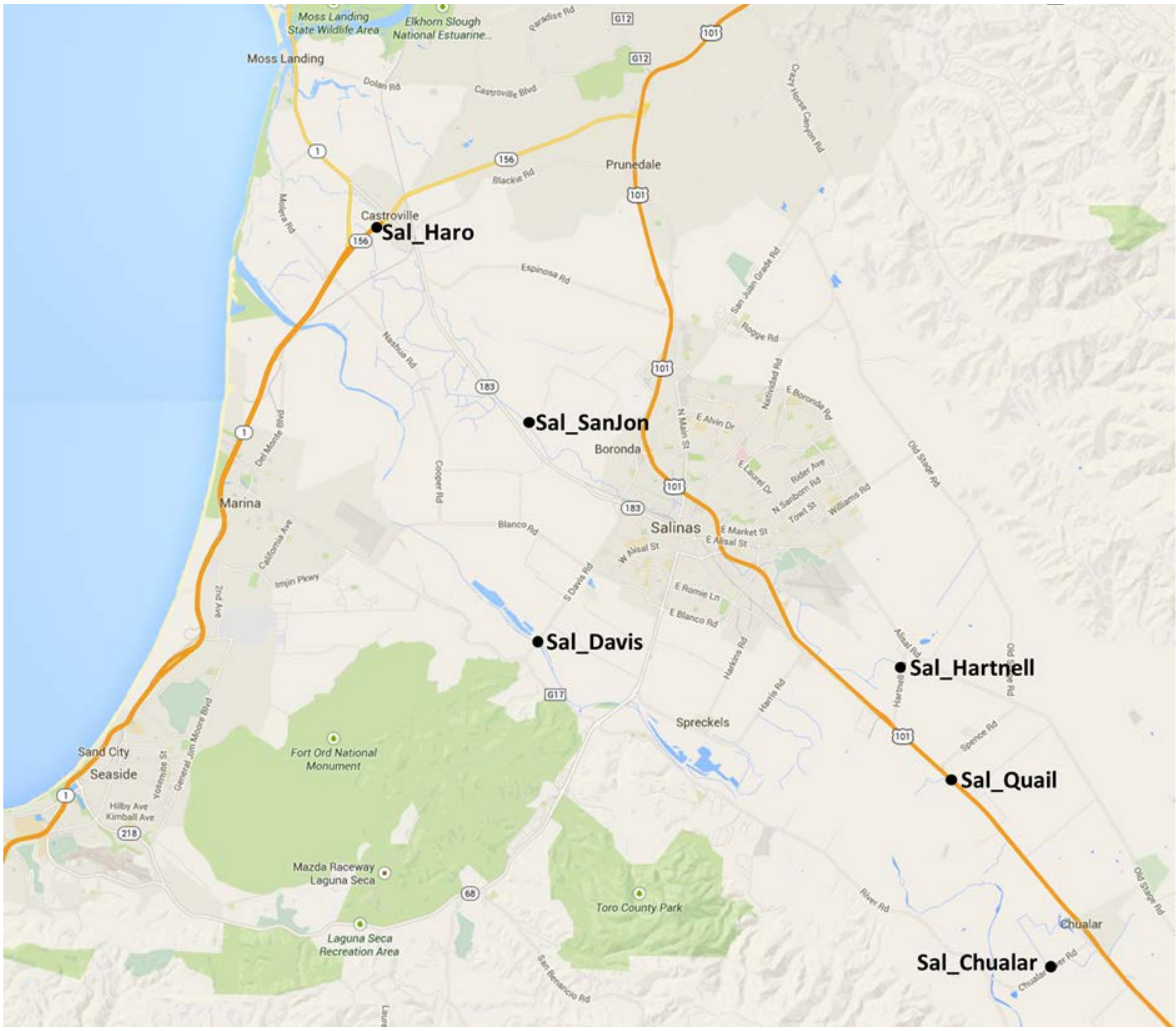

Figure 2. Monitoring Sites in Salinas River and Tembladero Slough in Monterey County

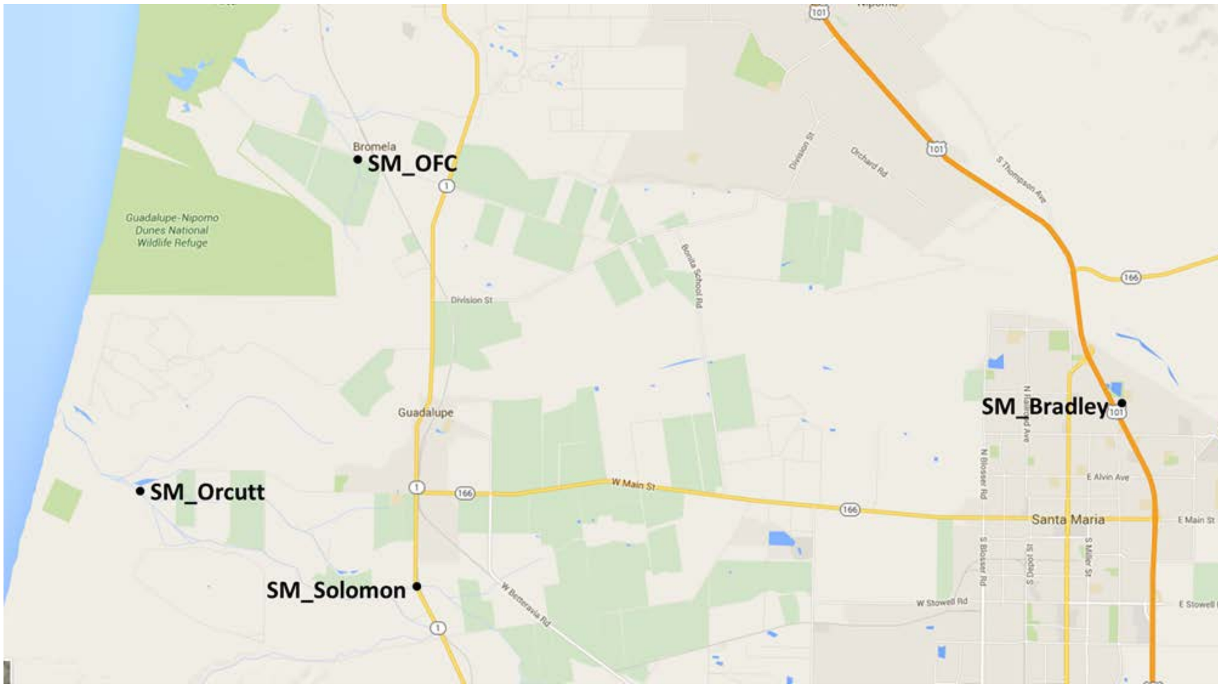

Figure 3. Monitoring Sites in Orcutt Creek and Oso Flaco Creek in Santa Barbara and San Luis Obispo Counties