Pesticides in Surface Water from Agricultural Regions of California

2007 - 2008

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ABSTRACT

The California Department of Pesticide Regulation (CDPR) collected surface water samples from Salinas Valley, Pajaro Valley, Santa Maria Valley, and Imperial Valley throughout California between August 2007 and June 2008. Samples were analyzed for organophosphate and carbamate insecticides and a variety of herbicides.

All pesticide concentrations are compared to aquatic toxicity benchmarks and water quality criteria. Quantifiable pesticide concentrations are referred to as detections; the presence of an analyte at a concentration too low to be quantified is referred to as a “trace” detection.

Of a total of 89 water samples, 84 (94%) had detections of at least one active ingredient (AI); 69 samples (78%) had detections of more than one AI. There were a total of 255 detections, including 14 AIs and 2 degradates. The most frequently detected AIs were diazinon, methomyl, chlorpyrifos, dimethoate, malathion and oxyfluorfen. At least one US EPA benchmark was exceeded in 55 samples (62%). In samples collected during the irrigation seasons from river and tributary sites, US EPA benchmarks were exceeded for diazinon (51%), chlorpyrifos (28%), dimethoate (10%), malathion (22%), methomyl (12%) and oxyfluorfen (12%).

INTRODUCTION

In California, a wide variety of pesticides are applied throughout the year: in 2008 over 300 pesticide AIs were applied in agricultural areas of the state (CDPR 2011a). Monitoring data are needed in order to assess the potential impacts of California pesticide use on aquatic systems.

The objective of the study was to provide data for a multi-year assessment of California surface water pesticide contamination in areas of high agricultural use. This report covers the period between August 2007 and June 2008.

MATERIALS AND METHODS

Targeted Pesticides

Pesticide AIs were selected for monitoring based on their toxicity to aquatic organisms, relatively high agricultural use, and either recent detections or lack of recent surface water monitoring data from the regions of high use (Starner 2007a, 2007b, 2011). Targeted AIs included diazinon, chlorpyrifos, malathion, dimethoate, methomyl, trifluralin, and oxyfluorfen. Samples were collected in four regions, each with agricultural use of several targeted AIs. Regions sampled were Salinas Valley, Pajaro Valley, Santa Maria Valley, and Imperial Valley (Figures 1 through 5).

Sample Collection and Handling

Samples for chemical analysis were collected into 1-liter amber glass bottles using a grab pole. Bottles were sealed with Teflon-lined lids and transported on wet ice and stored at 4 degrees C until extraction for chemical analysis.

Water Quality Measurements

At each sampling event, temperature, dissolved oxygen (DO), pH, salinity, and electrical conductivity (EC) were measured *in situ* at each sampling site. Measurements were made with YSI 85 and YSI 60 meters (YSI Incorporated, Yellow Springs, Ohio.) Instruments were calibrated according to manufacturer's recommendations.

Chemical Analysis

Chemical analyses were performed by the California Department of Food and Agriculture's Center for Analytical Chemistry. Analytical method details are presented in Table 1. Additional analytical details are provided on-line in the detailed analytical methods (CDPR 2011b).

Data Analysis

For each of the targeted AIs, agricultural use by season was compiled for the study period (August 2007 through June 2008). Pesticide use by season within each sampling region was then determined using CalWater 2.2 watershed maps (Figure 1). Total agricultural use was determined by spatial analysis.

For frequently detected AIs, analytical results were compared to the lowest US EPA Office of Pesticide Programs' Aquatic Life Benchmark ("benchmark") (US EPA 2010a). According the US EPA, the benchmarks are "estimates of the concentrations below which pesticides are not expected to have the potential for adverse effects on aquatic life". Additionally, "…benchmarks can be used as indicators of potential hazard to aquatic life, but they are not detailed toxicity and risk assessments. Concentrations of pesticides in streams…that exceed benchmarks indicate that further work needs to be done to gather more detailed information and…to characterize the likelihood of adverse effects on aquatic life" (US EPA 2010a).

Water Quality Criteria developed by the University of California at Davis ("UCD-WQC") (UC Davis 2009, 2010a, 2010b) (Table 2), when lower than the EPA benchmarks, were also included in the analysis.

The number of samples and frequencies of detection, trace detections, and exceedance of benchmarks were examined for each of the frequently detected AIs.

RESULTS AND DISCUSSION

Monitoring sites are shown in Figures 2 through 5; detailed site information is provided in Appendix 1. Site codes provided are those used in CDPR's Surface Water Database (CDPR 2011c). An on-line map with site locations and images is available at http://bit.ly/smI5zR .

Pesticide use in the monitoring regions is presented in Table 3.

Water Quality Measurements

Water quality measurement data and sample site information are presented in Appendix 1.

Overall, the pH varied from 7.0 to 9.4 By region, samples from the Salinas Valley had the highest median pH (8.1); Pajaro Valley sample sites had the lowest median pH (7.3).

Salinity was generally between 0.4 and 2 parts per thousand. Exceptions were the tidally-influenced sites (especially 27_11 and 27_14) and a site at the Salton Sea (13_58), (Appendix 1) which had higher measured salinity and specific EC. Higher salinity at the tidally-influenced river sites is an indication of the dilution of freshwater with incoming seawater. For samples from these sites, it is likely that the measured diluted pesticide concentrations and detection frequencies were lower that would have been obtained if undiluted runoff into the water bodies had been sampled directly.

Water temperature ranged from a low of 11.3 to a high of 28.6 degrees C. These results were as expected; lowest temperatures were measured in waters collected in spring and higher temperatures later in the season.

Pesticide Detections and Data Analysis

A total of 89 samples were collected for pesticide analysis. Of these, 83 were collected during irrigation seasons (between August and October 2007, and between March and June 2008) from river or tributary sites. Of the 83, 51 samples were collected in Salinas Valley, 12 in Pajaro Valley, 15 in Imperial Valley, and 5 in Santa Maria Valley.

Two additional samples were collected during the irrigation seasons from the Salton Sea in Imperial Valley; four samples were collected in December 2007 during a winter rain storm. The discussion below is focused on results from the 83 irrigation-season river/tributary samples, with separate inclusion of the additional sample results where relevant.

Pesticide analysis results by sampling site are presented in Appendix 2. Not all AIs were sampled at all sites; specific analytical screens included at each sample event are as indicated. Analytes included in each analytical screen are shown in Table 1. All Quality Control results are presented in Appendix 3.

A total of 89 water samples were collected from the four regions. Overall, 84 samples (94%) had detections of at least one AI; 69 samples (78%) had detections of more than one AI. There were a total of 255 detections, including 14 AIs and 2 degradates. Additionally, there were 60 trace detections including 14 AIs and 2 degradates. At least one US EPA benchmark was exceeded in 55 samples (62%). The most frequently detected AIs were diazinon, methomyl, chlorpyrifos, dimethoate, malathion and oxyfluorfen. An on-line map of sample sites and associated pesticide detections is available at http://bit.ly/smI5zR .

An overall summary of benchmark exceedances (Figure 6) shows that toxicity benchmarks were exceeded for 7 AIs. Diazinon had the highest overall exceedance frequency, followed by chlorpyrifos, malathion, dimethoate, methomyl and oxyfluorfen.

For frequently detected AIs, a summary of detections and exceedances by region is provided in Tables 4 and 5, respectively. These clearly illustrate some of the differences between the regions and seasons. For example, Table 4 shows that tributary sites in Salinas Valley had more frequent detections than river sites and that, other than diazinon, there were relatively few detections in Pajaro Valley. Regarding exceedances, Table 5 illustrates that in Salinas and Santa Maria Valleys, exceedances in tributary samples occurred for as many as six different AIs in a single season; diazinon exceedances were measured in every region sampled. In Imperial Valley, chlorpyrifos and diazinon benchmarks were exceeded in the fall, while malathion exceedances only occurred in the spring.

In several instances, multiple samples were collected from the same sample site over the course of one, two or three days. Pesticide detections in these samples indicate that in some cases aquatic organisms were likely exposed to specific AIs for at least several hours and up to 24 hours (Appendix 2). In some water bodies, organisms may be exposed for several days at a time. Similar results for these regions were reported previously (Starner 2011). It has also been shown that, in agricultural regions where organophosphate and carbamate insecticides are applied for extended periods, nontarget aquatic organisms may be exposed to these insecticides for several days, or up to several months (Gruber and Mund 1998). Chronic exposure may occur, and comparison of detected concentrations to chronic toxicity benchmarks may frequently be valid. As such, the chronic exposure toxicity benchmarks are included in this report and analysis.

Detailed results for each AI, including detection frequencies and frequency of toxicity benchmarks exceedances in river and tributary samples, are presented below.

<u>Diazinon</u>

Samples were collected for diazinon analysis from all four regions. Of 83 samples collected from rivers and tributaries, diazinon was detected in 90% (75 samples) (Table 6). Trace detections were not reported for diazinon. The US EPA benchmark was exceeded in 54% of all samples.

In summer in Salinas Valley, diazinon was detected in 98% of samples (50 of 51 samples). Over 50,000 pounds of diazinon AI was applied in Salinas Valley in the summer seasons (Table 3). In Imperial Valley in fall, detection frequency was 100% (8 of 8 samples); use was also high with over 30,000 pounds AI applied. In Santa Maria Valley, detection frequency was 100% (5 of 5 samples); use there was relatively low (2,000 pounds AI applied) (Table 3, Table 6).

Diazinon was also detected in a sample from the Salton Sea collected in the fall of 2007. This sample was collected from the southern end of the Sea, between the mouths of the Alamo and New Rivers. Additionally, diazinon was detected in 2 of 3 storm samples collected in the Salinas Valley in December 2007 (Appendix 2).

CDPR placed irrigation-season use of diazinon into reevaluation in June 2010 based on an analysis of diazinon in-season monitoring data (CDPR 2010a, Starner 2009). The diazinon data reported here were included in that analysis. The reevaluation process is ongoing (CDPR 2011d, Zhang and Starner 2011).

Chlorpyrifos

Samples were collected for chlorpyrifos analysis from all four regions. Of the 83 river and tributary samples, chlorpyrifos was detected in 43% (36 samples). Trace detections were not reported for chlorpyrifos. The US EPA benchmark was exceeded in 28% of samples; the UCD WQC was exceeded in 42% (Table 7).

Exceedance of the US EPA Benchmark was greater than 25% in all regions except for Pajaro, where chlorpyrifos use was relatively low (Table 7, Table 3).

Chlorpyrifos was also detected in 2 of 3 storm samples collected in the Salinas Valley in December 2007 (Appendix 2).

In March 2004, CDPR placed chlorpyrifos into reevalution due to numerous detections in surface waters throughout California (Spurlock 2004, CDPR 2004). At that time, registrants were informed of their obligation to identify mitigation strategies that would reduce or eliminate chlorpyrifos residues in surface waters. The reevaluation process is ongoing; additional information on the California reevaluation process is available (CDPR 2001, 2010c).

In 2009, statewide reported use of chlorpyrifos had declined only slightly compared to use in 2007 (an approximately 15% decline) (CDPR 2011a). Continued inclusion of chlorpyrifos in agricultural ambient monitoring efforts in regions of high use is recommended.

Malathion

Samples were collected for malathion analysis from all four regions. Of 83 river and tributary irrigation-season samples, malathion was detected in 18 samples (22%). Both the US EPA benchmark and the UCD WQC were exceeded in 22% of all river and tributary samples (Table 8).

Detection and exceedance frequencies for malathion were highest in Imperial Valley in the spring (86%) and in Santa Maria Valley in the summer (80%), and were significantly lower in Salinas Valley (16%). Malathion was not detected in Pajaro Valley, where agricultural use is relatively low (Table 3). Malathion was applied primarily to alfalfa in Imperial in the spring; use was primarily on lettuce and strawberries in the Santa Maria and Salinas Valleys (CDPR 2011a).

These detection and exceedance frequencies do not include trace detections of malathion. An additional 9 samples (11%) contained trace concentrations of malathion. For the malathion analytical method used in this project, the method reporting limit was 0.04 ug/L (Table 1). Both comparison toxicity benchmarks used in this analysis are below that reporting limit. As such, malathion at concentrations exceeding the benchmarks may have gone undetected; increasing the sensitivity of the analytical method for malathion is recommended.

Agricultural use of malathion is increasing; in 2009, use statewide was 40% higher than in 2006. In this same period, agricultural use of malathion in Monterey county has increased over three-fold (CDPR 2011a). Based on this and the results of malathion monitoring in these regions, continued monitoring for malathion in areas with significant agricultural use is recommended.

Dimethoate

Samples were collected for dimethoate analysis from all four regions. Of 83 river and tributary samples, dimethoate was detected in 45% (37 samples). The US EPA benchmark was exceeded in 10 samples; all exceedances were in tributary samples. Seven exceedances were in samples from Salinas Valley; 3 were from Santa Maria Valley. Dimethoate was detected in 100% of samples from Imperial Valley in the spring, but there were no exceedances of the toxicity benchmark in samples from Imperial (Table 9). Use in Imperial Valley in the spring is primarily on alfalfa; in Salinas and Santa Maria Valleys was on broccoli, celery and cauliflower (CDPR 2011a).

Methomyl

Samples were collected for methomyl analysis from all four regions. Of 78 samples, methomyl was detected in 41 (56%), with trace detections in an additional 3 samples. Detections frequencies were highest in Salinas Valley and in Imperial Valley in the fall, where use is high (Table 3). The US EPA benchmark was exceeded in 12% of all river and tributary samples (Table 10). All exceedances were in samples taken from tributary sites in the Salinas Valley, where use is primarily on lettuce.

Oxyfluorfen

Samples were collected for oxyfluorfen analysis from three regions with significant agricultural use (Imperial, Salinas and Santa Maria). Of 34 river and tributary samples collected during the irrigation season, oxyfluorfen was detected in 14 (41%). The US EPA benchmark was exceeded in 4 samples (12%). All exceedances were in tributary samples from Salinas and Santa Maria Valleys (Table 11).

Additionally, three samples were collected in Salinas Valley in December 2007 during a winter storm; oxyfluorfen was detected in two samples, with a trace detection in the third (Appendix 2).

Although oxyfluorfen is an herbicide, it also inhibits acetylcholinesterase (AChE) in aquatic species (Hassanein 2002). As such, its effects may be additive with other AChE inhibiting pesticides detected simultaneously.

Oxyfluorfen monitoring had not been conducted by CDPR in agricultural regions prior to this study. Detections of oxyfluorfen from the regions monitored in this study have also been reported elsewhere (Smalling and Orlando 2011). Additional monitoring is recommended in order to better characterize the off-site movement of oxyfluorfen.

Trifluralin

Agricultural use of trifluralin was low in all regions sampled in this study except for Imperial Valley in the spring, when over 100,000 pounds of trifluralin AI was applied. Use was primarily on alfalfa. (Table 3). Trifluralin was detected in 5 of 7 samples (71%), with trace detections in the remaining 2 samples. The US EPA benchmark was not exceeded (Table 12). Due to the very high use of trifluralin in Imperial Valley during the spring, continued monitoring is recommended.

DDVP

DDVP (dichlorvos) was detected in two samples from the Salinas Valley region; the concentrations in these samples both exceeded the US EPA benchmark (Table 2). There was no reported agricultural use of DDVP in the region during the time period of the study. However, naled, which rapidly degrades into DDVP in the environment (Pierce 1998), was applied within the region on strawberries during the period under study (CDPR 2011a). It is likely that the detections of DDVP in samples from the Salinas Valley resulted from the degradation of naled originally applied to strawberries. Due to its extremely high aquatic toxicity (Table 2), continued monitoring for DDVP in regions of high naled use is recommended.

Additional detections

In addition to those AIs discussed above, several additional AIs were detected at least one time. These include pendimethalin (5 detections), carbaryl (4 detections), carbofuran (3 detections), and atrazine (3 detections); also methidathion, oryzalin, oxamyl, and 3-hydroxycarbofuran (1 detection each). There were no exceedances of any toxicity benchmarks for these compounds.

Frequent Detection of Pesticide Mixtures

Multiple active ingredients were frequently detected simultaneously in surface water samples from both river and tributary sites (Appendix 2). The most commonly detected AIs were all acetylcholinesterase (AChE) inhibitors. Research indicates that the effects of such mixtures on aquatic organisms are frequently additive or synergistic (Laetz *et al*.2009, Scholz *et al.* 2006, Lydy and Austin 2004, Lydy *et al.* 2004, Bailey *et al.* 1997). Interpreting the toxicological significance of such pesticide mixtures is complex (Macneale *et al.* 2010, Belden *et al.*2007, Junghans *et al.* 2006, Monosson 2005, Lydy *et al.* 2004); however, it is clear that the potential combined effects of such a mixture of pesticides is likely greater than indicated by a comparison of concentrations to individual toxicity benchmarks on a one-by-one chemical basis.

Overall in this study, ten different AChE-inhibiting pesticides were detected (diazinon, chlorpyrifos, malathion, dimethoate, methomyl, oxyfluorfen, methidathion, carbaryl, carbofuran and oxamyl). Sixty samples had at least 2 co-occurring AChE-inhibiting pesticide detections; thirty samples had at least 4 and thirteen samples had at least 5 (Appendix 2).

Samples with at least two co-occurring AChE-inhibiting pesticide detections were collected from all four of the monitoring regions. Such samples were not limited to tributary sites, but occurred in rivers as well. This count does not include any trace detections of AChE-inhibiting pesticides, which also occurred in many of these samples. Similar results were reported previously for these regions (Starner 2011).

As these results show, toxicologically-relevant surface water contamination is not limited to just a few high profile AIs (i.e., diazinon and chlorpyrifos), but also includes several other compounds such as malathion, dimethoate, methomyl, and oxyfluorfen. As such, management practices which focus on just one or two surface water contaminants may not effectively mitigate pesticide-associated risk to aquatic organisms.

CONCLUSIONS

The overall results of this study show that, in the agricultural regions monitored, several pesticide AIs frequently moved off-site, resulting in contamination of surface waters. These AIs include diazinon, chlorpyrifos, malathion, dimethoate, methomyl, and oxyfluorfen. Detections were not limited to tributaries (smaller creeks and drains) but also occurred frequently in rivers. In samples collected during the irrigation seasons from river and tributary sites, US EPA benchmarks were exceeded for diazinon (51%), chlorpyrifos (28%), dimethoate (10%), malathion (22%), methomyl (12%) and oxyfluorfen (12%).

Additionally, the combined effect of multiple AIs occurring in surface water simultaneously may have even greater impact on aquatic organisms than indicated by the comparison to individual toxicity benchmarks.

This frequent simultaneous occurrence of multiple active ingredients in streams of agricultural areas of California underscores the need for improved regulatory and technical efforts to minimize offsite movement of pesticides. CDPR is currently developing regulations that would address the reduction of off-site movement of the most frequently detected pesticides in California, including those frequently detected in this study (CDPR 2011d).

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Organophosphate (OP) insecticide analytical method
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Carbamate (CB) insecticide analytical method
http://www.cdpr.ca.gov/docs/emon/pubs/anl_methds/imeth_156_01.pdf

Dinitroaniline herbicide and oxyfluorfen method
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Herbicide/triazine (TR) analytical method
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Table 1. Department of Food and Agriculture, Center for Analytical Chemistry Method Details.

Organophosphate Insecticides in Surface Water by GC/FPD

Compound	***Method Detection Limit (µg/L)***	***Reporting Limit (µg/L)***
Azinphos methyl	0.0099	0.05
Chlorpyrifos	0.0008	0.01
Diazinon	0.0012	0.01
Dichlorvos	0.0098	0.05
Dimethoate	0.0079	0.04
Disulfoton	0.0093	0.04
Ethoprop	0.0098	0.05
Fenamiphos	0.0125	0.05
Fonofos	0.008	0.04
Malathion	0.0117	0.04
Methidathion	0.0111	0.05
Methyl Parathion	0.008	0.03
Phorate	0.0083	0.05
Profenofos	0.0114	0.05
Tribufos	0.0142	0.05

Carbamate (CB) Insecticides by LCMS

Chemical	***Method Detection Limit (µg/L)***	***Reporting Limit (µg/L)***
Aldicarb SO	0.0277	0.05
Aldicarb SO2	0.0214	0.05
Oxamyl	0.0255	0.05
Methomyl	0.0265	0.05
3 OH-Carbofuran	0.0232	0.05
Aldicarb	0.0196	0.05
Carbofuran	0.0244	0.05
Carbaryl	0.0136	0.05
Mesurol	0.0270	0.05

Dinitroaniline (DN) Herbicides/ Oxyfluorfen in Surface Water

Chemical	***Method Detection Limit (µg/L)***	***Reporting Limit (µg/L)***
Oryzalin	0.01	0.05
Ethalfluralin	0.01	0.05
Trifluralin	0.01	0.05
Benfluralin	0.01	0.05
Prodiamine	0.01	0.05
Pendimethalin	0.01	0.05
Oxyfluorfen	0.01	0.05

Table 1. Department of Food and Agriculture, Center for Analytical Chemistry Method Details (continued).

Herbicides in Surface Water by LC/MS/MS

Compound	***Method Detection Limit (µg/L)***	***Reporting Limit (µg/L)***
Atrazine	0.02	0.05
Simazine	0.013	0.05
Diuron	0.022	0.05
Prometon	0.016	0.05
Bromacil	0.031	0.05
Prometryn	0.016	0.05
Hexazinone	0.04	0.05
Metribuzin	0.025	0.05
Norflurazon	0.019	0.05
DEA	0.010	0.05
ACET	0.030	0.05
DACT	0.016	0.05

Thiram (TH) in Surface Water

Chemical	***Method Detection Limit (µg/L)***	***Reporting Limit (µg/L)***
Thiram	0.10	0.50

Table 2. Aquatic toxicity benchmarks and Water Quality Criteria.

	US EPA								UCD WQC	
Chemical	AI	CI	AF	CF	CMC	CCC	ANV	AV	AWQC	CWQC
Atrazine	360	60	2650	65			1	37		
Carbaryl	0.85	0.5	110	6.8			660	1500		
Carbofuran	1.12	0.75	44	5.7						
Chlorpyrifos	0.05	0.04	0.9	0.57	0.083	0.041	140		0.01	0.01
Diazinon	0.11	0.17	45	< 0.55	0.17		3700		0.2	0.2
DDVP	0.035	0.0058	79.5	5.2			14000			
Dimethoate	21.5	0.5	3100	430			84			
Diuron	80	200	200	26			2.4	15		
Ethoprop	22	0.8	150	24			8400			
Malathion	0.3	0.035	16.4	8.6		0.1	2400		0.17	0.028
Methidathion	1.5	0.66	1.1	6.6						
Methomyl	2.5	0.7	160	12						
Oryzalin	750	358	1440	220			42	>15.4		
Oxamyl	90	27	2100	770			120	30000		
Pendimethalin	140	14.5	69	6.3			5.2	12.5		
Tribufos	3.4	1.56	122.5	3.5			148	1100		
Trifluralin	280	2.4	20.5	1.14			7.52	43.5		
Oxyfluorfen	40	13	102	1.3			0.29	0.35		

All values are in ug/L. Values used in analysis are underlined.
AI= acute invertebrate; CI = chronic invertebrate; AF = acute fish; CF = chronic fish;
CMC = maximum concentration; CCC = continuous concentration;
ANV = acute nonvascular plant; AV = acute vascular plant;
AWQC = acute water quality criteria
CWQC = chronic water quality criteria.

Table 3. Agricultural use of frequently detected pesticides, California, 2007 and 2008, in pounds of active ingredient applied.

	Salinas			Imperial		S Maria	Pajaro		
Chemical	Summer	Fall	Spring	Fall	Spring	Summer	Spring	Fall	Summer
Chlorpyrifos	20,197	12,205	19,404	31,197	10,704	8,586	2,194	329	1,800
Diazinon	57,919	19,294	50,128	23,280	774	1,999	920	756	11,829
Dimethoate	14,069	9,343	7,146	4,100	16,454	2,488	780	574	2,809
Malathion	42,370	13,266	10,942	3,761	31,318	37,662	1,584	337	2,213
Methomyl	37,909	15,595	10,268	11,028	6,003	3,567	1,692	3,294	3,859
Oxyfluorfen	3,537	3,585	3,401	3,125	281	3,124	1,167	952	309

Summer is average of 2007 and 2008 Use.

Table 4. Summary of pesticide detections in surface water samples taken during California irrigation seasons, 2007 and 2008.

Region	Season	Site Type	Chemical diazinon	chlorpyrifos	dimethoate	malathion	methomyl	oxyfluorfen
Imperial	spring	R	y	y	y	y	n	(y)
Imperial	spring	T	n	y	y	y	y	(y)
Imperial	fall	R	y	y	n	(y)	y	NS
Imperial	fall	T	y	y	n	n	y	NS
Salinas	spring	R	y	n	y	n	y	y
Salinas	spring	T	y	y	y	y	y	y
Salinas	summer	R	y	n	(y)	n	y	y
Salinas	summer	T	y	y	y	y	y	y
Salinas	fall	R	y	n	y	n	y	NS
Salinas	fall	T	y	y	y	y	y	NS
S Maria	summer	T	y	y	y	y	y	y
Pajaro	spring	R	y	n	n	n	n	n
Pajaro	spring	T	NS	NS	NS	NS	NS	NS
Pajaro	summer	R	y	n	n	n	y	NS
Pajaro	summer	T	y	n	y	n	n	NS
Pajaro	fall	R	y	n	n	n	n	NS
Pajaro	fall	T	y	n	n	n	n	NS

Site type: R=river, T=tributary (creek or drain); y indicates at least one detection; (y) indicates trace detection only; n = no detection; NS = not sampled

Table 5. Summary of exceedances of pesticide toxicity benchmarks in surface water samples taken during California irrigation seasons, 2007 and 2008.

Region	Season	Site Type	Chemical diazinon	chlorpyrifos	dimethoate	malathion	methomyl	oxyfluorfen
Imperial	spring	R	n	y	n	y	n	n
Imperial	spring	T	n	n (y 0.01)	n	y	n	n
Imperial	fall	R	y	y	n	n	n	NS
Imperial	fall	T	y	y	n	n	n	NS
Salinas	spring	R	y	n	n	n	n	n
Salinas	spring	T	y	y	y	y	y	y
Salinas	summer	R	n	n	n	n	n	n
Salinas	summer	T	y	y	n	y	y	n
Salinas	fall	R	y	n	n	n	n	NS
Salinas	fall	T	y	y	y	y	y	NS
S Maria	summer	T	y	y	y	y	n	y
Pajaro	spring	R	y	n	n	n	n	n
Pajaro	spring	T	NS	NS	NS	NS	NS	NS
Pajaro	summer	R	n	n	n	n	n	NS
Pajaro	summer	T	y	n	n	n	n	NS
Pajaro	fall	R	n	n	n	n	n	NS
Pajaro	fall	T	n	n	n	n	n	NS

Site type: R=river, T=tributary (creek or drain);y indicates at least one exceedance; (y) indicates secondary benchmark exceedance; n = no exceedances; NS = not sampled.

Table 6. Diazinon monitoring results by region and season, 2007 and 2008.

Region	Season	Site Type	Detection Freq. (%)	Exceedance Freq. (%)	Count Samples	Detects	Exceeds (>0.11 ug/L)
Imperial V.	spring	R	75.0	0.0	4	3	0
Imperial V.	spring	T	0.0	0.0	3	0	0
Imperial V.	**spring**	**ALL**	**42.9**	**0.0**	**7**	**3**	**0**
Imperial V.	fall	R	100.0	100.0	5	5	5
Imperial V.	fall	T	100.0	66.7	3	3	2
Imperial V.	**fall**	**ALL**	**100.0**	**87.5**	**8**	**8**	**7**
Salinas V.	spring	R	88.9	55.6	9	8	5
Salinas V.	spring	T	100.0	85.7	14	14	12
Salinas V.	summer	R	100.0	0.0	7	7	0
Salinas V.	summer	T	100.0	90.9	11	11	10
Salinas V.	fall	R	100.0	25.0	4	4	1
Salinas V.	fall	T	100.0	83.3	6	6	5
Salinas V.	**ALL**	**ALL**	**98.0**	**64.7**	**51**	**50**	**33**
S. Maria V.	**summer**	**T**	**100.0**	**60.0**	**5**	**5**	**3**
Pajaro V.	spring	R	66.7	33.3	3	2	1
Pajaro V.	spring	T	0.0	0.0	0	0	0
Pajaro V.	summer	R	100.0	0.0	2	2	0
Pajaro V.	summer	T	66.7	33.3	3	2	1
Pajaro V.	fall	R	100.0	0.0	1	1	0
Pajaro V.	fall	T	66.7	0.0	3	2	0
Pajaro V.	**ALL**	**ALL**	**75.0**	**16.7**	**12**	**9**	**2**
All	**All**	**R**	**89.7**	**34.3**	**35**	**32**	**12**
All	**All**	**T**	**89.6**	**68.8**	**48**	**43**	**33**
All	**All**	**All**	**88.8**	**50.6**	**83**	**75**	**45**

Site type: R = river, T = tributary (creek or drain);

Table 7. Chlorpyrifos monitoring results by region and season, 2007 and 2008.

Region	Season	Site Type	Detection Freq. (%)	Exceedance Freq. (%) (0.04)	Exceedance Freq. (%) (0.01)	Count Samples	Detects	Exceeds (> 0.04 ug/L)	(>0.01ug/L)
Imperial V.	spring	R	100.0	50.0	100.0	4	4	2	4
Imperial V.	spring	T	66.7	0.0	66.7	3	2	0	2
Imperial V.	**spring**	**ALL**	**85.7**	**28.6**	**85.7**	**7**	**6**	**2**	**6**
Imperial V.	fall	R	80.0	40.0	80.0	5	4	2	4
Imperial V.	fall	T	66.7	66.7	66.7	3	2	2	2
Imperial V.	**fall**	**ALL**	**75.0**	**50.0**	**75.0**	**8**	**6**	**4**	**6**
Salinas V.	spring	R	0.0	0.0	0.0	9	0	0	0
Salinas V.	spring	T	64.3	57.1	64.3	14	9	8	9
Salinas V.	summer	R	0.0	0.0	0.0	7	0	0	0
Salinas V.	summer	T	72.7	45.5	63.6	11	8	5	7
Salinas V.	fall	R	0.0	0.0	0.0	4	0	0	0
Salinas V.	fall	T	50.0	33.3	50.0	6	3	2	3
Salinas V.	**ALL**	**ALL**	**39.2**	**29.4**	**37.3**	**51**	**20**	**15**	**19**
S. Maria V.	**summer**	**T**	**80.0**	**40.0**	**80.0**	**5**	**4**	**2**	**4**
Pajaro V.	spring	R	0.0	0.0	0.0	3	0	0	0
Pajaro V.	spring	T	NS	NS	NS	0	NS	NS	NS
Pajaro V.	summer	R	0.0	0.0	0.0	2	0	0	0
Pajaro V.	summer	T	0.0	0.0	0.0	3	0	0	0
Pajaro V.	fall	R	0.0	0.0	0.0	1	0	0	0
Pajaro V.	fall	T	0.0	0.0	0.0	3	0	0	0
Pajaro V.	**ALL**	**ALL**	**0.0**	**0.0**	**0.0**	**12**	**0**	**0**	**0**
All	**All**	**R**	**22.9**	**11.4**	**22.9**	**35**	**8**	**4**	**8**
All	**All**	**T**	**58.3**	**39.6**	**56.3**	**48**	**28**	**19**	**27**
All	**All**	**All**	**43.4**	**27.7**	**42.2**	**83**	**36**	**23**	**35**

NS = not sampled

Table 8. Malathion monitoring results by region and season, 2007 and 2008.

Region	Season	Site Type	Detection Freq. (%)	Exceedance Freq. (%) (0.035)	Trace Freq. (%)	Count Samples	Detects (trace)	Exceeds (>0.035ug/L)	(>0.028ug/L)
Imperial V.	spring	R	100.0	100.0	0.0	4	4	4	4
Imperial V.	spring	T	66.7	66.7	0.0	3	2	2	2
Imperial V.	**spring**	**ALL**	**85.7**	**85.7**	0.0	**7**	**6**	**6**	**6**
Imperial V.	fall	R	0.0	0.0	40.0	5	0 (2)	0	0
Imperial V.	fall	T	0.0	0.0	0.0	3	0	0	0
Imperial V.	**fall**	**ALL**	**0.0**	**0.0**	25.0	**8**	**0 (2)**	**0**	**0**
Salinas V.	spring	R	0.0	0.0	0.0	9	0	0	0
Salinas V.	spring	T	21.4	21.4	21.4	14	3 (3)	3	3
Salinas V.	summer	R	0.0	0.0	0.0	7	0	0	0
Salinas V.	summer	T	36.4	36.4	18.2	11	4 (2)	4	4
Salinas V.	fall	R	0.0	0.0	0.0	4	0	0	0
Salinas V.	fall	T	16.7	16.7	16.7	6	1 (1)	1	1
Salinas V.	**ALL**	**ALL**	**15.7**	**15.7**	**11.8**	**51**	**8 (6)**	**8**	**8**
S. Maria V.	**summer**	**T**	**80.0**	**80.0**	20.0	**5**	**4 (1)**	**4**	**4**
Pajaro V.	spring	R	0.0	0.0	0.0	3	0	0	0
Pajaro V.	spring	T	0.0	0.0	0.0	0	0	0	0
Pajaro V.	summer	R	0.0	0.0	0.0	2	0	0	0
Pajaro V.	summer	T	0.0	0.0	0.0	3	0	0	0
Pajaro V.	fall	R	0.0	0.0	0.0	1	0	0	0
Pajaro V.	fall	T	0.0	0.0	0.0	3	0	0	0
Pajaro V.	**ALL**	**ALL**	**0.0**	**0.0**	0.0	**12**	**0**	**0**	**0**
All	**ALL**	**R**	**11.4**	**11.4**	**5.7**	**35**	**4 (2)**	**4**	**4**
All	**ALL**	**T**	**29.2**	**29.2**	**14.6**	**48**	**14 (7)**	**14**	**14**
All	**ALL**	**ALL**	**21.7**	**21.7**	**10.8**	**83**	**18 (9)**	**18**	**18**

Table 9. Dimethoate monitoring results by region and season, 2007 and 2008.

Region	Season	Site Type	Detection Freq. (%)	Exceedance Freq. (%)	Trace Freq. (%)	Count Samples	Detects (trace)	Exceeds (>0.5ug/L)
Imperial V.	spring	R	100.0	0.0	0.0	4	4	0
Imperial V.	spring	T	100.0	0.0	0.0	3	3	0
Imperial V.	**spring**	**ALL**	**100.0**	**0.0**	**0.0**	**7**	**7**	**0**
Imperial V.	fall	R	0.0	0.0	0.0	5	0	0
Imperial V.	fall	T	0.0	0.0	0.0	3	0	0
Imperial V.	**fall**	**ALL**	**0.0**	**0.0**	**0.0**	**8**	**0**	**0**
Salinas V.	spring	R	55.6	0.0	0.0	9	5	0
Salinas V.	spring	T	71.4	35.7	21.4	14	10 (3)	5
Salinas V.	summer	R	0.0	0.0	14.3	7	0 (1)	0
Salinas V.	summer	T	63.6	0.0	36.4	11	7 (4)	0
Salinas V.	fall	R	25.0	0.0	50.0	4	1 (2)	0
Salinas V.	fall	T	50.0	33.3	50.0	6	3 (3)	2
Salinas V.	**ALL**	**ALL**	**51.0**	**13.7**	**25.5**	**51**	**26 (13)**	**7**
S. Maria V.	**summer**	**T**	**60.0**	**60.0**	**40.0**	**5**	**3 (2)**	**1**
Pajaro V.	spring	R	0.0	0.0	0.0	3	0	0
Pajaro V.	spring	T	0.0	0.0	0.0	0	0	0
Pajaro V.	summer	R	0.0	0.0	0.0	2	0	0
Pajaro V.	summer	T	33.3	0.0	0.0	3	1	0
Pajaro V.	fall	R	0.0	0.0	0.0	1	0	0
Pajaro V.	fall	T	0.0	0.0	0.0	3	0	0
Pajaro V.	**ALL**	**ALL**	**8.3**	**0.0**	**0.0**	**12**	**1**	**0**
All	**ALL**	**T**	**56.3**	**16.7**	**25.0**	**48**	**27 (12)**	**8**
All	**ALL**	**R**	**28.6**	**0.0**	**8.6**	**35**	**10 (3)**	**0**
All	**ALL**	**ALL**	**44.6**	**10.0**	**18.1**	**83**	**37 (15)**	**8**

Table 10. Methomyl monitoring results by region and season, 2007 and 2008.

Region	Season	Site Type	Detection Freq. (%)	Exceed Freq. (%)	Trace Freq. (%)	Count Samples	Detects (trace)	Exceeds (>0.7)
Imperial V.	spring	R	0.0	0.0	0.0	3	0	0
Imperial V.	spring	T	100.0	0.0	0.0	1	1	0
Imperial V.	**spring**	**ALL**	**25.0**	**0.0**	**0.0**	**4**	**1**	**0**
Imperial V.	fall	R	60.0	0.0	0.0	5	3	0
Imperial V.	fall	T	33.3	0.0	33.3	3	1 (1)	0
Imperial V.	**fall**	**ALL**	**50.0**	**0.0**	**12.5**	**8**	**4 (1)**	**0**
Salinas V.	spring	R	44.4	0.0	0.0	9	4	0
Salinas V.	spring	T	50.0	7.1	7.1	14	7 (1)	1
Salinas V.	summer	R	60.0	0.0	0.0	5	3	0
Salinas V.	summer	T	90.9	54.5	0.0	11	10	6
Salinas V.	fall	R	100.0	0.0	0.0	4	4	0
Salinas V.	fall	T	83.3	33.3	16.7	6	5 (1)	2
Salinas V.	**ALL**	**ALL**	**67.3**	**18.4**	**4.1**	**49**	**33 (2)**	**9**
S. Maria V.	**summer**	**T**	**40.0**	**0.0**	**0.0**	**5**	**2**	**0**
Pajaro V.	spring	R	0.0	0.0	0.0	3	0	0
Pajaro V.	spring	T	NS	NS	NS	0	0	0
Pajaro V.	summer	R	50.0	0.0	0.0	2	1	0
Pajaro V.	summer	T	0.0	0.0	0.0	3	0	0
Pajaro V.	fall	R	0.0	0.0	0.0	1	0	0
Pajaro V.	fall	T	0.0	0.0	0.0	3	0	0
Pajaro V.	**ALL**	**ALL**	**8.3**	**0.0**	**0.0**	**12**	**1**	**0**
All	**ALL**	**T**	**56.5**	**19.6**	**6.5**	**46**	**26 (3)**	**9**
All	**ALL**	**R**	**46.9**	**0.0**	**0.0**	**32**	**15**	**0**
All	**ALL**	**ALL**	**52.6**	**11.5**	**3.8**	**78**	**41 (3)**	**9**

Table 11. Oxyfluorfen monitoring results by region and season, 2007 and 2008.

Region	Season	Site Type	Detection Freq. (%)	Exceed Freq. (%)	Trace Freq. (%)	Count Samples	Detects (trace)	Exceeds (>0.29ug/L)
Imperial V.	spring	R	0.0	0.0	50.0	4	0 (2)	0
Imperial V.	spring	T	0.0	0.0	33.3	3	0 (1)	0
Imperial V.	**spring**	**ALL**	**0.0**	**0.0**	42.9	**7**	**0 (3)**	**0**
Salinas V.	spring	R	33.3	0.0	16.7	6	2 (1)	0
Salinas V.	spring	T	57.1	28.6	14.3	7	4 (1)	2
Salinas V.	summer	R	50.0	0.0	0.0	2	1	0
Salinas V.	summer	T	60.0	0.0	20.0	5	3 (1)	0
Salinas V.	**ALL**	**ALL**	**50.0**	**10.0**	**15.0**	**20**	**10 (3)**	**2**
S. Maria V.	**summer**	**T**	**80.0**	**40.0**	20.0	**5**	**4 (1)**	**2**
All	**ALL**	**R**	**21.4**	**0.0**	**21.4**	**14**	**3 (3)**	**0**
All	**ALL**	**T**	**55.0**	**20.0**	**20.0**	**20**	**11 (4)**	**4**
All	**ALL**	**ALL**	**41.2**	**11.8**	**20.6**	**34**	**14 (7)**	**4**

Table 12. Trifluralin monitoring results by region and season, 2007 and 2008.

Region	Season	Site Type	Detection Freq. (%)	Exceed Freq. (%)	Trace Freq. (%)	Count Samples	Detects (trace)	Exceeds (>1.14ug/L)
Imperial V.	spring	R	75.0	0.0	25.0	4	3 (1)	0
Imperial V.	spring	T	66.7	0.0	33.3	3	2 (1)	0
Imperial V.	spring	ALL	71.4	0.0	28.6	7	5 (2)	0

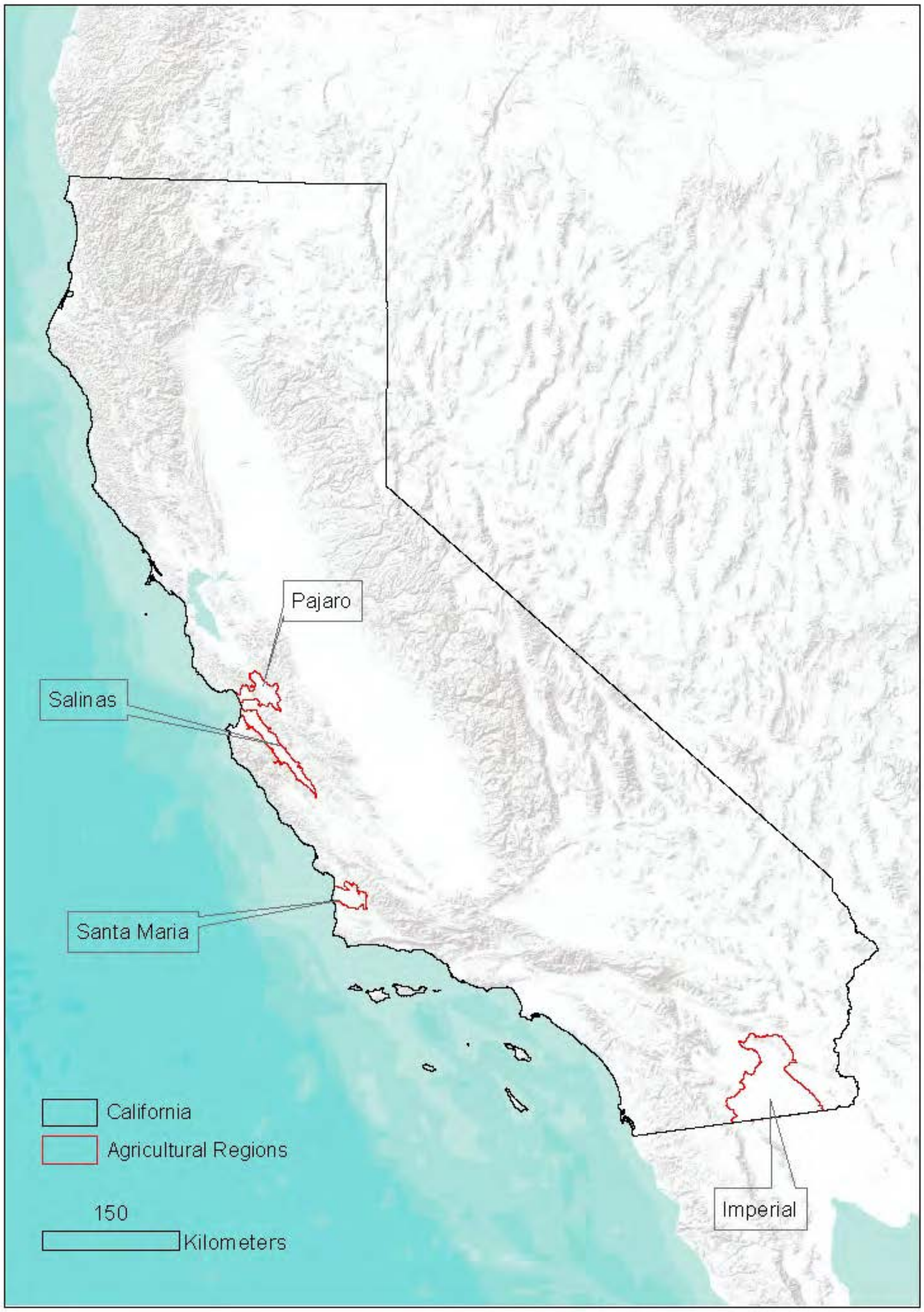

Figure 1. Monitoring regions in agricultural areas of California, 2007 - 2008.

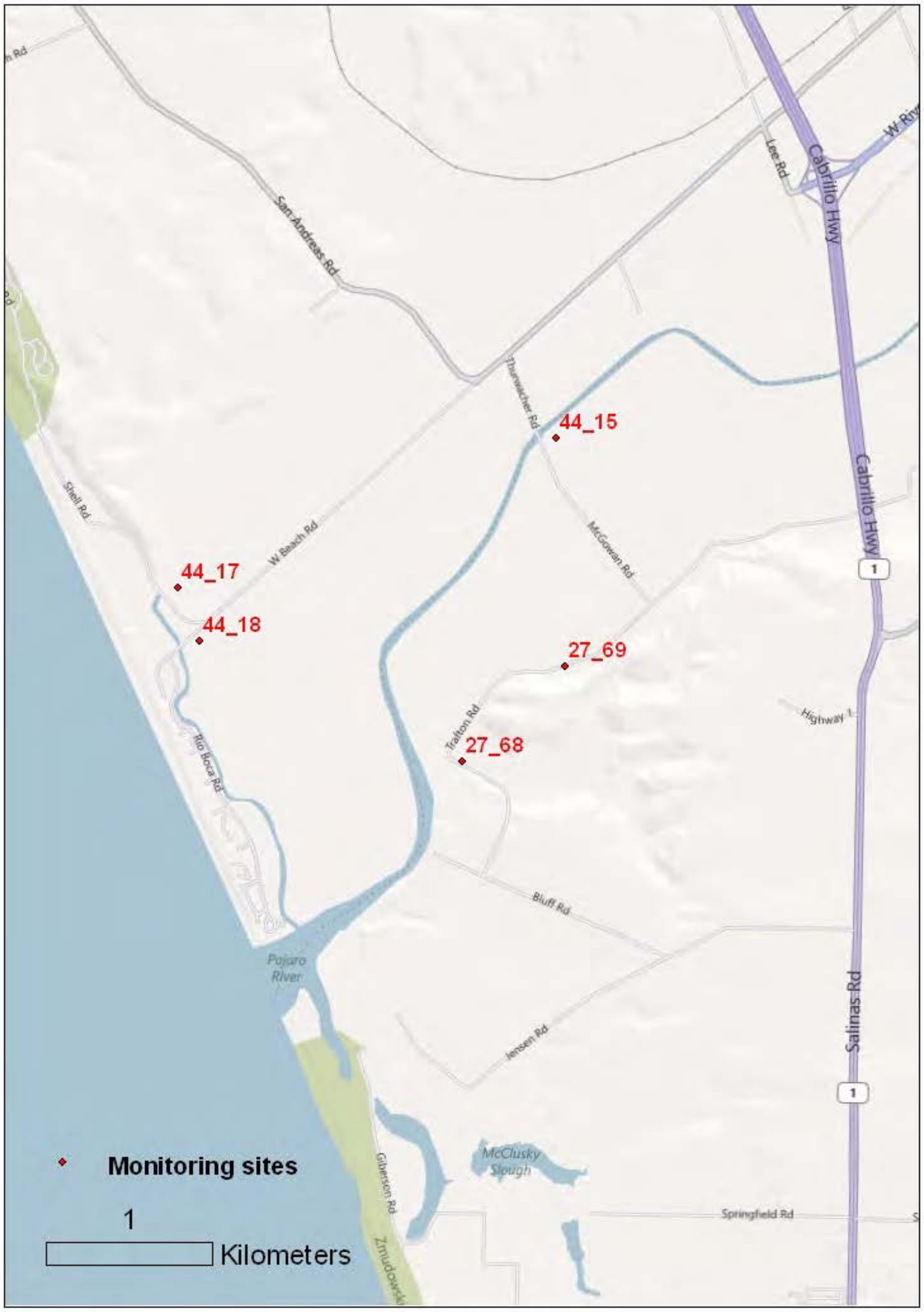

Figure 2. Monitoring sites in Pajaro Valley, 2007-2008.

For site information, see Appendix 1 and http://bit.ly/smI5zR.

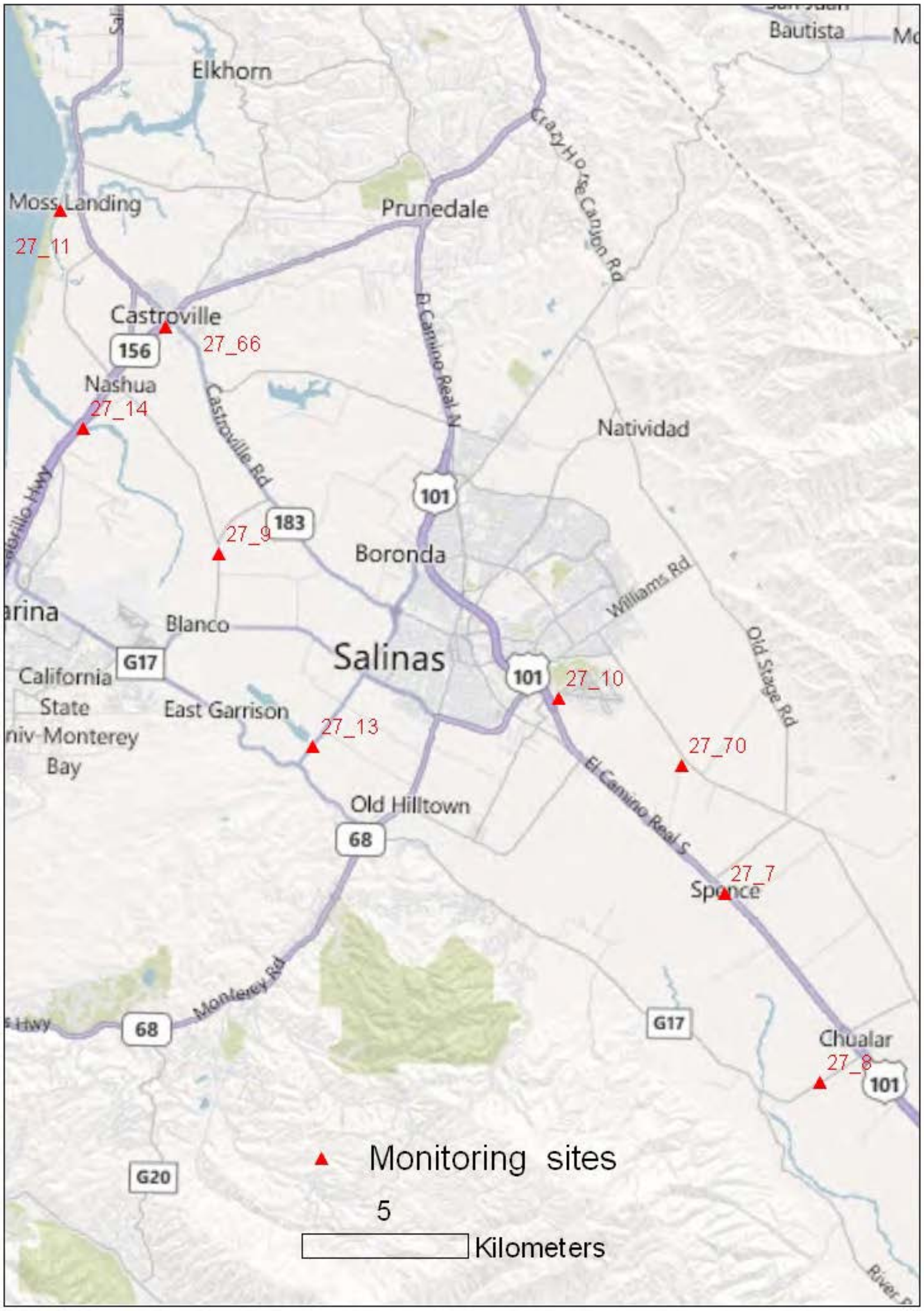

Figure 3. Monitoring sites in Salinas Valley, 2007-2008.

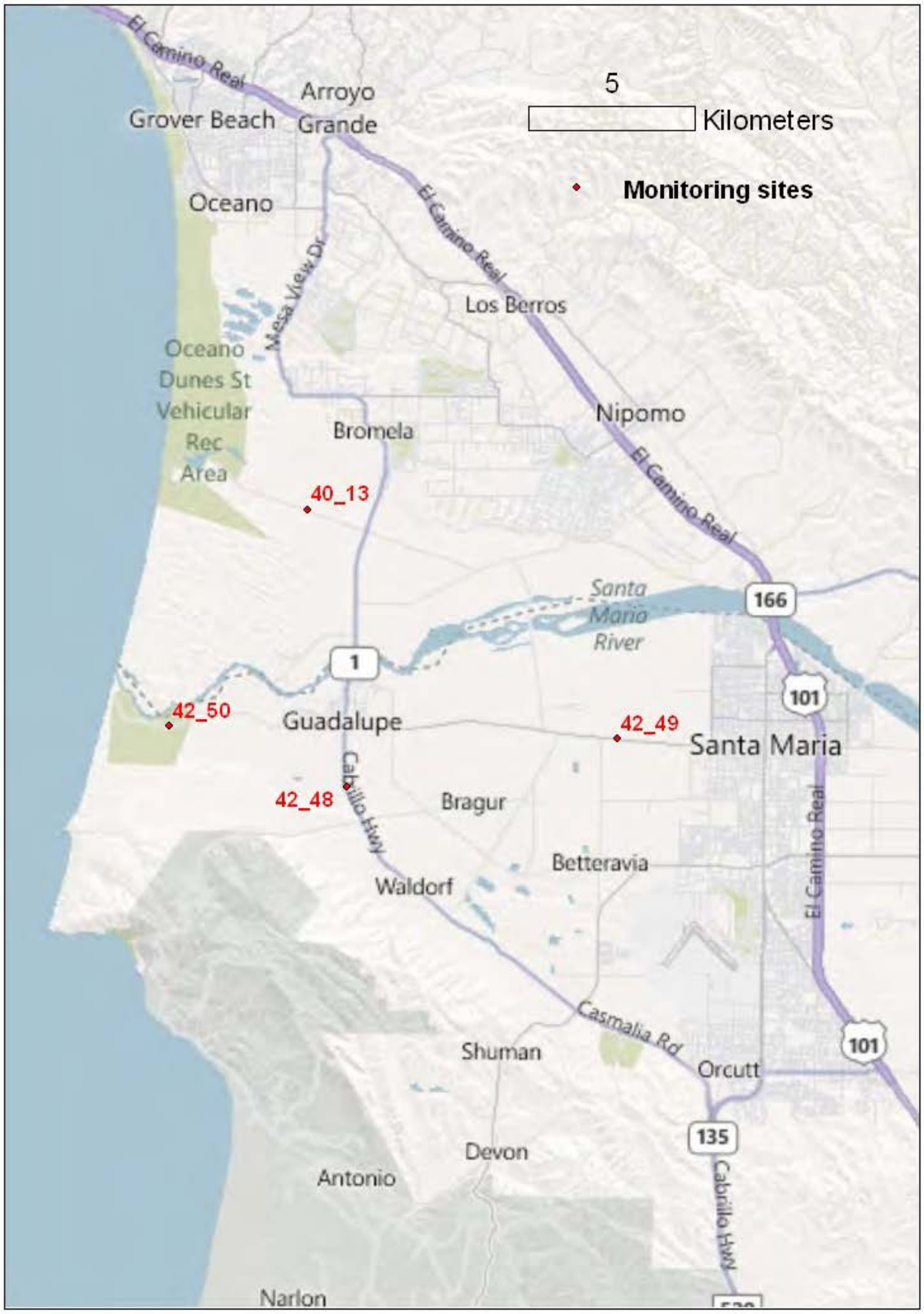

Figure 4. Monitoring sites in Santa Maria Valley, 2007-2008.

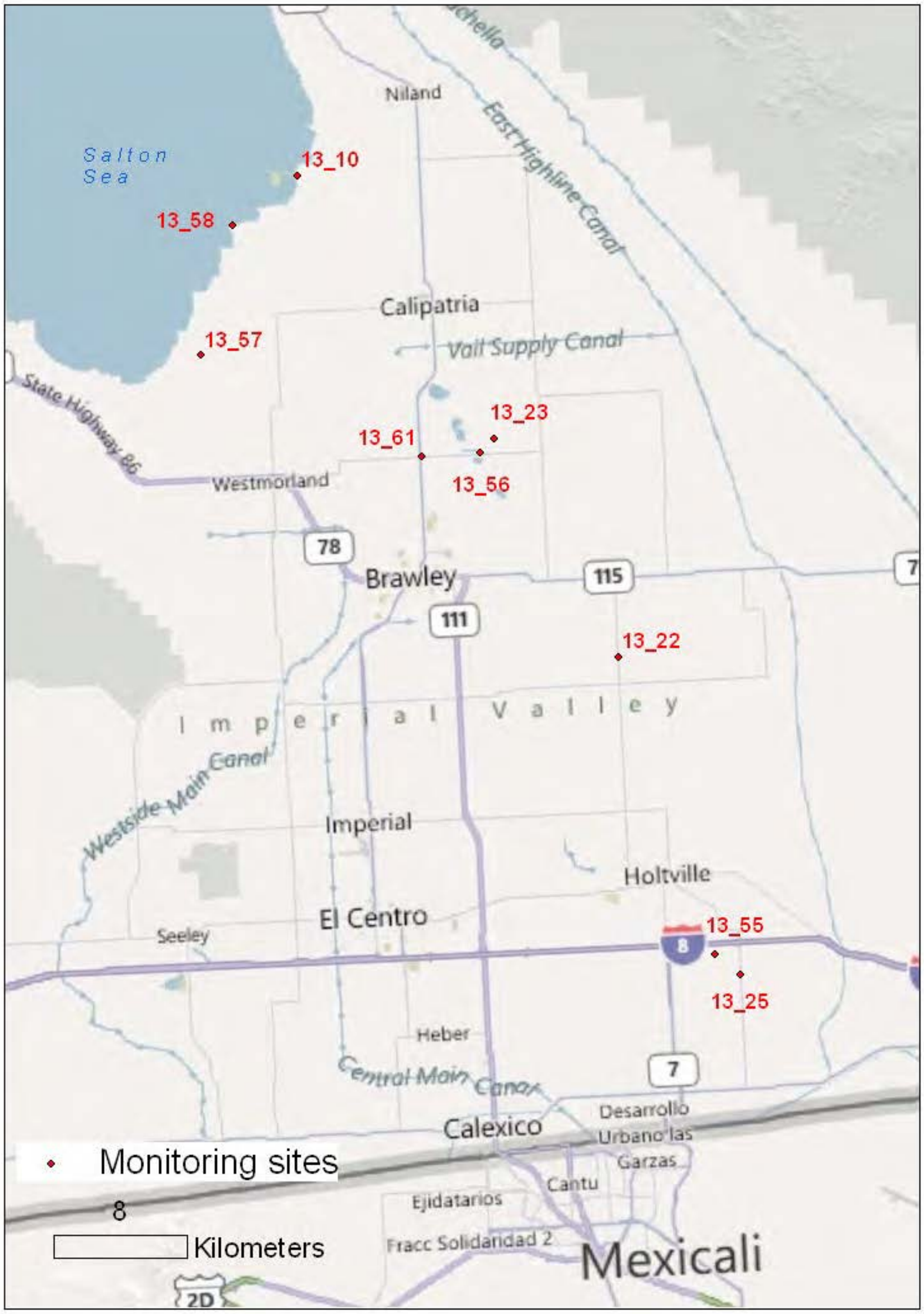

Figure 5. Monitoring sites in Imperial Valley, 2007 - 2008.

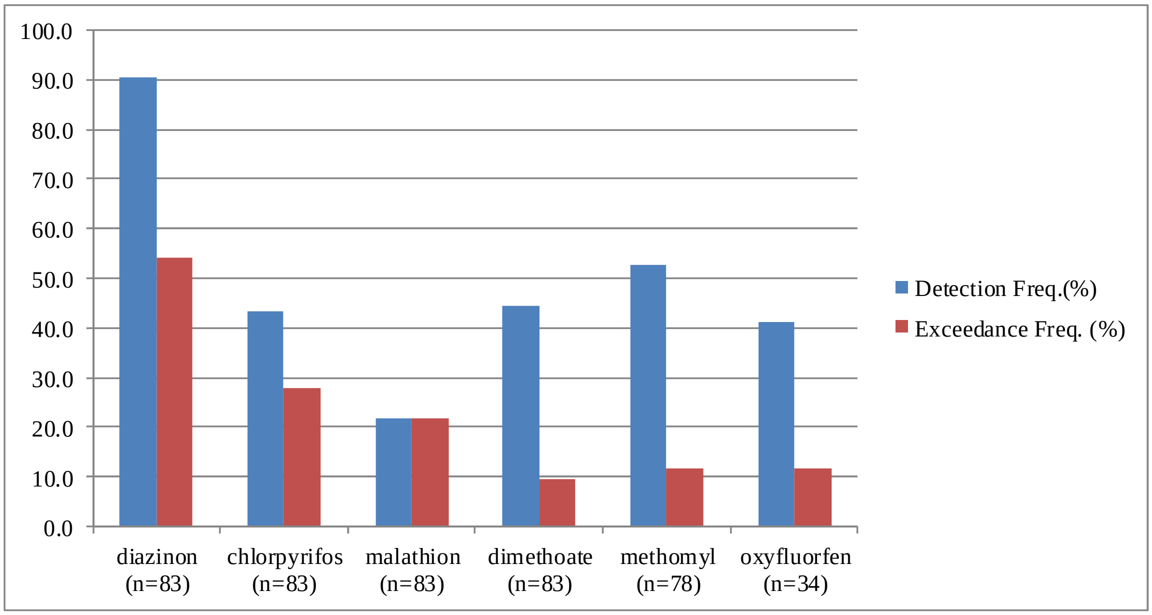

Figure 6. Detection and exceedance frequency of pesticides in surface water, as a percentage of the total number of samples (n) taken during the irrigation season from river and tributary sites in California, 2007 and 2008. Only pesticides with an exceedance frequency of greater than 5 percent were included.

Appendix 1. Water Quality and Field Site Information

Table A-1. Surface Water Monitoring Sample Sites.

Site Code	Site	Region	Latitude	Longitude	Site Type
13_10	Alamo River at Garst	Imperial	33.19924	-115.59623	R
13_22	Holtville Main Drain at 115	Imperial	32.93074	-115.40521	T
13_23	Malva Drain nr. Park	Imperial	33.05179	-115.4785	T
13_25	Verde Drain at Bonds Corner Rd	Imperial	32.75549	-115.33678	T
13_55	Alamo River at Hunt Rd	Imperial	32.7668	-115.35277	R
13_56	Alamo River at Rutherford Rd (upstream of Imperial State Wildlife Area)	Imperial	33.04454	-115.48738	R
13_57	New River at Vail Rd (USGS Gaging Station)	Imperial	33.10459	-115.66364	R
13_58	Salton Sea at Obsidian Butte	Imperial	33.17435	-115.64	SALT
13_61	New River at Rutherford/HWY S26	Imperial	33.04437	-115.52509	R
27_10	Alisal Creek (Reclamation Ditch) at De La Torre St., near Airport Blvd.	Salinas	36.66121	-121.61921	T
27_11	Old Salinas River at Potrero	Salinas	36.79081	-121.78973	R
27_13	Salinas River at Davis Rd	Salinas	36.64705	-121.70132	R
27_14	Salinas River at Del Monte Rd	Salinas	36.73192	-121.78088	R
27_66	Tembladero Slough at Haro	Salinas	36.75964	-121.75348	T
27_7	Quail Creek at HWY 101, btwn Spence and Potter Roads (trib. to Salinas R.)	Salinas	36.60923	-121.56227	T
27_70	Alisal Creek at Hartnell Rd	Salinas	36.64359	-121.57736	T
27_8	Chualar Creek at Chualar River Rd., ca. 1.2 mi. from HWY 101 (trib. to Salinas R.)	Salinas	36.55861	-121.52886	T
27_9	Blanco Drain at Cooper Rd, ca 0.2 mi. S of Nashua Rd, drains to Salinas R.	Salinas	36.69876	-121.73414	T
40_13	Oso Flaco Crk at Oso Flaco Lake Rd	S Maria	35.01637	-120.58655	T
42_48	Orcutt/Solomon Canyon Crk at HWY 1	S Maria	34.94145	-120.57329	T
42_49	Main St. Ditch at HWY 166, Santa Maria	S Maria	34.95485	-120.4841	T
42_50	Orcutt Crk at W. Main	S Maria	34.95757	-120.63149	T
27_68	South Ag Drain at Trafton	Pajaro	36.86248	-121.79796	T
27_69	North Ag Drain at Trafton	Pajaro	36.86768	-121.79112	T
44_15	Pajaro River at Thurwachter Bridge	Pajaro	36.88006	-121.79204	R
44_17	Watsonville Slough at Shell Rd, just upstream of tidegates	Pajaro	36.87154	-121.81734	R
44_18	Beach Street ditch, just upstream of Watsonville Slough tidegate	Pajaro	36.86871	-121.81584	T

Site Type: R = river; T = tributary (creek or drain); SALT = Salton Sea.

Appendix 1, Table A-2. Water Quality Data.

Site Code	Date	Time	pH	T (C)	Salinity (ppt)	DO (mg/L)
13_10	16-Oct-2007	1510	7.88	21.7	1.6	7.27
13_10	25-Mar-2008	1535	7.54	19.5	1.5	8.6
13_22	16-Oct-2007	1210	7.96	20.7	1.6	8
13_22	25-Mar-2008	1238	7.75	17.4	1.5	10.76
13_23	16-Oct-2007	1300	8	21.9	1.3	7.8
13_23	25-Mar-2008	1445	7.76	23.3	1.3	8.75
13_25	16-Oct-2007	1045	7.9	19.4	1.3	7.43
13_25	25-Mar-2008	1045	7.88	17.2	2	9.54
13_55	16-Oct-2007	1120	8.15	19.9	1.8	13.9
13_55	25-Mar-2008	1140	7.5	20.9	2.4	8.17
13_56	16-Oct-2007	1330	7.89	21.7	1.7	7.52
13_56	25-Mar-2008	1414	7.65	19	1.6	9.73
13_57	16-Oct-2007	1700	7.87	21.8	2.5	6.93
13_57	25-Mar-2008	1725	7.65	20.4	1.7	8.04
13_58	16-Oct-2007	1600	7.92	23.5	39	6.3
13_58	25-Mar-2008	1640	8.29	25.2	38.8	10.82
13_61	16-Oct-2007	1400	7.82	22.1	2.7	7.46
27_10	27-Aug-2007	1230	7.77	23.6	0.5	11.8
27_10	28-Aug-2007	1610	9.28	26.7	0.6	14.81
27_10	10-Sep-2007	1145	8.12	20.2	0.4	9.6
27_10	14-Apr-2008	1155	8.06	16.1	0.6	10.75
27_10	15-Apr-2008	1110	7.6	13.3	0.5	7.65
27_10	7-May-2008	1145	8.07	13.1	0.5	10.16
27_10	9-Jun-2008	1410	8.11	28.6	0.6	9.18
27_11	27-Aug-2007	1550	8.64	25.1	3.9	11.1
27_11	28-Aug-2007	1325	7.68	17.8	21.2	4.89
27_11	29-Aug-2007	1045	8.71	23	2.8	9.75
27_11	29-Aug-2007	1045	7.82	17.8	26.8	0.6
27_11	10-Sep-2007	1445	8.72	25.9	5.3	11.13
27_11	11-Sep-2007	1700	9.01	26	6.6	17.6
27_11	12-Sep-2007	930	8.71	19.1	5.4	5.88
27_11	18-Dec-2007	1240			3.44	
27_11	18-Dec-2007	2225			1.33	
27_11	19-Dec-2007	2230			2.11	
27_11	14-Apr-2008	1320	7.85	20	0.4	7.43
27_11	15-Apr-2008	1405	8.13	17.4	2.8	11.45
27_11	6-May-2008	1143	7.69	14.7	7.1	4.21
27_11	7-May-2008	1345	7.39	20	9.2	9.61
27_11	8-May-2008	840	7.65	15.2	14.3	4.04
27_11	9-Jun-2008	1137	7.77	21.5	10.9	5.86
27_13	10-Sep-2007	1415	9.07	22.8	1.4	
27_13	7-May-2008	1505	8.22	18.2	0.7	18.92
27_14	27-Aug-2007	1510	9.08	22.9	1.3	18.2
27_14	15-Apr-2008	1440	7.97	17.7	5.1	8.91
27_14	6-May-2008	1430	8.29	18.4	4.1	12.09
27_14	7-May-2008	1415	8.11	18.5	14.2	11.92
27_14	9-Jun-2008	1311	8.01	22.2	10.5	11.34

Appendix 1, Table A-2. Water Quality Data (continued).

Site Code	Date	Time	pH	T (C)	Salinity (ppt)	DO (mg/L)
27_66	27-Aug-2007	1630	8.03	25.8	1.1	
27_66	28-Aug-2007	1515	8.93	27	0.9	
27_66	10-Sep-2007	1525	8.44	23.8	0.8	11.81
27_66	11-Sep-2007	1300	8.62	21	1	
27_66	12-Sep-2007	1010	8.58	18.3	1	8.63
27_66	14-Apr-2008	1245	8.07	18	1.1	10.73
27_66	15-Apr-2008	1255	7.93	15.3	1.2	12.47
27_66	6-May-2008	1400	7.85	17.3	1.1	8.83
27_66	7-May-2008	1120	7.86	16.9	1.2	9.22
27_66	9-Jun-2008	1237	8.34	21	1.1	14.14
27_68	28-Aug-2007	1115	7.32	18	0.9	3.26
27_68	11-Sep-2007	1100	7.39	16.9	0.9	4.77
27_69	28-Aug-2007	1155	7.64	19	0.9	5.5
27_69	11-Sep-2007	1125	7.69	17.9	0.9	6.1
27_7	27-Aug-2007	1350	8.5	25.3	0.5	8.52
27_7	10-Sep-2007	1230	8.3	19.6	0.4	8.76
27_7	15-Apr-2008	957	7.98	11.3	0.6	6.31
27_7	7-May-2008	1035	8.42	11.9	0.8	10.91
27_7	9-Jun-2008	1510	7.86	26.2	0.5	7.12
27_70	15-Apr-2008	1035	7.64	15.3	0.5	7.45
27_70	7-May-2008	1105	7.94	12.5	0.5	9.53
27_70	9-Jun-2008	1440	7.86	26	0.4	6.15
27_8	27-Aug-2007	1415	9.42	26.3	0.8	16.75
27_8	10-Sep-2007	1300	8.89	23.8	1.1	9.91
27_8	15-Apr-2008	925	8.08	11.4	0.8	10.43
27_8	7-May-2008	1005	8.67	15.4	1	17.17
27_8	9-Jun-2008	1535	8.68	27.4	0.7	12.31
27_9	6-May-2008	1505	8.54	22.5	1.4	19.49
40_13	10-Jun-2008	1420	7.2	16.7	1.5	8.64
42_48	10-Jun-2008	1320	7.49	23.2	1.5	10.5
42_49	10-Jun-2008	1300	7.62	19.6	0.8	4.41
42_50	10-Jun-2008	1150	7.94	23.4	1.4	10.23
42_50	10-Jun-2008	1350	7.77	25.3	1.4	10.34
44_15	6-May-2008	1245	7.95	15	0.8	7.81
44_17	28-Aug-2007	930	7.03	17.1	1.2	0.9
44_17	29-Aug-2007	1000	7.15	17.6	1.2	0.65
44_17	11-Sep-2007	955	7.06	16.6	1.3	0.84
44_17	14-Apr-2008	1410	7.59	17.6	0.8	7.98
44_17	6-May-2008	1315	7.36	15.3	1.2	4.6
44_18	28-Aug-2007	1030	7.29	18.6	1.8	2.22
44_18	11-Sep-2007	1030	7.34	18.7	1.2	2.62

Appendix 2. Raw Data.
Table A-3. Analytical Data

Site	Code	Type (1)	Sample Date	Time	Analyses (2)	Detections	Conc (ug/L)	Exceeds (3)
Alisal Crk (Rec. Ditch) at De La Torre	27_10	T	27-Aug-2007	1230	OP, CB	chlorpyrifos	0.0112	(x)
						diazinon	2.072	x
						dimethoate	0.05	
						malathion	trace	
						methomyl	1.41	x
Quail Creek at HWY 101	27_7	T	27-Aug-2007	1350	OP, CB	chlorpyrifos	0.0653	x
						diazinon	9.375	x
						dimethoate	0.34	
						malathion	0.43	x
						methomyl	0.71	x
Chualar Creek at Chualar River Rd.	27_8	T	27-Aug-2007	1415	OP, CB	chlorpyrifos	0.0444	x
						diazinon	0.384	x
						dimethoate	0.4	
						methomyl	1.69	x
Salinas River at Del Monte Rd	27_14	R	27-Aug-2007	1510	OP, CB	diazinon	0.028	
Old Salinas River at Potrero	27_11	R	27-Aug-2007	1550	OP, CB	diazinon	0.11	
Tembladero Slough at Haro	27_66	T	27-Aug-2007	1630	OP, CB	carbaryl	0.0625	
						diazinon	0.237	x
						dimethoate	trace	
						methomyl	1.3	x
Watsonville Slough at Shell Rd	44_17	R	28-Aug-2007	930	OP, CB, TH	diazinon	0.043	
					OP, CB, TH	methomyl	0.15	
Beach Street ditch,upstrm of tidegate	44_18	T	28-Aug-2007	1030	OP, CB, TH	carbaryl	0.36	

(1) Type = type of sample site; R = river, T= tributary (creek or drain)
(2) Analyses: OP = organophosphates; CB = carbamates; DN = dinitroanilines and oxyfluorfen; TR = triazines/herbicides; TH = thiram
(3) Exceeds: x = measured concentration exceeded US EPA Benchmark; (x) = alternate benchmark exceeded
An on-line map of sample sites and associated pesticide detections is available at http://bit.ly/smI5zR .

Table A-3. Analytical Data (continued).

Site	Code	Type	Sample Date	Time	Analyses	Detections	Conc (ug/L)	Exceeds
South Ag Drain at Trafton	27_68	T	28-Aug-2007	1115	OP, CB, TH	carbaryl	trace	
					OP, CB, TH	diazinon	0.289	x
					OP, CB, TH	dimethoate	0.21	
North Ag Drain at Trafton	27_69	T	28-Aug-2007	1155	OP, CB, TH	carbaryl	trace	
Old Salinas River at Potrero	27_11	R	28-Aug-2007	1325	OP, CB	diazinon	0.075	
					OP, CB	methomyl	0.13	
Tembladero Slough at Haro	27_66	T	28-Aug-2007	1515	OP, CB, TH	carbaryl	trace	
					OP, CB, TH	diazinon	0.582	x
					OP, CB, TH	dimethoate	trace	
					OP, CB, TH	methomyl	0.98	x
Alisal Crk (Rec. Ditch) at De La Torre	27_10	T	28-Aug-2007	1610	OP, CB, TH	chlorpyrifos	0.01	
					OP, CB, TH	diazinon	1.44	x
					OP, CB, TH	dimethoate	0.08	
					OP, CB, TH	malathion	trace	
					OP, CB, TH	methomyl	2	x
Watsonville Slough at Shell Rd	44_17	R	29-Aug-2007	1000	OP, CB, TH	diazinon	0.042	
Old Salinas River at Potrero	27_11	R	29-Aug-2007	1045	OP, CB, TH	diazinon	0.077	
					OP, CB, TH	methomyl	0.66	
Alisal Crk (Rec. Ditch) at De La Torre	27_10	T	10-Sep-2007	1145	OP, CB	chlorpyrifos	0.0173	(x)
					OP, CB	diazinon	0.239	x
					OP, CB	dimethoate	0.56	x
					OP, CB	methomyl	0.105	
Quail Creek at HWY 101	27_7	T	10-Sep-2007	1230	OP, CB	chlorpyrifos	0.9	x
					OP, CB	diazinon	7.69	x
					OP, CB	dimethoate	9.47	x
					OP, CB	malathion	trace	
					OP, CB	methomyl	10.29	x
Chualar Creek at Chualar River Rd.	27_8	T	10-Sep-2007	1300	OP, CB	chlorpyrifos	0.0551	x
					OP, CB	DDVP	0.13	
					OP, CB	diazinon	1.82	x
					OP, CB	dimethoate	0.22	
					OP, CB	malathion	0.96	x
					OP, CB	methomyl	0.785	x

Table A-3. Analytical Data (continued).

Site	Code	Type	Sample Date	Time	Analyses	Detections	Conc (ug/L)	Exceeds
Salinas River at Del Monte Rd	27_14	R	10-Sep-2007	1415	OP, CB	diazinon	0.0224	
					OP, CB	methomyl	0.061	
Old Salinas River at Potrero	27_11	R	10-Sep-2007	1445	OP, CB	DDVP	0.26	
					OP, CB	diazinon	0.117	x
					OP, CB	dimethoate	0.1	
					OP, CB	methomyl	0.336	
Tembladero Slough at Haro	27_66	T	10-Sep-2007	1525	OP, CB, TH	diazinon	0.08	
					OP, CB, TH	dimethoate	trace	
					OP, CB, TH	methomyl	trace	
Watsonville Slough at Shell Rd	44_17	R	11-Sep-2007	955	OP, CB, TH	diazinon	0.0491	
Beach Street ditch, upstrm of gate	44_18	T	11-Sep-2007	1030	OP, CB, TH	no detection	NA	
South Ag Drain at Trafton	27_68	T	11-Sep-2007	1100	OP, CB, TH	diazinon	0.0242	
North Ag Drain at Trafton	27_69	T	11-Sep-2007	1125	OP, CB, TH	diazinon	0.0109	
Tembladero Slough at Haro	27_66	T	11-Sep-2007	1300	OP, CB, TH	diazinon	0.29	x
					OP, CB, TH	dimethoate	trace	
					OP, CB, TH	methomyl	0.149	
Old Salinas River at Potrero	27_11	R	11-Sep-2007	1700	OP, CB, TH	diazinon	0.0744	
					OP, CB, TH	dimethoate	trace	
					OP, CB, TH	methomyl	0.241	
Old Salinas River at Potrero	27_11	R	12-Sep-2007	930	OP, CB	diazinon	0.0569	
					OP, CB	dimethoate	trace	
					OP, CB	methomyl	0.07	
Tembladero Slough at Haro	27_66	T	12-Sep-2007	1010	OP, CB, TH	diazinon	0.18	x
					OP, CB, TH	dimethoate	trace	
					OP, CB, TH	methomyl	0.056	

Table A-3. Analytical Data (continued).

Site	Code	Type	Sample Date	Time	Analyses	Detections	Conc (ug/L)	Exceeds
Verde Drain at Bonds Corner Rd	13_25	T	16-Oct-2007	1045	OP, CB	diazinon	0.0413	
					OP, CB	methomyl	trace	
Alamo River at Hunt Rd	13_55	R	16-Oct-2007	1120	OP, CB	diazinon	0.126	x
					OP, CB	methomyl	0.064	
Holtville Main Drain at 115	13_22	T	16-Oct-2007	1210	OP, CB	chlorpyrifos	0.0466	x
					OP, CB	diazinon	0.164	x
					OP, CB	methomyl	0.074	
Malva Drain nr. Park	13_23	T	16-Oct-2007	1300	OP, CB	chlorpyrifos	0.0609	x
					OP, CB	diazinon	0.0211	
Alamo River at Rutherford Rd	13_56	R	16-Oct-2007	1330	OP, CB	chlorpyrifos	0.097	x
					OP, CB	diazinon	0.415	x
					OP, CB	methomyl	0.07	
New River at Rutherford	13_61	R	16-Oct-2007	1400	OP, CB	chlorpyrifos	0.0137	(x)
					OP, CB	diazinon	0.42	x
					OP, CB	malathion	trace	
					OP, CB	oxamyl	0.127	
Alamo River at Garst	13_10	R	16-Oct-2007	1510	OP, CB	chlorpyrifos	0.0797	x
					OP, CB	diazinon	0.595	x
					OP, CB	methomyl	0.116	
Salton Sea at Obsidian Butte	13_58	SALT	16-Oct-2007	1600	OP, CB	diazinon	0.0655	
New River at Vail Rd	13_57	R	16-Oct-2007	1700	OP, CB	chlorpyrifos	0.0218	(x)
					OP, CB	diazinon	2.22	x
					OP, CB	malathion	trace	
Old Salinas River at Potrero	27_11	R	18-Dec-2007	1240	OP, DN	oxyfluorfen	trace	
Old Salinas River at Potrero	27_11	R	18-Dec-2007	2225	OP, DN	chlorpyrifos	0.0214	(x)
					OP, DN	diazinon	0.015	
					OP, DN	dimethoate	trace	
					OP, DN	methidathion	trace	
					OP, DN	oxyfluorfen	0.161	
Old Salinas River at Potrero	27_11	R	19-Dec-2007	2230	OP, DN	chlorpyrifos	0.0276	(x)
					OP, DN	diazinon	0.027	
					OP, DN	dimethoate	trace	
					OP, DN	malathion	trace	
					OP, DN	oryzalin	0.186	
					OP, DN	oxyfluorfen	0.206	
Moro Cojo Slough at HWY 1	27_48	R	07-Jan-2008	1645	OP	chlorpyrifos	0.0115	(x)
					OP	diazinon	0.04	

Table A-3. Analytical Data (continued).

Site	Code	Type	Sample Date	Time	Analyses	Detections	Conc (ug/L)	Exceeds
Verde Drain at Bonds Corner Rd	13_25	T	25-Mar-2008	1045	OP, CB, TR, DN	carbofuran	0.082	
					OP, CB, TR, DN	chlorpyrifos	trace	
					OP, CB, TR, DN	dimethoate	0.262	
					OP, CB, TR, DN	malathion	4.12	x
					OP, CB, TR, DN	methomyl	0.063	
					OP, CB, TR, DN	pendimethalin	0.0894	
					OP, CB, TR, DN	trifluralin	0.907	
Alamo River at Hunt Rd	13_55	R	25-Mar-2008	1140	OP, CB, TR, DN	chlorpyrifos	0.0141	(x)
					OP, CB, TR, DN	dimethoate	0.246	
					OP, CB, TR, DN	diuron	trace	
					OP, CB, TR, DN	malathion	0.07	x
					OP, CB, TR, DN	pendimethalin	trace	
					OP, CB, TR, DN	prodiamine	trace	
					OP, CB, TR, DN	trifluralin	trace	
Holtville Main Drain at 115	13_22	T	25-Mar-2008	1238	OP, TR, DN	atrazine	trace	
					OP, TR, DN	chlorpyrifos	0.0248	(x)
					OP, TR, DN	DEA	trace	
					OP, TR, DN	dimethoate	0.493	
					OP, TR, DN	malathion	0.323	x
					OP, TR, DN	oxyfluorfen	trace	
					OP, TR, DN	pendimethalin	0.349	
					OP, TR, DN	tribufos	trace	
					OP, TR, DN	trifluralin	0.629	
Alamo River at Rutherford Rd	13_56	R	25-Mar-2008	1414	OP, CB, TR, DN	atrazine	0.26	
					OP, CB, TR, DN	carbofuran	0.176	
					OP, CB, TR, DN	chlorpyrifos	0.062	x
					OP, CB, TR, DN	DACT	trace	
					OP, CB, TR, DN	DEA	trace	
					OP, CB, TR, DN	diazinon	0.0502	
					OP, CB, TR, DN	dimethoate	0.462	
					OP, CB, TR, DN	malathion	0.861	x
					OP, CB, TR, DN	oxyfluorfen	trace	
					OP, CB, TR, DN	pendimethalin	0.409	
					OP, CB, TR, DN	trifluralin	0.396	
Malva Drain nr. Park	13_23	T	25-Mar-2008	1445	OP, TR, DN	chlorpyrifos	0.0263	(x)
					OP, TR, DN	dimethoate	0.0562	
					OP, TR, DN	pendimethalin	trace	
					OP, TR, DN	trifluralin	trace	

Table A-3. Analytical Data (continued).

Site	Code	Type	Sample Date	Time	Analyses	Detections	Conc (ug/L)	Exceeds
Alamo River at Garst	13_10	R	25-Mar-2008	1535	OP, CB, TR, DN	3-OH	0.065	
					OP, CB, TR, DN	atrazine	0.19	
					OP, CB, TR, DN	carbofuran	0.366	
					OP, CB, TR, DN	chlorpyrifos	0.0473	x
					OP, CB, TR, DN	DACT	trace	
					OP, CB, TR, DN	DEA	trace	
					OP, CB, TR, DN	diazinon	0.0145	
					OP, CB, TR, DN	dimethoate	0.262	
					OP, CB, TR, DN	malathion	0.0945	x
					OP, CB, TR, DN	oxyfluorfen	trace	
					OP, CB, TR, DN	pendimethalin	0.496	
					OP, CB, TR, DN	trifluralin	0.314	
Salton Sea at Obsidian Butte	13_58	SALT	25-Mar-2008	1640	OP, TR, DN	atrazine	0.134	
					OP, TR, DN	dimethoate	trace	
New River at Vail Rd	13_57	R	25-Mar-2008	1725	OP, TR, DN	atrazine	trace	
					OP, TR, DN	chlorpyrifos	0.0155	(x)
					OP, TR, DN	diazinon	0.0376	
					OP, TR, DN	dimethoate	0.2	
					OP, TR, DN	malathion	0.374	x
					OP, TR, DN	pendimethalin	0.175	
					OP, TR, DN	trifluralin	0.167	

Table A-3. Analytical Data (continued).

Site	Code	Type	Sample Date	Time	Analyses	Detections	Conc (ug/L)	Exceeds
Alisal Crk (Rec. Ditch) at De La Torre	27_10	T	14-Apr-2008	1155	OP, CB	chlorpyrifos	0.0482	x
					OP, CB	diazinon	0.467	x
					OP, CB	dimethoate	0.801	x
					OP, CB	methomyl	0.177	
Tembladero Slough at Haro	27_66	T	14-Apr-2008	1245	OP, CB	diazinon	0.471	x
					OP, CB	dimethoate	0.428	
Watsonville Slough at Shell Rd	44_17	R	14-Apr-2008	1410	OP, CB	diazinon	0.0544	
Chualar Creek at Chualar River Rd.	27_8	T	15-Apr-2008	925	OP, CB	chlorpyrifos	0.0968	x
					OP, CB	diazinon	0.497	x
					OP, CB	dimethoate	0.513	x
Old Salinas River at Potrero	27_11	R	14-Apr-2008	1320	OP, CB	diazinon	0.562	x
Quail Creek at HWY 101	27_7	T	15-Apr-2008	957	OP, CB	chlorpyrifos	0.47	x
					OP, CB	diazinon	0.263	x
					OP, CB	dimethoate	trace	
Old Salinas River at Potrero	27_11	R	14-Apr-2008	1320	OP, CB	dimethoate	0.059	
Alisal Creek at Hartnell Rd	27_70	T	15-Apr-2008	1035	OP, CB	chlorpyrifos	0.0428	x
					OP, CB	diazinon	0.835	x
					OP, CB	dimethoate	0.589	x
					OP, CB	methomyl	trace	
Alisal Crk (Rec. Ditch) at De La Torre	27_10	T	15-Apr-2008	1110	OP, CB	carbaryl	trace	
					OP, CB	chlorpyrifos	0.0945	x
					OP, CB	diazinon	1.03	x
					OP, CB	dimethoate	0.351	
					OP, CB	malathion	0.04	x
					OP, CB	methomyl	0.07	
Tembladero Slough at Haro	27_66	R	15-Apr-2008	1255	OP, CB	diazinon	0.341	x
					OP, CB	dimethoate	0.092	
Old Salinas River at Potrero	27_11	R	15-Apr-2008	1405	OP, CB	diazinon	0.348	x
					OP, CB	dimethoate	0.34	
Salinas River at Del Monte Rd	27_14	R	15-Apr-2008	1440	OP, CB	diazinon	0.32	x
					OP, CB	methomyl	0.237	
Old Salinas River at Potrero	27_11	R	06-May-2008	1143	OP, CB, DN	diazinon	0.23	x
					OP, CB, DN	dimethoate	0.048	
					OP, CB, DN	methomyl	0.051	
					OP, CB, DN	oxyfluorfen	0.054	
Pajaro River at Thurwacher Bridge	44_15	R	06-May-2008	1245	OP, CB, DN	no detection	NA	
Watsonville Slough at Shell Rd	44_17	R	06-May-2008	1315	OP, CB, DN	diazinon	0.131	x

Table A-3. Analytical Data (continued).

Site	Code	Type	Sample Date	Time	Analyses	Detections	Conc (ug/L)	Exceeds
Tembladero Slough at Haro	27_66	T	06-May-2008	1400	OP, CB, DN	diazinon	0.971	x
					OP, CB, DN	dimethoate	0.459	
					OP, CB, DN	methomyl	0.136	
					OP, CB, DN	oxyfluorfen	0.342	x
Salinas River at Del Monte Rd	27_14	R	06-May-2008	1430	OP, CB, DN	diazinon	0.023	
Blanco Drain at Cooper Rd	27_9	T	06-May-2008	1505	OP, CB, DN	diazinon	0.0173	
					OP, CB, DN	dimethoate	trace	
Chualar Creek at Chualar River Rd.	27_8	T	07-May-2008	1005	OP, CB, DN	chlorpyrifos	0.14	x
					OP, CB, DN	diazinon	3.85	x
					OP, CB, DN	malathion	trace	
					OP, CB, DN	methomyl	0.52	
					OP, CB, DN	oxyfluorfen	0.074	
Quail Creek at HWY 101	27_7	T	07-May-2008	1035	OP, CB, DN	chlorpyrifos	0.526	x
					OP, CB, DN	diazinon	0.181	x
					OP, CB, DN	dimethoate	trace	
					OP, CB, DN	malathion	trace	
Alisal Crk at Hartnell Rd	27_70	T	07-May-2008	1105	OP, CB, DN	chlorpyrifos	0.05	x
					OP, CB, DN	diazinon	0.0621	
					OP, CB, DN	dimethoate	0.538	x
					OP, CB, DN	malathion	0.08	x
					OP, CB, DN	methomyl	0.622	
					OP, CB, DN	oxyfluorfen	0.189	
Alisal Crk (Rec. Ditch) at De La Torre	27_10	T	07-May-2008	1145	OP, CB, DN	chlorpyrifos	0.0276	(x)
					OP, CB, DN	diazinon	0.308	x
					OP, CB, DN	dimethoate	1.204	x
					OP, CB, DN	malathion	0.16	x
					OP, CB, DN	methomyl	0.886	x
					OP, CB, DN	oxyfluorfen	trace	
Tembladero Slough at Haro	27_66	T	07-May-2008	1220	OP, CB, DN	diazinon	0.196	x
					OP, CB, DN	dimethoate	0.214	
					OP, CB, DN	malathion	trace	
					OP, CB, DN	methomyl	0.47	
					OP, CB, DN	oxyfluorfen	0.54	x
Old Salinas River at Potrero	27_11	R	07-May-2008	1345	OP, CB, DN	diazinon	0.462	x
					OP, CB, DN	dimethoate	0.16	
					OP, CB, DN	methomyl	0.208	
					OP, CB, DN	oxyfluorfen	0.08	

Table A-3. Analytical Data (continued).

Site	Code	Type	Sample Date	Time	Analyses	Detections	Conc (ug/L)	Exceeds
Salinas River at Del Monte Rd	27_14	R	07-May-2008	1415	OP, CB, DN	diazinon	0.0302	
Salinas River at Davis Rd	27_13	R	07-May-2008	1505	OP, CB, DN	no detection	NA	
Old Salinas River at Potrero	27_11	R	08-May-2008	840	OP, CB, DN	diazinon	0.0903	
					OP, CB, DN	dimethoate	0.074	
					OP, CB, DN	methomyl	0.107	
					OP, CB, DN	oxyfluorfen	trace	
Old Salinas River at Potrero	27_11	R	09-Jun-2008	1137	OP, DN	diazinon	0.0391	
					OP, DN	dimethoate	trace	
					OP, DN	oxyfluorfen	0.051	
Tembladero Slough at Haro	27_66	T	09-Jun-2008	1237	OP, CB, DN	diazinon	0.13	x
					OP, CB, DN	dimethoate	trace	
					OP, CB, DN	methidathion	0.045	
					OP, CB, DN	methomyl	0.187	
					OP, CB, DN	oxyfluorfen	0.051	
Salinas River at Del Monte Rd	27_14	R	09-Jun-2008	1311	OP, CB, DN	diazinon	0.0152	
				1311	OP, CB, DN	methomyl	0.046	
Alisal Crk (Rec. Ditch) at De La Torre	27_10	T	09-Jun-2008	1410	OP, CB, DN	chlorpyrifos	0.209	x
					OP, CB, DN	diazinon	0.341	x
					OP, CB, DN	dimethoate	0.007	
					OP, CB, DN	malathion	0.335	x
					OP, CB, DN	methomyl	0.324	
					OP, CB, DN	oxyfluorfen	trace	
Alisal Creek at Hartnell Rd	27_70	T	09-Jun-2008	1440	OP, CB, DN	chlorpyrifos	0.011	(x)
					OP, CB, DN	diazinon	0.398	x
					OP, CB, DN	dimethoate	0.395	
					OP, CB, DN	malathion	0.207	x
					OP, CB, DN	methomyl	0.33	
					OP, CB, DN	oxyfluorfen	0.064	
Quail Creek at HWY 101	27_7	T	09-Jun-2008	1510	OP, CB, DN	chlorpyrifos	0.0982	x
					OP, CB, DN	diazinon	0.443	x
					OP, CB, DN	dimethoate	trace	
					OP, CB, DN	malathion	0.047	x
Chualar Creek at Chualar River Rd.	27_8	T	09-Jun-2008	1535	OP, CB, DN	chlorpyrifos	0.123	x
					OP, CB, DN	diazinon	0.0961	
					OP, CB, DN	dimethoate	0.043	
					OP, CB, DN	methomyl	0.265	
					OP, CB, DN	oxyfluorfen	0.116	

Table A-3. Analytical Data (continued).

Site	Code	Type	Sample Date	Time	Analyses	Detections	Conc (ug/L)	Exceeds
Orcutt Crk at W. Main	42_50	T	10-Jun-2008	1150	OP, CB, DN	carbaryl	0.076	
					OP, CB, DN	chlorpyrifos	0.159	x
					OP, CB, DN	diazinon	0.0494	
					OP, CB, DN	dimethoate	0.526	x
					OP, CB, DN	malathion	0.04	x
					OP, CB, DN	methomyl	0.335	
					OP, CB, DN	oxyfluorfen	0.446	x
Main St. Ditch at HWY 166	42_49	T	10-Jun-2008	1300	OP, CB, DN	chlorpyrifos	0.0329	(x)
					OP, CB, DN	diazinon	0.0565	
					OP, CB, DN	dimethoate	trace	
					OP, CB, DN	malathion	0.161	x
					OP, CB, DN	oxyfluorfen	trace	
Orcutt/Solomon Canyon Crk at HWY 1	42_48	T	10-Jun-2008	1320	OP, CB, DN	chlorpyrifos	0.0202	(x)
					OP, CB, DN	diazinon	1.465	x
					OP, CB, DN	dimethoate	trace	
					OP, CB, DN	malathion	1.96	x
					OP, CB, DN	oxyfluorfen	0.053	
Orcutt Crk at W. Main	42_50	T	10-Jun-2008	1350	OP, CB, DN	carbaryl	0.048	
					OP, CB, DN	chlorpyrifos	0.273	x
					OP, CB, DN	diazinon	0.141	x
					OP, CB, DN	dimethoate	0.161	
					OP, CB, DN	malathion	trace	
					OP, CB, DN	methomyl	0.343	
					OP, CB, DN	oxyfluorfen	0.479	x
Oso Flaco Crk at Oso Flaco Lake Rd	40_13	T	10-Jun-2008	1420	OP, CB, DN	diazinon	0.201	x
					OP, CB, DN	dimethoate	0.067	
					OP, CB, DN	ethoprop	trace	
					OP, CB, DN	malathion	0.08	x
					OP, CB, DN	oxyfluorfen	0.111	

Appendix 3. Quality Control Data.

For the organophosphate (OP) insecticide screen, a total of fifteen QC samples were analyzed during the study. Of those, thirteen were blank-matrix spikes (Table A-4) and 2 were blind spikes (Table A-9). Recoveries for all blind spike samples were within the control limits.

The lower control limits (LCL) were exceeded for chlorpyrifos in one blank-matrix spike. Because the recoveries in the blank-matrix spike were below the LCL, the reported chlorpyrifos concentrations in the field samples analyzed with these QC samples may be biased downwards. The associated field samples analyzed with these QC samples were collected in the field in December 2007 in Salinas Valley. For the three associated samples, there were two detections and on non-detection. These reported concentrations may be biased low.

For the carbamate (CB) insecticide screen, a total of eleven QC samples were analyzed. Of those, 9 were blank-matrix spikes (Table A-5) and 2 were blind spikes (Table A-9).

The Upper Control Limits (UCL) were exceeded for 3-hydroxy carbofuran (3-OH) in 1 blank-matrix spike. Because the recoveries in the blank-matrix spike sample were above the UCL, the reported 3-OH concentrations in field samples analyzed with these QC samples may be biased upward.

The associated field samples analyzed with this QC sample were collected in the field in March 2008 in Imperial Valley. The only reported detection of 3-OH in the associated samples was in one sample collected at site 13_10; this reported concentration may be biased upwards.

The lower control limits were exceeded for methomyl in 2 blank-matrix spike samples. Because the recoveries in the blank-matrix spike were below the LCL, the reported methomyl concentrations in the field samples analyzed with these QC samples may be biased downwards.

The associated field samples analyzed with these QC samples were collected from Salinas and Pajaro Valleys in August and September of 2007. There were nine methomyl detections and one trace detection in these samples, all from Salinas Valley samples. These reported detections may be biased downward; the actual concentrations may be higher than those reported. The remaining samples, reported as non-detections, may also be biased downward.

The lower control limits were exceeded for carbofuran in 1 blank-matrix spike samples. Because the recoveries in the blank-matrix spike were below the LCL, the reported carbofuran concentrations in the field samples analyzed with these QC samples may be biased downwards.

The associated field samples analyzed with this QC sample were collected from the Imperial Valley in the fall of 2007. There were no detections of carbofuran in any of the associated field samples. There was no reported carbofuran use in Imperial Valley during this period; detections would not normally be expected. However, it is possible that the reported non-detections may be biased downward.

The lower control limits were exceeded for aldicarb sulfoxide in four blank matrix spike samples and aldicarb sulfone in one blank matrix spike sample. Because the recoveries in the blank-matrix spike were below the LCL, the reported concentrations in the field samples analyzed with these QC samples may be biased downwards.

The associated field samples were collected from Salinas, Santa Maria and Pajaro Valleys. There were not detections of either of these aldicarb degradates in any of the samples. There was no reported agricultural use of the parent chemical aldicarb in any of these regions during the study period. As such, detections of the aldicarb degradates would not be expected. However, it is possible that the reported non-detections may be biased downward.

For the dinitoraniline/oxyfluorfen (DN) screen, a total of 6 QC samples were analyzed during the study Of those, 5 were blank-matrix spikes (Table A-6) and 1 was a blind spike (Table A-9). Recoveries for all of these samples were within the control limits.

For the triazine/herbicide (TR) screen, 1 blank-matrix spike was analyzed (Table A-7). Recoveries were within the control limits.

For the thiram (TH) screen, 1 blank-matrix spike was analyzed (Table A-8). Recoveries were within the control limits.

Appendix 3. Quality Control Data. Table A-4. Quality Control, Organophosphate Screen

Study 248 Continuing Quality Control- Organophosphate Screen

Extraction Date	Sample Numbers	Percent Recovery Ethoprop	Diazinon	Disulfoton	Chlorpyrifos	Malathion	Methidathion	Fenamiphos	Azinphos-Methyl	Dichlorvos	Phorate	Fonophos	Dimethoate	Methyl Parathion	Tribufos (DEF)	Profenofos
8/30/07	1042, 3001, 3002, 3003, 3004, 3005, 3006, 3007,	80.8	96.8	69.4	100	87.7	82.9	78.1	90.9	72.1	74.2	81.1	78.3	86.8	89.6	89.4
8/30/07	1001, 1003, 1005, 1007, 1009, 1011, 1013, 1018,	105	98.8	85.4	97.2	108	98.2	92.3	67.8	71.4	72.5	77.5	71.6	83.6	87.7	87.0
9/13/07	1049, 1053, 1055, 1057, 1059, 1071, 3009, 3010,	97.2	99.6	88.4	92.0	96.8	95.3	88.9	80.0	83.4	91.2	89.4	79.4	91.2	100	96.4
9/13/07	3012, 1073, 1076, 1079, 1082, 1085, 1088, 1091,	83.5	99.6	75.4	94.4	96.3	86.2	78.5	105	90.8	83.6	93.1	90.6	95.1	109	105.0
10/18/07	2001, 2005, 2009, 2013, 2017, 2020, 2025, 2029,	87.0	95.2	81.7	98.0	90.8	88.6	89.3	79.8	82.1	83.2	82.8	83.1	89.6	92.9	89.1
12/27/07	1097, 1099, 1101	91.1	88.0	79.2	56.0	89.6	88.4	81.1	83.1	74.2	74.1	74.1	82.2	78.3	79	77.8
1/11/08	3013, 3014, 3015, 3016, 3017, 3018, 3019, 3020	75.0	79.2	73.5	80.7	79.2	80.6	80.4	91.6	68.5	74.2	73.6	70.0	73.6	77.0	75.4
4/1/08	2097, 2042, 2047, 2056, 2061, 2065, 2074, 2078	92.1	102	91.6	101	94.4	86.9	92.2	95.5	104	92.1	91.3	89.0	93.5	92.2	96.2
4/1/08	2037, 2042, 2047, 2056, 2061, 2065, 2074, 2078	92.1	102	91.6	101	94.4	86.9	92.2	95.5	104	92.1	91.3	89.0	93.5	92.2	96.2
4/18/08	1103, 1104, 1105, (1169), 1106, 1107, 1108, 1109,	94.7	97.2	89.2	96.8	97.1	99.5	108	126	78.9	76.7	76.6	76.1	79.3	74.5	77.1
4/18/08	1121, 1123, 1127, (1171), 1131, 1135, 1139, 1143, 1147, 1151	97.8	100	83.9	100	95.0	107	100	113	78.6	83.2	86.3	88.2	88.3	91.2	93.0
5/9/08	1153, 1156, 1159, 1162, 1165, 1173, 1176, 1179, 1184, 1189, 1194, 1199,	98.0	89.6	97.2	92.4	103	102	98.7	107	93.3	97.6	93.8	87.7	93.6	98.1	109.0
6/13/08	1221, 1223, 1228, 1235, 1240, 1245, 1250, 1253, 1257, 1261, 1265, 1269	70.2	96.0	66.2	96.8	70.0	72.5	72.6	75.4	93.1	92.9	92.1	98.3	97.0	96.7	98.7
Average Recovery																
Standard Deviation																
CV																
Upper Control Limit		123	117	119	119	126	128	125	137	106	110	113	117	119	126	125
Upper Warning Limit		113	109	109	111	116	117	115	122	98.2	102	105	108	111	116	115
Lower Warning Limit		70.7	77.2	68.1	77.2	75.7	74.6	77.3	64.0	67.0	73.5	75.5	73.2	76.6	74.9	74.2
Lower Control Limit		60.2	69.2	58.0	68.8	65.7	63.9	67.9	49.4	59.2	66.3	68.1	64.5	68.0	64.7	64.1

*Highlighted cells are percent recoveries exceeding control limits

() sample numbers are blind spikes

Appendix 3. Quality Control Data. Table A-5. Quality Control, Carbamate Screen

Study 248 continuing quality control for the carbamate screen

Extraction date	Sample numbers	Percent Recovery: Aldicarb sulfoxide	aldicarb sulfone	methomyl	3-OH Carbofuran	aldicarb	carbofuran	carbaryl	Oxamyl	Methiocarb
08/30/07	1002, 1004, 1006, 1008, 1010, 1012, 1014	50.0	72.7	75.3	79.3	80.7	101	97.3	76.0	97.3
08/30/07	1019, 1024, 1029, 1034, 1038, 1043, 1048, 1065	51.8	67.3	70.7	80.7	76.7	92.7	86.7	86.7	94.0
09/14/07	1050, 1054, 1056, 1058, 1060, 1070, 1074	56.0	72.0	68.0	80.0	76.0	76.0	80.0	84.0	88.0
09/14/07	1077, 1080, 1083, 1086, 1089, 1092, 1094	68.7	88.0	86.7	88.0	93.3	89.3	92.7	94.0	90.7
10/19/07	2002, 2006, 2010, 2014, 2018, 2022, 2026, 2030, 2034, (2050), (2052), (2053)	66.3	77.3	74.7	72.7	72.7	65.9	76.7	90.0	80.0
03/27/08	2038, 2043, 2057, 2066	88.8	71.8	73.9	114	73.9	93.6	92.0	76.6	75.7
04/17/08	1110, 1114, 1118, 1122, 1124, 1128, (1172), 1132, 1136, 1140, 1144, 1148, (1170)	66.0	92.7	88.7	92.0	85.3	88.7	94.7	92.7	86.7
05/09/08	1154, 1157, 1160, 1163, 1166, 1174, 1177, 1180, 1185, 1190, 1195, 1200, 1205, 1208, 1210	64.0	83.3	80.0	76.7	77.3	96.7	83.3	84.0	87.3
06/13/08	1224, 1229, 1241, 1246, 1250, 1254, 1236, 1258, 1262, 1266, 1270	58.7	81.3	86.7	84.7	84.7	80	81.3	84.7	76.7
Average Recovery		63.4	78.5	78.3	85.3	80.1	87.1	87.2	85.4	86.3
Standard Deviation		11.6	8.44	7.56	12.2	6.64	11.1	7.28	6.33	7.48
CV		18.3	10.8	9.66	14.3	8.29	12.7	8.35	7.41	8.67
Upper Control Limit		110	115	107	131	112	122	117	105	112
Upper Warning Limit		102	108	101	121	104	113	110	101	106
Lower Warning Limit		70.5	81.0	78.2	79.4	73.3	80.3	82.3	83.2	80.1
Lower Control Limit		62.7	74.3	72.5	69.1	65.6	72.0	75.4	78.9	73.7

Appendix 3. Quality Control Data. Table A-6. Quality Control, Dinitroaniline/Oxyfluorfen Screen.

Study 248 continuing quality control for dinitroanilines screen with oxyfluorfen

		Percent recovery						
[redacted]	Sample numbers	Oryzalin	Ethalfluralin	Trifluralin	Benfluralin	Prodiamine	Pendimethalin	Oxyfluorfen
12/28/07	1098, 1100, 1102	104	80.0	89.0	92.0	87.3	78.0	74.7
3/28/08	2039, 2044, 2048, 2058, 2062, 2067, 2075, 2079	90.7	84.0	88.0	94.7	104	98.7	110
5/13/08	1155, 1158, 1161, 1164, 1167, 1168, 1175, 1178, 1181, 1186	82.0	98.0	103	95.3	117	103	98.7
5/14/08	1191, 1196, 1201, 1206, 1211, (1234), (1233)	74.7	103	108	104	82.7	90.0	82.7
6/13/08	1222, 1225, 1230, 1237, 1242, 1247, 1252, 1255, 1259, 1263, 1267, 1271,	65.3	104	108	105	114	109	118
Average Recovery		83.3	93.8	99.2	98.2	101	95.7	96.8
Standard Deviation		14.9	11.1	10.0	5.89	15.5	12.1	18.1
CV		17.8	11.8	10.1	6.00	15.3	12.6	18.7
Upper Control Limit		112	119	117	120	134	127	142
Upper Warning Limit		103	112	111	113	123	118	127
Lower Warning Limit		66.1	84.8	84.2	82.3	77.0	79.8	65.8
Lower Control Limit		56.9	77.9	77.5	74.7	65.6	70.4	50.6

Appendix 3. Quality Control Data. Table A-7. Quality Control, Triazine/herbicide Screen.

Study 248 continuing quality control for the triazine/herbicide screen

Extraction Date	Sample Numbers	Percent Recovery										
		Atrazine	Simazine	Diuron	Prometon	Bromacil	Hexazinone	Norflurazaon	DEA (Deethyl)	ACET (Deiso)	DACT	Propazine (Surrogate)
3/28/08	2040, 2045, 2054, 2059, 2063, 2068, 2076, 2080	103	96.5	91.0	95.5	106	97.5	105	99.5	102	96.5	94.0
Upper Control Limit		105	108	118	106	117	121	113	116	140	101	115
Upper Warning Limit		98.2	101	109	99.2	111	113	107	109	128	95.7	107
Lower Warning Limit		72.2	73.2	73.4	73.8	84.9	76.9	84.8	79.1	78.3	73.7	72.4
Lower Control Limit		65.8	66.3	64.4	67.4	78.4	68.1	79.2	71.7	66.0	68.2	63.8

Appendix 3. Quality Control Data. Table A-8. Quality Control, Thiram Screen.

Study 248 continuing quality control for thiram analysis

Extraction	Sample	Percent Recovery	
Date	Numbers	spike 1	spike 2
8/31/07	1015, 1020, 1025, 1030, 1039, 1044, 1061, 1066	81.7	89.5
9/14/07	1072, 1075, 1078, 1081, 1084, 1087, 1090, 1095	79.7	85.0
Average Recovery		80.7	87.3
Standard Deviation		1.41	3.18
CV		1.8	3.6
Upper Control Limit		131	131
Upper Warning Limit		116	116
Lower Warning Limit		58.0	58.0
Lower Control Limit		44.0	44.0

Appendix 3. Quality Control Data. Table A-9. Quality Control, Blind Spikes.

Blind Spike Data for Study 248

Extraction Date	Sample Number	Screen	Pesticide	Spike Level	Recovery	Percent recovery	Exceed CLs
10/19/07	2053	cb	carbaryl	0.25	0.194	77.6	yes
10/19/07	2052	cb	oxamyl	0.35	0.29	82.9	no
10/19/07	2050	cb	methomyl	0.20	0.19	95.0	no
10/18/07	2051	op	malathion	0.20	0.16	80.0	no
10/18/07	2049	op	chlorpyrifos	0.15	0.118	78.7	no
5/14/08	1233	dn	oxyfluorfen	0.25	0.24	96.0	no
5/14/08	1234	dn	oryzalin	0.35	0.307	87.7	no
4/18/08	1169	op	azinphos-methyl	0.25	0.287	115	no
			diazinon	150	152	101	no
4/18/08	1171	op	ethoprop	0.20	0.186	93.0	no
			fenamiphos	0.25	0.248	99.2	no
4/17/08	1170	cb	carbofuran	0.40	0.38	95.0	no
			aldicarb	0.25	0.238	95.2	no
4/17/08	1172	cb	carbofuran	0.30	0.247	82.3	*

diazinon=value in ppt
a CL=Control Limit; Upper CL (UCL), Lower CL (LCL).
*Initially not detected. The lab was notified and noticed carbofuran the system integrated the peak and misidentified the peak.

Study 239 Blind spike data for similar time period

Extraction Date	Sample Number	Screen	Pesticide	Spike Level	Recovery	Percent recovery	Exceed CLs
10/17/07	1300	TR	DACT	0.15	0.13	84.7	NO
10/17/07	1299	OP	Dimethoate	0.25	0.22	88.0	no
10/17/07	1297	OP	Diazinon	300	206	68.7	LCL