# San Joaquin River Chlorpyrifos and Diazinon 2014 Water Year Annual Monitoring Report

For Compliance with the Central Valley Regional Water Quality Control Board Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Diazinon and Chlorpyrifos Runoff into the Lower San Joaquin River (October 2005)

| | |
|---|---|
| Reporting period: | October 1, 2013 – September 30, 2014 |
| Report Submitted: | May 1, 2015 |

Prepared by the East San Joaquin Water Quality Coalition and the Westside San Joaquin River Watershed Coalition

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| | |
|---|---|
| AI | Active Ingredient |
| AMR | Annual Monitoring Report |
| CalPIP | California Pesticide Information Portal |
| CDEC | California Data Exchange Center |
| CEDEN | California Environmental Data Exchange Network |
| CIMIS | California Irrigation Management Information System |
| COC | Chain of Custody |
| CV RDC | Central Valley Regional Data Center |
| DO | Dissolved Oxygen |
| DWR | (California) Department of Water Resources |
| EPA | Environmental Protection Agency |
| ESJWQC | East San Joaquin Water Quality Coalition |
| FB | Field Blank |
| FD | Field Duplicate |
| ILRP | Irrigated Lands Regulatory Program |
| LCS | Laboratory Control Spike |
| LCSD | Laboratory Control Spike Duplicate |
| LSJR | Lower San Joaquin River |
| MDL | Minimum Detection Limit |
| MLJ-LLC | Michael L. Johnson, LLC |
| MPM | Management Plan Monitoring |
| MPUR | Management Plan Update Report |
| MRP | Monitoring and Reporting Program Order No R5-2008-0831 |
| MRPP | Monitoring and Reporting Program Plan |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| NA | Not Applicable |
| NONPJ | Non-project |
| OP | Organophosphorus compounds |
| PR | Percent Recovery |
| PUR | Pesticide Use Report |
| QA | Quality Assurance |
| QAPP | Quality Assurance Project Plan |
| QC | Quality Control |
| RL | Reporting Limit |
| RPD | Relative Percent Difference |
| SAMR | Semi-Annual Monitoring Report |
| S | Sum loading capacity |
| SC | Specific Conductance |
| SM | Standard Methods for the Examination of Water and Wastewater |
| SWAMP | Surface Water Ambient Monitoring Program |
| TIE | Toxicity Identification Evaluation |
| TMDL | Total Maximum Daily Load |
| USDA | United States Department of Agriculture |

| | |
|---|---|
| USGS | United States Geological Survey |
| Westside Coalition | Westside San Joaquin River Watershed Coalition |
| WQO | Water Quality Objective |
| WY | Water Year |

# LIST OF UNITS

| | |
|---|---|
| cm | centimeter |
| cfs | cubic feet per second |
| °C | degrees Celsius |
| L | Liter |
| µg | microgram |
| µmhos | micromhos |
| µS | microsiemens |
| mg | milligram |

# LIST OF TERMS

**Basin Plan** – Water Quality Control Plan for the Sacramento River and San Joaquin River Basins, Fourth Edition

**Basin Plan Amendment** – Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Diazinon and Chlorpyrifos Runoff into the Lower San Joaquin River (Final Staff Report October 2005)

**Coalitions** – East San Joaquin Water Quality Coalition and Westside San Joaquin River Watershed Coalition

**Drainage** – water that moves horizontally across the surface or vertically into the subsurface from land

**ESJWQC region** – The region within the Central Valley in which the East San Joaquin Water Quality Coalition is responsible for implementing the Irrigated Lands Regulatory Program (ILRP) on behalf of its members

**Not detected** – The concentration of a constituent within a sample is below the minimum detection limit

**Regional Board –** Central Valley Regional Water Quality Control Board

**Waterbody** – standing or flowing water of any size that may or may not move into a larger body of water, including lakes, reservoirs, ponds, rivers, streams, tributaries, creeks, sloughs, canals, laterals and drainage ditches

**Water Year –** the twelve month period from October through September, designated by the calendar year in which it ends and which includes nine of the twelve months

**Watershed** – The land area that drains into a stream; the watershed for a major river may encompass a number of smaller watersheds that ultimately combine at a common point. [Environmental Protection Agency (EPA) terms of environment: http://www.epa.gov/OCEPAterms/wterms.html)]

**Westside Coalition region** – The region within the Central Valley in which the Westside San Joaquin River Watershed Coalition is responsible for implementing the ILRP on behalf of its members

# EXECUTIVE SUMMARY

The Lower San Joaquin River (LSJR) is divided into seven subareas as described in the *Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Diazinon and Chlorpyrifos Runoff into the Lower San Joaquin River* (hereafter Basin Plan Amendment). The Central Valley Regional Water Quality Control Board (Regional Board) developed the Basin Plan Amendment (finalized in October 2005) to establish a Total Maximum Daily Load (TMDL) for the organophosphorus (OP) pesticides chlorpyrifos and diazinon in the lower reaches of the LSJR. As part of the Basin Plan Amendment, a surveillance and monitoring program is required. The East San Joaquin Water Quality Coalition (ESJWQC) and Westside San Joaquin River Watershed Coalition (Westside Coalition) jointly developed a monitoring strategy to comply with the chlorpyrifos and diazinon TMDL seven Monitoring Objectives:

1. Determine compliance with established water quality objectives (WQOs) and the loading capacity applicable to diazinon and chlorpyrifos in the LSJR.
2. Determine compliance with established load allocations for diazinon and chlorpyrifos.
3. Determine the degree of implementation of management practices to reduce off-site movement of diazinon and chlorpyrifos.
4. Determine the effectiveness of management practices and strategies to reduce off-site migration of diazinon and chlorpyrifos.
5. Determine whether alternatives to diazinon and chlorpyrifos are causing surface water quality impacts.
6. Determine whether the discharge causes or contributes to toxicity impairment due to additive or synergistic effects of multiple pollutants.
7. Demonstrate that management practices are achieving the lowest pesticide levels technically and economically achievable.

The monitoring design for the 2014 Water Year (WY) was the same as the monitoring design utilized during 2013. It involves monitoring six compliance points on the LSJR to determine load compliance and monitoring in tributaries to determine load allocation. During the 2014 WY, the ESJWQC monitored three of the six compliance points (San Joaquin River at Hills Ferry Road, San Joaquin River at the Maze Boulevard (Highway 132) Bridge, and San Joaquin River at the Airport Way Bridge near Vernalis) once in February and from May through September. The Westside Coalition monitored the other three compliance points (San Joaquin River at Sack Dam, San Joaquin River at Highway 165 near Stevinson, and San Joaquin River at Las Palmas Avenue near Patterson) monthly. Tributary monitoring occurred on a monthly basis based on each Coalition's approved monitoring plan. The ESJWQC and Westside Coalition assess monitoring results based on the monitoring objectives and report these results annually on May 1.

Water samples collected from the LSJR were analyzed for chlorpyrifos and diazinon. Habitat information and field data, including dissolved oxygen (DO), pH, specific conductance (SC), and water temperature, were collected at each site during each monitoring event. Discharge was obtained from the Department of Water Resources (DWR) gauge readings posted on the California Data Exchange Center (CDEC) Website. The ESJWQC and Westside Coalition created a decision tree to guide the Coalition's actions when a non-compliant load is detected in the LSJR.

During the 2014 WY there were no exceedances of the WQO for chlorpyrifos or diazinon at the LSJR compliance sites. However, there were three exceedances of the chlorpyrifos WQTL in samples collected on three different dates from ESJWQC tributaries (Northeast Bank, Bear Creek, and Tuolumne River subareas). Three sediment samples collected from ESJWQC tributary sites exhibited sufficient sediment toxicity to *Hyalella azteca* for follow-up pesticide analysis. All three samples contained chlorpyrifos and a number of other pyrethroid pesticides. In the Westside Coalition region, chlorpyrifos was detected in fourteen water samples (over four different monitoring events), all of which exceeded the load criteria. Diazinon was not detected in any sample during 2014 WY. Nine sediment samples from the Westside Coalition exhibited sufficient sediment toxicity for follow-up pesticide analysis. All those samples contained chlorpyrifos and pyrethroids. In all of the samples exhibiting toxicity within the ESJWQC and Westside Coalition region, there was no indication of synergistic effects. Potential alternative pesticides to chlorpyrifos and/or diazinon were detected in the ESJWQC and Westside Coalition regions, but it is unknown if the pesticides were used as an alternative or as part of a rotation to manage specific pests. The management practices implemented by growers in both Coalition regions are achieving the lowest pesticide levels technically and economically feasible.

To address water quality impairments, the ESJWQC developed a management plan for waterways and prioritized both the waterways and constituents detected in those waterways. The Coalition focuses on constituents likely originating from agriculture including pesticides and suspended solids. The outreach and education strategy is designed to inform growers of impairments in their watershed and provide information on effective management practices. A key component of the ESJWQC's management strategy is to hold individual member meetings to discuss farm management practices and water quality impairments. The Coalition considers the significant decrease in exceedances of the WQO for chlorpyrifos since outreach began an important step in demonstrating the effectiveness of its management plan strategy. By demonstrating water quality improvements, the ESJWQC has received approval to remove 38 constituents from 16 site subwatershed management plans. Of those 38 constituents approved for management plan completion, three management plans have been reinstated due to exceedances of WQTLs during recent monitoring.

The Westside Coalition is also in the process of evaluating management practice implementation and effectiveness. To accomplish this, the Westside Coalition utilizes its two-pronged strategy guided by the tiered approach described in the Westside Coalition Management Plan. Because there is likely an overlap in effect from practices to address a specific constituent, the Westside Coalition identified a prioritized, tiered list of actions to be taken to address impairments of the most immediate concern (highest tier constituents), and, presumably, those actions will also benefit lower prioritized (tiered) constituents. These actions are then employed under two concurrent approaches (prongs) to improve water quality within the region. The General Approach identifies and employs common, constituent-specific strategies that can be applied throughout the region. Focused Watershed Management Plans, the second prong, identify and employ a subwatershed specific approach to implement management practices and improve water quality.  Together, these strategies enable the Westside Coalition to adequately assess water quality and management practice implementation in its region.  Management practices assessments are reported in the Westside Coalition Semi-Annual Monitoring Reports (SAMRs).

Both Coalitions monitor chlorpyrifos, diazinon, and several other constituents as a part of tributary monitoring within their respective regions.  Results from ESJWQC and Westside Coalition tributary monitoring during the reporting period (October 2013 through September 2014) are discussed as they pertain to the TMDL Monitoring Objectives 1 through 7.  Additional details can be found in the ESJWQC Annual Report submitted May 1, 2015, and the Westside Coalition SAMRs submitted June 15, 2014 (September 2013 through February 2014 data) and November 30, 2014 (March 2014 through August 2014 data) and to be submitted in the June 15, 2015 Semi-Annual Monitoring Report (SAMR) (September 2014 data).

# INTRODUCTION

The Central Valley Regional Water Quality Control Board (Regional Board) developed the *Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Diazinon and Chlorpyrifos Runoff into the Lower San Joaquin River* (hereafter Basin Plan Amendment) to establish a Total Maximum Daily Load (TMDL) for the organophosphorus (OP) pesticides chlorpyrifos and diazinon in the lower reaches of the San Joaquin River (LSJR). This Basin Plan Amendment (finalized in October 2005) requires a surveillance and monitoring program to collect information necessary to assess compliance with seven monitoring objectives. Assessment of compliance with the Basin Plan Amendment is addressed at two levels: 1) compliance within the LSJR at six compliance points, and 2) compliance at tributaries within seven subareas that drain to the LSJR.

The LSJR and subareas include agricultural drainages monitored under the Irrigated Lands Regulatory Program (ILRP) by the East San Joaquin Water Quality Coalition (ESJWQC) and Westside San Joaquin River Watershed Coalition (Westside Coalition). Each Coalition conducts a monitoring program designed to assess water quality within their region. In addition, both Coalitions have developed management plans to address exceedances of the water quality objectives for chlorpyrifos and diazinon in specific subwatersheds. To address the Basin Plan Amendment's regulation of discharges of OP pesticides, the ESJWQC and the Westside Coalition jointly conducted monitoring at six compliance points in the LSJR during the 2014 Water Year (WY). This report summarizes the water quality monitoring conducted during the reporting period (October 2013 through September 2014) and compares those results with the water quality objectives (WQOs) outlined in the Basin Plan Amendment. This annual report also includes data to demonstrate how the Coalitions are complying with load allocations for the seven subareas that drain to the LSJR.

# MONITORING OBJECTIVES AND DESIGN

## MONITORING OBJECTIVES

The ESJWQC and Westside Coalition developed a monitoring strategy to comply with the following seven Monitoring Objectives for the chlorpyrifos and diazinon TMDL program:

1. Determine compliance with established WQOs and the loading capacity applicable to diazinon and chlorpyrifos in the LSJR.
2. Determine compliance with established load allocations for diazinon and chlorpyrifos.
3. Determine the degree of implementation of management practices to reduce off-site movement of diazinon and chlorpyrifos.
4. Determine the effectiveness of management practices and strategies to reduce off-site migration of diazinon and chlorpyrifos.
5. Determine whether alternatives to diazinon and chlorpyrifos are causing surface water quality impacts.
6. Determine whether the discharge causes or contributes to toxicity impairment due to additive or synergistic effects of multiple pollutants.
7. Demonstrate that management practices are achieving the lowest pesticide levels technically and economically achievable.

The chlorpyrifos and diazinon WQOs (Basin Plan, Fourth Edition; Page III-6.01) are used to determine compliance with the concentration based loading capacity for the LSJR and load allocations within the upstream tributaries (Table 1). The loading capacity at any location/time is exceeded if the measured concentration of either constituent in a sample collected from the LSJR exceeds their respective 4-day average (chronic) maximums WQOs listed in Table 1. The load allocation is exceeded if the measured concentration of either constituent in a sample collected from a tributary within one of the seven subareas exceeds the WQO. The chlorpyrifos and diazinon loading capacity or load allocation can also be exceeded if the combined concentrations of chlorpyrifos and diazinon cause the sum (Equation 1) to be greater than one, even if both concentrations are below the respective WQOs.

**Table 1. WQOs for chlorpyrifos and diazinon.**

| Pesticide | Maximum Concentration and Average Period |
|---|---|
| Chlorpyrifos | 0.025 µg/L ; 1-hour average (acute)<br>0.015 µg/L ; 4-day average (chronic)<br>Not to be exceeded more than once in a three year period. |
| Diazinon | 0.16 µg/L ; 1-hour average (acute)<br>0.10 µg/L ; 4-day average (chronic)<br>Not to be exceeded more than once in a three year period. |

**Equation 1. Formula used to calculate chlorpyrifos and diazinon loading capacity in LSJR and load allocation for waterways entering the River.**

$$S = \frac{C_D}{WQO_D} + \frac{C_C}{WQO_C} \leq 1.0$$

S = Sum loading capacity. A sum exceeding one indicates that the beneficial use might be impacted.

$C_D$ = diazinon concentration in µg/L

$WQO_D$ = diazinon water quality objective; 0.1 µg/L

$C_C$ = chlorpyrifos concentration in µg/L

$WQO_C$ = chlorpyrifos water quality objective; 0.015 µg/L

To assess compliance with Objective 1 (loading capacity), the ESJWQC and Westside Coalition conducted monitoring at six designated compliance sites on the LSJR during the 2014 WY. To assess compliance with Objectives 2 (load allocation) through 7, the Coalitions reviewed results from the LSJR monitoring and outreach conducted within their respective Coalition regions as a part of the ILRP. Table 2 is an overview of the ESJWQC and Westside Coalition actions and associated reporting documents utilized to assess each of the seven Monitoring Objectives. The Comparison with TMDL Objectives section of this report details each Coalition's strategy to assess compliance with each of the objectives and the outcomes of their strategies during the reporting period. Table 3 lists all the ESJWQC and Westside Coalition submittal dates for each of their reporting elements listed in Table 2; all relevant documents for each Coalition are listed below as reference.

### ESJWQC

- ESJWQC Monitoring and Reporting Program Plan (MRPP)
- ESJWQC Quality Assurance Project Plan (QAPP)
- ESJWQC Annual Monitoring Reports (AMR)
- ESJWQC Management Plan
- ESJWQC Management Plan Update Reports (MPUR)
- ESJWQC Annual Report

### Westside Coalition

- Westside Coalition Monitoring and Reporting Program Order No R5-2008-0831 (MRP)
- Westside Coalition Quality Assurance Project Plan (QAPP, approved January 7, 2014)
- Westside Coalition Semi-Annual Monitoring Reports (SAMR) with management plan status updates
- Westside Coalition Management Plan and Focused Watershed Plans

**Table 2. Monitoring objectives and actions by the ESJWQC and Westside Coalition for the control of diazinon and chlorpyrifos runoff into the lower San Joaquin River.**

| Objective Number | Coalition Actions | Location of Additional Information |
|---|---|---|
| 1 | • Monitor six compliance sites on the San Joaquin River.<br>• Assess monitoring results to determine compliance with chlorpyrifos and diazinon WQO and loading capacity. | This report |
| 2 | • Conduct representative monitoring of the Coalition region according to Monitoring Strategy.<br>• Assess monitoring results to determine compliance with chlorpyrifos and diazinon load allocations. | ESJWQC MRPP, MP, MPURs, and ARs<br>Westside Coalition MRP and MP |
| 3-4 | • Adhere to strategy put forth in the Management Plans.<br>• Assess and review results of management plan strategy to determine the degree of implementation and the effectiveness of management practices implemented to reduce off-site movement of chlorpyrifos and diazinon. | ESJWQC MP, MPURs, and ARs<br>Westside Coalition MP and SAMRs |
| 5 | • Conduct representative monitoring of Coalition region according to Monitoring Strategy.<br>• Assess monitoring results to determine whether alternatives to diazinon and chlorpyrifos are causing surface water impairments. | ESJWQC MRPP, MP, MPURs, and ARs<br>Westside Coalition MRP and SAMRs |
| 6 | • Conduct representative monitoring of Coalition region according to Monitoring Strategy.<br>• Assess monitoring results to assess toxicity and determine if agricultural discharge contributes to toxicity impairment due to additive or synergistic effects of multiple pollutants. | ESJWQC MRPP, MP, MPURs, and ARs<br>Westside Coalition MRP and SAMRs |
| 7 | • Assess the information collected to meet Objectives 3 and 4 to determine if management practices are achieving the lowest pesticides levels technically and economically achievable according to Management Plans. | ESJWQC MP, MPURs, and ARs<br>Westside Coalition MP and SAMRs |

**Table 3. The ESJWQC and Westside Coalition MRP Order/MRPP, QAPP, AMRs/SAMRs, Management Plans, and MPURs submission dates.**

| Document Name | Submission Date | Sampling Dates Addressed |
|---|---|---|
| ESJWQC MRPP | 8/25/2008 | NA |
| ESJWQC QAPP | 8/25/2008<br>2/15/2013 | NA |
| ESJWQC Management Plan | 9/30/2008 | August 2004 – December 2007 |
| ESJWQC SAMR /AMR | 6/30/2008<br>3/1/2009<br>3/1/2010<br>3/1/2011<br>3/1/2012<br>3/1/2013 | October 2007 – December 2012 |
| ESJWQC MPUR | 4/1/2010<br>4/1/2011<br>4/1/2012<br>4/1/2013 | October 2008 – December 2012 |
| ESJWQC Annual Report | 5/1/2014<br>5/1/2015 | January 2013 – September 2014 |
| Westside Coalition MRP<br>Order No.R5-2008-0831 | 9/15/2008 | NA |
| Westside Coalition Management Plan and Focused Management Plan | 10/23/2008 | March 2009 to Present |
| Westside Coalition QAPP | 1/07/2014 | NA |
| Westside Coalition SAMR | 6/15/2009<br>11/30/2009<br>6/15/2010<br>11/30/2010<br>6/15/2011<br>11/30/2011<br>6/15/2012<br>11/30/2012<br>6/15/2013<br>11/30/2013<br>6/15/2014<br>11/30/2014 | September 2008 – August 2014 |

NA – Not Applicable. The document addresses and is applicable to the entire project, not a subset of sampling dates.

## MONITORING DESIGN

Monitoring is designed to characterize the concentrations of chlorpyrifos and diazinon in the LSJR. The Regional Board determined that monitoring for the chlorpyrifos and diazinon TMDL in the six LSJR compliance points should focus on periods of peak applications, and months when chlorpyrifos and diazinon have been detected above the WQTL in the LSJR or its tributaries. The Coalitions evaluated chlorpyrifos and diazinon use over time using Pesticide Use Report (PUR) data from the California Pesticide Information Portal (CalPIP). CalPIP data are available through 2012. The Coalitions obtained PUR data through September 2014 directly from the counties in the two Coalition regions. PUR data are considered preliminary until received and posted on CalPIP. The peak period of diazinon use has changed over time (Figure 1 and Figure 2). Before 2008 the peak period for diazinon was between December and February. Since 2008, January applications of diazinon decreased substantially, and applications between March and June have become relatively more common.

**Figure 1. Pounds of diazinon applied in the lower San Joaquin River watershed from 2004 through September 2014.**

PUR data after 2012 are considered preliminary. PUR data are incomplete through 2014.

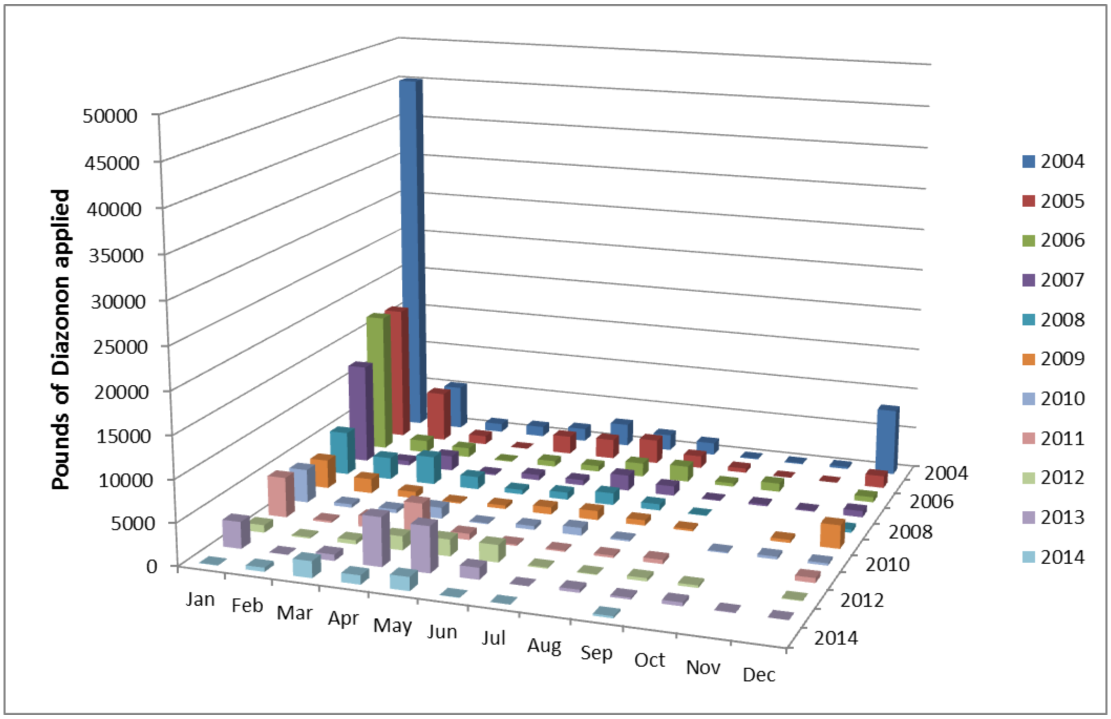
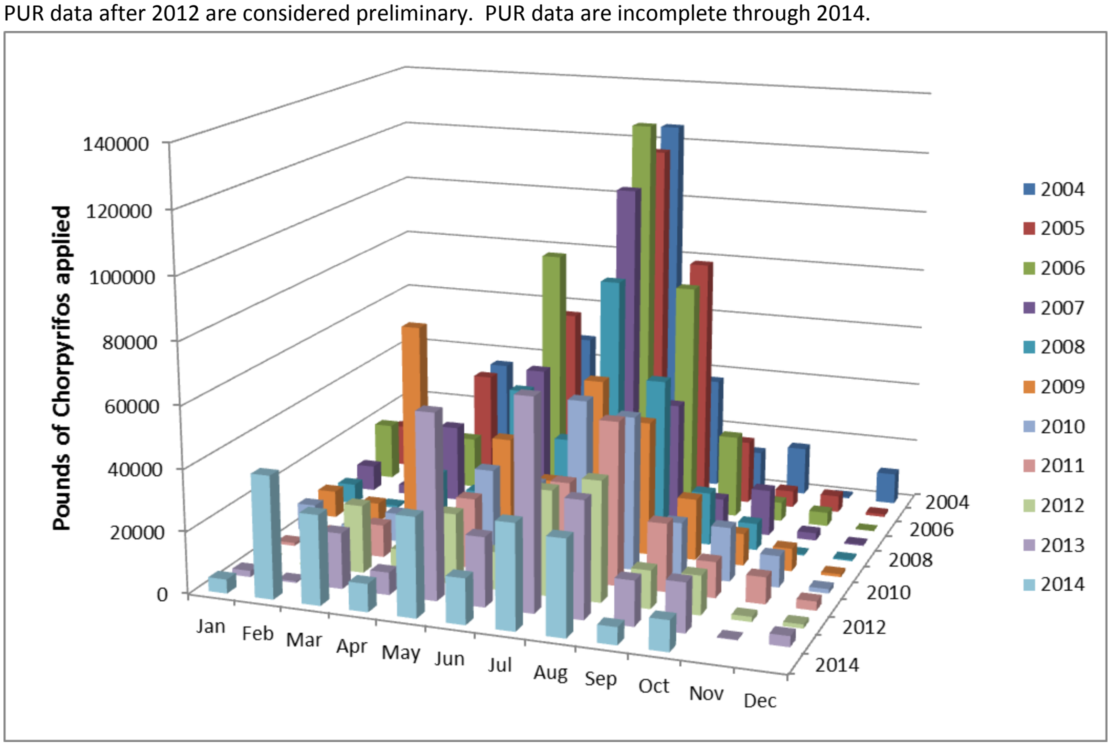



**Figure 2. Pounds of chlorpyrifos applied in the lower San Joaquin River watershed from 2004 through October 2014.**

PUR data after 2012 are considered preliminary. PUR data are incomplete through 2014.



The monitoring design for the 2014 WY was similar to the monitoring design utilized during 2013. During the 2014 WY, the ESJWQC monitored three of the six compliance points (San Joaquin River at Hills Ferry Road, San Joaquin River at the Maze Boulevard (Highway 132) Bridge, and San Joaquin River at the Airport Way Bridge near Vernalis) once in February and from May through September. The Westside Coalition monitored the other three compliance points (San Joaquin River at Sack Dam, San Joaquin River at Highway 165 near Stevinson, and San Joaquin River at Las Palmas Avenue near Patterson) on a monthly basis. San Joaquin River TMDL monitoring, ESJWQC tributary monitoring, and Westside Coalition tributary monitoring are typically scheduled for the second Tuesday of the month and are adjusted for storm events as necessary.

The Coalitions report chlorpyrifos and diazinon TMDL monitoring results from the previous WY annually on May 1. This report includes a complete analysis and discussion of all monitoring data collected from October 2013 through September 2014. If a non-compliant load is detected in the LSJR, the Coalitions utilize the decision tree in Figure 3 to guide the Coalition's actions to address any water quality impairments in a timely and efficient manner.

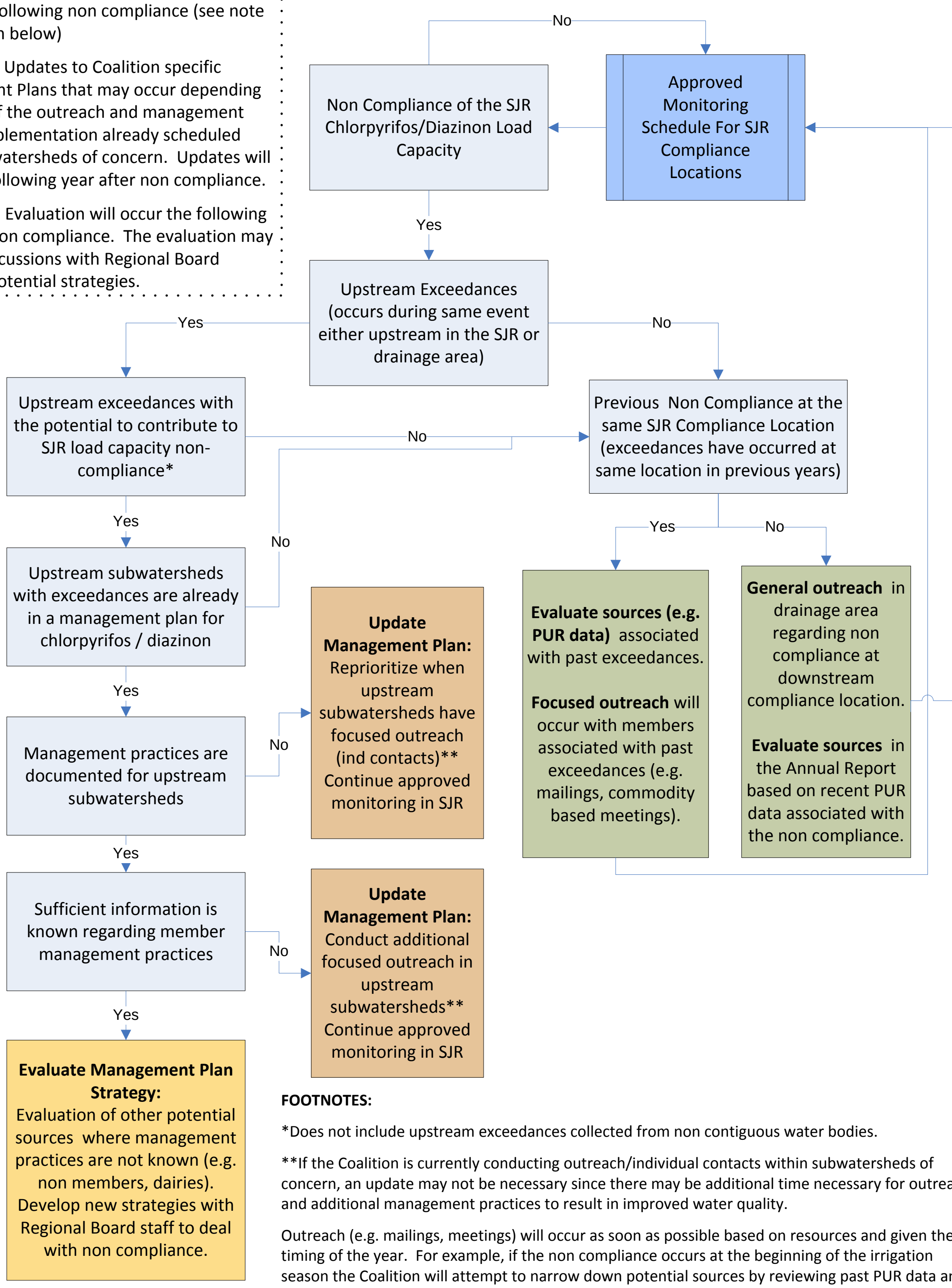
**Figure 3. Chlorpyrifos and diazinon San Joaquin River TMDL decision tree for compliance monitoring and actions resulting from non-compliance of the San Joaquin River load capacity.**

**COLOR KEY TO ACTION BOXES:**

**Green box:** Actions that will occur within the same year following non compliance (see note on Outreach below)

**Brown box:** Updates to Coalition specific Management Plans that may occur depending on timing of the outreach and management practice implementation already scheduled within subwatersheds of concern. Updates will occur the following year after non compliance.

**Yellow box:** Evaluation will occur the following year after non compliance. The evaluation may result in discussions with Regional Board regarding potential strategies.




**FOOTNOTES:**

*Does not include upstream exceedances collected from non contiguous water bodies.

**If the Coalition is currently conducting outreach/individual contacts within subwatersheds of concern, an update may not be necessary since there may be additional time necessary for outreach and additional management practices to result in improved water quality.

Outreach (e.g. mailings, meetings) will occur as soon as possible based on resources and given the timing of the year. For example, if the non compliance occurs at the beginning of the irrigation season the Coalition will attempt to narrow down potential sources by reviewing past PUR data and inform those growers of the non compliance with the goal of improving SJR water quality during the rest of the high use period.

## Constituents Monitored

Water samples collected from the LSJR for the TMDL compliance program were analyzed for chlorpyrifos and diazinon. Habitat information and field parameter measurements, including dissolved oxygen (DO), pH, specific conductance (SC), and water temperature, were collected at each site during each monitoring event. Discharge calculations were obtained from Department of Water Resources (DWR) and/or United Stated Geological Survey (USGS) gauge readings posted on the CDEC website. Samples collected by the Westside Coalition during monthly monitoring of the LSJR compliance points were also analyzed for additional constituents for compliance with the Coalition's WDR as described in the Westside Coalition MRP. Results from ILRP monitoring (of both additional constituents analyzed in the LSJR and tributary monitoring) are reported in the Westside SAMRs and the ESJWQC Annual Report. The sampling procedures and analytical methods are further discussed in the Sampling and Analytical Methods section.

# SAMPLE SITE DESCRIPTIONS

The Basin Plan Amendment requires the Coalitions to assess compliance with WQOs and loading capacity for, at a minimum, six designated water quality compliance points on the LSJR (Table 5). The compliance points (listed from upstream to downstream) are:

- San Joaquin River at Sack Dam,
- San Joaquin River at Highway 165 near Stevinson (USGS 11260815),
- San Joaquin River at Hills Ferry Road,
- San Joaquin River at Las Palmas Avenue near Patterson (USGS 11274570),
- San Joaquin River at the Maze Boulevard (Highway 132) Bridge (USGS 11290500), and
- San Joaquin River at the Airport Way Bridge near Vernalis (USGS 11303500).

These compliance points are not named consistently in all sources used to prepare this report; hence Table 4 provides a crosswalk of the sites as they are named in other data sources.

Additionally, the Basin Plan Amendment specifies that compliance with load allocations for nonpoint source discharges into the LSJR must be determined for the following five groups of tributary subareas:

- Bear Creek and Fresno-Chowchilla subareas
- Stevinson and Grassland subareas,
- Turlock, Merced, and Greater Orestimba subareas,
- Tuolumne River, Northeast Bank, and Westside Creek subareas, and
- Stanislaus River, North Stanislaus, and Vernalis North subareas.

Monitoring at five of the six compliance points on the LSJR assesses drainage from these subareas (Table 4). Although none of the tributary subareas drain into San Joaquin River at Sack Dam, there is the potential for indirect drainage and spray drift to occur in a small area next to the river upstream of this monitoring location (Figure 4). During the 2014 WY, the Coalitions collected samples from 38 tributaries (19 in ESJWQC region and 19[1] in Westside Coalition region). The LSJR compliance sites and the associated tributaries that drain to each compliance point are listed in Table 5.

Results from ESJWQC and Westside Coalition tributary monitoring are discussed in this report as they pertain to LSJR monitoring. Details of ESJWQC 2014 WY tributary monitoring locations can be found in the ESJWQC Annual Report submitted May 1, 2015. Westside Coalition tributary monitoring locations from October 2013 through August 2014 were reported in the Westside Coalition SAMRs submitted June 15 and November 30, 2014. Westside Coalition tributary monitoring locations from September 2014 will be reported in the Westside Coalition SAMR to be submitted June 15, 2015.

[1] In April 2014 the Turner Slough at Edminster Road monitoring site was removed from the Westside Coalition's monitoring program, reducing the total number of monitoring sites to 37 tributaries.

**Table 4. San Joaquin River chlorpyrifos and diazinon compliance sites designated in the Basin Plan Amendment, subareas that drain to those sites, and a crosswalk of the site names as used in the appendices and electronic files of this report.**
Listed in order from upstream to downstream.

| Site Name | Subareas | USGS ID No. | Appendices Site Name | Appendices Code | CEDEN Site Name | CEDEN Code | Latitude | Longitude | Coalition |
|---|---|---|---|---|---|---|---|---|---|
| San Joaquin River at Sack Dam | NA | NA | LSJR @ Sack Dam | SJRSD | LSJR @ Sack Dam | 541MAD007 | 36.98361 | -120.50028 | Westside |
| San Joaquin River at Highway 165 near Stevinson | Bear Creek, Fresno-Chowchilla | 11260815 | LSJR @ Hwy 165 | SJRLA | San Joaquin River at Lander Ave | 541MER522 | 37.29528 | -120.85028 | Westside |
| San Joaquin River at Hills Ferry Road | Stevinson, Grassland | NA | LSJR @ Hills Ferry | 541STC512 | LSJR @ Hills Ferry | 541STC512 | 37.34250 | -120.97722 | ESJWQC |
| San Joaquin River at Las Palmas Avenue near Patterson | Turlock, Merced, Greater Orestimba | 11274570 | LSJR @ Las Palmas Ave | SJRPP | LSJR @ Patterson | 541STC5071 | 37.49778 | -121.08167 | ESJWQC |
| | | | | | San Joaquin River at PID Pumps | 541XSJRPP | 37.49720 | -121.08280 | Westside |
| San Joaquin River at the Maze Boulevard (Highway 132) Bridge | Tuolumne River, Northeast Bank, Westside Creek | 11290500 | LSJR @ Maze Blvd | 541STC510 | San Joaquin River above Maze Boulevard | 541STC510 | 37.64194 | -121.22778 | ESJWQC |
| San Joaquin River at the Airport Way Bridge near Vernalis | Stanislaus River, North Stanislaus, Vernalis North | 11303500 | LSJR @ Airport Way | 541SJC501 | San Joaquin River at Airport Way near Vernalis | 541SJC501 | 37.67556 | -121.26417 | ESJWQC |

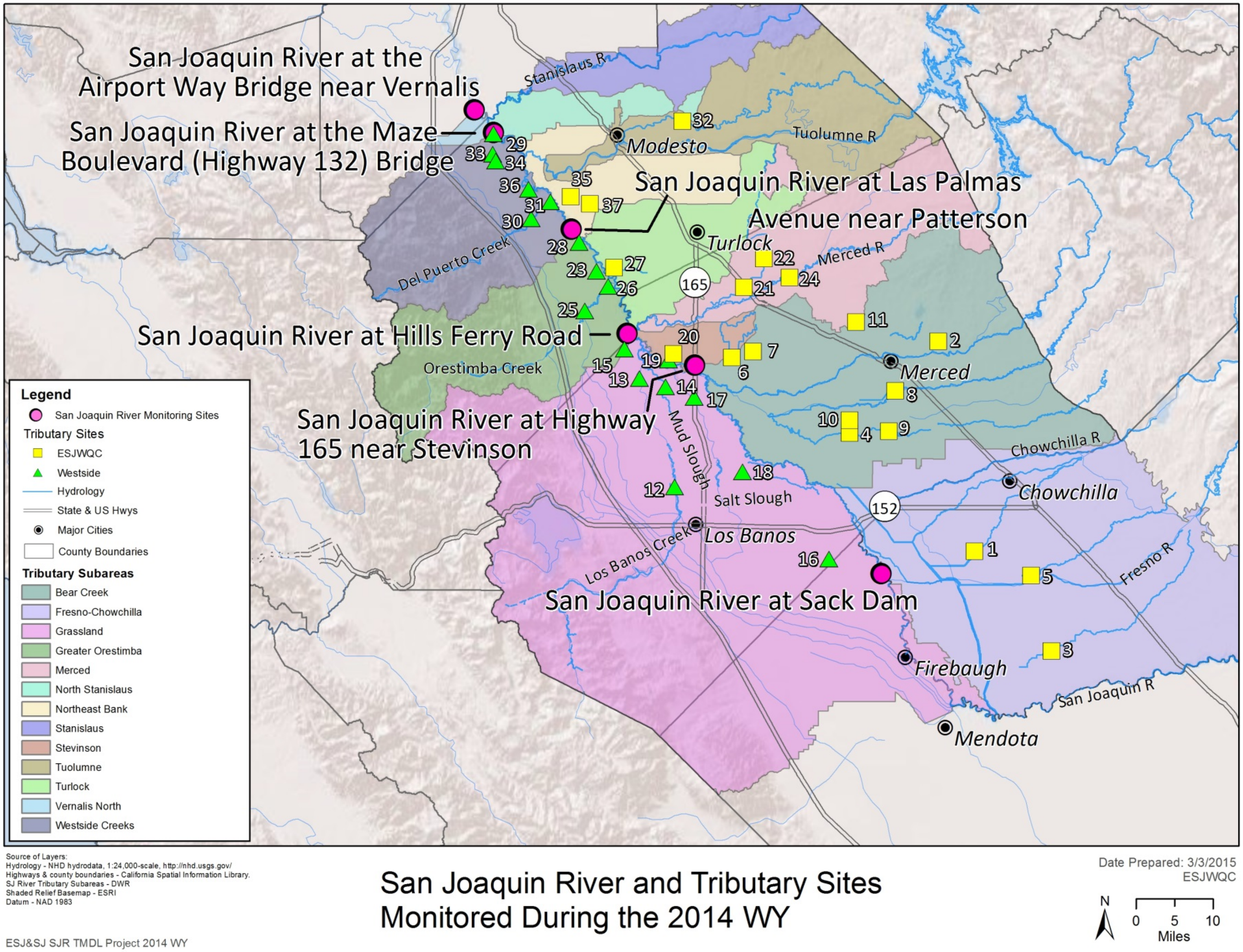
NA – Not Applicable. This station is not identified as having drainage from subareas as listed in the Basin Plan amendment. However, this report identifies some drainage possible along the river in the Fresno-Chowchilla and Grassland subareas (see Figure 4).
CEDEN – California Environmental Data Exchange Network

**Table 5. The ESJWQC and Westside Coalition upstream tributary monitoring during 2014 WY.**
Organized by nearest downstream LSJR monitoring location.

| Coalition | Map Key | Site Name | Station Code | Latitude | Longitude | LSJR Downstream Monitoring Location |
|---|---|---|---|---|---|---|
| ESJWQC | 1 | Berenda Slough along Ave 18 1/2 | 545XBSAAE | 37.0182 | -120.3265 | San Joaquin River at Highway 165 near Stevinson |
| ESJWQC | 2 | Black Rascal Creek @ Yosemite Rd | 535BRCAYR | 37.332 | -120.39435 | |
| ESJWQC | 3 | Cottonwood Creek @ Rd 20 | 545XCCART | 36.8686 | -120.1818 | |
| ESJWQC | 4 | Deadman Creek @ Gurr Rd | 535XDCAGR | 37.1951 | -120.56147 | |
| ESJWQC | 5 | Dry Creek @ Rd 18 | 545XDCARE | 36.9818 | -120.22056 | |
| ESJWQC | 6 | Howard Lateral @ Hwy 140 | 535XHLAHO | 37.3079 | -120.782 | |
| ESJWQC | 7 | Livingston Drain @ Robin Ave | 535XLDARA | 37.3169 | -120.74229 | |
| ESJWQC | 8 | Miles Creek @ Reilly Rd | 535XMCARR | 37.2583 | -120.47524 | |
| ESJWQC | 9 | Deadman Creek @ Hwy 59 | 535DMCAHF | 37.1976 | -120.48763 | |
| ESJWQC | 10 | Duck Slough @ Gurr Rd | 535XDSAGR | 37.2141 | -120.56126 | |
| ESJWQC | 11 | Canal Creek @ West Bellevue Rd | 535CCAWBR | 37.3609 | -120.5494 | San Joaquin River at Hills Ferry Road |
| Westside | 12 | Los Banos Creek at China Camp Road | 541XLBCCC | 37.1145 | -120.8895 | |
| Westside | 13 | Los Banos Creek at Hwy 140 | 541MER554 | 37.2762 | -120.9555 | |
| Westside | 14 | Mud Slough Upstream of San Luis Drain | 541XMSUSL | 37.2639 | -120.90611 | |
| Westside | 16 | Poso Slough at Indiana Ave | 541XPSAIA | 37.0062 | -120.5996 | |
| Westside | 17 | Salt Slough at Lander Ave | 541MER531 | 37.2479 | -120.8522 | |
| Westside | 18 | Salt Slough at Sand Dam | 541XSSASD | 37.1366 | -120.7619 | |
| Westside | 19 | Turner Slough at Edminster Road | 541XTSAER | 37.3041 | -120.9008 | |
| ESJWQC | 20 | Unnamed Drain @ Hwy 140 | 535XUDAHO | 37.3133 | -120.89218 | |
| ESJWQC | 21 | Highline Canal @ Hwy 99 | 535XHCHNN | 37.4125 | -120.75941 | San Joaquin River at Las Palmas Avenue near Patterson |
| ESJWQC | 22 | Highline Canal @ Lombardy Rd | 535XHCALR | 37.4555 | -120.72181 | |
| Westside | 23 | Marshall Road Drain near River Road | 541XMRDRR | 37.4363 | -121.0362 | |
| ESJWQC | 24 | Merced River @ Santa Fe | 535XMRSFD | 37.4271 | -120.67353 | |
| Westside | 15 | Newman Wasteway near Hills Ferry Road | 541XNWHFR | 37.3204 | -120.9834 | |
| Westside | 25 | Orestimba Creek at Hwy 33 | 541STC519 | 37.3772 | -121.05812 | |
| Westside | 26 | Orestimba Creek at River Road | 541STC019 | 37.4139 | -121.01417 | |
| ESJWQC | 27 | Prairie Flower Drain @ Crows Landing Rd | 535XPFDCL | 37.4419 | -121.00331 | |
| Westside | 28 | Ramona Lake near Fig Avenue | 541XROLFA | 37.4788 | -121.0684 | |
| Westside | 29 | Blewett Drain at Highway 132 | 541XVH132 | 37.6405 | -121.2296 | San Joaquin River at the Maze Boulevard (Highway 132) Bridge |
| Westside | 30 | Del Puerto Creek at Hwy 33 | 541XDPCHW | 37.5142 | -121.15875 | |
| Westside | 31 | Del Puerto Creek near Cox Road | 541XDPCCR | 37.5394 | -121.1221 | |
| ESJWQC | 32 | Dry Creek @ Wellsford Rd | 535XDCAWR | 37.66 | -120.87526 | |
| Westside | 33 | Hospital Creek at River Road | 541XHCARR | 37.6105 | -121.23078 | |
| Westside | 34 | Ingram Creek at River Road | 541STC040 | 37.6002 | -121.22506 | |
| ESJWQC | 35 | Lateral 2 1/2 near Keyes Rd | 535LTHNKR | 37.5477 | -121.08509 | |
| Westside | 36 | Westley Wasteway near Cox Road | 541XWWNCR | 37.5582 | -121.1637 | |
| ESJWQC | 37 | Westport Drain @ Vivian Rd | 535XWDAVR | 37.5368 | -121.04861 | |

ESJWQC – East San Joaquin Water Quality Coalition
Map Key – refer to Figure 4.

**Figure 4. San Joaquin River tributary subareas, chlorpyrifos and diazinon TMDL compliance sites (circles), and tributary sites monitored by ESJWQC (squares) and Westside Coalition (triangles) during the 2014 WY.**
Refer to Table 5 for tributary site names.



## LAND USE ANALYSIS OF SUBAREAS

The Coalitions reviewed land use from the United States Department of Agriculture (USDA) cropland data from 2014 to better characterize the upstream drainage area for each of the LSJR monitoring compliance points (Table 6 and Table 7). The entire drainage area is estimated to include little over three million acres. Agriculture within the LSJR basin includes orchards, pasture, rice, row crops, vineyards, and nursery/berries. Row crops and orchards cover the most area and together account for about 25% of estimated acreage.

Table 7 identifies the crop types with the largest acreage within the immediate upstream drainage to each monitoring site on the LSJR. Almonds and alfalfa are among the three top crops by acreage throughout the region. In the upstream portions of the LSJR, grapes occupy the larges acreage, whereas various row crops and orchards are more common downstream (Table 7). Corn, cotton, oats, tomatoes, and winter wheat are also all very common in the LSJR drainage area.

Land use maps for all ESJWQC upstream tributaries can be found in the 2015 Annual Report (Appendix VII). A discussion of land use within the Westside Coalition is located in the November 30, 2014 SAMR (Page 13).

**Table 6. Estimated land use acreage upstream of the San Joaquin River compliance points.**

| Land Use | San Joaquin River at Sack Dam | San Joaquin River at Highway 165 near Stevinson | San Joaquin River at Hills Ferry Road | San Joaquin River at Las Palmas Avenue near Patterson | San Joaquin River at the Maze Blvd. (Highway 132) Bridge | San Joaquin River at the Airport Way Bridge |
|---|---|---|---|---|---|---|
| Native | 13,400 | 323,800 | 494,500 | 195,500 | 227,600 | 35,200 |
| Orchard | 8,300 | 160,200 | 25,900 | 94,500 | 87,300 | 33,900 |
| Field Crops | 13,000 | 114,300 | 161,600 | 76,300 | 30,000 | 12,000 |
| Pasture | 9,000 | 103,100 | 80,300 | 43,500 | 30,400 | 28,300 |
| Outside Study Area | 8,400 | 91,700 | 91,300 | 800 | 40,900 | 0 |
| Developed | 3,200 | 51,300 | 15,800 | 22,600 | 35,800 | 27,600 |
| Vineyard | 15,100 | 97,400 | 2,600 | 12,500 | 6,200 | 2,200 |
| Truck/Nursery/Berry | 1,200 | 28,000 | 59,600 | 12,600 | 12,400 | 3,900 |
| Grain & Hay | 4,000 | 38,700 | 13,200 | 4,200 | 5,300 | 1,800 |
| Open Water | 3,100 | 4,900 | 22,100 | 2,400 | 9,700 | 3,000 |
| Semi-agricultural | 400 | 13,000 | 5,500 | 12,800 | 7,300 | 4,900 |
| Fallow/Idle Cropland | 1,000 | 7,300 | 3,500 | 1,800 | 2,700 | 800 |
| Rice | 100 | 3,600 | 7,800 | 0 | 1,200 | 600 |
| **Total Subwatershed Acres** | **80,200** | **1,037,300** | **983,700** | **479,500** | **496,800** | **154,200** |
| **Total Cumulative Acres** | **80,200** | **1,117,500** | **2,101,200** | **2,580,700** | **3,077,500** | **3,231,700** |

Source: Acreages estimated from 2014 USDA data.

**Table 7. Top ten commodities (in order of largest to smallest acreage) upstream of each San Joaquin River sampling site for 2014 WY.**

| San Joaquin River at Sack Dam | San Joaquin River at Highway 165 near Stevinson | San Joaquin River at Hills Ferry Road | San Joaquin River at Las Palmas Avenue near Patterson | San Joaquin River at the Maze Boulevard (Highway 132) Bridge | San Joaquin River at the Airport Way Bridge near Vernalis |
|---|---|---|---|---|---|
| Cotton | Almonds | Cotton | Almonds | Almonds | Almonds |
| Alfalfa | Alfalfa | Alfalfa | Corn | Corn | Corn |
| Almonds | Corn | Tomatoes | Alfalfa | Walnuts | Walnuts |
| Pistachios | Cotton | Corn | Beans | Alfalfa | Alfalfa |
| Trees & Shrubs | Pistachios | Melons, Squash and Cucumbers | Walnuts | Tomatoes | Peaches and Nectarines |
| Tomatoes | Tomatoes | Almonds | Tomatoes | Peaches and Nectarines | Melons, Squash and Cucumbers |
| Oranges | Figs | Sugar Beets | Peaches and Nectarines | Beans | Beans |
| Corn | Sweet Potatoes | Beans | Sweet Potatoes | Apricots | Flowers, Nursery, Christmas Tree Farms |
| Walnuts | Peaches and Nectarines | Sudan | Poultry Farms | Sudan | Tomatoes |
| Sudan | Oranges | Walnuts | Melons, Squash and Cucumbers | Cherries | Apples |

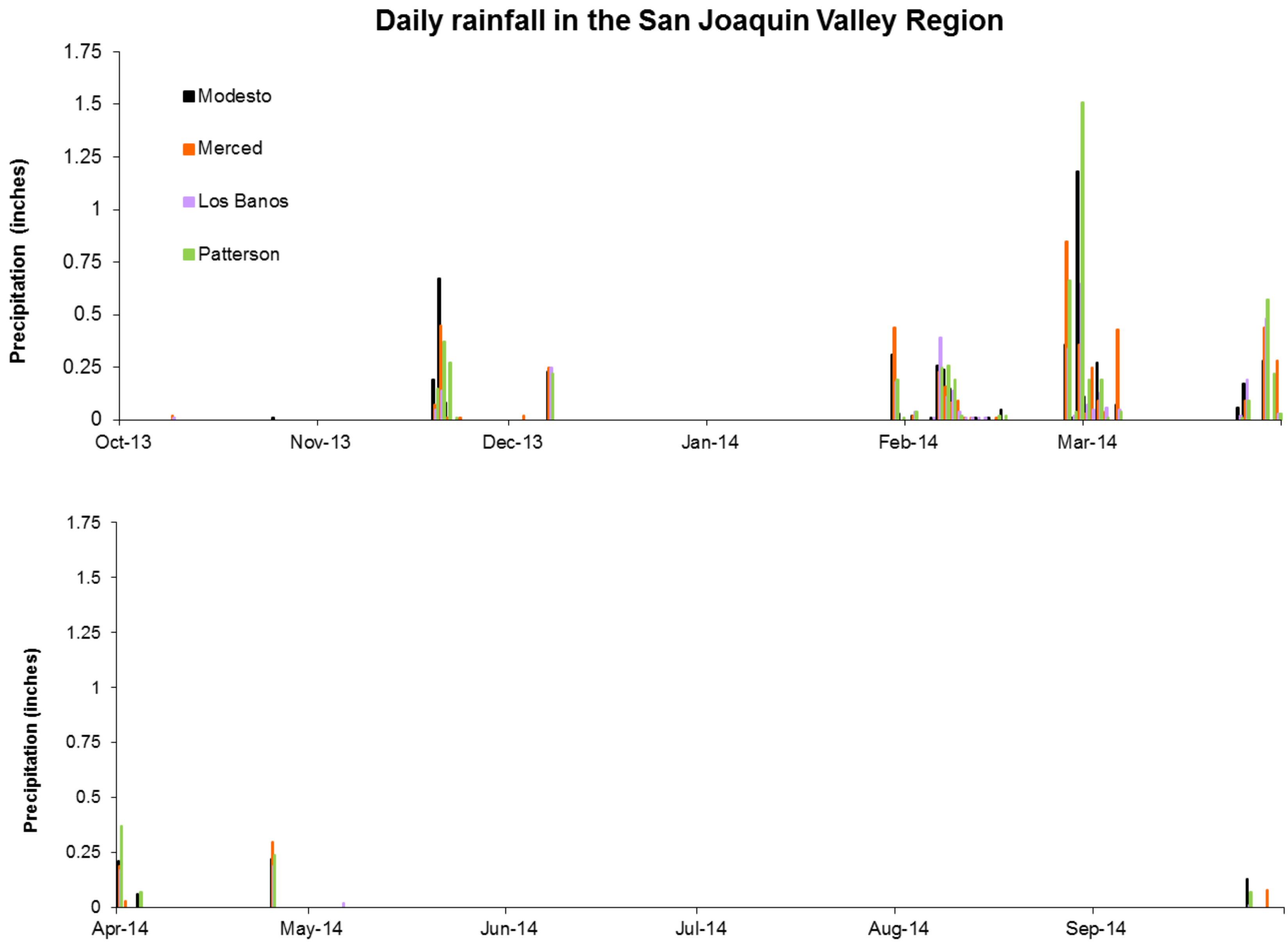
Source: Acreages estimated from 2014 USDA data.

## RAINFALL RECORDS

Daily rainfall records are provided for four locations within the ESJWQC and Westside Coalition regions: Modesto, Merced, Los Banos, and Patterson. Precipitation records were retrieved from the California Irrigation Management Information System (CIMIS). The 2014 WY included few significant storms and has been classified as a critically dry year. The first measurable precipitation did not occur until late November 2013, with a handful of periodic storms occurring throughout the winter months interrupted by dry periods (Figure 5).

From October 2013 through September 2014, a few rainfall events produced enough runoff across the LSJR drainage area for storm sample collection. The ESJWQC collected storm samples at tributary sites on February 10 and March 3; and at the three LSJR compliance locations on February 11, 2013. Storm samples were collected in the Westside Coalition region at both tributary and TMDL compliance locations on February 10 and March 3, 2014.

**Figure 5. Precipitation history from October 1, 2013 through September 30, 2014 at three CIMIS stations in Modesto, Merced, Los Banos, and Patterson, CA.**



# SAMPLING AND ANALYTICAL METHODS

Information on sample collection containers, volumes, preservations and holding times is provided in Table 8 and field instrument information in Table 9. Site-specific discharge methods are described in Table 10, and analytical methods and reporting limits (RL) are provided in Table 11.

The ESJWQC sampled the San Joaquin River at the Airport Way Bridge near Vernalis, San Joaquin River at Hills Ferry Road, and San Joaquin River at the Maze Boulevard (Highway 132) Bridge according to field sampling procedures outlined in the standard operating procedures (SOPs) provided in the ESJWQC QAPP (approval on February 23, 2011, Appendices I-X, Pages 67-73). The ESJWQC field samplers collected integrated river water samples using a three liter polytetrafluoroethylene (PFTE) bottle from a bridge crossing. Amber glass bottles were filled from the integrated sample collected in the PFTE bottle.

The Westside Coalition sampled the San Joaquin River at Highway 165 near Stevinson, San Joaquin River at Las Palmas Avenue near Patterson, and San Joaquin River at Sack Dam according to the field sampling procedures and methods described in the Westside Coalition QAPP (approved January 7, 2014, Pages 24-29). The Westside Coalition field samplers collected sample water directly into amber glass bottles from the LSJR bank at each site. Due to safety concerns, Westside Coalition samplers do not perform bridge sampling.

The complete field sampling SOPs for the Westside Coalition and the ESJWQC were included in Appendix I of the San Joaquin River Chlorpyrifos and Diazinon 2010 AMR (submitted October 31, 2010); no deviations from these procedures occurred during monitoring for the 2014 WY. Samples from both Coalitions were analyzed for chlorpyrifos and diazinon by APPL Inc. according to the Environmental Protection Agency (EPA) 8141A method. The SOPs for the EPA 8141A method were submitted with both Coalitions' QAPPs as Appendix XII to the ESJWQC QAPP (Pages 143-159) and with the Westside Coalition QAPP (Appendix D, Attachment 7).

In addition to LSJR monitoring data, both Coalitions use tributary monitoring data, where applicable, to assess compliance with the TMDL program. The ESJWQC performed field sampling procedures and methods, including discharge measurements at tributaries as outlined in the SOPs provided with the ESJWQC QAPP (Appendices I-X, Pages 67-73). Any deviations from these procedures are documented in the Precision, Accuracy, and Completeness section of this report.

The Westside Coalition conducted field sampling procedures and methods, including discharge measurements, at tributaries as described in the Westside Coalition QAPP (Appendix B); no deviations from these procedures occurred during the monitoring. The laboratory procedures used to analyze samples collected from ESJWQC tributaries are contained in Appendices XI-XXXIII of the ESJWQC QAPP (Pages 108-394). The laboratory procedures used to analyze samples collected from Westside Coalition tributaries can be found in the Westside Coalition QAPP (Appendix D, Attachment 7).

**Table 8. Sampling procedures.**

| Analytical Parameter | Sample Volume[1] | Sample Container | Initial Preservation/Holding Requirements | Holding Time[2] |
|---|---|---|---|---|
| Organophosphates | 1 L | 1x L Amber Glass | Store at <6°C; extract within 7 days | 40 Days |

[1] Additional volume is collected at designated quality control (QC) sites.
[2] Holding time after initial preservation or extraction.

**Table 9. Field parameters and instruments used to collect measurements.**

| Parameter | Instrument |
|---|---|
| Dissolved Oxygen | YSI Model 556 and Professional Plus |
| Temperature | YSI Model 556 and Professional Plus |
| pH | YSI Model 556 and Professional Plus |
| Specific Conductance | YSI Model 556 and Professional Plus |
| Discharge | DWR or USGS Gauge/CDEC Website |

DWR – California Department of Water Resource
USGS – United States Geological Survey
CDEC – California Data Exchange Center

**Table 10. Site specific discharge methods.**

| Responsible Coalition | Site Name | Discharge Method | Gauge |
|---|---|---|---|
| Westside | San Joaquin River at Sack Dam | DWR Gauge | CDEC San Joaquin River near Dos Palos (SDP) |
| Westside | San Joaquin River at Highway 165 near Stevinson | DWR Gauge | CDEC San Joaquin River near Stevinson (SJS) |
| ESJWQC | San Joaquin River at Hills Ferry Road | USGS and DWR Gauge | CDEC San Joaquin River Near Newman (NEW) |
| Westside | San Joaquin River at Las Palmas Avenue near Patterson | DWR Gauge | CDEC San Joaquin River near Patterson (SJP) |
| ESJWQC | San Joaquin River at the Maze Boulevard (Highway 132) Bridge | DWR Gauge | CDEC San Joaquin River at Maze Rd Bridge (MRB) |
| ESJWQC | San Joaquin River at the Airport Way Bridge near Vernalis | USGS and DWR Gauge | CDEC San Joaquin River near Vernalis (VNS) |

**Table 11. Field and laboratory analytical methods.**

| Constituent | Matrix | Analyzing Lab | RL | MDL | Analytical Method |
|---|---|---|---|---|---|
| **Physical Parameters** | | | | | |
| pH | Water | Field Measure | 0.1 pH units | NA | EPA 150.1 |
| Specific Conductance | Water | Field Measure | 100 µmhos/cm | NA | EPA 120.1 |
| Dissolved Oxygen | Water | Field Measure | 0.1 mg/L | NA | SM 4500-O |
| Temperature | Water | Field Measure | 0.1 °C | NA | SM 2550 |
| **Organophosphates** | | | | | |
| Chlorpyrifos | Water | APPL Inc | 0.015 µg/L | 0.0026 µg/L | EPA 8141A |
| Diazinon | Water | APPL Inc | 0.02 µg/L | 0.004 µg/L | EPA 8141A |

MDL – Minimum Detection Limit
NA – Not Applicable
EPA - Environmental Protection Agency
SM – Standard Method

# MONITORING RESULTS

All monitoring data collected from October 2013 through September 2014 is found in Appendices I-VI. Appendices, along with associated laboratory reports (as pdfs and electronic files) are submitted in a CD along with this report.

Appendix I contains copies of the original Chain of Custody (COC) forms. The COCs document the timing of sample collection and delivery to the laboratories. These are faxed by the laboratories to Michael L. Johnson, LLC (MLJ-LLC) and Summers Engineering after receipt of samples. If there are any discrepancies between the COC and sample delivery, the issues are resolved and documented directly on the COC. COCs are used to evaluate field and transport completeness and hold time compliance as discussed in the Precision, Accuracy, and Completeness section.

Appendix II and III contain complete monitoring results from sampling conducted at the compliance points on the LSJR. Appendix II contains the monitoring results for field parameters (DO, SC, pH, temperature, and discharge) and laboratory analyses for chlorpyrifos and diazinon. Monitoring results are evaluated in the Comparison with TMDL Objectives, Objective 1 section. Appendix III contains field and laboratory Quality Assurance/Quality Control (QA/QC) data, including results from field duplicate (FD) and blank (FB), laboratory duplicate and blank, laboratory control spike (LCS) and matrix spike (MS). QA data are discussed in the Precision, Accuracy, and Completeness section.

Appendix IV contains all loading capacity and load allocation calculations for samples collected during the reporting period. Loading capacities and compliance status for samples collected from the LSJR are reported in Table IV-1. Load allocations and compliance status for samples collected form each of the five tributary subareas are reported in Tables IV-2 through 8. Loading capacity are discussed in the Comparison with TMDL Objectives, Objective 1 section; load allocations are discussed in the Comparison with TMDL Objectives, Objective 2 section.

Appendix V contains all original field data sheets. Appendix VI contains monitoring site photos from all events.

## SAMPLE DETAILS

Table 12 lists sample dates for each LSJR sampling location, and tributaries in both Coalitions' areas. Sampling times for these events are found in the Appendix II. During the 2014 WY, storm samples were collected for both Coalitions at LSJR compliance locations and tributary sites on February 10 and March 3 (Westside Coalition), and February 11 (ESJWQC) (Table 12).

**Table 12. Dates of monitoring at San Joaquin River and upstream tributary sites during the 2014 WY.** Monitoring by the Westside Coalition (WC) and the ESJWQC (ES) was done during storm events (Storm), irrigation events (Irr), and non-irrigation events (NI).

| Sampling Date | San Joaquin River above Maze Boulevard | San Joaquin River at Airport Way near Vernalis | LSJR @ Hills Ferry | San Joaquin River at Highway 165 near Stevinson | San Joaquin River at Las Palmas Avenue near Patterson | San Joaquin River at Sack Dam | Westside Tributaries | ESJWQC Tributaries |
|---|---|---|---|---|---|---|---|---|
| 10/8/2013 | | | | WC-NI | WC-NI | WC-NI | WC | |
| 10/15/2013 | | | | | | | | ES |
| 11/12/2013 | | | | WC-NI | WC-NI | WC-NI | WC | ES |
| 10/10/2013 | | | | WC-NI | WC-NI | WC-NI | WC | ES |
| 1/14/2014 | | | | WC-NI | WC-NI | WC-NI | WC | ES |
| 2/10/2014 | | | | WC-Storm | WC-Storm | WC-Storm | WC-Storm | ES-Storm |
| 2/11/2014 | ES-Storm | ES-Storm | ES-Storm | | | | | |
| 3/3/2014 | | | | WC- Storm | WC- Storm | WC- Storm | WC- Storm | ES-Storm |
| 3/5/2014 | | | | | | | | ES |
| 4/8/2014 | | | | WC-Irr | WC-Irr | WC-Irr | WC | ES |
| 5/13/2014 | ES-Irr | ES-Irr | ES-Irr | WC-Irr | WC-Irr | WC-Irr | WC | ES |
| 6/10/2014 | ES-Irr | ES-Irr | ES-Irr | WC-Irr | WC-Irr | WC-Irr | WC | ES |
| 7/8/2014 | | | | WC-Irr | WC-Irr | WC-Irr | WC | ES |
| 7/15/2014 | ES-Irr | ES-Irr | ES-Irr | | | | | |
| 8/12/2014 | ES-Irr | ES-Irr | ES-Irr | WC-Irr | WC-Irr | WC-Irr | WC | ES |
| 9/9/2014 | ES-Irr | ES-Irr | ES-Irr | WC-Irr | WC-Irr | WC-Irr | WC | ES |

# PRECISION, ACCURACY AND COMPLETENESS

An assessment of precision, accuracy, and completeness is tabulated in Tables 13 through Table 16. The assessment of precision, accuracy, and completeness includes data collected by the Westside and the ESJWQC at the six LSJR TMDL compliance locations. In a few instances, some data quality objectives were not met, but these do not affect the usability of data.

All results are tabulated in Appendix II (Monitoring Results) and Appendix III (Field and Laboratory QA Results). A result is flagged if it does not meet data quality objectives (acceptability criteria) using Surface Water Ambient Monitoring Program (SWAMP) codes. Results are maintained in the SWAMP comparable database managed by the Central Valley Regional Data Center (CV RDC). The Coalitions work with the CV RDC to ensure all data remain SWAMP comparable and all data are suitable to be uploaded to the California Environmental Data Exchange Network (CEDEN). A copy of the SWAMP comparable database is submitted to the Regional Board with the hardcopy of this report. The database and spreadsheets include all data from for the 2014 WY sampling.

## COMPLETENESS

Completeness is assessed on three levels: field and transport completeness, analytical completeness, and batch completeness. Field and transport completeness assesses how many of the scheduled samples were collected and sent for analysis. Field and transport completeness may be less than 100% for reasons such as bottle breakage during transportation or inability to access a site. Analytical completeness assesses the number of samples that arrived at a laboratory and were analyzed. Analytical completeness may be less than 100% for various reasons including bottle breakage while the sample was stored at the laboratory or laboratory error resulting in an analysis not being performed. Batch completeness assesses whether chemistry batches have all required laboratory Quality Control (QC). For batch completeness, the number of batches with complete laboratory QC is compared to the overall number of batches. Table 13 includes an evaluation of completeness for the various levels.

### Field and Transport Completeness

Field and transport completeness is calculated by dividing the number of samples collected by the number of samples scheduled to be collected for each analyte. All sites and constituents were monitored as scheduled during the 2014 WY. Field and transport completeness is 100% for the 2014 WY.

Because the ESJWQC and Westside Coalition share sampling responsibilities, each Coalition was responsible for three sites per sampling event, and each Coalition collected its own set of field QC samples. Monitoring occurred at the Westside TMDL compliance sites 12 times whereas, monitoring occurred at the ESJWQC TMDL compliance sites six times each during the 2014 WY. The sampling methods for water sample collection are the same for all sites in the Coalitions involved with this report.

Measurements for the field parameters, DO, discharge, pH, SC, and water temperature were taken at each site sampled. Discharge was recorded as zero in eight events, due to no measureable flow (5 events). Sampling crews were unable to deploy the flow device in 3 events. When sampling crews were unable to deploy flow device, the discharge was estimated by movement of surface debris. Discharge completeness is 94% for the 2014 WY (Table 13).

**Table 13. The ESJWQC and Westside Coalition field and transport completeness for chlorpyrifos and diazinon samples and field parameters.**

| Method | Analyte | Env. Samples Scheduled | Env. Samples Collected | Field and Transport Completeness |
|---|---|---|---|---|
| EPA 8141A | Chlorpyrifos | 54 | 54 | 100% |
| EPA 8141A | Diazinon | 54 | 54 | 100% |
| CDEC at CRS | Discharge, cfs | 54 | 51 | 94% |
| SM 4500-O | Dissolved Oxygen, mg/L | 54 | 54 | 100% |
| EPA 150.1 | pH | 54 | 54 | 100% |
| EPA 120.1 | Specific Conductivity, µS/cm | 54 | 54 | 100% |
| SM 2550 | Water Temperature, °C° | 54 | 54 | 100% |
| | **Total** | **378** | **378** | **100%** |

EPA – Environmental Protection Agency
CDEC - California Data Exchange Center
CRS - Cressy flow gage station
SM – Standard Method

## Analytical Completeness

Analytical completeness reflects the number of environmental, field duplicates, and field blank samples that were collected in the field, and received and analyzed by the laboratory. Field QC samples may be collected from tributaries or the LSJR as long as all samples are collected on the same day during the same sampling event. Field blanks and field duplicates must be collected for each monitoring event and make up 5% of the total samples collected.

All samples collected, including field QC samples, were preserved and analyzed accordingly. Therefore, analytical completeness for environmental samples was 100% (Table 14). Field blanks and field duplicates made up 18% of the total samples collected in the San Joaquin River sites by the ESJWQC and Westside Coalition sites during the 2014 WY (Table 14). Therefore, field duplicates and blank samples met the required 5% for analytical completeness.

**Table 14. The ESJWQC and Westside Coalition analytical completeness for chlorpyrifos and diazinon samples.**

| Method | Analyte | Env. and Field QC Samples (#) | Env. and QC Samples Analyzed | Env. Sample completeness (%) | Field Blanks (#) | Field Blanks (%) | Field Dup. (#) | Field Dup. (%) |
|---|---|---|---|---|---|---|---|---|
| EPA 8141A | Chlorpyrifos | 89 | 89 | 100% | 18 | 18% | 17 | 19% |
| EPA 8141A | Diazinon | 89 | 89 | 100% | 18 | 18% | 17 | 19% |
| | **Total** | **178** | **178** | **100%** | **36** | **20%** | **34** | **19%** |

## Batch Completeness

All chemistry batches were reviewed for Quality Assurance/Quality Control (QA/QC) completeness. A complete batch must have a minimum of one laboratory blank (method blank), one laboratory duplicate, one LCS, and one MS. Chemistry batch completeness is 100% for the 2014 WY.

Tributary samples can be used to evaluate the accuracy and/or precision of a lab batch containing LSJR samples. Samples collected in ESJWQC tributaries are recorded in the CV RDC database under a different project name than are samples collected for the LSJR Chlorpyrifos and Diazinon TMDL. Hence, if a sample collected from an ESJWQC tributary site is used as a MS for samples collected from the LSJR, the MS in the CV RDC is labeled as a non-project (NONPJ). If a sample collected from a Westside Coalition tributary site is used as a MS for LSJR samples, it is labeled as part of the same project.

## Hold Time Compliance

Samples for chlorpyrifos or diazinon analysis must be extracted within seven days of the sampling date and analyzed within 40 days after the extraction occurs. All samples were extracted and analyzed within hold time (Table 15).

**Table 15. The ESJWQC and Westside Coalition summary of holding time evaluations for environmental, FB, FD, and MS samples.**

| Method | Analyte | Data Quality Objective | Number of Samples | Samples Within Control Limits | Percent Samples Acceptable |
|---|---|---|---|---|---|
| EPA 8141A | Chlorpyrifos | 7 days | 124 | 124 | 100% |
| EPA 8141A | Diazinon | 7 days | 124 | 124 | 100% |
| | | **Total** | **148** | **148** | **100%** |

# SUMMARY OF PRECISION AND ACCURACY

Data quality objectives (DQOs) are established criteria that QC samples must meet to demonstrate precision and accuracy as well as rule out sources of contamination in procedures conducted in the fields and in the laboratory. Accuracy is demonstrated by evaluating the percent recovery (PR) of chlorpyrifos and diazinon in Matrix Spikes (MS), Laboratory Control Spikes (LCS), and the PR of surrogates. Laboratory precision is demonstrated by evaluating the relative percent difference (RPD) between MS and LCS duplicate pairs (MSD and LCSD); and field collection precision is demonstrated by evaluating the RPD between duplicated environmental samples. Contamination is ruled out by testing blank samples.

Samples must meet the acceptability criteria of the DQOs at a frequency of 90% to be considered acceptable and useable. When acceptability is not met in QC samples at a frequency of 90% or greater, further justification is provided for the usability of the data. Table 16 summarizes the frequency of acceptability for each QC sample as well as the overall acceptability of all the data for chlorpyrifos and diazinon. During the 2014 WY, the combined completeness of all QC samples collected for Westside and ESJWQC TMDL monitoring met acceptability at a frequency of 97% for chlorpyrifos and 94% for diazinon.

Field and laboratory blanks are deionized water samples (blank water) and should have results that are below the RL. DQO were met in 100% of the field and laboratory blank samples (Table 16). Field duplicates met the DQO in 94% of the chlorpyrifos samples and in 100% of the diazinon samples. Only one of the field duplicates analyzed for chlorpyrifos (RPD of 26%) was outside the DQO.

Surrogates are used as an indicator of recovery of the extraction protocol. Surrogates recoveries were within acceptable limits in 98% of both the tributylphosphate and the triphenylphosphate samples analyzed.

MS samples recovered chlorpyrifos within limits in 94% of the samples, and diazinon in 89% of the samples (Table 16). Five of the 35 MS samples did not recover diazinon within acceptable limits. One MS sample, collected at a Westside tributary site on December 10, 2013, recovered diazinon below the acceptable limit. However, the MSD for the same sample had acceptable recoveries. Both the MS and the MSD samples from one ESJWQC tributary site collected on May 13, 2014, recovered diazinon below the acceptable limit. The same laboratory batch also had both LCS and LCSD samples recover diazinon below the acceptable limit. The laboratory re-extracted the MS and LCS at a later date and obtained acceptable recoveries. Finally, both the MS and the MSD samples collected from a Westside tributary on July 8, 2014, recovered diazinon above the acceptable limit. In the same batch, chlorpyrifos also recovered above the acceptable limit. The batch was accepted as useable because the environmental results were non-detect, which indicate the quality of the sample data was not impacted by the high recoveries.

LCS samples recovered chlorpyrifos within limits in 100% of samples, and diazinon in 86% of samples. Four LCS samples recovered diazinon below the acceptable DQO. These represented both the LCS and the LCSD from two separate batches for the May 2014 ESJWQC and Westside Coalition monitoring events. The laboratory re-extracted both batches 22 days after collection and analyzed them with acceptable recoveries. All environmental sample results were non-detect in both batches. In the Westside Coalition's batch, the triphenylphosphate surrogate in the sample collected from San Joaquin River at Las Palmas Avenue near Patterson recovered above the acceptable limits. The sample was accepted as useable because the environmental results were non-detect, which indicate the quality of the sample data was not impacted by the high recoveries.

Overall, 100% of the chlorpyrifos MSD pairs and 95% (20 of 21) of the diazinon MSD pairs met the RPD $\leq$ 25% data acceptability criteria. LCSD samples met the acceptability criteria in 100% of the chlorpyrifos and diazinon spikes.

**Table 16. The ESJWQC and Westside Coalition summary of QA/QC evaluations.**
Samples that did not meet the 90% or greater acceptability criterion are bolded.

| Sample Type Code | Analyte | Data Quality Objective | Number of Samples | Samples Within Control Limits | Percent Samples Acceptable |
|---|---|---|---|---|---|
| Field Blank | Chlorpyrifos | <RL or < (env sample/5) | 18 | 18 | 100% |
| Field Blank | Diazinon | <RL or < (env sample/5) | 18 | 18 | 100% |
| | | **FB Total** | **36** | **36** | **100%** |
| Field Duplicate | Chlorpyrifos | RPD ≤ 25% | 17 | 16 | 94% |
| Field Duplicate | Diazinon | RPD ≤ 25% | 17 | 17 | 100% |
| | | **FD Total** | **34** | **33** | **97%** |
| Lab Blank | Chlorpyrifos | <RL | 24 | 24 | 100% |
| Lab Blank | Diazinon | <RL | 24 | 24 | 100% |
| | | **LB Total** | **48** | **48** | **100%** |
| Surrogate | Tributylphosphate | PR 60%-150% | 183 | 180 | 98% |
| Surrogate | Triphenyl phosphate | PR 56%-129% | 183 | 179 | 98% |
| | | **Surrogate Total** | **366** | **359** | **98%** |
| MS | Chlorpyrifos | PR 61%-125% | 42 | 38 | 90% |
| MS | Diazinon | PR 57%-130% | 42 | 37 | 88% |
| | | **MS Total** | **84** | **75** | **89%** |
| MSD pairs | Chlorpyrifos | RPD ≤ 25% | 21 | 21 | 100% |
| MSD pairs | Diazinon | RPD ≤ 25% | 21 | 20 | 95% |
| | | **MSD Total** | **42** | **41** | **98%** |
| LCS | Chlorpyrifos | PR 61%-125% | 28 | 28 | 100% |
| LCS | Diazinon | PR 57%-130% | 28 | 24 | 86% |
| | | **LCS Total** | **56** | **52** | **93%** |
| LCSD pairs | Chlorpyrifos | RPD ≤ 25% | 4 | 4 | 100% |
| LCSD pairs | Diazinon | RPD ≤ 25% | 4 | 4 | 100% |
| | | **LCSD Total** | **8** | **8** | **100%** |
| **Overall acceptability** | **Chlorpyrifos** | **>90%** | **154** | **149** | **97%** |
| **Overall acceptability** | **Diazinon** | **>90%** | **154** | **144** | **94%** |

## Corrective Actions

Corrective actions were performed by the laboratories as outlined in the ESJWQC QAPP (approved February 23, 2011) and in the Westside Coalition QAPP (January 7, 2014) for QA/QC results that did not meet acceptance criteria for the 2014 WY. The necessary corrective actions are listed in Table 15 and Table 16 of the ESJWQC QAPP (Pages 46-51) and in Table B-2a and B-2b of the Westside Coalition QAPP (Pages 39-40). If corrective actions occurred (e.g. reanalysis), details are included in the above sections.

The laboratory notified MLJ-LLC staff in April 2014 that they were having poor recovery issues for diazinon and conducting studies to identify and remedy the cause. When MLJ-LLC staff met with the laboratory in August 2014, the cause was determined to be poor extraction performance by analysts at the laboratory. The laboratory has since corrected this issue and improved analyst extraction performances.

# COMPARISON WITH TMDL OBJECTIVES

The monitoring of the six compliance points in the LSJR during the 2014 WY was designed to assess compliance with Objective 1. Objectives 2 through 7 are addressed individually by each Coalition through an assessment of results and outcomes of actions taken (e.g. monitoring and outreach) to meet the specifications of either Coalition's ILRP monitoring program. The following sections assess the ESJWQC's and Westside Coalition's compliance with the seven TMDL objectives.

## OBJECTIVE 1: DETERMINE COMPLIANCE WITH ESTABLISHED WATER QUALITY OBJECTIVES AND THE LOADING CAPACITY APPLICABLE TO DIAZINON AND CHLORPYRIFOS IN THE LOWER SAN JOAQUIN RIVER.

### Water Quality Objectives

During 2014 WY, the Coalitions evaluated compliance with the chlorpyrifos and diazinon WQOs by reviewing monitoring results from the LSJR compliance points listed in Table 4. Chlorpyrifos and diazinon were not detected in any samples collected from the LSJR sites during the 2014 WY; therefore, no exceedances of the WQOs for chlorpyrifos or diazinon occurred. Complete environmental monitoring results are listed in Appendix II; complete quality control monitoring results, including field duplicates, are listed in Appendix III.

### Loading Capacity

Loading capacity was calculated using the formula in Equation 1. All samples collected from the San Joaquin River sites during the 2014 WY were in compliance with loading capacity since there were no detections of either chlorpyrifos or diazinon (Appendix IV, Table IV-1).

The Basin Plan Amendment required compliance with the loading capacity for the chlorpyrifos and diazinon TMDL in the LSJR by December 1, 2010. Table 17 includes a tally of the number of samples in compliance with the LSJR loading capacity before and after that date. Prior to the compliance date, 13 samples (7%) collected from the LSJR compliance locations were out of compliance with the loading capacity (Table 17). Since the compliance date, 99% of the samples collected by the ESJWQC and Westside Coalition from the LSJR have been in compliance with loading capacity.

Overall, 400 samples have been collected from the LSJR compliance points since July 2004, and 96% have been compliant with the load capacity (Table 17).

**Table 17. Tally of chlorpyrifos and diazinon TMDL load capacity compliance per site before and after the compliance date of December 1, 2010.**

| Site Name | Sample Dates | Compliant | Out of Compliance | Total Samples Collected | Percent Compliant |
|---|---|---|---|---|---|
| **Prior to Compliance Date (Dec. 1, 2010)[1]** | | | | | |
| San Joaquin River at Sack Dam | Jul 2004 - Nov 2010 | 37 | 3 | 40 | 93% |
| San Joaquin River at Highway 165 near Stevinson | Jul 2004 - Nov 2010 | 82 | 2 | 84 | 98% |
| San Joaquin River at Hills Ferry Road | Mar 2010 - Oct 2010 | 4 | 0 | 4 | 100% |
| San Joaquin River at Las Palmas Avenue near Patterson | Apr 2008 - Nov 2010 | 28 | 8 | 36 | 78% |
| San Joaquin River at the Maze Boulevard (Highway 132) Bridge | Mar 2010 - Oct 2010 | 4 | 0 | 4 | 100% |
| San Joaquin River at the Airport Way Bridge near Vernalis | Jan 2006 - Aug 2006 | 32 | 0 | 33 | 97% |
| | **Total** | **187** | **13** | **201** | **93%** |
| **After Compliance Date (Dec. 1, 2010)** | | | | | |
| San Joaquin River at Sack Dam | Dec 2010 - Sep 2014 | 45 | 0 | 45 | 100% |
| San Joaquin River at Highway 165 near Stevinson[2] | Dec 2010 - Sep 2014 | 42 | 0 | 42 | 100% |
| San Joaquin River at Fremont Ford[2] | Dec 2010 - Sep 2014 | 4 | 0 | 4 | 100% |
| San Joaquin River at Hills Ferry Road | Dec 2010 - Sep 2014 | 21 | 0 | 21 | 100% |
| San Joaquin River at Las Palmas Avenue near Patterson | Dec 2010 - Sep 2014 | 44 | 1 | 45 | 98% |
| San Joaquin River at the Maze Boulevard (Highway 132) Bridge | Dec 2010 - Sep 2014 | 21 | 0 | 21 | 100% |
| San Joaquin River at the Airport Way Bridge near Vernalis | Dec 2010 - Sep 2014 | 21 | 0 | 21 | 100% |
| | **Total** | **198** | **1** | **199** | **99%** |
| | | | | | |
| | **Grand Total** | **385** | **14** | **400** | **96%** |

[1] Data before December 2010 are from the Westside Coalition ILRP monitoring program and from the monitoring conducted by the Regional Board to support the development and implementation of the chlorpyrifos and diazinon TMDL in the Lower San Joaquin River (Organophosphate TMDL Monitoring for the San Joaquin River (Region 5) project).

[2] Compliance monitoring occurred at the San Joaquin River at Fremont Ford site from November 2011 through February 2012 because road construction prevented access to the San Joaquin River at Highway 165 near Stevinson site.

## OBJECTIVE 2: DETERMINE COMPLIANCE WITH ESTABLISHED LOAD ALLOCATIONS FOR DIAZINON AND CHLORPYRIFOS.

The ESJWQC and Westside Coalitions are required to assess compliance with load allocations for agricultural discharges to the LSJR for each of the five subareas (Table 5). The two Coalitions each characterize and assess water quality within their respective regions through their own strategies of representative monitoring (described in the ESJWQC WDR and Westside Coalition MRP). The following sections include a review of monitoring results from the Coalition's respective tributary monitoring during the 2014 WY. The formula in Equation 1 is applied to tributary monitoring results to assess compliance with chlorpyrifos and diazinon load allocations.

## ESJWQC Load Allocation Compliance

The ESJWQC conducted 129 monitoring events for chlorpyrifos and diazinon in 19 tributaries from October 2013 through September 2014 (Table 18). Of those 129 events 39 sites were dry and therefore no samples were collected.

In total, 126 of the 129 tributary monitoring events during the 2014 WY were in compliance with load allocation. There were three exceedances of WQTLs for chlorpyrifos during ESJWQC tributary monitoring (Table 19). The calculation of load allocations for all tributaries sampled during the 2014 WY is included in Appendix IV (Tables IV-2 through IV-5). Note that values in the Appendix include only environmental samples collected. Samples not collected because the waterbody was dry (39 events) are not included in the Appendix. To identify the sources contributing to the exceedances of the WQOs in these samples, the PUR database was queried for applications of the constituents four weeks prior to each exceedance in the associated subwatershed.

**Table 18. The ESJWQC tributary monitoring schedule for chlorpyrifos (C) and diazinon (D) during the 2014 WY.**

| Subarea | Tributary Site Name | Monitoring Type | 10/15/2013 | 11/12/2013 | 12/10/2013 | 1/14/2014 | 2/10/2014 | 3/3/2014 | 3/5/2014 | 4/8/2014 | 5/13/2014 | 6/10/2014 | 7/8/2014 | 8/12/2014 | 9/9/2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bear Creek, Fresno-chowchilla | Berenda Slough along Ave 18 1/2 | MPM | | | | | | | | C | C | C | C | C | C |
| | Black Rascal Creek @ Yosemite Rd | MPM | | | | | | | | | C | | C | C | C |
| | Cottonwood Creek @ Rd 20 | MPM, NM | C,D | C,D | C,D | C,D | C,D | C,D | | C,D | C,D | C,D | C,D | C,D | C,D |
| | Deadman Creek @ Gurr Rd | MPM | | | | | | | C | C | | | | C | C |
| | Dry Creek @ Rd 18 | MPM | C | C | C | | C | | | C | | | C | C | |
| | Howard Lateral @ Hwy 140 | NM | | C | | C | | | | | | | | | |
| | Livingston Drain @ Robin Ave | MPM | | | | C | | | | C | C | C | C | C | |
| | Miles Creek @ Reilly Rd | MPM | | | | C | C | | C | | | C | C | C | C |
| | Deadman Creek @ Hwy 59 | MPM | | | | | | | C | C | | | | C | C |
| | Duck Slough @ Gurr Rd | NM | C,D | C,D | C,D | C,D | C,D | C,D | | C,D | C,D | C,D | C,D | C,D | C,D |
| | Canal Creek @ West Bellevue Rd | NM | | C | | C | | | | | C | | | C | |
| Stevinson | Unnamed Drain @ Hwy 140 | NM | | C | | C | | | | | | | | | |
| Turlock, Merced | Highline Canal @ Hwy 99 | NM | C,D | C,D | C,D | C,D | C,D | C,D | | C,D | C,D | C,D | C,D | C,D | C,D |
| | Highline Canal @ Lombardy Rd | MPM | | | | C | | | C | | | | | | |
| | Merced River @ Santa Fe | MPM | C,D | C,D | C,D | C,D | C,D | C,D | | C,D | C,D | C,D | C,D | C,D | C,D |
| | Prairie Flower Drain @ Crows Landing Rd | NM | C,D | C,D | C,D | C,D | C,D | C,D | | C,D | C,D | C,D | C,D | C,D | C,D |
| Tuolumne River, Northeast Bank | Dry Creek @ Wellsford Rd | MPM, NM | C,D | C,D | C,D | C,D | C,D | C,D | | C,D | C,D | C,D | C,D | C,D | C,D |
| | Lateral 2 1/2 near Keyes Rd | MPM | | | | | | | | C | C | C | C | C | |
| | Westport Drain @ Vivian Rd | MPM | | | | | | | C | | | | C | C | C |

MPM - Management Plan Monitoring
NM-Normal Monitoring

**Table 19. Chlorpyrifos and diazinon load allocation calculations for tributary sites in the ESJWQC out of compliance during the 2014 WY.**

| LSJR Subarea | Site Name | Sample Date | Chlorpyrifos | Diazinon | Load | Load Allocation Compliance |
|---|---|---|---|---|---|---|
| Tuolumne River, Northeast Bank | Dry Creek @ Wellsford Rd | 10/15/2013 | 0.016 | <0.004 | 1.1 | Out of compliance |
| Bear Creek, Fresno-chowchilla | Duck Slough @ Gurr Rd | 3/03/2014 | 0.053 | <0.004 | 3.5 | Out of compliance |
| Tuolumne River, Northeast Bank | Lateral 2 1/2 near Keyes Rd | 7/08/2014 | 0.16 | NT | 10.7 | Out of compliance |

NT – Not tested

The concentration of chlorpyrifos in the sample collected during the storm event from Duck Slough @ Gurr Rd on March 3, 2014 was above the 0.015 µg/L WQTL (0.053 µg/L; Table 19). The waterbody was non-contiguous at the time of collection. This is the first exceedance of the WQTL for chlorpyrifos to occur in the site subwatershed since 2004. Toxicity to *Ceriodaphnia dubia* (75% compared to the control) and *Pimephales promelas* (85% compared to the control) were associated with this sample. The PUR data associated with the March exceedance indicate that from February 8 through February 20, 2014 there were 10 applications of chlorpyrifos totaling of 473 lbs of Active Ingredient (AI) across 561 acres of alfalfa. Applications were made by ground and aerial spray methods where it is possible for chlorpyrifos to enter the waterway via drift. In addition, a substantial amount of rainfall in the ESJWQC region from late January through March 6, 2014 (2.48 inches) may have mobilized some of the applied chlorpyrifos into Duck Slough. The site was dry in January and non-contiguous in December, February, March, April, and July.

The concentration of chlorpyrifos in a sample collected from Dry Creek @ Wellsford Rd on October 15, 2013 was above the 0.015 µg/L WQTL (0.016 µg/L; Table 19). Samples collected one month prior also exceeded the WQTL at a concentration of 0.14 µg/L (2014 Annual Report). The PUR data indicate that from August 24, 2013 through October 15, 2013 there were 17 applications totaling 910 lbs AI across 625 acres of corn, grape, alfalfa, and walnuts. Applications were made by ground and aerial spray methods where it is possible for chlorpyrifos to enter the waterway via drift. In addition, there were applications of chlorpyrifos on the same day samples were collected. Further information about this exceedance is provided in the ESJWQC Annual Report (submitted May 1, 2015).

The concentration of chlorpyrifos in a sample collected from Lateral 2 1/2 near Keyes Rd on July 18, 2014 was above the 0.015 µg/L WQTL (0.016 µg/L; Table 19). The PUR data associated with the exceedance indicate that from June 13 through July 3, 2014 there were 39 applications of chlorpyrifos totaling 1666 lbs AI across 885 acres of almonds and walnuts. Applications were made by ground and aerial spray methods where it is possible for chlorpyrifos to enter the waterway via drift. Further information about this exceedance is provided in the ESJWQC Annual Report (submitted May 1, 2015).

During the 2014 WY, 98% of the samples were compliant (Table 20) with load allocation. None of the tributary exceedances in the ESJWQC tributaries affected load compliance in the LSJR. Overall, 96% of samples collected from ESJWQC tributaries have been compliant with load allocations since the inception of TMDL monitoring in January 2010.

**Table 20. Tally of ESJWQC chlorpyrifos and diazinon TMDL load allocation compliance for each subarea since inception of San Joaquin River monitoring (January 2010 through September 2014).**

| Subarea | WY | In Compliance | Out of compliance | Samples Collected | Percent in Compliance |
|---|---|---|---|---|---|
| Bear Creek, Fresno-Chowchilla | 2010 | 19 | 5 | 24 | 79% |
| | 2011 | 56 | 3 | 59 | 95% |
| | 2012 | 34 | 0 | 34 | 100% |
| | 2013 | 49 | 1 | 50 | 98% |
| | 2014 | 67 | 1 | 68 | 99% |
| Stanislaus River, North Stanislaus | 2010 | 9 | 0 | 9 | 100% |
| | 2011 | 10 | 0 | 10 | 100% |
| | 2012 | 12 | 0 | 12 | 100% |
| | 2013 | 9 | 0 | 9 | 100% |
| Stevinson, Grassland | 2013 | 10 | 0 | 10 | 100% |
| | 2014 | 2 | 0 | 2 | 100% |
| Tuolumne River, Northeast Bank | 2010 | 7 | 3 | 10 | 70% |
| | 2011 | 12 | 0 | 12 | 100% |
| | 2012 | 3 | 0 | 3 | 100% |
| | 2013 | 4 | 1 | 5 | 80% |
| | 2014 | 19 | 2 | 21 | 90% |
| Turlock, Merced | 2010 | 12 | 1 | 13 | 92% |
| | 2011 | 34 | 0 | 34 | 100% |
| | 2012 | 29 | 0 | 29 | 100% |
| | 2013 | 32 | 0 | 32 | 100% |
| | 2014 | 38 | 0 | 38 | 100% |
| **Totals** | | | | | |
| | **2010** | 47 | 9 | 56 | 84% |
| | **2011** | 112 | 3 | 115 | 97% |
| | **2012** | 78 | 0 | 78 | 100% |
| | **2013** | 104 | 2 | 106 | 98% |
| | **2014** | 126 | 3 | 129 | 98% |
| | **Grand Total** | **341** | **14** | **355** | **96%** |

## Westside Coalition Load Allocation Compliance

The Westside Coalition collected monthly samples from tributary sites flowing to the LSJR from October 2013 through September 2014 in accordance with its MRP. The 2014 WY was a critically dry year, and there were few significant storm events during the non-irrigation season. The Westside Coalition collected a storm sample from tributary sites on February 10 and March 3, 2014.

**Table 21. Westside Coalition tributary monitoring schedule during the 2014 WY.**

| Monitoring Site | Non-Irrigation Season | | | | | Irrigation Season | | | | | | Non-Irrigation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Event 107 | Event 108 | Event 109 | Event 110 | Event R14 | Event R15 | Event 112 | Event 113 | Event 114 | Event 115 | Event 116 | Event 117 |
| | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sept |
| **Discharge Sites** | | | | | | | | | | | | |
| Hospital Cr at River Road | N | N | N | N | P, NF | P, NF | P | P | P | P | P | P, NF |
| Ingram Cr at River Road | N | N, NF | N, NF | N, NF | P, NF | P | P | P | P | P | P | P |
| Westley Wasteway near Cox Road | N | N | N | N | P, NF | P, NA | P | P | P | P | P | P |
| Del Puerto Cr near Cox Road | N | N | N | N | P | P | P | P | P | P | P | P |
| Del Puerto Cr at Hwy 33 | N | N | N | N | P, NF | P, NF | P | P | P, NF | P, NF | P, NF | P, NF |
| Ramona Lake near Fig Avenue | N | N | N | N | P, NF | P | P | P | P | P | P | P |
| Marshall Road Drain near River Road | N | N | N | N | P, NF | P | P | P | P | P | P, NF | P |
| Orestimba Cr at River Road | N | N, NF | N, NF | N, NF | P, NF | P, NF | P, NF | P, NF | P, NF | P, NF | P, NF | P, NF |
| Orestimba Cr at Hwy 33 | N | N | N | N | P | P | P | P | P | NA | P | P |
| Newman Wasteway near Hills Ferry Road | N | N | N | N | P | P | P | P | P | P | P | P |
| Mud Slough u/s San Luis Drain | P | P | P | P | P | P | P | P | P | P | P | P |
| Salt Slough at Lander Avenue | P | P | P | P | P | P | P | P | P | P | P | P |
| Salt Slough at Sand Dam | N | N | N | N | P | P | P | P | P | P | P | P |
| Los Banos Creek at Highway 140 | P | P | P | P | P | P | P | P | P | P | P | P |
| Los Banos Creek at China Camp Road | N | N | N | N | P | P | P | P | P | P | P | P |
| Turner Slough near Edminster Road | N | N | N | N | P | P | P | P | N* | N* | N* | N* |
| Blewett Drain near Highway 132 | N | N, NF | N, NF | N | P, NF | P, NF | P | P | P, NF | P | P | P |
| Poso Slough at Indiana Avenue | N | N | N | N | P | P | P | P | P | P | P | P |
| Source Water Sites | | | | | | | | | | | | |
| Delta Mendota Canal at Del Puerto WD | P | P | P | P | P | P | P | P | P | P | P | P |

N -- Sample not tested for pesticides
NF -- Not sampled due to lack of flow
NA -- Not Sampled due to lack of safe access
P -- Sample tested for chlorpyrifos & diazinon if adequate water is present.
N* -- Site removed from monitoring plan.

Although there were no exceedances of either the chlorpyrifos or diazinon WQTL in the LSJR samples, chlorpyrifos was detected in fourteen tributary samples (over four different monitoring events), all of which were in excess of the load criteria. There were no detections of diazinon during this report period.

Table 22 shows the sites and dates where chlorpyrifos was detected. The Westside Coalition's November 2014 SAMR discusses these detections, as well as other pesticide detections, in greater detail. A tabulation of load allocations for all tributary results is included in Appendix IV.

Table 23 provides load allocations for Westside Coalition tributaries for each subarea. Overall, the percentage of load allocations in compliance during the 2014 WY (October 2013 – September 2014; 89%) was approximately the same as the 2013 WY (87%) and greater compared to 2010 (January – September; 79%) when implementation of the TMDL program began.

**Table 22. Chlorpyrifos and diazinon load allocation calculations for tributary sites in the Westside Coalition out of compliance during the 2014 WY.**

| Main Stem Monitoring Point | Tributary Site | Sample Date | Sample Event | Flow (cfs) | Chlorpyrifos (µg/L) | Diazinon (µg/L) | Load | Load Allocation Compliance |
|---|---|---|---|---|---|---|---|---|
| Greater Orestimba | Ramona Lake near Fig Avenue | 3/3/2014 | R15 | NA | 0.034 | <0.004 | 2.27 | Out of compliance |
| Stevinson, Grassland | Newman Wasteway near Hills Ferry Road | 3/3/2014 | R15 | NA | 0.037 | <0.004 | 2.47 | Out of compliance |
| | Poso Slough at Indiana Ave | 3/3/2014 | R15 | 13 | 0.092 | <0.004 | 6.13 | Out of compliance |
| | Poso Slough at Indiana Ave | 4/8/2014 | 112 | 0 | 0.040 | <0.004 | 2.67 | Out of compliance |
| | Poso Slough at Indiana Ave | 8/12/2014 | 116 | 12 | 0.066 | <0.004 | 4.40 | Out of compliance |
| | Poso Slough at Indiana Ave | 9/9/2014 | 117 | 0 | 0.048 | <0.004 | 3.20 | Out of compliance |
| | Salt Slough at Lander Ave | 3/3/2014 | R15 | 131 | 0.057 | <0.004 | 3.80 | Out of compliance |
| | Salt Slough at Lander Ave | 4/8/2014 | 112 | 222 | 0.034 | <0.004 | 2.27 | Out of compliance |
| | Salt Slough at Sand Dam | 4/8/2014 | 112 | 60 | 0.052 | <0.004 | 3.47 | Out of compliance |
| | Salt Slough at Sand Dam | 8/12/2014 | 116 | 14 | 0.038 | <0.004 | 2.53 | Out of compliance |
| | Turner Slough at Edminster Road | 3/3/2014 | R15 | 0 | 0.085 | <0.004 | 5.67 | Out of compliance |
| | Turner Slough at Edminster Road | 4/8/2014 | 112 | 0 | 0.024 | <0.004 | 1.60 | Out of compliance |
| Westside Creek | Del Puerto Creek near Cox Road | 3/3/2014 | R15 | 0 | 0.091 | <0.004 | 6.07 | Out of compliance |
| | Del Puerto Creek near Cox Road | 9/9/2014 | 117 | 273 | 0.094 | <0.004 | 6.27 | Out of compliance |

**Table 23. Tally of Westside Coalition chlorpyrifos and diazinon TMDL load allocation compliance per each of the subareas.**

| Subarea | WY | In Compliance | Out of compliance | Samples Collected | Percent in Compliance |
|---|---|---|---|---|---|
| Greater Orestimba | 2010 | 18 | 12 | 30 | 60% |
| | 2011 | 26 | 7 | 33 | 79% |
| | 2012 | 30 | 1 | 31 | 96% |
| | 2013 | 16 | 3 | 19 | 84% |
| | 2014 | 19 | 1 | 20 | 95% |
| Stevinson, Grassland | 2010 | 70 | 4 | 74 | 95% |
| | 2011 | 87 | 3 | 90 | 97% |
| | 2012 | 87 | 4 | 91 | 96% |
| | 2013 | 65 | 6 | 71 | 92% |
| | 2014 | 61 | 11 | 72 | 85% |
| Westside Creeks | 2010 | 18 | 13 | 31 | 58% |
| | 2011 | 30 | 6 | 36 | 83% |
| | 2012 | 36 | 5 | 41 | 88% |
| | 2013 | 19 | 6 | 25 | 76% |
| | 2014 | 31 | 2 | 33 | 94% |
| **Totals** | | | | | |
| | **2010 WY** | 106 | 29 | 135 | 79% |
| | **2011 WY** | 143 | 16 | 159 | 90% |
| | **2012 WY** | 153 | 10 | 163 | 94% |
| | **2013 WY** | 100 | 15 | 115 | 87% |
| | **2014 WY** | 111 | 14 | 125 | 89% |
| | **Grand Total** | **613** | **84** | **697** | **88%** |

Data in the table represents complete data sets for 2010 through 2014 WY.

The PUR data listed in Table 24 have been provided by the county agricultural commissioners and is summarized for the sites listed in Table 22. The PUR data summary is organized by site and material AI, and includes the number of treatments and total acres treated of each commodity. Available PUR data identified 238 separate pesticide applications within subwatersheds where chlorpyrifos was detected during sampling. For the two chlorpyrifos detections at Turner Slough (see Table 23), no use for that material was reported within eight weeks of the detection date.

**Table 24. Chlorpyrifos and diazinon applications made four weeks prior in subwatersheds with exceedances in the Westside Coalition region.**
Only listed applications based on available PUR data are shown.

| Tributary Name | Material | Application Month | Commodity | Number of Applications* | Acres Treated* |
|---|---|---|---|---|---|
| Del Puerto Creek | Chlorpyrifos | August | Alfalfa | 12 | 437 |
| | Chlorpyrifos | February | Alfalfa | 16 | 643 |
| | Chlorpyrifos | July | Alfalfa | 2 | 264 |
| Newman Wasteway | Chlorpyrifos | February | Alfalfa | 1 | 28 |
| | Chlorpyrifos | January | Alfalfa | 3 | 162 |
| Poso Slough | Chlorpyrifos | August | Alfalfa | 37 | 1682 |
| | Chlorpyrifos | February | Alfalfa | 30 | 1177 |
| | Chlorpyrifos | February | Alfalfa | 8 | 271 |
| | Chlorpyrifos | January | Alfalfa | 2 | 192 |
| | Chlorpyrifos | July | Alfalfa | 4 | 500 |
| | Chlorpyrifos | March | Alfalfa | 23 | 1426 |
| | Chlorpyrifos | September | Alfalfa | 3 | 154 |
| | Chlorpyrifos | July | Asparagus | 1 | 106 |
| | Chlorpyrifos | January | Wheat | 2 | 68 |
| | Chlorpyrifos | March | Wheat | 1 | 31 |
| Salt Slough | Chlorpyrifos | April | Alfalfa | 4 | 372 |
| | Chlorpyrifos | February | Alfalfa | 4 | 410 |
| | Chlorpyrifos | July | Alfalfa | 14 | 754 |
| | Chlorpyrifos | March | Alfalfa | 64 | 3037 |
| | Chlorpyrifos | February | Alfalfa | 6 | 543 |
| | Chlorpyrifos | March | Alfalfa | 1 | 126 |
| Ramona Lake | Chlorpyrifos | February | Alfalfa | 4 | 94 |
| | Chlorpyrifos | January | Almonds | 1 | 17 |

*PUR data is provisional and subject to change.

# OBJECTIVE 3: DETERMINE DEGREE OF IMPLEMENTATION OF MANAGEMENT PRACTICES AND STRATEGIES TO REDUCE OFF-SITE MOVEMENT OF DIAZINON AND CHLORPYRIFOS

Each Coalition developed their own management practice tracking and evaluation strategies suitable for their regions and members (ESJWQC Management Plan submitted September 30, 2008 and Westside Coalition Management Plan and Focused Management Plan submitted October 23, 2008). The Coalitions review the results of their respective strategies to determine the degree of implementation of management practices and strategies to reduce the offsite movement of chlorpyrifos and diazinon.

## ESJWQC Implementation of Management Practices to Reduce Offsite Movement of Diazinon and Chlorpyrifos

After one exceedance of the WQO for chlorpyrifos or diazinon, individually or in combination, at a tributary monitoring site, the ESJWQC must establish a management plan for the site subwatershed. To allow for source identification, focused outreach, and evaluation, the ESJWQC prioritizes site subwatersheds based on the number, frequency, and magnitude of chlorpyrifos and diazinon exceedances, among other factors (2013 MPUR, Pages 23-24). When a site subwatershed rotates to high priority, the ESJWQC develops a three year process designed to document current management practices (Year 1), encourage and document the implementation of new management practices (Years 1 and 2), and evaluate the effectiveness of outreach in the site subwatershed via Management Plan Monitoring (MPM) for management plan constituents (Years 1-3). Members with the greatest potential to influence water quality are targeted. These are growers with the potential for direct drainage and growers with past applications of management plan constituents (i.e. chlorpyrifos or diazinon). The focused outreach and management practice documentation rotates to additional site subwatersheds annually.

The ESJWQC outreach activities and actions to address water quality exceedances during the 2014 WY are documented in the 2015 Annual Report. A major goal of ESJWQC outreach is to help growers eliminate the offsite movement of agricultural constituents. The ESJWQC identified five categories of management practices that are effective in reducing the offsite movement of chlorpyrifos and diazinon:

- Irrigation Water Management
- Storm Drainage Management
- Erosion and Sediment Management
- Pest Management
- Dormant Spray Management

The ESJWQC has completed its focused outreach strategy in the first through fifth priority site subwatersheds (Hatch Drain @ Tuolumne Rd, Highline Canal @ Lombard Rd, Merced River @ Santa Fe, Miles Creek @ Reilly Rd) and documented all current and newly implemented management practices for targeted member parcels. The ESJWQC has conducted individual meetings with targeted growers and documented current management practices for the sixth priority site subwatersheds (Ash Slough @ Ave 21, Mustang Creek @ East Ave, Westport Drain @ Vivian Rd). The ESJWQC has initiated focused outreach to document currently implemented practices in seventh priority site subwatersheds (Howard Lateral @ Hwy 140, Levee Drain @ Carpenter Rd, Mootz Drain downstream of Langworth Pond). Growers have been contacted through mailings in 2014, and individual meetings are scheduled to occur during 2015. These data will be assessed in the ESJWQC 2016 Annual Report.

Targeted growers in the first through fifth priority site subwatersheds indicated they implemented management practices within each of the above categories before focused ESJWQC outreach. Several growers implemented new management practices in each of these categories following outreach. Figure 6 includes the acreage associated with management practices implemented before ESJWQC outreach (previously implemented) and after ESJWQC outreach (newly implemented) in the first through fifth priority subwatersheds per each of the five categories). The acreage represented in Figure 6 is associated with at least one management practice per each category, but acreage may have multiple practices implemented within a category (acreage is only counted once per each category). The majority of targeted acreages have at least one management practice designed to address erosion and sediment management, irrigation management, and pest management. The newly implemented practices are focused on irrigation management, pest management, and storm drainage management.

Within each of the five categories, growers implemented various management practices (Table 25). Pest management practices such as adjusting spray nozzles to match crop canopy profile and using nozzles that provide the largest effective droplet size to minimize drift are utilized by almost every targeted grower. Other common practices include laser leveling fields and planting or allowing vegetation to grow along ditches. A total of 2,847 growers implement management practices across 687,914 irrigated acres (growers can implement more than one management practice therefore the number of growers and acres does not reflect the number of members and reported acreage in each subarea).

**Figure 6. Acreage with one or more implemented management practice per each category in the ESJWQC first through fifth priority subwatersheds.** Targeted acreage associated with grower displayed if one or more practice(s) are implemented per category. Several practices serve multiple purposes and fall into more than one category, but practices are counted only once with their primary category.

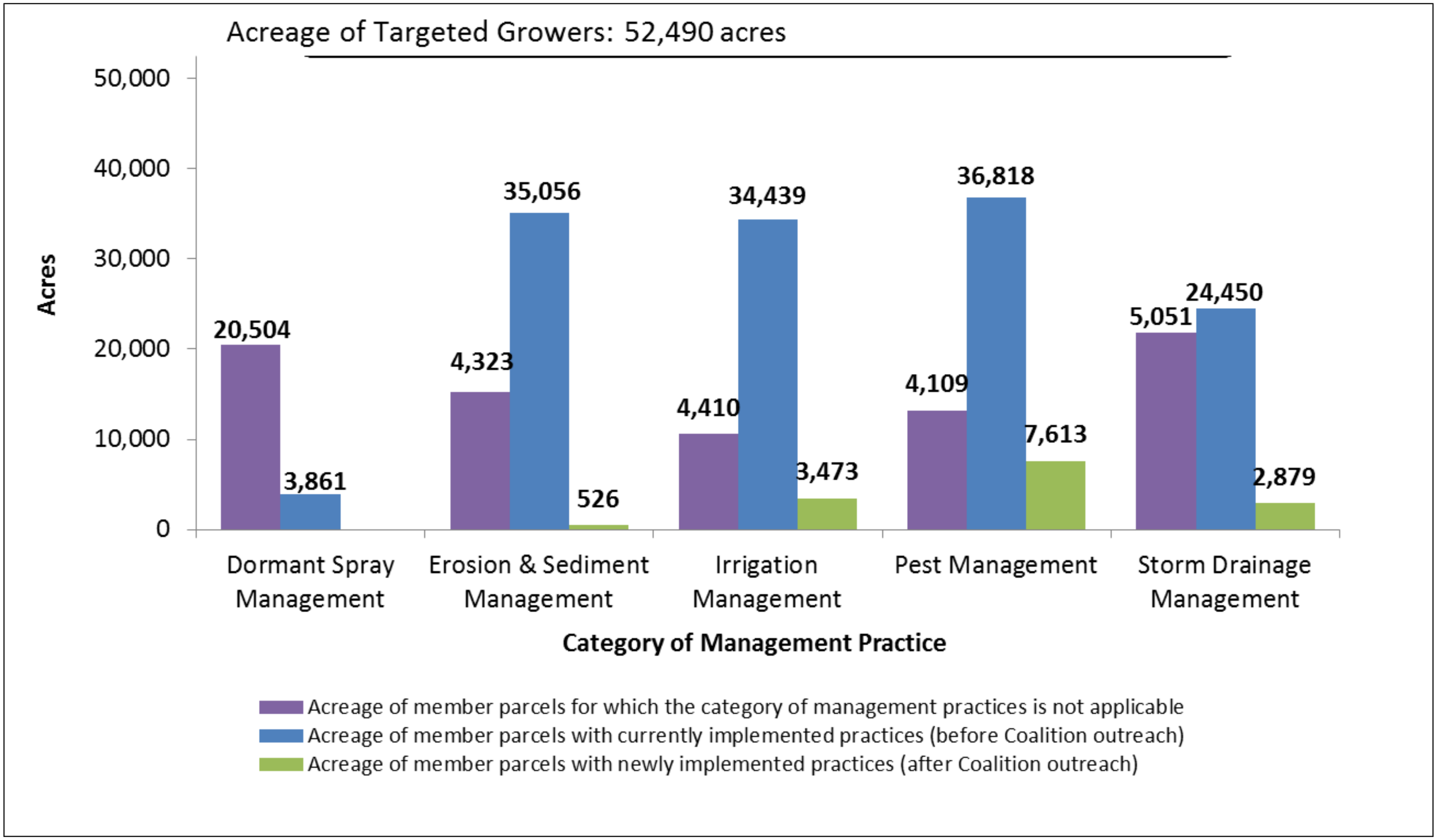


**Table 25. Current and newly implemented management practices designed to reduce offsite movement of chlorpyrifos and diazinon in the ESJWQC first through fifth priority subwatersheds listed by TMDL subarea.**

| Category | Management Practice | Bear Creek, Fresno-Chowchilla | | Tuolumne River, Northeast Bank | | Turlock, Merced | | Total | |
|---|---|---|---|---|---|---|---|---|---|
| | | Growers | Acres | Growers | Acres | Growers | Acres | Growers | Acres |
| Dormant Spray Management | Check weather conditions prior to spraying (i.e. storm status) | 14 | 5656 | 5 | 382 | 11 | 3332 | 30 | 9370 |
| | Do not apply dormant spray when moisture is at field capacity | 8 | 3301 | 4 | 302 | 9 | 3056 | 21 | 6659 |
| | Maintain setback zones | 14 | 5656 | 3 | 131 | 8 | 2379 | 25 | 8166 |
| | Vegetation cover and/or disked | 16 | 5565 | 10 | 712 | 3 | 201 | 29 | 6478 |
| Erosion & Sediment Management | Constructed wetlands | 1 | 87 | 1 | 2450 | 1 | 115 | 3 | 2652 |
| | Grass Row Centers (Orchards, Vineyards) | 98 | 24112 | 39 | 6546 | 32 | 9306 | 169 | 39964 |
| | Maintain vegetated filter strips around field perimeter at least 10' wide | 102 | 21130 | 24 | 6227 | 31 | 6423 | 157 | 33780 |
| | Riparian vegetation / fences prevents livestock access to water | 6 | 640 | 2 | 53 | 0 | 0 | 8 | 693 |
| | Vegetation is planted along or allowed to grow along ditches | 84 | 21724 | 24 | 6532 | 19 | 8089 | 127 | 36345 |
| Irrigation Management | Determine Irrigation Schedule by Actual Moisture Levels in Soil/Crop Needs | 164 | 37007 | 24 | 5753 | 42 | 10602 | 230 | 53362 |
| | Drainage basins (sediment ponds) | 33 | 11670 | 5 | 3203 | 11 | 3789 | 49 | 18662 |
| | Drip irrigation, other | 6 | 408 | 1 | 77 | 36 | 6362 | 43 | 6847 |
| | Laser leveled fields | 112 | 23574 | 40 | 6779 | 23 | 8722 | 175 | 39075 |
| | Microirrigation | 101 | 27624 | 25 | 6721 | 3 | 269 | 129 | 34614 |
| | Polyacrylamide (PAM) | 1 | 15 | 1 | 2450 | 16 | 7375 | 18 | 9840 |
| | Recirculation - Tailwater return system | 48 | 13295 | 7 | 4046 | 4 | 468 | 59 | 17809 |
| | Reduce Amount of Water Used in Surface Irrigation | 12 | 1903 | 1 | 162 | 4 | 317 | 17 | 2382 |
| Pest Management | Adjust spray nozzles to match crop canopy profile | 131 | 30091 | 48 | 8052 | 50 | 12128 | 229 | 50271 |
| | Calibrate spray equipment prior to each application | 146 | 33551 | 69 | 9832 | 48 | 12382 | 263 | 55765 |
| | Shut off outside nozzles when spraying outer rows next to sensitive sites | 128 | 28574 | 46 | 7921 | 50 | 12582 | 224 | 49077 |
| | Spray areas close to waterbodies when the wind is blowing away from them | 138 | 31146 | 47 | 7884 | 55 | 13007 | 240 | 52037 |
| | Use air blast applications when wind is between 3-10 mph and upwind of a sensitive site | 91 | 18491 | 30 | 5895 | 28 | 6340 | 149 | 30726 |
| | Use electronic controlled sprayer nozzles | 9 | 1981 | 3 | 2555 | 6 | 362 | 18 | 4898 |
| | Use nozzles that provide largest effective droplet size to minimize drift | 139 | 31879 | 47 | 7954 | 55 | 11981 | 241 | 51814 |
| Storm Drainage | Berms Between Field & Waterway | 18 | 2975 | 0 | 0 | 9 | 5430 | 27 | 8405 |
| | Device Controls Timing of Pump/Drain into Waterway | 22 | 6389 | 2 | 3147 | 8 | 1445 | 32 | 10981 |
| | No Storm Drainage | 12 | 2272 | 1 | 36 | 53 | 18662 | 66 | 20970 |
| | Recirculation - Tailwater return system | 29 | 9507 | 1 | 26 | 2 | 278 | 32 | 9811 |
| | Settling Pond | 26 | 9844 | 3 | 2499 | 8 | 4118 | 37 | 16461 |
| | **Totals** | **1709** | **410067** | **513** | **108327** | **625** | **169520** | **2847** | **687914** |

The ESJWQC submitted a revised Surface Water Quality Management Plan on May 1, 2014 (pending approval) as outlined in the WDR. The revised Management Plan presents the Coalition's approach, includes a compliance schedule for each specific constituent, and eliminates the prioritization of sites and constituents, as described above. The approach involves source identification, outreach to all members who are potential sources of exceedances to provide recommendations about potential management practices that are known to be efficacious in managing discharges, and monitoring to evaluate the efficacy of implemented management practices.

## Westside Coalition Implementation of Management Practices to Reduce Offsite Movement of Diazinon and Chlorpyrifos

In 2008, the Westside Coalition adopted a Management Plan to address water quality exceedances detected by the monitoring order. Although the Management Plan outlined area specific measures based on the exceedances in that region, identified management practices for pesticides (including chlorpyrifos and diazinon) are uniform for the entire Westside Coalition. These measures include:

- Construct sediment basins to intercept tailwater.
- Install high-efficiency irrigation systems such as sprinkler or drip irrigation, tailwater recirculation, gated pipes, shorter runs, etc., where warranted by the crops that are grown.
- Implement additional use of polyacrylamide (PAM) to address sedimentation discharge.
- Reduce use of pesticides, or incorporate use of pesticides that are less likely to be transported to the State waterways, or which breakdown quickly and are less likely to impact water quality.
- Calibrate ground spray rigs utilized on farmed acres to address possible overspray.
- Address potential aerial overspray by identifying the sensitive regions for all aerial applicators, or elimination of this as an acceptable application procedure.
- Increase size of vegetated buffer zones along the perimeters waterways.

As a mechanism to encourage and track the implementation of management practices, the Westside Coalition implemented an aggressive outreach program that included field meetings with individual growers, workshops, sponsorship of integrated pest management programs (such as the Sustainable Cotton Program) and a detailed management practice inventory survey to determine what management practices have already been implemented. A status update of management plan implementation is included in Attachment 6 of each SAMR. Table 26 summarizes the management practice inventory data for the Westside Coalition region In addition to these actions, a staff person of the Westside Coalition travels through the Coalition area frequently to review irrigation activities, drainage conditions, and meet with growers to review management practice implementation. All of these management practices are implemented at the farm-level and driven by a variety of factors, including water supply, crop values, soil quality, and regulatory pressures.

In response to the diazinon and chlorpyrifos exceedances during the irrigation season, the Westside Coalition mailed out newsletters to growers within the entire Coalition. The newsletter emphasized importance of implementing management practices to prevent pesticide discharge.

**Table 26. Management practice inventory data for subwatersheds in the Westside Coalition region.**

| Subwatersheds | Year | Data Type | Survey Area | Surveys Collected | Irrigated Acreage | Furrow/Flood (% Irrig. Ac.) | Drip/Micro/Sprinkler (% Irrig. Ac.) | Fallow/Non Irrigated (% Irrig. Ac.) | Mix of Irrigation Methods (% Irrig. Ac.) | Tree Crops (% Irrig. Ac.) | Field Crops (% Irrig. Ac.) | Open / Other (% Irrig. Ac.) | Sedimentation Ponds (% Field Crops) | Tailwater Return System (% Field Crops) | Use of PAM (% Irrig. Ac.) | Tailwater Leaves Property (% Irrig. Ac.) | Stormwater Leaves Property (% Irrig. Ac.) | Dormant Spray Usage (% Tree Crops) | Horticultural Oil Usage (% Tree Crops) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Salt Slough | 2011/12 | Acres | 64,996 | 874 | 63,978 | 49,575 | 14,403 | 1,056 | 0 | 1,203 | 62,890 | 1,039 | 370 | 0 | 710 | 58,704 | 57,490 | | |
| | | % | 100% | 100% | 98% | 77% | 23% | 2% | 0% | 1.90% | 98% | 1.60% | 0.60% | 0% | 1% | 92% | 90% | | |
| Westley Wasteway | 2010 | Acres | 5,248 | 70 | 4,565 | 1,489 | 2,891 | 0 | 185 | 2,891 | 1,670 | 662 | 1,092 | 150 | 3,346 | 2,234 | 2,517 | 905 | 905 |
| | | % | 100% | 100% | 87% | 33% | 63% | 0% | 4% | 63% | 37% | 15% | 65% | 9% | 73% | 49% | 55% | 31% | 31% |
| Del Puerto Creek | 2010 | Acres | 9,195 | 274 | 7,926 | 3,210 | 3,952 | 230 | 535 | 4,237 | 3,678 | 325 | 3,331 | 402 | 2,955 | 3,471 | 5,050 | 1,147 | 748 |
| | | % | 100% | 100% | 86% | 41% | 50% | 3% | 7% | 53% | 46% | 4% | 36% | 4% | 37% | 44% | 64% | 27% | 18% |
| Orestimba Creek | 2010 | Acres | 12,851 | 160 | 11,714 | 4,491 | 5,821 | 1,354 | 48 | 5,481 | 5,626 | 847 | 5,019 | 2,154 | 3,408 | 4,134 | 6,384 | 400 | 806 |
| | | % | 100% | 100% | 91% | 38% | 50% | 12% | 0% | 47% | 48% | 7% | 89% | 38% | 29% | 35% | 55% | 7% | 15% |
| Hospital Creek | 2009 | Acres | 7,142 | 91 | 5,193 | 1,678 | 3,515 | 1,949 | | 3,621 | 1,583 | 1949 | 1,085 | 205 | 488 | 1,473 | 4,118 | 926 | |
| | | % | 100% | 100 % | 69% | 32% | 68% | 38% | | 48% | 21% | 26% | 14% | 3% | 29% | 28% | 79% | 12% | |
| Ingram Creek | 2009 | Acres | 5,779 | 55 | 5,526 | 4,599 | 927 | 3 | | 876 | 4,665 | 3 | 935 | 828 | 4,375 | 4,393 | 5,204 | 22 | |
| | | % | 100% | 100% | 96% | 80% | 16% | <1% | | 16% | 84% | <1% | 17% | 15% | 95% | 76% | 90% | <1% | |
| Blewett | 2014 | Acres | 2,592 | 32 | 2,519 | 763 | 1,756 | 80 | 0 | 1,662 | 857 | 80 | 811 | | 348 | 818 | 1,506 | | |
| | | % | 100% | 100% | 97% | 30% | 70% | 3% | 0% | 66.00% | 34% | 3% | 32.00% | | 14% | 32% | 60% | | |
| Marshall Road Drain | 2014 | Acres | 6,909 | 199 | 5,778 | 2,470 | 3,308 | 877 | 0 | 2,339 | 3,900 | 416 | 2,309 | | 1,515 | 1,811 | 3,686 | | |
| | | % | 100% | 100% | 84% | 43% | 57% | 15% | 0% | 40% | 68% | 7% | 40% | | 26% | 31% | 64% | | |
| Spanish Land Grant Drain | 2014 | Acres | 4,398 | 74 | 4,262 | 2,743 | 1,519 | 4 | 0 | 1,161 | 3,101 | 4 | 2,193 | | 1,912 | 2,805 | 2,321 | | |
| | | % | 100% | 100% | 97% | 64% | 36% | 0% | 0% | 27% | 73% | 0% | 51% | | 45% | 66% | 54% | | |

# OBJECTIVE 4: DETERMINE DEGREE OF EFFECTIVENESS OF MANAGEMENT PRACTICES AND STRATEGIES TO REDUCE OFF-SITE MOVEMENT OF DIAZINON AND CHLORPYRIFOS

The Coalitions review management practice effectiveness at the subwatershed level within their regions to offer evidence of management practice effectiveness in addition to water quality in the LSJR.

## ESJWQC Effectiveness of Management Practices to Reduce Offsite Movement of Diazinon and Chlorpyrifos

The ESJWQC uses the results of MPM and Normal Monitoring to evaluate the effectiveness of current and newly implemented management practices. The following evaluation is based on the monitoring results from 2014 WY.

The ESJWQC has conducted focused outreach since 2009, resulting in the implementation of several new management practices designed to address the offsite movement of agricultural constituents, including chlorpyrifos and diazinon (Figure 6 and Table 25). Results from MPM during months of past exceedances and months of high use, in addition to monthly monitoring at Core sites, indicate focused outreach and implementation of new management practices from 2009 through 2014 coincided with an overall decrease in chlorpyrifos and diazinon exceedances (Table 27). Prior to focused outreach, there were 14 to 19 exceedances of the WQTL for chlorpyrifos per year (12-15% of samples collected annually) in the first through fifth priority subwatersheds (Table 27). There have been only four exceedances of the diazinon WQTL since 2006 (< 1% of samples collected, Table 27).

Three exceedances of the WQTL for chlorpyrifos occurred during the 2014 WY in site subwatersheds where focused outreach is complete (Dry Creek @ Wellsford Rd, Duck Slough @ Gurr Rd, and Lateral 2 ½ near Keyes Rd). Dry Creek @ Wellsford Rd is within the first set of high priority subwatersheds and the Coalition completed focused outreach in 2010. The ESJWQC established a management plan for chlorpyrifos in the Dry Creek @ Wellsford Rd site subwatershed in 2006. The exceedance of the chlorpyrifos WQTL in October was the second exceedance in 2013 (one occurred in September). Prior to 2013, no exceedances had occurred since 2010. Based on PUR data, applications of chlorpyrifos were made on the date the sample was collected. Parcels next to the waterbody have a higher likelihood of having direct drainage and a higher potential for spray drift to end up in the water column. Chlorpyrifos applications to corn were made to a member and non-member parcels located within a mile of the creek and along a canal/lateral that drains directly to Dry Creek and likely caused the exceedance. As of 2010, members within this subwatershed have been implementing the following practices: shutting off outside nozzles when spraying outer rows next to sensitive sites, constructing drainage basins/sediment ponds, maintaining filter strips at least 10 feet wide around field perimeters, allowing grass to grow in the centers of orchard rows, using recirculation/tailwater return systems, and using less water during surface irrigation for operations with no irrigation drainage.

Duck Slough @ Gurr Rd is within the second set of high priority subwatersheds and completed focused outreach in 2012. The March 2014 exceedance of the WQTL for chlorpyrifos is the first to occur in the site subwatershed since 2004; chlorpyrifos was approved for removal from the site's active management plan on May 30, 2012. Due to the 2014 exceedance, the chlorpyrifos management plan for Duck Slough @ Gurr Rd will be reinstated. Based on PUR data, applications of chlorpyrifos were made on the date the sample was collected. As of 2011, members within this subwatershed have been implementing the following practices: shutting off outside nozzles when spraying outer rows next to sensitive sites, constructing drainage basins/sediment ponds, maintaining filter strips at least 10 feet wide around field perimeters using recirculation/tailwater return systems, and spraying areas close to waterbodies when the wind is blowing away from them.

Lateral 2 ½ near Keyes Rd is a large site subwatershed within the third set of high priority subwatersheds and the Coalition completed focused outreach in 2013. The ESJWQC established a management plan for chlorpyrifos in the Lateral 2 ½ near Keyes Rd site subwatershed in 2010. The exceedance of the chlorpyrifos WQTL in July was the first exceedance since focused outreach was complete. Based on PUR data, applications of chlorpyrifos were made five days prior to sampling. All parcels associated with the July exceedance are currently members of the Coalition; however, not all were targeted for focused outreach in 2012 and 2013 based on location of parcels, when they became a member, and potential for direct drainage.

Overall, the management practices implemented by growers in the site subwatersheds have been effective in improving water quality. Of the 116 samples analyzed for chlorpyrifos during the 2014 WY, only three exceedances occurred (4%). The Coalition will continue to conduct outreach in all site subwatersheds and inform growers of the water quality concerns in the ESJWQC region.

On October 15, 2013, the ESJWQC received approval to remove eight specific site/constituent pairs from active management plans in seven site subwatersheds, of those site subwatersheds, two were approved to have chlorpyrifos removed and one was approved to have diazinon removed. The removal of these constituents (including chlorpyrifos and diazinon) from active management plans indicates the effectiveness of management practices implemented by members of the ESJWQC in each of the site subwatersheds.

**Table 27. Count of exceedances and samples collected for high priority pesticides in first through fifth priority subwatersheds.**

| Year | Chlorpyrifos | | | | Diazinon | | | |
|---|---|---|---|---|---|---|---|---|
| | Count of Exceedances | Count of Samples[1] | % Exceedance | Lbs Applied[2] | Count of Exceedances | Count of Samples[1] | % Exceedance | Lbs Applied[2] |
| 2006 | 14 | 96 | 15% | 114066 | 0 | 95 | 0% | 4653 |
| 2007 | 16 | 137 | 12% | 98482 | 1 | 132 | 1% | 4927 |
| 2008 | 19 | 163 | 12% | 57505 | 2 | 152 | 1% | 2517 |
| 2009 | 4 | 54 | 9% | 113217 | 0 | 37 | 0% | 1953 |
| 2010 | 8 | 45 | 21% | 66199 | 0 | 27 | 0% | 1149 |
| 2011 | 3 | 121 | 3% | 51248 | 0 | 108 | 0% | 1109 |
| 2012 | 0 | 41 | 0% | 45628 | 0 | 32 | 0% | 414 |
| Jan-Sept 2013 | 1 | 58 | 2% | 79541 | 1 | 28 | 4% | 415 |
| 2014 WY | 3 | 116 | 4% | 33456 | 0 | 76 | 0% | 511 |
| **Total** | 68 | 831 | 8% | 659342 | 4 | 687 | <1% | 17648 |

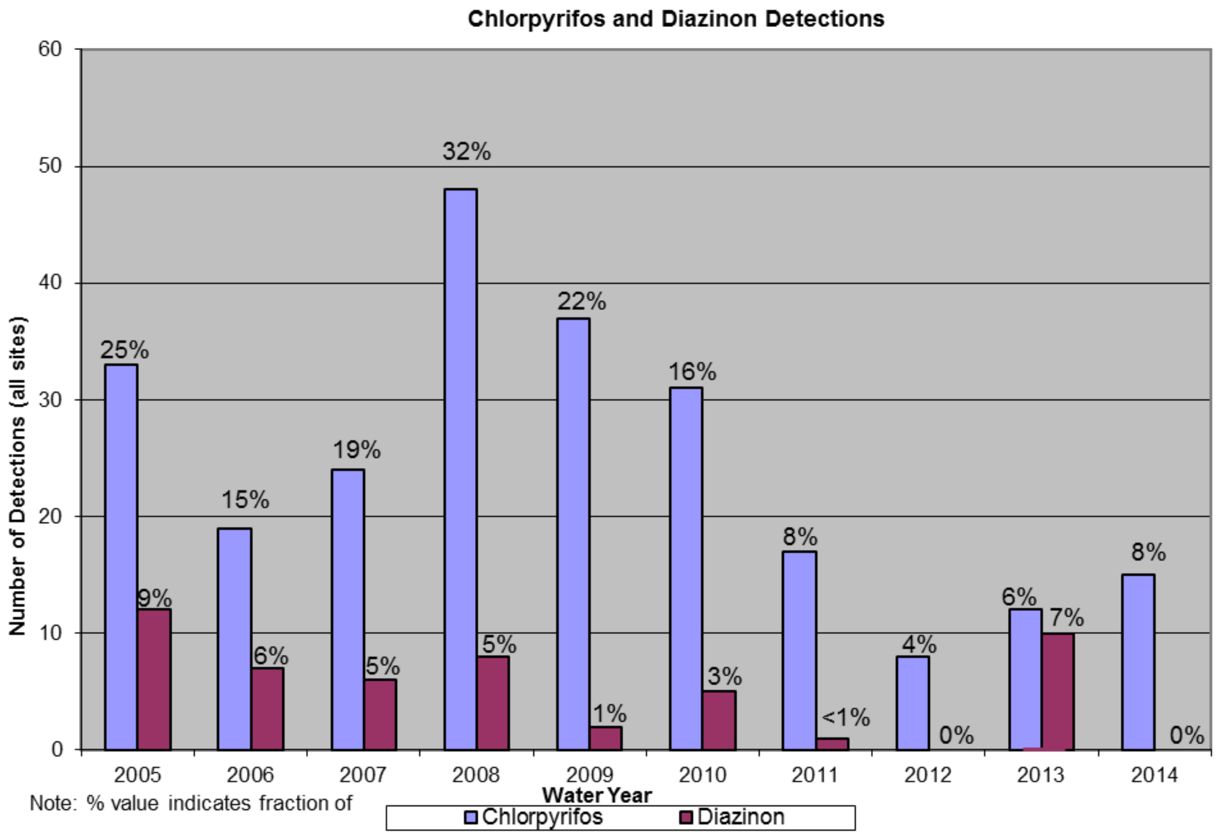
[1] Refers to all samples scheduled for constituent analysis (dry sites are included).
[2] PUR data since 2013 is considered preliminary.

## Westside Coalition Effectiveness of Management Practices to Reduce Offsite Movement of Diazinon and Chlorpyrifos

The Westside Coalition continues to struggle with chlorpyrifos exceedances at tributary monitoring sites. Since 2010, the Westside Coalition has mailed more than 600 notices regarding chlorpyrifos and diazinon exceedances and followed up with field visits to review water quality impairments and farming activities with individual growers.

A review of chlorpyrifos and diazinon detections since the beginning of the Westside Coalition's monitoring program provides a promising trend. Figure 7 shows the number of detections of both materials since 2005. Although the number of detections of chlorpyrifos was higher for 2014 when compared to the previous year, they remain substantially lower when compared to monitoring results prior to the implementation of the Westside Coalition Management Plan (2010 and prior).

**Figure 7. Count of chlorpyrifos and diazinon detections from 2006 through 2014 in the Westside Coalition tributaries**




## OBJECTIVE 5: DETERMINE WHETHER ALTERNATIVES TO DIAZINON AND CHLORPYRIFOS ARE CAUSING SURFACE WATER QUALITY IMPACTS

Since 2004, use of diazinon and chlorpyrifos in the LSJR watershed has shown an overall decline with some years of slight increases (Figures 1 and 2). Chlorpyrifos continues to be a widely used pesticide due to the large number of crops for which it is registered, it's relatively low cost, and because it effectively controls a variety of pest species even when pest pressures are high. Despite the benefits of chlorpyrifos, growers are aware of the water quality implications and there is evidence suggesting that they have been using alternative products throughout the year to reduce pest pressures and avoid harming beneficial insects.

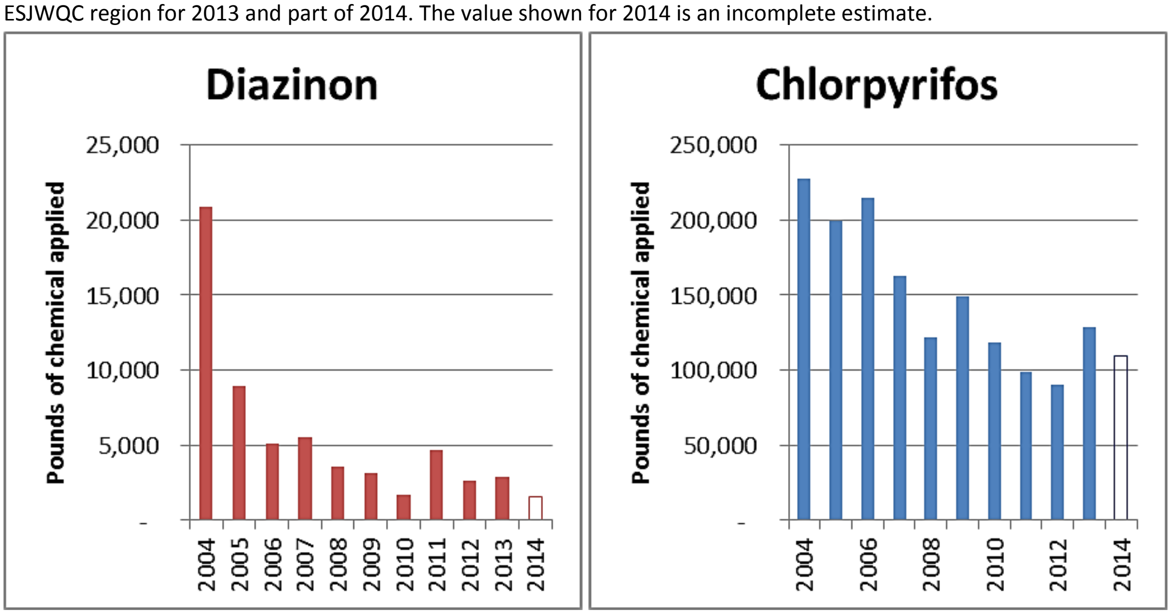
During grower outreach, ESJWQC and Westside Coalition representatives encourage growers to switch to products that are lower risk alternatives to chlorpyrifos and diazinon, and workshops are offered to educate growers about the selection of these alternatives. The use of alternatives to chlorpyrifos and diazinon depend on many factors including but not limited to commodity type, pest pressure, cost, and timing of pest control. In addition, pesticide groups have to be rotated to prevent insects from developing resistance. The Coalitions do not monitor for many new pesticides due to a lack of analytical methods and, in many cases, relatively limited use. However, PUR data can provide insight to the products being applied and how use has changed over time.

## ESJWQC Assessment of Alternatives to Diazinon and Chlorpyrifos

The pounds of diazinon and chlorpyrifos applied in the ESJWQC region has declined considerably since 2004 (Figure 8). The PUR data available from the counties in the ESJWQC region are incomplete through 2014, but it seems to follow the same decreasing trend of previous years. In 2013, the amount of diazinon applied within the LSJR watershed was only 14% of 2004 applications (Figure 8). The use of chlorpyrifos has declined slower than diazinon, but in 2013 chlorpyrifos use was 57% of its use in 2004. During 2013 and 2014 chlorpyrifos use was high relatively to previous years.

**Figure 8. Pounds of diazinon and chlorpyrifos applied in the ESJWQC region from 2004 through 2014 calendar years.**

PUR data from CalPIP are available through December 2012. Preliminary PUR data are available from the counties in the ESJWQC region for 2013 and part of 2014. The value shown for 2014 is an incomplete estimate.




The ESJWQC first investigated what pesticides are being used as alternatives to chlorpyrifos and diazinon. The Coalition reviewed the commodities with the most use of diazinon or chlorpyrifos in the region, the highest priority pests associated with those commodities, and the pesticides available to control them. Almonds, peaches, prunes, walnuts, alfalfa, grapes, and corn were identified as the commodities with the most pounds of chlorpyrifos or diazinon applied in the ESJWQC region since 2004 (Table 28). The highest priority pests are pests that are of major concern for a commodity and that are geographically widespread in the ESJWQC region. The ESJWQC reviewed alternative pesticides and other management strategies (i.e. applications of plant growth regulators) recommended for each high priority pest in each commodity (Table 29).

**Table 28. Commodities with the most pounds of chlorpyrifos and diazinon use in the ESJWQC region from 2004 through September 2014.**

PUR data after 2012 are considered preliminary. PUR data are incomplete through 2014.

| Commodity | Lbs AI Applied |
|---|---|
| **Chlorpyrifos** | |
| Almonds | 46,596 |
| Peaches | 20,032 |
| Prunes | 19,229 |
| **Diazinon** | |
| Almonds | 697,315 |
| Walnuts | 273,622 |
| Alfalfa | 196,724 |
| Grapes | 152,332 |
| Corn | 117,423 |

**Table 29. High priority pests of the commodities that use the most diazinon and/or chlorpyrifos in the ESJWQC region, with alternative pesticides recommended for those pests.**

| Commodity | Pest | Pesticide Class[1] | Active Ingredient |
|---|---|---|---|
| Alfalfa | Alfalfa weevil | Organophosphate | Chlorpyrifos, Malathion, Phosmet |
| | | Oxadiazine | Indoxacarb |
| | | Pyrethroid | Lambda-cyhalothrin, Cyfluthrin |
| | Blue and pea aphid | Botanical | Azadirachtin |
| | | Organophosphate | Chlorpyrifos, Dimethoate |
| | | Pyrethroid | Pyrethrin |
| | Spotted alfalfa aphid | Botanical | Azadirachtin |
| | | Organophosphate | Chlorpyrifos, Dimethoate |
| | | Pyrethroid | Pyrethrin |
| Almond | Navel orange worm | Avermectin | Emamectin benzoate |
| | | Bacterium | Bacillus thuringiensis |
| | | Diacylhydrazine | Methoxyfenozide |
| | | Diamide | Chlorantraniliprole, Flubendiamide |
| | | Organophosphate | Chlorpyrifos, Diazinon, Phosmet |
| | | Pyrethroid | Bifenthrin, Esfenvalerate, Fenpropathrin, Lambda-cyhalothrin |
| | | Spinosyn | Spinetoram, Spinosad |
| | | Unclassified | Buprofezin |
| | Peach twig borer | Avermectin | Emamectin benzoate |
| | | Bacterium | Bacillus thuringiensis |
| | | Benzoylurea | Diflubenzuron |
| | | Diacylhydrazine | Methoxyfenozide |
| | | Diamide | Chlorantraniliprole, Flubendiamide |
| | | Neonicotinoid | Acetamiprid |
| | | Organophosphate | Chlorpyrifos, Diazinon |
| | | Pyrethroid | Bifenthrin, Esfenvalerate, Lambda-cyhalothrin, Cyfluthrin, |
| | | Spinosyn | Spinetoram, Spinosad |
| | | Unclassified | Buprofezin |
| | San Jose scale | Carbamate | Carbaryl |

| Commodity | Pest | Pesticide Class[1] | Active Ingredient |
|---|---|---|---|
| | | Hormone | Pyriproxyfen |
| | | Organophosphate | Chlorpyrifos, Diazinon, Methidathion |
| | | Unclassified | Buprofezin |
| Corn | Corn earworm | Bacterium | Bacillus thuringiensis |
| | | Carbamate | Methomyl |
| | | Organophosphate | Chlorpyrifos |
| | | Pyrethroid | Esfenvalerate, Permethrin |
| | | Spinosyn | Spinosad, Spinetoram |
| Grape | Vine mealybug | Carbamate | Methomyl |
| | | Neonicotinoid | Acetamiprid, Imidacloprid |
| | | Organophosphate | Chlorpyrifos, Dimethoate |
| | | Unclassified | Buprofezin |
| Peach | Apricot scale (lecanium) | Organophosphate | Diazinon |
| | Peach twig borer | Bacterium | Bacillus thuringiensis |
| | | Benzoylurea | Diflubenzuron |
| | | Diacylhydrazine | Methoxyfenozide |
| | | Diamide | Chlorantraniliprole, Flubendiamide |
| | | Organophosphate | Diazinon |
| | | Pyrethroid | Esfenvalerate, Permethrin |
| | | Spinosyn | Spinetoram, Spinosad |
| | | Unclassified | Buprofezin |
| | San Jose scale | Carbamate | Carbaryl |
| | | Hormone | Pyriproxyfen |
| | | Organophosphate | Diazinon |
| | | Unclassified | Buprofezin |
| Prune | Peach twig borer | Bacterium | Bacillus thuringiensis |
| | | Benzoylurea | Diflubenzuron |
| | | Diacylhydrazine | Methoxyfenozide |
| | | Organophosphate | Chlorpyrifos, Diazinon, Methidathion, Phosmet |
| | | Pyrethroid | Esfenvalerate, Lambda-cyhalothrin |
| | | Spinosyn | Spinosad |
| | San Jose scale | Carbamate | Carbaryl |
| | | Hormone | Pyriproxyfen |
| | | Organophosphate | Chlorpyrifos, Diazinon, Methidathion |
| Walnut | Codling moth | Avermectin | Emamectin benzoate |
| | | Benzoylurea | Diflubenzuron |
| | | Carbamate | Carbaryl |
| | | Diacylhydrazine | Methoxyfenozide |
| | | Diamide | Chlorantraniliprole, Flubendiamide |
| | | Organophosphate | Chlorpyrifos, Phosmet |
| | | Pyrethroid | Bifenthrin, Cyfluthrin, Esfenvalerate, Lambda-cyhalothrin, Permethrin |
| | | Spinosyn | Spinetoram, Spinosad |
| | Walnut husk fly | Neonicotinoid | Imidacloprid |
| | | Organophosphate | Chlorpyrifos, Malathion, Phosmet |
| | | Pyrethroid | Cyfluthrin, Esfenvalerate |
| | | Spinosyn | Spinetoram, Spinosad |

[1] For organization purposes, Pesticide Class includes categories that are not pesticides, such as bacterium.

NA – Not available; no PUR data available

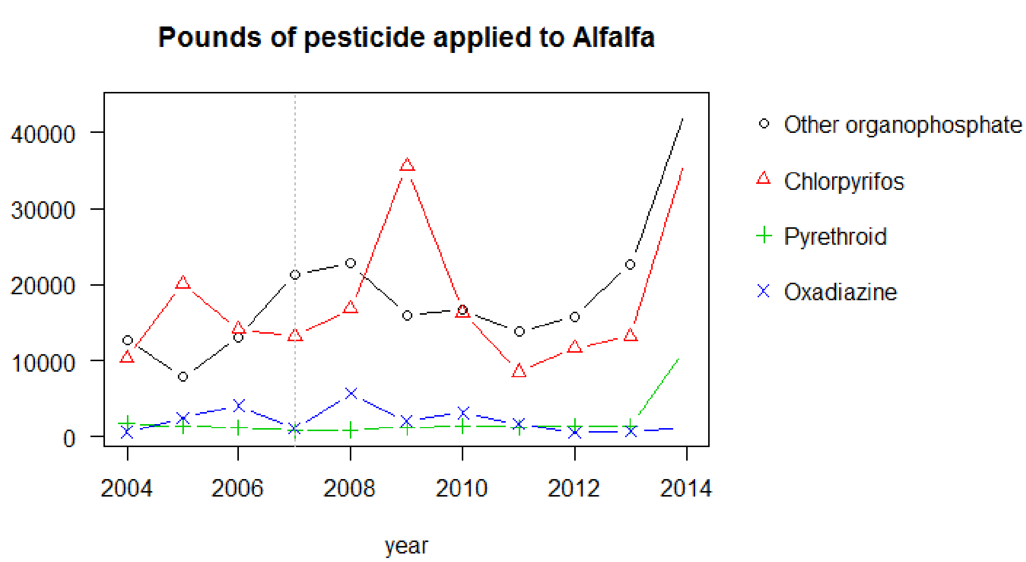
Sources: (California Department of Water Resources, 2015; Daane, et al., 1993; Elliott, et al., 2004; Insecticide Resistance Action Committee, 2005; Zalom, et al., 1999; Summers, et al., 2007; University of California Agriculture and Natural Resources, n.d.)

Several alternative options exist to manage high priority pests (Table 29). The alternative pesticides are different for each commodity. For example, the high priority pests in alfalfa are Alfalfa weevil, Blue and pea aphid, and Spotted alfalfa aphid. Eight different pesticides (organophosphates, pyrethroids, oxadiazines, and botanicals) are recommended and could be used to manage those pests (Table 29). The highest priority pests for almonds in the ESJWQC region are navel orange worm, peach twig borer, and San Jose scale. Over 10 different classes of pesticides, in addition to diazinon and chlorpyrifos, can be used to manage these pests in almonds (Table 29). Nine pesticides can be used to manage the same peach twig borer and San Jose scale in peaches, and seven to manage the same pest in prunes.

To evaluate which alternative pesticides are been used as alternatives to chlorpyrifos and diazinon, the ESJWQC reviewed PUR data for chlorpyrifos, diazinon, and alternative pesticides listed in Table 29 per each commodity. The analysis includes applications starting in 2004, although 2007 was the first year that general outreach focused on alternative strategies. PUR data are incomplete through 2014, but initial estimates are included in the figures for information purposes.

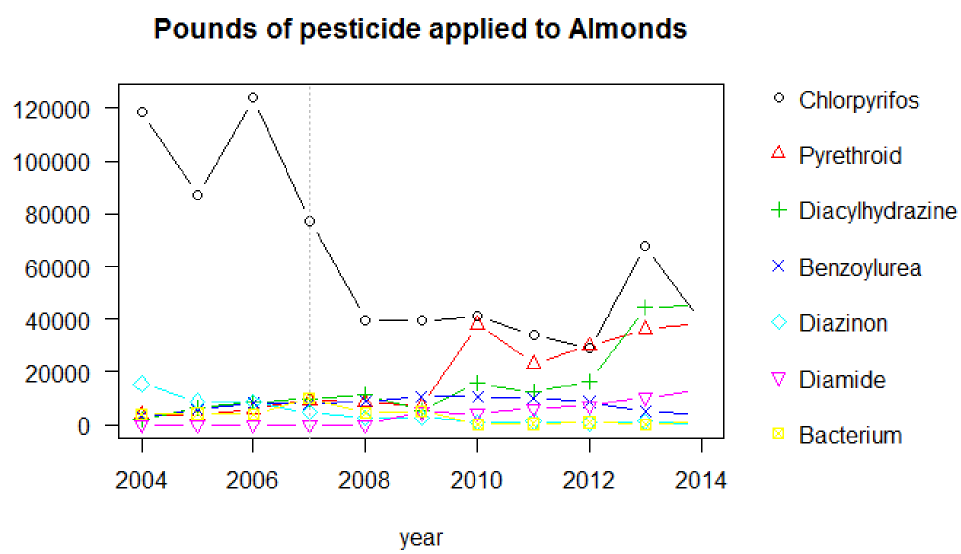
Pesticide use in alfalfa shows no clear trends since 2004 (Figure 9). Chlorpyrifos applications to alfalfa have remained relatively constant since 2004, with two sharp peaks in applications in 2009 and 2014. Even though 2014 data are incomplete, it is clear that 2014 saw higher than average pesticides applications for chlorpyrifos, other organophosphates, and pyrethroids. Overall use of other organophosphates has increased slightly over time (10% average increase per year), but this trend may be driven by the spike of 2014. Oxadiazines and pyrethroids are used much less than chlorpyrifos and other organophosphates. Pounds of oxadiazines and pyrethroids represent less than half of the pesticide applications of the organophosphates, and show no clear change in use over the time period.

**Figure 9. Pounds of alternative pesticide groups applied to alfalfa in the ESJWQC region since 2004. Vertical grey line indicates the beginning of outreach focusing on alternative pesticides.**
PUR data after 2012 are considered preliminary. PUR data are incomplete through 2014.



In almonds, chlorpyrifos was by far the major pesticide applied before 2007 (Figure 10). Chlorpyrifos applications per year before 2007 totaled nearly ten times the pounds of the other applied pesticides. Since outreach started focusing on pesticide alternatives in 2007, chlorpyrifos use has declined to about half the amounts used before (Figure 10). Since 2008, chlorpyrifos applications have remained relatively constant, while the applications of diacylhydrazines and pyrethroids have increased substantially (36% and 16% average increase per year since 2009, respectively). These two pesticides are now equally important with respect to total use per year as chlorpyrifos. The use of diamides has also increased over time (32% per year), but applications of this and other chlorpyrifos alternatives still represent less than half the pounds of chlorpyrifos, diacylhydrazines, or pyrethroids (Figure 10).

**Figure 10. Pounds of different pesticide groups applied to almonds in the ESJWQC region since 2004. Vertical grey line indicates the beginning of outreach focusing on alternative pesticides in 2007.**
PUR data after 2012 are considered preliminary. PUR data are incomplete through 2014.




In corn, the chlorpyrifos applications are quite variable among years, but there has been a decreasing trend in use (10% average reduction per year; Figure 11). Pyrethroids are currently the most important chlorpyrifos alternative for corn in terms of pounds applied per year. However, their use has remained relatively constant since 2004. Other alternative pesticides identified in Table 29 and Figure 11 have decreased in use (carbamates) or remain used at very low levels (spinosyns, bacterium).

In grapes, there has been no strong trend in the use of chlorpyrifos since 2004 (Figure 12). Chlorpyrifos applications have decrease on average 3% per year, except for a spike in chlorpyrifos applications during 2009 and 2010. Among the alternatives to chlorpyrifos identified in Table 29, neonicotinoids have shown a clear increase in use (17% average increase per year), and are currently used more than chlorpyrifos (Figure 12). There was a spike in the use of buprofezin during 2009 and 2010 (same years as chlorpyrifos) but use of buprofezin has fallen since then. Currently, buprofezin, carbamates, and other organophosphates are minor alternatives, with pounds applied per year ten times lower than chlorpyrifos and the neonicotinoids.

**Figure 11. Pounds of different pesticide groups applied to corn in the ESJWQC region since 2004. Vertical grey line indicates the beginning of outreach focusing on alternative pesticides in 2007.**
PUR data after 2012 are considered preliminary. PUR data are incomplete through 2014.

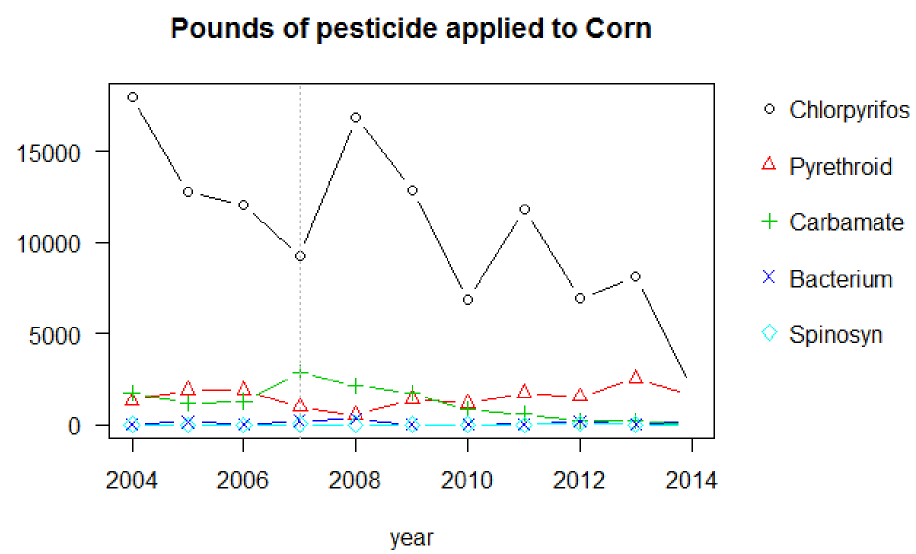
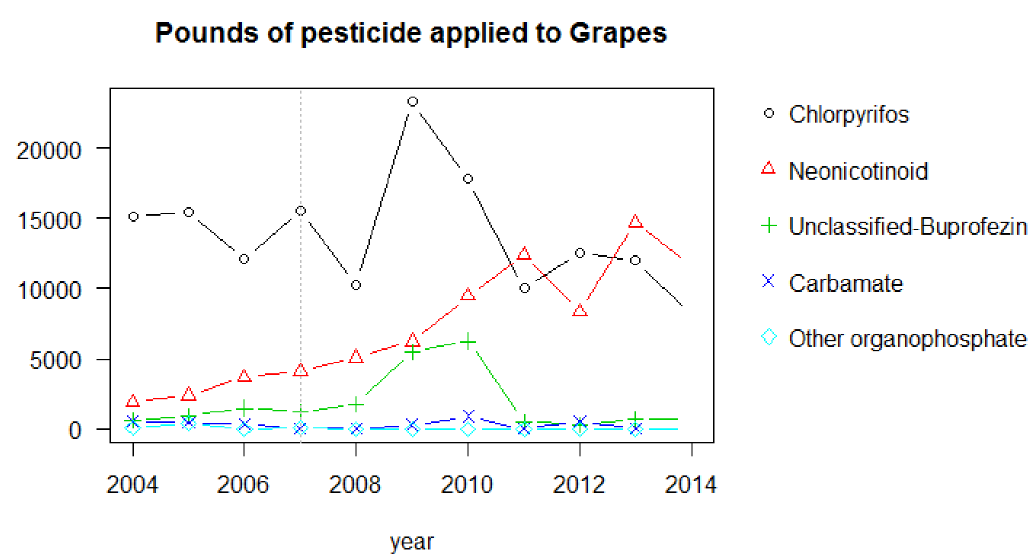
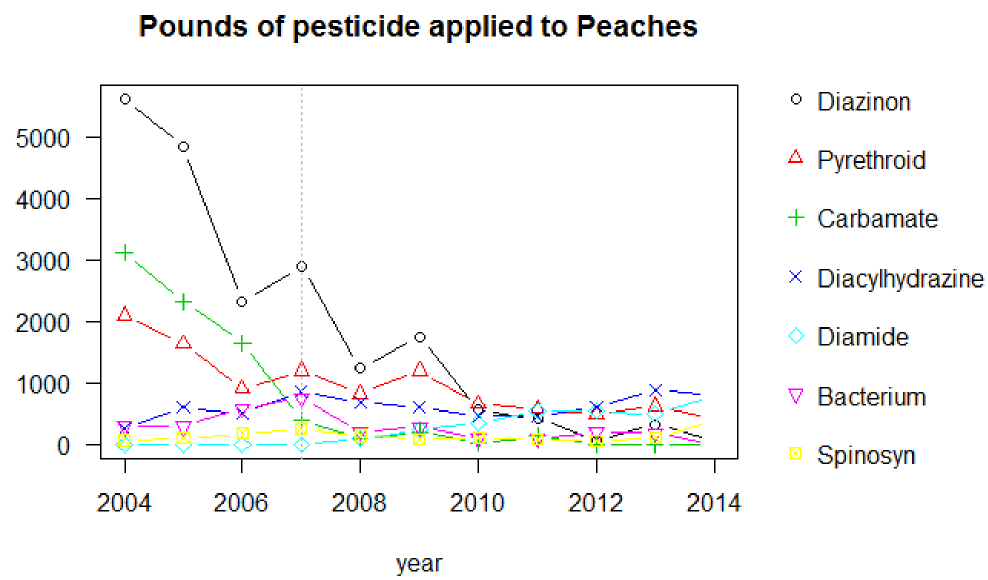



**Figure 12. Pounds of different pesticide groups applied to grapes in the ESJWQC region since 2004. Vertical grey line indicates the beginning of outreach focusing on alternative pesticides in 2007.**
PUR data after 2012 are considered preliminary. PUR data are incomplete through 2014.



In peaches, there has been a strong decrease in the use of diazinon since 2004 (29% average decrease per year; Figure 13). Diazinon was the major pesticide applied to peaches until 2009, but has been almost phased out since then. The two major alternative pesticides to diazinon before 2007, carbamates and pyrethroids, have also decreased in use (Figure 13). Diamides and diacylhydrazines have increased in use (29% and 5% per year, respectively). Together with pyrethroids, they are currently applied at higher rates than diazinon, but overall pesticide use is low. Total pesticide used in peaches has decreased from 3,000 to 6,000 lbs per year before 2007, to around 2,000 lbs per year since 2008.

**Figure 13. Pounds of different pesticide groups applied to peaches in the ESJWQC region since 2004. Vertical grey line indicates the beginning of outreach focusing on alternative pesticides in 2007.**
PUR data after 2012 are considered preliminary. PUR data are incomplete through 2014.




In prunes, diazinon was a major pesticide only in 2004, and since 2005 it has decreased in use at a rate of 24% average reduction per year (Figure 14). None of the alternative pesticides listed in Table 29 has increased in use to a degree that could be considered to be replacing diazinon use.

In walnuts, chlorpyrifos use has decreased since 2007 at an average rate of 6% per year (Figure 15). Chlorpyrifos remains the most used pesticide for walnuts. Other organophosphates have also decreased in the use since 2007 (18% average decrease per year). All other pesticide groups have increased in use in walnuts but are still used in small amounts relative to chlorpyrifos (Figure 15). Diamides and neonicotinoids have been introduced since 2007 and use has increased on average 30% per year since then. Pyrethroids, spinosyns, and diacylhydrazine have all increased on average of 15-20% per year.

**Figure 14. Pounds of different pesticide groups applied to prunes in the ESJWQC region since 2004. Vertical grey line indicates the beginning of outreach focusing on alternative pesticides in 2007.**
PUR data after 2012 are considered preliminary. PUR data are incomplete through 2014.

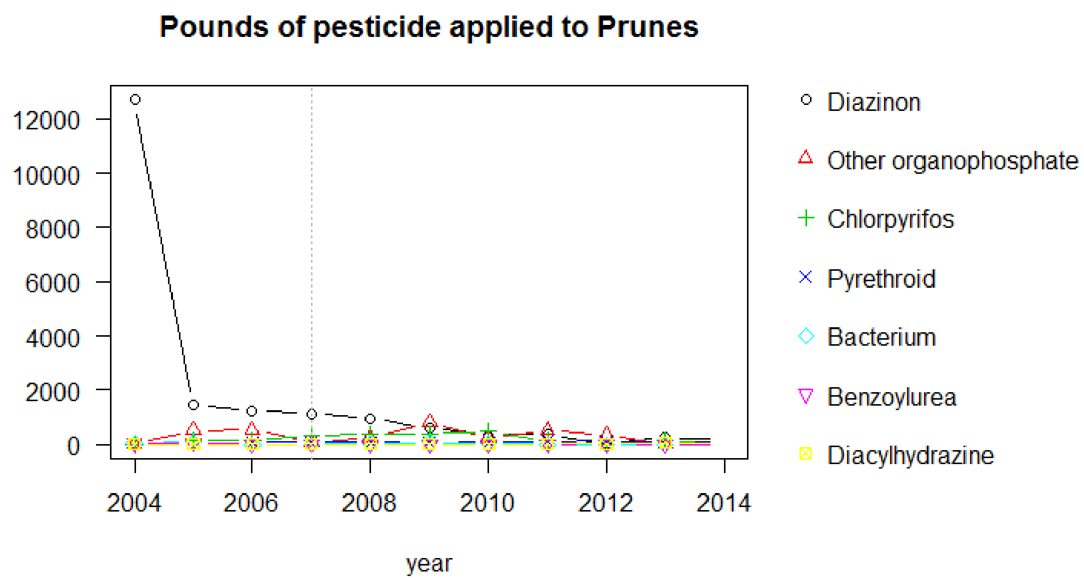
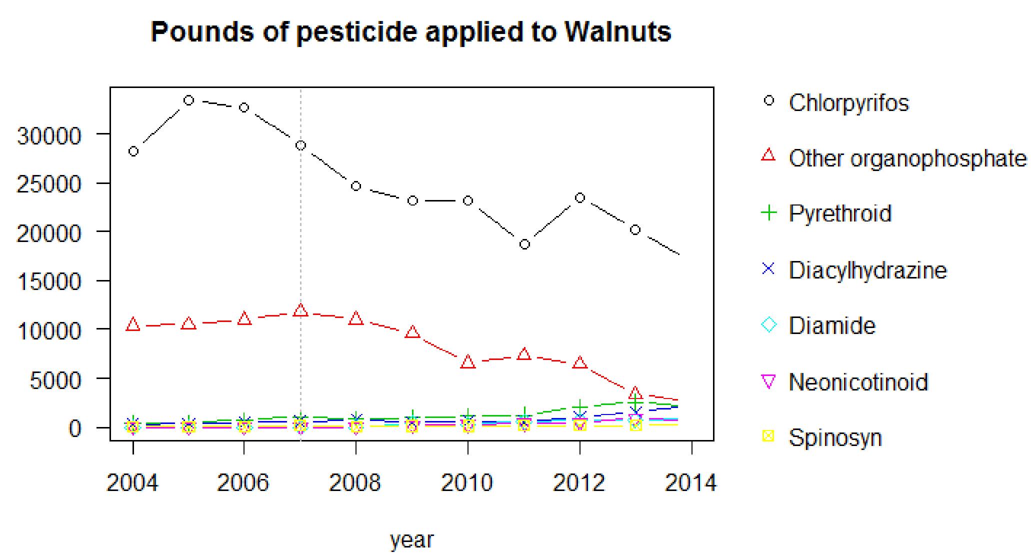



**Figure 15. Pounds of different pesticide groups applied to walnuts in the ESJWQC region since 2004. Vertical grey line indicates the beginning of outreach focusing on alternative pesticides in 2007.**
PUR data after 2012 are considered preliminary. PUR data are incomplete through 2014.




These trends suggest that pesticide use in the ESJWQC is changing in some crops more than in others. Chlorpyrifos is a major pesticide in alfalfa, almonds, corn, grapes, and walnuts (Table 28). Chlorpyrifos use has decreased in corn, almonds, and walnuts, but there has been no clear trend in alfalfa and grapes. In all those commodities chlorpyrifos remains a major pesticide. In almonds and grapes some alternatives have increased to a point where they became used as much as chlorpyrifos. In walnuts, alternative pesticides still have very low use relative to chlorpyrifos despite increases in use. In alfalfa and corn, alternative pesticides show no trends and are used at similar levels since before 2007. Diazinon use has decreased in almonds, prunes, and peaches. In those crops there are no clear indications of alternative pesticides being used as alternatives to diazinon, as there have been only small or no increase at all in the use of alternative pesticides.

It is important to keep in mind that these trends in pesticide use are not corrected for changes in the acreage of the different crops over time or the relative toxicity of the different pesticides to the target pests. Hence increases or decreases in yearly applications may also reflect increases or decreases in crop areas. Also, many changes in pesticide use may be explained by pesticide rotations to avoid pest resistance or changes in pest pressure from year to year. Finally, with these data it is not possible to determine if pesticides were used in place of chlorpyrifos or diazinon or if they were applied in response to the presence of a different pest, or applied during a different phase of the life cycle of a common insect pest.

The ESJWQC monitored for some alternative pesticides during 2014 WY (Table 30). The ESJWQC sampled 25 tributary sites for potential alternative pesticides and/or for water column and sediment toxicity which could indicate the presence of alternative pesticides.

Samples collected from Duck Slough @ Gurr Rd indicated the presence of malathion (Table 31). There is a prohibition of discharge of malathion for all Coalitions except for the Rice Coalition and any detection of malathion is considered an exceedance. This is the first exceedance of the WQTL for malathion at Duck Slough @ Gurr Rd. Malathion was monitored monthly at Duck Slough @ Gurr Rd. The PUR data associated with the April exceedance indicate there were 14 applications of malathion from March 12 through April 6, 2014. These applications totaled 1,073 lbs AI across 862 acres of alfalfa, barley, and corn. Applications were made by aerial and ground methods indicating a potential for spray drift from parcels treated adjacent to Duck Slough. Malathion is known to be toxic to *C. dubia* ($LC_{50}$ = 3.35 µg/L); however no toxicity occurred at the time of the malathion exceedance.

**Table 30. The ESJWQC tributary monitoring schedule for potential alternatives to chlorpyrifos and diazinon and toxicity during the 2014 WY.**

| Subarea | Site Name | Site Type | Organophosphates | | | | | | | | | | | Carbamates | | | | | | | Toxicity | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Azinphos-methyl | Dichlorvos | Dimethoate | Demeton-s | Disulfoton | Malathion | Methamidophos | Methidathion | Parathion, methyl | Phorate | Phosmet | Aldicarb | Carbaryl | Carbofuran | Methiocarb | Methomyl | Oxamyl | C. dubia | P. promelas | H. azteca[1] |
| Bear Creek, Fresno-chowchilla | Bear Creek @ Kibby Rd | R | | | | | | | | | | | | | | | | | | | | |
| | Black Rascal Creek @ Yosemite Rd | R | | | | | | | | | | | | | | | | | | X* | | |
| | Canal Creek @ West Bellevue Rd | R | | | | | | | | | | | | | | | | | | X | | |
| | Duck Slough @ Gurr Rd | C | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X* |
| | Deadman Creek @ Gurr Rd | R | | | | | | | | | | | | | | | | | | X* | X* | |
| | Miles Creek @ Reilly Rd | R | | | | | | | | | | | | | | | | | | X* | | X* |
| | Cottonwood Creek @ Rd 20 | R | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| | Dry Creek @ Rd 18 | R | | | | | | | | | | | | | | | | | | | | X* |
| Stanislaus River, North Stanislaus, Vernalis North | Mootz Drain downstream of Langworth Pond | R | | | | | | | | | | | | | | | | | | | | X |
| Stevinson, Grassland | Unnamed Drain @ Hwy 140 | R | | | | | | | | | | | | | | | | | | X | | |
| Tuolumne River, Northeast Bank, Westside Creek | Dry Creek @ Wellsford Rd | C | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X* |
| | Lateral 2 ½ near Keyes Rd | R | | | | | | | | | | | | | | | | | | | | R |
| | Westport Drain @ Vivian Rd | R | | | | | | | | | | | | | | | | | | | | R |
| Turlock, Merced, Greater Orestimba | Prairie Flower Drain @ Crows Landing | C | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X* |
| | Hatch Drain @ Tuolumne Rd | R | | | X | | | | | | | | | | | | | | | | | X* |
| | Hilmar Drain @ Central Ave | R | | | X | | | | | | | | | | | | | | | | | X* |
| | Lateral 5 1/2 @ South Blaker Rd | R | | | X | | | | | | | | | | | | | | | X | X | X |
| | Lateral 6 and 7 @ Central Ave | R | | | X | | | | | | | | | | | | | | | X | X | X |
| | Levee Drain @ Carpenter Rd | R | | | X | | | | | | | | | | | | | | | X | X | X |
| | Lower Stevinson @ Faith Home Rd | R | | | X | | | | | | | | | | | | | | | X | X | X |
| | Unnamed Drain @ Hogin Rd | R | | | X | | | | | | | | | | | | | | | X | X | X |
| | Highline Canal @ Hwy 99 | C | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X* |
| | Highline Canal @ Lombardy Rd | R | | | | | | | | | | | | | | | | | | X* | | X* |
| | Mustang Creek @ East Ave | R | | | | | | | | | | | | | | | | | | | | X |
| | Merced River @ Santa Fe | C | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |

X - Monitoring occurred during the 2014 WY; C - Core site; R-Represented site; X*- Monitoring due to a management plan.

[1]If *H. azteca* survival is less than 80% compared to the control, the following pesticides are analyzed: bifenthrin, cyfluthrin, cypermethrin, deltamethrin, esfenvalerate, lambda-cyhalothrin, permethrin, fenpropathrin and chlorpyrifos. Sediment samples are only collected twice a year.

**Table 31. Water column detections of potential alternative pesticides in ESJWQC tributaries during the 2014 WY.**
Bold indicates results in exceedance of the associated WQTL.

| Zone | Site Name | Sample Date | Analyte Name | Result (µg/L) | WQTL (µg/L) |
|---|---|---|---|---|---|
| Bear Creek, Fresno-chowchilla | Duck Slough @ Gurr Rd | 4/08/2014 | Malathion | **0.12** | 0.00 |

Monitoring results indicate ten instances of toxicity. Five water column samples were toxic, two to *Ceriodaphnia dubia* and three to *Pimephales promelas*. Five sediment samples were toxic to *Hyalella azteca* (Table 32). Toxicity Identification Evaluation (TIE) analyses are required for toxic water column samples when survival is below 50% of control. However, TIE was not conducted in the three water column toxicity events below this threshold because the lab measured extremely high levels of ammonia in those samples (Table 32). Hence, it is assumed that ammonia was the cause of toxicity. When sediment toxicity results in *H. azteca* survival fall below 80% of control, the toxic sediment sample is tested for chlorpyrifos and eight pyrethroids. Three of the five events of sediment toxicity were analyzed and all resulted in detections of chlorpyrifos and multiple pyrethroids (Table 32).

Monitoring results in 2014 WY indicate malathion and pyrethroids were present in tributaries within the ESJWQC region (Table 31 and Table 32). In addition, toxicity evaluation identification tests indicate pyrethroids were associated with impaired water quality (Table 32). Pyrethroids are among the top alternatives applied on alfalfa, almonds, corn, peaches, and walnuts.

**Table 32. The ESJWQC tributary water column and sediment toxicity exceedance summary for the 2014 WY.**
During 2014 WY there were instances of toxicity to *S. capricornutum* in the ESJWQC. These are not included in this table because algae toxicity is associated with herbicides, not with insecticides that can be used as alternatives to chlorpyrifos or diazinon.

| Site Name | Sample Date | Species | Sample Mean (% survival) | Percent Control | Toxicity Significance | Summary Comments |
|---|---|---|---|---|---|---|
| Deadman Creek @ Gurr Rd | 11/12/13 | *C. dubia* | 0 | 0 | SL | Toxicity coincides with high levels of ammonia (47.3 mg/L) |
| Deadman Creek @ Gurr Rd | 11/13/13 | *P. promelas* | 0 | 0 | SL | Toxicity coincides with high levels of ammonia (37.0 mg/L) |
| Deadman Creek @ Gurr Rd | 12/10/13 | *P. promelas* | 0 | 0 | SL | Toxicity coincides with high levels of ammonia (70.5 mg/L) |
| Duck Slough @ Gurr Rd | 3/3/14 | *C. dubia* | 75 | 75 | SL | Toxicity coincides with an exceedance level detection of chlorpyrifos (0.053 ug/L). |
| Duck Slough @ Gurr Rd | 3/3/14 | *P. promelas* | 85 | 85 | SG | Toxicity coincides with an exceedance level detection of chlorpyrifos (0.053 ug/L). |
| Mootz Drain downstream of Langworth Pond | 3/4/14 | *H. azteca* | 88 | 88 | SG | |
| Hatch Drain @ Tuolumne Rd | 3/4/14 | *H. azteca* | 56 | 56 | SL | Sediment detections of bifenthrin (32ng/g), chlorpyrifos (20 ng/g), lambda-cyhalothrin (1.3 ng/g), cypermethrin (6.3 ng/g), and esfenvalerate: fenvalerate (J0.28 ng/g) |
| Levee Drain @ Carpenter Rd | 3/4/14 | *H. azteca* | 76 | 76 | SL | Sediment detections of bifenthrin (6.3 ng/g), chlorpyrifos (26 ng/g), lambda-cyhalothrin (3.2 ng/g), and permethrin (0.93 ng/g) |
| Hatch Drain @ Tuolumne Rd | 9/9/14 | *H. azteca* | 48 | 52 | SL | Sediment detections of bifenthrin (27ng/g), chlorpyrifos (4.6ng/g), cyfluthrin (J0.21ng/g), lambda-cyhalothrin (2.2ng/g), cypermethrin (1.4ng.g), and permethrin (J0.31ng/g) |
| Lateral 6 and 7 @ Central Ave | 9/9/14 | *H. azteca* | 74 | 80 | SG | |

SL-Statistically significant difference from control; less than 80% threshold
SG-Statistically significant difference from control; greater than 80% threshold
J-Estimated value

## Westside Coalition Assessment of Alternatives to Diazinon and Chlorpyrifos

The Westside Coalition tests collected samples for a variety of carbamate, OP, and organochlorine insecticides (depending on the site). During the 2014 WY, there were 33 detections of insecticides at sites monitored by the Westside Coalition. Of these, four represented legacy insecticides that are no longer in use (DDT and DDE). Of the remaining detections, 26 were OP insecticides (15 detections of chlorpyrifos and 11 of dimethoate), and three were carbamates (methomyl).

The Westside Coalition collects sediment samples for toxicity testing in March and September of 2014, and sediment pesticide analyses are performed as a follow-up to observations of sediment toxicity. During the 2014 WY, seventeen samples were collected (including one duplicate) and tested for toxicity to *H. azteca* on March 10th, 2014. Statistically significant toxicity was measured at ten sites, although six of the sites with observed toxicity measured survival greater than 80%. Five samples exhibited sufficient toxicity to warrant follow-up analysis (>20% difference from control). Follow-up analysis included pesticide testing for a variety of pyrethroids, legacy organochlorines, and selected OP insecticides. On September 8$^{th}$, 2014 sixteen sediment samples were collected and tested for sediment toxicity (including one duplicate). Of these, six showed significant toxicity and four of those samples were tested for selected pesticides. Of the eight sediment samples tested for pesticides (over both events), chlorpyrifos was detected above the RL in six samples. Sediment toxicity and pesticide detections are discussed in greater detail in Section 8 and Attachment 4 of the Westside Coalition's SAMRs.

The Westside Coalition also reviewed available PUR data to evaluate applications of insecticides. Table 33 lists the most applied insecticides (based on total application area, October 2013 to September 2014).

**Table 33. Insecticide applications within the Westside Coalition in order of highest application area.**

| Fresno County | Merced County | Stanislaus County |
|---|---|---|
| Chlorpyrifos | Dimethoate | Lambda-cyhalothrin |
| Bifenthrin | Chlorpyrifos | Dimethoate |
| Imidacloprid | Imidacloprid | Chlorothalonil |
| Dimethoate | Lambda-Cyhalothrin | Esfenvalerate |
| Acetamiprid | Indoxacarb | Imidacloprid |
| Indoxacarb | Thiamethoxam | Bifenthrin |
| Clofentezine | Beta-Cyfluthrin | Chlorpyrifos |
| Lambda-Cyhalothrin | Malathion | Hexythiazox |
| Malathion | Bifenthrin | Myclobutanil |
| Chlorothalonil | S-Cypermethrin | Mancozeb |
| Thiamethoxam | Methomyl | Iprodiod |
| S-Cypermethrin | Acetamiprid | Indoxacarb |
| Methomyl | Esfenvalerate | Clofentezine |
| Hexythiazox | Propargite | Malathion |
| Esfenvalerate | Hexythiazox | Methomyl |
| Acephate | Acephate | Acetamiprid |
| Maled | Permethrin | Permethrin |
| Beta-Cyfluthrin | Naled | Bifenazate |

## Summary of Alternatives Detected

The ESJWQC and Westside Coalition detected several pesticides that are alternatives to chlorpyrifos and/or diazinon, including alternatives recommended by the Pest Control Advisors for use on grapes, almonds, and walnuts. Some of these alternative pesticides were found to impair water quality by either exceeding their respective WQOs or contributing to toxicity. Below is a brief description of the detected pesticides:

- Bifenthrin is a pyrethroid insecticide used to treat a variety of insects in orchards and field crops such as alfalfa, cotton, tomatoes, and corn but also has significant residential use.
- Cyfluthrin is a pyrethroid insecticide used to treat a variety of insects in orchards and field crops such as alfalfa, corn, tomatoes, and cotton.
- Cypermethrin is a pyrethroid insecticide used to treat a variety of insects in field crops such as alfalfa, cotton, onions, and cabbage.
- Dimethoate is an OP pesticide used to control a wide range of insects. It is used on a variety of field crops including alfalfa, beans, tomatoes, and cotton.
- Esfenvalerate/Fenvalerate is a pyrethroid insecticide which is used on a wide range of pests on vegetable crops, tree fruits, and nut crops. It may be mixed with a wide variety of other types of pesticides such as carbamate compounds or organophosphates
- Lambda cyhalothrin is a pyrethroid insecticide used to treat a variety of insects in orchards and field crops such as corn, tomatoes, and cotton.
- Malathion is an OP insecticide used on a variety of crops including alfalfa, walnuts, lettuce, grapes, and cotton.
- Methomyl is a carbamate insecticide used to control a variety of pests on vegetable, fruit, and field crops.
- Permethrin is a pyrethroid insecticide used to treat a variety of insects in orchards and field crops such as corn, tomatoes, and cotton and is also used for mosquito and residential insect control.

Although the Coalitions detected nine different insecticides in waterways during this reporting period, it is not possible to determine with certainty if any of these materials were selected as an alternative to chlorpyrifos or diazinon, or were used as part of a grower's pesticide management rotation. Pesticide Control Advisors are recommending the use of some of these pesticides, but the PUR and monitoring data do not provide sufficient information for the Coalitions to establish if the detected pesticides were indeed from applications of pesticides used in an alternative capacity. It is a necessary cultural practice to rotate pesticide selection through specific modes of action (i.e. pyrethroids to organophosphates to carbamates) in order to minimize the risk of pesticide resistance. As a result of this practice, a material other than chlorpyrifos or diazinon may be selected simply because it was next in the rotation rather than as a specific alternative. Based on the Coalition's conversations with growers and Pest Control Advisors, regulatory pressure on diazinon use has phased that material out of the pest management rotation. Chlorpyrifos continues to be a preferred material due to its wide range of allowable use and effectiveness. The Coalitions continue to educate growers through outreach of other applicable alternatives to chlorpyrifos.

## OBJECTIVE 6: DETERMINE WHETHER THE DISCHARGE CAUSES OR CONTRIBUTES TO TOXICITY IMPAIRMENT DUE TO ADDITIVE OR SYNERGISTIC EFFECTS OF MULTIPLE POLLUTANTS.

The formula used to calculate loading capacity and load allocation (Equation 1) for chlorpyrifos and diazinon are based on current understanding of the two pesticides' additive effects. As part of each Coalition's tributary monitoring strategies, the ESJWQC and Westside Coalition sample for a wide range of pesticides and toxicity. TIEs are conducted on toxic water samples to determine the cause of toxicity (if survival is 50% or less compared to the control). Toxic sediment samples are subject to further analysis for chlorpyrifos and pyrethroids (if survival is less than 80% compared to the control). From these results, the Coalitions are able to consider the additive and/or synergistic effects of multiple pollutants.

### ESJWQC Evaluation of Toxicity Impairment Due to Additive or Synergistic Effects of Multiple Pollutants

To assess if toxicity occurred due to the additive or synergistic effects of chlorpyrifos or diazinon and another pollutant, the ESJWQC reviewed toxicity results for *C. dubia* and *P. promelas* in the water column and *H. azteca* in sediment samples. During the 2014 WY, two water column samples were toxic to *C. dubia*, three to *P. promelas*, and six sediment samples were toxic to *H. azteca* (Table 32).

Sediment chemistry analysis for pyrethroids and chlorpyrifos was performed on samples toxic to *H. azteca* from Hatch Drain @ Tuolumne Rd collected March 4, 2014 and September 9, 2014, and from Levee Drain @ Carpenter Rd collected September 9, 2014. Sediment samples collected on March 4, 2014, and September 9, 2014 from Mootz Drain downstream of Longwood Pond and Lateral 6 and 7 @ Central Ave, respectively, did not require additional sediment chemistry analysis because survival was greater than 80% compared to the control (Table 32).

The sediment chemistry analyses indicated the presence of bifenthrin, chlorpyrifos, cyfluthrin, lambda cyhalothrin, cypermethrin, permethrin, and esfenvalerate/fenvalerate (Table 32). Those compounds could have acted additively or synergistically to cause to toxicity, however with the available data, it is not possible to evaluate if the detected pesticides interacted in an additive or synergistic manner to cause the sediment toxicity.

### Westside Coalition Evaluation of Toxicity Impairment Due to Additive or Synergistic Effects of Multiple Pollutants

The Westside Coalition reviewed aquatic and sediment toxicity results to assess if toxicity occurred due to the additive or synergistic effects of chlorpyrifos or diazinon and another pollutant. During the 2014 WY, four samples were toxic to *Selenastrum capricornutum*, and sixteen sediment samples were toxic to *Hyalella azteca*. Table 34 and Table 35 provide details regarding the survival, follow-up testing, and apparent causes of these toxicity events. Diuron was present in two of the four of the samples exhibiting aquatic toxicity to *S. capricornutum*. It is worth noting that no toxicity was observed to *Ceriodaphnia dubia* (the species that would be most affected by chlorpyrifos and diazinon) during the 2014 WY.

Chlorpyrifos was detected in 15 separate water samples, including one source water sample. However, in all cases there was no observed aquatic toxicity to *C. dubia*. Because aquatic toxicity to *C. dubia* was not observed during the 2014 WY, there is no evidence of any synergistic effects causing toxicity.

**Table 34. Westside Coalition tributary water column toxicity exceedance summary for 2014 WY.**

| Station Name | Sample Date | Reactive Species | Results | Units | TIE Comments | Apparent Cause |
|---|---|---|---|---|---|---|
| Salt Slough @ Sand Dam | 2/10/2014 | *S. capricornutum* | 57 | % Difference | Toxicity was not persistent in the TIE. | Diuron (5.6 µg/L), Dimethoate (1.3µg/L), Prowl (0.71 µg/L) |
| Orestimba Creek @ Hwy 33 | 3/3/2014 | *S. capricornutum* | 36 | % Difference | TIE was not Required | DDE (0.0083 µg/L) |
| LSJR @ Lander Ave | 3/3/2014 | *S. capricornutum* | 64 | % Difference | Tie indicated pesticides are the likely cause | Diuron (5.4 µg/L) |
| Orestimba Creek @ Hwy 33 | 4/8/2012 | *S. capricornutum* | 59 | % Difference | TIE indicated multiple compounds were likely the cause of toxicity. | Dimethoate (3.6 µg/L) |

## *Evaluation of Detected Sediment Pesticides*

### March 2014 Sediment Toxicity Follow Up

Sediment toxicity tests were performed on 17 samples (including one duplicate) collected in March 2014 (Event 111). Statistically significant toxicity was measured in 10 of those samples, although six of those samples measured survival >80% (Table 35), follow up pesticide testing was performed on the four samples exhibiting severe toxicity. These results were compared to literature values for the purpose of determining the probable cause of toxicity in each sample. In all cases pesticides were present in sufficient quantity to have caused the toxicity.

- Blewett Drain at Highway 132 (61.3% survival): A total of 2.75 sediment toxic units (TUs) were calculated based on the detected pesticides. Bifenthrin accounted for 1.77 TUs, esfenvalerate 0.16 TUs, lambda-cyhalothrin 0.19 TUs, permethrin 0.01 TUs, and chlorpyrifos accounted for 0.61 TUs.
- Ingram Creek (40% Survival): 2.19 TUs were calculated, with bifenthrin 0.58 TUs, and lambda cyhalothrin 0.33 TUs, esfenvalerate 0.20, and chlorpyrifos accounted for 0.39 TUs.
- Del Puerto Creek near Cox Road (23.8% Survival): A total of 2.67 TUs were calculated with bifenthrin 0.56 TUs, lambda cyhalothrin 0.66 TUs, esfenvalerate 0.06 TUs, and chlorpyrifos, accounted for 1.39 TUs.

- Orestimba Creek at Highway 33 (76.3% survival): 1.14 TUs were calculated, with bifenthrin 0.72 TUs, cyfluthrin 0.01 TUs, lambda cyhalothrin 0.33 TUs, esfenvalerate 0.06, and chlorpyrifos accounted for 0.02 TUs.

### September 2014 Sediment Toxicity Follow-Up

Sediment toxicity tests were performed on 16 samples (including one duplicate) collected in September 2014 (Event 117). Statistically significant toxicity was measured at six sites, five of which were sufficient to require follow-up pesticide analysis (see Table 35). These results were compared to literature values for the purpose of determining the probable cause of toxicity in each sample.

- The Blewett Drain at Highway 132 sample had a total of 5.96 TUs, with bifenthrin accounting for 1.43 TUs and esfenvalerate accounting for 4.32 TUs. Chlorpyrifos accounted for 0.07 TUs. There were sufficient pyrethroid TUs to account for the 26.3% survival observed.
- The Hospital Creek sample had a total of 9.31 TUs. Bifenthrin accounted for 0.74 TUs, lambda-cyhalothrin accounted for 3.77 TUs, esfenvalerate accounted for 4.72 TUs and chlorpyrifos accounted for 0.07 TUs.
- The Ingram Creek sample had a total of 3.02 TUs, with bifenthrin accounting for 1.07 TUs and lambda-cyhalothrin accounting for 1.71 TUs. Chlorpyrifos accounted for 0.05 TUs. There were sufficient pyrethroid TUs to account for the 18.8% amphipod survival observed in the sample.
- The Orestimba Creek at Highway 33 sample had a total of 0.74 TUs, with bifenthrin accounting for 0.73 TUs. Chlorpyrifos accounted for 0.01 TUs. There were sufficient pyrethroid TUs to account for the 57.5% amphipod survival observed in the sample.
- The Westley Wasteway sample had a total of 3.23 TUs, with bifenthrin for 3.05 TUs and lambda-cyhalothrin accounting for 0.14 TUs. Chlorpyrifos accounted for 0.01 TUs. There were sufficient pyrethroid TUs to account for the 61.25% amphipod survival observed in the sample.

In each of the sediment samples where follow-up pesticide analyses were performed, at least one pyrethroid insecticide was detected at a level sufficient to cause the observed toxicity itself. Hence, synergistic effects between chlorpyrifos and other materials were unlikely.

**Table 35. The Westside Coalition tributary sediment toxicity exceedance summary for the 2014 WY.**

| Station Name | Sample Date | Reactive Species | % Survival | Detected Pesticides |
|---|---|---|---|---|
| Belwett Drain @ Hwy 132. | 3/10/14 | *H. azteca* | 61.25 | Bifenthrin (3.4 ng/g), Chlorpyrifos (4.0 ng/g), Lambda-cyhalothrin (0.31j ng/g), DDE (11 ng/g), DDT (2.3j ng/g), Esfenvalerate (0.89 ng/g), Permethrin (0.52 ng/g).. |
| Del Puerto Creek near Cox Rd | 3/10/14 | *H. azteca* | 23.75 | Bifenthrin (3.9 ng/g), Chlorpyrifos (34ng/g), Lymbda-cyhalothrin (4.0 ng/g). DDD (2.6j ng/g), DDE (47 ng/g), DDT (8.0 ng/g), Esfenvalerate (1.3 ng/g), Permethrin (0.4 ng/g) |
| Ingram Creek @ River Rd. | 3/10/14 | *H. azteca* | 40 | Bifenthrin (1.7 ng/g), Chlorpyrifos (3.9 ng/g), Lambda-cyhalothrin (1.7 ng/g), Cypermethrin (0.7 ng/g), DDD (2.1j ng/g), DDE (52 ng/g), DDT (18 ng/g) Esfenvalerate (1.7 ng/g), Permethrin (0.24j ng/g) |
| Orestimba Creek @ Hwy 33 | 3/10/14 | *H. azteca* | 76.25 | Bifenthrin (9.3 ng/g), Chlorpyrifos (0.71 ng/g), Cyfluthrin (0.16j ng/g), Lambda-cyhalothrin (3.7 ng/g), DDD (17 ng/g), DDE (170 ng/g), DDT (14 ng/g), Esfenvalerate (2.1 ng/g), Permethrin (0.43 ng/g) |
| Ramona Lake near Fig Ave | 3/10/14 | *H. azteca* | 81.3 | No follow-up testing required |
| Hospital Creek @ River Rd. | 3/10/14 | *H. azteca* | 87.5 | No follow-up testing required |
| Westley Wasteway near Cox Rd. | 3/10/14 | *H. azteca* | 87.5 | No follow-up testing required |
| Los Banos Creek @ Hwy 140 | 3/10/14 | *H. azteca* | 92.9 | No follow-up testing required |
| Los Banos Creek @ China Camp Rd | 3/10/14 | *H. azteca* | 88.8 | No follow-up testing required |
| Salt Slough @ Sand Dam | 3/10/14 | *H. azteca* | 81.3 | No follow-up testing required |
| Blewett Drain @ Hwy 132 | 9/8/14 | *H. azteca* | 26.25 | Bifenthrin (3.9 ng/g), Chlorpyrifos (0.67j ng/g), Lambda-cyhalothrin (0.32j ng/g), DDE (10 ng/g), DDT (1.8j ng/g), Esfenvalerate (35 ng/g) |
| Hospital Creek @ River Rd. | 9/8/14 | *H. azteca* | 2.5 | Bifenthrin (4 ng/g), Chlorpyrifos (0.67 ng/g), Lambda-cyhalothrin (5.5 ng/g), Cypermethrin (0.21j ng/g)DDD (6.7 ng/g), DDE (95 ng/g), DDT (1.3j ng/g) Esfenvalerate (1.1 ng/g), Permethrin (0.41 ng/g) |
| Ingram Creek @ River Rd. | 9/8/14 | *H. azteca* | 18.8 | Bifenthrin (23 ng/g), Chlorpyrifos (0.2j ng/g), Cyfluthrin (1.2 ng/g), Lambda-cyhalothrin (0.86 ng/g), Esfenvalerate (1.7 ng/g) |
| Orestimba Creek @ Hwy 33 | 9/8/14 | *H. azteca* | 57.5 | Bifenthrin (3.6 ng/g), Chlorpyrifos (0.22j ng/g), Lambda-cyhalothrin (0.13j ng/g), DDD (8 ng/g), DDE (130 ng/g), DDT (1.3j ng/g), Permethrin (0.71 ng/g) |
| Westley Wasteway near Cox Rd. | 9/8/14 | *H. azteca* | 61.25 | Bifenthrin (27 ng/g), Chlorpyrifos (0.3j ng/g), Cyfluthrin (0.13j ng/g), Lambda-cyhalothrin (1.1 ng/g) |
| Los Banos Creek @ China Camp Rd | 9/8/14 | *H. azteca* | 81.3 | No follow-up testing required. |

# OBJECTIVE 7: DEMONSTRATE THAT MANAGEMENT PRACTICES ARE ACHIEVING THE LOWEST PESTICIDE LEVELS TECHNICALLY AND ECONOMICALLY ACHIEVABLE

A determination of technical and economic feasibility needs to be done at the individual farm level and, consequently, is expected to vary with the specific operation and commodity farmed. The goal of the ESJWQC and Westside Coalition is for their members to have no discharge of pesticides to surface waters. Economic feasibility is determined by factors outside the control of the Coalitions. Profitable operations can afford to implement management practices such as constructing sediment basins or installing pressurized irrigation, both of which can significantly reduce the runoff of irrigation and stormwater carrying agricultural discharges. Marginally profitable operations may not be able to afford these practices. Consequently, efforts by the ESJWQC and Westside Coalition to obtain additional funding for growers have been important to achieving the Coalitions' goal. Both Coalitions have been instrumental in helping growers obtain AWEP funding and publicizing the current funding available through the Proposition 84 grant program run by the Coalition for Urban/Rural Environmental Stewardship (CURES) as well as NRCS funding and internal grant/loan funding provided by local water agencies. These programs offer several million dollars towards the implementation of structural management practices within their respective regions. However, there remain many growers in the eastside drainage area of the LSJR who are not members of either Coalition and not influenced by the Coalitions' efforts.

It is technically feasible to eliminate all discharges of chemicals to surface waters, although it could require steps that are not economically feasible for even the most profitable operations. Given the success in the ESJWQC and Westside Coalition regions in the 2014 WY, it seems possible to reduce discharges to surface waters to the point that they do not impair beneficial uses.

During the 2014 WY, there were fewer exceedances of the WQTLs of both chlorpyrifos and diazinon compared to the 2013 WY. The new membership enrollment in ESJWQC increased in 2013; however there still are numerous non-members in the Coalition that could be contributing to exceedances and who have not received focused outreach. Until the Coalition reaches 100% grower membership it's not entirely possible to determine who is discharging and therefore it is not possible to determine if growers in the ESJWQC are achieving the lowest pesticide levels achievable. Consequently, the management practices implemented by members of the Coalition appear to be resulting in a reduction of discharges, and are in the process of achieving the lowest pesticide levels technically and economically feasible.

# CONCLUSIONS AND RECOMMENDATIONS

The ESJWQC and Westside Coalition assessed compliance with the seven Monitoring Objectives of the chlorpyrifos and diazinon TMDL program by evaluating results collected from their joint chlorpyrifos and diazinon TMDL monitoring program and their individual Coalition tributary monitoring programs. During the 2014 WY there were no exceedances of the WQO for chlorpyrifos in the San Joaquin River.

There were three detections of chlorpyrifos in water samples collected from ESJWQC tributaries during the 2014 WY. Prior to the two 2014 WY exceedances of chlorpyrifos in the Tuolumne River, Northeast Bank subarea (Table 20), there was one chlorpyrifos detection at the same subarea one month prior in 2013 WY. Chlorpyrifos was detected in samples collected from Dry Creek @ Wellsford Rd on September 10, 2013 (2013 WY) and October 15, 2013 (2014WY). In the Westside Coalition, chlorpyrifos was detected in fourteen samples (over four different monitoring events), all of which were in excess of the load criteria. There were no detections of diazinon during this report period. Of the six tributaries with chlorpyrifos exceedances during the 2014 WY, two of them (Turner Slough and Ramona Lake) are not under a management plan. The lands discharging through the Turner Slough monitoring site withdrew from the Westside Coalition (all are part of the dairy program) and the monitoring site was eliminated in April 2014. The tributaries with chlorpyrifos exceedances in the ESJWQC region are all under a management plan for chlorpyrifos; the Duck Slough @ Gurr Rd management plan was reinstated after the exceedance occurred in March 2014.

Both Coalitions determined the degree of implementation and evaluated the effectiveness of management practices designed to reduce the off-site movement of chlorpyrifos and diazinon. The ESJWQC and Westside evaluated alternatives to chlorpyrifos and diazinon including use within the two Coalition regions and water quality impairments due to other pesticides. Alternative pesticides may be impairing water and sediment quality; synergistic and/or additive effects do not appear to be occurring in ESJWQC and Westside Coalition tributaries.

Chlorpyrifos use in recent years has declined (Figure 4) but it remains a product in high use. Diazinon use declined dramatically in the LSJR watershed over the past few years (Figure 4). In addition, growers are cognizant of water quality concerns related to OP pesticides and implement management practices to prevent off-site movement of chlorpyrifos and diazinon. Both Coalitions include discussions of chlorpyrifos and diazinon during focused outreach to growers.

The monitoring frequency of the chlorpyrifos and diazinon TMDL program was originally designed to occur quarterly in the LSJR and monitoring would occur during one month of each quarter to coincide with the greatest applications (2010 WY). Beginning on the 2011 WY, monitoring frequency was increased to include monthly samples for three of the six compliance points, and beginning on the 2012 WY frequency was increased to six times a year for the other three compliance points. Despite the four-fold increase in monitoring frequency since 2010, there has been only one single exceedance of chlorpyrifos and no detections of diazinon in the LSJR.

# REFERENCES

California Department of Water Resources, 2015. *California Irrigation Management Information System.* [Online]
Available at: http://wwwcimis.water.ca.gov/
[Accessed 2015].

Daane, K. M., Yokota, G. Y. & Dlott, J. W., 1993. Dormant-season sprays affect the mortality of peach twig borer (Lepidoptera: Gelechiidae) and its parasitoids. *Journal of Economic Entomology,* Volume 86, pp. 1679-1685.

Elliott, B., Wilhoit, L., Brattesani, M. & Gorder, N., 2004. *Pest management assessment for almonds: Reduced-risk alternatives to dormant organophosphate insecticides,* Sacramento, CA: California Department of Pesticide Regulation (DPR).

Insecticide Resistance Action Committee, 2005. *Resistance Management for Sustainable Agriculture and Improved Public Health - Crop Information.* [Online]
Available at: http://www.irac-online.org/crops/
[Accessed 12 February 2013].

Rice, R. E., Jones, R. A. & Black, J. H., 1972. Dormant sprays with experimental insecticides for control of peach twig borer. *California Agriculture,* Volume 26, pp. 14-15.

Summers, C., Godfrey, L. & Natwick, E., 2007. Managing insects in alfalfa. In: C. G. Summers & D. H. Putnam, eds. *Irrigated alfalfa management for Mediterranean and Desert zones.* Oakland: University of California Agriculture and Natural Resources Publication 8295.

University of California Agriculture and Natural Resources, n.d. *Statewide Integrated Pest Management Program - Agricultural pests.* [Online]
Available at: http://www.ipm.ucdavis.edu/PMG/crops-agriculture.html
[Accessed 10 February 2013].

Zalom, F., Oliver, M. & Hinton, D., 1999. *Alternatives to chlorpyrifos and diazinon dormant sprays.,* Davis, CA: Statewide Integrated Pest Management Project, University of California Agricultural and Natural Resources.