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SACRAMENTO VALLEY WATER QUALITY COALITION

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# Management of Chlorpyrifos and Diazinon Discharges to the Sacramento and Feather Rivers and the Sacramento-San Joaquin Delta: 2018 TMDL Compliance Monitoring Report

*Prepared by*

L A R R Y  
W A L K E R



ASSOCIATES



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## Introduction

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In December 2008, the Sacramento Valley Water Quality Coalition (Coalition or SVWQC) submitted a Management Plan to address specific water quality impairments within the Coalition area. A requirement of the Management Plan is to document monitoring and management activities conducted on behalf of members of the Coalition and required by the Central Valley Regional Water Quality Control Board (Regional Water Board)'s Basin Plan Amendments for the Control of Diazinon and Chlorpyrifos Runoff into the Sacramento and Feather Rivers (Resolution No. R5-2007-0034) and the Sacramento-San Joaquin Delta (Delta) (R5-2006-0061).<sup>1</sup> The Basin Plan Amendments set forth Total Maximum Daily Load (TMDL) requirements for dischargers and require that dischargers comply with the monitoring and management criteria defined in the *Water Quality Control Plan for the Sacramento River and San Joaquin River Basins* (Basin Plan). An Addendum<sup>2</sup> to the Coalition's approved Management Plan addresses the Coalition's planned activities to comply with the TMDL requirements specific to two organophosphate (OP) pesticides, chlorpyrifos and diazinon. Beginning in 2009, the Addendum for TMDL compliance monitoring was developed in collaboration with the Irrigated Lands Regulatory Program (ILRP) staff and was formally submitted to the Regional Water Board on April 30, 2010, as part of the *Management Plan Progress Report*. At the request of ILRP staff, the Addendum was resubmitted as a separate document on December 7, 2010.

In fulfillment of the requirements set forth in the Management Plan and an agreement with the Regional Water Board which now allows submittal of this report every two years, the Coalition is submitting this biennial TMDL Compliance Report summarizing the monitoring objectives, locations of sampling sites, and compliance results covering the period October 2016 through September 2018 (i.e., 2017 and 2018 monitoring years).

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<sup>1</sup> On March 28, 2014, the Regional Water Board adopted Resolution R5-2014-0041, Amendment to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Diazinon and Chlorpyrifos Discharges. Before becoming fully effective, the Amendment must be approved by the State Water Resources Control Board (State Water Board), the Office of Administrative Law (OAL), and U.S. Environmental Protection Agency (U.S. EPA). The State Water Board approved the Basin Plan amendment on June 16, 2015 with Resolution No. 2015-0043. On March 8, 2017, the OAL provided notice of approval of this regulatory action (OAL File No. 2017-0124-04S). The U.S. EPA provided approval on August 16, 2017. [http://www.waterboards.ca.gov/centralvalley/water\\_issues/tmdl/central\\_valley\\_projects/central\\_valley\\_pesticides/index.shtml](http://www.waterboards.ca.gov/centralvalley/water_issues/tmdl/central_valley_projects/central_valley_pesticides/index.shtml)

<sup>2</sup> *Addendum to Sacramento Valley Water Quality Coalition Management Plan: Chlorpyrifos and Diazinon TMDLs*. Sacramento Valley Water Quality Coalition, Sacramento, California. April 2010.

## Background

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The federal Clean Water Act requires each state to identify waters within its boundaries that are not currently meeting or maintaining water quality standards (33 USC 1313 (d)(1)). Water quality standards consist of the beneficial uses for which waterways are used as well as water quality objectives set at specified levels to maintain the beneficial uses. In 1994, the Sacramento and Feather Rivers were listed as impaired by diazinon by the Regional Water Board. As a result of the 303(d) listings, the Regional Water Board adopted a TMDL in accordance with the federal Clean Water Act (33 USC 1313 (d)(1)). Loads established in a TMDL are required to implement the applicable water quality standards, considering seasonal variations and a margin of safety (*Id.*). In addition to adopting a TMDL, the Regional Water Board also prepared and adopted a Basin Plan Amendment that included new water quality objectives for diazinon, as well as an implementation plan. The Basin Plan Amendment was intended to establish an orchard runoff control program that focused on protecting the Sacramento and Feather Rivers from the impacts of diazinon.

More specifically, the Regional Water Board adopted (and the State Water Board and U.S. EPA approved) diazinon water quality objectives of 0.080 µg/L as a 1-hour average (i.e., acute objective) and 0.050 µg/L as a 4-day average (i.e., chronic objective). At the time of adoption (and subsequently), questions were raised about the validity of the objectives and the studies from which the objectives were derived. As a result of subsequent litigation, the Regional Water Board committed to reviewing the objectives by July 1, 2007, and potentially amending the objectives by July 1, 2008. The Regional Water Board adopted new amendments to revise the diazinon objectives to **0.16 µg/L** as a 1-hour average and **0.10 µg/L** as a 4-day average (*Basin Plan 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 Sacramento and San Joaquin River Basins*).<sup>3</sup> The previously approved Basin Plan amendment contained requirements for an Orchard Pesticide Runoff and Diazinon Runoff Control Program. As part of the Control Program, the Regional Water Board required dischargers of diazinon to submit a management plan that “describes actions that the discharger will take to reduce diazinon discharges and meet the applicable allocations by the required compliance date.” In lieu of individual discharger plans, the Basin Plan Amendment allows a discharger group or a coalition to submit management plans.

The Basin Plan Amendments (R5-2007-0034 and R5-2006-0061) require dischargers, either individually or as a coalition, to submit a management plan that describes the actions that they will take to reduce chlorpyrifos and diazinon discharges and meet the applicable allocations by the required compliance dates. The Coalition’s Management Plan (SVWQC 2009) includes a process for source identification and identification of additional management practices that may be needed to achieve additional reductions in chlorpyrifos and diazinon discharges. Quarterly meetings are held with the Regional Water Board in order to evaluate progress in meeting these reductions, and revisions to the Management Plan will be made if sufficient progress is not being achieved.

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<sup>3</sup> The 2007 Basin Plan Amendment also included objectives for chlorpyrifos: **0.025 µg/L** as a 1-hour average and **0.015 µg/L** as a 4-day average.



The Coalition continues to monitor chlorpyrifos and diazinon according to the Coalition's approved monitoring schedules (i.e., annual Monitoring Plan Updates) and the SVWQC 2014 Monitoring and Reporting Program (MRP) Order<sup>4</sup>. The monitoring locations are representative of agricultural discharges to the Sacramento River, Feather River, and other Delta waterways. This monitoring will continue to provide information on the wide range of discharges and hydrologic conditions likely to occur in the Sacramento Valley watershed and Delta. The Coalition's Addendum to the Management Plan presents the technical rationale for selecting the representative monitoring locations for the TMDL compliance monitoring and for the schedule for chlorpyrifos and diazinon monitoring.

Monitoring to augment the routine ILRP Core and Assessment monitoring is conducted at existing Coalition monitoring sites in water bodies where at least one exceedance has occurred and that are directly tributary to the affected TMDL water bodies. Coalition efforts in these subwatersheds include, but are not limited to: (1) continued monitoring during time periods when peak pesticide application use occurs, (2) analysis of Pesticide Use Reporting (PUR) data, (3) holding subwatershed grower meetings, (4) continuing to encourage and evaluate implementation of management practices, and (5) addressing the seven compliance components described in the Basin Plan and listed below in conjunction with other entities identified as potential sources of discharges. Additional activities addressing Basin Plan and MRP Order requirements for source identification, outreach, and management practice evaluation are described in the Coalition's Comprehensive Surface Water Quality Management Plan (CSQMP).

The Coalition's monitoring frequency and locations are evaluated and updated annually for the CSQMP, subject to approval by the Executive Officer of the Regional Water Board. These annual updates are required by the WDR. The CSQMP was most recently updated and approved by the Regional Water Board in November 2016. Beginning with the 2018 monitoring year (October 2017 – September 2018), the Coalition was required to schedule its pesticide monitoring according to the requirements set forth in the Regional Water Board's 2016 Pesticides Evaluation Protocol (PEP). The PEP requires the Coalition to monitor specific registered pesticides, including chlorpyrifos and diazinon, based on (1) their rate of application in a given Coalition drainage (lbs applied per drainage) and (2) a pesticide-specific relative risk (the ratio of the amount of chemical applied to a reference value with a specific averaging period).

On May 6, 2015, the California Department of Pesticide Regulation (CDPR) filed the final documentation to add chlorpyrifos to the list of State Restricted Use Pesticides. This rule, which became effective on July 1, 2015, affects all products containing chlorpyrifos as an active ingredient (AI) when labeled for production of an agricultural commodity. The state-restricted<sup>5</sup>

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<sup>4</sup> Prior to adoption of the Waste Discharge Requirements (WDRs) *General Order for Growers within the Sacramento River Watershed that are Members of a Third-Party Group* (R5-2014-0030), the Coalition was subject to a Conditional Waiver of WDRs for the ILRP and subsequent amendments to the ILRP requirements (WQO-2004-0003, SWRCB 2004, R5-2005-0833, R5-2008-0005, R5-2009-0875).

<sup>5</sup> State-restricted materials include pesticides deemed to have a higher potential to cause harm to public health, farm workers, domestic animals, honeybees, the environment, wildlife, or other crops compared to other pesticides. Additional information is available at: <http://www.cdpr.ca.gov/docs/enforce/permitting.htm>

status requires that all chlorpyrifos products registered for production agricultural use must adhere to additional requirements for all California restricted materials.

## MONITORING OBJECTIVES

The purpose of the TMDL monitoring is to determine whether numeric water quality objectives for chlorpyrifos and diazinon contained in the Basin Plan are continuing to be met in the Sacramento and Feather Rivers, as well as other Sacramento-San Joaquin Delta waterways. Specifically, the Basin Plan identifies the goals listed in **Table 1** (Chapter V. Surveillance and Monitoring, page V-4.00) for compliance monitoring for the TMDL. These goals are addressed in the Compliance Monitoring Report.

**Table 1. Basin Plan Amendment TMDL Compliance Monitoring Goals**

<b>Compliance Monitoring Goal</b>	<b>Report Section Heading(s)</b>	<b>Page(s)</b>
1. Determine compliance with established water quality objectives and loading capacity for chlorpyrifos and diazinon in the Sacramento and Feather Rivers and the Sacramento-San Joaquin Delta	Monitoring Results	10-16
2. Determine compliance with established waste load allocations and load allocations for chlorpyrifos and diazinon	Discussion	17-29
3. Determine the degree of implementation of management practices to reduce off-site migration of chlorpyrifos and diazinon	Outreach and Follow-Up Regarding TMDL Exceedances	30-32
4. Determine the effectiveness of management practices and strategies to reduce off-site migration of chlorpyrifos and diazinon	Outreach and Follow-Up Regarding TMDL Exceedances	30-32
5. Determine whether alternatives to chlorpyrifos and diazinon are causing surface water quality impacts	Toxicity and Additional Pesticide Results	33-34
6. Determine whether the discharge causes or contributes to a toxicity impairment due to additive or synergistic effects of multiple pollutants	Compliance with Load Allocations in the TMDL Receiving Water Bodies; Toxicity and Additional Pesticide Results	21-29; 33-34
7. Demonstrate that management practices are achieving the lowest pesticide levels technically and economically achievable	Summary	35

## **SAMPLING SITES**

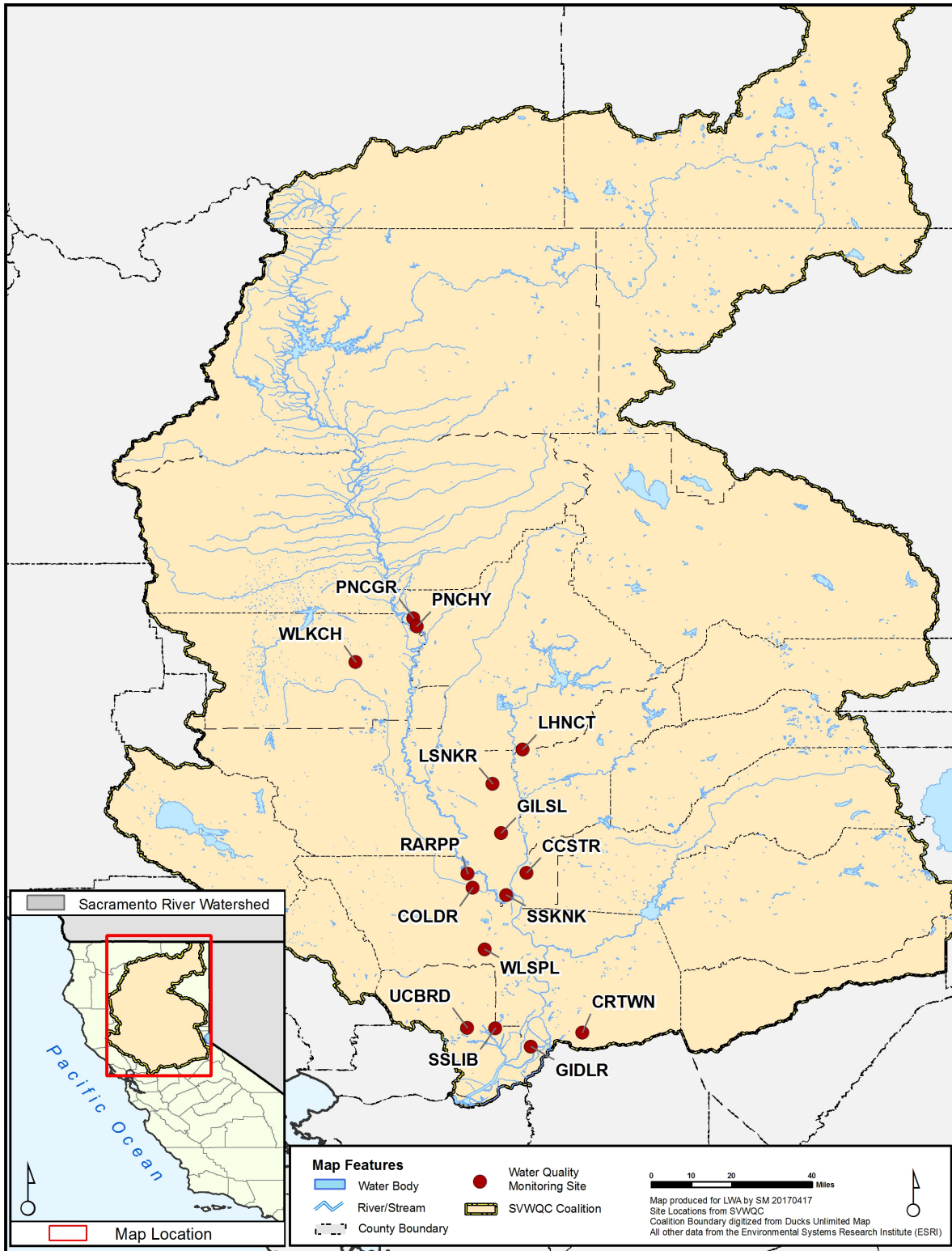
A map of the Coalition compliance monitoring sites for chlorpyrifos and diazinon is presented in **Figure 1**. Locations within the Coalition area for monitoring of chlorpyrifos and diazinon to satisfy the TMDL requirements are presented in **Table 2**. Compliance with TMDL objectives and loading capacity concentrations is assessed at the 14 sites identified as compliance monitoring sites. These specific sites were selected because they are within the TMDL watersheds, are tributary to the TMDL water bodies, and have minimal non-agricultural influences. The schedule of monitoring for organophosphate pesticides at these compliance sites is documented in the Coalition's annual Monitoring Plan Updates. The seasonal timing of the Coalition's ILRP pesticide monitoring at individual sites is based on pesticide use patterns in each subwatershed, as characterized in the Coalition's approved 2009 Monitoring and Reporting Program Plan (MRPP). These schedules were retained for any TMDL monitoring in the 2017 monitoring year, but were revised during the 2018 monitoring year, following the new requirement for the Coalition to develop its Monitoring Plan Update using the Regional Water Board's Pesticides Evaluation Protocol.

### **Delta Regional Monitoring Program Participation**

The Coalition has chosen to participate in the Delta Regional Monitoring Program (Delta RMP) in lieu of some monitoring requirements for the Sacramento-San Joaquin Delta Chlorpyrifos and Diazinon TMDL. Prior to the start of the 2017 monitoring year, the Coalition negotiated with the Regional Water Board to use Delta RMP data collected at Ulatis Creek at Brown Road (UCBRD) for TMDL compliance purposes. The Delta RMP terminated sample collection at the UCBRD site in June 2017 and the Coalition had to collect the remaining two samples. The Coalition also negotiated additional reductions in chlorpyrifos and diazinon monitoring which are documented in the approval letter from the Regional Water Board that is included in **Appendix B**<sup>6</sup>.

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<sup>6</sup> Water Year 2016 (October 1, 2015- September 30, 2016) & Water Year 2017 (October 1, 2016-September 30, 2017) are Non-Assessment Monitoring Years.



**Figure 1. Coalition Compliance Monitoring Sites for Chlorpyrifos and Diazinon Runoff Management Plan**

**Table 2. Compliance Monitoring Sites for Chlorpyrifos and Diazinon Runoff Management Plan**

<b>Subwatershed</b>	<b>Location</b>	<b>Site ID</b>	<b>Lat.</b>	<b>Long.</b>	<b>Delta, Sacramento, or Feather River Basin Subarea</b>
Butte Yuba Sutter	Gilsizer Slough at George Washington Rd.	GILSL	39.0090	-121.6716	Lower Feather River, Sac. River
Butte-Yuba-Sutter	Lower Honcut Creek at Hwy 70	LHNCT	39.30915	-121.59542	Feather River
Butte-Yuba-Sutter	Lower Snake River at Nuestro Rd.	LSNKR	39.18531	-121.70358	Feather River
Butte-Yuba-Sutter	Pine Creek at Highway 32 <sup>1</sup>	PNCHY	39.75338	-121.97124	Sac. River
Butte-Yuba-Sutter	Sacramento Slough Bridge near Karnak	SSKNK	38.7850	-121.6533	Sac. River, Northern Delta
Colusa-Glenn	Colusa Basin Drain above Knight's Landing	COLDR	38.8121	-121.7741	Sac. River
Colusa-Glenn	Rough and Ready Pumping Plant (RD 108)	RARPP	38.86209	-121.7927	Sac. River, NW Delta
Colusa-Glenn	Walker Creek near 99W and CR33	WLKCH	39.62423	-122.19652	Sac. River
PNSSNS	Coon Creek at Striplin Rd.	CCSTR	38.8661	-121.5803	Sac. River
Sacramento-Amador	Cosumnes River at Twin Cities Rd.	CRTWN	38.29098	-121.38044	Eastern Delta
Sacramento-Amador	Grand Island Drain near Leary Rd.	GIDLR	38.2399	-121.5649	Northern Delta
Solano	Shag Slough at Liberty Island Bridge	SSLIB	38.30677	-121.69337	NW Delta
Solano	Ulatis Creek at Brown Road	UCBRD	38.3070	-121.7940	NW Delta
Yolo	Willow Slough Bypass at Pole Line	WLSPL	38.59015	-121.73058	NW Delta

**Note:**

1. Beginning in February 2014 (Event 96), the Pine Creek monitoring site (located in the Butte-Yuba-Sutter Subwatershed) was moved downstream from Pine Creek at Nord-Gianella Road (PNCGR) to Highway 32 (PNCHY).

# Monitoring Results

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All TMDL monitoring data through September 2018 have been previously submitted to the Regional Water Board as required by the ILRP. A complete set of relevant monitoring data for Coalition compliance sites for January 2009 through September 2018 is also provided in **Appendix A**.

## DATA INTERPRETATION

### Assessment of Data Quality Objectives

The data quality objectives for the TMDL monitoring effort are described in the Coalition's Quality Assurance Project Plan (QAPP) for the ILRP. All quality assurance (QA) for TMDL compliance monitoring is integrated into the Coalition's ILRP monitoring program. As required by the ILRP, these QA results have been submitted to the Regional Water Board on a quarterly basis along with targeted environmental monitoring results.

Representativeness of the data collected was assured by selection of appropriate sampling and analytical methods. There was no deviation from the standard operating procedures specified in the QAPP, and the data are considered adequately representative for the purpose of the compliance monitoring program. Analytical precision is assessed by analyzing laboratory-prepared matrix spike duplicates, and sampling precision is evaluated by analyzing field-collected sample replicates. Analytical accuracy is assessed by routine calibration and analysis of a laboratory-prepared matrix and by addition of surrogate organic compounds to sample matrices. Based on the results of field and laboratory QA analyses, precision and accuracy met program data quality objectives and were adequate for the purposes of the monitoring compliance program.

*Completeness* is defined as the percent of planned data that were successfully collected and analyzed. Approximately 97% of samples planned for October 2016 through September 2018 were successfully collected and analyzed (i.e., 71 of the 73 scheduled water column samples). Based on the total number of planned and analyzed samples, overall completeness for planned chlorpyrifos and diazinon analyses from January 2009 through September 2018 was 99% (**Table 3**). All planned October 2016 through September 2018 TMDL compliance parameters have been successfully collected and analyzed, with the following exception:

- Flow measurements could not be collected for all sites and events due to site access or site conditions during some events.<sup>7</sup> Furthermore, the Delta RMP does not report observations for flow.
- Walker Creek near 99W and CR33 (WLKCH) was dry during a planned event in April 2018.
- Cosumnes River at Twin Cities Road (CRTWN) was dry during a planned event in August 2018.

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<sup>7</sup> In some cases, the field crew visually estimated the flow when measurements could not be collected.

**Table 3. TMDL Compliance Sampling Completeness Summary**

Compliance Site	JAN 2009 – SEP 2016		OCT 2016 – SEP 2018			JAN 2009 – SEP 2018	
	Planned	Collected	Planned	Collected	Note	Planned	Collected
Colusa Basin Drain above KL	44	45	6	6	(2)	50	51
Coon Creek at Striplin Road	25	25	---	---	(2)	25	25
Cosumnes River at Twin Cities Road	26	16	2	1	(2)	28	17
Gilsizer Slough at George Washington Road	37	39	7	7	---	44	46
Grand Island Drain near Leary Road	38	41	7	7	---	45	48
Lower Honcut Creek	37	38	2	2	(2)	39	40
Lower Snake River at Nuestro Road	35	37	3	3	(2)	38	40
Pine Creek <sup>(1)</sup>	32	31	14	14	---	46	45
Rough and Ready Pumping Plant (RD 108)	36	37	---	---	(2)	36	37
Sacramento Slough bridge near Karnak	31	32	4	4	(2)	35	36
Shag Slough at Liberty Island Bridge	38	38	3	3	(2)	41	41
Ulatis Creek at Brown Road	55	56	16	16	(3)	67	68
Walker Creek near 99W and CR33	36	30	1	0	(2)	37	30
Willow Slough Bypass at Pole Line	42	44	8	8	---	50	52
<b>Totals</b>	<b>512</b>	<b>509</b>	<b>73</b>	<b>71</b>		<b>585</b>	<b>581</b>
<b>Percent Completeness</b>		<b>99%</b>		<b>97%</b>			<b>99%</b>

Notes:

1. Beginning with Event 96 (February 2014), the Pine Creek monitoring site was moved from Nord-Gianella Road (PNCGR) to Highway 32 (PNCHY).
2. Monitoring at this site during Water Year 2017 (October 1, 2016-September 30, 2017), a non-assessment monitoring year, and Water Year 2018 (October 1, 2017-September 30, 2018), an assessment monitoring year, is indirectly addressed by the Delta RMP. Refer to the approval letter for reduced individual monitoring as a result of the Coalition's participation in the Delta RMP, provided as **Appendix B**.
3. Monitoring at this site during Water Year 2017 (October 1, 2016-September 30, 2017), a non-assessment monitoring year, was directly addressed by the Delta RMP. Monitoring at this site during Water Year 2018 (October 1, 2017-September 30, 2018), an assessment monitoring year, was indirectly addressed by the Delta RMP. Refer to the approval letter for reduced individual monitoring as a result of the Coalition's participation in the Delta RMP, provided as **Appendix B**.

## Comparison with TMDL Objectives and Discussion of Exceedances

A summary of the number of analyses of water quality samples collected from January 2009 through September 2018 for TMDL compliance monitoring is presented in **Table 4** and **Table 5** for chlorpyrifos and diazinon, respectively. The number of results that exceeded water quality objectives at a given monitoring site is also indicated in the tables.

**Table 4. Summary of 2009-2018 TMDL Monitoring Results for Chlorpyrifos**

Compliance Site	JAN 2009 – SEP 2016		OCT 2016 – SEP 2018		JAN 2009 – SEP 2018	
	Total >WQO	Total Samples	Total >WQO	# of Samples	Total >WQO	Total Samples
Colusa Basin Drain above KL		45		6		51
Coon Creek at Striplin Rd.	1	25			1	25
Cosumnes River at Twin Cities Rd.		16				16
Gilsizer Slough at George Washington Rd.	4	39	1	7	5	46
Grand Island Drain near Leary Rd.	2	41		7	2	48
Lower Honcut Creek		38		2		40
Lower Snake River at Nuestro Rd.		37		3		40
Pine Creek <sup>(1)</sup>	8 <sup>(2)</sup>	31		14	8	45
Rough and Ready Pumping Plant (RD 108)		37				37
Sacramento Slough bridge near Karnak		32		4		36
Shag Slough at Liberty Island Bridge	1	38		3	1	41
Ulatis Creek at Brown Rd.	5	56		15	5	71
Walker Creek near 99W and CR33	1	30			1	30
Willow Slough Bypass at Pole Line	2	44		8	2	52
<b>Totals</b>	<b>24</b>	<b>509</b>	<b>1</b>	<b>69</b>	<b>25</b>	<b>578</b>

Notes:

1. Beginning with Event 96 (February 2014), the Pine Creek monitoring site was moved from Nord-Gianella Road (PNCGR) to Highway 32 (PNCHY).
2. Five exceedances at Pine Creek occurred in isolated ponded water with no flow. A flow measurement could not be collected for one event for which an exceedance was observed. A review of these data indicates that three "exceedances" reflect degradation of the original elevated concentration and not additional discharges of chlorpyrifos.



**Table 5. Summary of 2009-2018 TMDL Monitoring Results for Diazinon**

Compliance Site	JAN 2009 – SEP 2016		OCT 2016 – SEP 2018		JAN 2009 – SEP 2018	
	>WQO	# of Samples	>WQO	# of Samples	Total >WQO	Total Samples
Colusa Basin Drain above KL		45		6		51
Coon Creek at Striplin Road		25				25
Cosumnes River at Twin Cities Road		16		1		17
Gilsizer Slough at George Washington Rd.	2	39	1	7	3	46
Grand Island Drain near Leary Road	2 <sup>(2)(3)</sup>	41	1	4	3	45
Lower Honcut Creek		38				38
Lower Snake River at Nuestro Road		37		2		39
Pine Creek <sup>(1)</sup>		31		8		39
Rough and Ready Pumping Plant (RD 108)		37				37
Sacramento Slough bridge near Karnak		32		3		35
Shag Slough at Liberty Island Bridge		38		3		41
Ulatis Creek at Brown Road		56		16		72
Walker Creek near 99W and CR33		30				30
Willow Slough Bypass at Pole Line		44		8		52
<b>Totals</b>	<b>4</b>	<b>509</b>	<b>2</b>	<b>58</b>	<b>6</b>	<b>567</b>

Notes:

1. Beginning with Event 96 (February 2014), the Pine Creek monitoring site was moved from Nord-Gianella Road (PNCGR) to Highway 32 (PNCHY).
2. The exceedance occurred in only one of two field samples collected on 10/19/2010.
3. The associated field replicate results (0.1672 µg/L) collected on 10/29/2013 also exceeded the WQO.

**Delta Regional Monitoring Program**

Between October 2016 through June 2017, the Delta RMP conducted monitoring for the project “Delta RMP - Current Use Pesticides” at the following five sites:

- Ulatis Creek at Brown Road (511ULCABR);
- Mokelumne River at New Hope Road (544SAC002);
- Sacramento River at Hood Monitoring Station Platform (510SACC3A);
- San Joaquin River at Buckley Cove (544LSAC13); and
- San Joaquin River at Airport Way near Vernalis (541SJC501).

A total of 45 monthly samples were collected at these five sites. Diazinon was detected only once (2.2% detection rate) and chlorpyrifos was not detected in any of the samples. The one detected diazinon concentration did not exceed either the Basin Plan 4-day chronic or 1-hour acute objective.

## **Compliance with Concentration-Based and Load-Based TMDL Objectives**

Concentrations of chlorpyrifos and diazinon were compared to the Basin Plan objectives for the Sacramento and Feather Rivers and Delta. All detected concentrations are presented in **Table 6**.

### ***Chlorpyrifos***

Between October 2016 through September 2018, chlorpyrifos was detected in one (1) of 69 samples (1.4% detection rate) collected at the ten (10) compliance monitoring locations that were monitored during this time period. A single sample (1.4% of samples) exceeded the Basin Plan 4-day chronic objective (0.015 µg/L) and the 1-hour acute objective (0.025 µg/L) for chlorpyrifos. The exceedance occurred at Gilsizer Slough at George Washington Road (August 2018).

#### **Gilsizer Slough (Event 150)**

There were 32 reported applications of chlorpyrifos in the month prior to the August 22, 2018, exceedance. Chlorpyrifos was applied to approximately 108 acres of alfalfa, 255 acres of almonds, and 1,334 acres of walnuts in the Gilsizer Slough drainage during that time. All of the alfalfa applications were made aurally, and 100 acres of walnut applications were also made by air. During the event, the field crews noted that water was present, but there was no measurable flow. In the preceding weeks before the event, there had been no recorded precipitation. Toxicity tests were not performed during this event.

### ***Diazinon***

Between October 2016 through September 2018, diazinon was detected in only two (2) of the 58 samples (3.4% detection rate) collected at ten (10) compliance monitoring locations that were monitored during this period. Two concentrations exceeded the Basin Plan 4-day chronic objective (0.10 µg/L), but not the 1-hour acute objective (0.16 µg/L) for diazinon. The exceedances occurred at Grand Island Drain near Leary Road (September 2017) and at Gilsizer Slough at George Washington Road (January 2018).

#### **Grand Island Drain (Event 140)**

There were 27 reported applications of diazinon in the month prior to the October 25, 2017, exceedance. Diazinon was applied to approximately 1,120 acres of pears in the Grand Island Drain drainage during that time. All of the applications were made on the ground. During the event, the field crews noted that water was present, but there was no measurable flow. There had been about 0.15 inches of precipitation in the week preceding the event, but there had been no precipitation for the 48 hours before the sample was collected. A *Selenastrum capricornutum* test also was performed on the sample, but no toxicity was observed.

#### **Gilsizer Slough (Event 143)**

There were 15 reported applications of diazinon in the month prior to the January 23, 2018, exceedance. Diazinon was applied to approximately 357 acres of peaches in the Gilsizer Slough drainage during that time. All of the applications were made on the ground. During the event, the field crews noted that water was present, but there was no measurable flow. There had been about 0.41 inches of precipitation in the week preceding the event, with about 0.25 inches of that

total coming in the 48 hours before the sample was collected. Toxicity tests were not performed during this event.

**Load Estimates**

Instantaneous loads were also calculated for all compliance sites. Loads were calculated as:

$$Load = Q \times C \times UCF$$

Where, *Load* is the instantaneous load expressed in g/day,

*Q* = instantaneous discharge in cubic feet per second (cfs)

*C* = sample chlorpyrifos or diazinon concentration in µg/L, and

*UCF* = a unit conversion factor of 2.45 (g\*second\*L/ µg\*day\*cubic feet)<sup>8</sup>.

Loads for all detected concentrations are provided in **Table 6**.

**Table 6. Load Estimates for Detected Chlorpyrifos and Diazinon, October 2016 – September 2018**

Site ID	Water Body	Sample Date	Discharge, CFS	Concentrations, µg/L		Instantaneous Loads, g/day		Notes
				Chlorpyrifos	Diazinon	Chlorpyrifos	Diazinon	
GIDLR	Grand Island Drain	10/25/2017	0	ND	0.15	0.00	0.00	(2,3)
GILSL	Gilsizer Slough	1/23/2018	0	ND	0.15	0.00	0.00	(2,3)
GILSL	Gilsizer Slough	8/22/2018	0	0.023	ND	0.00	0.00	(2,3)

Notes: Exceedances of TMDL concentration objectives are highlighted yellow in the table (where they occur).

NR = Not Recorded

ND = Not Detected

1. Concentrations were below WQO; no contribution to exceedances.
2. Concentrations exceeded WQO.
3. No measurable flow.
4. Unable to measure flow; zero flow was visually estimated.

The Basin Plan TMDL amendments also implement measures designed to address the additive toxicity of chlorpyrifos and diazinon. Compliance with the TMDL Load Allocations for non-point sources was determined using the methodology outlined in the Basin Plan Amendments for the Control of Diazinon and Chlorpyrifos Runoff (Resolutions R5-2007-0034 and R5-2006-0061). This methodology takes into account the additive effects of chlorpyrifos and diazinon.

<sup>8</sup> Unit conversion factor: [1 g/ 1,000,000 µg]\*[86,400 seconds/day]\*[28.32 liter/cubic foot]

Compliance was calculated using the following equation:

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

Where the loading concentration may not exceed the *Sum(S)* of one (1.0):

$C_D$  = diazinon concentration in µg/L; analytical results reported as “non-detected” concentrations are considered to be zero

$C_C$  = chlorpyrifos concentration in µg/L; analytical results reported as “non-detected” concentrations are considered to be zero

$WQO_D$  = 1-hour or 4-day average diazinon water quality objective in µg/L

$WQO_C$  = 1-hour or 4-day average chlorpyrifos water quality objective in µg/L

The three samples collected between October 2016 through September 2018 that exceeded the individual TMDL concentration objectives (Basin Plan objectives) also exceeded the 4-day TMDL Load Allocation, but not the 1-hour TMDL Load Allocation, based on combined (i.e., additive) toxic units (TUc or TUa) (**Table 7**).

**Table 7. Compliance with Load Capacity Objectives for Detected Chlorpyrifos and Diazinon, October 2016 – September 2018**

Site ID	Water Body	Sample Date	Discharge, CFS	Concentrations, µg/L		Load Allocation Compliance <sup>(4)</sup>		Notes
				Chlorpyrifos	Diazinon	1-Hour (TUa)	4-Day Average (TUc)	
GIDLR	Grand Island Drain	10/25/2017	0	ND	0.15	0.94	1.50	(1,2,3)
GILSL	Gilsizer Slough	1/23/2018	0	ND	0.15	0.94	1.50	(1,2,3)
GILSL	Gilsizer Slough	8/22/2018	0	0.023	ND	0.92	1.53	(1,2,3)

Notes: Exceedances of TMDL concentration objectives are highlighted yellow in the table (where they occur).

NR = Not Recorded

ND = Not Detected

1. Concentration exceeded WQO.

2. No measurable flow; therefore, no loads to downstream TMDL receiving waters.

3. Concentrations exceeded 4-day average-based Load Allocation.

4. Compliance is assessed based on the sum of chlorpyrifos and diazinon, TUa and TUc; exceedances are indicated for values greater than 1.0 (values highlighted in yellow, where they occur).

## Discussion

The California Department of Pesticide Regulation (CDPR) has documented the decline in use of insecticide organophosphate chemicals, including chlorpyrifos and diazinon, for nearly every year since 1995. Statewide diazinon use decreased by 88% and chlorpyrifos use decreased by 53% from 1996 to 2010, respectively.<sup>9,10</sup> PUR data from the two most recent years available, 2015 and 2016, show continued reductions in Statewide use of both pesticides (see **Table 8**). The significant decrease in the use of chlorpyrifos when comparing the two years was likely caused by the pesticide being designated as a state-restricted material on July 1, 2015. In the five Coalition subwatersheds within the TMDL compliance region (Butte-Yuba-Sutter; Glenn-Colusa; Placer-Nevada-South Sutter-North Sacramento (PNSSNS); Sacramento-Amador; Solano; Yolo), a substantial (28.2%) decrease in the application of chlorpyrifos also occurred between 2015 and 2016. A more modest (5.5%) decrease in diazinon use was observed among the five subwatersheds over the same time period.

When comparing the annual application of chlorpyrifos in the five subwatersheds from 2003 through 2016, no steady increasing or decreasing trend is observed. As illustrated in **Figure 2**, agriculture's use of chlorpyrifos has shown upswings and downturns in use over the years until the noticeable decrease in 2016. In contrast, diazinon use in the region showed a steady decrease from 2003 to 2011, before showing an increasing trend beginning in 2012 (see **Figure 3**).

**Table 8. Chlorpyrifos and Diazinon Use in California and the Five Coalition Subwatersheds: 2015 – 2016**

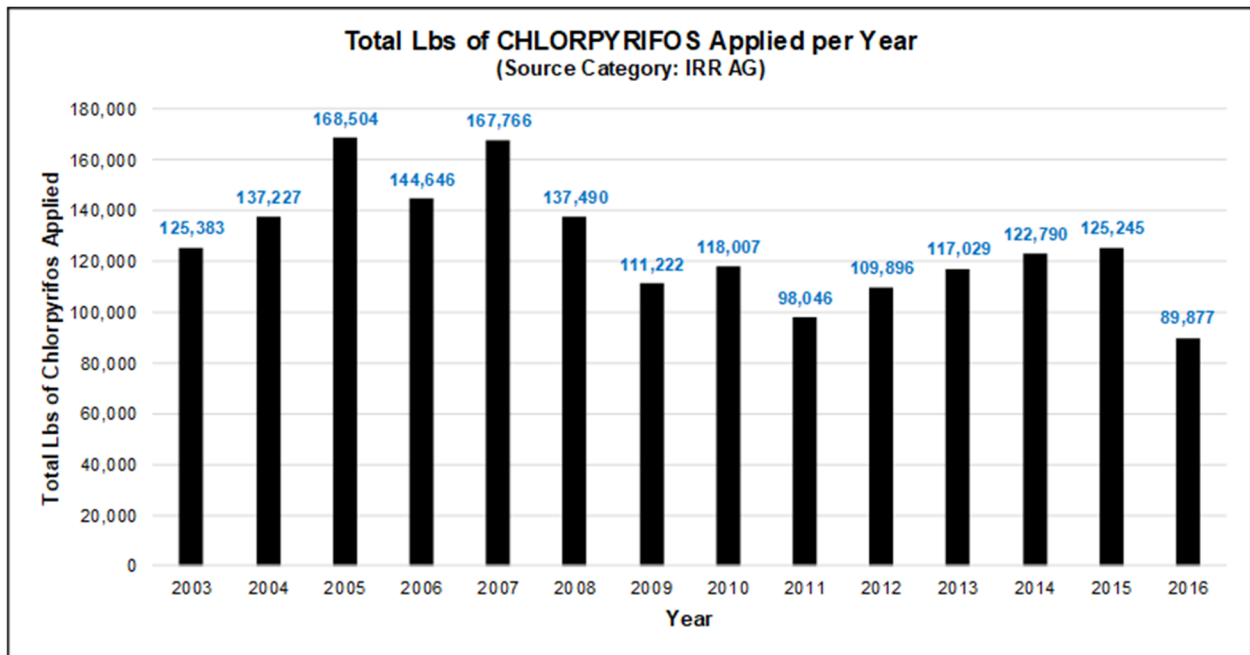
Year	Area	Pesticide	Lbs. Applied	% Change
2015	Statewide	Chlorpyrifos	1,105,207	-18.8
2016			897,938	
2015	Five Coalition Subwatersheds	Chlorpyrifos	125,245	-28.2
2016			89,877	
2015	Statewide	Diazinon	52,663	-7.3
2016			48,819	
2015	Five Coalition Subwatersheds	Diazinon	28,236	-5.5
2016			26,689	

All 2015 PUR data taken from: <https://www.cdpr.ca.gov/docs/pur/pur15rep/15sum.htm>

All 2016 PUR data taken from: <https://www.cdpr.ca.gov/docs/pur/pur16rep/16sum.htm>

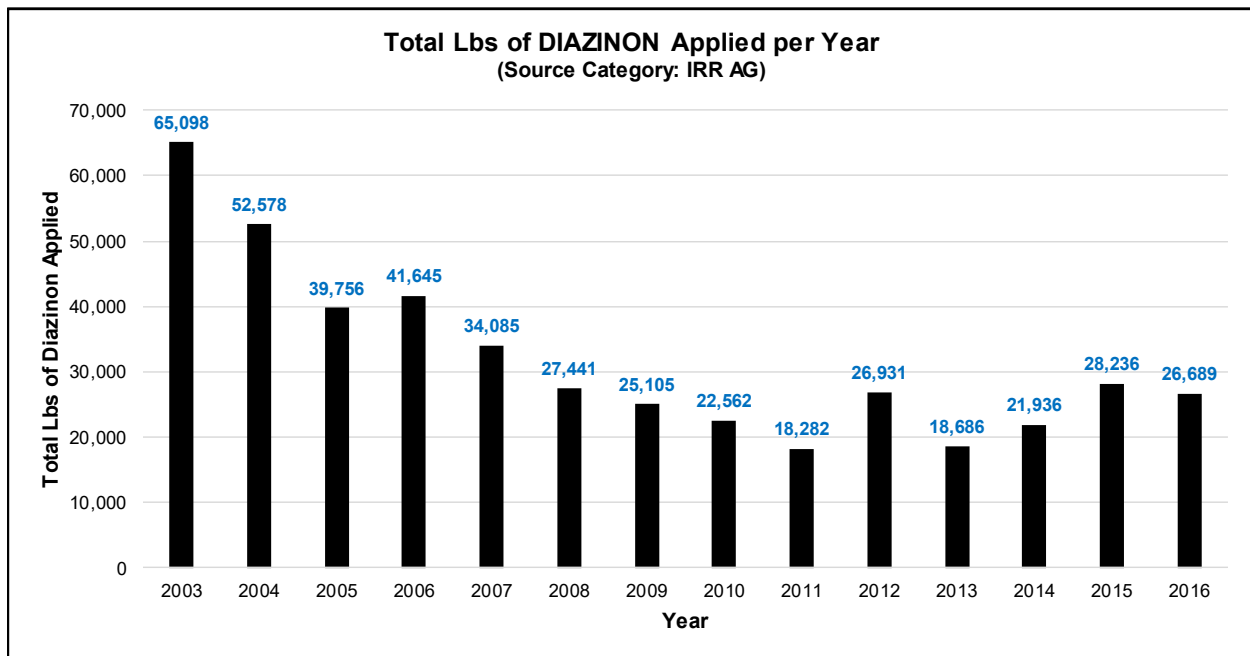
<sup>9</sup>California Department of Pesticide Regulation (2007). <http://www.cdpr.ca.gov/docs/pur/pur06rep/trends06.pdf>

<sup>10</sup>California Department of Pesticide Regulation (2011). <http://www.cdpr.ca.gov/docs/pur/pur10rep/tables/table8.pdf>



**Figure 2. Trends in Agricultural Use of Chlorpyrifos**

The data plotted above are for the five Coalition subwatersheds in the TMDL compliance region (Butte-Yuba-Sutter; Colusa-Glenn; Placer-Nevada-South Sutter-North Sacramento; Sacramento-Amador; Solano; Yolo) and were taken from the California Department of Pesticide Regulation PUR Database.



**Figure 3. Trends in Agricultural Use of Diazinon**

The data plotted above are for the five Coalition subwatersheds in the TMDL compliance region (Butte-Yuba-Sutter; Colusa-Glenn; Placer-Nevada-South Sutter-North Sacramento; Sacramento-Amador; Solano; Yolo) and were taken from the California Department of Pesticide Regulation PUR Database.

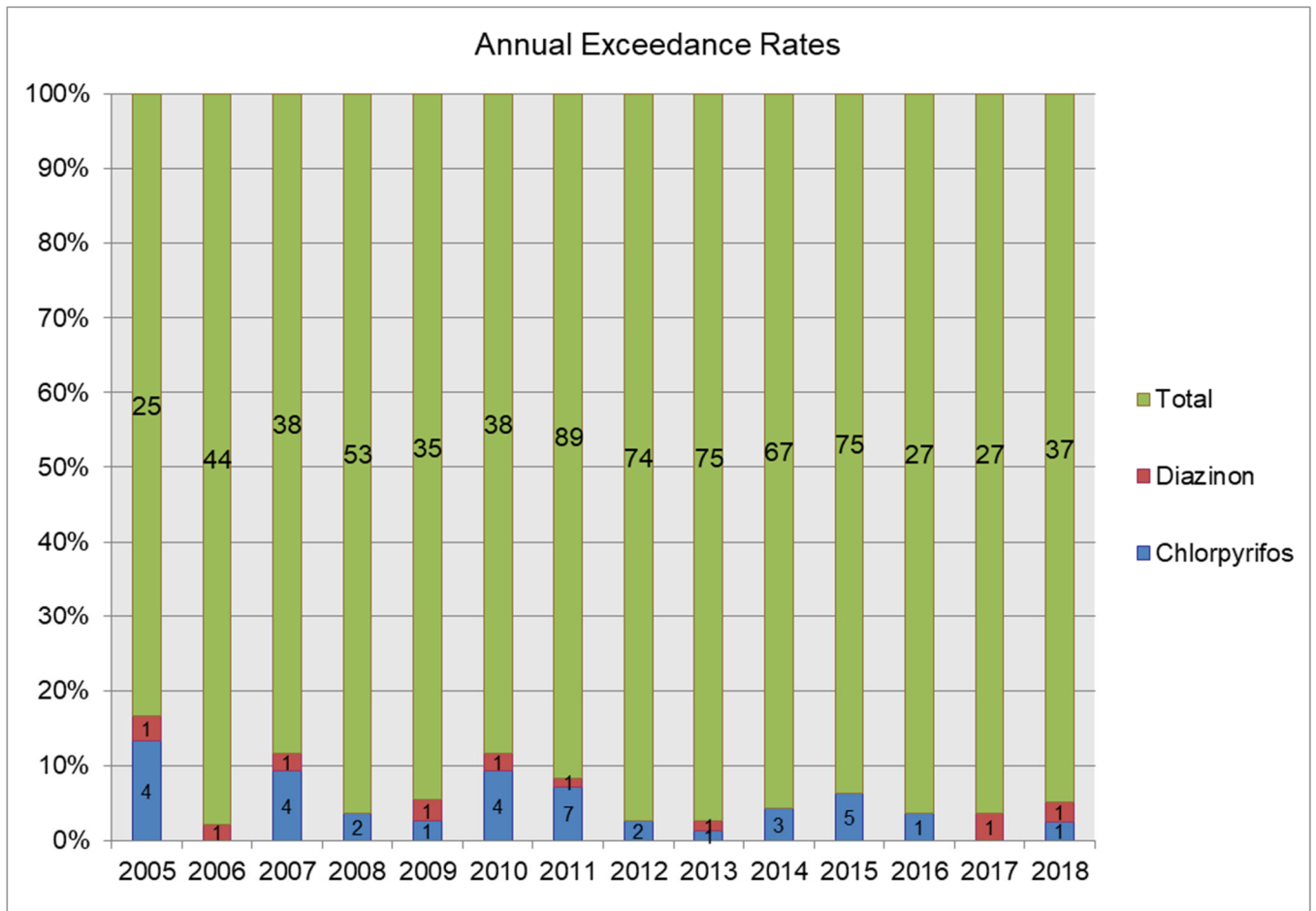
From the beginning of the Coalition’s monitoring efforts (January 2005) through September 2018, there have been 751 samples collected and analyzed for chlorpyrifos and 740 samples collected and analyzed for diazinon under the ILRP at the 14 compliance sites. Results for Coalition monitoring at TMDL compliance sites are summarized in **Table 9**.

**Table 9. Summary of Chlorpyrifos and Diazinon Exceedances in Coalition Monitoring at TMDL Compliance Sites, 2005-2018**

Data for the five Coalition subwatersheds in the TMDL compliance region (Butte-Yuba-Sutter, Colusa-Glenn, Placer-Nevada-South Sutter-North Sacramento, Sacramento-Amador, Solano; Yolo)

Constituent	Exceedances	Non-Exceedances	Total Samples
Chlorpyrifos	35	716	751
Diazinon	9	731	740
Total	44	1,447	1,491

There have been a total of 44 exceedances of chlorpyrifos and diazinon combined (approximately 3% of all samples) observed in Coalition monitoring at the TMDL compliance sites from January 2005 through September 2018. Of the 44 total exceedances, 35 have been for chlorpyrifos (~5% of total samples analyzed for chlorpyrifos) and nine have been for diazinon (~1% of total samples analyzed for diazinon). These exceedances have been observed at nine of the 14 compliance sites, with seven sites having more than one exceedance. At five of the compliance sites, there have been no exceedances observed in Coalition monitoring. With respect to the 69 samples collected and analyzed from October 2016 through September 2018 for TMDL compliance monitoring, there was only one exceedance at the Grand Island Drain site and two exceedances at the Gilsizer Slough site. The rates of exceedance have been highly variable from year to year, but the longer trend appears to be a decrease in exceedances at the Coalition’s compliance monitoring sites (**Figure 4**).



**Figure 4: Annual Exceedance Rates at TMDL Compliance Sites, 2005-2018**

Annual exceedance rates are calculated as the number of exceedances for each pesticide divided by the total number of samples analyzed for the year. Value labels indicate actual number of samples in compliance or exceedances for each pesticide.



## COMPLIANCE WITH LOAD ALLOCATIONS IN THE TMDL RECEIVING WATER BODIES

In separate TMDL monitoring conducted by the Coalition from 2006 to 2008, there were two diazinon exceedances observed at one of the compliance sites (Colusa Basin Drain) in 2008,<sup>11</sup> and no exceedances observed in 2006 and 2007. Chlorpyrifos was not detected in any TMDL samples collected from the five TMDL monitoring locations sampled from 2006 to 2008 (Sacramento River at Colusa, Colusa Basin Drain above Knight's Landing, Sacramento Slough, Feather River above Yuba City, and Feather River near Verona). Although two diazinon exceedances were observed in 2008, the majority of the 95 samples collected from 2006 through 2008 and all 21 concentrations estimated at the Sacramento River at Verona monitoring location were in compliance with the TMDL objectives. The overall monitoring results for the Sacramento and Feather River diazinon TMDL indicate that the combination of outreach and education, the increased awareness and the resulting changes in diazinon use patterns and management practices, and the modifications to pesticide labeling have been successful in reducing instream ambient chlorpyrifos and diazinon concentrations and loads below the historically observed levels that resulted in listing the Sacramento River and Feather River as impaired for chlorpyrifos and diazinon. The relatively low rate of exceedances observed in the current TMDL compliance monitoring of the tributaries to these water bodies further indicates that the TMDL objectives will continue to be met.

The TMDL compliance monitoring conducted from 2006-2008 in the named TMDL water bodies indicated that conditions have improved and that these water bodies are generally in compliance with the TMDL. After 2008, continued compliance with the TMDL in the named TMDL water bodies has been assessed indirectly through analysis of monitoring conducted primarily in tributary water bodies (see **Table 2**). The TMDL compliance monitoring from 2009 through 2018 was conducted at Coalition monitoring sites that were selected to be representative of the larger drainage areas that contribute flows and pollutant loads to the receiving water bodies specifically identified for compliance in the TMDL.

Data from the compliance sites monitored from 2009 through September 2018 can be used in a number of ways to evaluate whether compliance in named TMDL water bodies is continuing and/or improving. The three following scenarios were evaluated for TMDL receiving waters for all cases where 2016 – 2018 compliance monitoring site concentrations exceeded or equaled the 1.0 TUc (4-day average) concentration-based Load Allocation (see **Table 7**).

### Scenario 1: No Upstream Receiving Water Loads

The first level of evaluation is to determine whether the loads observed in the individual monitored water bodies were sufficient to *directly cause* exceedances in the named TMDL receiving water bodies. This was accomplished by simple mass load calculations based on the measured loads at the compliance sites and a conservative estimate of the receiving water discharge volume. The receiving water discharges were based on measured flows in Delta

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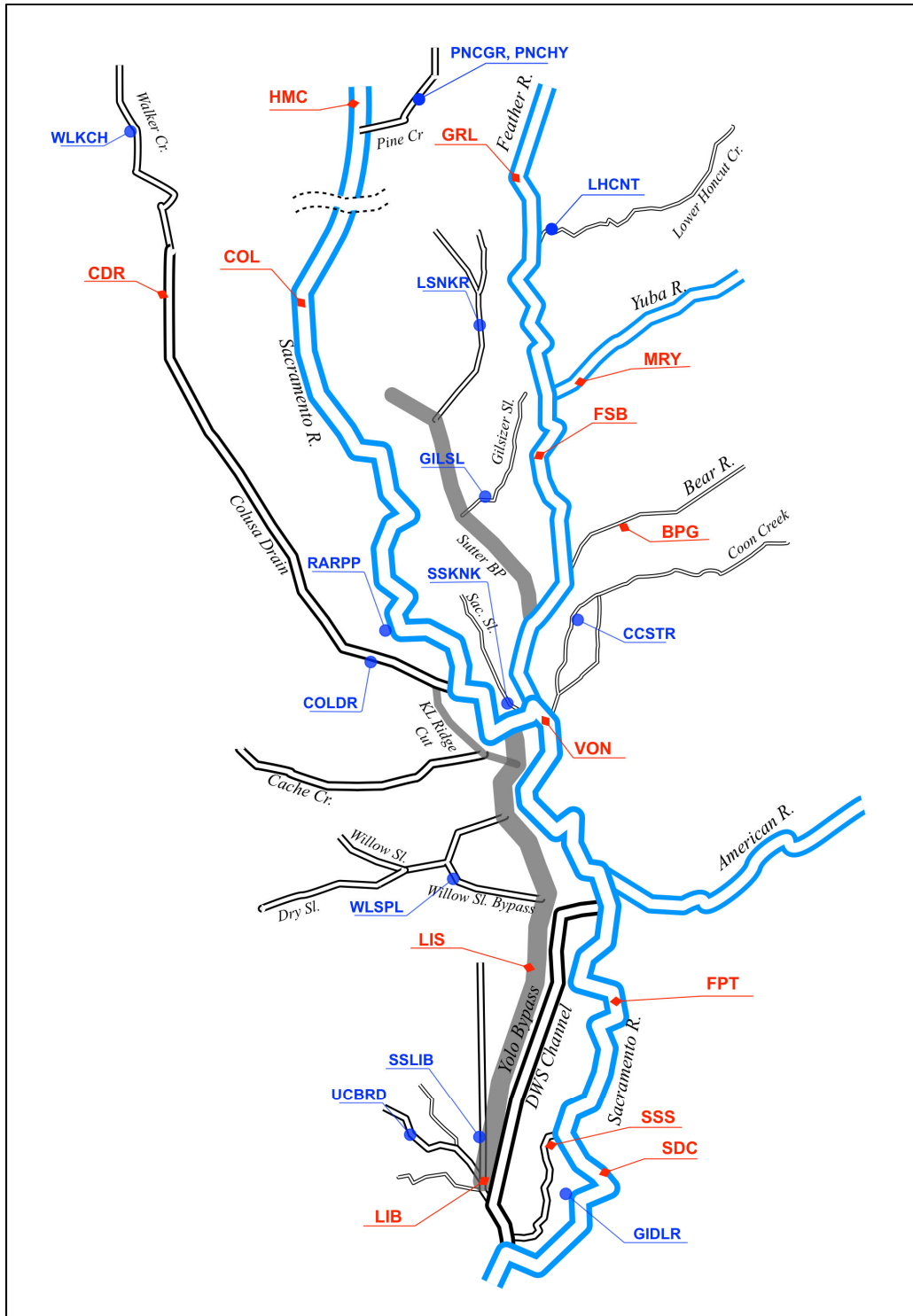
<sup>11</sup> Diazinon Runoff Management Plan for Orchard Growers in the Sacramento Valley: 2008 Annual Report. Sacramento Valley Water Quality Coalition. June 2008.

tributaries and tidal fluxes for the Delta (Liberty Island) reported by the Department of Water Resources California Data Exchange Center (CDEC)<sup>12</sup>. The relationship between all monitoring sites and receiving water flow sites is illustrated in **Figure 5**.

This initial evaluation assumes no chlorpyrifos or diazinon loads ( $TU_c = 0$ ) in the upstream receiving water. This analysis estimated that the dilution of loads from the monitored TMDL compliance sites with exceedances observed between October 2016 through September 2018 would result in TMDL receiving water concentrations of 0.00  $TU_c$  for the August 2018 event at GILSL, the January 2018 event at GILSL and the October 2017 event at GILDR because there were no measurable flows associated with those exceedances (**Table 11**, Scenario 1).

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<sup>12</sup> CDEC Historical Data Selector available at: <http://cdec.water.ca.gov/selectQuery.html>



**Figure 5. Compliance and Flow Monitoring Sites used for Analysis of Receiving Water Impacts**  
 (Key for sites on following page)

<b>Feature</b>	<b>KEY</b>	<b>Description</b>
Monitoring Sites	<b>WLKCH</b>	Walker Creek near 99W and CR33
	<b>PNCGR</b>	Pine Creek at Nord Gianella Rd.
	<b>PNCHY</b>	Pine Creek at Highway 32
	<b>LHCNT</b>	Lower Honcut Creek at Hwy 70
	<b>LSNKR</b>	Lower Snake River at Nuestro Rd.
	<b>GILSL</b>	Gilsizer Slough at George Washington Rd.
	<b>CCSTR</b>	Coon Creek at Striplin Rd.
	<b>RARPP</b>	Rough and Ready Pumping Plant (RD 108)
	<b>SSKNK</b>	Sacramento Slough Bridge near Karnak
	<b>COLDR</b>	Colusa Basin Drain above Knight's Landing
	<b>WLSPL</b>	Willow Slough Bypass at Pole Line
	<b>SSLIB</b>	Shag Slough at Liberty Island Bridge
	<b>UCBRD</b>	Ulatis Creek at Brown Road
	<b>GIDLR</b>	Grand Island Drain near Leary Rd.
<b>CRTWN</b>	Cosumnes River at Twin Cities Rd. (off-scale, not included in figure)	
Flow Sites	<b>HMC</b>	Sac. R. at Hamilton City
	<b>COL</b>	Sac. R. at Colusa
	<b>VON</b>	Sac. R. at Verona
	<b>FPT</b>	Sac. R. at Freeport
	<b>SDC</b>	Sac. R. at the Delta Cross-Channel
	<b>CDR</b>	Colusa Drain at Highway 20
	<b>LIS</b>	Yolo Bypass at Lisbon
	<b>LIB</b>	Liberty Island at S. Center End
	<b>SSS</b>	Steamboat Slough between Sutter Slough and Sac. River
	<b>GRL</b>	Feather River at Gridley
	<b>MRY</b>	Yuba River at Marysville
	<b>FSB</b>	Feather River above Star Bend
	<b>BPG</b>	Bear River at Pleasant Grove

## Scenario 2: Upstream Receiving Water Loads Equivalent to Additional Represented Loads Extrapolated from Compliance Sites

This evaluation uses the same methods as Scenario 1 above but assumes that the loads in the *upstream* receiving waters are equal to the additional loads from the irrigated acreage represented by the compliance site where an exceedance was observed. The additional loads from the represented irrigated acres were extrapolated from the compliance site loads using the following extrapolation factor:

$$\left( \frac{\text{Represented Irrigated Acres}}{\text{Compliance Drainage Irrigated Acres}} \right) \times \text{Compliance Site Frequency of Exceedance}$$

Where the ratio of irrigated acres accounts for that additional represented acreage, and the frequency of exceedance (for 2009 through the current reporting year) accounts for the probability of individual represented drainages exceeding the concentration-based Load Allocation.

This analysis also estimates that dilution of loads from the monitored TMDL compliance sites and represented irrigated acres would result in TMDL receiving water concentrations of 0.00015 TUc for the August 2018 event at GILSL, 0.00008 for the January 2018 event at GILSL, and 0.00029 at GILDR for the October 2017 event (Table 11, Scenario 2).

## Scenario 3: Reasonable “Worst Case,” Upstream Receiving Water Loads Approaching Load Allocation

This evaluation also uses the same methods as Scenarios 1 and 2 but assumes that the cumulative loads in the *upstream* receiving waters are 90% of the TMDL concentration-based Load Allocation (i.e., 0.9 TUc). This scenario represents a reasonable “worst case” scenario for receiving water conditions coinciding with exceedances at the compliance sites. The addition of the observed load from the compliance site would not cause the receiving water to exceed the concentration-based TMDL Load Allocation of 1 TUc for the August 2018 or January 2018 events at GILSL, or the October 2017 event at GILDR under this scenario.

## Summary of Evaluation of Compliance with Load Allocations

Continued compliance in the TMDL named water bodies with the TMDL concentration-based Load Allocations can also be inferred from several lines of evidence:

- Past compliance in TMDL water bodies has been demonstrated through direct monitoring of the named TMDL water bodies.
- Use of diazinon and chlorpyrifos in the Sacramento Valley watersheds that drain to these TMDL water bodies continues to decrease or remain constant.
- There is a decreasing trend in the frequency of exceedances for chlorpyrifos and diazinon at the currently monitored TMDL compliance monitoring sites.
- In 2010, the Feather River was removed from the 303(d) list for impairment due to diazinon.
- Loads represented by exceedances observed at individual Coalition TMDL compliance monitoring sites are not sufficient to directly cause an exceedance in the

named TMDL water bodies under reasonably expected receiving water conditions (**Table 11**, Scenario 1).

- Loads and exceedance rates extrapolated from representative compliance sites to larger represented regions are also extremely unlikely to cause exceedances in the named TMDL water bodies (**Table 11**, Scenario 2).
- Loads represented by exceedances observed at individual Coalition TMDL compliance monitoring sites are not sufficient to directly cause an exceedance in the named TMDL water bodies under reasonably worst-case upstream receiving water conditions (**Table 11**, Scenario 3).

Additional qualitative evidence supporting continued compliance is represented by the ongoing outreach and education efforts to address chlorpyrifos and diazinon exceedances throughout the Coalition area. Outreach specific to the exceedances observed between October 2016 through September 2018 is discussed below (Outreach and Follow-Up Regarding TMDL Exceedances). As these efforts continue, it is reasonable to assume that management of pesticide applications and runoff will continue to improve and that exceedances in contributing tributaries and named TMDL receiving waters will continue to decrease in frequency and magnitude.

Changes that were implemented in Yolo County to classify chlorpyrifos and diazinon as restricted materials have also proven successful in further increasing compliance. Coalition monitoring conducted at Yolo County sites since the 2007 implementation of these additional label and use restrictions have resulted in only five additional exceedances in a total of 136 samples at the compliance site sampled in the Yolo subwatershed (Willow Slough).

Beginning on July 1, 2015, chlorpyrifos began to be regulated statewide as a restricted material, with similar restrictions to those in Yolo County. The new state-restricted material status requires that all chlorpyrifos products registered for production agricultural use must adhere to the additional requirements for all California restricted materials:

- Applications must be made or supervised by a certified applicator.
- Purchase, possession, or use requires the property operator to obtain a permit from the County Agricultural Commissioner.
- Businesses require a recommendation from a California Department of Pesticide Regulation (CDPR) licensed pest control adviser.

The Coalition submitted formal requests to the Executive Officer of the Regional Water Board for completion of chlorpyrifos management plans in two drainages (Walker Creek and Lower Snake River) in 2013 on the basis that these drainages are meeting water quality objectives. The Walker Creek management plan was approved as complete in January 2014, and the Lower Snake River management plan was approved as complete in March 2015. Additionally, a request for completion of the management plan at Gilsizer Slough for diazinon and Willow Slough for chlorpyrifos were submitted in December 2015. Both were approved for completion in July 2016. The most recent Management Plan to be deemed complete by the Regional Water Board is that for chlorpyrifos in Ulatis Creek, which received approval on April 2, 2019. A summary of the Coalition's active Management Plans for chlorpyrifos and diazinon during the period covered by this report is included in **Table 10**.

**Table 10. Active Management Plans for Chlorpyrifos and Diazinon during October 2016 through September 2018**

<b>Subwatershed</b>	<b>Waterbody</b>	<b>Analyte</b>	<b>Management Plan Status</b>
Butte-Yuba-Sutter	Gilsizer Slough	Chlorpyrifos	Management Plan approved December 2016
	Pine Creek	Chlorpyrifos	Management Plan approved December 2016
Solano	Ulatis Creek	Chlorpyrifos	Request for Completion approved April 2, 2019.

Note: A Management Plan is triggered when a monitoring result exceeds water quality objectives twice within a 3-year period. To complete the Management Plan, no exceedances may be observed during a 3-year period and growers/applicators must be provided outreach and education specific to management practices known to avoid or limit future agricultural discharges of the subject pesticide to surface waters.

**Table 11. Estimated TMDL Receiving Water Body Loads from Compliance Sites and Represented Areas**

Compliance Site Water Body	Sample Date	4-Day Average TUC for Compliance Site	TMDL Receiving Water	Receiving Water Discharge Estimate, cfs <sup>(1)</sup>	Basis for Receiving Water Discharge Estimate	Compliance site drainage irrigated acres	Represented total Irrigated acres	Frequency of Exceedance for compliance monitoring site (2009-2018)	Load extrapolation factor <sup>(2)</sup>	Represented additional load <sup>(3)</sup> , TUC	TMDL Receiving Water Estimation Scenarios <sup>(4)</sup>		
											1. Estimated TMDL RW Concentration when upstream load is 0, TUC	2. Estimated downstream TMDL RW Concentration including additional represented load, TUC	3. Estimated downstream TMDL RW Load when upstream concentration assumed to be 0.9, TUC
Gilsizer Slough at George Washington Road	8/22/2018	1.53	Feather River (via Sutter Bypass)	6,313	Feather River above Star Bend + Bear River	22,655	179,576	8.7%	0.603	0.924	0.0	0.00015	0.9000
Gilsizer Slough at George Washington Road	1/23/2018	1.50	Feather River (via Sutter Bypass)	6,650	Feather River above Star Bend+ Bear River	22,655	179,576	5.4%	0.373	0.559	0.0	0.00008	0.9000
Grand Island Drain near Leary Road	10/25/2017	1.50	Delta (Sacramento River at Cross channel)	4,110	Measured in Sac River	102,443	1,024,434	8.7%	0.783	1.175	0.0	0.00029	0.9000

Notes:

- (1) Receiving Water Discharge Estimate = measured or estimated instantaneous discharge for the receiving water
- (2) Load Extrapolation Factor = (Represented area irrigated acres + Compliance site irrigated acres) X compliance site exceedance percentage
- (3) Represented Additional Load = Monitoring site load X Load Extrapolation Factor
- (4) Estimates of TUC concentration in the TMDL Receiving Water Body, calculated using standard mass balance methods, for comparison to TUC Load Allocation of 1.0 TU.  
 Scenario 1 assumes a concentration of 0 TUC in the upstream TMDL Receiving Water Body. The resulting RW TU concentration is thus based on dilution of Compliance site load only.  
 Scenario 2 assumes TUC load in the upstream TMDL Receiving Water Body is based on the represented additional load extrapolated from the compliance site. This scenario represents the most realistic RW TU concentration estimate.  
 Scenario 3 assumes (very conservatively) a concentration of 0.9 TUC in the upstream TMDL Receiving Water Body. This scenario represents a "worst-case" RW TU concentration estimate.



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## OUTREACH AND FOLLOW-UP REGARDING TMDL EXCEEDANCES

Follow-up actions and source evaluations for exceedances in the TMDL water bodies and tributaries have been reported in past Annual Monitoring Reports and Management Plan Progress Reports, and will be reported in future versions of this reports. Typically, the first step taken is to analyze the pesticide application data from the California Department of Pesticide Regulation (CDPR) Pesticide Use Reporting (PUR) database. All users that were considered to have the potential to contribute to the observed chlorpyrifos or diazinon exceedance are contacted directly to inform them of the exceedances and appropriate management practices to reduce the risk of future exceedances.

Descriptions of all outreach and education activities conducted by the Coalition’s subwatersheds during October 2016 through September 2018 are provided in Appendix F (*SVWQC Outreach Materials*) of the Coalition’s 2018 Annual Monitoring Report (AMR). Outreach activities specific to chlorpyrifos and diazinon exceedances that occurred during the time period covered by this report are provided below.

### Butte-Yuba-Sutter Water Quality Coalition (Gilsizer Slough)

Targeted outreach was conducted by the Butte-Yuba-Sutter Water Quality Coalition in response to the diazinon exceedance observed on January 23, 2018 and the chlorpyrifos exceedance observed on August 22, 2018, both at Gilsizer Slough. The targeted outreach and general outreach efforts are summarized below in **Table 12**.

**Table 12. Outreach Activities Conducted by the Butte-Yuba-Sutter Water Quality Coalition**

Date	Location	Attendance	Type of Outreach	Description
<b>Targeted Outreach for the Diazinon Exceedance observed at GILSL on January 23, 2018</b>				
2/28/2018	The Refuge, Yuba City	95	Meeting	Member Obligations, Current Exceedances, FES, NMP, Upcoming Events
<b>Targeted Outreach for both the Diazinon Exceedance observed at GILSL on January 23, 2018, and the Chlorpyrifos Exceedance observed at GILSL on August 22, 2018</b>				
11/14/2018	Sutter Co. Ag Commissioner’s Office, Yuba City	120	Meeting	Member Obligations, Current Exceedances (Gilsizer Slough & Lower Honcut Creek), FES, NMP, Upcoming Events
11/28/2018	Sutter Co. Ag Commissioner’s Office, Yuba City	120	Meeting	Member Obligations, Current Exceedances (Gilsizer Slough & Lower Honcut Creek), FES, NMP, Upcoming Events
12/05/2018	Sutter Co. Ag Commissioner’s Office, Yuba City	120	Meeting	Member Obligations, Current Exceedances (Gilsizer Slough & Lower Honcut Creek), FES, NMP, Upcoming Events

Date	Location	Attendance	Type of Outreach	Description
<b>Targeted Outreach for both the Diazinon Exceedance observed at GILSL on January 23, 2018, and the Chlorpyrifos Exceedance observed at GILSL on August 22, 2018</b>				
12/12/2018	Sutter Co. Ag Commissioner's Office, Yuba City	120	Meeting	Member Obligations, Current Exceedances (Gilsizer Slough & Lower Honcut Creek), FES, NMP, Upcoming Events
1/16/2019	Yuba-Sutter Fairgrounds	250	Meeting	Member Obligations, Current Exceedances (Gilsizer Slough & Lower Honcut Creek), FES, NMP, Upcoming Events
1/24/2019	Yuba-Sutter Fairgrounds	250	Meeting	BYS Update, Monitoring Review, Member Requirements, CVRWQCB Update
1/30/2019	Yuba-Sutter Farm Bureau	5	Meeting	BYS Update, Member Requirements, Current Exceedances (Gilsizer Slough & Lower Honcut)
<b>General Outreach Efforts</b>				
1/01/2018	Admin	2500	Article/Newsletter	Member Obligations, Current Exceedances, FES, NMP, Upcoming Events
1/10/2018	Butte Co. Fairgrounds	75	Meeting	Member Obligations, Current Exceedances, FES, NMP, Upcoming Events
1/23/2018	The Palms, Chico	120	Meeting	Member Obligations, Current Exceedances, FES, NMP, Upcoming Events
1/31/2019	Silver Dollar Fairgrounds, Chico	311	Meeting	Member Obligations, Current Exceedances, FES, NMP, Upcoming Events
Jan – Dec 2018	Online	2500	Article/Newsletter	Member Obligations, Current Exceedances, FES, NMP, Upcoming Events
1/17/2019	Yuba-Sutter Fairgrounds	70	Meeting	NMP Self-Certification Training, BYS Member Requirements, Update on Events

### **Sacramento Amador Water Quality Coalition (Grand Island Drain)**

Targeted outreach was conducted by the Sacramento Amador Water Quality Coalition in response to the diazinon exceedance at Grand Island Drain observed on October 22, 2017. The targeted outreach and general outreach efforts are summarized below in **Table 13**.

**Table 13. Outreach Activities Conducted by the Sacramento-Amador Water Quality Coalition**

<b>Date</b>	<b>Location</b>	<b>Attendance</b>	<b>Type of Outreach</b>	<b>Description</b>
<b>Targeted Outreach for the Diazinon Exceedance observed at GIDLR on October 22, 2017</b>				
2/27/2018 - 3/9/2018	SAWQA	17	Phone Call	Diazinon exceedance
3/29/2018	Plymouth	~135	Workshop	Foothills Grape Grower Day: Water Quality Results/General
7/2/2018	Elk Grove	~35	Meeting	Open House: Water Quality Results/General
7/13/2018	Jackson	~15	Meeting	Open House: Water Quality Results/General
Winter 2018/2019	SAWQA	605	Article/Newsletter	General/Water Quality Results
<b>General Outreach Efforts</b>				
Winter 2017/2018	SAWQA	605	Article/Newsletter	General/Water Quality Results
11/7/2017	Galt/Wilton	6	Other	Member Site Visits - SECP/NMP/General Member Requirements
11/8/2017	Plymouth/ Jackson	12	Other	Member Site Visits - SECP/NMP/General Member Requirements
11/9/2017	Acampo	3	Other	Member Site Visits - SECP/NMP/General Member Requirements
11/20/2017	Galt/Wilton	4	Other	Member Site Visits - SECP/NMP/General Member Requirements
11/30/2017	Plymouth	4	Other	Member Site Visits - SECP/NMP/General Member Requirements
12/01/2017	Plymouth/ Jackson	3	Other	Member Site Visits - SECP/NMP/General Member Requirements
1/31/2018	Walnut Grove	~45	Workshop	SECP Training/Water Quality Results
1/31/2018	Walnut Grove	~45	Meeting	Open House: Water Quality Results/General
2/07/2018	Elk Grove	~35	Meeting	Open House: Water Quality Results/General
2/14/2018	Jackson	~45	Meeting	Open House: Water Quality Results/General
7/23/2018 – 7/29/2018	Jackson	~2000	Other	County Fair: Water Quality Results/General

Date	Location	Attendance	Type of Outreach	Description
<b>General Outreach Efforts</b>				
Monthly 2017 – 2018	SAWQA	~40 (average)	Phone Call	SECP/NMP/NMS/General Program

## TOXICITY AND ADDITIONAL PESTICIDE RESULTS

The results of pesticide monitoring from October 2016 through September 2018 are reported in the Coalition’s 2017 and 2018 AMRs. There were 2,524 individual pesticide results analyzed in 164 water column samples collected from 21 different sites, including both Representative and Management Plan or Special Study sites. Analyses were conducted for organophosphates, carbamates, organochlorines, benzophenyls, pyrethroids, and a variety of herbicides. Greater than 95.2% of all pesticide results were below detection during the two years covered by this report.

### Determine Whether the Discharge Causes or Contributes to a Toxicity Impairment Due to Additive or Synergistic Effects of Multiple Pollutants (TMDL Monitoring Goal 6)

Pesticides that have modes of action that are potentially additive to chlorpyrifos and/or diazinon include carbaryl, malathion, methomyl, naled, and dichlorvos (cholinesterase inhibitors). These pesticides are typically detected much less frequently than chlorpyrifos or diazinon. However, none of these pesticides were detected during the event at Grand Island Drain (GIDLR) when diazinon was detected in a sample, nor were they detected in the two Gilsizer Slough (GILSL) water quality samples when diazinon and chlorpyrifos were detected.

Reviewing the results of the past five monitoring years indicates that toxicity due to additive or synergistic effects with chlorpyrifos or diazinon is extremely rare. There were 269 individual toxicity results analyzed in water column and sediment samples collected from 18 different sites during the 2017 through 2018 Coalition monitoring years. Toxicity analyses were conducted for *Selenastrum capricornutum*, *Ceriodaphnia dubia*, and *Hyaella azteca*. Toxicity to *Ceriodaphnia* was tested 120 times during these two monitoring years and there was never any observed toxicity. During the 2016 Monitoring Year, statistically significant toxicity was not observed in any of the individual toxicity results analyzed in either sediment or water column samples, including 18 samples tested for toxicity to *Ceriodaphnia*. The last time that Coalition monitoring observed *Ceriodaphnia* toxicity that was determined to be caused solely by chlorpyrifos, based on measured concentration, was during the 2015 monitoring year. With respect to the last six years of Coalition monitoring, we can reasonably and definitively conclude that 302 out of 303 samples collected since 2013 did not have additive or synergistic toxicity associated with chlorpyrifos or diazinon (99.7%) and four or fewer samples (0.3%) had toxicity that *may potentially* have been attributable to additive or synergistic effects with chlorpyrifos and diazinon.

## Determine Whether Alternatives to Diazinon and Chlorpyrifos are Causing Surface Water Quality Impacts (TMDL Monitoring Goal 5)

Based on our evaluation of the relative risks of current use pesticides, most potential alternatives to chlorpyrifos and diazinon have a much lower risk of causing adverse impacts to surface waters and have not been prioritized for monitoring. One exception to this finding is the category of pyrethroid pesticides, which have been identified as having significant potential to cause toxicity in sediments. The potential current impacts of pyrethroid pesticides are being assessed by the Coalition through toxicity and chemical monitoring of sediment, initially driven by the requirement for the Coalition to implement the Regional Water Board's 2016 Pesticides Evaluation protocol and more recently by the approved Central Valley Pyrethroid Pesticides Total Maximum Daily Load and Basin Plan Amendment<sup>13</sup>. Prior to the recent pyrethroid pesticides monitoring effort, the Coalition observed several cases of pyrethroid-caused sediment toxicity and addressed these cases through Management Plans and other targeted outreach mechanisms. However, our longer-term monitoring indicates that sediment toxicity is not a widespread or common problem in the Coalition's watersheds. Out of 263 sediment toxicity sample events, there have been only 14 cases (5.3%) of significant toxicity with *Hyaella azteca* survival less than 80% compared to laboratory controls.

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<sup>13</sup> Pyrethroid pesticides considered in the 2017 Central Valley Pyrethroid Pesticides Total Maximum Daily Load and Basin Plan Amendment (Amendment) include the following: Bifenthrin, Cyfluthrin, Cypermethrin, Esfenvalerate, Lambda-Cyhalothrin, and Permethrin (The Amendment was adopted by the Central Valley Water Board on June 8, 2017, approved by the State Water Resources Control Board on July 10, 2018, and approved by the Office of Administrative Law on February 19, 2019.)

## Summary

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Based on the results of the Coalition’s routine and TMDL monitoring, compliance with the TMDL water quality objectives and load allocations is achieved in the overwhelming percentage of samples. These results demonstrate that outreach and education, the resulting changes in use patterns and changes in management practices, and modifications to pesticide labeling have been successful in reducing in-stream ambient concentrations of chlorpyrifos and diazinon to the degree required by the TMDL. The relatively low rate of exceedances since the beginning of the ILRP suggests that many of the changes were successfully implemented prior to or soon after 2005. Although exceedances are still occasionally observed, the overall trend from 2005 through September 2018 has been a decrease in the rate of annual exceedances (**Figure 4**). Exceedances observed in the TMDL tributaries monitored for compliance during the 2017 and 2018 monitoring years were determined unlikely to cause exceedances of the TMDL Load Allocations in the named TMDL receiving water bodies under any reasonably probable scenario (**Table 11**).

Continuing efforts to further reduce exceedances are being implemented through the Coalition’s Management Plans for sites that have triggered Management Plan requirements for these two pesticides. Additionally, the Coalition aggressively investigates all exceedances and conducts follow-up contact with growers reporting applications that have the potential to cause specific observed exceedances. These combined efforts, along with the implementation of the state-restricted material status for chlorpyrifos in July 2015, are expected to result in a continuation of the observed decreasing trend in the number of exceedances for these pesticides.

Demonstrating that management practices are achieving the lowest “technically and economically achievable” pesticide concentrations is fundamentally addressed through the TMDL compliance monitoring (Goal 7). The high level of compliance discussed extensively within this Compliance Report is empirical evidence that this goal is being achieved on a broad geographic scale through the practices employed in the Coalition’s watersheds. Further evidence is provided by the progress toward completion of the Coalition’s Management Plans for chlorpyrifos and diazinon. Furthermore, achieving the level of compliance required for completion of the Management Plans is direct evidence that the combination of practices employed are effective at reducing and eliminating discharges of chlorpyrifos and diazinon. Six Management Plans have already been approved for completion: Lower Coon Creek in the Placer-Nevada-South Sutter-North Sacramento Subwatershed (chlorpyrifos), Walker Creek in the Colusa-Glenn Subwatershed (chlorpyrifos), Willow Slough in the Yolo Subwatershed (chlorpyrifos), Gilsizer Slough in Butte-Yuba-Sutter Subwatershed (diazinon), Lower Snake River in the Butte-Yuba-Sutter Subwatershed (chlorpyrifos), and Ulatis Creek in the Solano Subwatershed (chlorpyrifos).

## References

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California Regional Water Quality Control Board – Central Valley Region. *Water Quality Control Plan for the Sacramento River and San Joaquin River Basins (Basin Plan)*. Fourth Edition. Most recently revised in July 2016.

[http://www.waterboards.ca.gov/rwqcb5/water\\_issues/basin\\_plans/](http://www.waterboards.ca.gov/rwqcb5/water_issues/basin_plans/)

California Regional Water Quality Control Board – Central Valley Region. *Amendment 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 Sacramento and Feather Rivers*. Resolution No. R5-2007-0034.

California Regional Water Quality Control Board – Central Valley Region. *Amendment 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 Sacramento-San Joaquin Delta*. Resolution No. R5-2006-0061.

California Regional Water Quality Control Board – Central Valley Region. *Waste Discharge Requirements General Order for Growers within the Sacramento River Watershed that are Members of a Third-Party Group*. Order R5-2014-0030. March 2014.

California Regional Water Quality Control Board – Central Valley Region. *Amendment to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Diazinon and Chlorpyrifos Discharges*. Resolution R5-2014-0041. Approved by the State Water Resources Control Board (June 16, 2015, Resolution No. 2015-0043) and the State of California - Office of Administrative Law (March 8, 2017, OAL File No. 2017-0124-04S), but pending action by the United States Environmental Protection Agency.

California Regional Water Quality Control Board – Central Valley Region. *Minor, Non-Substantive Changes to the Basin Plan Amendments Adopted Under Central Valley Water Board Resolution R5-2014-0041*. Letter from Pamela C. Creedon, Executive Officer, to Tom Howard, Executive Director of the State Water Board. March 7, 2017.

Sacramento Valley Water Quality Coalition. *Water Quality Management Plan*. Prepared by Larry Walker Associates for the Sacramento Valley Water Quality Coalition. Davis, California. January 2009.

Sacramento Valley Water Quality Coalition. *Addendum to Sacramento Valley Water Quality Coalition Management Plan: Chlorpyrifos and Diazinon TMDLs*. April 2010.

Sacramento Valley Water Quality Coalition. *Quality Assurance Project Plan (QAPP) V.5.0, Sacramento Valley Water Quality Coalition Monitoring and Reporting Program Plan – Sacramento River Basin*. Prepared for the Sacramento Valley Water Quality Coalition by Larry Walker Associates, Davis, California. March 2010.

State of California, Office of Administrative Law. *Notice of Approval of Regulatory Action*. OAL File No. 2017-0124-04S. March 8, 2017.



State Water Resources Control Board. *Approving an Amendment to the Water Quality Control Plan for the Sacramento and San Joaquin River Basins (Basin Plan) for the Control of Diazinon and Chlorpyrifos Discharges*. Resolution No. 2015-0043. June 16, 2015.

## **Appendix A**

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Sacramento Valley Water Quality Coalition Chlorpyrifos and Diazinon TMDL Monitoring Results, January 2009 – September 2018

*Please see attached Microsoft Excel spreadsheet file.*

## **Appendix B**

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Delta Regional Monitoring Program Participation Approval Letter for Reduced Individual Monitoring (February 26, 2016)

## **Appendix C**

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Delta Regional Monitoring Program Chlorpyrifos and Diazinon Monitoring Results, October  
2016 – September 2018