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SACRAMENTO VALLEY
WATER QUALITY COALITION

Management of Chlorpyrifos and Diazinon Discharges to the Sacramento and Feather Rivers and the Sacramento-San Joaquin Delta: 2015 TMDL Compliance Monitoring Report

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Introduction

In December 2008, the Sacramento Valley Water Quality Coalition (Coalition) 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 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).¹ 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 Addendum² to the Coalition's approved Management Plan addresses the Coalition's planned activities to comply with the TMDL requirements specific to 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 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, the Coalition is submitting this annual TMDL Compliance Report summarizing the 2015 monitoring objectives, locations of sampling sites, and compliance results.

Background

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 Board. As a result of the 303(d) listing, the Regional 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.*).

¹ On March 28, 2014, the Regional 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, the Office of Administrative Law, and U.S. EPA. The public comment period for the State Board's consideration of the Amendment closed April 23, 2015.
http://www.waterboards.ca.gov/centralvalley/water_issues/tmdl/central_valley_projects/central_valley_pesticides/index.shtml

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

In addition to adopting a TMDL, the Regional 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 Board adopted (and the State Water Resources Control 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 Board committed to reviewing the objectives by July 1, 2007, and potentially amending the objectives by July 1, 2008. The Regional 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*).³ 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 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 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 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.

The Coalition continues to monitor chlorpyrifos and diazinon according to the Coalition’s approved monitoring schedules and the SVWQC 2010-2014 Monitoring and Reporting Program (MRP) Order⁴. 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.

³ 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.

⁴ 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).

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 Report (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 Management Plan.

The Coalition’s monitoring frequency and locations are evaluated and updated annually for the Management Plan, subject to approval by the Executive Officer of the Regional Board. These annual updates are required by the WDR.

Recently, chlorpyrifos began to be regulated statewide as a restricted material. 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 new state-restricted 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** (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

Compliance Monitoring Goal	Report Section Heading(s)	Page(s)
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	6-13
2. Determine compliance with established waste load allocations and load allocations for chlorpyrifos and diazinon	Discussion	14-29

Compliance Monitoring Goal	Report Section Heading(s)	Page(s)
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	26-28
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	26-28
5. Determine whether alternatives to chlorpyrifos and diazinon are causing surface water quality impacts	Toxicity and Additional Pesticide Results	28-29
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	17-25; 28-29
7. Demonstrate that management practices are achieving the lowest pesticide levels technically and economically achievable	Summary	30

SAMPLING SITES

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 plans. 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 MRPP. These schedules were retained for the TMDL monitoring in 2010 and 2011, and updated subsequently for current pesticide use patterns.

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

Subwatershed	Location	Site ID	Lat.	Long.	Delta, Sacramento, or Feather River Basin Subarea
ButteYubaSutter	Gilsizer Slough at George Washington Rd.	GILSL	39.0090	-121.6716	Lower Feather River, Sac. River
ButteYubaSutter	Lower Honcut Creek at Hwy 70	LHNCT	39.3092	-121.5954	Feather River
ButteYubaSutter	Lower Snake River at Nuestro Rd.	LSNKR	39.1853	-121.7036	Feather River
ButteYubaSutter	Pine Creek at Nord Gianella Rd.(1)	PNCGR	39.7811	-121.9877	Sac. River
ButteYubaSutter	Pine Creek at Highway 32 (1)	PNCHY	39.7534	-121.9712	Sac. River
ButteYubaSutter	Sacramento Slough Bridge near Karnak	SSKNK	38.7850	-121.6533	Sac. River, Northern Delta
ColusaGlenn	Colusa Basin Drain above Knight's Landing	COLDR	38.8121	-121.7741	Sac. River
ColusaGlenn	Rough and Ready Pumping Plant (RD 108)	RARPP	38.8621	-121.7927	Sac. River, NW Delta
ColusaGlenn	Walker Creek near 99W and CR33	WLKCH	39.6242	-122.1965	Sac. River
PNSSNS	Coon Creek at Striplin Rd.	CCSTR	38.8661	-121.5803	Sac. River
SacramentoAmador	Cosumnes River at Twin Cities Rd.	CRTWN	38.2910	-121.3804	Eastern Delta
SacramentoAmador	Grand Island Drain near Leary Rd.	GIDLR	38.2399	-121.5649	Northern Delta
SolanoYolo	Shag Slough at Liberty Island Bridge	SSLIB	38.3068	-121.6934	NW Delta
SolanoYolo	Ulati Creek at Brown Road	UCBRD	38.3070	-121.7940	NW Delta
SolanoYolo	Willow Slough Bypass at Pole Line	WLSPL	38.5902	-121.7306	NW Delta

Note:

(1) Beginning February 2014, the Pine Creek monitoring site was moved downstream from PNCGR to PNCHY.

Monitoring Results

All TMDL data through September 2015 have been previously submitted to the Regional Board as required by the ILRP. A complete set of relevant monitoring data for compliance sites for 2005 through September 2015 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. These results have been submitted to the Regional Board on a quarterly basis, as required by the ILRP.

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 was successfully collected and analyzed. Approximately 92% of samples planned for October 2014 through September 2015 were successfully collected and analyzed. Based on the total number of planned and analyzed samples, overall completeness for planned chlorpyrifos and diazinon analyses for January 2009 through September 2015 was 99% (**Table 3**). All planned October 2014 through September 2015 TMDL compliance parameters have been successfully collected and analyzed, with the following exceptions.

- One sample each for Shag Slough at Liberty Island Bridge (SSLIB) and Willow Slough Bypass at Pole Line (WLSPL) were not collected due to an error in sample plan preparation.
- Four of the six samples planned for Cosumnes River (CRTWN) were not collected because the site was dry November of 2014 and June, July, and August 2015.
- Three of the four samples planned for Walker Creek near 99W and CR33 (WLKCH) were not collected in July, August, and September 2015 because the site was dry.
- Flow measurements could not be collected for all sites and events due to site access or site conditions during some events.⁵ This prevented the calculation of loads using data recorded by the field crew for one chlorpyrifos detection in Pine Creek at Highway 32 (PNCHY) (**Table 6**), so an estimate for flow was obtained through a different source.

⁵ In some cases, the field crew visually estimated the flow when measurements could not be collected.

Loads were successfully characterized for all TMDL compliance results during the period October 2014 through September 2015.

Table 3. TMDL Compliance Sampling Completeness Summary

Compliance Site	JAN 2009 – SEP 2014		OCT 2014 – SEP 2015			JAN 2009 – SEP 2015	
	Planned	Collected	Planned	Collected	Note	Planned	Collected
Colusa Basin Drain above KL	33	34	7	7		40	41
Coon Creek at Striplin Road	21	21	4	4		25	25
Cosumnes River at Twin Cities Road	20	14	6	2	(2)	26	16
Gilsizer Slough at George Washington Road	25	27	6	6		31	33
Grand Island Drain near Leary Road	28	30	7	8	(3)	35	38
Lower Honcut Creek	30	31	7	7		37	38
Lower Snake River at Nuestro Road	29	31	6	6		35	37
Pine Creek (1)	24	22	4	5	(4)	28	27
Rough and Ready Pumping Plant (RD 108)	28	29	8	8		36	37
Sacramento Slough bridge near Karnak	24	25	6	6		30	31
Shag Slough at Liberty Island Bridge	31	32	7	6	(5)	38	38
Ulatis Creek at Brown Road	33	34	6	6		39	40
Walker Creek near 99W and CR33	32	29	4	1	(6)	36	30
Willow Slough Bypass at Pole Line	32	35	6	5	(5)	38	40
Totals	390	394	84	77		474	471
Percent Completeness		101%		92%			99%

Notes:

- (1) Beginning Event 96, the Pine Creek monitoring site was moved from Nord Gianella Road (PNCGR) to Highway 32 (PNCHY).
- (2) Samples were not collected in November of 2014 and June, July, and August 2015 because the site was dry.
- (3) An additional result was obtained in March 2015 than planned since a sample was collected and analyzed for other organophosphorous pesticides by the same analytical method (EPA 625M).
- (4) An additional sample was obtained in April 2015 than planned since a sample was collected and analyzed for other organophosphorous pesticides by the same analytical method (EPA 8141A).
- (5) The May 2015 sample was inadvertently omitted from the sample plan preparation.
- (6) Samples were not collected in July, August, and September 2015 because the site was dry.

Comparison with TMDL Objectives and Discussion of Exceedances

A summary of the number of analyses of water quality samples collected January 2009 through September 2015 for TMDL compliance monitoring is presented in **Table 4** and **Table 5** for chlorpyrifos and diazinon, respectively. Occurrences when results exceeded water quality objectives are also indicated in the tables.

Table 4. Summary of 2009-2015 TMDL Monitoring Results for Chlorpyrifos

Compliance Site	JAN 2009 – SEP 2014		OCT 2014 – SEP 2015		JAN 2009 – SEP 2015	
	>WQO	# of Samples	>WQO	# of Samples	Total >WQO	Total Samples
Colusa Basin Drain above KL		34		7		41
Coon Creek at Striplin Rd.	1	21		4	1	25
Cosumnes River at Twin Cities Rd.		14		2		16
Gilsizer Slough at George Washington Rd.	1	27	3	6	4	33
Grand Island Drain near Leary Rd.	2	30		8	2	38
Lower Honcut Creek		31		7		38
Lower Snake River at Nuestro Rd.		31		6		37
Pine Creek ⁽¹⁾	6 ⁽²⁾	22	1	5	7	27
Rough and Ready Pumping Plant (RD 108)		29		8		37
Sacramento Slough bridge near Karnak		25		6		31
Shag Slough at Liberty Island Bridge	1	32		6	1	38
Ulatis Creek at Brown Rd.	4	34	1	6	5	40
Walker Creek near 99W and CR33	1	29		1	1	30
Willow Slough Bypass at Pole Line	2	35		5	2	40
<i>Total</i>	18	394	5	77	23	471

Note:

- (1) Beginning 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. Review of data indicates that three "exceedances" reflect degradation of the original elevated concentration and not additional discharges of chlorpyrifos.

Table 5. Summary of 2009-2015 TMDL Monitoring Results for Diazinon

Compliance Site	JAN 2009 – SEP 2014		OCT 2014 – SEP 2015		JAN 2009 – SEP 2015	
	>WQO	# of Samples	>WQO	# of Samples	Total >WQO	Total Samples
Colusa Basin Drain above KL		34		7		41
Coon Creek at Striplin Road		21		4		25
Cosumnes River at Twin Cities Road		14		2		16
Gilsizer Slough at George Washington Rd.	2	27		6	2	33
Grand Island Drain near Leary Road	2 ⁽²⁾⁽³⁾	30		8	2	38
Lower Honcut Creek		31		7		38
Lower Snake River at Nuestro Road		31		6		37
Pine Creek ⁽¹⁾		22		5		27
Rough and Ready Pumping Plant (RD 108)		29		8		37
Sacramento Slough bridge near Karnak		25		6		31
Shag Slough at Liberty Island Bridge		32		6		38
Ulatis Creek at Brown Road		34		6		40
Walker Creek near 99W and CR33		29		1		30
Willow Slough Bypass at Pole Line		35		5		40
<i>Total</i>	4	394		77	4	471

Notes:

(1) Beginning Event 96 (February 2014), the Pine Creek monitoring site was moved from Nord Gianella Road (PNCGR) to Highway 32 (PNCHY).

(2) Exceedance occurred in only one of two field samples collected on 10/19/2010.

(3) The associated field replicate result (0.1672 µg/L) collected on 10/29/2013 also exceeded the WQO.

Compliance with Concentration-Based and Load-Based TMDL Objectives

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

Chlorpyrifos

Between October 2014 through September 2015, chlorpyrifos was detected in 12 of 77 samples (16%) collected at the 14 compliance monitoring locations. A total of five samples (6% of samples) exceeded the adopted Basin Plan Amendment 4-day chronic objective (0.015 µg/L) and four samples (5% of samples) exceeded the adopted Basin Plan Amendment 1-hour acute objective (0.025 µg/L) for chlorpyrifos. The exceedances occurred at Gilsizer Slough (January, July, and August 2015), Pine Creek (April 2015), and Ulatis Creek (May 2015).

Gilsizer Slough (Event 107)

There were nine reported applications of chlorpyrifos in the month prior to the January 20, 2015, exceedance. Chlorpyrifos was applied to approximately 694 acres of peaches and other deciduous trees in the Gilsizer Slough drainage during the month of December 2014. There was an additional application to four acres on the morning of the exceedance. All of the applications were ground applications. Although standing water was present in the drain, there was no

observable or detectable flow at this site. The area received approximately 0.1 inches of rain⁶ in the month preceding the exceedance, but no single rain event recorded greater than a few hundredths of an inch of rain, so precipitation and runoff were expected to have had minimal impact on the exceedance. Toxicity tests for *Ceriodaphnia*, *Pimephales*, and *Selenastrum* were performed with this sample, and no toxicity was observed.

Pine Creek (Event 110)

There were three reported applications of chlorpyrifos in the month prior to the April 22, 2015, exceedance. Chlorpyrifos was applied to approximately 470 acres of almonds and 52 acres of beets in the Pine Creek drainage during that time. The beet application occurred less than a week before the exceedance and was applied aerially. Although water was present in the creek, field crews were unable to measure flow at this site. Flow was visually estimated to be 0.2 feet per second. The area received approximately 0.79 inches of rain⁷ in the month preceding the exceedance, but the area was dry for 14 days preceding the event. Toxicity tests for *Ceriodaphnia*, *Pimephales*, and *Selenastrum* were performed with this sample, and the sample was found to be toxic to *Ceriodaphnia*.

Ulati Creek (Event 111)

There were 11 reported applications of chlorpyrifos in the month prior to the May 19, 2015, exceedance. Chlorpyrifos was applied to approximately 835 acres of alfalfa and other miscellaneous crops in the Ulati Creek drainage during the months of April and May. Early applications in April were made aerially. The most recent application to the date of exceedance was applied to 100 acres, two weeks prior to the date. Field crews observed water in the creek and estimated the discharge to be 21.7 cubic feet per second (cfs). The area received approximately 0.1 inches of rain⁸ in the month preceding the exceedance. No toxicity tests were performed for this sample.

Gilsizer Slough (Event 113)

There were 10 reported applications of chlorpyrifos in the month prior to the July 21, 2015, exceedance. Chlorpyrifos was applied to approximately 254 acres of almonds and 203 acres of walnuts in the Gilsizer Slough drainage during the months of June and July. Field crews observed water in the drain and estimated the discharge to be 2.9 cfs. The area received no rain⁶ in the month preceding the exceedance. No aerial applications were performed. No toxicity tests were performed for this sample.

Gilsizer Slough (Event 114)

There were eight reported applications of chlorpyrifos in the month prior to the August 18, 2015, exceedance. Chlorpyrifos was applied to approximately 238 acres of walnuts in the Gilsizer Slough drainage during the months of June and July. Although standing water was present in the

⁶ Based on precipitation data from CDEC site “Bear River Near Wheatland (BRW)” <http://cdec.water.ca.gov/cdecstation/?staid=brw>

⁷ Based on precipitation data from CDEC site “Chico (CHI)” <http://cdec.water.ca.gov/cdecstation/?staid=chi>

⁸ Based on precipitation data from CDEC site “Liberty Island – Yolo Bypass (LIY)” <http://cdec.water.ca.gov/cdecstation/?staid=liy>

drain, there was no observable or detectable flow at this site. The area received no rain⁶ in the month preceding the exceedance. No aerial applications were performed. No toxicity tests were performed for this sample.

Diazinon

Between October 2014 through September 2015, diazinon was not detected in any of the 77 samples collected at the 14 compliance monitoring locations. As such, no concentrations exceeded the adopted Basin Plan Amendment 4-day chronic objective (0.10 µg/L) nor the 1-hour acute objective (0.16 µg/L) for diazinon.

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)⁹.

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

Table 6. Load Estimates for Detected Chlorpyrifos and Diazinon, October 2014 – September 2015

Site ID	Water Body	Sample Date	Discharge, CFS	Concentrations, µg/L		Instantaneous Loads, g/day		Notes
				Chlorpyrifos	Diazinon	Chlorpyrifos	Diazinon	
CCSTR	Coon Creek	4/22/2015	6.91	0.0019	ND	0.03	0.00	(1)
CCSTR	Coon Creek	9/15/2015	4.41	0.0015	ND	0.02	0.00	(1)
GILSL	Gilsizer Slough	1/20/2015	0	0.2	ND	0.00	0.00	(2,3)
GILSL	Gilsizer Slough	7/21/2015	2.92	0.0249	ND	0.18	0.00	(2)
GILSL	Gilsizer Slough	8/18/2015	0	0.74	ND	0.00	0.00	(2,3)
GILSL	Gilsizer Slough	9/15/2015	0	0.0078	ND	0.00	0.00	(1,3)
LHNCT	Lower Honcut Creek	7/21/2015	0	0.005	ND	0.00	0.00	(1,4)
LSNKR	Lower Snake River	7/21/2015	81.70	0.0054	ND	1.08	0.00	(1)
LSNKR	Lower Snake River	9/16/2015	36.32	0.0019	ND	0.17	0.00	(1)
PNCHY	Pine Creek	4/22/2015	11 (NM ¹⁰)	0.26	ND	7.01	0.00	(2)

⁹ Unit conversion factor: [1 g/ 1,000,000 µg]*[86,400 seconds/day]*[28.32 liter/cubic foot]

Site ID	Water Body	Sample Date	Discharge, CFS	Concentrations, µg/L		Instantaneous Loads, g/day		Notes
				Chlorpyrifos	Diazinon	Chlorpyrifos	Diazinon	
RARPP	Sycamore Slough	7/21/2015	0	0.0018	ND	0.00	0.00	(1,3)
UCBRD	Ulatis Creek	5/19/2015	21.69	0.035	ND	1.86	0.00	(2)

Notes: Exceedances of TMDL concentration objectives are highlighted yellow in the table.

NM = Not Measured

ND = Not Detected

(1) Concentrations were below WQO; no contribution to exceedances

(2) Concentrations exceeded WQO

(3) No measureable flow

(4) Unable to measure flows, 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.

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

Of the five samples collected between October 2014 through September 2015 that exceeded the individual TMDL concentration objectives, all exceeded the 4-day TMDL Load Allocation and four exceeded the 1-hour TMDL Load Allocation, respectively, based on combined (i.e., additive) chronic toxic units (TUC) (**Table 7**).

¹⁰ The water was too deep for the field crew to collect flow measurements during this event. As such, the flow is estimated using data reported by the Department of Water Resources California Data Exchange Center, as the difference between flow from the Sacramento River at Ord Ferry-Main Channel (ORD) and Sacramento River at Hamilton City-Main CH (HMC) stations.

Table 7. Compliance with Load Capacity Objectives for Detected Chlorpyrifos and Diazinon, October 2014 – September 2015

Site ID	Water Body	Sample Date	Discharge, CFS	Concentrations, µg/L		Load Allocation Compliance ⁽⁸⁾		
				Chlorpyrifos	Diazinon	1-Hour (TUa)	4-Day Average (TUc)	Notes
CCSTR	Coon Creek	4/22/2015	6.91	0.0019	ND	0.08	0.13	(1)
CCSTR	Coon Creek	9/15/2015	4.41	0.0015	ND	0.06	0.10	(1)
GILSL	Gilsizer Slough	1/20/2015	0	0.2	ND	8.00	13.33	(2,3,5,6)
GILSL	Gilsizer Slough	7/21/2015	2.92	0.0249	ND	1.00	1.66	(2,5)
GILSL	Gilsizer Slough	8/18/2015	0	0.74	ND	29.60	49.33	(2,3,5,6)
GILSL	Gilsizer Slough	9/15/2015	0	0.0078	ND	0.31	0.52	(1,3)
LHNCT	Lower Honcut Creek	7/21/2015	0	0.005	ND	0.20	0.33	(1,4)
LSNKR	Lower Snake River	7/21/2015	81.7	0.0054	ND	0.22	0.36	(1)
LSNKR	Lower Snake River	9/16/2015	36.32	0.0019	ND	0.08	0.13	(1)
PNCHY	Pine Creek	4/22/2015	11 (NM ¹¹)	0.26	ND	10.40	17.33	(2,4,5,6)
RARPP	Sycamore Slough	7/21/2015	0	0.0018	ND	0.07	0.12	(1,3)
UCBRD	Ulatis Creek	5/19/2015	21.69	0.035	ND	1.40	2.33	(2,5,6)

Notes: Exceedances of TMDL concentration objectives are highlighted yellow in the table.

NM = Not Measured

ND = Not Detected

(1) Concentrations were below WQO; no contribution to exceedances

(2) Concentrations exceeded WQO

(3) No measureable flow, therefore, no loads to downstream TMDL receiving waters

(4) Unable to measure flows, zero flow was visually estimated

(5) Concentrations exceeded 4-day average based Load Allocation

(6) Concentrations exceeded 1-hour average based Load Allocation

(7) 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).

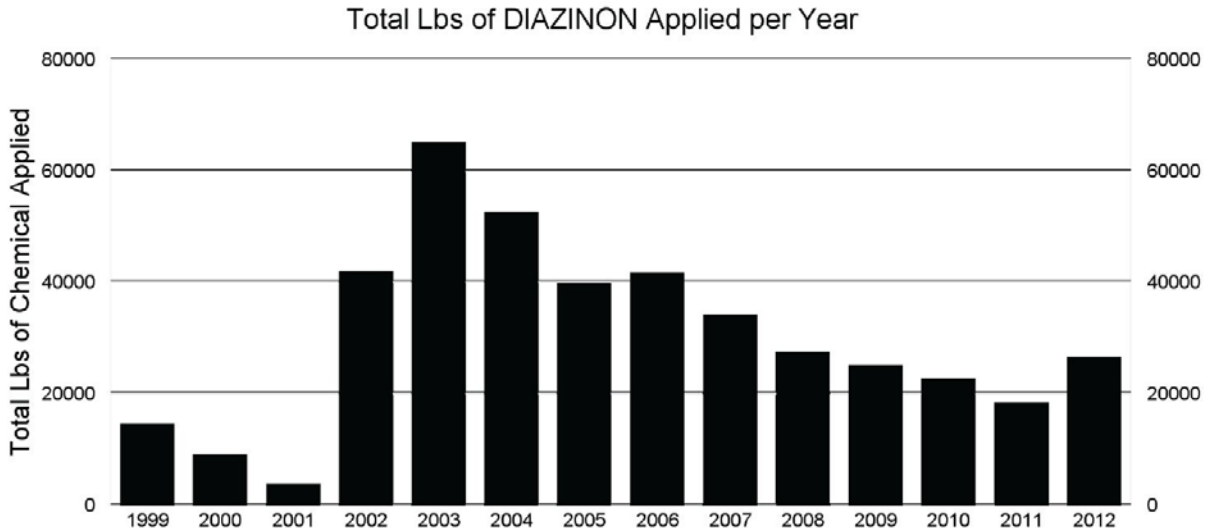
¹¹ The water was too deep for the field crew to collect flow measurements during this event. As such, the flow is estimated using data reported by the Department of Water Resources California Data Exchange Center, as the difference between flow from the Sacramento River at Ord Ferry-Main Channel (ORD) and Sacramento River at Hamilton City-Main CH (HMC) stations.

Discussion

The California Department of Pesticide Regulation 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.^{12,13} In the five Coalition subwatersheds within the TMDL compliance region (Butte-Yuba-Sutter; Glenn-Colusa; Placer-Nevada-South Sutter-North Sacramento; Sacramento-Amador; Solano-Yolo), substantial decreases are also evident for diazinon, but the pattern is somewhat different for chlorpyrifos. As illustrated in **Figure 1**, agricultural diazinon use decreased by about 60% in these five subwatersheds from 2003-2012. In contrast, chlorpyrifos use in the region increased from 2001 to 2005, but has since decreased from these peak levels (**Figure 2**); although less consistently than diazinon. The recent period of decreasing trend in chlorpyrifos use coincides with the monitoring timeframe of the ILRP.

¹²California Department of Pesticide Regulation (2007). <http://www.cdpr.ca.gov/docs/pur/pur06rep/trends06.pdf>

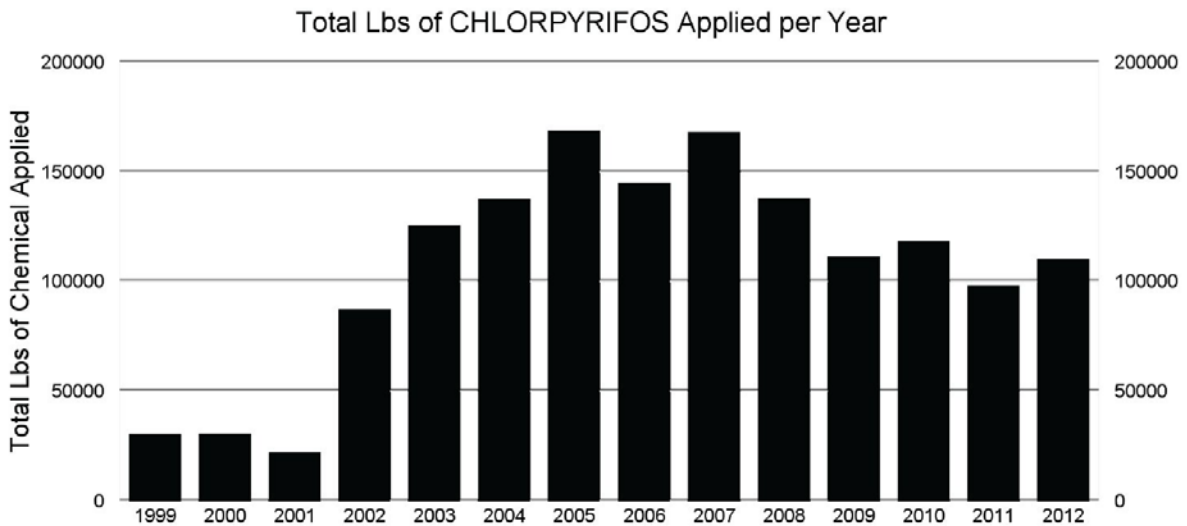
¹³California Department of Pesticide Regulation (2011). <http://www.cdpr.ca.gov/docs/pur/pur10rep/tables/table8.pdf>



Source Category: IRR AG

Figure 1. 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.



Source Category: IRR AG

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.

From January 2005 through September 2015, there have been 644 samples collected for the ILRP and analyzed for chlorpyrifos and diazinon at the 14 compliance sites. Results for Coalition ILRP monitoring at TMDL compliance sites are summarized in **Table 8**.

Table 8. Summary of Chlorpyrifos and Diazinon Exceedances in Coalition ILRP Monitoring at TMDL Compliance Sites, 2005-2015

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	33	611	644
Diazinon	7	637	644

There have been a total of 40 exceedances of chlorpyrifos and diazinon combined (approximately 6% of all samples) observed in Coalition ILRP monitoring at the TMDL compliance sites. Of the 40 total exceedances, 33 have been for chlorpyrifos (~5% of total samples) and seven have been for diazinon (~1% of total samples). 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 ILRP monitoring. In the 77 samples collected and analyzed for October 2014 through September 2015 TMDL compliance monitoring, there were five exceedances at three sites. 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 compliance sites (**Figure 3**).

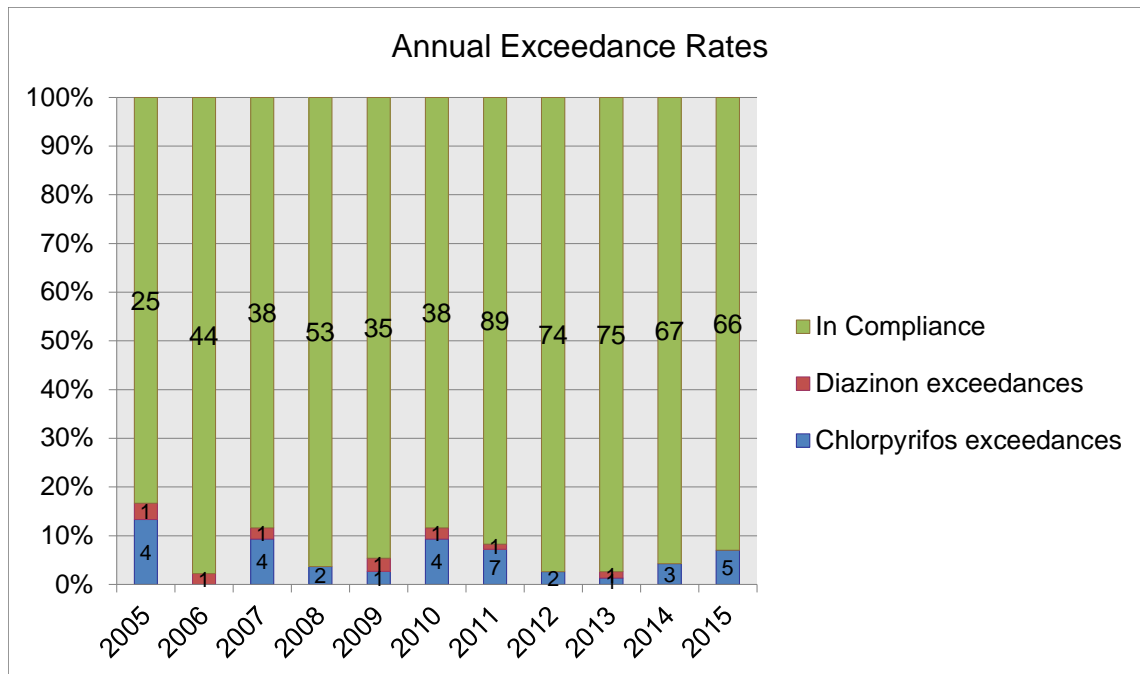


Figure 3. Annual Exceedance Rates at TMDL Compliance Sites, 2005-2015

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 Drain) in 2008,¹⁴ and there were no exceedances observed in 2006 and 2007. Chlorpyrifos was not detected in any TMDL samples collected from the five TMDL monitoring locations sampled from 2006-2008 (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 of the 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 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

¹⁴ Diazinon Runoff Management Plan for Orchard Growers in the Sacramento Valley: 2008 Annual Report. Sacramento Valley Water Quality Coalition. June 2008.

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 2009-2014 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 2015 can be used in a number of ways to evaluate whether compliance in named TMDL water bodies is continuing and/or improving. The following scenarios were evaluated for TMDL receiving waters for all cases where compliance monitoring site concentrations exceeded or equaled the 1.0 TUc concentration-based Load Allocation.

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 in the compliance sites and a conservative estimate of the receiving water discharge volume. The receiving water discharges were based on measured flows in Delta tributaries and tidal fluxes for the Delta (Liberty Island) reported by the Department of Water Resources California Data Exchange Center (CDEC)¹⁵. The relationship between all monitoring sites and receiving water flow sites is illustrated in **Figure 4**.

This initial evaluation assumes no chlorpyrifos or diazinon loads (TUc = 0) in the upstream receiving water. This analysis estimated that dilution of loads from the monitored TMDL compliance sites with an exceedance observed between October 2014 through September 2015 (GILSL, and PNCHY, and UCBRD) would result in TMDL receiving water concentrations of 0.00 TUc for the January and August 2015 GILSL events because there was no measurable flow associated with either exceedance, 0.0014 TUc for the July 2015 GILSL exceedance, 0.0436 TUc for the April 2015 PNCHY exceedance, and 0.0071 TUc for the UCBRD exceedance (**Table 10**, Scenario 1).

¹⁵ CDEC Historical Data Selector available at: <http://cdec.water.ca.gov/selectQuery.html>

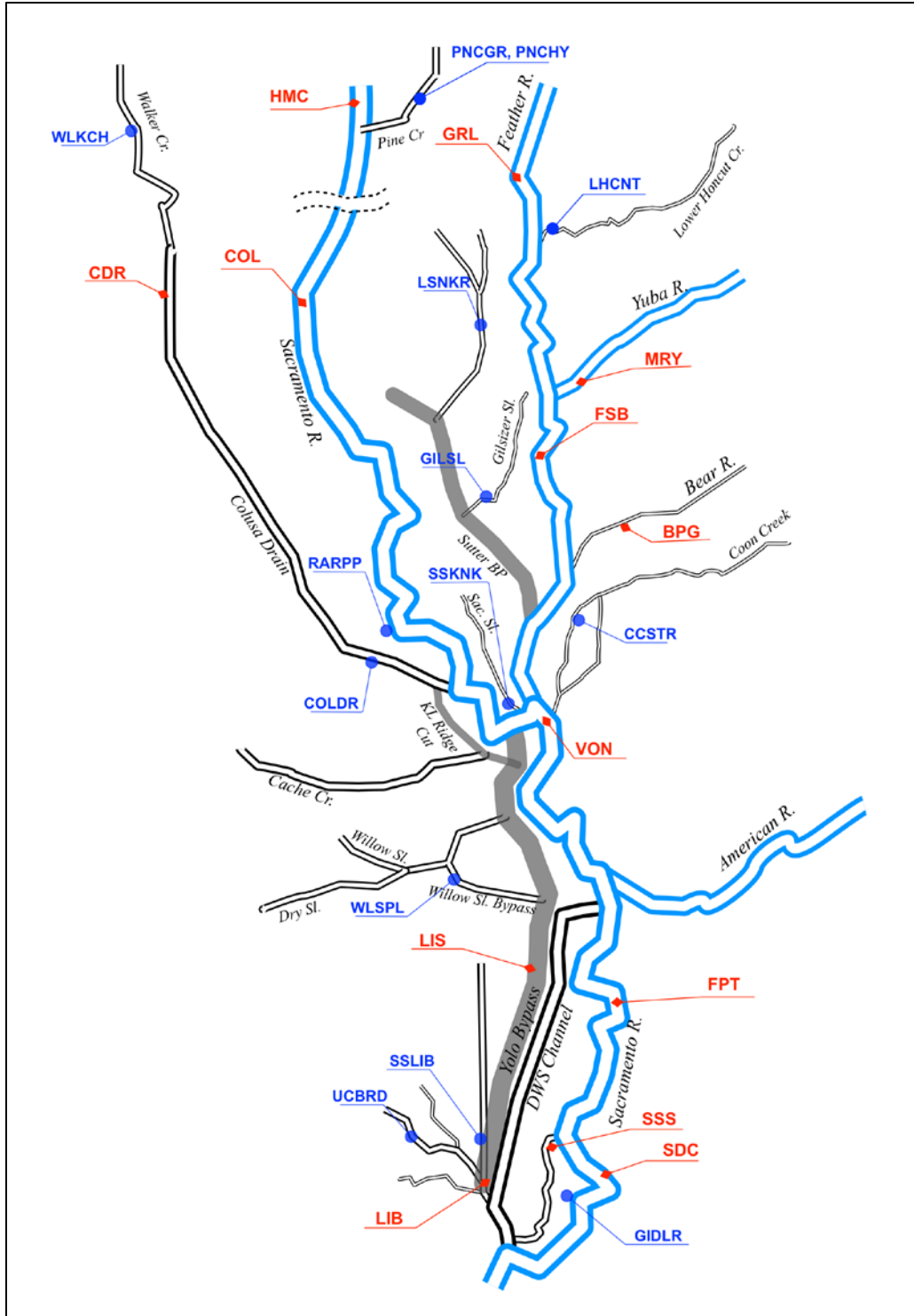


Figure 4. Compliance and Flow Monitoring Sites used for Analysis of Receiving Water Impacts
 (Key for sites on following page)

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

Feature	KEY	Description
	MRY	Yuba River at Marysville
	FSB	Feather River above Star Bend
	BPG	Bear River at Pleasant Grove

Scenario 2: Upstream Receiving Water Loads Equivalent to Additional Represented Loads Extrapolated From Compliance Site

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 the 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 (GILSL, PNCHY, and UCBD) and represented irrigated acres would result in TMDL receiving water concentrations less than 0.05 TUc (**Table 10**, 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 in the compliance sites. The addition of the observed load from the compliance sites (GILSL, PNCHY, and UCBD) would not cause the receiving waters to exceed the concentration-based TMDL Load Allocation of 1 TUc 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 10**, 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 10**, 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 10**, 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 2014 through September 2015 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. ILRP monitoring conducted at Yolo County sites since the implementation in 2007 of these additional label and use restrictions have resulted in only five additional exceedances in a total of 112 samples at the compliance site sampled in the Yolo subwatershed (Willow Slough).

Beginning on July 1, 2015, chlorpyrifos also began to be regulated statewide as a restricted material, with similar restrictions to those in Yolo County. The new state-restricted 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 Department of Pesticide Regulation (DPR) licensed pest control adviser.

The Coalition submitted formal requests to the Executive Officer of the Regional 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 was submitted in December 2015. A summary of the relevant management plans is included in the following table.

Table 9. Management Plans for Chlorpyrifos and Diazinon

Subwatershed	Waterbody	Analyte	Management Plan Status
ButteYubaSutter	Gilsizer Slough	Chlorpyrifos	Management Plan in progress
		Diazinon	Request for completion submitted December 2015
ColusaGlenn PNSSNS	Lower Snake River	Chlorpyrifos	Request for completion approved March 2015
	Pine Creek	Chlorpyrifos	Management Plan submitted November 2015
	Walker Creek	Chlorpyrifos	Request for completion approved January 2014
Solano Yolo	Coon Creek		Completed
	Ulatis Creek	Chlorpyrifos	MPIPG Addendum submitted in 2013
	Willow Slough	Chlorpyrifos	Request for completion submitted December 2015

Note: A Management Plan is triggered when a monitoring result exceeds water quality objectives twice within a three year period. To complete the plan, no exceedances may be observed during a period of three years.

Table 10. 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 ⁽¹⁾	Basis for Receiving Water Discharge Estimate	Compliance site drainage irrigated acres	Represented total irrigated acres	Frequency of Exceedance for compliance monitoring site (2009-2012)	Load extrapolation factor ⁽²⁾	Represented additional load ⁽³⁾ , TUc	TMDL Receiving Water Estimation Scenarios ⁽⁴⁾		
											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	1/20/2015	13.33	Feather River (via Sutter Bypass)	2,611	Feather River above Star Bend + Bear River	22,655	179,576	12.1%	0.839	11.19	0.0000	0.0043	0.90
Gilsizer Slough at George Washington Road	7/21/2015	1.66	Feather River (via Sutter Bypass)	3,578	Feather River above Star Bend + Bear River	22,655	179,576	12.1%	0.839	1.39	0.0014	0.0017	0.90
Gilsizer Slough at George Washington Road	8/18/2015	49.33	Feather River (via Sutter Bypass)	2,610	Feather River above Star Bend + Bear River	22,655	179,576	12.1%	0.839	41.42	0.0000	0.0159	0.90
Pine Creek at Highway 32	6/18/2014	17.33	Sacramento River at Hamilton City	4,359	Measured at Hamilton City	28,384	77,641	25.9%	0.449	7.79	0.0436	0.0454	0.94
Ulatis Creek at Brown Road	5/19/2015	2.33	Delta (via Cache Slough)	7,100	Measured at Liberty Island	136,900	150,490	12.5%	0.012	0.03	0.0071	0.0071	0.90

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, Management Plan Progress Reports, or will be reported in future versions of these reports. Typically, the first step taken is to analyze the pesticide application data from the California Department of Pesticide Regulation (CDPR) PUR database. All users that were considered to have the potential to contribute to observed chlorpyrifos or diazinon exceedances were contacted directly to inform them of the exceedances and of appropriate management practices to reduce the risk of future exceedances.

Descriptions of the outreach and education activities conducted by the Coalition's subwatersheds during October 2014 through September 2015 are provided in Appendix F (*SVWQC Outreach Materials*) of the Coalition's 2015 Annual Monitoring Report.

Butte Yuba Sutter Water Quality Coalition (Gilsizer Slough and Pine Creek)

Targeted outreach was conducted by the Butte-Yuba-Sutter Water Quality Coalition in response to the chlorpyrifos exceedances in Gilsizer Slough and Pine Creek. Specific actions taken to address the exceedances included mailings, meetings, email distributions, and special events:

- Letters were mailed to members and pest control advisors (PCAs) serving members of the Butte-Yuba Sutter Water Quality Coalition notifying them of the recent chlorpyrifos exceedances and that a Management Plan had been triggered.
- Newsletters were sent to members that included reminders of the recent pesticide exceedances and to implement appropriate Best Management Practices (BMPs) for pesticide application, such as to be mindful of the weather and other conditions when planning to apply chemicals, to follow all instructions on the label, and to apply only the necessary amount.
- Meetings were held to discuss specific management plan requirements.
- Presentations were given to provide an overview of the coalition and relevant regulation, overall 2015 monitoring results, including discussion of the recent chlorpyrifos exceedances and management plans, and appropriate BMPs.

Date	Location	Attendance	Type of Outreach	Description
5/15/2015	---	1,617 (mailing distribution list)	Article in newsletter	Summer 2015 Newsletter
7/9/2015	---	544 (email distribution list)	Article in E-newsletter	July 9, 2015 E-Newsletter
7/30/2015	Butte County Farm Bureau	23 ⁽¹⁾	Meeting/presentation	Chlorpyrifos Management Plan (Pine Creek)
10/6/2015	---	544 (email distribution list)	Article in E-newsletter	October 6, 2015 E-Newsletter
11/12, 11/17, 12/1/2015	Sutter County Agricultural Commissioner's Office (Yuba City)	109, 94, 83	Meeting/presentation	Sutter County Ag. Dept. CEC
11/15/2015	---	1,617 (mailing distribution list)	Article in newsletter	Fall 2015 Newsletter
11/16/2015	---	106 (<i>specific to Gilsizer Slough drainage</i>)	Letter	Chlorpyrifos Notification Letter (Gilsizer Slough)
12/2/2015	Silver Dollar Fairgrounds (Chico)	300	Meeting/presentation	Butte County Grower Day
12/10/2015	Sutter County Agricultural Commissioner's Office (Yuba City)	7 ⁽²⁾	Meeting, flyer, (mail)	Chlorpyrifos Management Plan (Gilsizer Slough)
1/8/2016	Yuba-Sutter Fairgrounds (Yuba City)	Talked to approx. 15 growers	Flyer	Yuba City Annual Walnut Trade Show (<i>not a designated outreach event</i>)
1/14/2016	Butte County Fairgrounds (Gridley)	190	Meeting, flyer	Annual Member Meeting
1/20/2016	Yuba-Sutter Fairgrounds (Yuba City)	136	Meeting/presentation	Spray Safe
1/21/2016	Sutter County Agricultural Commissioner's Office (Yuba City)	57	Meeting/presentation	UCCE Peach Day
2/5/2016	Elks Lodge (Chico)	125	Meeting/presentation	UCCE Almond Day
2/15/2016	---	1,617 (mailing distribution list)	Article in newsletter	Winter 2016 Newsletter
2/18/2016	Peachtree Country Club	20	Meeting/	Big Valley Ag. Services

Date	Location	Attendance	Type of Outreach	Description
	(Marysville)		presentation	
2/25/2016	Sutter Co. Memorial Hall (Yuba City)	248	Meeting/ presentation	UCCE Walnut Day
2/26/2016	Elks Lodge (Chico)	50	Meeting/ presentation	Chico Annual Walnut Trade Show

Notes: (1) 100 members in the Pine Creek watershed received exceedance notification and invitation to meeting. (2) Prior to the meeting, all 10 on PUR list were contacted via mail first, followed by phone, then by email (to five). Three members not in attendance were sent meeting materials via mail.

Solano Water Quality Coalition (Ulatis Creek)

Targeted outreach was conducted by the Solano Water Quality Coalition in response to the chlorpyrifos exceedance in Ulatis Creek, including notification through direct emails to the PCAs and growers as well as follow up phone conversations. In August 2015, literature material listing recommended practices to address chlorpyrifos water quality issues, which included mention of the occurrence, was updated.

TOXICITY AND ADDITIONAL PESTICIDE RESULTS

The results of pesticide monitoring between October 2014 and September 2015 are reported in the Coalition's 2015 Annual Monitoring Report. There were 4,014 individual pesticide results analyzed in 302 water column samples (including 36 duplicates) collected from 22 different sites, including both Representative and Management Plan or Special Study sites, during October 2014 through September 2015 Coalition Monitoring. Analyses were conducted for organophosphates, carbamates, organochlorines, benzophenyls, pyrethroids, and a variety of herbicides. Approximately 84% of samples had no detected pesticides and more than 98.6% of all pesticide results were below detection.

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

Pesticides detected between October 2014 and September 2015 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, both dichlorvos and naled were detected in the sample collected at Gilsizer Slough (GILSL) on January 20, 2015 when an exceedance of the chlorpyrifos objectives occurred (**Table 7**).¹⁶ No toxicity tests were performed for this sample, so further conclusions regarding a toxicity impairment could not be made.

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. Of the 92 samples (including 11 field duplicates) tested in the 2015 monitoring year (October 2014-September 2015), there

¹⁶ The Basin Plan TMDL amendments include methodology to take into account the additive effects of multiple pollutants. For this sample, the detected concentration of chlorpyrifos alone exceeds the load allocation compliance sum of 1.0.

was only one sample with significant toxicity to *Ceriodaphnia*. The toxic sample was determined to have been caused solely by chlorpyrifos, based on detected concentrations. Previously, of the 118 samples tested between the 2012 and 2014 monitoring years, there were no samples with significant toxicity to *Ceriodaphnia*. Of the 119 samples tested with *Ceriodaphnia* for the 2011 monitoring year, 113 were not toxic, and of the remaining six (6) significantly toxic samples, three (3) were confirmed to have no detectible concentrations of chlorpyrifos or diazinon, for a total of 116 samples free of significant additive or synergistic toxic effects. Of the remaining three samples, one was determined to have been caused solely by chlorpyrifos based on detected concentrations, the second had detected chlorpyrifos and oxyfluorfen below effect concentrations, and the third had no associated pesticide analyses. None of these three significantly toxic samples observed in 2011 can definitively be determined (or excluded) to be the result of synergistic toxic effects with chlorpyrifos and diazinon. However, we can reasonably and definitively conclude that 325 out of 329 samples collected since 2011 did not have additive or synergistic toxicity associated with chlorpyrifos or diazinon (98.8%) and four or fewer samples (<2%) 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 (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 impacts of pyrethroid pesticides are assessed by the Coalition through toxicity and chemical monitoring of sediment. The Coalition has observed several cases of pyrethroid-caused sediment toxicity and has 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 216 sediment toxicity sample events, there have been only 14 cases (6.5%) of significant toxicity with survival less than 80% compared to lab controls, and sediment toxicity has proven to be a recurrent problem at only one site (Z-Drain in Solano County).

Summary

Based on the results of ILRP 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 labeling have been successful in reducing instream 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 2015 has been a decrease in the rate of annual exceedances (**Figure 3**). Exceedances observed in the TMDL tributaries monitored for compliance were determined unlikely to cause exceedances of the TMDL Load Allocations in the named TMDL receiving water bodies under any reasonably probable scenario (**Table 10**).

Continuing efforts to further reduce exceedances are being implemented through the Coalition Management Plans for sites that have triggered a Management Plan requirement for these pesticides. Additionally, the Coalition aggressively investigates all exceedances and conducts follow-up contact with growers reporting applications with the potential to cause specific observed exceedances. These combined efforts and the implementation of statewide restricted status for chlorpyrifos are expected to result in continuation of the 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. Three management plans have already been approved for completion (Coon Creek in the Placer-Nevada-South Sutter-North Sacramento subwatershed, Walker Creek in the Colusa-Glenn subwatershed, and Lower Snake River in the Butte-Yuba-Sutter subwatershed).

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Appendix A

Chlorpyrifos and Diazinon TMDL Monitoring Results, January 2009 – September 2015

Please see attached Excel file
