



December 15, 2015

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Central Valley Regional Water Quality Control Board
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The Sacramento Valley Water Quality Coalition (SVWQC or Coalition) and Yolo subwatershed respectfully request your determination that the subwatershed's Management Plan requirements for chlorpyrifos for the Willow Slough represented drainages be deemed complete. The Yolo subwatershed's management goals for chlorpyrifos are based on compliance with Yolo County's 2008 restricted materials designation of chlorpyrifos, which requires users to obtain a Restricted Material Permit for application of chlorpyrifos and submit a Notice of Intent 24 hours prior to any use. Additionally, as per label requirements, no application shall take place 72 hours prior to a forecasted storm event or planned irrigation event. The primary basis for this request is that Willow Slough has been determined to meet the water quality objectives (WQOs) for chlorpyrifos. Additional factors supporting the request include the extensive outreach conducted with members and non-member agencies in the subwatershed and county, and focused in the represented drainage area to further augment and expand implementation of management practices to manage discharges of chlorpyrifos and other agricultural pesticides.

BACKGROUND FOR MANAGEMENT PLAN REQUIREMENT

The Willow Slough Bypass monitoring location at Pole Line Road (WLSPL) is in the Willow Slough drainage and is a representative monitoring site for SVWQC. The Willow Slough drainage is 101,903 acres, approximately 66,200 irrigated acres, and currently represents a total of 618,000 acres in the Yolo subwatershed, including the North Yolo Bypass, South Yolo Bypass, Cache Creek, Foothill Cache Creek, Middle Cache Creek, Buckeye Creek, Oat Creek, Bird Creek, Smith Creek, Breton Creek, Meridian Edge, and portions of Lower Colusa Drain, Sycamore Area, and West Canal Landing drainages in Yolo County. The Management Plan requirement for chlorpyrifos was originally triggered by exceedances observed in April and August of 2007, with subsequent exceedances observed in September 2007 and March and August 2010.

DATA AND EXCEEDANCES

Relevant monitoring data for chlorpyrifos are provided in **Table 1**. The monitoring results indicate the following:

- A total of 52 sample events have been conducted for chlorpyrifos in Willow Slough. There have been *five* (5) exceedances of the chlorpyrifos trigger limit, with the last observed in August 2010 (see **Table 1**).

- A total of 48 sample events have been conducted for *Ceriodaphnia* toxicity in Willow Slough. There have been three (3) exceedances of the toxicity trigger limit, with the last observed in observed in July 2011 (see Table 1). One of these exceedances were determined to be caused by elevated chlorpyrifos (April 2007), while the other exceedances either were not associated with a detected concentration of chlorpyrifos (December 2007) or with a detected concentration less than the pesticide's trigger limit (July 2011).
- There have been 27 chlorpyrifos sample events conducted over the last 5 years with no exceedances since August 2010.
- There have been 21 *Ceriodaphnia* sample events conducted over the last 4 years with no exceedances since July 2011.

Evaluations of the five observed chlorpyrifos exceedances (based on the Basin Plan chronic WQO of 0.015 µg/L) and reported pesticide applications indicate that in some cases agriculture was a contributing source of the observed chlorpyrifos exceedances. The detected chlorpyrifos concentration in the April 2007 water quality sample was sufficient to explain the observed toxicity to *Ceriodaphnia* (based on an EC50 for *Ceriodaphnia* of 0.065 µg/L taken from the USEPA ECOTOX Database), and occurred during the time that chlorpyrifos applications were made in the Willow Slough drainage. The detected chlorpyrifos concentrations in the August and September 2007 samples were unlikely to cause toxicity, and no toxicity to *Ceriodaphnia* was observed for these two monitoring events. Because chlorpyrifos applications were reported in the Willow Slough drainage during the month of sampling, it is likely that agricultural application of the herbicide caused or contributed to the observed exceedances. *Ceriodaphnia* toxicity observed in the December 2007 water quality sample collected in Willow Slough Bypass was further investigated through a toxicity identification evaluation (TIE), but results proved inconclusive¹. Three herbicides (bromacil, diuron, simazine) and no insecticides were detected in the sample. The detected pesticides did not approach concentrations toxic to *Ceriodaphnia* and no other analytes were detected at concentrations toxic to *Ceriodaphnia*.

Exceedance of the chronic and acute (0.025 µg/L) WQOs for chlorpyrifos in March 2010 could not be linked to the agricultural application of the pesticide because no chlorpyrifos application requests in the Willow Slough Bypass drainage were made to Yolo County Agriculture Department in the month prior to sampling. In Yolo County, chlorpyrifos was made a restricted material in 2008 and requires a permit and a notice of intent prior to its use. The requirement allows the County Ag Department to prescribe conditions on its use. The conditions used are the label requirements plus a 72-hour period of no irrigation or rain after use. The notice of intent allows the Department to perform a pre-application inspection to ensure that conditions are being met. Similarly, the August 2010 exceedance of the chronic and acute WQOs for chlorpyrifos could not be linked to the agricultural application of the pesticide because no requests for its application were made to the County Ag Department in July or August 2010.

In a toxicity test conducted with *Ceriodaphnia* using the Willow Slough Bypass water quality sample collected in July 2011, the Coalition observed a reduction in survival of 100% compared to the control. The toxicity observed in the sample (>50% reduction compared to control) triggered initiation of TIE procedures and a serial dilution test using *Ceriodaphnia*. TIEs were initiated on the day following observance of >50% mortality for *Ceriodaphnia* tests. Toxicity was not persistent in the original sample

¹ *Source Evaluation Report: Ceriodaphnia Toxicity in Willow Slough*. Sacramento Water Quality Coalition. March 2010.

(100% survival), and the TIE was therefore inconclusive. This pattern is consistent with a rapidly degrading source of toxicity, indicating that the toxicity would probably not be persistent under ambient conditions. Analyses for organophosphate and pyrethroid pesticides and the herbicide oxyfluorfen were conducted for this sample. Chlorpyrifos (0.0007 µg/L) and oxyfluorfen (0.026 µg/L) were detected well below concentrations expected to cause toxicity. No pyrethroid pesticides were detected.

Overall, these monitoring data indicate that chlorpyrifos is (1) currently meeting water quality objectives, (2) is no longer a chronic problem in the Willow Slough Bypass, and (3) that agricultural management practices in the Willow Slough drainage and larger represented area are adequate to prevent exceedances of the Basin Plan water quality objective for chlorpyrifos and potential contributions to *Ceriodaphnia* toxicity (see **Table 2**). To this end, we concluded that the practices that growers and applicators are implementing are sufficient.

SUMMARY OF EVALUATIONS SUPPORTING REQUEST

The following evaluations and factors support this request:

Assessment of Compliance with Water Quality Objectives	<ul style="list-style-type: none"> • All samples analyzed for chlorpyrifos since August 2010 have been in compliance with the 0.015 µg/L Basin Plan chronic water quality objective (A total of 27 chlorpyrifos analyses were performed over the past 5 years). • All samples analyzed for <i>Ceriodaphnia</i> toxicity since July 2011 have been in compliance with the Basin Plan narrative toxicity objective (A total of 21 <i>Ceriodaphnia</i> analyses were performed over the past 4 years).
Lack of agricultural contribution to toxicity	<ul style="list-style-type: none"> • Since July 2011, only 1 detected chlorpyrifos concentration (well below concentrations known to cause or substantially contribute to toxicity in sensitive invertebrate species) was associated with 18 corresponding toxicity analyses performed for the Willow Slough drainage over the past 4 years.
Outreach and Education	<ul style="list-style-type: none"> • Extensively conducted to increase awareness of issues for this Management Plan and other Management Plans in the Willow Slough drainage (and other drainages in this subwatershed).
Implemented Practices	<ul style="list-style-type: none"> • Already adequate to prevent chlorpyrifos exceedances (based on monitoring results, survey results, Farm Evaluations, and use patterns). • Increased implementation for other Management Plans will further reduce risks of chlorpyrifos exceedances.

SOURCE EVALUATIONS

An evaluation of potential sources contributing to chlorpyrifos exceedances in the Willow Slough drainage was completed in 2010². The source evaluation assessed the chlorpyrifos applications by agriculture, which crops applied chlorpyrifos prior to exceedances, irrigation patterns and methods, and environmental conditions relevant to potential discharges of chlorpyrifos, and potential non-agricultural sources of chlorpyrifos. The source evaluation included analysis of PUR data from the California Department of Pesticide Regulation (CDPR) and the Yolo County Agriculture Department. Conclusions of

² *Source Evaluation Report: Chlorpyrifos in Willow Slough*. Sacramento Valley Water Quality Coalition. March 2010

the original source evaluations included have been updated using 2011 – 2013 PUR data where appropriate:

- Based on evaluations of reported pesticide applications and predominant crops in the drainage, agriculture was a potential contributing source of some of the observed toxicity exceedances associated with elevated chlorpyrifos.
- Chlorpyrifos was determined to cause or contribute to the toxicity of one of the three cases of observed toxicity. The causes of the remaining two cases of toxicity were inconclusive based on TIE results. Based on these results, chlorpyrifos should be the focus of surveys and outreach for the Ceriodaphnia toxicity Management Plan for Willow Slough.
- Chlorpyrifos use on alfalfa appeared to account for the largest proportion of the agricultural applications of the organophosphate pesticide relevant to the observed exceedances. More recently (2011 – 2013), walnuts, alfalfa, and almonds have together accounted for the majority of applications (93%), with walnuts alone accounting for 65% of uses. These crops should continue to be the priority for surveys and outreach. Several other crops (corn, grapes, apples, sunflower seed, and sudangrass) account for the remaining 7% of chlorpyrifos applied in the County from 2011 – 2013. Non-production agricultural uses of chlorpyrifos are extremely limited (<1% of total use) and include only research commodities and landscape maintenance.
- Non-production agricultural uses of chlorpyrifos are small (<1%) compared to agricultural uses, but may have represented a potential non-production agricultural source of chlorpyrifos in Willow Slough Bypass and the represented drainages. Additionally, unreported and unregulated residential urban use may have contributed to detected chlorpyrifos. However, the impact of this potential non-production agricultural residential source is expected to be minor since retail sales of chlorpyrifos were discontinued in 2002. Additionally, chlorpyrifos is not used for mosquito abatement in Yolo County.

Based on evaluations of reported pesticide applications and predominant crops in the drainage, agriculture was determined to be the probable cause of the majority of the chlorpyrifos exceedances observed during the period 2007 – 2010.

Based on a review of currently available pesticide use information in Yolo County for 1999 – 2013, the use of chlorpyrifos has shown a decreasing trend in the County for irrigated agriculture since 2008 with the establishment of chlorpyrifos as a restricted material, and for all other uses since 2002 (see **Figure 1**). Application of chlorpyrifos on alfalfa (March and April, July through September), almonds (May through August) and walnut orchards (May through September) remains the primary use of the pesticide in the County. The primary pathways of transport in agricultural applications are storm runoff discharges and drift from applications, and managing these has been the focus of outreach to control chlorpyrifos exceedances.

OUTREACH AND EDUCATION

Outreach and education efforts are not specifically cited as a basis for this request. However, growers in the subwatershed have been made aware of the Yolo subwatershed's internal management goals for chlorpyrifos, the consequences of any detections of chlorpyrifos, transport and transfer pathways, and recommended management practices. In addition to direct communication with all 2008-2010 registered users of chlorpyrifos, the Yolo County Farm Bureau Education Corporation (YCFBEC), Yolo County Agricultural Commissioner, and University of California Cooperative Extension Farm Advisor have

continued to include information on the water quality risks, recommended practices, and the special circumstances regarding regulation of chlorpyrifos detections in our outreach activities. Outreach specific to the internal management goals for chlorpyrifos was conducted in tandem with outreach for the Diuron Management Plan in this watershed. The combined outreach for these Management Plans has reached all of the Yolo subwatershed membership (currently 660 members) by newsletter in the represented drainages. Increased awareness by the growers and applicators has contributed to changes in practices and reduced chlorpyrifos discharges from agriculture and non-agricultural users, as evidenced by the lack of chlorpyrifos and *Ceriodaphnia* toxicity exceedances since August 2010 and July 2011, respectively.

Relevant Outreach & Education Conducted from 2009 – 2015

- 2009 – Yolo County Farm Bureau provided pesticide education seminars.
- 2009 – 2015 – Yolo County Agricultural Commissioner’s office conducted pesticide application, mix/load and equipment inspections, and provided pesticide education seminars.
- 2010 – Spray Safe program workshop provided to 225 attendees by Yolo County Farm Bureau Education Corporation (YCFBEC) and Yolo County Agriculture Department.
- 2011 – Spray Safe program workshop provided to 350 attendees by YCFBEC and Yolo Co. Ag. Dept.
- 2012 – Spray Safe program workshop provided to 327 attendees by YCFBEC and Yolo Co. Ag. Dept.
- 2012, 2013, 2014, and 2015 – New and past users of chlorpyrifos informed of the potential risks of chlorpyrifos applications, and of the available and recommended management practices to limit this risk by Yolo Co. Ag. Dept. staff when applying for pesticide application permits.
- 2013 – Spray Safe program workshop provided to 348 attendees by YCFBEC and Yolo Co. Ag. Dept.
- 2013 – Yolo County Coalition members that used chlorpyrifos from 2008 – 2010 provided the same information described above regarding potential risks of chlorpyrifos and best management practices to limit risk during the annual Coalition invoicing process.
- 2014 – Spray Safe program workshop provided to 344 attendees by YCFBEC and Yolo Co. Ag. Dept.
- 2015 – Spray Safe program workshop provided to 361 attendees by YCFBEC and Yolo Co. Ag. Dept.
- Annually – Review pesticide use reports annually to incorporate any new users of chlorpyrifos into the direct outreach efforts described above.
- Annually – Continue ongoing education efforts for other potential chlorpyrifos uses in the Yolo County Coalition.

SURVEYS

The degree to which management practices are implemented in the drainage was initially evaluated through surveys of selected high priority growers along Willow Slough in 2009, and a report³ summarizing these results was prepared and submitted to the Water Board in 2011. Twenty-eight individual high-priority parcels (20 members with 2,866 total acres) were identified representing the acreage with the highest potential to contribute to observed exceedances in this initial survey. Based on the responses from the initial targeted survey, it was concluded that most growers in the Willow Slough drainage are implementing adequate best management practices to protect surface water quality.

- Awareness of IPM pesticide management practices, use of PCAs, and appropriate training were universally high, as was implementation of practices to control and minimize overspray and drift.
- Most growers implemented at least one type of relevant irrigation management and drainage practice and projected installing more within two years. The majority of growers indicated having storm runoff from their fields only in heavy rainstorms.
- Most operations also implemented additional practices to minimize discharge of pesticides in irrigation and storm runoff (e.g., sediment traps, vegetated ditches, and tailwater returns systems).

A second survey consisting of the Farm Evaluations for agricultural operations in the represented drainages was completed in March 2015 and has been compiled for the evaluation of implementation of a wide range of management practices, including irrigation, pesticide, and sediment management practices relevant to the subwatershed’s internal management goals for chlorpyrifos. Preliminary results indicate high levels of awareness of issues related to pesticide exceedances, as well as high levels of implementation of management practices to reduce and eliminate pesticide and toxicity exceedances.

MANAGEMENT PRACTICES

Based on the monitoring results, management practices in the drainage appear adequate to prevent discharges of chlorpyrifos to surface waters, and the implementation of practices is part of the basis for this request. We believe that the lack of chlorpyrifos exceedances related to agricultural applications can be attributed largely to changes in practices as a result of increased awareness of the growers and applicators, and that this resulted from the consistent and intensive outreach efforts of the YCFBEC and Yolo Co. Ag. Dept. The specific internal management goals for chlorpyrifos – 100% compliance with the Yolo County restricted materials permit and notification requirements – have been achieved in the Willow Slough drainage and larger represented area.

Implementation Goals Achieved

- 100% of users apply chlorpyrifos file the required Notice of Intent (NOI) to apply.
- 100% of growers consider potential for rain and wind to result in runoff and drift prior to applications.
- 100% of growers do not apply less than 72 hours before irrigation or expected precipitation.
- 100% of growers applying chlorpyrifos consider soil saturation and precipitation forecast and DO NOT apply when ground is at field capacity (when runoff is most likely).⁽¹⁾

1. Response based on 100% restricted materials permit compliance.

³ *Grower Survey Report: Willow Slough*. Prepared for Sacramento Valley Water Quality Coalition By The Coalition for Urban/Rural Environmental Stewardship. 2011.

OTHER RELEVANT INFORMATION

Implementation of additional practices continues to be pursued as part of the Management Plans for diuron and malathion in the same represented drainages. Although it does not appear necessary to further control and prevent chlorpyrifos exceedances, the additional awareness and implementation of practices will further reduce the risks of chlorpyrifos use in the represented drainages.

CONCLUSIONS

Based on the monitoring results summarized above, Willow Slough is meeting the Basin Plan water quality objectives for chlorpyrifos and toxicity and has done so for the last 5 and 4 years, respectively. Outreach and education efforts and implemented practices have achieved the subwatershed's internal management goals for chlorpyrifos and resulted in meeting the water quality objectives. Based on the findings presented in this request, we conclude that agricultural practices implemented in the Willow Slough drainage and represented area have been and continue to be sufficient to prevent agricultural contributions to exceedances of chlorpyrifos and *Ceriodaphnia* toxicity in the area represented by the Willow Slough drainage. Additionally, ongoing Management Plans for diuron and malathion continue to pursue implementation of additional practices that will further reduce the risk of chlorpyrifos discharges and exceedances in regional surface waters.

As specified in the Management Plan Completion section of the MRP-1: Management Plan Requirements for Surface Water and Groundwater (Waste Discharge Requirements General Order for Growers within the Sacramento River Watershed that are Members of a Third Party Group; Order R5-2014-0030-R1), we respectfully request that you make a determination of the completeness of this Management Plan.

Sincerely,



David J. Guy
President
Northern California Water Association

Cc: Sue McConnell
Susan Fregien
Denise Sagara
Bruce Houdesheldt
Claus Suverkropp

TABLES AND FIGURES

Table 1: Monitoring results for chlorpyrifos in Willow Slough Bypass water quality samples.

Event	Sample Date	Chlorpyrifos (µg/L)	<i>Ceriodaphnia</i> Survival (% of control)	Notes
17	02/10/2007	<0.001	100	
19	04/17/2007	0.083	0	1, 2, 3
19.1	04/24/2007	---	105.3	
20	05/15/2007	0.013	100	
21	06/19/2007	<0.001	100	
22	07/17/2007	<0.001	100	
23	08/21/2007	0.023	95	2
24	09/19/2007	0.016	100	2
25	12/19/2007	<0.001	40	1
26	01/28/2008	<0.001	105.3	
27	02/21/2008	<0.001	105.3	
28	04/21/2008	<0.001	100	
29	05/19/2008	<0.001	100	
30	06/17/2008	<0.001	100	
31	07/14/2008	<0.001	95	
32	08/18/2008	<0.001	100	
33	09/15/2008	<0.001	100	
35	01/26/2009	<0.001	100	
36	02/16/2009	---	100	
37	03/19/2009	<0.001	95	
38	04/23/2009	---	100	
39	05/19/2009	<0.001	---	
42	08/18/2009	<0.001	---	
43	09/22/2009	<0.001	---	
47	01/19/2010	<0.001	---	
49	03/16/2010	0.1521	---	2, 3
51	05/18/2010	0.01	---	2
54	08/17/2010	0.0471	---	2, 3
60	02/15/2011	<0.001	100	
61	03/15/2011	<0.001	94.4	
62	04/20/2011	<0.001	100	
63	05/17/2011	0.0082	100	
64	06/21/2011	<0.001	100	
65	07/19/2011	0.000748	0	1
66	08/16/2011	<0.001	95	
72	02/21/2012	<0.001	100	
73	03/14/2012	<0.001	100	
74	04/17/2012	<0.001	100	
75	05/15/2012	0.0027	105	
76	06/19/2012	<0.001	105	
77	07/18/2012	<0.001	100	
78	08/21/2012	<0.001	105	
84	02/19/2013	<0.0005	182	
85	03/20/2013	<0.0005	100	

Event	Sample Date	Chlorpyrifos (µg/L)	<i>Ceriodaphnia</i> Survival (% of control)	Notes
86	04/17/2013	<0.0005	100	
87	05/21/2013	<0.0005	100	
88	06/18/2013	<0.0005	100	
89	07/18/2013	<0.0005	100	
90	08/21/2013	<0.0005	100	
96	02/11/2014	---	100	
97	03/18/2014	<0.0026	100	
98	04/17/2014	<0.0026	100	
99	05/21/2014	<0.0005	---	
100	06/18/2014	---	100	
101	07/15/2014	---	90	
102	08/19/2014	<0.0026	---	
103	09/16/2014	<0.0026	105.3	
109	03/19/2015	<0.0026	---	

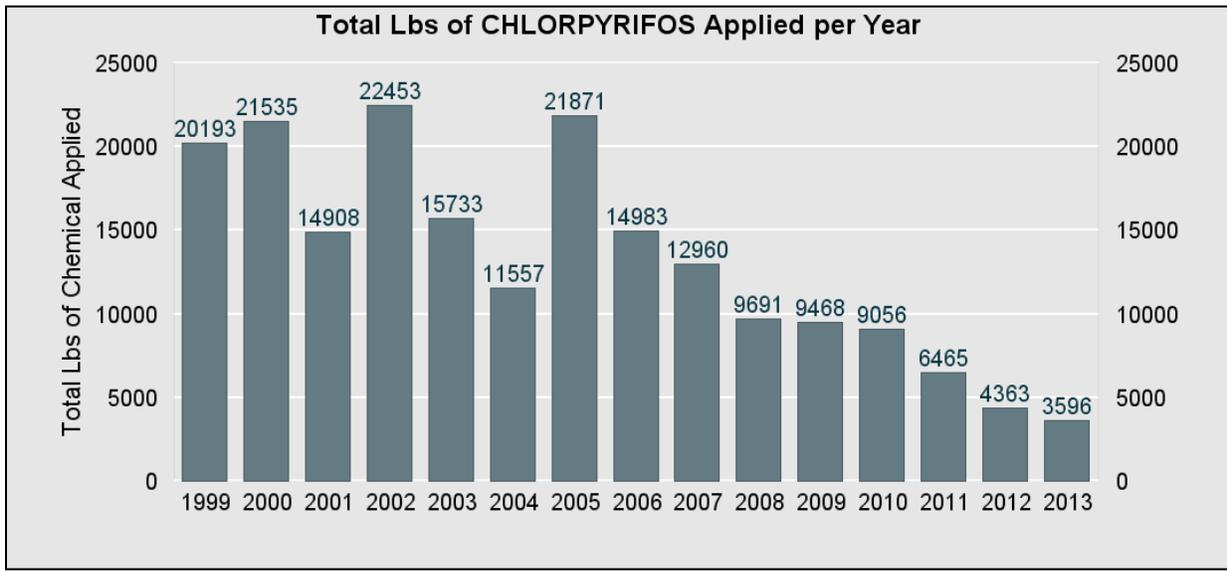
1. Significant toxicity.
2. Exceedance of chlorpyrifos chronic trigger limit (0.015 µg/L, Basin Plan).
3. Exceedance of chlorpyrifos acute trigger limit (0.025 µg/L, Basin Plan).

Table 2: Summary of Agricultural Practices Implemented in Willow Slough and Represented Drainages (Source: 2015 Farm Evaluation Survey).

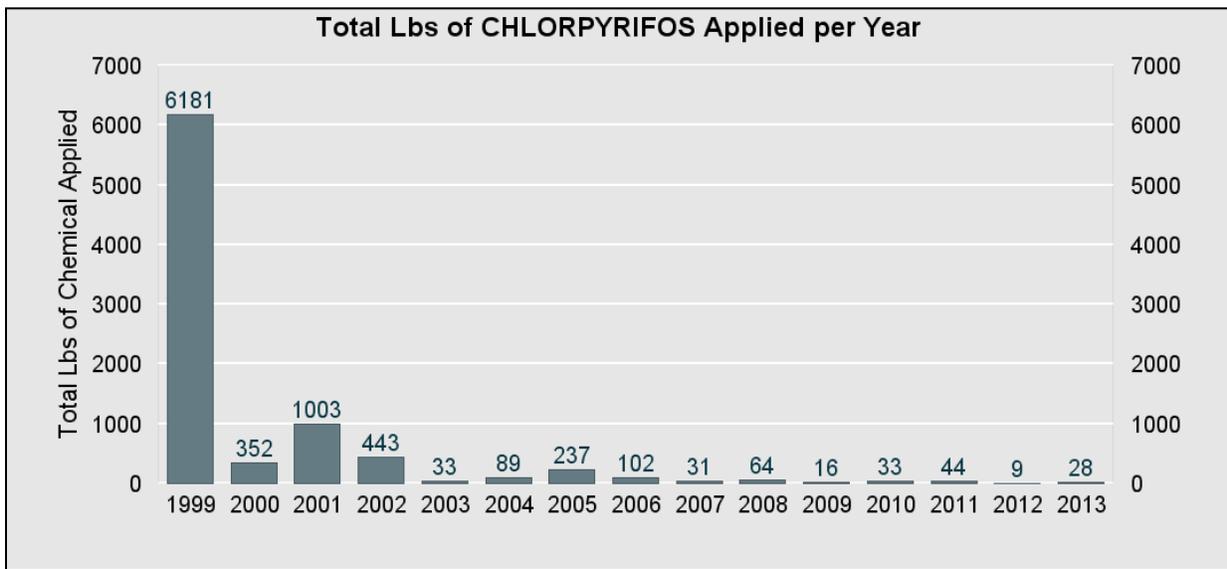
<i>PRACTICE CATEGORY</i>	Acres Reported	Percent of Total Acres Reported (218,129 acres)
Individual Practice		
<i>PESTICIDE APPLICATION PRACTICES</i>		
Monitor Wind Conditions	196,055	89.9
Follow Label Restrictions	195,630	89.7
County Permit Followed	195,380	89.6
Avoid Surface Water When Spraying	193,787	88.8
Monitor Rain Forecasts	190,985	87.6
Use PCA Recommendations	190,428	87.3
Attend Trainings	181,106	83.0
End of Row Shutoff When Spraying	180,825	82.9
Use Drift Control Agents	178,065	81.6
Use Appropriate Buffer Zones	177,511	81.4
Sensitive Areas Mapped	120,121	55.1
Reapply Rinsate to Treated Field	108,738	49.9
Use Vegetated Drain Ditches	97,348	44.6
Chemigation	81,860	37.5
Target Sensing Sprayer used	52,844	24.2
Other1	20,119	9.2
No Pesticides Applied	4,235	1.9
Other2	1,566	0.7
No Selection	83	0.04
<i>WHO DO YOU HAVE HELP DEVELOP YOUR CROP FERTILITY PLAN?</i>		
Pest Control Advisor (PCA)	191,747	87.9
Certified Crop Advisor (CCA)	107,850	49.4
Professional Soil Scientist	57,532	25.9
Independently Prepared by Member	55,373	25.4
UC Farm Advisor	52,855	24.2
Professional Agronomist	49,865	22.9
Certified Technical Service Providers by NRCS	3,836	1.8
None of the above	3,708	1.7
<i>DOES YOUR FARM HAVE THE POTENTIAL TO DISCHARGE SEDIMENT TO OFF-FARM SURFACE WATERS?</i>		
No	114,246	52.4
Yes	99,619	45.7
No Selection	4,264	2.0
<i>IRRIGATION PRACTICES</i>		
Drip	87,870	40.3
Furrow	37,794	17.3
Flood	35,640	16.3
Micro Sprinkler	16,230	7.4
Sprinkler	15,322	7.0
Border Strip	4,184	1.9

PRACTICE CATEGORY	Acres Reported	Percent of Total Acres Reported (218,129 acres)
Individual Practice		
No Selection	3,524	1.6
SECONDARY IRRIGATION		
No Selection	145,415	66.7
Sprinkler	26,844	12.3
Micro Sprinkler	10,633	4.9
Furrow	7,071	3.2
Border Strip	3,699	1.7
Drip	3,557	1.6
Flood	3,345	1.5
NITROGEN MANGEMENT METHODS TO MINIMIZE LEACHING PAST THE ROOT ZONE		
Split Fertilizer Applications	159,252	73.0
Soil Testing	148,121	67.9
Tissue/Petiole Testing	119,406	54.7
Fertigation	87,803	40.3
Cover Crops	86,995	39.9
Irrigation Water N Testing	78,951	36.2
Foliar N Application	66,482	30.5
Variable Rate Applications using GPS	22,364	10.3
Do Not Apply Nitrogen	11,467	5.3
Other	5,051	2.3
No Selection	4,780	2.2
Other2	20	0.01
IRRIGATION PRACTICES FOR MANAGING SEDIMENT AND EROSION		
The time between pesticide applications and the next irrigation is lengthened as much as possible to mitigate runoff of pesticide residue.	125,378	57.5
Use drip or micro-irrigation to eliminate irrigation drainage.	113,659	52.1
Shorter irrigation runs are used with checks to manage and capture flows.	85,136	39.0
No irrigation drainage due to field or soil conditions.	54,625	25.0
In-furrow dams are used to increase infiltration and settling out of sediment prior to entering the tail ditch.	53,898	24.7
Tailwater Return System.	47,563	21.8
Catchment Basin.	31,902	14.6
Use of flow dissipaters to minimize erosion at discharge point.	22,430	10.3
Other	10,033	4.6
PAM (polyacrylamide) used in furrow and flood irrigated fields to help bind sediment and increase infiltration.	9,178	4.2
No Selection	7,358	3.4
CULTURAL PRACTICES TO MANAGE SEDIMENT AND EROSION		
Soil water penetration has been increased through the use of amendments, deep ripping and/or aeration.	138,603	63.5
Crop rows are graded, directed and at a length that will optimize the use of rain and irrigation water.	119,374	54.7

PRACTICE CATEGORY	Acres Reported	Percent of Total Acres Reported (218,129 acres)
Individual Practice		
Minimum tillage incorporated to minimize erosion.	114,716	52.6
Cover crops or native vegetation are used to reduce erosion.	114,101	52.3
Vegetated ditches are used to remove sediment as well as water soluble pesticides, phosphate fertilizers and some forms of nitrogen.	84,752	38.9
Berms are constructed at low ends of fields to capture runoff and trap sediment.	66,274	30.4
Storm water is captured using field borders.	66,179	30.3
Creek banks and stream banks have been stabilized.	61,349	28.1
Hedgerows or trees are used to help stabilize soils and trap sediment movement.	60,784	27.9
Vegetative filter strips and buffers are used to capture flows.	58,243	26.7
Subsurface pipelines are used to channel runoff water.	43,540	20.0
Sediment basins / holding ponds are used to settle out sediment and hydrophobic pesticides such as pyrethroids from irrigation and storm runoff.	42,117	19.3
No storm drainage due to field or soil conditions.	22,650	10.4
Field is lower than surrounding terrain.	19,273	8.8
No Selection	8,921	4.1
Other	5,274	2.4



(a) Irrigated Agriculture



(b) All Other Uses

Figure 1: Annual Chlorpyrifos Use (lbs/year) for (a) Irrigated Agriculture and (b) All Other Uses in Yolo County: 1999 – 2013.