

MAY 2018

SACRAMENTO VALLEY
WATER QUALITY COALITION

Monitoring and Reporting Program

Annual Monitoring Report 2018

Prepared by

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Executive Summary

SUMMARY OF MONITORING PROGRAM

The Sacramento Valley Water Quality Coalition (Coalition) has developed and implemented a Monitoring and Reporting Program (MRP) to meet the requirements of the *Waste Discharge Requirements General Order for Growers within the Sacramento River Watershed that are Members of a Third-Party Group (R5-2014-0030)* (WDR).¹ The scope of the MRP and the sampling and analytical methods used in 2016 Coalition Monitoring have been approved by the Central Valley Regional Water Quality Control Board (Water Board).

In accordance with the WDR requirements, the Coalition is achieving these objectives by implementing an MRP that evaluates samples for the presence of statistically significant toxicity and exceedances of applicable numeric water quality objectives and *Irrigated Lands Regulatory Program (ILRP)* Trigger Limits. The Coalition initiates follow-up actions designed to identify constituents causing significant toxicity when toxicity is of sufficient magnitude. Exceedances of numeric objectives and *ILRP* Trigger Limits for chemical, physical and microbiological parameters trigger follow-up actions designed to identify potential sources and to inform potential users of the constituents of concern. Additionally, the Coalition is evaluating the degree of implementation of current management practices in priority watersheds and recommending additional practices as water quality results indicate a need to do so. The Coalition is committed to the principle of adaptive management to control specific discharges of waste that are having an impact on water quality. This iterative approach allows for the most effective use of limited human and fiscal resources.

The 2016 Coalition Monitoring was conducted in coordination with the Northeastern California Water Association, the Napa County-Putah Creek Watershed Group, the Placer-Nevada-South Sutter-North Sacramento Watershed Group, the Goose Lake Watershed Group, and the Upper Feather River Watershed Group. Monitoring in the Upper Feather River and Pit River subwatersheds was conducted in coordination with the California's Surface Water Ambient Monitoring Program (SWAMP) beginning in 2012. The Coalition also continues to coordinate with the California Rice Commission (CRC) under the December 2004 Coalition-CRC Memorandum of Understanding.

The parameters monitored in 2016 by the Coalition to achieve these objectives are as specified in the current WDR and MRP (*Order No. R5-2014-0030*):

- Water column and sediment toxicity
- Physical and conventional parameters in water
- Organic carbon
- Pathogen indicator organisms in water

¹ Prior to adoption of the WDR, the Coalition was subject to a Conditional Waiver of Waste Discharge Requirements for the Irrigated Lands Regulatory Program (ILRP) and subsequent amendments to the ILRP requirements (WQO-2004-0003, SWRCB 2004, R5-2005-0833, R5-2008-0005, R5-2009-0875).

- Trace metals in water
- Pesticides in water
- Nitrogen and phosphorus compounds in water

The current WDR and MRP also requires testing for 303(d)-listed constituents identified in water bodies downstream from Coalition sites and discharged within the watershed, if irrigated agriculture has been identified as a contributing source within the Sacramento River Watershed and such monitoring has been requested by the Executive Officer.

Note that not all parameters are monitored at every site for every event. Specific individual parameters measured for 2016 Coalition Monitoring are listed in **Table 2**.

A total of 23 sampling sites were monitored by the Coalition and coordinating subwatershed monitoring programs during 2016 (**Table 3**). A map of these sites is presented in **Figure 1**.

As required by the MRP, Coalition monitoring events includes storm season monitoring and irrigation season monitoring. The sites and numbers of samples scheduled for collection for 2016 Coalition Monitoring are summarized in **Table 4**. This *2016 Annual Monitoring Report (AMR)* includes results for October 2015 through September 2016.

Sample collection and analysis has been performed by the following agencies and subcontractors.

- Pacific EcoRisk (Fairfield, California) performs toxicity analyses and conducts sampling for all sites, with the specific exceptions noted below:
 - Vestra Environmental conducted sampling on behalf of the Northeastern California Water Association for the Pit River subwatershed site and for the Goose Lake Watershed Group for the Lower Lassen Creek site;
 - Placer County Resource Conservation District conducted sampling for the Placer-Nevada-South Sutter-North Sacramento subwatershed;
 - Kleinfelder conducted sampling at sites on the Colusa Basin Drain and Sacramento Slough as part of monitoring work done for the California Rice Commission.
- Caltest Analytical Laboratory (Napa, California) and Basic Lab (Redding, California) conducted all conventional and microbiological analyses; and
- APPL (Fresno, California) and Physis Environmental Laboratories (Anaheim, California) conducted pesticide analyses.

TREND ANALYSIS

The results of trend analyses conducted for the 2015 Annual Monitoring Report did not indicate a need for any additional locations, events, or parameters. These evaluations will be conducted again for the 2018 AMR after the 2017 Assessment monitoring period.

MANAGEMENT PRACTICES AND ACTIONS TAKEN

Response to Exceedances

To address specific water quality exceedances, the Coalition and its partners developed a Management Plan in 2008, subsequently approved by the Water Board. The Coalition also previously developed a *Landowner Outreach and Management Practices Implementation Communications Process for Monitoring Results (Management Practices Process)* to address exceedances. Implementation of the approved Management Plan is the primary mechanism for addressing exceedances observed in the Coalition's *ILRP* monitoring.

Management Plan Status Update

The Management Plan Progress Report (MPPR), documenting the status and progress toward meeting Management Plan requirements for 2016, is provided to the Water Board with this Annual Monitoring Report. Activities conducted in 2016 to implement the Coalition's Management Plan included addressing exceedances of objectives for registered pesticides, development of new Management Plans, evaluating Management Plans that could be deemed complete, and monitoring required for toxicity and pesticide management plans and TMDLs.

Implementation completed specifically for registered pesticides and toxicity included review and evaluation of pesticide application data, identification of potential sources, and determination of likely agricultural sources. Prior to 2015, for Management Plans for registered pesticides and identified causes of toxicity, surveys of Coalition members operating on high priority parcels were conducted to determine the degree of implementation of relevant management practices. Beginning in 2015, these surveys were replaced with data compiled from Coalition member Farm Evaluations. The Farm Evaluation data have been used to establish goals for additional management practice implementation needed to address exceedances of Basin Plan water quality objectives and *ILRP* Trigger Limits.

CONCLUSIONS AND RECOMMENDATIONS

The Coalition submits this *2016 Annual Monitoring Report (AMR)* as required under the Water Board's Irrigated Lands Regulatory Program (*ILRP*). The AMR provides a detailed description of the Coalition's monitoring results as part of its ongoing efforts to characterize irrigated agricultural and wetlands-related water quality in the Sacramento River Basin.

To summarize, the results from the *ILRP* monitoring in 2016 continue to indicate that with few exceptions, there are no major water quality problems with agricultural and managed wetlands discharges in the Sacramento River Basin.

This AMR characterizes potential water quality impacts of agricultural drainage from a broad geographic area in the Sacramento Valley from October 2015 through September 2016. To date, a total of 127 Coalition storm and irrigation season events have been completed since the beginning of Coalition monitoring in January 2005, with additional events collected by coordinating programs and for follow-up evaluations. For the period of record in this AMR (October 2015 through September 2016), samples were collected for eight scheduled monthly events and 2 wet weather ("storm") events.

Pesticides were infrequently detected (~2.3% of all pesticide results for 2016 were detected), and, when detected, rarely exceeded applicable objectives. Only one registered pesticide, chlorpyrifos, exceeded applicable water quality objectives or *ILRP* Trigger Limits.

Many of the pesticides specifically required to be monitored in the past by the *ILRP* have rarely been detected in Coalition water samples, including glyphosate, paraquat, and all of the pyrethroid pesticides. Over 98.3% of all pesticide analyses performed to date for the Coalition have been below detection. Coalition monitoring of pesticides for the *ILRP* for 2016 was conducted based on Management Plan requirements and on reported pesticide use and relative toxicity risks for pesticides in the subwatersheds. The Coalition also conducted focused monitoring of the *ILRP*-required trace elements (arsenic, cadmium, lead, molybdenum, nickel, selenium, and zinc) informed by the Coalition's past monitoring results, which have demonstrated that most of these metals rarely approach or exceed objectives and are not likely to cause adverse impacts to aquatic life or human health in waters receiving agricultural runoff in the Coalition watershed. This focused strategy for monitoring pesticides and trace metals was implemented in 2010 in accordance with the Coalition's 2009 MRP (*Order No. R5-2009-0875*, CVRWQCB 2009), and this same strategy is consistent with the requirements of the current WDR and MRP (*Order No. R5-2014-0030*).

The majority of exceedances of adopted numeric objectives continue to consist of conductivity, dissolved oxygen, and *E. coli*. Agricultural runoff and irrigation return flows may contribute to exceedances of these objectives, but these parameters are primarily controlled or significantly affected by natural processes and sources that are not controllable by agricultural management practices.

The Coalition has implemented the required elements of the *ILRP* since 2004. The Coalition developed a Watershed Evaluation Report (WER) that set the priorities for development and implementation of the initial Monitoring and Reporting Program Plan (MRPP). The Coalition successfully developed the MRPP, Quality Assurance Project Plan (QAPP), and Management Plan as required by the *ILRP*, and these documents were approved by the Water Board. Subsequent revisions requested by the Water Board and the Coalition were incorporated into the Coalition's program and implemented through the Coalition's ongoing *ILRP* monitoring efforts. The Coalition also continues to adapt and improve elements of the monitoring program based on the knowledge gained through *ILRP* monitoring efforts.

The 2016 monitoring program was developed to be consistent with the requirements of the current WDR and MRP (*Order No. R5-2014-0030*) and was approved by the Water Board for this purpose with the understanding that it would serve as the first "Non-Assessment" monitoring period for the new MRP. The Coalition has implemented the approved monitoring program in coordination with its subwatershed partners, has initiated follow-up activities required to address observed exceedances, and continued to implement the previously approved Management Plan while updating the CSQMP in 2016. Throughout this process, the Coalition has kept an open line of communication with the Water Board and has made every effort to fulfill the requirements of the *ILRP* in a cost-effective, scientifically defensible, and management-focused manner. This AMR is documentation of the success and continued progress of the Coalition in achieving these objectives.

Introduction

The primary purpose of this report is to document the monitoring efforts and results of the Sacramento Valley Water Quality Coalition (Coalition) Monitoring and Reporting Program (MRP). This Annual Monitoring Report (AMR) for 2016 also serves to document the Coalition’s progress toward fulfilling the requirements of the *Waste Discharge Requirements General Order for Growers within the Sacramento River Watershed that are Members of a Third-Party Group (R5-2014-0030)* (WDR).²

The AMR includes the following elements noted in **Table 1**, as specified in the WDR’s MRP:

Table 1. MRP Annual Monitoring Report Requirements³

MRP Section	AMR Requirement	Report Section Headings	Page
V.C.1	Signed Transmittal Letter	NA	-
V.C.2	Title page	Title page	-
V.C.3	Table of Contents	Table of Contents	<i>i</i>
V.C.4	Executive Summary	Executive Summary	<i>vi</i>
V.C.5	Description of the Coalition Group geographical area	Description of the Watershed	4
V.C.6	Monitoring objectives and design	Monitoring Objectives	5
V.C.7	Sampling site descriptions and rainfall records for the time period covered under the AMR	Sampling Site Locations and Land Uses; Summary of Sampling Conditions	7; 36
V.C.8	Location map(s) of sampling sites, crops and land uses	Appendix E: Drainage Maps	CD
V.A.1; ¹ V.C.9; V.C.11	An Excel workbook containing an export of all data records uploaded and/or entered into the CEDEN-comparable database (surface water data). The workbook shall contain, at a minimum, those items detailed in the most recent version of the third-party’s approved QAPP Guidelines; Tabulated results of all analyses arranged in tabular form so that the required information is readily discernible; Electronic data submittal.	Appendix C: Tabulated Monitoring Results	CD

² Prior to adoption of the WDR, the Coalition was subject to a Conditional Waiver of Waste Discharge Requirements for the Irrigated Lands Regulatory Program (ILRP) and subsequent amendments to the ILRP requirements (WQO-2004-0003, SWRCB 2004, R5-2005-0833, R5-2008-0005, R5-2009-0875).

³ Monitoring and Reporting Program (Attachment B to R5-2014-0030), Section V.C.

MRP Section	AMR Requirement	Report Section Headings	Page
V.C.10	Discussion of data relative to water quality objectives/Trigger Limits and water quality management plan milestones/Basin Plan Amendment Workplan (BPAW) updates, if applicable	Exceedances of Relevant Water Quality Objectives	50
V.C.12	Sampling and analytical methods used	Sampling and Analytical Methods	18
V.A.5; ¹ V.A.7.c.; V.C.13	Electronic copies of all applicable laboratory analytical reports on a CD; Chain of custody (COCs) and sample receipt documentation; Associated laboratory and field quality control samples results	Appendix B: Lab Reports and Chains of Custody	CD
V.C.14	Summary of Quality Assurance Evaluation results (as identified in the most recent version of the Coalition's QAPP for Precision, Accuracy and Completeness)	Quality Assurance	26
V.A.3-4; ¹ V.C.15	Electronic copies of all field sheets; Electronic copies of photos obtained from all surface water monitoring sites, clearly labeled with the CEDEN comparable station code and date; Specification of the method(s) used to obtain estimated flow at each surface water monitoring site during each monitoring event	Appendix A: Field Log Copies	CD
V.C.16	Summary of exceedances of water quality objectives/Trigger Limits occurring during the reporting period and surface water-related pesticide use information	Exceedances of Relevant Water Quality Objectives; Appendix D: Exceedance Reports	50; CD
V.C.17	Actions taken to address water quality exceedances that have occurred, including, but not limited to, revised or additional management practices implemented	Management Practices and Actions Taken; Appendix F: SVWQC Outreach Materials	66
V.C.18	Evaluation of monitoring data to identify temporal and spatial trends and patterns	Trend Analysis; Appendix G: Trend Analysis Results	62
V.C.19	Summary of Nitrogen Management Plan information submitted to the Coalition	---	NA

MRP Section	AMR Requirement	Report Section Headings	Page
V.C.20	Summary of Management Practice information collected as part of Farm Evaluations	Summary of Farm Evaluation Data ²	68
V.C.21	Summary of Mitigation Monitoring	--- ³	NA
V.C.22	Summary of education and outreach activities	Management Practices and Actions Taken; Appendix F: SVWQC Outreach Materials	66
V.C.23	Reduced Monitoring/Management Plan Verification Option Reports	Appendix H: Reduced Monitoring Reports	NA
V.C.24	Conclusions and recommendations	Conclusions and Recommendations	69

1. Quarterly Submittals of Monitoring Results (WDR Provision V.A) are re-submitted with the AMR.
2. The 2016 Farm Evaluation (FE) and Nitrogen Management Plan (NMP) Summary Report will be submitted to the *ILRP* by 30 June 2017, as authorized in a letter to the Coalition dated 5 April 2017 from the Central Valley Water Board's Executive Officer.
3. This item is not applicable because no mitigation monitoring was conducted in 2016.

With the exceptions noted in **Table 1**, all report elements required by the WDR are included in this report.

Description of the Watershed

The Sacramento River Watershed drains over 27,000 square miles of land in the northern part of California's Central Valley into the Sacramento River. The upper watersheds of the Sacramento River region include the Pit River watershed above Lake Shasta and the Feather River above Lake Oroville. The Sacramento Valley drainages include the Colusa, Cache Creek, and Yolo Bypass watersheds on the west side of the valley, and the Feather, Yuba, and American River watersheds on the east side of the valley. The Coalition also monitors in the Cosumnes River watershed, which is not part of the Sacramento River Watershed.

Beginning at its northern terminus near the city of Redding, the Sacramento Valley stretches approximately 180 miles to the southeast, where it merges into the Sacramento-San Joaquin River Delta south of the Sacramento metropolitan area at Rio Vista. The valley is 30 to 45 miles wide in the southern to central parts, but narrows to about 5 miles wide near Redding. Its elevation decreases from 300 feet at its northern end to near sea level in the Delta. The greater Sacramento River Watershed includes sites from 5,000 feet in elevation to near sea level.

The Sacramento River Basin is a unique mosaic of farm lands, refuges, and managed wetlands for waterfowl habitat; spawning grounds for numerous salmon and steelhead trout; and the cities and rural communities that make up this region. This natural and working landscape between the crests of the Sierra Nevada and the Coast Range includes the following:

- More than a million acres of family farms that provide the economic engine for the region; provide a working landscape and pastoral setting; and serve as valuable habitat for waterfowl along the Pacific Flyway. The predominant crops include: rice, general grain and hay, improved pasture, corn, tomatoes, alfalfa, almonds, walnuts, prunes, safflower, and vineyards.
- Habitat for 50% of the threatened and endangered species in California, including the winter-run and spring-run salmon, steelhead, and many other fish species.
- Six National Wildlife Refuges, more than fifty state Wildlife Areas, and other privately managed wetlands that support the annual migration of waterfowl, geese, and water birds in the Pacific Flyway. These seasonal and permanent wetlands provide for 65% of the North American Waterfowl Management Plan objectives.
- The small towns and rural communities that form the backbone of the region, as well as the State Capital that serves as the center of government for the State of California.
- The forests and meadows in the numerous watersheds of the Sierra Nevada and Coast Range.

Monitoring Objectives

The Coalition's monitoring program conforms to the goals of the Nonpoint Source (NPS) Program and achieves the following objectives as a condition of the WDR's MRP:

1. Track, monitor, assess and report program activities;
2. Ensure consistent and accurate reporting of monitoring activities;
3. Target NPS Program activities at the watershed level;
4. Coordinate with public and private partners; and
5. Track implementation of management practices to improve water quality and protect existing beneficial uses.

In accordance with the WDR requirements, the Coalition is achieving these objectives by implementing an MRP that evaluates samples for the presence of statistically significant toxicity and exceedances of applicable numeric water quality objectives and *ILRP* Trigger Limits. The Coalition initiates follow-up actions designed to identify constituents causing significant toxicity when toxicity is of sufficient magnitude. Exceedances of numeric objectives and *ILRP* Trigger Limits for chemical, physical and microbiological parameters trigger follow-up actions designed to identify potential sources and to inform potential users of the constituents of concern. Additionally, the Coalition is evaluating the degree of implementation of current management practices in priority watersheds and recommending additional practices as water quality results indicate a need to do so. The Coalition is committed to the principle of adaptive management to control specific discharges of waste that are having an impact on water quality. This iterative approach allows for the most effective use of limited human and fiscal resources.

The parameters monitored in 2016 by the Coalition to achieve these objectives are as specified in the current WDR and MRP (*Order No. R5-2014-0030*):

- Water column and sediment toxicity
- Physical and conventional parameters in water
- Organic carbon
- Pathogen indicator organisms in water
- Trace metals in water
- Pesticides in water
- Nitrogen and phosphorus compounds in water

The current WDR and MRP also require testing for 303(d)-listed constituents identified in water bodies downstream from Coalition sites and discharged within the watershed, if irrigated agriculture has been identified as a contributing source within the Sacramento River Watershed and such monitoring has been requested by the Executive Officer.

Note that not all parameters are monitored at every site for every event. Specific individual parameters measured for 2016 Coalition Monitoring are listed in **Table 2**.

Table 2. Constituents Monitored for the 2016 Monitoring Year

Analyte	Quantitation Limit ^(a)	Reporting Unit
<i>Physical Parameters</i>		
Flow	NA	CFS (Ft ³ /Sec)
pH	0.1 ^(b)	-log[H ⁺]
Conductivity	0.1 ^(b)	μS/cm
Dissolved Oxygen	0.1 ^(b)	mg/L
Temperature	0.1 ^(b)	°C
Hardness, total as CaCO ₃	10	mg/L
Turbidity	1.0	NTU
Total Suspended Solids	3.0	mg/L
Total Organic Carbon	0.5	mg/L
Grain size (in sediment)	1	% fraction
<i>Pathogen Indicators</i>		
<i>E. coli</i> bacteria	2	MPN/100 mL
<i>Water Column Toxicity</i>		
<i>Ceriodaphnia</i> , 96-h acute	NA	% Survival
<i>Selenastrum</i> , 96-h short-term chronic	NA	% of Survival
<i>Sediment Toxicity</i>		
<i>Hyalella</i> , 10-day short-term chronic	NA	% Survival
<i>Pesticides</i>		
Benzophenyls	(c)	μg/L
Carbamates	(c)	μg/L
Herbicides	(c)	μg/L
Organochlorine	(c)	μg/L
Organophosphorus	(c)	μg/L
Pyrethroids and chlorpyrifos	(c)	ng/g, dw.
<i>Trace Elements</i>		
Arsenic	0.5	μg/L
Boron	10	μg/L
Copper	0.5	μg/L
Lead	0.25	μg/L
Selenium	0.5	μg/L
<i>Nutrients</i>		
Ammonia as N	0.1	mg/L
Nitrate + Nitrite as N	0.1	mg/L
Orthophosphate as P	0.1	mg/L
Phosphorus, total	0.1	mg/L

Notes:

- (a) The Quantitation Limit (QL) represents the concentration of an analyte that can be routinely measured in the sampled matrix within stated limits and confidence in both identification and quantitation.
- (b) Detection and reporting limits are not strictly defined. Value is required reporting precision.
- (c) Limits are different for individual pesticides.

Sampling Site Descriptions

To successfully implement the monitoring and reporting program requirements contained in the *ILRP* adopted by the Water Board in June 2003, the Coalition worked directly with landowners in the 21 county watersheds to identify and develop ten (now 13) subwatershed groups. Representatives from each subwatershed group utilized agronomic and hydrologic data generated by the Coalition in an attempt to prioritize watershed areas for initial evaluation to ultimately select monitoring sites in their respective areas based upon existing infrastructure, historical monitoring data, land use patterns, historical pesticide use, and the presence of 303(d)-listed water bodies.

Coalition members selected sampling sites in priority watersheds based upon the following fundamental assumptions regarding management of non-point source discharges to surface water bodies: 1) Landscape scale sampling at the bottom of drainage areas allows determination of the presence of water quality problems using a variety of analytical methods, including water column and sediment toxicity testing, water chemistry analyses, and bioassessment; 2) Strategic source investigations utilizing Geographic Information Systems can be used to identify upstream parcels with attributes that may be related to the analytical results, including crops, pesticide applications, and soil type; and 3) Management practice effectiveness can best be assessed by coalitions at the drainage and watershed scale to determine compliance with water quality objectives in designated water bodies. Results from farm-level management practices evaluations are used to complement Coalition efforts on the watershed scale by providing crop-specific information that supports management practice recommendations.

The Coalition uses a “Representative Monitoring” approach to achieve the goals of the 2016 MRP:

- Representative monitoring is conducted at sites in drainages representative of larger regions based on shared agricultural and geographic characteristics;
- Representative monitoring includes a cycle of two years of “Assessment” monitoring for the broader suite of *ILRP* analytes, followed by two years of sampling needed for Management Plan implementation (referred to as “Non-Assessment” monitoring); and
- Monitoring schedules and the analytes monitored are customized based on the characteristics of individual subwatersheds and Management Plans.

Monitoring sites for 2016 were continued from previously monitored locations and included ongoing representative sites and sites monitored only for management plans or TMDLs. A total of 17 representative sites were monitored, and Management Plan sampling was conducted at all 17 of the representative monitoring sites and at 18 additional sites.

SAMPLING SITE LOCATIONS AND LAND USES

The water and sediment sites monitored by the Coalition in 2016 are listed in **Table 3**. All sites monitored in 2016 were approved by the Water Board as MRP compliance sites. An overall map of Coalition and subwatershed sites is presented in **Figure 1**. Site-specific drainage maps with land use patterns for all monitoring locations are provided in **Appendix E**.

Table 3. Monitoring Sites for 2016 Coalition Monitoring

Subwatershed	Site Name	Latitude	Longitude	Agency	Site ID & Category (Fig. 1) ¹	
Butte-Yuba-Sutter	Butte Slough at Pass Road	39.1873	-121.90847	SVWQC	BTTSL	MP
Butte-Yuba-Sutter	Gilsizer Slough at George Washington Rd	39.009	-121.6716	SVWQC	GILSL	MP
Butte-Yuba-Sutter	Lower Honcut Creek at Hwy 70	39.30915	-121.59542	SVWQC	LHNCT	REP
Butte-Yuba-Sutter	Lower Snake R. at Nuestro Rd	39.18531	-121.70358	SVWQC	LSNKR	REP
Butte-Yuba-Sutter	Pine Creek at Highway 32 ⁺	39.75338	-121.97124	SVWQC	PNCHY	REP
Butte-Yuba-Sutter	Sacramento Slough bridge near Karnak	38.785	-121.6533	SVWQC	SSKNK	REP
Colusa Glenn	Colusa Basin Drain above KL	38.8121	-121.7741	SVWQC	COLDR	REP
Colusa Glenn	Freshwater Creek at Gibson Rd	39.17664	-122.18915	SVWQC	FRSHC	REP
Colusa Glenn	Stony Creek on Hwy 45 near Rd 24	39.71005	-122.00404	SVWQC	STYHY	MP
Colusa Glenn	Walker Creek near 99W and CR33	39.62423	-122.19652	SVWQC	WLKCH	REP
El Dorado	North Canyon Creek	38.76242	-120.70996	SVWQC	NRTCN	REP
Lake	McGaugh Slough at Finley Road East	39.00417	-122.86233	SVWQC	MGSLU	MP
Lake	Middle Creek u/s from Highway 20	39.17641	-122.91271	SVWQC	MDLCR	REP
Pit River	Fall River at Fall River Ranch Bridge	41.0351	-121.4864	NECWA	FRRRB	MP
Pit River	Pit River at Canby Bridge	41.4017	-120.931	NECWA	PRCAN	MP
Pit River	Pit River at Pittville	41.0454	-121.3317	NECWA	PRPIT	REP
PNSSNS	Coon Creek at Brewer Road	38.93399	-121.45184	PNSSNS	CCBRW	REP
Sacramento/Amador	Grand Island Drain near Leary Road	38.2399	-121.5649	SVWQC	GIDLR	REP
Shasta/Tehama	Anderson Creek at Ash Creek Road	40.418	-122.2136	SVWQC	ACACR	REP
Solano	Ulati Creek at Brown Road	38.307	-121.794	SVWQC	UCBRD	REP
Solano	Z-Drain	38.45215	-121.6752	SVWQC	ZDDIX	MP
Upper Feather River	Middle Fk Feather River above Grizzly Cr	39.816	-120.426	UFRW	MFFGR	REP
Yolo	Willow Slough Bypass at Pole Line	38.59015	-121.73058	SVWQC	WLSPL	REP

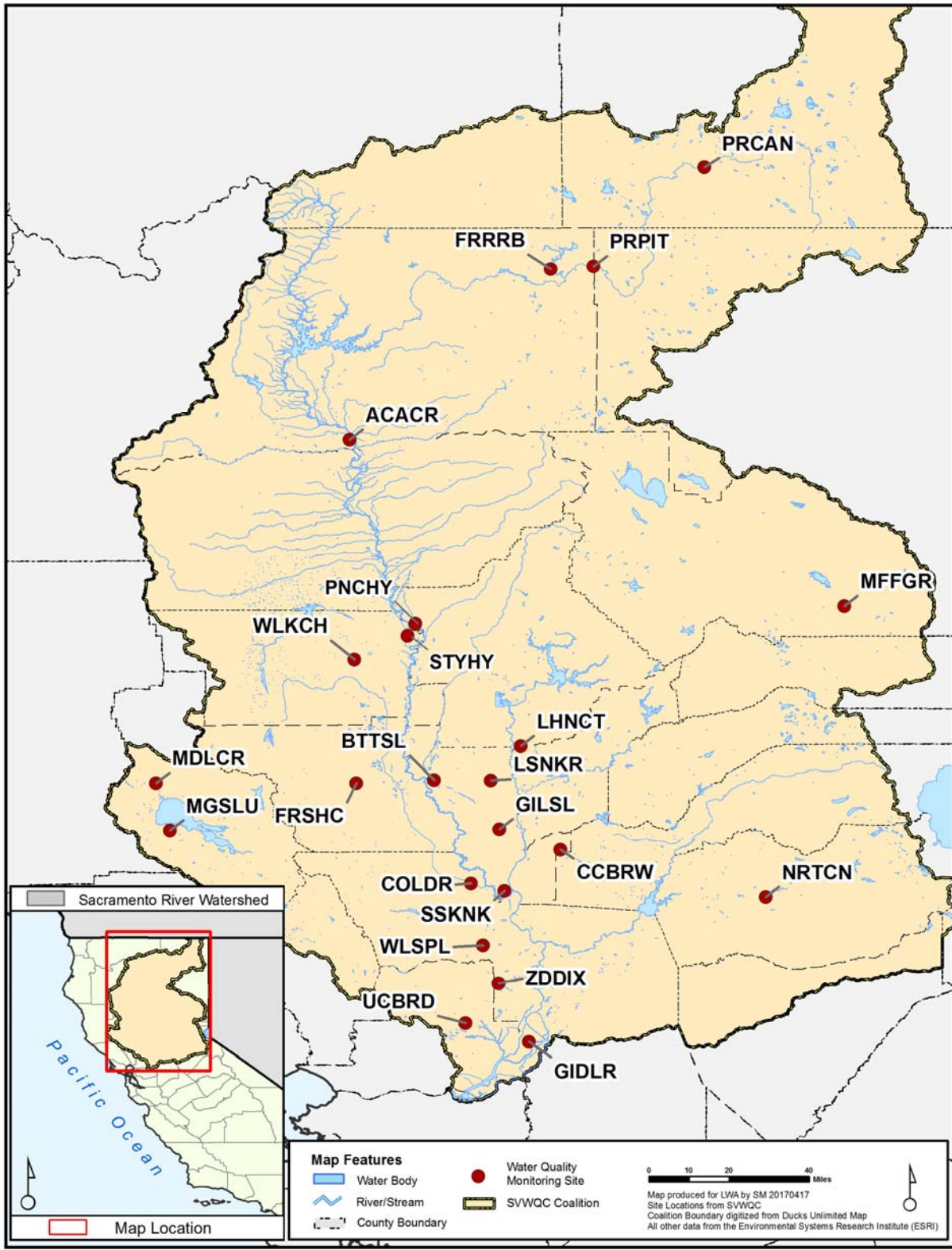


Figure 1. Coalition Monitoring Sites, 2016

SITE DESCRIPTIONS

Butte-Yuba-Sutter Subwatershed

Butte Slough at Pass Road (BTTSL)

Butte Slough is a tributary of Butte Creek. It joins Butte Creek near its outflow to the Sacramento River. The sampling location is approximately 1.5 miles from the confluence with Butte Creek. Butte Creek is a source of water in Butte Slough when irrigation withdrawals are being made. In addition to the water from Butte Creek, Butte Slough receives drainage from the wetlands of Gray Lodge Waterfowl Management Area, Butte Sink Wildlife Management Area, the fields surrounding Cherokee Canal and the orchards and fields west of Gridley and the Sutter Buttes.

Gilsizer Slough at George Washington Road (GILSL)

Gilsizer Slough is an unlined storm drainage outfall canal that runs from the Gilsizer County Drainage District's north pump station approximately 15 miles to the Sutter Bypass, draining 6,005 total acres. The monitoring location is located roughly 1.5 miles from its confluence with the Sutter bypass and is a natural drainage channel that historically has drained Yuba City and the area south of town. Principal crops grown in this area include prunes, walnuts, peaches, and almonds.

Lower Honcut Creek at Highway 70 (LHNCT)

Lower Honcut Creek (in the Lower Honcut Creek drainage) was selected to represent the drainages in the eastern part of the Butte-Yuba-Sutter subwatershed. This drainage includes the dominant crops and typically has flows allowing sampling through irrigation season. The sampling site is located approximately 3.5 miles from its confluence with the Feather River. Dominant crops in this drainage include rice, walnuts, prunes, pasture, citrus, olive, grapes. Lower Honcut receives flows from North Honcut Creek and South Honcut Creek, which extend up into the foothills and include more pasture acreage.

Lower Snake River at Nuestro Road (LSNKR)

The Lower Snake River is an unlined irrigation supply and runoff canal that serves approximately 25,000 total acres and includes a relatively high percentage of rice acreage. The other predominant crops include prunes, peaches, idle acreage, and operations producing flowers, nursery stock, and Christmas trees.

Pine Creek at Highway 32 (PNCHY)

The watershed sampled upstream from the Pine Creek monitoring site represents approximately 28,000 acres of varied farmland, riparian habitat, and farmsteads. The predominant crops in this area are walnuts, almonds, prunes, wheat, oats, barley, beans, squash, cucumbers, alfalfa, pasture, and safflower.

Sacramento Slough Bridge near Karnak (SSKNK)

This site aggregates water from all areas in the subwatershed between the Feather and Sacramento Rivers. The major contributing areas include the areas downstream of the Butte

Slough and Wadsworth monitoring sites. These areas include Sutter Bypass and its major inputs from Gilsizer Slough, Reclamation District (RD) 1660, RD 1500, and the Lower Snake River. Monitoring at this site is coordinated with the California Rice Commission.

Colusa Glenn Subwatershed

Colusa Basin Drain above Knights Landing (COLDR)

This site is near the outfall gates of the Colusa Basin Drain before its confluence with the Sacramento River. This site is downstream of all of the other monitoring sites within the basin. The upstream acreage consists of almonds, tomatoes, wetlands, pasture, corn, and walnuts. Monitoring at this site is coordinated with the California Rice Commission.

Freshwater Creek at Gibson Road (FRSHC)

The Freshwater Creek drainage includes approximately 83,000 total acres. Irrigated acreage (excluding rice acreage) is approximately 19,000 acres. Predominant crops in the drainage are rice, tomatoes, idle acreage, squash, grain, pasture, and safflower.

Stony Creek on Hwy 45 near Rd 24 (STYHY)

This site characterizes water from the contributing area downstream of Black Butte Reservoir just north of the town of Orland and includes approximately 20,000 acres of irrigated lands. The major irrigated crops in the Lower Stony Creek drainage are pasture, almonds, prunes, and wheat.

Walker Creek near 99W and CR33 (WLKCH)

The Walker Creek drainage is located east of Wilson Creek in Glenn County, and the Walker Creek monitoring site is located 1.3 miles north of the Town of Willows. The Walker Creek drainage includes approximately 27,000 total irrigated acres. Predominant crops in this drainage are almonds, rice, corn, and alfalfa. This is a representative site for this subwatershed.

El Dorado Subwatershed

The El Dorado subwatershed (~3500 irrigated acres) is currently operating under the submitted and approved *Reduced Monitoring/Management Practices Verification Option*. Their Management Practices Verification report is included in **Appendix H**.

North Canyon Creek (NRTCN)

This site captures representative agricultural drainage from the Camino-“Apple Hill” drainage in El Dorado County. Crops grown in this region include apples, pears, wine grapes, stone fruit, and Christmas trees. This site is approximately one (1) mile upstream from the confluence with the South Fork American River and is a perennial stream. This is a representative site for this subwatershed.

Lake Subwatershed

The Lake subwatershed is currently operating under the submitted and approved *Reduced Monitoring/Management Practices Verification Option*. Their Management Practices Verification report is included in **Appendix H**.

Middle Creek Upstream from Highway 20 (MDLCR)

The Middle Creek drainage contains approximately 60,732 acres. Over 55,000 acres are listed as Native Vegetation with the U.S. Forest Service controlling the majority of the land. Irrigated agriculture constitutes approximately 1,100 acres farmed by members participating in the Lake County Watershed group. This includes 374 acres of walnuts, 308 acres of grapes, 186 acres of pears 159 acres of hay/pasture, 10 acres of specialty crops/nursery crops and about 70 acres of wild rice.

The sampling location was chosen to avoid influence from the town of Upper Lake, and captures approximately 60% of irrigated agricultural operations within this drainage. This is a representative site for this subwatershed.

McGaugh Slough at Finley Road East (MGSLU)

McGaugh Slough captures irrigated agricultural drainage from about 10,300 acres of orchard and vineyard crops in Lake County. This site characterizes the most prevalent drain for the Big Valley, which is the most intensive area for agricultural operations in Lake County.

Napa Subwatershed

The Napa subwatershed (approximately 3500 irrigated acres) is currently operating under the *Reduced Monitoring/Management Practices Verification Option*. Their Management Practices Verification report is included in **Appendix H**.

Pope Creek above Lake Berryessa (PCULB)

The site on Pope Creek in Napa County is downstream of major storm runoff and above Lake Berryessa. Primary crops in the drainage are vineyards and olive orchards. Additional tributaries in the Pope Creek area (Burton Creek, Swartz Creek, Maxwell Creek, and upper Pope Creek) have been sampled to help establish regional characteristics for management plan source evaluations. This site is a representative site for this subwatershed.

Pit River Subwatershed

Monitoring in this subwatershed was conducted in coordination with the Northeastern California Watershed Association (NECWA) and the California's Surface Water Ambient Monitoring Program (SWAMP).

Fall River at Fall River Ranch Bridge (FRRRB)

This site is located at the lower end of Fall River before the river is partially diverted for hydroelectric uses at the Pit 1 Power House. The majority of the Fall River flow is spring-fed water that emerges in the northern portions of the valley (e.g., Lava Creek Springs, Spring Creek Springs, Crystal Springs, Mallard Springs, Big Lake Springs, Thousand Springs, Hideaway Spring, Rainbow Spring). These springs form the Little Tule River, Tule River, Spring Creek,

Lava Creek, Mallard Creek, and Ja She Creek. A major tributary to Fall River (Bear Creek) captures flow mostly from private timberland comprising approximately 27 square miles of watershed. Bear Creek joins the Fall River near Thousand Springs. Finally, small amounts of water enter the Fall River from overland flow during winter and from irrigated lands during the growing season. Pasture, wild rice, and alfalfa are the primary agriculture crops in the northern portion of the valley. Total irrigated acreage draining to this site is approximately 12,000 acres

Pit River at Pittville Bridge (PRPIT)

This site captures drainage from Big Valley, Ash Creek and Horse Creek. This site captures drainage from native pasture (the primary land use), as well as alfalfa, oat hay, grain and duck marsh, ultimately incorporating approximately 9,000 acres in the Fall River Valley. This is a representative site for this subwatershed.

Pit River at Canby (PRCAN)

This site captures drainage from the Alturas and Canby drainage areas, as well as drainage from the North and South Fork of Pit River and Hot Springs Valley. Land uses are primarily pasture and grain and hay crops. The irrigated acreage is approximately 50,000 acres.

Placer-Nevada-South Sutter-North Sacramento Subwatershed

The Placer-Nevada-South Sutter-North Sacramento (PNSSNS) Subwatershed has applied for the *Reduced Monitoring/Management Practices Verification Option* under the current WDR.

Coon Creek at Brewer Road (CCBRW)

This site captures drainage from the Middle Coon Creek drainage areas as identified in the Placer-Northern Sacramento Drainage Prioritization Table in the Coalition's Watershed Evaluation Report (WER). This site is on Coon Creek about six miles northwest of the town of Lincoln and includes predominantly agricultural acreage. The drainage includes approximately 65,000 irrigated acres of rice, pasture, grains, and sudan grass, with a high percentage of rice acreage. Irrigated acres (excluding rice) is approximately 13,000. This is a representative site for this subwatershed.

Sacramento/Amador Subwatershed

Grand Island Drain near Leary Road (GIDLR)

Grand Island is located in the heart of the Sacramento Delta. Crops include alfalfa, corn, safflower, apples, pears, cherries, blueberries, asparagus, grapes, and pasture land. Water is pumped on to the island at several locations. The monitoring site is located just up-slough from a station that returns water to the Delta. Approximately 8,000 irrigated acres drains to the monitoring site. This is a representative site for this subwatershed.

Shasta/Tehama Subwatershed

Anderson Creek at Ash Creek Road (ACACR)

Anderson Creek was identified as the highest priority drainage in the Shasta county portion of the Shasta/Tehama subwatershed. This ranking was based on total irrigated acreage, crop types

by acreage, and amount and type of pesticide use. Anderson Creek originates about three miles west of the city of Anderson and then flows into the Sacramento River. Crops are predominantly pasture, followed by walnuts and alfalfa/hay and then smaller amounts of other field and orchard crops. Total irrigated land is 8,989 acres. This is a representative site for this subwatershed.

Solano Subwatershed

Ulatis Creek at Brown Road (UCBRD)

Ulatis Creek is a flood control project (FCP) that drains the majority of the central portion of Solano County. The Ulatis Creek FCP monitoring site is approximately 8.5 miles south of Dixon and 1.5 miles east of State Highway 113 on Brown Road. This site drains the Cache Slough area, as designated in the Yolo/Solano subwatershed map, and empties into Cache Slough. The major crops in this area include wheat, corn, pasture, tomatoes, alfalfa, Sudan grass, walnuts and almonds. This is a representative site for this subwatershed.

Z-Drain (ZDDIX)

The Z-Drain is a tributary draining into the Yolo Bypass south of Interstate 80. This site drains the SW Yolo Bypass drainage area. The major crops in this drainage include pasture, wheat, corn, tomatoes, and alfalfa. A secondary site (ZDDSS) is located immediately downstream of ZDDIX and is occasionally sampled for follow-up source evaluations.

Upper Feather River Watershed

Agriculture in this subwatershed is localized in mountain valleys that are suitable for grazing and growing alfalfa, hay, and grain crops. Monitoring in this subwatershed is therefore focused on characterizing drainage from three valleys with considerable agricultural acreage. Monitoring in this subwatershed was conducted in coordination with the Upper Feather River Watershed (UFRW) Group and the California's Surface Water Ambient Monitoring Program (SWAMP).

Middle Fork Feather River above Grizzly Creek (MFFRG)

The Middle Fork above Grizzly Creek is below the last irrigated site in the Sierra Valley subwatershed and has year-round flow in most years. This site replaced Middle Fork Feather River at County Rd A-23, which lacks year-round flows (often dry by mid-July) and has numerous non-agricultural uses, including recreation and filling water trucks. This is a representative site for this subwatershed.

Yolo Subwatershed

Willow Slough Bypass at Pole Line Road (WLSPL)

The Willow Slough Bypass is a large drainage including approximately 102,000 total acres. Irrigated acreage (excluding rice acreage) is approximately 66,000 acres. Predominant crops in the drainage are grain, pasture, corn, tomatoes, rice, almonds, and walnuts. This is a representative site for this subwatershed.

Sampling and Analytical Methods

The objective of data collection for this monitoring program is to produce data that represent, as closely as possible, *in situ* conditions of agricultural discharges and water bodies in the Central Valley. This objective will be achieved by using standard accepted methods to collect and analyze surface water and sediment samples. Assessing the monitoring program's ability to meet this objective will be accomplished by evaluating the resulting laboratory measurements in terms of detection limits, precision, accuracy, representativeness, comparability, and completeness, as described in the Coalition's QAPP (SVWQC 2010) and approved by the Water Board.

Surface water samples were collected for analysis of the constituents listed in **Table 2** as specified in the Coalition's Monitoring Plans. Surface water and sediment samples were collected for chemical analyses and toxicity testing. All samples were collected and analyzed using the methods specified in the QAPP; any deviations from these methods were explained.

SAMPLE COLLECTION METHODS

All samples were collected in a manner appropriate for the specific analytical methods used and to ensure that water column samples were representative of the flow in the channel cross-section. Water quality samples were collected using clean techniques that minimize sample contamination. Samples were cross-sectional composite samples or mid-stream, mid-depth grab samples, depending on sampling site and event characteristics. When grab sample collection methods were used, samples were taken at approximately mid-stream and mid-depth at the location of greatest flow (where feasible). Where appropriate, water samples were collected using a standard multi-vertical depth integrating method. Abbreviated sampling methods (i.e., weighted-bottle or dip sample) may be used for collecting representative water samples.

Sediment sampling was conducted at sampling sites on an approximately 50-meter reach of the waterbody near the water sampling location. If USGS methods were applicable, sediment sub-samples were collected from five to ten wadeable depositional zones. Depositional zones include areas on the inside bend of a stream or areas downstream from obstacles such as boulders, islands, sand bars, or simply shallow waters near the shore. In low-energy, low-gradient waterbodies, composite samples may be collected from the bottom of the channel using appropriate equipment, as specified in the Coalition's QAPP.

Details of the standard operating procedures (SOPs) for collection of surface water and sediment samples are provided in the Coalition's QAPP. The sites and number of samples for 2016 Coalition Monitoring are summarized in **Table 4**. The Coalition's monitoring strategy for 2016 was designed to characterize high priority drainages that are representative of a subwatershed's dominant agricultural crops and practices. This sampling approach was initially designed to comply with the requirements in *Order No. R5-2008-0005* and with the later adopted *ILRP MRP (Monitoring and Reporting Program Order No. R5-2009-0875)*; this approach was maintained for the current WDR and MRP (*Order No. R5-2014-0030*). The elements that are key to achieving the Coalition's goals and satisfying the intent of the requirements of the *R5-2014-0030* MRP are (1) the Coalition's prioritization process for selecting representative drainages and monitoring sites, and (2) identification of monitoring parameters and schedules appropriate for these representative drainages. This approach was detailed in the Coalition's 2009 Monitoring and Reporting Program Plan, as required by *Order No. R5-2008-0005*, and the monitoring plan is updated annually in August, as required by *Order No. R5-2014-0030*.

Table 4. 2016 Coalition Monitoring Year: Planned Samples, October 2015 – September 2016

SiteID	Water Column Sample Events	Sediment Sample Events	pH, conductivity, DO, temperature, flow	Turbidity, TSS, TOC	Pathogen Indicators: E. Coli	Nutrients: Ammonia	Nutrients: Nitrate+nitrite	Nutrients Group	Nutrients: Total P	arsenic (total)	boron (total)	copper (total and dissolved)	lead (total and dissolved)	Hardness	chlorpyrifos	diazinon	diuron	malathion	naled (dichlorvos)	Algae - Selenastrum	Fathead Minnow - Pimephales	Water Flea - Ceriodaphnia	Hyalella azteca	grain size in sediments	Pyrethroids, Chlorpyrifos, TOC in sediments	
ButteYubaSutter																										
SSKNK	4		4	4				4							2	2										
LHNCT	6		4		3							2			3	1										
PNCHY	6		6		4							3			4											
BTTSL	5		5																							
GILSL	6		3												3	3			4							
LSNKR	6	2	6		3										3	3	2					3	2	2	2	
ColusaGlenn																										
FRSHC	3		3		3																					
LRLNC	3																									
SCCMR	3																									
COLDR	6		5	4	3			4							4	2		3								
RARPP	3		3												4	2										
STYHY	4	2	4																			2	2	2	2	
WLKCH	4		4		3	3									4	4										
EIDorado																										
COONH																										
NRTCN																										
Lake																										
MGLSU	4		4						4																	
MDLCR	5		4		3				4									2								
Napa																										
PCULB	1	1																					1	1	1	
NECWA																										
FRRRB	4		4																							
PRCAN	4		4																							
PRPIT	6		4		4			4				4														

SiteID	Water Column Sample Events	Sediment Sample Events	pH, conductivity, DO, temperature, flow	Turbidity, TSS, TOC	Pathogen Indicators: E. Coli	Nutrients: Ammonia	Nutrients: Nitrate+nitrite	Nutrients Group	Nutrients: Total P	arsenic (total)	boron (total)	copper (total and dissolved)	lead (total and dissolved)	Hardness	chlorpyrifos	diazinon	diuron	malathion	naled (dichlorvos)	Algae - Selenastrum	Fathead Minnow - Pimephales	Water Flea - Ceriodaphnia	Hyalella azteca	grain size in sediments	Pyrethroids, Chlorpyrifos, TOC in sediments	
PNSSNS																										
CCBRW	4		4									2		2	4	4										
CCSTR	4																									
SacramentoAmador																										
CRTWN	4		4		4										4	4										
DCGLT	3																									
LAGAM	3																									
GIDLR	6	2	6		3		3			3					3	4							2	2	2	
ShastaTehama																										
ACACR	3		3		3																					
COYTR	3																									
Solano																										
UCBRD	6		6		3										4	4	2			2						
SSLIB	4	1	4	4	4			4							4	4				4	4	4	1	1	1	
ZDDIX	3	2	2																				2	2	2	
UFRW																										
MFFGR	4		4																							
Yolo																										
CCCPY	3		2																						2	
TCHWY	3		3								3															
WLSPL	8		8		3						3				5	2	3	2		3				5		
Totals	144	10	113	12	46	3	3	16	8	3	6	7	4	2	51	39	7	7	4	9	4	16	10	10	10	

ANALYTICAL METHODS

Water chemistry samples were analyzed for filtered and unfiltered fractions of the samples. Pesticide analyses were conducted only on unfiltered (whole) samples. Laboratories analyzing samples for this program have demonstrated the ability to meet the minimum performance requirements for each analytical method, including the ability to meet the project-specified quantitation limits (QL), the ability to generate acceptable precision and recoveries, and other analytical and quality control parameters documented in the Coalition's QAPP. Analytical methods used for chemical analyses follow accepted standard methods or approved modifications of these methods, and all procedures for analyses are documented in the QAPP or are available for review and approval at each laboratory.

Toxicity Testing and Toxicity Identification Evaluations

Water quality samples were analyzed for toxicity to *Ceriodaphnia dubia* and *Selenastrum capricornutum* for 2016 Monitoring. Sediment samples were analyzed for toxicity to *Hyaella azteca*. Toxicity tests were conducted using standard USEPA methods for these species.

- Determination of acute toxicity to *Ceriodaphnia* was performed as described in *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, Fifth Edition* (USEPA 2002a). Toxicity tests with *Ceriodaphnia* were conducted as 96-hour static renewal tests, with renewal 48 hours after test initiation.
- Determination of toxicity to *Selenastrum* was performed using the non-EDTA procedure described in *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, Fourth Edition* (USEPA 2002b). Toxicity tests with *Selenastrum* were conducted as a 96-hour static non-renewal test.

For all initial screening toxicity tests at each site, 100% ambient water and a control were used for the acute water column tests. If 100% mortality to a test species was observed any time after the initiation of the initial screening toxicity test, a multiple dilution test using a minimum of five sample dilutions was conducted with the initial water sample to estimate the magnitude of toxicity.

Procedures in the Coalition's QAPP state that if any measurement endpoint from any of the two aquatic toxicity tests exhibits a statistically significant reduction in survival (*Ceriodaphnia*) or cell density (*Selenastrum*) of greater than or equal to 50% compared to the control, Toxicity Identification Evaluation (TIE) procedures will be initiated using the most sensitive species to investigate the cause of toxicity. The 50% mortality threshold is consistent with the approach recommended in guidance published by USEPA for conducting TIEs (USEPA 1996b), which recommends a minimum threshold of 50% mortality because the probability of completing a successful TIE decreases rapidly for samples with less than this level of toxicity. For samples that met these trigger criteria, Phase 1 TIEs to determine the general class of constituent (e.g., metal, non-polar organics) causing toxicity or pesticide-focused TIEs were conducted. TIE methods generally adhere to the documented USEPA procedures referenced in the QAPP. TIE procedures were initiated as soon as possible after toxicity was observed to reduce the potential for loss of toxicity due to extended sample storage. Procedures for initiating and conducting TIEs are documented in the QAPP.

Detection and Quantitation Limits

The Method Detection Limit (MDL) is the minimum analyte concentration that can be measured and reported with a 99% confidence that the concentration is greater than zero. The Quantitation Limit (QL) represents the concentration of an analyte that can be routinely measured in the sampled matrix within stated limits and confidence in both identification and quantitation. For this program, QLs were established based on the verifiable levels and general measurement capabilities demonstrated by labs for each method. Note that samples required to be diluted for analysis (or corrected for percent moisture for sediment samples) may have sample-specific QLs that exceed the established QLs. This is unavoidable in some cases.

Project Quantitation Limits

Laboratories generally establish QLs that are reported with the analytical results—these may be called *reporting limits*, *detection limits*, *reporting detection limits*, or several other terms used by different laboratories. In most cases, these laboratory limits are less than or equal to the project QLs listed in **Table 5** and **Table 6**. Wherever possible, project QLs are lower than the proposed or existing relevant numeric water quality objectives or toxicity thresholds, as required by the *ILRP*.

All analytical results between the MDL and QL are reported as numerical values and qualified as estimates (Detected, Not Quantified (DNQ), or sometimes, “J-values”).

Table 5. Laboratory Method Detection Limit (MDL) and Quantitation Limit (QL) Data Quality Objectives for Analyses of Surface Water

Method	Analyte	Fraction	Units	MDL	QL	Note
<i>Physical and Conventional Parameters</i>						
EPA 130.2	Hardness, total as CaCO ₃	Unfiltered	mg/L	3	5	
EPA 180.1; SM2130B	Turbidity	Unfiltered	NTU	0.1	1.0	
SM20-2540 C	Total Dissolved Solids (TDS)	Particulate	mg/L	4	10	(a)
EPA 160.2; SM2540D	Total Suspended Solids (TSS)	Particulate	mg/L	2	3	
EPA 415.1; SM5310C	Organic Carbon, Total (TOC)	Unfiltered	mg/L	0.1	0.5	
<i>Pathogen Indicators</i>						
SM 9223	<i>E. Coli</i> bacteria	NA	MPN/100mL	2	2	
<i>Organophosphorus Pesticides</i>						
EPA 625(m)	Azinphos methyl	Unfiltered	µg/L	0.05	0.1	
EPA 625(m)	Chlorpyrifos	Unfiltered	µg/L	0.005	0.01	
EPA 625(m)	Demeton-S	Unfiltered	µg/L	0.005	0.01	
EPA 625(m)	Diazinon	Unfiltered	µg/L	0.005	0.01	
EPA 625(m)	Dichlorvos	Unfiltered	µg/L	0.005	0.01	
EPA 625(m)	Dimethoate	Unfiltered	µg/L	0.005	0.01	
EPA 625(m)	Disulfoton	Unfiltered	µg/L	0.01	0.02	
EPA 625(m)	Ethoprop	Unfiltered	µg/L	0.001	0.002	(a)
EPA 625(m)	Fenchlorphos	Unfiltered	µg/L	0.002	0.004	(a)
EPA 625(m)	Fensulfothion	Unfiltered	µg/L	0.001	0.002	(a)
EPA 625(m)	Fenthion	Unfiltered	µg/L	0.002	0.004	(a)
EPA 625(m)	Malathion	Unfiltered	µg/L	0.005	0.01	
EPA 625(m)	Methamidophos	Unfiltered	µg/L	0.05	0.01	
EPA 625(m)	Methidathion	Unfiltered	µg/L	0.01	0.02	
EPA 625(m)	Mevinphos	Unfiltered	µg/L	0.008	0.0016	(a)
EPA 625(m)	Naled	Unfiltered	µg/L	0.2	0.5	(a)
EPA 625(m)	Parathion, Methyl	Unfiltered	µg/L	0.01	0.02	
EPA 625(m)	Parathion, Ethyl	Unfiltered	µg/L	0.01	0.02	
EPA 625(m)	Phorate	Unfiltered	µg/L	0.01	0.02	
EPA 625(m)	Phosmet	Unfiltered	µg/L	0.05	0.1	
EPA 625(m)	Sulprofos	Unfiltered	µg/L	0.001	0.002	(a)
EPA 625(m)	Tetrachlorvinphos	Unfiltered	µg/L	0.002	0.004	(a)
EPA 625(m)	Tokuthion	Unfiltered	µg/L	0.003	0.006	(a)
EPA 625(m)	Trichloronate	Unfiltered	µg/L	0.001	0.002	(a)
<i>Organochlorine Pesticides</i>						
EPA 625(m)	4,4'-DDT (o,p' and p,p')	Unfiltered	µg/L	0.001	0.005	
EPA 625(m)	4,4'-DDE (o,p' and p,p')	Unfiltered	µg/L	0.001	0.005	
EPA 625(m)	4,4'-DDD (o,p' and p,p')	Unfiltered	µg/L	0.001	0.005	
EPA 625(m)	Aldrin	Unfiltered	µg/L	0.001	0.005	
EPA 625(m)	Chlordane	Unfiltered	µg/L	0.001	0.005	
EPA 8081A	Chlorothalonil	Unfiltered	µg/L	0.1	0.2	(a)
EPA 625(m)	Dacthal	Unfiltered	µg/L	0.008	0.05	

Method	Analyte	Fraction	Units	MDL	QL	Note
EPA 625(m)	Dicofol	Unfiltered	µg/L	0.05	0.1	
EPA 625(m)	Dieldrin	Unfiltered	µg/L	0.001	0.005	
EPA 625(m)	Endosulfan I	Unfiltered	µg/L	0.001	0.005	
EPA 625(m)	Endosulfan II	Unfiltered	µg/L	0.001	0.005	
EPA 625(m)	Endosulfan sulfate	Unfiltered	µg/L	0.001	0.005	
EPA 625(m)	Endrin	Unfiltered	µg/L	0.001	0.005	
EPA 625(m)	Endrin Aldehyde	Unfiltered	µg/L	0.001	0.005	
EPA 625(m)	Endrin Ketone	Unfiltered	µg/L	0.001	0.005	
EPA 625(m)	HCH	Unfiltered	µg/L	0.001	0.005	
EPA 625(m)	Heptachlor	Unfiltered	µg/L	0.001	0.005	
EPA 625(m)	Heptachlor epoxide	Unfiltered	µg/L	0.001	0.005	
EPA 625(m)	Hexachlorobenzene	Unfiltered	µg/L	0.001	0.005	
EPA 625(m)	Methoxychlor	Unfiltered	µg/L	0.001	0.005	
EPA 625(m)	Mirex	Unfiltered	µg/L	0.001	0.005	
EPA 625(m)	Nonachlor	Unfiltered	µg/L	0.001	0.005	
EPA 625(m)	Oxychlorthane	Unfiltered	µg/L	0.001	0.005	
EPA 625(m)	Perthane	Unfiltered	µg/L	0.001	0.005	
<i>Carbamate and Urea Pesticides</i>						
EPA 8321	Aldicarb	Unfiltered	µg/L	0.2	0.4	
EPA 8321	Aminocarb	Unfiltered	µg/L	0.2	0.4	
EPA 8321	Barban	Unfiltered	µg/L	1.75	3.5	
EPA 8321	Benomyl/Carbendazim	Unfiltered	µg/L	0.2	0.4	
EPA 8321	Carbaryl	Unfiltered	µg/L	0.05	0.07	
EPA 8321	Carbofuran	Unfiltered	µg/L	0.05	0.07	
EPA 8321	Chlorpropham	Unfiltered	µg/L	0.4	0.8	
EPA 8321	Methiocarb	Unfiltered	µg/L	0.2	0.4	
EPA 8321	Methomyl	Unfiltered	µg/L	0.05	0.07	
EPA 8321	Mexacarbate	Unfiltered	µg/L	0.4	0.8	
EPA 8321	Oxamyl	Unfiltered	µg/L	0.2	0.4	
EPA 8321	Propham	Unfiltered	µg/L	1.75	3.5	
EPA 8321	Propoxur	Unfiltered	µg/L	0.2	0.4	
<i>Pyrethroid Pesticides</i>						
GCMS-NCI	Allethrin	Unfiltered	µg/L	0.0001	0.0015	
GCMS-NCI	Bifenthrin	Unfiltered	µg/L	0.0001	0.0015	
GCMS-NCI	Cyfluthrin	Unfiltered	µg/L	0.0002	0.0015	
GCMS-NCI	Cypermethrin	Unfiltered	µg/L	0.0002	0.0015	
GCMS-NCI	Deltamethrin/Tralomethrin	Unfiltered	µg/L	0.0002	0.003	
GCMS-NCI	Esfenvalerate/Fenvalerate	Unfiltered	µg/L	0.0002	0.003	
GCMS-NCI	Fenpropathrin	Unfiltered	µg/L	0.0002	0.0015	
GCMS-NCI	Fluvalinate	Unfiltered	µg/L	0.0002	0.0015	
GCMS-NCI	Lambda-Cyhalothrin	Unfiltered	µg/L	0.0002	0.0015	
GCMS-NCI	Permethrin	Unfiltered	µg/L	0.002	0.015	
GCMS-NCI	Tetramethrin	Unfiltered	µg/L	0.0002	0.0015	

Method	Analyte	Fraction	Units	MDL	QL	Note
<i>Other Herbicides</i>						
EPA 8321	Bromacil	Unfiltered	µg/L	0.2	0.4	(a)
EPA 8321	Chloroxuron	Unfiltered	µg/L	0.2	0.4	
EPA 8081A	Dacthal	Unfiltered	µg/L	0.008	0.05	
EPA 8321	Diuron	Unfiltered	µg/L	0.2	0.4	
EPA 8321	Fenuron	Unfiltered	µg/L	0.2	0.4	
EPA 8321	Fluometuron	Unfiltered	µg/L	0.2	0.4	
EPA 8141A	Hexazinone	Unfiltered	µg/L	0.1	0.5	(a)
EPA 8321	Linuron	Unfiltered	µg/L	0.2	0.4	
EPA 625	Merphos	Unfiltered	µg/L	0.001	0.002	(a)
EPA 625	Metolachlor	Unfiltered	µg/L	0.26	0.5	(a)
EPA 8321	Monuron	Unfiltered	µg/L	0.2	0.4	
EPA 8321	Neburon	Unfiltered	µg/L	0.2	0.4	
EPA 8321	Oryzalin	Unfiltered	µg/L	0.2	0.4	
EPA 8081A	Oxyfluorfen	Unfiltered	µg/L	0.008	0.05	
EPA 8321	Propachlor	Unfiltered	µg/L	0.2	0.4	(a)
EPA 8321	Siduron	Unfiltered	µg/L	0.2	0.4	
EPA 625(m)	Simazine	Unfiltered	µg/L	0.005	0.01	
EPA 8321	Tebuthiuron	Unfiltered	µg/L	0.2	0.4	
<i>Benzophenyls</i>						
EPA 8321	Diflubenzuron	Unfiltered	µg/L	0.2	0.4	
<i>Trace Elements</i>						
EPA 200.8	Arsenic	Filtered, Unfiltered	µg/L	0.08	0.5	
EPA 2008	Cadmium	Filtered, Unfiltered	µg/L	0.04	0.1	
EPA 200.8	Boron	Filtered, Unfiltered	µg/L	0.04	0.1	
EPA 200.8	Copper	Filtered, Unfiltered	µg/L	0.2	0.5	
EPA 200.8	Lead	Filtered, Unfiltered	µg/L	0.02	0.25	
EPA 200.8	Selenium	Unfiltered	µg/L	0.5	1	
<i>Nutrients</i>						
EPA 350.1; 350.2	Ammonia, Total as N	Unfiltered	mg/L	0.02	0.1	
EPA 353.2	Nitrate + Nitrite as N	Unfiltered	mg/L	0.02	0.05	
EPA 365.2; SM4500-P E	Orthophosphate, as P	Unfiltered	mg/L	0.01	0.05	
EPA 365.2; SM4500-P E	Phosphorus, Total	Unfiltered	mg/L	0.02	0.05	
EPA 351.3; 351.2	Total Kjeldahl Nitrogen	Unfiltered	mg/L	0.07	0.1	

Note:

(a) No QL target has been established for this analyte.

Table 6. Laboratory Method Detection Limit (MDL) and Quantitation Limit (QL) Data Quality Objectives for Analyses of Sediments for the Coalition Monitoring and Reporting Program Plan

Method	Analyte	Fraction	Units	MDL	QL
<i>Physical and Conventional Parameters</i>					
SM 2560D	Grain Size Analysis	NA	% fraction	NA	1
EPA 160.3	Solids (TS)	Total	%	NA	0.1
EPA 9060	Organic Carbon, Total (TOC)	Total	mg/kg d.w.	50	200
<i>Pyrethroids</i>					
EPA 8270C(m)	Allethrin	Total	ng/g d.w.	0.1	1
EPA 8270C(m)	Bifenthrin	Total	ng/g d.w.	0.1	1
EPA 8270C(m)	Cyfluthrin	Total	ng/g d.w.	0.1	1
EPA 8270C(m)	Cypermethrin	Total	ng/g d.w.	0.1	1
EPA 8270C(m)	Deltamethrin/Tralomethrin	Total	ng/g d.w.	0.15	1
EPA 8270C(m)	Esfenvalerate/Fenvalerate	Total	ng/g d.w.	0.15	1
EPA 8270C(m)	Fenpropathrin	Total	ng/g d.w.	0.15	1
EPA 8270C(m)	Fluvalinate	Total	ng/g d.w.	0.1	1
EPA 8270C(m)	Lambda-Cyhalothrin	Total	ng/g d.w.	0.1	1
EPA 8270C(m)	Permethrin	Total	ng/g d.w.	0.1	1
EPA 8270C(m)	Tetramethrin	Total	ng/g d.w.	0.1	1
<i>Organochlorine Pesticides</i>					
EPA 8270C(m)	Chlorpyrifos	Total	ng/g d.w.	0.1	3
EPA 8270C(m)	Diazinon	Total	ng/g d.w.	5	40

Monitoring Results

The following sections summarize the monitoring conducted by the Coalition and its Subwatershed partners in 2016 (October 2015 through September 2016).

SUMMARY OF SAMPLE EVENTS CONDUCTED

This report presents monitoring results from ten Coalition sampling events (Events 118-127), as well as data for events conducted by coordinating Subwatershed monitoring programs and other agencies between October 2015 and September 2016. Samples collected for all of these events are listed in **Table 7**.

The Coalition collected samples between December 2015 and September 2016. Events were planned for October and November, but the Regional Board approved moving the sites and constituents for these two events to the December event so that they could be analyzed as a storm event.

The Delta Regional Monitoring Program (RMP) conducted sampling for the Coalition at UCBRD from October 2015 to September 2016. Results were validated and submitted to CEDEN by the RMP.

The Department of Water Resources conducted monitoring at FRRRB, PRPIT, PRCAN, and MFFGR in November of 2015 and February, May, and August of 2016.

The Coalition and Subwatershed monitoring events were conducted throughout the year. Analyses included water chemistry and toxicity, with pesticides monitored during months when higher use is typical. Sediment toxicity testing and/or chemistry analyses were also conducted by the Coalition at 23 sites as part of the assessment and source evaluation efforts for the Management Plan requirement for sediment toxicity. The sites and parameters for all events were monitored in accordance with the Coalition's current MRP and QAPP.

The field logs for all Coalition and Subwatershed samples collected for the October 2015 through September 2016 events, as well as associated site photographs, are provided in **Appendix A**.

Table 7. Sampling for the 2016 Coalition Monitoring Year

Subwatershed (Agency)	Site ID	Sample Count		116	117	118	119	120	121	122	123	124	125	126	127
		Planned	Collected	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Butte-Yuba-Sutter (SVWQC)	BTTSL	2	2	-	-	-	-	-	-	W	W	-	-	-	-
	GILSL	6	6	-	-	W	-	-	-	W	W	-	W	W	W
	LHNCT	5	5	-	-	-	-	-	-	W	W	-	W	W	W
	LSNKR	6	6	-	-	W	-	-	W	W	-	-	W	W	W
	PNCHY	6	6	-	-	-	-	-	-	W	W	W	W	W	W
	SSKNK	4	4	-	-	W	-	-	W,S	-	W	-	-	W	-
Colusa Glenn (SVWQC)	COLDR	5	5	-	-	W	-	-	W,S	-	W	-	-	W,S	W
	FRSHC	4	4	-	-	W	-	-	-	W	-	-	-	W	W
	STYHY	2	2	-	-	-	W	-	W	-	-	-	-	-	-
	WLKCH	4	2	-	-	-	-	-	W	-	-	-	W	D	D
El Dorado (SVWQC)	NRTCN	2	2	-	-	-	-	-	-	W,S	-	-	-	-	W,S
Lake (SVWQC)	MDLCR	5	5	-	-	W	-	W	-	-	W	-	-	W	W
	MGSLU	4	2	-	-	D	-	D	-	W	-	-	W	-	-
Napa (SVWQC)	PCULB	1	0	-	-	-	-	-	-	-	-	-	-	D	-
Pit River (NECWA)	FRRRB	4	4	-	DWR	-	-	DWR	-	-	DWR	-	-	DWR	-
	PRCAN	4	4	-	DWR	-	-	DWR	-	-	DWR	-	-	DWR	-
	PRPIT	6	6	-	DWR	-	-	DWR	-	-	DWR	W	W	DWR	-
PNSSNS	CCBRW	4	4	-	-	-	-	-	-	W	W	-	W	-	W
Sac/Amador (SVWQC)	GIDLR	4	4	-	-	W	-	-	-	W,S	-	W	-	-	W,S
Shasta/Tehama (SVWQC)	ACACR	3	3	-	-	-	-	-	W	-	W	-	W	-	-
Solano (SVWQC)	UCBRD	12	12	RMP	RMP	RMP	RMP	RMP	RMP	RMP	RMP	RMP	RMP	RMP	RMP
	ZDDIX	2	2	-	-	-	-	-	-	W,S	-	-	-	W,S	-
Yolo (SVWQC)	WLSPL	8	8	-	-	W	W	W	W	W	-	-	W	W	W
Upper Feather River (UFRW)	MFFGR	4	4	-	DWR	-	-	DWR	-	-	DWR	-	-	DWR	-
Totals		107	102												

Notes:

NECWA = Northeastern California Watershed Association
 PNSSNS = Placer-Nevada-South Sutter-North Sacramento
 SVWQC = Sacramento Valley Water Quality Coalition
 UFRW = Upper Feather River Watershed Group

W = Water sample collected
 S = Sediment sample collected
 D = Site was dry; no samples collected.
 “-“ = no samples planned

DWR = Monitoring Completed by the Department of Water Resources
 RMP = Monitoring completed by the Delta Regional Monitoring Program

SAMPLE CUSTODY

All samples that were collected for the Coalition monitoring effort met the requirements for sample custody. Sample custody must be traceable from the time of sample collection until results are reported. A sample is considered under custody if:

- it is in actual possession;
- it is in view after in physical possession; and
- it is placed in a secure area (i.e., accessible by or under the scrutiny of authorized personnel only after in possession).

The chain-of-custody forms (COCs) for all samples collected by Coalition contractors for the monitoring events conducted from October 2015 through September 2016 are included with the related lab reports and are provided in **Appendix B**. All COCs for *ILRP* monitoring conducted by Coalition partners during this same period are also provided in **Appendix B** with their associated lab reports. Field and laboratory documentation for samples collected by DWR and RMP are maintained by each entity and not included in **Appendix B**.

QUALITY ASSURANCE RESULTS

The Data Quality Objectives (DQOs) used to evaluate the results of the Coalition monitoring effort are detailed in the Coalition's QAPP. These DQOs are the detailed quality control specifications for precision, accuracy, representativeness, comparability, and completeness. These DQOs are used as comparison criteria during data quality review to determine if the minimum requirements have been met, and the data may be used as planned.⁴

Results of Field and Laboratory QA/QC Analyses

Quality Assurance/Quality Control (QA/QC) data are summarized in **Table 8** through **Table 16** and discussed below. All program QA/QC results are included with the lab reports in **Appendix B** of this document, and any qualifications of the data are presented with the tabulated monitoring data. All program monitoring results discussed are tabulated in **Appendix C**.

Contamination Assessments

Absence of sample contamination from sampling and analytical procedures was assessed by analysis of field blank and method blank samples, respectively.

Field Blanks

Field Blanks were collected and analyzed for all analyses (**Table 8**). The data quality objective for field blanks is no detectable concentrations of the analyte of interest above the QL. With the exceptions discussed below, analytes of interest were generally not detected in field blanks:

⁴ During the 2016 Monitoring year, the data qualification process was modified to accommodate the California Environmental Data Exchange Network (CEDEN) submittal requirements for the *ILRP* data. The discussion of quality assurance results presented herein reflects those changes and may not be directly comparable with those in past AMRs.

- Total organic carbon was detected above the QL in one field blank analysis. One environmental result was affected.
- Total lead was detected above the QL in one field blank analysis. One environmental result was affected.

Method Blanks

Method Blanks were analyzed for all parameters (**Table 9**). The data quality objective for method blanks is no detectable concentration of the analyte of interest above the QL. All method blanks met the project criteria and no environmental results needed qualification based on these QA/QC samples.

Accuracy Assessments

Analytical accuracy was assessed based on compliance with analytical hold times, achievement of target analytical reporting limits, and analysis of laboratory control spikes, surrogate spikes, and matrix spike samples.

Hold Times

Results were evaluated for compliance with required preparation and analytical hold times. With the exceptions discussed below, analyses met the target DQOs:

- 6 of 89 *E. coli* results were analyzed slightly outside of their 24-hour hold times. This was considered unlikely to affect the outcome of assessment of exceedances.

Method Detection Limits and Quantitation Limits

Target Method Detection Limits (MDL) and Quantitation Limits (QL) were assessed for all parameters. With the exceptions discussed below, analyses met the target DQOs:

- 5 of 6 boron results had MDLs and QLs greater than the project DQO due to dilutions required to analyze the samples. Assessment of exceedances was not affected.
- 1 of 9 total Nitrate+Nitrite as N results had MDLs and QLs greater than the project DQO due to dilutions required to analyze the samples. Assessment of exceedances was not affected.
- 3 of 14 oryzalin results had QLs greater than the project DQO due to dilutions required to analyze the samples. Assessment of exceedances was not affected.
- 8 of 9 turbidity results had MDLs greater than the project DQO due to dilutions required to analyze the samples. Assessment of exceedances was not affected.

Laboratory Control Spikes

Laboratory Control Spike (LCS) recoveries were analyzed for TSS, TOC, hardness, turbidity, trace metals, nutrients, and pesticides (**Table 10**). The DQO for an LCS is 80-120% recovery of the analyte of interest for most analytes. The DQOs for LCS recoveries of pesticides vary by analyte and surrogate and are based on the standard deviation of actual recoveries for the method. In accordance with CEDEN data reporting protocols, the data were not specifically qualified as being high- or low-biased, but these terms are used below for the

purpose of discussion. With the exceptions discussed below, all LCS analyses met their specific DQO:

- The result of one LCS recovery analysis associated with carbamate pesticides, benzophenyls, and other herbicides was outside the acceptable recovery DQO and was qualified as high-biased. The low-biased recovery did not result in a qualification of an environmental result.
- The results of three LCS recovery analyses for organophosphate pesticides were outside the acceptable recovery DQO. Two recoveries were high-biased, and one recovery was low-biased. Two environmental results were affected as high-biased.

Surrogate Spike Recoveries

Surrogate recoveries were analyzed for pesticide analyses (**Table 11**). The DQOs for surrogate recoveries of pesticides vary by surrogate and are based on the standard deviation of actual recoveries for the method. In accordance with CEDEN data reporting protocols, the data were not specifically qualified as being high- or low-biased, but these terms are used below for the purpose of discussion. With the exceptions discussed below, all surrogate spike analyses met their specific DQO:

- The results of two surrogate recovery analyses for pesticides by EPA Method 625 were outside the acceptable recovery DQO, and both were considered low-biased. Four different surrogates were included with EPA Method 625 analyses. No samples had more than two of the surrogates exceed the recovery objectives, and results for the target pesticides in environmental samples were not significantly affected.
- The result of one surrogate recovery analysis for pesticides by EPA Method 8141A was outside the acceptable recovery DQO and was considered to be high-biased. Two different surrogates were included with EPA Method 8141A analyses. Results for the target pesticides in environmental samples were not significantly affected.

Matrix Spikes

Matrix Spikes and Matrix Spike Duplicates were analyzed for trace metals, nutrients, TOC and pesticides (**Table 12**). The data quality objective for matrix spikes is 80-120% recovery for most analytes of interest. The data quality objective for matrix spike recoveries of pesticides varies for each analyte or surrogate and is based on the standard deviation of actual recoveries for the method. The data were not specifically qualified as being high- or low-biased, but these terms are used below for the purpose of discussion. With the exceptions discussed below, all matrix spike analyses met their specific DQOs:

- Matrix Spike recoveries for five organophosphate pesticide analyses were outside the DQO. Four were considered to be high-biased, and one was low-biased. One environmental result was affected. Assessment of exceedances was not affected.

Precision

Sampling and analytical precision was assessed by analysis of duplicate field samples and duplicate analysis of environmental samples, laboratory control spikes, and matrix spike samples.

Field Duplicates

Field Duplicate samples were collected and analyzed for all parameters (**Table 13**). The data quality objective for a field duplicate analysis is a Relative Percent Difference (RPD) not exceeding 25% or a difference between the environmental sample and the field duplicate that is less than the QL. With the exceptions discussed below, all field duplicates met this DQO:

- Field duplicate RPD results exceeded the DQO for one total ammonia as N analysis. One environmental result was affected. Assessment of exceedances was not affected.
- Field duplicate RPD results exceeded the DQO for one nitrate+nitrite as N analysis. One environmental result was affected. Assessment of exceedances was not affected.
- Field duplicate RPD results exceeded the DQO for two total suspended solids analyses. Two environmental results were affected. Assessment of exceedances was not affected.
- Field duplicate RPD results exceeded the DQO for two turbidity tests. Two environmental results were affected. Assessment of exceedances was not affected.

Laboratory Duplicates

Laboratory Duplicates were analyzed for pesticides (**Table 14**). The data quality objective for laboratory duplicates is a Relative Percent difference (RPD) not exceeding 25%. With the exceptions discussed below, all laboratory duplicates met this DQO:

- Laboratory duplicate RPD results exceeded the DQO for one organophosphate pesticide analysis. One environmental result was affected. Assessment of exceedances was not affected.

Laboratory Control Spike Duplicates

Laboratory Control Spike and Laboratory Control Spike Duplicate Recoveries and their associated Relative Percent Differences (RPDs) were analyzed for nutrients and pesticides (**Table 15**). The data quality objective for LCS duplicates is a RPD not exceeding 25%. All results met this data quality objective.

Matrix Spike Duplicates

Matrix Spike and Matrix Spike Duplicate Recoveries and their associated Relative Percent Differences (RPDs) were analyzed for trace metals, nutrients, TOC and pesticides (**Table 16**). The data quality objective for matrix spike duplicates is an RPD not exceeding 25%. With the exceptions discussed below, all matrix spike duplicate analyses met this DQO:

- RPDs calculated for matrix spike duplicate results exceeded the DQO for one result associated with carbamate pesticides, benzophenyls, and other herbicides. One environmental result was affected on this basis, but was below detection. Assessment of exceedances was not affected.

Summary of Precision and Accuracy

Based on the QA/QC data for the 2016 Coalition Monitoring discussed above, the precision and accuracy of the vast majority of monitoring results met the DQOs adopted for the monitoring

program, and there were no systematic sampling or analytical problems. These data are adequate for the purposes of the Coalition's monitoring program.

Of the 13 total qualified environmental data points, eight results were associated with elevated variability in lab or field replicate analyses, three results were associated with *high-biased* or *low-biased* recoveries outside of DQOs, and two results were potentially affected by contamination. None of the data potentially affected by contamination exceeded a water quality standard.

All QC sample types had success rates in excess of 95%. Of the 1,074 environmental analytical results generated from October 2015 through September 2016, 1,061 results required no qualification, resulting in 99% of analytical results having no restrictions on their use.

Completeness

The objectives for completeness are intended to apply to the monitoring program as a whole. As summarized in **Table 7**, 102 of the 107 initial water column and toxicity sample events planned by the Coalition and coordinating programs were conducted, for an overall sample event success rate of approximately 95%. Planned sample collection at three locations did not occur because the monitoring sites were dry or inaccessible. Planned sampling that was not completed successfully is summarized below:

- Samples for two events planned for McGaugh Slough (MGSLU) were not collected because the sampling site was dry.
- Samples for one event planned for Pope Creek (PCULB) were not collected because the sampling site was dry.
- Samples for two events planned for Walker Creek (WLKCH) were not collected because the sampling site was dry.

Sample containers are occasionally lost or broken in transit due to shipping and handling factors beyond the Coalition's control. Broken containers are relevant to program completeness if the incident prevents the Coalition from completing the required sample analyses or if they are analyzed and may potentially affect analytical quality. In general, broken bottles do not impact completeness of analyses. In most cases, sufficient remaining sample volume is available to complete the planned environmental and quality assurance analyses. If program completeness was affected, the issue of broken bottles is discussed in the AMR. The protocol that is followed if a broken bottle is reported is to contact the sampling crew and let them know of the issue so that they may review their packing and shipping procedures. Any known shipping and handling deficiencies are also noted. If samples lost or broken in shipping affect overall completeness for specific analyses at a specific location and the analyses are relevant to synoptically collected toxicity samples, additional sample volume is preferentially aliquoted from the sample collected for toxicity. If additional sample volume from another appropriately collected and preserved sample container is not available, the analyses are rescheduled for future events to ensure program completeness objectives are met. Sample containers that were received broken are summarized below:

- Sample shipments for 2016 monitoring were all received with no broken or damaged bottles.

In addition, sample containers occasionally arrive at the analytical laboratory at a temperature that is above the recommended maximum for Coalition samples. This may occur when samples do not have sufficient time to cool down to the target temperature or when extended shipping times and higher external temperatures cause sample temperatures to increase above 6°C. This has proven to be a challenge for toxicity samples because the sample volumes are large (1 gallon containers), require additional shipping protection (bubble wrap), and take longer to cool, particularly when ambient water temperatures exceed 25°C. However, because toxicity tests are typically conducted at ~20°C over four days, sample temperatures slightly elevated above 6°C on receipt are not expected to have a significant impact on the toxicity test results. However, all samples received above recommended temperatures are qualified as required (*BY; Sample received at improper temperature*). In each case, the sampling crews are notified, and the conditions and shipping procedures are reviewed to attempt to determine the cause of the elevated temperatures.

Sample shipments for 2016 monitoring were all received at temperatures below 6°C.

All samples collected were analyzed, for an analytical success rate of 100%.

As summarized in **Table 7**, all nine sediment samples planned by the Coalition were collected, for an overall sediment sample event success rate of 100%. In addition, all analyses planned for these sediment samples were completed, for an analytical success rate of 100%.

Table 8. Summary of Field Blank Quality Control Sample Evaluations for 2016 Coalition Monitoring

Method	Analyte	DQO	Number of Analyses	Number Passing	% Success
EPA 350.1 / SM20-4500-NH3 C	Ammonia, Total as N	< PQL	3	3	100%
EPA 8321A / 8081A	Carbamate Pesticides, Benzophenyls, and other Herbicides	< PQL	128	128	100%
SM20-9223	E. coli	< PQL	9	9	100%
SM20-2340C	Hardness as CaCO3	< PQL	4	4	100%
EPA 353.2	Nitrate+Nitrite, as N	< PQL	3	3	100%
EPA 625 / 8081A	Organochlorine Pesticides	< PQL	26	26	100%
EPA 625 / GCMS-NCI-SIM	Organophosphate Pesticides	< PQL	62	62	100%
EPA 365.2 / SM4500-P E	Orthophosphate, as P	< PQL	8	8	100%
SM20-4500-P E	Phosphorus as P, Total	< PQL	5	5	100%
SM20-5310 B / SM5310C	Total Organic Carbon	< PQL	5	4	80%
SM20-2540D	Total Suspended Solids	< PQL	4	4	100%
EPA 200.8	Trace Metals	< PQL	13	12	92%
EPA 180.1 / SM 2130B	Turbidity	< PQL	4	4	100%
Totals			274	272	99.3%

Table 9. Summary of Method Blank Results for 2016 Coalition Monitoring

Method	Analyte	DQO	Number of Analyses	Number Passing	% Success
EPA 350.1 / SM20-4500-NH3 C	Ammonia, Total as N	<QL	6	6	100%
EPA 625 / 8081A / 9141A / 8321A	Carbamate Pesticides, Benzophenyls, and other Herbicides	<QL	160	160	100%
SM20-9223	E. coli	<QL	17	17	100%
SM20-2340C	Hardness as CaCO3	<QL	8	8	100%
EPA 353.2	Nitrate+Nitrite, as N	<QL	4	4	100%
EPA 625 / 8081A	Organochlorine Pesticides	<QL	26	26	100%
EPA 625 / 8141A	Organophosphate Pesticides	<QL	74	74	100%
EPA 365.2 / SM4500-P E	Orthophosphate, as P	<QL	4	4	100%
SM20-4500-P E	Phosphorus as P, Total	<QL	7	7	100%
SM20-5310 B / SM5310C	Total Organic Carbon	<QL	5	5	100%
SM20-2540D	Total Suspended Solids	<QL	6	6	100%
EPA 200.8	Trace Metals	<QL	24	24	100%
EPA 180.1 / SM 2130B	Turbidity	<QL	5	5	100%
Totals			346	346	100%

Table 10. Summary of Lab Control Spike Results for 2016 Coalition Monitoring

Method	Analyte	DQO	Number of Analyses	Number Passing	% Success
EPA 350.1 / SM20-4500-NH3 C	Ammonia, Total as N	90 - 110%	6	6	100%
EPA 625 / 8081A / 9141A / 8321A	Carbamate Pesticides, Benzophenyls, and other Herbicides	[1]	160	159	99%
SM20-2340C	Hardness as CaCO3	80 - 120%	8	8	100%
EPA 353.2	Nitrate+Nitrite, as N	90 - 110%	4	4	100%
EPA 625 / 8081A	Organochlorine Pesticides	[1]	26	26	100%
EPA 625 / 8141A	Organophosphate Pesticides	[1]	74	71	96%
EPA 365.2 / SM4500-P E	Orthophosphate, as P	90 - 110%	4	4	100%
SM20-4500-P E	Phosphorus as P, Total	90 - 110%	7	7	100%
SM20-5310 B/ SM5310C	Total Organic Carbon	80 - 120%	5	5	100%
SM20-2540D	Total Suspended Solids	80 - 120%	6	6	100%
EPA 200.8	Trace Metals	85 - 115%	24	24	100%
EPA 180.1 / SM 2130B	Turbidity	90 - 110%	5	5	100%
Totals			329	324	98.8%

1. Data Quality Objectives for pesticide LCS recoveries vary by parameter and are based on 3x the standard deviation of the lab's actual recoveries for each parameter.

Table 11. Summary of Surrogate Recovery Results for 2016 Coalition Monitoring

Method	Analytes	DQO	Number of Analyses	Number Passing	% Success
EPA 625	Organophosphorus,	[1]	40	38	95%
EPA 8081	Organochlorine, Carbamate,	[1]	64	64	100%
EPA 8141A	Benzophenyls and other	[1]	136	135	99%
EPA 8321	Pesticides	[1]	35	35	100%
Totals			275	272	98.9%

1. Data Quality Objectives for pesticide surrogate recoveries vary by parameter and are based on 3x the standard deviation of the lab's actual recoveries for each parameter.

Table 12. Summary of Matrix Spike Recovery Results for 2016 Coalition Monitoring

Method	Analyte	DQO	Number of Analyses	Number Passing	% Success
EPA 625 / 8081A / 9141A / 8321A	Carbamate Pesticides, Benzophenyls, and other Herbicides	[1]	128	128	100%
SM20-2340C	Hardness as CaCO3	80 - 120%	2	2	100%
EPA 353.2	Nitrate+Nitrite, as N	90 - 110%	1	1	100%
EPA 625 / 8081A	Organochlorine Pesticides	[1]	26	26	100%
EPA 625 / 8141A	Organophosphate Pesticides	[1]	62	57	92%
SM20-5310 B/ SM5310C	Total Organic Carbon	80 - 120%	1	1	100%
EPA 200.8	Trace Metals	85 - 115%	13	13	100%
Totals			233	228	97.8%

1. Data Quality Objectives for pesticide matrix spike recoveries vary by parameter and are based on 3x the standard deviation of the lab's actual recoveries for each parameter.

Table 13. Summary of Field Duplicate Quality Control Sample Results for 2016 Coalition Monitoring

Method	Analyte	DQO	Number of Pairs Analyzed	Number Passing	% Success
EPA 350.1 / SM20-4500-NH3 C	Ammonia, Total as N	RPD ≤25%	3	2	66%
EPA 625 / 8081A / 9141A / 8321A	Carbamate Pesticides, Benzophenyls, and other Herbicides	RPD ≤25%	128	128	100%
SM20-9223	E. coli	RPD ≤25%	9	9	100%
SM20-2340C	Hardness as CaCO3	RPD ≤25%	3	3	100%
EPA 353.2	Nitrate+Nitrite, as N	RPD ≤25%	3	2	66%
EPA 625 / 8081A	Organochlorine Pesticides	RPD ≤25%	26	26	100%
EPA 625 / 8141A	Organophosphate Pesticides	RPD ≤25%	62	62	100%
EPA 365.2 / SM4500-P E	Orthophosphate, as P	RPD ≤25%	4	4	100%
SM20-4500-P E	Phosphorus as P, Total	RPD ≤25%	4	4	100%
SM20-5310 B/ SM5310C	Total Organic Carbon	RPD ≤25%	4	4	100%
SM20-5310 B/ SM5310C	Toxicity	RPD ≤25%	18	18	100%
SM20-2540D	Total Suspended Solids	RPD ≤25%	4	2	50%
EPA 200.8	Trace Metals	RPD ≤25%	13	13	100%
EPA 180.1 / SM 2130B	Turbidity	RPD ≤25%	4	2	50%
Totals			285	279	97.9%

Table 14. Summary of Lab Duplicate Results for 2016 Coalition Monitoring

Method	Analyte	DQO	Number of Pairs Analyzed	Number Passing	% Success
EPA 625 / 8141A	Organophosphate Pesticides	RPD \leq 25%	20	19	95%
Totals			20	19	95%

Table 15. Summary of Lab Control Spike Duplicate Precision Results for 2016 Coalition Monitoring

Method	Analyte	DQO	Number of Pairs Analyzed	Number Passing	% Success
EPA 350.1 / SM20-4500-NH3 C	Ammonia, Total as N	RPD $<$ 25%	3	3	100%
EPA 625 / 8141A	Organophosphate Pesticides	RPD $<$ 25%	20	20	100%
SM20-5310 B/ SM5310C	Total Organic Carbon	RPD $<$ 25%	1	1	100%
Totals			24	24	100%

Table 16. Summary of Matrix Spike Duplicate Precision Results for 2016 Coalition Monitoring

Method	Analyte	DQO	Number of Pairs Analyzed	Number Passing	% Success
EPA 625 / 8081A / 9141A / 8321A	Carbamate Pesticides, Benzophenyls, and other Herbicides	RPD \leq 25%	128	127	99%
SM20-2340C	Hardness as CaCO3	RPD \leq 25%	2	2	100%
EPA 353.2	Nitrate+Nitrite, as N	RPD \leq 25%	1	1	100%
EPA 625 / 8081A	Organochlorine Pesticides	RPD \leq 25%	26	26	100%
EPA 625 / 8141A	Organophosphate Pesticides	RPD \leq 25%	62	62	100%
SM20-5310 B/ SM5310C	Total Organic Carbon	RPD \leq 25%	1	1	100%
EPA 200.8	Trace Metals	RPD \leq 25%	13	13	100%
Totals			233	232	99.6%

TABULATED RESULTS OF LABORATORY ANALYSES

Copies of final laboratory reports and all reported QA/QC data for Coalition monitoring results are provided in **Appendix B**. The tabulated results for all validated and Quality Assurance-evaluated (QA) data are provided in **Appendix C**. These data were previously submitted as part of the quarterly data submittals. Monitoring results collected and verified by DWR and the RMP are also included in **Appendix C**.

Data Interpretation

SUMMARY OF SAMPLING CONDITIONS

Samples were collected throughout the year for the Coalition (see **Table 2**, Sampling for the 2016 Coalition Monitoring Year). The October 1, 2015, through September 30, 2016, monitoring year was characterized by above-average precipitation during the months of January, March, and April, and below-average precipitation during all other months.⁵ The water year was classified as “Below Normal” for the Sacramento Valley by the California Department of Water Resources, with an estimated 98% of average total runoff (based on 1966-2015 mean).^{6,7} The mean temperature was warmer than the historical average (1949-2005), with an increase of 2.2 degrees Fahrenheit (°F). At the end of the 2016 water year, statewide precipitation was 110% of average and reservoir storage was 80% of average.⁸

The two sample collection periods include the monitoring period from October 2015 to March 2016 and the Coalition Irrigation Season from April 2016 through September 2016. The Coalition Storm Season monitoring period had above-average precipitation in January and March with below-average amounts in the remaining months. The Coalition Irrigation Season had above-average precipitation in April and below-average in all other months.

Regional precipitation patterns for October 2015 through September 2016 are illustrated in **Figure 2-a** through **Figure 2-f**. In previous annual monitoring reports, the Placerville precipitation gauge had been used to characterize precipitation in the Sierra Foothills. Due to multi-month data gaps that made the measurements unusable for this station, the Sly Park station is used as a replacement, as shown in **Figure 2-d**.

Beginning in October 2015, the 2016 water year was characterized by average weather after an extended period of drought. Compared to previous water years, more frequent precipitation events of varying sizes occurred throughout the year from October to June, resulting in relatively high flows (**Figure 3-a** through **Figure 3-f**). Water samples were collected during high- and low-flow hydrologic conditions.

Based on climate data available from the Sacramento Executive Airport weather station, there was less than average rainfall during the April – September 2016 irrigation season (**Table 17**). No precipitation (or only trace amounts) occurred from June through August. Aside from a wet January and March, precipitation was below normal from October through March. The maximum temperature exceeded 90° on 8 days in May, 18 days in June, 19 days in July, 17 days in August, and 14 days in September.

⁵ Climate data (general trends) for the Sacramento-Delta region available at: http://www.wrcc.dri.edu/monitor/cal-mon/frames_version.html

⁶ <http://cdec.water.ca.gov/cgi-progs/iodir/WSIHIST> and <http://cdec.water.ca.gov/cgi-progs/previous/WSI>

⁷ Sacramento River Region unimpaired runoff, for water year 2016, was about 17.4 million acre-feet (MAF), approximately 98% of average. During water year 2015, the observed Sacramento River Region unimpaired runoff was about 9.3 MAF, or 51% of average.

⁸ http://www.water.ca.gov/floodmgmt/hafoo/hb/csm/docs/Monthly_Weather_Summary_092016.pdf

Table 17. Summary of Climate Data⁹ at Sacramento Executive Airport, October 2015 – September 2016

Month	Departure from Normal Mean Temperature	Days with Maximum Temperature $\geq 90^{\circ}\text{F}$	Precipitation Total (Inches)	Departure from Normal Precipitation
October 2015	6.0	7	0.12	-0.83
November 2015	-2.1	0	1.57	-0.51
December 2015	0.5	0	1.75	-1.50
January 2016	4.0	0	5.44	1.80
February 2016	3.9	0	0.82	-2.65
March 2016	2.4	0	5.07	2.32
April 2016	4.3	0	1.03	-0.12
May 2016	2.7	8	0.39	-0.29
June 2016	2.8	18	Trace	-0.21
July 2016	0.6	19	0.00	0.00
August 2016	-0.6	17	0.00	-0.05
September 2016	0.0	14	Trace	-0.29

⁹ Preliminary monthly climate data (temperature and precipitation) for Sacramento Executive Airport weather station available at: <http://www.weather.gov/climate/index.php?wfo=sto>

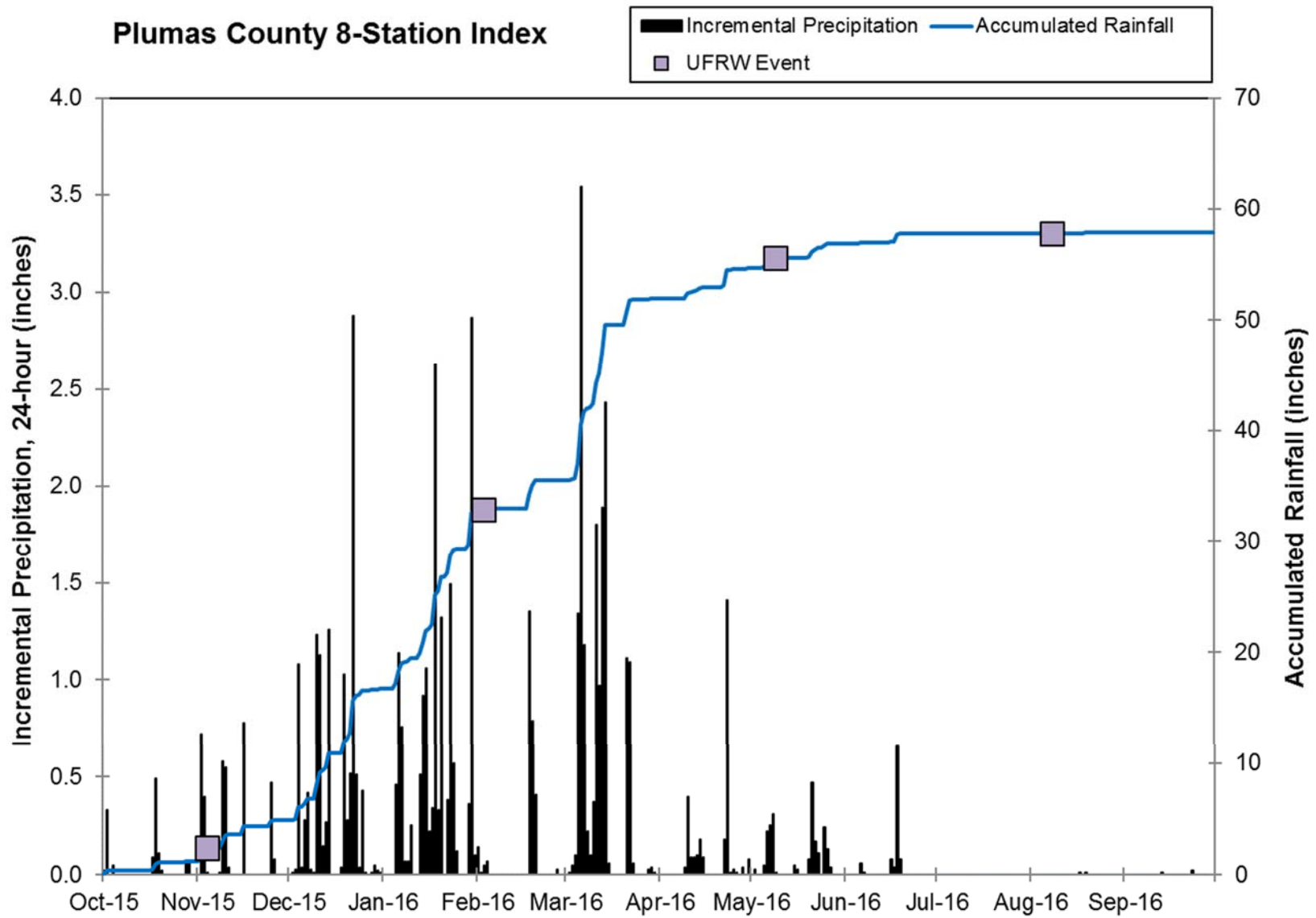


Figure 2-a. Precipitation during 2016 Coalition Monitoring: Plumas County

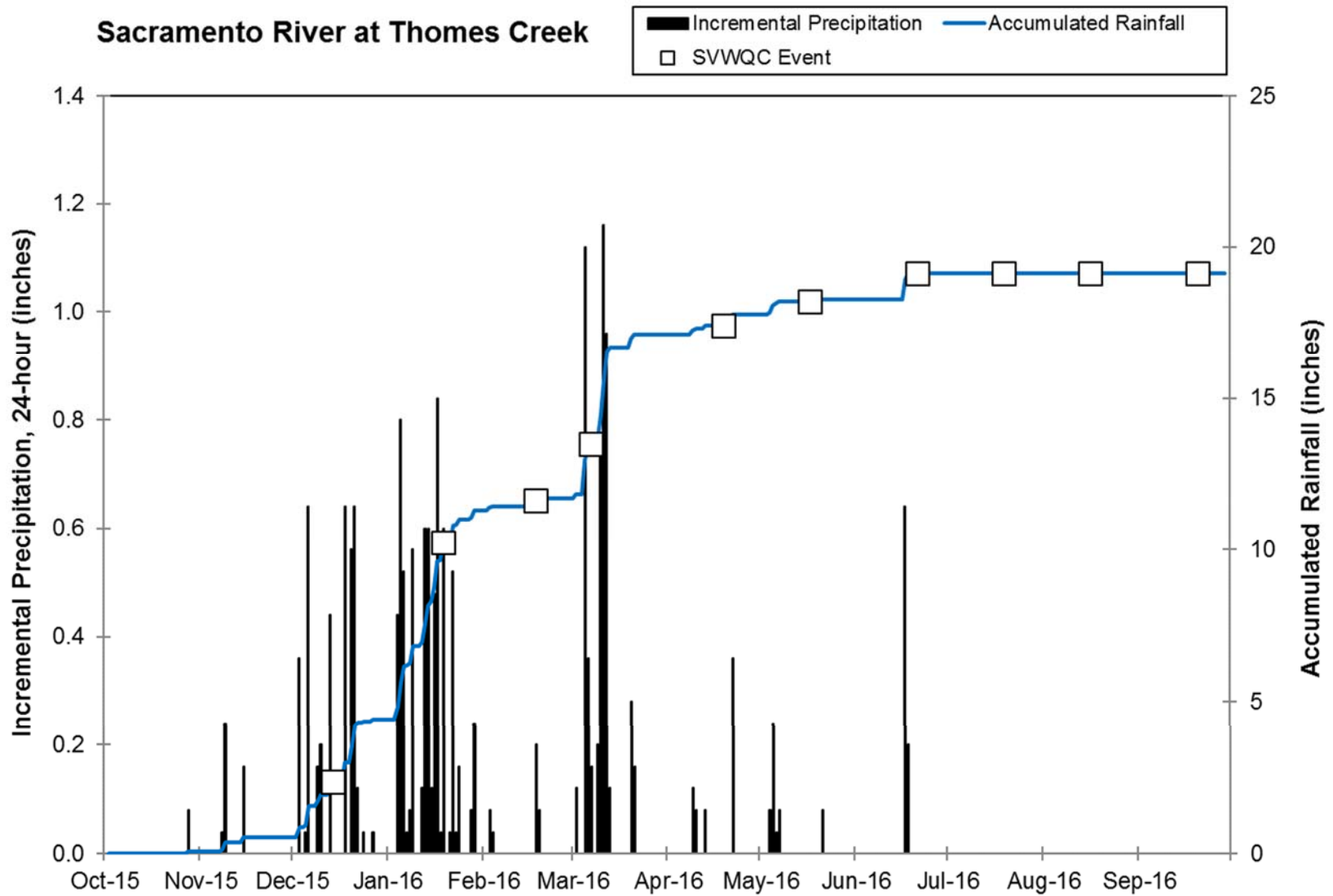


Figure 2-b. Precipitation during 2016 Coalition Monitoring: Upper Sacramento Valley

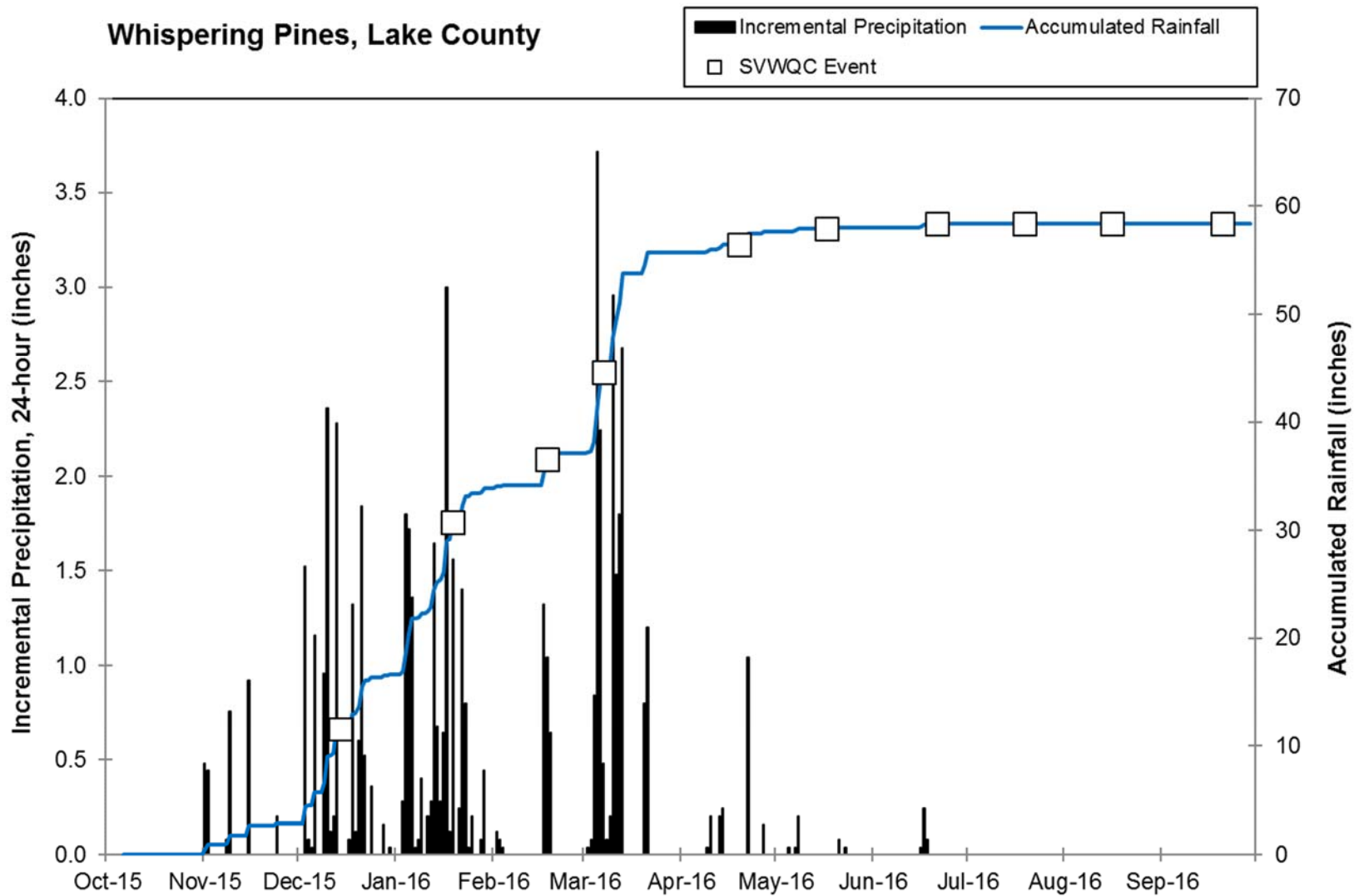


Figure 2-c. Precipitation during 2016 Coalition Monitoring: Lake County

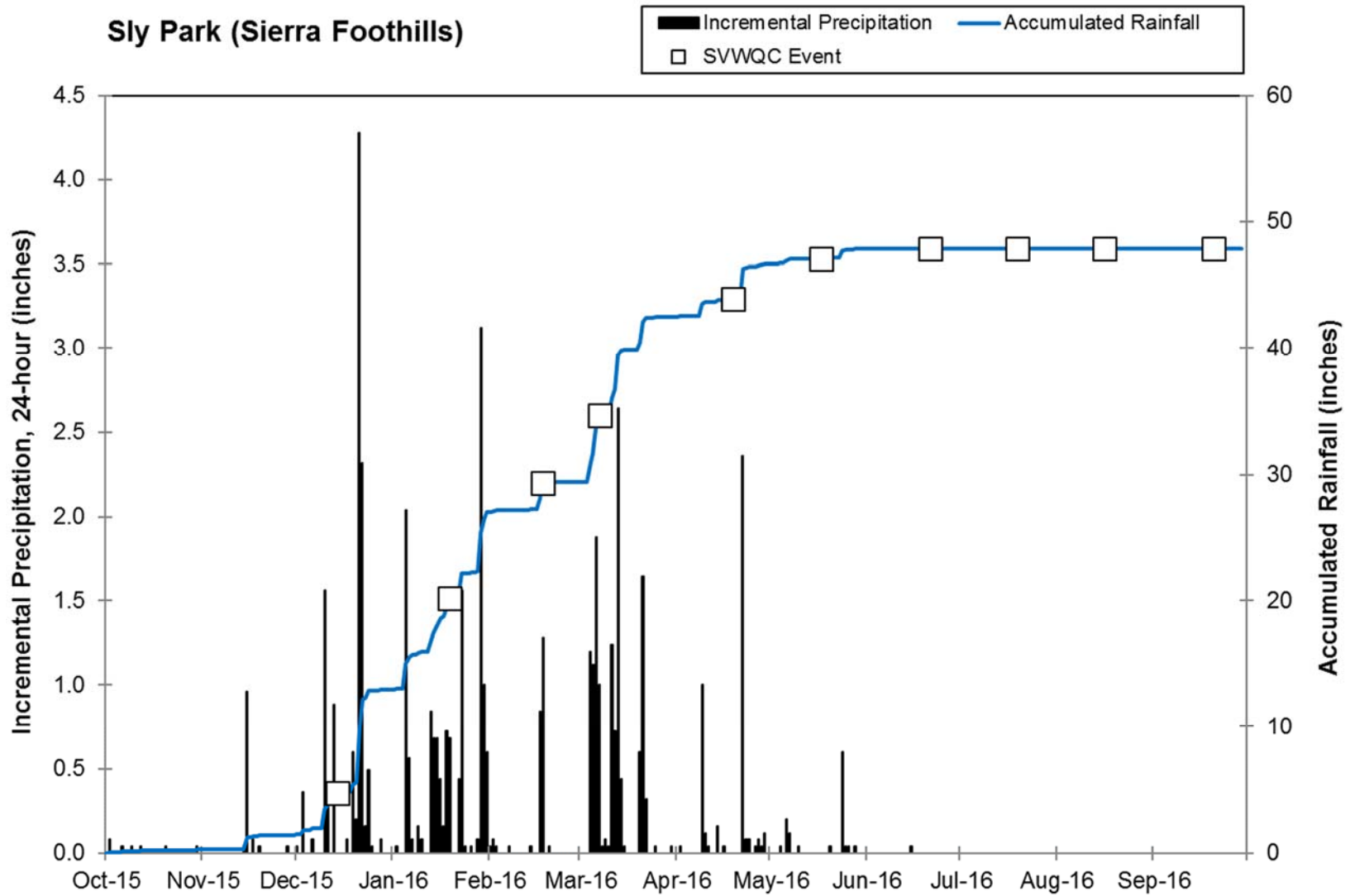


Figure 2-d. Precipitation during 2016 Coalition Monitoring: Sierra Foothills

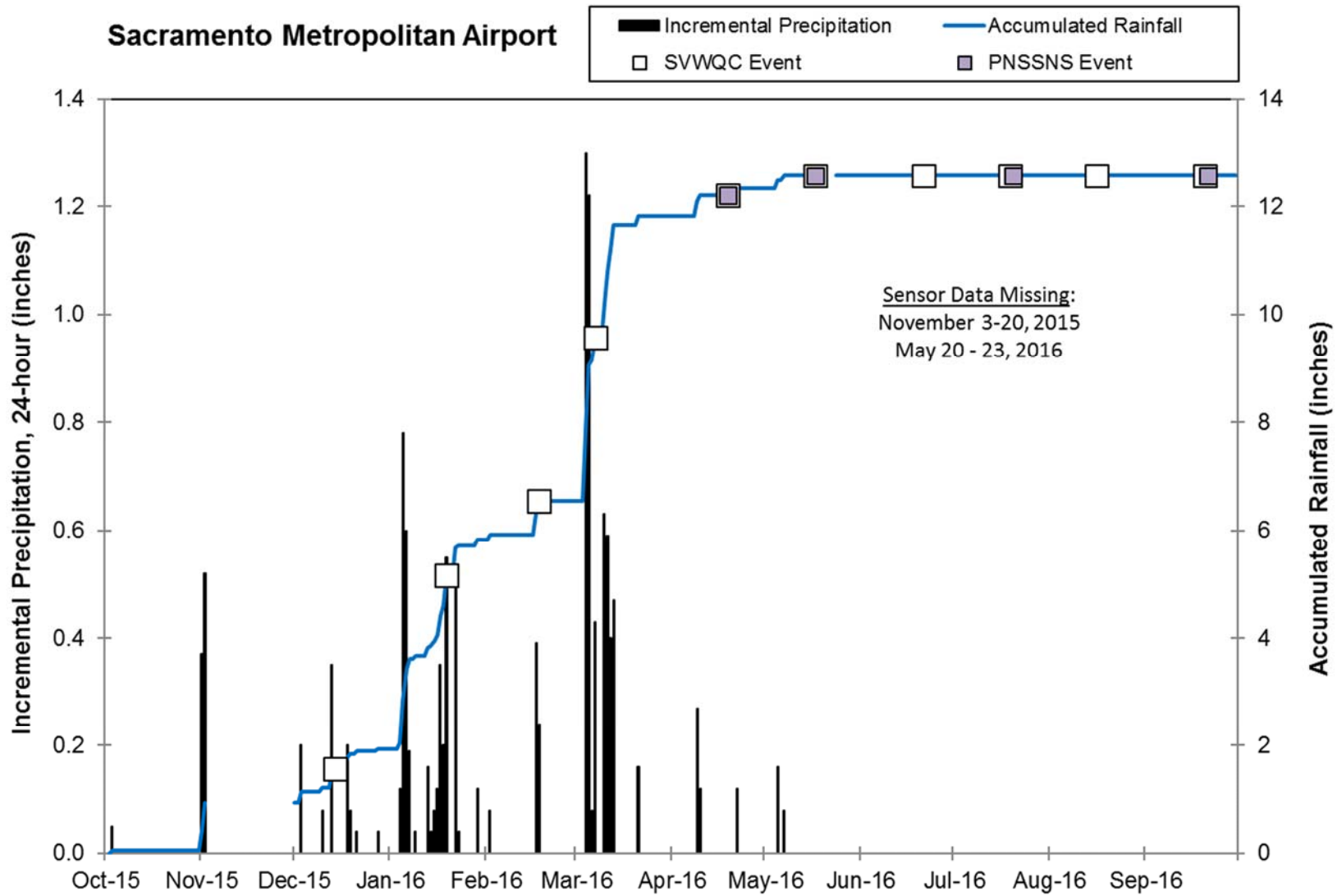


Figure 2-e. Precipitation during 2016 Coalition Monitoring: Lower Sacramento Valley

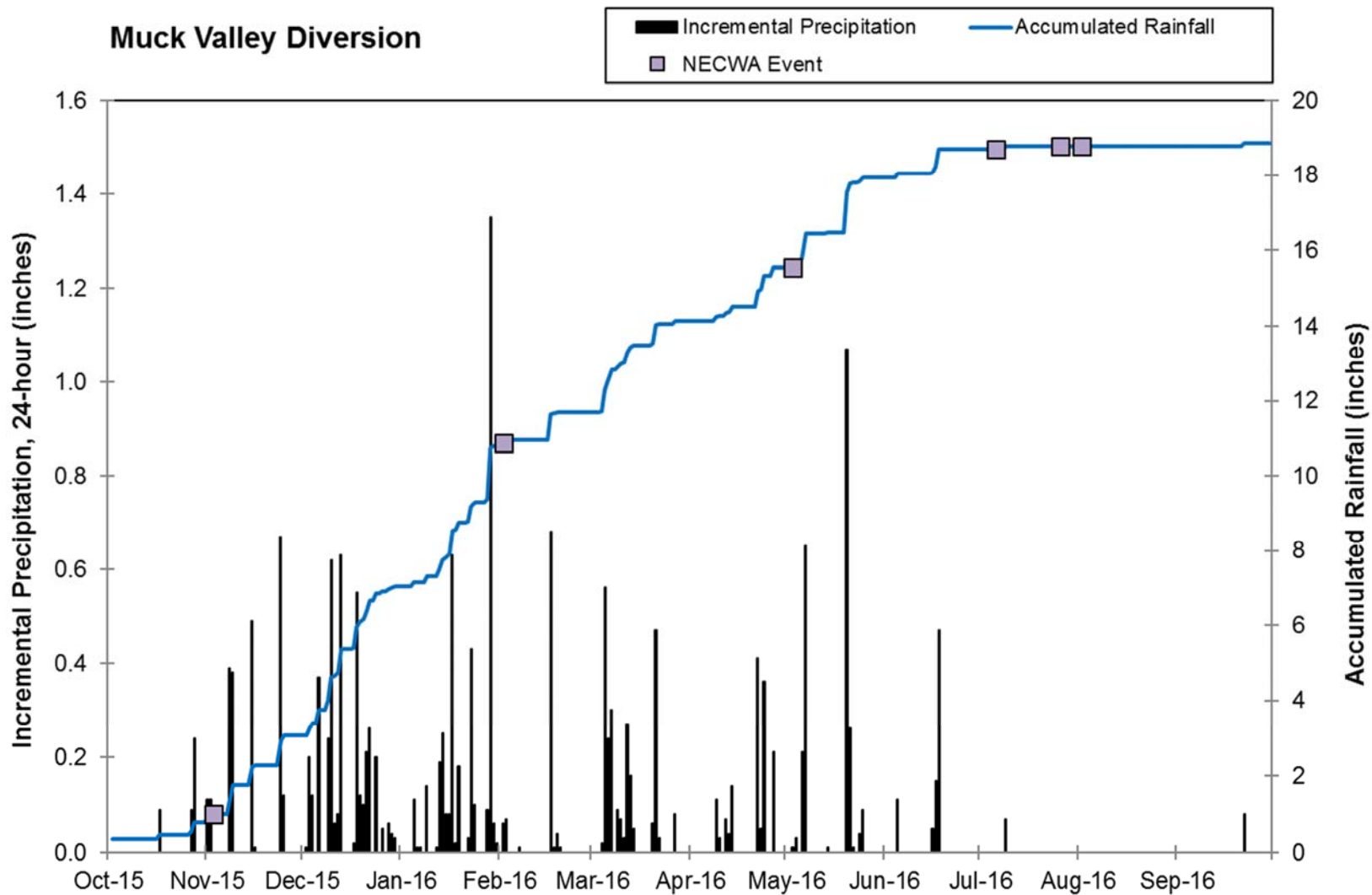


Figure 2-f. Precipitation during 2016 Coalition Monitoring: Pit River

Middle Fork of the Feather River near Portola

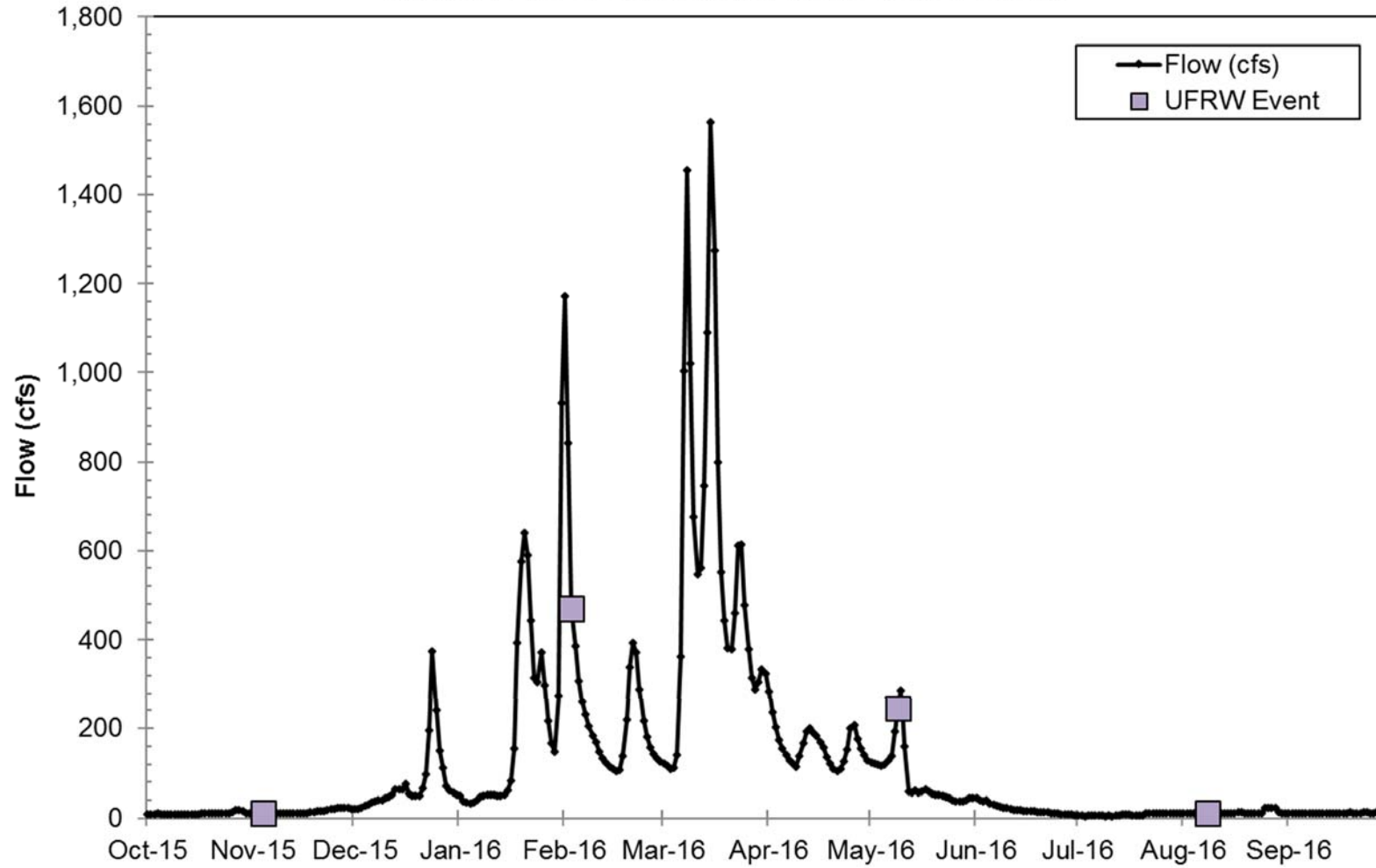


Figure 3-a. Flows during 2016 Coalition Monitoring: Plumas County

Butte Slough near Meridian

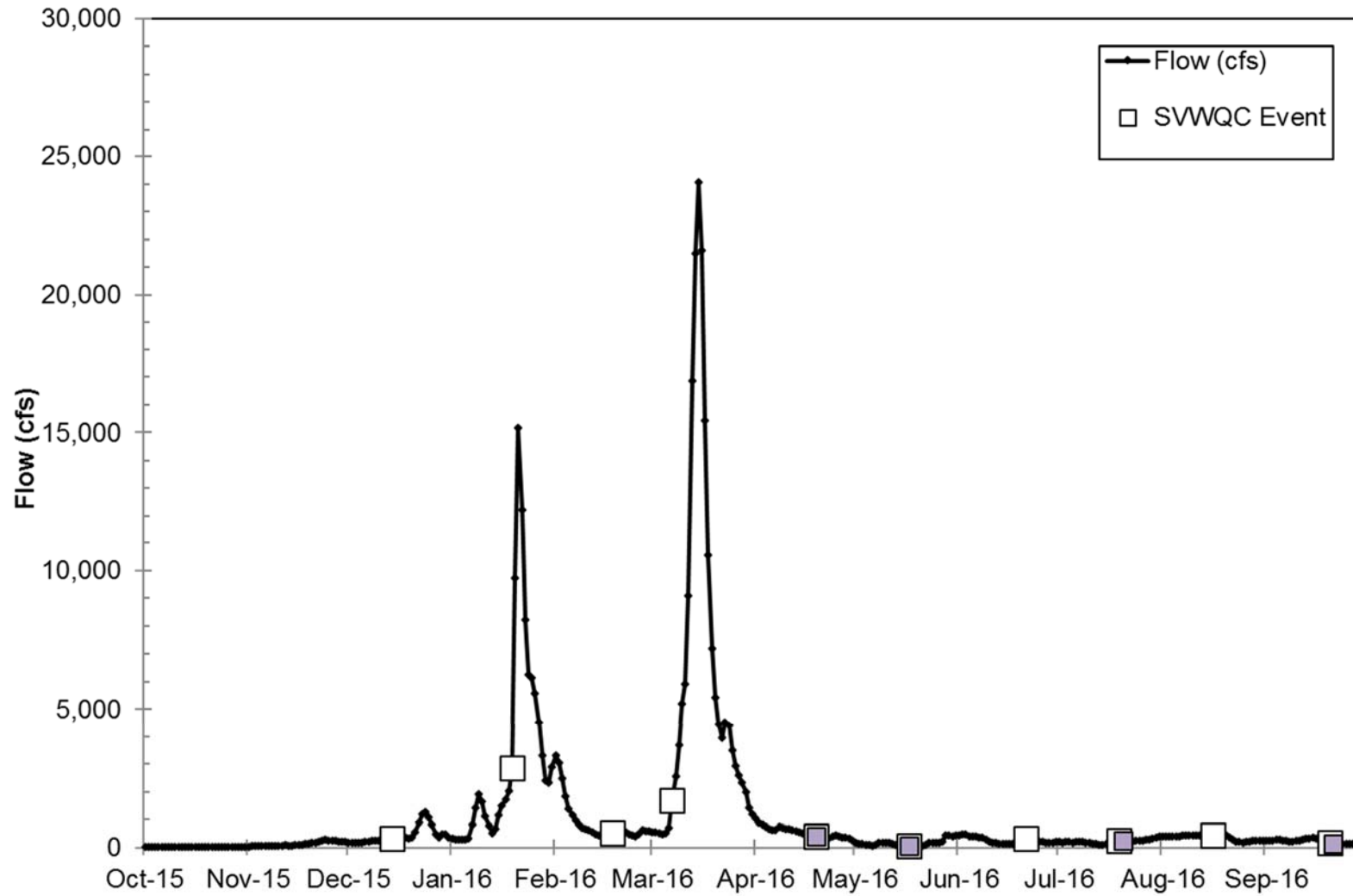


Figure 3-b. Flows during 2016 Coalition Monitoring: East Sacramento Valley

Colusa Basin Drain at Hwy 20

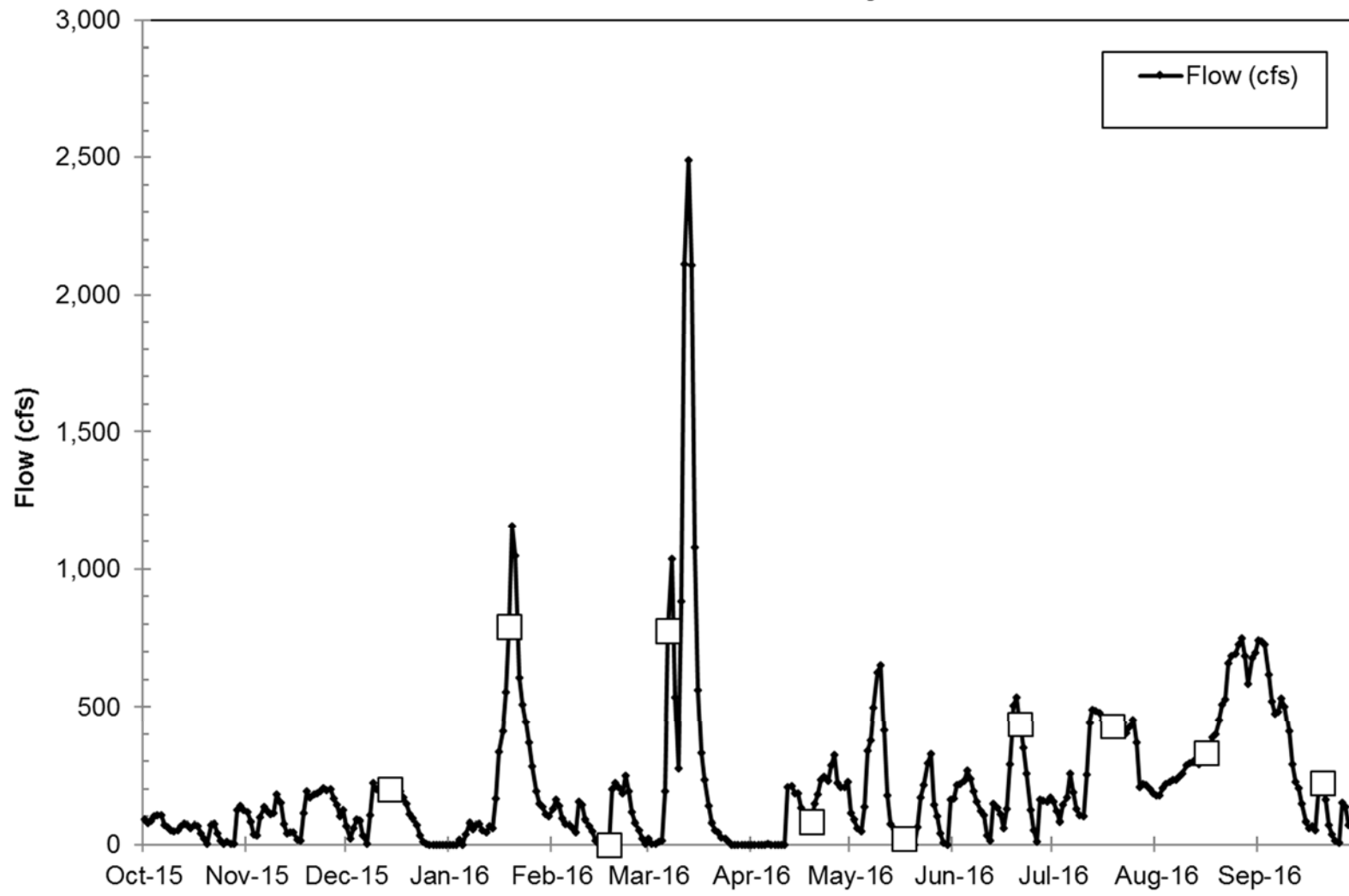


Figure 3-c. Flows during 2016 Coalition Monitoring: West Sacramento Valley

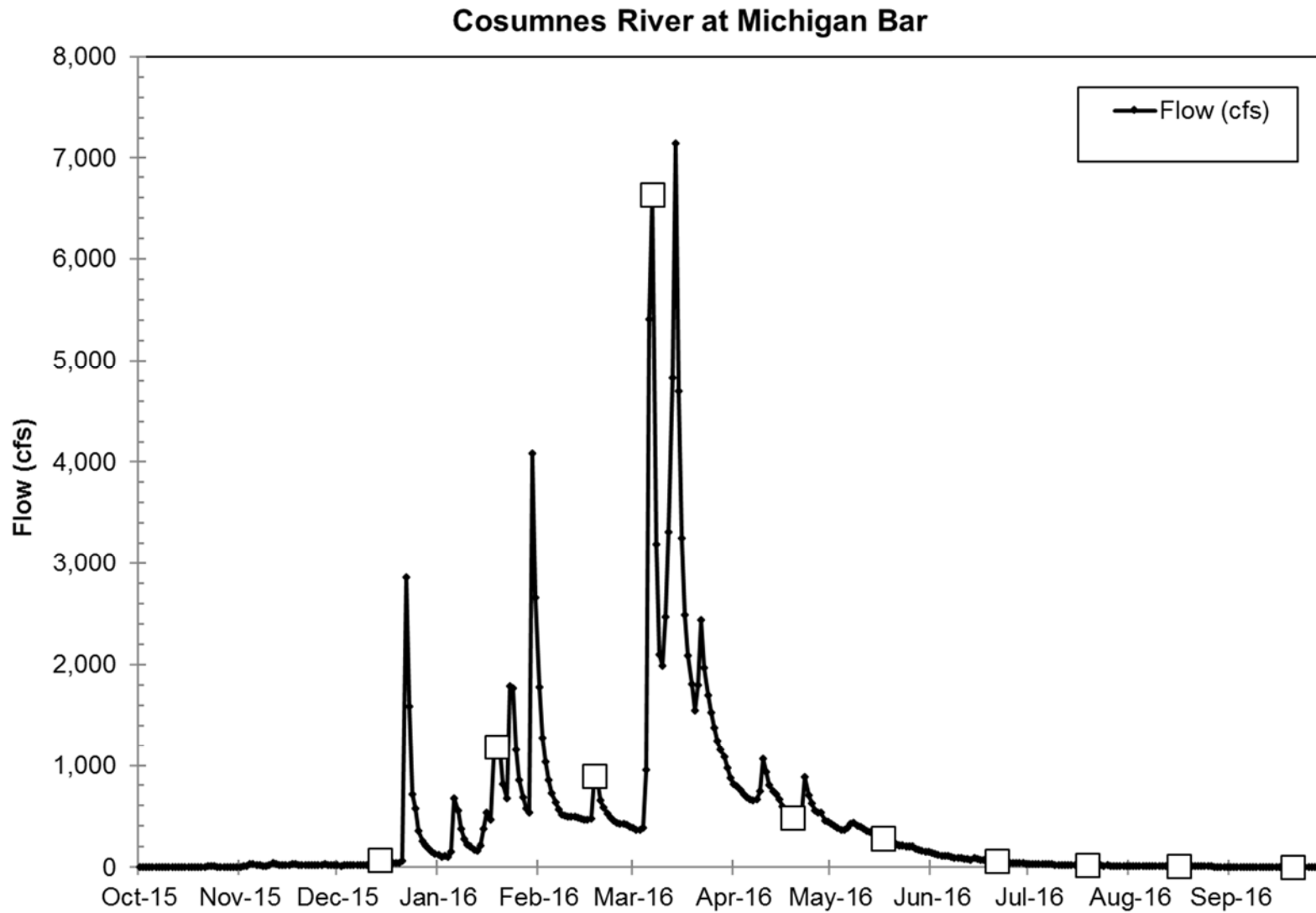


Figure 3-d. Flows during 2016 Coalition Monitoring: Lower Sacramento Valley

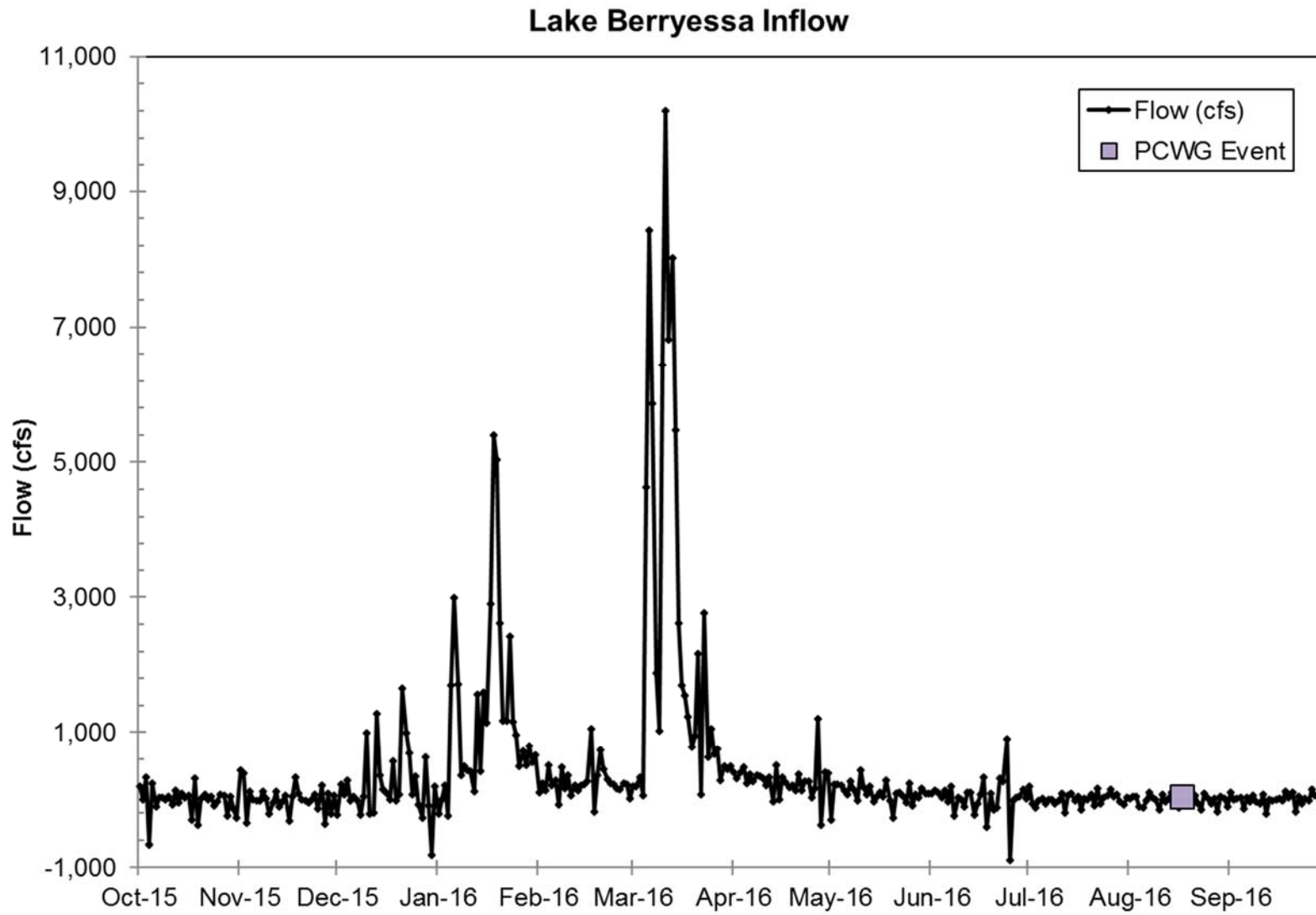


Figure 3-e. Flows during 2016 Coalition Monitoring: Lake Berryessa (Reservoir Inflow)

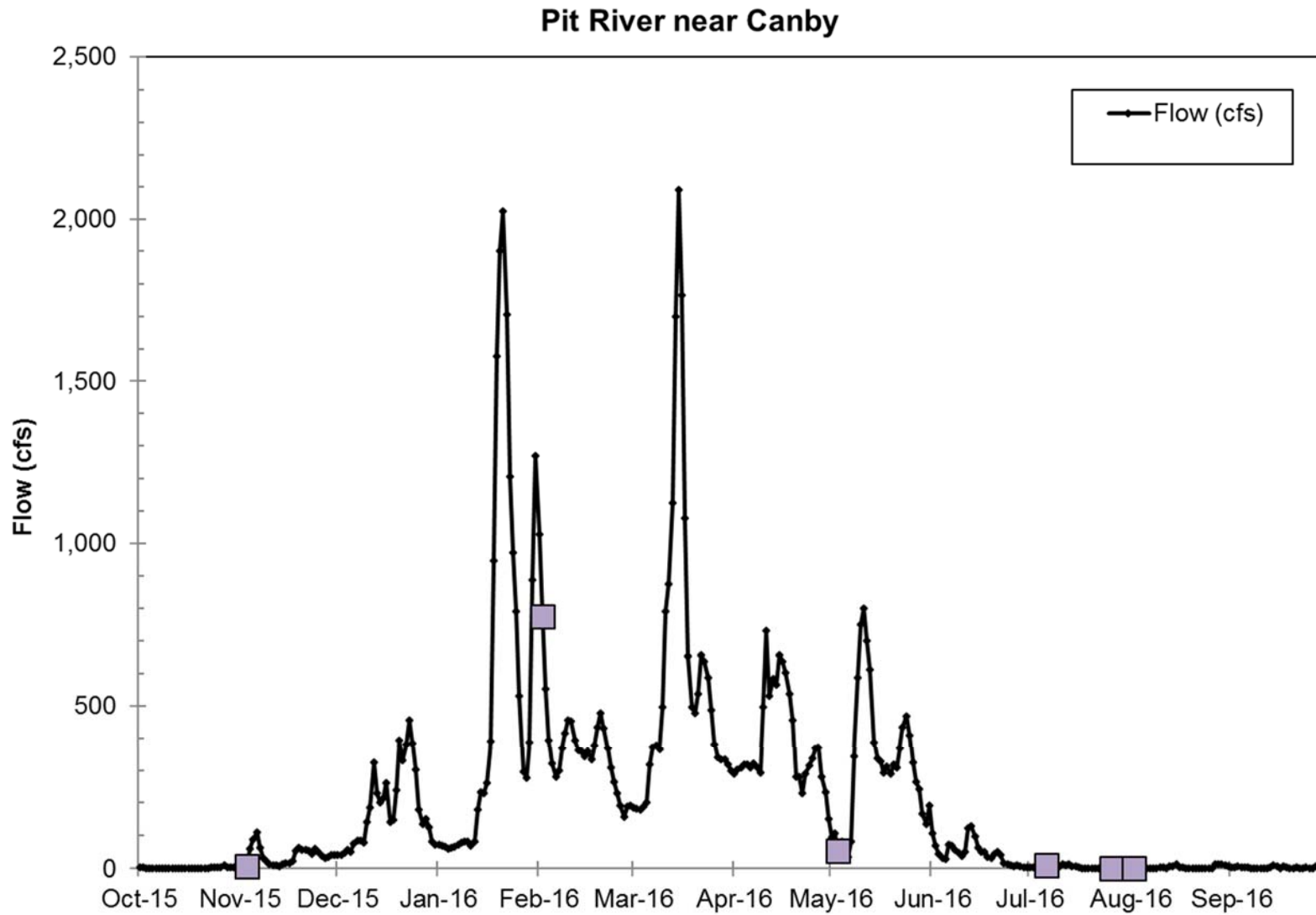


Figure 3-f. Flows during 2016 Coalition Monitoring: Pit River near Canby

Assessment of Data Quality Objectives

The QA/QC data for the Coalition's monitoring program have been evaluated and discussed previously in this document (*Quality Assurance Results*). Based on these evaluations, the program DQOs of completeness, representativeness, precision, and accuracy of monitoring data have been achieved. These results indicate that the data collected are valid and adequate to support the objectives of the monitoring program, and demonstrate compliance with the requirements of the *ILRP*. The results of these evaluations were summarized previously in **Table 8** through **Table 16**.

EXCEEDANCES OF RELEVANT WATER QUALITY OBJECTIVES

Coalition and subwatershed monitoring data were compared to *ILRP* Trigger Limits. Generally, these trigger limits are based on applicable narrative and numeric water quality objectives in the Central Valley Basin Plan (CVRWQCB, 2011), subsequent adopted amendments, the California Toxics Rule (USEPA 2000), and numeric interpretations of the Basin Plan narrative objectives. Observed exceedances of the *ILRP* Trigger Limits are the focus of this discussion.

Other relevant non-regulatory toxicity thresholds were also considered for the purpose of identifying potential causes of observed toxicity. It should be noted that these unadopted non-regulatory toxicity thresholds are not appropriate criteria for determining exceedances for the purpose of the Coalition's monitoring program and evaluating compliance with the *ILRP*. The additional toxicity thresholds were acquired from USEPA's Office of Pesticide Programs (OPP) Ecotoxicity database (USEPA 2007).

Water quality objectives and other relevant water quality thresholds discussed in this section are summarized in **Table 18** and **Table 19**. Monitored analytes without relevant water quality objectives or *ILRP* Trigger Limits are listed in **Table 20**.

The data evaluated for exceedances as described in this document include all Coalition collected results, as well as the compiled results from the Subwatershed monitoring programs presented in this report. The results of these evaluations are discussed below.

Table 18. Adopted Basin Plan and California Toxics Rule Objectives for Analytes Monitored for 2016 Coalition Monitoring

Analyte	Most Stringent Objective ⁽¹⁾	Units	Objective Source ⁽²⁾
Aldicarb	3	µg/L	CA 1° MCL
Aldrin	0.00013	µg/L	CTR
Ammonia, Total as N	narrative	mg/L	Basin Plan
Arsenic, total	50	µg/L	CA 1° MCL
Cadmium, dissolved	hardness dependent ⁽³⁾	µg/L	CTR
Carbofuran	0.4 ⁽⁴⁾	µg/L	BP
Chlordane, cis	0.00057	µg/L	CTR
Chlordane, trans	0.00057	µg/L	CTR
Chlorpyrifos	0.015	µg/L	Basin Plan
Copper, dissolved	hardness dependent ⁽³⁾	µg/L	CTR
DDD (o,p' and p,p')	0.00083	µg/L	CTR
DDE (o,p' and p,p')	0.00059	µg/L	CTR
DDT (o,p' and p,p')	0.00059	µg/L	CTR
Diazinon	0.10	µg/L	Basin Plan
Dieldrin	0.00014	µg/L	CTR
Dissolved Oxygen	5	mg/L	Basin Plan
Endosulfan I	110	µg/L	CTR
Endosulfan II	110	µg/L	CTR
Endosulfan sulfate	110	µg/L	CTR
Endrin	0.036	µg/L	CTR
Endrin aldehyde	0.76	µg/L	CTR
HCH	0.0039	µg/L	CTR
Heptachlor	0.00021	µg/L	CTR
Heptachlor epoxide	0.0001	µg/L	CTR
Lead, dissolved	hardness dependent ⁽³⁾	µg/L	CTR
Malathion	0.1 ⁽⁴⁾	µg/L	Basin Plan
Methoxychlor	30	µg/L	CA 1° MCL
Nitrate, as N	10	mg/L	CA 1° MCL
Oxamyl	50	µg/L	CA 1° MCL
Parathion, Methyl	0.13 ⁽⁴⁾	µg/L	Basin Plan
pH	6.5-8.5	-log[H ⁺]	Basin Plan
Selenium, total	5.0	µg/L	CTR
Temperature	narrative	µg/L	Basin Plan
Toxicity, Algae (<i>Hyalella</i>) Survival	narrative	µg/L	Basin Plan
Toxicity, Algae (<i>Selenastrum</i>) Cell Density	narrative	µg/L	Basin Plan

Analyte	Most Stringent Objective ⁽¹⁾	Units	Objective Source ⁽²⁾
Toxicity, Water Flea (<i>Ceriodaphnia</i>) Survival	narrative	µg/L	Basin Plan
Turbidity	narrative	µg/L	Basin Plan

Notes:

1. For analytes with more than one limit, the most limiting applicable adopted water quality objective is listed.
2. CA 1° MCLs are California's Maximum Contaminant Levels for treated drinking water; CTR = California Toxics Rule criteria.
3. Objective varies with the hardness of the water.
4. These values are Basin Plan performance goals. The Basin Plan states: "...discharge is prohibited unless the discharger is following a management practice approved by the Board." This has been interpreted as an *ILRP* Trigger Limit of ND (Not Detected).

Table 19. Unadopted Water Quality Limits Used to Interpret Narrative Water Quality Objectives for Analytes Monitored for 2016 Coalition Monitoring

Analyte	Unadopted Limit ⁽¹⁾	Units	Limit Source
Boron, total	700	µg/L	Ayers and Westcott 1988
Conductivity	700	µS/cm	Ayers and Westcott 1988
Conductivity	900	µS/cm	CA Recommended 2° MCL
<i>E. coli</i> ⁽¹⁾	235	MPN/100mL	Basin Plan Amendment
Total Dissolved Solids	500	mg/L	CA Recommended 2° MCL
Total Dissolved Solids	450	mg/L	Ayers and Westcott 1988
Azinphos methyl	0.01	µg/L	USEPA NAWQC ⁽²⁾
Carbaryl	2.53	µg/L	USEPA NAWQC
Dichlorvos	0.085	µg/L	Cal/EPA Cancer Potency Factor
Dimethoate	1	µg/L	CDPH Notification Level ⁽³⁾
Disulfoton	.05	µg/L	USEPA NAWQC
Diuron	2	µg/L	USEPA Health Advisory
Linuron	1.4	µg/L	USEPA IRIS Reference Dose
Methidathion	0.7	µg/L	USEPA IRIS Reference Dose
Methiocarb	0.5	µg/L	USFW Acute Toxicity
Methomyl	0.52	µg/L	USEPA NAWQC
Phorate	0.7	µg/L	NAS Health Advisory
Phosmet	140	µg/L	USEPA IRIS Reference Dose

Note:

1. Adopted by the Water Board but not approved by State Water Resources Control Board
2. USEPA National Ambient Water Quality Criteria
3. Notification levels (formerly called "action levels") are published by the California Department of Public Health (CDPH) for chemicals for which there is no drinking water MCL.

Table 20. Analytes Monitored for 2016 Coalition Monitoring without Applicable Adopted or Unadopted Limits

Analytes		
% Solids	Fenchlorphos	Oxychlorthane
Allethrin	Fenpropathrin	Oxyfluorfen
Aminocarb	Fensulfothion	Permethrin
Barban	Fenthion	Phosphorus as P, Total
Benomyl/Carbendazim	Fenuron	Propachlor
Bifenthrin	Fluometuron	Propham
Bromacil	Fluvalinate	Propoxur
Chlorothalonil	Hardness as CaCO ₃	Siduron
Chloroxuron	Hexachlorobenzene	Sulprofos
Chlorpropham	Hexazinone	Tebuthiuron
Cyfluthrin	L-Cyhalothrin	Tetrachlorvinphos
Cypermethrin	Metolachlor	Tetramethrin
Dacthal	Mevinphos	Tokuthion
Deltamethrin/Tralomethrin	Mexacarbate	Total Coliforms
Demeton	Monuron	Total Organic Carbon
Diflubenzuron	Naled	Total Suspended Solids
Discharge (flow)	Neburon	Trichloronate
Endrin Ketone	Nitrate+Nitrite, as N	
Esfenvalerate/Fenvalerate	Orthophosphate, as P	
Ethoprop	Oryzalin	

Toxicity and Pesticide Results

A summary of the toxicity and pesticide results from 2016 Coalition Monitoring is provided in this section.

Toxicity Exceedances in Coalition Monitoring

There were 57 individual toxicity results (including 18 field duplicates) analyzed in water column and sediment samples collected from five different sites during 2016 Coalition Monitoring. Analyses were conducted for *Selenastrum capricornutum*, *Ceriodaphnia dubia*, and *Hyalella azteca*. Statistically significant toxicity was not observed in any of the individual toxicity results analyzed in either sediment or water column.

Pesticides Detected in Coalition Monitoring

There were 747 individual pesticide results (including 216 field duplicates) analyzed in 33 water column samples collected from eight different sites, including both Representative and Management Plan or Special Study sites, during 2016 Coalition Monitoring. Analyses were conducted for organophosphates, carbamates, organochlorines, benzophenyls, pyrethroids, and a variety of herbicides. Within these monitored categories, six different pesticides were detected (19 total detected results, including 7 field duplicates) in ten separate samples collected for Coalition monitoring. Approximately 70% of samples collected had no detected pesticides, and more than 97.5% of all pesticide results were below detection.

It should be noted that detections of pesticides are not equivalent to exceedances (with the exception of malathion, which has a prohibition of discharge in the Basin Plan). Only one registered pesticide (chlorpyrifos) exceeded applicable water quality objectives or *ILRP* Trigger Limits in one monitoring sample.

Discussion of Pesticides Detected in Water Column in Coalition Monitoring

All pesticides detected in water column samples for 2016 Coalition Monitoring are listed in **Table 21**. Pesticides were compared to relevant numeric and narrative water quality objectives, and to toxicity threshold concentrations published in USEPA's *ECOTOX Database (USEPA 2007; accessed on multiple occasions in 2015)*. A discussion of these detections and exceedances follows below.

- The insecticide bromacil was detected below the reporting limit in one sample from Willow Slough. There is currently no *ILRP* Trigger Limit or adopted water quality objective for bromacil.
- The insecticide carbaryl was detected below the reporting limit in one sample from Lower Snake River. Carbaryl did not exceed or approach the unadopted USEPA National Ambient Water Quality Criteria limit (2.53 µg/L) in any sample.
- The insecticide chlorpyrifos was detected in three samples from two different sites. Chlorpyrifos exceeded the Basin Plan Amendment chronic objective (0.015 µg/L) in one of these samples at Pine Creek.
 - Pine Creek (Event 125): There were five reported applications of chlorpyrifos in the month prior to the July 19, 2016, exceedance. Chlorpyrifos was applied to

approximately 232 acres of walnuts and 38 acres of walnuts in the Pine Creek drainage during that time. Although water was present in the creek, field crews were unable to measure flow at this site. The field crew visually inspected the water body and noted that there was no observed flow. In the preceding weeks before the event, there had been no recorded precipitation. Toxicity tests were not performed during this event

- The herbicide diuron was detected in one sample collected at Lower Snake River. Diuron did not exceed nor approach the narrative objective of 2 µg/L in any sample.
- The herbicide oryzalin was detected in three samples at Willow Slough. There is currently no *ILRP* Trigger Limit or adopted water quality objective for oryzalin.
- The herbicide oxyfluorfen was detected in two samples at Colusa Basin Drain and Sacramento Slough. There is currently no *ILRP* Trigger Limit or adopted water quality objective for oxyfluorfen.

Table 21. Pesticides Detected in 2016 Coalition Monitoring

Site ID	Date	Analyte	Result ⁽¹⁾ (µg/L)	Trigger Limit ⁽²⁾	Basis for Limit ⁽³⁾
WLSPL	2/18/2016	Bromacil	DNQ 0.22	NA	
WLSPL	2/18/2016	Bromacil ^[4]	DNQ 0.21	NA	
LSNKR	12/14/2015	Carbaryl	DNQ 0.05	2.53	USEPA NAWQC
GILSL	4/20/2016	Chlorpyrifos	= 0.0061	0.015	BP (chronic)
GILSL	4/20/2016	Chlorpyrifos ^[4]	= 0.0069	0.015	BP (chronic)
GILSL	7/19/2016	Chlorpyrifos	DNQ 0.013	0.015	BP (chronic)
PNCHY	7/19/2016	Chlorpyrifos^[4]	= 0.11	0.015	BP (chronic)
PNCHY	7/19/2016	Chlorpyrifos	= 0.11	0.015	BP (chronic)
LSNKR	3/8/2016	Diuron	DNQ 0.22	2	USEPA Health Advisory
WLSPL	12/15/2015	Oryzalin	= 3.9	NA	
WLSPL	1/19/2016	Oryzalin	= 3.6	NA	
WLSPL	1/19/2016	Oryzalin ^[4]	= 3.8	NA	
WLSPL	2/18/2016	Oryzalin	= 1.9	NA	
WLSPL	2/18/2016	Oryzalin ^[4]	= 2	NA	
COLDR	3/7/2016	Oryzalin	DNQ 0.35	NA	
COLDR	3/7/2016	Oryzalin ^[4]	DNQ 0.31	NA	
COLDR	3/7/2016	Oxyfluorfen	= 0.093	NA	
COLDR	3/7/2016	Oxyfluorfen ^[4]	= 0.086	NA	
SSKNK	3/7/2016	Oxyfluorfen	= 0.056	NA	

BOLD = Exceedance

- 1.. "DNQ" (Detected Not Quantified) indicates that the detected value was less than the quantitation or reporting limit (QL).
2. Water Quality Objective or Narrative Interpretation Limits for *ILRP*. "NA" if no *ILRP* limit established.
3. Water Quality Objective Basis: BP = Central Valley Basin Plan; BPA = Basin Plan Amendment; Cal/EPA = Cal/EPA Cancer Potency Factor; CDPH Notification Level = Notification levels (formerly called "action levels") are published by the California Department of Public Health (CDPH) for chemicals for which there is no drinking water MCL; CTR = California Toxics Rule; Narrative = unadopted limits used to interpret Basin Plan narrative objectives by the Central Valley Regional Board; USEPA Health Advisory = Drinking water health advisory.
4. Field duplicate sample

Other Coalition-Monitored Water Quality Parameters

Exceedances of adopted Basin Plan objectives, CTR criteria, or *ILRP* Trigger Limits were observed for conductivity, dissolved oxygen, *E. coli*, pH, and trace metals during 2016 Coalition Monitoring (see **Table 22**).

Conductivity

Conductivity was monitored in 98 samples from 23 Coalition sites. Conductivity exceeded the unadopted UN Agricultural Goal (700 $\mu\text{S}/\text{cm}$) in a total of 9 samples and also exceeded the California recommended 2^o MCL (900 $\mu\text{S}/\text{cm}$) for drinking water in 4 of the 9 samples. Exceedances were observed at 5 of the 23 monitored sites. COLDR and UCBRD each had three exceedances, while GIDLR, MGSLU, and ZDDIX each had one exceedance.

Dissolved Oxygen

During 2016 Coalition Monitoring, dissolved oxygen was measured in 82 samples at 20 Coalition sites; a total of 21 samples exceeded WARM and COLD Basin Plan lower limits. Dissolved oxygen concentrations were below the Basin Plan lower limit of 5.0 mg/L for waterbodies with a WARM designated beneficial use in seven samples from five sites, and below the Basin Plan lower limit of 7.0 mg/L for waterbodies with a COLD designated beneficial use in an additional 14 samples from eight sites.

Dissolved oxygen exceedances were caused primarily by low flows, stagnant conditions, or extensive submerged aquatic vegetation in some cases. The low flows and stagnant conditions have the potential to increase diurnal variability or limit oxygen production by instream algae and also to trap organic particulates that contribute to instream oxygen consumption.

***E. coli* Bacteria**

E. coli bacteria were analyzed in 43 samples from 11 Coalition sites, not including nine field blanks collected at six monitoring stations and 17 lab blanks. *E. coli* results exceeded the single sample maximum objective (235 MPN/100mL) in 16 samples (including four field duplicates) from eight different Coalition monitoring locations.

The Basin Plan objectives are intended to protect contact recreational uses where ingestion of water is probable (e.g., swimming). Agricultural lands commonly support a large variety (and very large numbers seasonally) of birds and other wildlife. These avian and wildlife resources are known to be significant sources of *E. coli* and other bacteria in agricultural runoff and irrigation return flows. Other potential sources of *E. coli* include, but are not limited to, cattle, horses, septic systems, treated wastewater, and urban runoff.

pH

During 2016 Coalition Monitoring, pH was measured in 98 samples from 23 Coalition sites. pH exceeded the Basin Plan maximum of 8.5 standard pH units ($-\log[\text{H}^+]$) once at WLSPL on December 15, 2015, and exceeded the Basin Plan minimum of 6.5 pH units in four samples from four other Coalitions sites. Low pH violations ranged from 5.74 to 6.38 s.u.

The Basin Plan limit for pH is intended to be assessed based on “...an appropriate averaging period that will support beneficial uses” (CVRWQCB 2011). This parameter typically exhibits

significant natural diurnal variation over 24 hours in natural waters with daily fluctuations controlled principally by photosynthesis, rates of respiration, and buffering capacity of the water. These processes are controlled by light and nutrient availability, concentrations of organic matter, and temperature. These factors combine to cause increasing pH during daylight hours and decreasing pH at night. Diurnal variations in winter are typically smaller because less light is available and there are lower temperatures and higher flows. Irrigation return flows may influence this variation primarily by increasing or decreasing in-stream temperatures or by increasing available nutrients or organic matter.

The reason for these pH exceedances was not immediately obvious nor easily determined. In most cases, the marginal pH exceedances were likely due primarily to in-stream algal respiration, caused in part by low flows or ponded and stagnant conditions and temperatures sufficient to stimulate algal growth.

Trace Metals

Trace metals monitored during 2016 Coalition Monitoring included both unfiltered metals (total arsenic, boron, copper, lead, and selenium) and filtered metals (dissolved cadmium, copper, lead, and selenium).

Total trace metals were monitored in 96 samples (not including 110 field or laboratory QA/QC samples) from 12 Coalition sites, and dissolved metals were monitored in 111 samples (not including 52 field or laboratory QA/QC samples) from 10 Coalition sites.

Arsenic

Twenty-five (25) total and 17 dissolved arsenic samples were collected from six Coalition sites (not including 30 field and laboratory QA/QC samples). Four samples (including two field duplicates) from monitoring site Grand Island Drain near Leary Road (GIDLR) exceeded the California 1° MCL of 50 µg/L on December 14, 2015, and April 19, 2016. No dissolved arsenic samples exceeded the California 1° MCL standard.

There are both legacy and a few current sources of arsenic in the Sacramento River Watershed. There is very little remaining agricultural use of arsenic-based pesticide products (based on review of DPR's PUR data), and arsenic has only a few potentially significant sources: (1) natural background from arsenic in the soils, (2) arsenic remaining from legacy lead arsenate use in orchards, (3) arsenic used in various landscape maintenance and structural pest control applications (non-agriculture), and (4) arsenic used in wood preservatives. One possible source is the wooden bridge structure just upstream of the Grand Island Drain sampling site, if arsenic-based preservatives were used in the wood. A final, but somewhat unlikely source is an arsenic-based additive that may still be used for chicken feed¹⁰ and which can potentially make its way through the chicken and into agricultural fields and runoff if the poultry litter is used on the field.

Boron

Six (6) total and 16 dissolved boron samples were collected from five different Coalition sites (not including 22 field and laboratory QA/QC samples). Four total boron samples (including two

¹⁰ <http://water.usgs.gov/owq/AFO/proceedings/afo/pdf/Wershaw.pdf>

field duplicate) at WLSPL exceeded the *ILRP* Trigger Limit (700 µg/L, based on Ayers and Westcott). No dissolved boron samples collected at MFFGR, FRRRB, PRCAN, and PRPIT exceeded the *ILRP* Trigger Limit.

Boron is a naturally-occurring mineral that is not applied by agriculture, but it is elevated in some irrigation supplies (especially groundwater) and soils, and concentrations may be elevated through consumptive use of irrigation water. It is known to be naturally elevated in the groundwater and major tributaries supplying irrigation water in the Willow Slough drainage.

Table 22. Other Physical, Chemical, and Microbiological Parameters Observed to Exceed Numeric Objectives in 2016 Coalition Monitoring

Site ID	Sample Date	Analyte	Units	Result	Trigger Limit ⁽¹⁾	Basis for Limit ⁽²⁾	Mgmt Plan ⁽³⁾
GIDLR	12/14/2015	Arsenic	µg/L	14	10	1° MCL ⁽⁵⁾	Active
GIDLR	12/14/2015	Arsenic	µg/L	14	10	1° MCL ⁽⁵⁾	Active
GIDLR	4/19/2016	Arsenic	µg/L	27	10	1° MCL ⁽⁵⁾	Active
GIDLR	4/19/2016	Arsenic	µg/L	27	10	1° MCL ⁽⁵⁾	Active
WLSPL	4/19/2016	Boron	µg/L	1700	700	Narrative	Active
WLSPL	4/19/2016	Boron	µg/L	1700	700	Narrative	Active
WLSPL	8/16/2016	Boron	µg/L	1200	700	Narrative	Active
WLSPL	8/16/2016	Boron	µg/L	1200	700	Narrative	Active
PNCHY	7/19/2016	Chlorpyrifos	µg/L	0.11	0.015	BP (chronic)	Active
PNCHY	7/19/2016	Chlorpyrifos	µg/L	0.11	0.015	BP (chronic)	Active
COLDR	12/14/2015	Conductivity	µS/cm	767	700, 900 ⁽⁴⁾	Narrative	Active
COLDR	3/7/2016	Conductivity	µS/cm	895	700, 900 ⁽⁴⁾	Narrative	Active
GIDLR	4/19/2016	Conductivity	µS/cm	763	700, 900 ⁽⁴⁾	Narrative	Active
ZDDIX	4/19/2016	Conductivity	µS/cm	1139	700, 900 ⁽⁴⁾	Narrative	Active
MGSLU	4/21/2016	Conductivity	µS/cm	1119	700, 900 ⁽⁴⁾	Narrative	Active
COLDR	5/17/2016	Conductivity	µS/cm	825	700, 900 ⁽⁴⁾	Narrative	Active
UCBRD	7/13/2016	Conductivity	µS/cm	1064	700, 900 ⁽⁴⁾	Narrative	Active
UCBRD	8/17/2016	Conductivity	µS/cm	716	700, 900 ⁽⁴⁾	Narrative	Active
UCBRD	9/20/2016	Conductivity	µS/cm	1049	700, 900 ⁽⁴⁾	Narrative	Active
GIDLR	4/19/2016	Dissolved Oxygen	mg/L	3.31	5	BP [SSO WARM]	Active
BTTSL	4/20/2016	Dissolved Oxygen	mg/L	6.31	7	BP [SSO COLD]	Active
GILSL	4/20/2016	Dissolved Oxygen	mg/L	4.67	5	BP [SSO WARM]	Active
PNCHY	4/21/2016	Dissolved Oxygen	mg/L	6.50	7	BP [SSO COLD]	Active
MGSLU	4/21/2016	Dissolved Oxygen	mg/L	4.68	7	BP [SSO COLD]	Active
BTTSL	5/17/2016	Dissolved Oxygen	mg/L	4.45	7	BP [SSO COLD]	Active
LHNCT	5/17/2016	Dissolved Oxygen	mg/L	6.12	7	BP [SSO COLD]	Active
COLDR	5/17/2016	Dissolved Oxygen	mg/L	6.54	7	BP [SSO COLD]	Active
GIDLR	6/21/2016	Dissolved Oxygen	mg/L	3.45	5	BP [SSO WARM]	Active
PRPIT	6/30/2016	Dissolved Oxygen	mg/L	5.50	7	BP [SSO COLD]	Active
WLSPL	7/19/2016	Dissolved Oxygen	mg/L	5.85	7	BP [SSO COLD]	Active
GILSL	8/16/2016	Dissolved Oxygen	mg/L	3.43	5	BP [SSO WARM]	Active
SSKNK	8/16/2016	Dissolved Oxygen	mg/L	3.68	5	BP [SSO WARM]	Active
COLDR	8/16/2016	Dissolved Oxygen	mg/L	5.70	7	BP [SSO COLD]	Active
ZDDIX	8/16/2016	Dissolved Oxygen	mg/L	4.93	5	BP [SSO WARM]	Active
WLSPL	8/16/2016	Dissolved Oxygen	mg/L	5.80	7	BP [SSO COLD]	Active
MDLCR	8/17/2016	Dissolved Oxygen	mg/L	5.31	7	BP [SSO COLD]	Active
UCBRD	9/20/2016	Dissolved Oxygen	mg/L	4.82	5	BP [SSO WARM]	Active

Site ID	Sample Date	Analyte	Units	Result	Trigger Limit ⁽¹⁾	Basis for Limit ⁽²⁾	Mgmt Plan ⁽³⁾
WLSPL	9/20/2016	Dissolved Oxygen	mg/L	5.95	7	BP [SSO COLD]	Active
LHNCT	9/21/2016	Dissolved Oxygen	mg/L	6.36	7	BP [SSO COLD]	Active
PNCHY	9/21/2016	Dissolved Oxygen	mg/L	4.98	7	BP [SSO COLD]	Active
GIDLR	12/14/2015	E. coli	MPN/100mL	2419.6	235	BP	Suspended
MDLCR	2/18/2016	E. coli	MPN/100mL	866.4	235	BP	Suspended
MDLCR	2/18/2016	E. coli	MPN/100mL	816.4	235	BP	Suspended
COLDR	3/7/2016	E. coli	MPN/100mL	1046.2	235	BP	Suspended
COLDR	3/7/2016	E. coli	MPN/100mL	1119.9	235	BP	Suspended
WLKCH	3/8/2016	E. coli	MPN/100mL	2419.6	235	BP	Suspended
GIDLR	4/19/2016	E. coli	MPN/100mL	365.4	235	BP	Suspended
WLSPL	4/19/2016	E. coli	MPN/100mL	272.3	235	BP	Suspended
PNCHY	4/21/2016	E. coli	MPN/100mL	2419.6	235	BP	Suspended
PNCHY	4/21/2016	E. coli	MPN/100mL	866.4	235	BP	Suspended
GIDLR	6/21/2016	E. coli	MPN/100mL	260.3	235	BP	Suspended
GIDLR	6/21/2016	E. coli	MPN/100mL	238.2	235	BP	Suspended
ACACR	7/20/2016	E. coli	MPN/100mL	344.8	235	BP	Suspended
FRSHC	8/17/2016	E. coli	MPN/100mL	259.5	235	BP	Suspended
GIDLR	9/20/2016	E. coli	MPN/100mL	648.8	235	BP	Suspended
ACACR	9/21/2016	E. coli	MPN/100mL	1986.3	235	BP	Suspended
WLSPL	12/15/2015	pH	std. units	8.57	6.5-8.5	BP	Active
NRTCN	4/19/2016	pH	std. units	6.36	6.5-8.5	BP	No
MGSLU	4/21/2016	pH	std. units	5.74	6.5-8.5	BP	No
GILSL	8/16/2016	pH	std. units	6.38	6.5-8.5	BP	No
FRSHC	8/17/2016	pH	std. units	6.37	6.5-8.5	BP	No

Notes:

1. Water Quality Objective or Narrative Interpretation Limits for *ILRP*.
2. Water Quality Objective Basis: BP = Central Valley Basin Plan; BPA = Basin Plan Amendment; CTR = California Toxics Rule; Narrative = unadopted limits used to interpret Basin Plan narrative objectives by the Central Valley Regional Board.
3. Indicates whether sites and parameter are currently being addressed by an ongoing management plan, study, or TMDL
4. Conductivity exceeded the unadopted UN Agricultural Goal (700 µS/cm) and/or the California recommended 2nd MCL (900 µS/cm) for drinking water.

Trend Analysis

As part of the evaluation of monitoring results, the WDR requires the Coalition to conduct trend analyses to...

“... identify potential trends^[11] and patterns in surface and groundwater quality that may be associated with waste discharge from irrigated lands. As part of this evaluation, the third-party must analyze all readily available monitoring data that meet program quality assurance requirements to determine deficiencies in monitoring for discharges from irrigated agricultural lands and whether additional sampling locations or sampling events are needed or if additional constituents should be monitored. If deficiencies are identified, the third-party must propose a schedule for additional monitoring or source studies. ... The third-party should incorporate pesticide use information, as needed, to assist in its data evaluation.”

As part of the 2014 AMR, the Coalition conducted the trend analysis for all representative monitoring sites, as well as all pesticides that were detected with $\geq 5\%$ detection^[12]. From this dataset, it was determined that the sites and constituents shown in **Table 23** had potential to degrade water quality.

Table 23. Significant Trends Further Evaluated for Potential Degradation of Water Quality (2014)

Category	Analyte	Site Name		
Physical	Conductivity	Anderson Creek at Ash Creek Road		
		Colusa Basin Drain above KL		
		Freshwater Creek at Gibson Rd		
		Lower Snake R. at Nuestro Rd		
		Middle Creek u/s from Highway 20		
		North Canyon Creek		
		Pine Creek at Nord Gianella Road		
		Pit River at Pittville		
		Sacramento Slough bridge near Karnak		
		Ulati Creek at Brown Road		
		Walker Creek near 99W and CR33		
		Willow Slough Bypass at Pole Line		
		Dissolved Oxygen	Dissolved Oxygen	Coon Creek at Brewer Road
				Lower Snake R. at Nuestro Rd
Middle Creek u/s from Highway 20				
Middle Fork Feather River above Grizzly Cr				

¹¹ “All results (regardless of whether exceedances are observed) must be included to determine whether there are trends in degradation that may threaten applicable beneficial uses.”

¹² Pesticides with lower than 5% detection rates were considered to have insufficient detected data to reliably identify trends.

Category	Analyte	Site Name
		Pine Creek at Highway 32
		Pine Creek at Nord Gianella Road
		Ulatis Creek at Brown Road
	pH	Colusa Basin Drain above KL
		Lower Snake R. at Nuestro Rd
		Pope Creek upstream from Lake Berryessa
	Temperature	Middle Creek u/s from Highway 20
Total Organic Carbon	Pine Creek at Nord Gianella Road	
	Walker Creek near 99W and CR33	
Total Suspended Solids	Grand Island Drain near Leary Road	
Nutrients	Ammonia, Total as N	Pine Creek at Nord Gianella Road
	Nitrate+Nitrite, as N	Freshwater Creek at Gibson Rd
	Orthophosphate, as P	Lower Honcut Creek at Hwy 70
Pine Creek at Nord Gianella Road		
Toxicity	Selenastrum growth	Anderson Creek at Ash Creek Road

Beginning in 2015, the Coalition proposed a prioritized approach that would focus on reanalyzing the higher priority trends from 2014. This approach was approved by the Regional Water Board for the second year of an Assessment period and for non-Assessment years. 2016 was a non-Assessment period so the trend analysis followed the prioritized approach. The modified trend assessment for 2016 reanalyzed the following:

- High priority pesticides with high detection rates
 - Chlorpyrifos
 - Diazinon
 - Diuron
- Sites with active Management Plans for Ceriodaphnia and Selenastrum
- Nutrient data for the 2014 sites that were listed in the “potential degradation subsection”

The methods used to analyze and evaluate the data were as follows:

- Data were initially evaluated using Spearman's non-parametric test for trend (concentrations vs. sample date). Table of the initial Spearman’s test results are provided in **Appendix G**.
 - Data below detection were coded as "0" for initial non-parametric Spearman's evaluation
 - Data were analyzed separately for each site for all parameters
 - The threshold for statistical significance was set at $p < 0.05$
- Significant preliminary results ($p < 0.05$) were screened for potential degradation impacts

- Increasing trends in pesticides, metals, nutrients, pathogen indicators
- Decreasing trends in toxicity survival or growth results
- The subset of the initial Spearman’s test results with potential degradation impacts are provided in **Appendix G**.
- Parameters with potential degradation trend indicators were plotted (concentration vs. date) for further evaluation (plots are provided in **Appendix G**.)
 - Data below detection were plotted at the detection limit
 - Reviewed for potential outliers
 - Linear, log-linear, or robust trend lines were plotted to illustrate trends (the selected method was based on visual inspection and best professional judgment)
 - Plots were evaluated for other (non-trend) patterns

A determination of the significance of a potential degradation trend was based on the likelihood of a continuing trend and the likelihood of adverse impacts on beneficial uses. Evaluations of beneficial use impacts were based on a continued increasing probability of exceedances of trigger limits. These determinations are provided in **Appendix G**, and significant findings are discussed below.

Pesticide use data were evaluated during the process of developing the annual monitoring plan update, as required by the WDR, and no additional evaluations of pesticide use data were conducted for this Annual Report. The results of pesticide evaluations conducted in 2013 and 2014 were incorporated into the 2014 and 2015 monitoring plans, respectively, that were approved by the Regional Water Board. Pesticide use information will next be evaluated in 2017 for the 2018 assessment monitoring period using the method being developed by the Regional Water Board and ILRP stakeholders, and approved for this use by the Regional Water Board.

DISCUSSION OF RESULTS

The Coalition’s 2016 Monitoring Plan Update was approved by Regional Water Board staff as meeting the requirements of the WDR. The WDR provides no additional guidance or criteria for making a determination that there are “deficiencies in monitoring” or that additional locations or events are needed, and none were identified as a result of the trend analysis conducted for this report.

Summary of initial Spearman’s test results

- 28 site-parameter combinations were evaluated
- Nutrients were not part of this evaluation due to a lack of new monitoring data at the sites listed in the 2014 evaluation “potential degradation subsection”
- 17 results were not significant ($p \geq 0.05$)
- Two results were not significant due to insufficient detected data
- Seven results were initially determined to have potentially significant trends ($p < 0.05$)

- Eight significant results were identified for trends with no potential negative impacts (i.e., they indicated potentially improving water quality)
- Only one initially significant result was identified as suggesting degradation with potential negative impacts on beneficial uses and was further evaluated
- One result (~5% of the beginning number of evaluations) was determined to have significant increasing trends suggesting potential degradation (**Table 24**) and was evaluated further.

Table 24. Significant Trends Further Evaluated for Potential Degradation

Category	Analyte	Site Name
Pesticide	Chlorpyrifos	Gilsizer Slough

Chlorpyrifos concentrations at Gilsizer Slough were elevated above the average for the site between 2014 and 2015 (**Figure 4**), which triggered a Management Plan in 2015. Results for 2016 Monitoring Year were below objectives. Risk of degradation and need for tracking are addressed by the Management Plan and ongoing monitoring.

In summary, the results of trend analyses conducted for this AMR did not indicate a need for any additional locations, events, or parameters. We recommend that these evaluations are conducted no more often than once per assessment period.

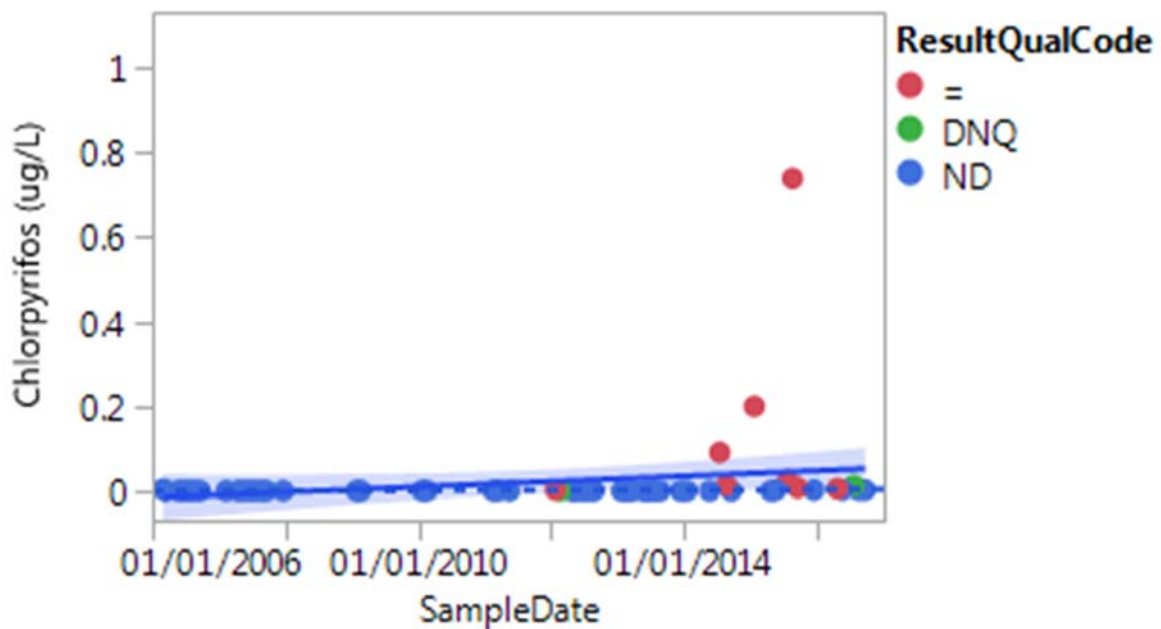


Figure 4. Chlorpyrifos, Gilsizer Slough

Management Practices and Actions Taken

RESPONSE TO EXCEEDANCES

To address specific water quality exceedances, the Coalition and its partners initially developed a Management Plan in 2008, subsequently approved by the Water Board. The Coalition also previously developed a *Landowner Outreach and Management Practices Implementation Communications Process for Monitoring Results (Management Practices Process)* to address exceedances. The Coalition subsequently developed an updated Comprehensive Surface Water Quality Management Plan¹³ (CSQMP) in 2015 to comply with specific requirements of the current WDR. Implementation of the CSQMP is the primary mechanism for addressing exceedances observed in the Coalition's *ILRP* surface water monitoring.

Management Plan Status Update

The Management Plan Progress Report (MPPR), documenting the status and progress toward meeting Management Plan requirements for 2016, is provided to the Water Board with this Annual Monitoring Report. Activities conducted in 2016 to implement the Coalition's Management Plan included addressing exceedances of objectives for registered pesticides, development of new Management Plans, evaluating Management Plans that could be deemed complete, and monitoring required for toxicity and pesticide management plans and TMDLs.

Implementation completed specifically for registered pesticides and toxicity included review and evaluation of pesticide application data, identification of potential sources, and determination of likely agricultural sources. Prior to 2015, for Management Plans for registered pesticides and identified causes of toxicity, surveys of Coalition members operating on high priority parcels were conducted to determine the degree of implementation of relevant management practices. Beginning in 2015, these surveys were replaced with data compiled from Coalition member Farm Evaluations. The Farm Evaluation data have been used to establish goals for additional management practice implementation needed to address exceedances of Basin Plan water quality objectives and *ILRP* Trigger Limits.

LANDOWNER OUTREACH EFFORTS

The Coalition and its subwatersheds, working with the Coalition for Urban/Rural Environmental Stewardship (CURES), stand committed to working with the Water Board and its staff to implement the *Management Practices Process* and the Coalition's CSQMP to address water quality problems identified in the Sacramento Valley. The primary strategic approach taken by the Coalition is to notify and educate the subwatershed landowners, farm operators, and/or wetland managers about the cause(s) of toxicity and/or exceedance(s) of water quality standards. Notifications are focused on (but not limited to) growers who operate directly adjacent to or within close proximity to the waterway. The broader outreach program, which includes both grower meetings and the notifications distributed through direct mailings, encourages the

¹³ *SVWQC Comprehensive Surface Water Quality Management Plan. Prepared for the Sacramento Valley Water Quality Coalition (SVWQC) by Larry Walker Associates, Davis, California. June 2015.*

adoption of BMPs and modification of the uses of specific farm and wetland inputs to prevent movement of constituents of concern into Sacramento Valley surface waters.

Targeted Outreach Efforts

The Coalition's targeted outreach approach is to focus on the growers with fields directly adjacent to or near the actual waterway of concern where statistically significant toxicity and/or exceedances of applicable numeric water quality objectives and *ILRP* Trigger Limits have been observed. To identify those landowners operating in high priority lands, the Coalition identifies the assessor parcels and subsequently the owners of agricultural operations nearest the water bodies of interest. From the list of assessor parcel numbers, the Coalition identifies its members and mails to them an advisory notice along with information on how to address the specific exceedances using BMPs. This same approach was also used to conduct management practice surveys in areas targeted by the Management Plan.

General Outreach Efforts

Highlights of outreach efforts conducted by the Coalition and its partners for specific subwatersheds during the monitoring period are summarized in an Excel table for each watershed in **Appendix F**. Available outreach materials are also included as attachments in **Appendix F**.

Summary of Farm Evaluation Data

The WDR requires that the Coalition collect and aggregates summarized information from Farm Evaluations. The summary of the management practice data includes:

- A data quality assessment of the information by township
- description of corrective actions to be taken regarding any deficiencies in the quality of data submitted

This information is provided as a separate report developed by Michael Johnson, LLC (MLJ) for SVWQC (Farm Evaluation Summary Report). The 2016 Farm Evaluation Summary Report will be submitted to the Water Board by June 30, 2017.

Conclusions and Recommendations

The Coalition submits this *2016 Annual Monitoring Report (AMR)* as required under the Water Board's Irrigated Lands Regulatory Program (*ILRP*). The AMR provides a detailed description of our monitoring results as part of our ongoing efforts to characterize irrigated agricultural and wetlands related water quality in the Sacramento River Basin.

To summarize, the results from the *ILRP* monitoring in 2016 continue to indicate that with few exceptions, there are no major water quality problems with agricultural and managed wetlands discharges in the Sacramento River Basin.

This AMR characterizes potential water quality impacts of agricultural drainage from a broad geographic area in the Sacramento Valley from October 2015 through September 2016. To date, a total of 127 Coalition storm and irrigation season events have been completed since the beginning of Coalition monitoring in January 2005, with additional events collected by coordinating programs and for follow-up evaluations. For the period of record in this AMR (October 2015 through September 2016), samples were collected for eight scheduled monthly events and 2 wet weather ("storm") events.

Pesticides were infrequently detected (~2.3% of all pesticide results for 2016 were detected), and, when detected, rarely exceeded applicable objectives. Only one registered pesticide, chlorpyrifos, exceeded applicable water quality objectives or *ILRP* Trigger Limits during the current monitoring year.

Many of the pesticides specifically required to be monitored in the past by the *ILRP* have rarely been detected in Coalition water samples, including glyphosate, paraquat, and all of the pyrethroid pesticides. Over 98.3% of all pesticide analyses performed to date for the Coalition have been below detection. Coalition monitoring of pesticides for the *ILRP* for 2016 was conducted based on Management Plan requirements and on reported pesticide use and relative toxicity risks for pesticides in the subwatersheds. The Coalition also conducted focused monitoring of the *ILRP*-required trace elements (arsenic, cadmium, lead, molybdenum, nickel, selenium, and zinc) informed by the Coalition's past monitoring results, which have demonstrated that most of these metals rarely approach or exceed objectives and are not likely to cause adverse impacts to aquatic life or human health in waters receiving agricultural runoff in the Coalition watershed. This focused strategy for monitoring pesticides and trace metals was implemented in 2010 in accordance with the Coalition's 2009 MRP (*Order No. R5-2009-0875*, CVRWQCB 2009), and this same strategy is consistent with the requirements of the current WDR and MRP (*Order No. R5-2014-0030*).

The majority of exceedances of adopted numeric objectives continue to consist of conductivity, dissolved oxygen, and *E. coli*. Agricultural runoff and irrigation return flows may contribute to exceedances of these objectives, but these parameters are primarily controlled or significantly affected by natural processes and sources that are not controllable by agricultural management practices.

The Coalition has implemented the required elements of the *ILRP* since 2004. The Coalition developed a Watershed Evaluation Report (WER) that set the priorities for development and implementation of the initial Monitoring and Reporting Program Plan (MRPP). The Coalition successfully developed the MRPP, QAPP, and Management Plan as required by the *ILRP*, and these documents were approved by the Water Board. Subsequent revisions requested by the

Water Board and the Coalition were incorporated into the Coalition’s program and implemented through the Coalition’s ongoing *ILRP* monitoring efforts. The Coalition also continues to adapt and improve elements of the monitoring program based on the knowledge gained through *ILRP* monitoring efforts.

The 2016 monitoring program was developed to be consistent with the requirements of the current WDR and MRP (*Order No. R5-2014-0030*) and was approved by the Regional Water Board for this purpose with the understanding that it would serve as the first “Non-Assessment” monitoring period for the new MRP. The Coalition has implemented the approved monitoring program in coordination with its subwatershed partners, has initiated follow-up activities required to address observed exceedances, and continued to implement the previously approved Management Plan while updating the CSQMP in 2016. Throughout this process, the Coalition has kept an open line of communication with the Water Board and has made every effort to fulfill the requirements of the *ILRP* in a cost-effective, scientifically defensible, and management-focused manner. This AMR is documentation of the success and continued progress of the Coalition in achieving these objectives.

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Appendices

The following appendices are available in electronic form on the CD provided.

Appendix A: Field Log Copies

Appendix B: Lab Reports and Chains-of-Custody

Appendix C: Tabulated Monitoring Results

Appendix D: Exceedance Reports

Appendix E: Site-Specific Drainage Maps

Appendix F: SVWQC Outreach Materials

Appendix G: Trend Analysis Results