Waste Discharge Requirements for Sacramento Valley Rice Growers 2015 Annual Monitoring Report

March 2016

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Prepared for

California Rice Commission

California Rice

Prepared by

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FINAL

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Prepared for

Central Valley Regional Water Quality Control Board

On Behalf of

California Rice Commission

March 2016

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Acronyms and Abbreviations

°F	degree(s) Fahrenheit
µg/L	microgram(s) per liter
µmho/cm	micromho(s) per centimeter
AMR	Annual Monitoring Report
Basin Plan	*Water Quality Control Plan for the Sacramento and San Joaquin River Basins*
CAC	County Agricultural Commissioner
cfs	cubic foot (feet) per second
CLS	California Laboratory Services
COC	chain-of-custody
CRC	California Rice Commission
CVRWQCB	Central Valley Regional Water Quality Control Board
CWA	Clean Water Act
CWFR	Conditional Waiver for Rice
DO	dissolved oxygen
DPR	California Department of Pesticide Regulation
DWR	California Department of Water Resources
EC	electrical conductivity
LCS	laboratory control spike
LCSD	laboratory control spike duplicate
MCL	maximum contaminant level
mg/L	milligram(s) per liter
MRL	method reporting limit
MRP	Monitoring and Reporting Program
MRP Order	Monitoring and Reporting Program Order
MS	matrix spike
MSD	matrix spike duplicate
N	nitrogen
ND	non-detect
NPS	nonpoint source
NTU	nephelometric turbidity unit(s)
PCA	Pest Control Adviser
PUR	Pesticide Use Report
QA	quality assurance

QAO	quality assurance objective
QAPP	Quality Assurance Project Plan
QC	quality control
RPD	relative percent difference
SE	sample event
TOC	total organic carbon
TMDL	total maximum daily load
TSS	total suspended solids
UC	University of California
UC IPM	University of California Integrated Pest Management
WDR	water discharge requirements
WQO	water quality objective

Executive Summary

The California Rice Commission (CRC) is a statutory organization representing approximately 2,500 rice farmers who farm approximately 550,000 acres of Sacramento Valley farmland. The California rice industry contributes significantly to the foundation of many rural economies, and rice fields provide an array of environmental benefits, including habitat for local and migrating birds and other aquatic and upland species.

The CRC performs surface water monitoring pursuant to the rice-specific Waste Discharge Requirements (Rice WDR) Order No. R5-2014-0032 (Central Valley Regional Water Quality Control Board [CVRWQCB] 2014). This Rice WDR Order implements the long-term Irrigated Lands Regulatory Program for rice lands in the Sacramento Valley and regulates landowners and operators of rice lands from which there are discharges of waste that could affect the quality of any waters of the state (CVRWQCB 2014).

In 2015, the CRC completed eight comprehensive surface water quality monitoring events during the rice growing season. Seven project-specific drain locations were sampled during each event, providing a snapshot of water quality during the rice growing season. A suite of water quality parameters were monitored onsite at each event, including water temperature, pH, dissolved oxygen (DO), electrical conductivity (EC), turbidity, and flow. In addition, water samples were collected for laboratory analysis of total organic carbon (TOC), total suspended solids (TSS), nutrients (ammonia as N and nitrate/nitrite as N), pesticides (clomazone and propanil), and toxicity (of indicator species fathead minnow [*Pimephales promelas*], water flea [*Ceriodaphnia dubia*], and green algae [*Selenastrum capricornutum*]). In addition, sediment monitoring was conducted during one event in 2015, with samples analyzed for toxicity (*Hyalella azteca)*, TOC, and grain size. The following summarizes the 2015 Rice WDR water quality results:

- **Water Temperature:** Temperature results indicate warm water conditions during the monitoring season. Water temperatures generally tracked with observed air temperatures, as seen in previous years; however, the peak temperature (84.8 degrees Fahrenheit) was observed during a June sampling event, which was unusual.
- **DO:** DO results were generally low, and at some monitoring sites, persisted at a low condition for the entire monitoring season. As in 2014, many of the observations were below the 7 milligrams per liter (mg/L) COLD water quality standard, likely attributable to the drought conditions.
- **EC:** The majority of EC observations were below 700 micromhos per centimeter (µmho/cm) in 2015. The observations of EC greater than 700 µmho/cm were limited to two sampling sites; one of the two had high EC at five of the seven sampling events in which EC was recorded.
- **Pesticides – Clomazone:** Samples were tested for clomazone at each of the first four sampling events. Concentrations ranged from non-detect (ND) to 12 micrograms per liter (µg/L), with the highest detections occurring during the late May and early June events, indicating that clomazone use trended late in 2015.
- **Pesticides – Propanil:** Samples were tested for propanil at each of the last four sampling events. Concentrations ranged from ND to 9.5 µg/L, with the highest detections occurring during the late June and early July events, indicating that propanil use also trended late in 2015.
- **Aquatic Toxicity:** Aquatic toxicity analyses were conducted on samples collected during three sampling events. Acute and chronic aquatic toxicity tests were performed on three test species: fathead minnow (*Pimephales promelas*), water flea (*Ceriodaphnia dubia*), and green algae (*Selenastrum capricornutum*). None of the samples had statistically significant toxicity, indicating that sampled waters were not toxic to these indicator organisms.

- **Sediment Parameters:** A sediment-specific sampling event was held in August 2015. Sediment samples were collected from sites with adequate bottom sediment and were analyzed for toxicity and TOC. None of the sediment samples had statistically significant toxicity to the test species (*Hyalella Azteca).* Because of these results, pesticide analysis was not required for these samples.

Monitoring year 2015 was generally typical; however, the persistent drought conditions have exacerbated existing water quality challenges. As the volume of water flowing through and out of rice fields has decreased because of smaller water allocations and longer required hold times, water temperature has increased and DO levels have decreased. In addition, environmental conditions such as higher air temperatures and generally lower flows in the Sacramento Valley have added to these trends. Implementation of management practices protective of water quality, along with additional educational outreach, monitoring, and management planning, will be important to track changes in these water bodies.

In early 2015, the CRC developed a web-based Farm Evaluation template that was approved by the CVRWQCB. The web-based template provides a convenient and streamlined approach to completing the Farm Evaluation for the Growers. In addition, the electronic database allows for robust summaries of the farm management practices information. The primary datasets collected are the Management Practices employed and the Acreage of Rice Grown on each field during the 2014 growing season. Other information was also collected, including Landowner Rice WDR Acknowledgement, Locations Water Leaving Property, Well Information, and Farm Maps. A review of the submitted rice farming information indicates that there was close to 100 percent reporting compliance by rice Growers for the 2014 growing season.

SECTION 1

Introduction

The California Rice Commission (CRC) is a statutory organization representing approximately 2,500 rice farmers who farm approximately 550,000 acres (est. 411,000 in 2015 due to drought conditions) of Sacramento Valley farmland. Rice is one of the top 20 crops produced in California and adds nearly a half billion dollars in revenue and thousands of jobs vital to the state's economy. The California rice industry contributes significantly to the foundation of many rural economies and the positive balance of international trade.

The CRC implements water quality monitoring and reporting activities in compliance with the rice-specific Waste Discharge Requirements (Rice WDR) Order R5-2014-0032 (Central Valley Regional Water Quality Control Board [CVRWQCB] 2014). This WDR Order implements the long-term Irrigated Lands Regulatory Program for rice lands in the Sacramento Valley and regulates landowners and operators of rice lands from which there are discharges of waste that could affect the quality of waters of the state (CVRWQCB 2014). The CRC acts as a third-party group representing and assisting the Growers to ensure the requirements of the Rice WDR Order are followed.

This report serves as the 2015 Annual Monitoring Report (AMR) for the Rice WDR and describes CRC-conducted program activities for the 2015 calendar year.

1.1 AMR Requirements

The AMR for the Rice WDR program covers monitoring conducted from November 1 of the previous year (2014) through October 31 of the current year (2015), even though the CRC completes and reports all results on an annual basis. The AMR has required components. The list of components and their location in this report are shown in Table 1-1.

Table 1-1. Location of Required AMR Information in this Report

Required Information	Location in this Report
Signed Transmittal Letter	Included with transmittal
Title Page	Front cover
Table of Contents	iii
Executive Summary	ix
Description of the CRC geographical area	Section 2
Monitoring objectives and design	Section 3
Sampling site descriptions and rainfall records for the time period covered under the AMR	Section 4
Location maps of sampling sites, crops, and land uses	Section 5
Summary of pesticides used on rice, including pounds of active ingredient applied and acreage, as well as any changes in label requirements	Section 6
Tabulated results of all analyses arranged in tabular form so that the required information is readily discernible	Section 7
Discussion of data relative to water quality objectives/trigger limits, and water quality management plan milestones, where applicable	Section 7
Proposed pesticide monitoring	Section 8

Table 1-1. Location of Required AMR Information in this Report

Required Information	Location in this Report
Electronic data submittal	Section 9
Sampling and analytical methods used	Section 10
Summary of quality assurance evaluation results	Section 11
Specification of the method(s) used to obtain estimated flow at each surface water monitoring site during each monitoring event	Section 7
Required every 3 years, an evaluation of monitoring data to identify spatial trends and patterns	Not required until the 2017 AMR
Electronic or hard copies of photos obtained from all monitoring sites, clearly labeled with site identification and date	Appendix A
Summary of exceedances of water quality objectives/trigger limits occurring during the reporting period and related pesticide use information	Sections 6 and 13
Actions taken to address water quality exceedances that have occurred, including but not limited to, revised or additional management practices implemented	Section 13
Status update on preparation and implementation of all management plans and other special projects	Section 14
Summary of management practice information collected as part of Farm Evaluations	Section 15
Summary or updates of mitigation monitoring	Section 16
Summary of education and outreach activities	Section 17
Summary of nitrogen management plan reporting, if applicable	Section 18
Conclusions and recommendations	Section 19

SECTION 2

CRC Geographical Area

The CRC geographical area includes nine Sacramento Valley rice-growing counties: Butte, Colusa, Glenn, Placer, Sacramento, Sutter, Tehama, Yolo, and Yuba. Rice is also farmed in counties outside the Sacramento Valley; however, the acreages are generally small, and rice is not the dominant crop in those areas. For the purposes of the rice-specific Monitoring and Reporting Program (MRP), the monitoring area is defined as the nine contiguous rice-producing counties in the Sacramento Valley.

The Sacramento Valley is surrounded by the Coast, Cascade, and Sierra Nevada mountain ranges, which have eroded through time to fill the valley with alluvial soils. The Sacramento Valley soils used for farming rice tend to have high clay content, have a duripan or claypan in the subsoil, or both. These soil features make flooding of the fields possible by restricting the downward flow of water through the soil. As a result, the soils of the Sacramento Valley are uniquely suited to growing rice.

Although rice fields are irrigated via surface water, the Sacramento Valley overlies one of the largest groundwater basins in the state. The groundwater underlying the Sacramento Valley provides high quality water for irrigation, municipal, industrial, and domestic uses. Changes in climate, rate of precipitation and runoff, and environmental regulation have increased the reliance on groundwater in the Sacramento Valley. The current Rice WDR identifies rice acreage as low vulnerability for nitrates, and requires trend monitoring of groundwater quality under rice fields. Therefore, this AMR focuses on surface water monitoring activities for the 2015 growing season.

2.1 California Rice

Rice fields provide numerous environmental and commercial advantages that no alternative land use would, including providing a variety of upland and shallow aquatic habitat. Rice farmers flood their fields in the winter to degrade the straw residue leftover after harvest, reducing the need to burn the rice straw and providing important wildlife habitat. The routine flooding of rice fields during the growing season also contributes to favorable habitat conditions. More than 230 species of wildlife and millions of migratory waterfowl thrive in California rice fields. In 2003, California rice lands were designated as shorebird habitat of international significance by the Manomet Center for Conservation Sciences in partnership with the Western Hemisphere Shorebird Reserve Network.

In 2015, an estimated 452,824 acres of rice were planted in the nine contiguous rice-growing counties of the Sacramento Valley, as reported by the County Agricultural Commissioners (CACs) based from pesticide use reporting. The CAC acreage numbers are preliminary and usually higher than actual planted acres because of accounting through pesticide applications; multiple applications on a single acre can result in double counting of acreage under the CAC method. The more realistic acreage estimate is 411,000 acres from the National Agricultural Statistics Survey (NASS) of the U.S. Department of Agriculture (NASS/USDA). Table 2-1 presents the planted acreage by county.

Table 2-1. 2015 Planted Acreage by County (as reported by the CACs)

County	Planted Acreage (percent change from 2014)
Butte	80,000 (down 14.4% from 93,500)
Colusa	108,668 (down 6.5% from 116,250)
Glenn	80,738 (up 13.1% from 71,385)
Placer	14,471 (up 6.3% from 13,614)
Sacramento	8,829 (up 3.3% from 8,548)
Sutter	89,636 (down 0.3% from 89,871)
Tehama	160 (no change from 2014)
Yolo	31,456 (up 2.5% from 30,680)
Yuba	38,866 (up 0.6% from 38,628)
Total	**452,824 (down 2.1% from 462,636)**

SECTION 3

Monitoring Objectives and Design

This section provides an overview of the monitoring and reporting requirements of the Rice WDR MRP, including the overall purpose and objectives, an overview of requirements, and a discussion of sampling schedule and constituents.

3.1 Purpose and Objectives

The purpose of the Rice WDR MRP is to monitor the discharge of wastes in irrigation return flows and stormwater from irrigated rice lands. These objectives are consistent with the State of California's nonpoint source (NPS) policy and include the following:

- Determine whether the discharge of waste from irrigated lands within the CRC Coalition boundaries causes or contributes to exceedances of applicable water quality standards or causes a nuisance.
- Provide information about the CRC Coalition area characteristics, including but not limited to land use, crops grown, and chemicals used.
- Monitor the effectiveness of management practices implemented to address exceedances of applicable water quality standards.
- Determine which management practices are most effective in reducing wastes discharged to surface waters from irrigated lands.
- Specify details about monitoring periods, parameters, protocols, and quality assurance (QA).
- Support the development and implementation of the Rice WDR.
- Verify the adequacy and effectiveness of the Rice WDR's conditions.
- Evaluate the CRC Coalition's compliance with the terms and conditions of the Rice WDR.

3.2 Overview of Monitoring Requirements

In March 2014, the CVRWQCB adopted Rice WDR Order No. R5-2014-0032, which outlines the requirements for water quality monitoring and reporting activities and regulates landowners and operators of rice lands from which there are discharges of waste that could affect the quality of waters of the state (CVRWQCB 2014). Consistent with the approach outlined in the Rice WDR MRP, the CRC's approach for its monitoring program includes three types of monitoring conducted on a 5-year rotation:

- Core monitoring at primary sites to track trends
- Assessment monitoring at primary and secondary sites to determine the condition of a water body
- Modified assessment monitoring at primary and secondary sites to provide additional pesticide information

In addition, special project monitoring may be used where monitoring identifies a specific water quality challenge.

3.2.1 Core Monitoring

Core monitoring sites and constituents are used to measure trends at the selected representative sites over extended periods of time. The core monitoring component of the monitoring strategy was designed to:

- Focus on a diversity of monitoring sites across the rice area (hydrology, size, and flow).
- Include sites that have been shown to be characteristic of rice farming areas within the CRC Coalition boundaries.
- Provide scientific rationale for the site selection process based on the assessment monitoring, existing monitoring projects, or historical information.
- Include water bodies that carry agricultural drainage, are dominated by agricultural drainage, or are otherwise affected by other irrigated agriculture activities.
- Establish status and trend relationships between management practice information and water quality monitoring information.
- In conjunction with assessment monitoring, demonstrate the effectiveness of management practices and implement new management practices as needed.
- Use established trend information about the effectiveness of the CRC Coalition's efforts to reduce or eliminate the impact of irrigated agriculture on surface waters.

3.2.2 Assessment Monitoring

Assessment monitoring is used to provide supporting data for sites that the CRC Coalition selects as core monitoring sites for trends. Supporting data also may allow some monitoring sites to be considered representative of other locations within the CRC Coalition study area. The assessment monitoring component of the monitoring strategy was designed to:

- Focus on a diversity of monitoring sites across the CRC Coalition's area (hydrology, size, and flow).
- Evaluate different types of water bodies.
- Include a sufficient number of sampling sites to assess the entire CRC Coalition area and all drainages.
- Include sampling sites in areas of known water quality impairments, even if they are not currently identified on the Clean Water Act (CWA) 303(d) listing.
- Include sampling sites that are compliance monitoring sites for total maximum daily loads (TMDLs), where the CRC Coalition conducts implementation.
- Provide scientific rationale for the site selection process based on historical and/or ongoing monitoring, drainage size, crop types and distribution, and topography and land use.
- Conduct the initial focus of monitoring on water bodies that carry agricultural drainage or are dominated by agricultural drainage.
- Identify priorities with respect to sampling of specific watersheds, subwatersheds, and water quality parameters.
- In conjunction with core monitoring for trends and special projects focused on specific problems, demonstrate the effectiveness of management practices, and identify locations for implementation of new management practices, as needed.

3.2.3 Special Project Monitoring

Special project monitoring includes specific targeted studies that are incorporated into the Rice WDR MRP to implement a TMDL, a management plan that results from exceedances, or other types of focused investigation that may assist in addressing data gaps or other technical evaluations. Management plans are required when more than one exceedance of the same constituent occurs at a given site within a 3-year period.

3.3 General Rice WDR Sampling Schedule

Monitoring requirements defined by the 2014 Rice WDR MRP incorporate a 5-year cycle of assessment monitoring and core monitoring. The schedule began in 2015 with assessment monitoring and will be followed by a year of modified assessment monitoring (2016) and then 3 years of core monitoring (2017, 2018, and 2019).

As described previously, each type of monitoring has a different set of requirements. Table 3-1 shows the requirements for each type of monitoring that will be collected under the Rice WDR. Since 2015 was a year for assessment monitoring, the full suite of parameters was collected.

Table 3-1. Monitoring Requirements by Monitoring Type

	Type of Monitoring		
	Assessment (2015)	**Modified Assessment (2016)**	**Core (2017, 2018, 2019)**
Monitoring sites	**Primary:** CBD5, BS1, CBD1, and SSB **Secondary:** F, G, and H	**Primary:** CBD5, BS1, CBD1, and SSB **Secondary:** F, G, and H	**Primary:** CBD5, BS1, CBD1, and SSB
Constituents to be monitored	Field and general parameters Nutrients Pesticides Water column toxicity Sediment toxicity, TOC, and grain size	Field and general parameters Nutrients Pesticides	Field parameters Pesticides

Note:

TOC = total organic carbon

3.4 Monitoring Schedule Development Approach

The monitoring schedule is based on the timing and frequency of discharge from rice fields and constituents specific to the crop. The current monitoring periods were developed based on the understanding of the rice growing season and an analysis of historical data, including data collected under the Conditional Waiver for Rice (CWFR).

The monitoring calendar was been developed to focus sampling to match the rice growing season and the periods of peak pesticide application. Therefore, the monitoring schedule provides for water quality assessment during the period where peak rice-pesticide applications and/or releases occur. A typical monitoring calendar is established in the Rice WDR MRP, but annual weather conditions, water availability, and other factors may affect planting and pesticide application; therefore, the actual start date of monitoring is established annually to ensure that sampling activities bracket the actual pesticide use season.

The basic monitoring schedule, with parameters, is shown in Table 3-2.

Table 3-2. Rice WDR Basic Monitoring Schedule

Rice Farming Calendar	Month	Parameters
Winter drainage	Mid-February through March	No monitoring
Irrigation season	April through August	Field measurements concurrent with all sampling events. General physical parameter and nutrient monitoring at two monthly sampling events. Pesticides monitored twice during the month of peak application (assessment, modified assessment, and core monitoring), and twice in the month following peak application (assessment and modified assessment monitoring). Toxicity monitored for 3 months starting with pesticide monitoring (*selenastrum)* and for 2 months starting with pesticide monitoring (*C. dubia,* minnow).
Fall drainage	Mid-August through September	Sediment toxicity, TOC, and grain size during assessment years.
Winter flood	October through mid-February	No monitoring

3.5 Required Constituents

The Rice WDR MRP specifies the constituents for which monitoring and laboratory analyses are to be conducted under each type of monitoring. Table 3-3 presents the required constituents and sampling frequency by monitoring type.

Table 3-3. Monitoring Constituents and Frequency for Each Monitoring Type

Constituent	Type of Monitoring	Frequency
Field parameters: pH EC DO Temperature Flow	Core (primary sites only) Assessment and modified assessment (primary and secondary sites)	All sampling events
General physical parameters: Turbidity TSS TOC	Assessment and modified assessment (primary and secondary sites)	Two monthly sampling events
Nutrient Analysis: Nitrate + nitrite as N Total ammonia as N	Assessment and modified assessment	Two monthly events during growing season
Photo monitoring (digital)	Assessment, modified assessment, and core	To be taken initially and as needed to document site changes that could affect monitoring results
Rice WDR pesticides (determined annually)	Assessment, modified assessment, and core	Core – two sampling events during the month of peak application. Assessment – two sampling events during month of peak application, and two sampling events in the month following peak application

Table 3-3. Monitoring Constituents and Frequency for Each Monitoring Type

Constituent	Type of Monitoring	Frequency
Water column toxicity[a]: *Selenastrum capricornutum* *Ceriodaphnia dubia* *Pimephales promelas*	Assessment only	Three monthly events starting with pesticide monitoring (*Selenastrum capricornutum)* Two monthly events starting with pesticide monitoring *(Ceriodaphnia dubia* and *Pimephales promelas)*
Sediment toxicity: *Hyalella azteca*[b]	Assessment only	One sampling event during fall drainage
Sediment pesticides: Lambda Cyhalothrin (s)-Cypermethrin	Assessment only, if triggered	Required only if sediment toxicity is observed[c]
Sediment TOC	Assessment only	Taken with sediment toxicity
Grain size	Assessment only	Taken with sediment toxicity

[a] Water column toxicity analyses shall be conducted on 100 percent (undiluted) sample for the initial screening with adequate sample volume collected to allow for the toxicity test and any subsequent analysis (dilution series, Toxicity Identification Evaluation [TIE] or pesticide analysis) required by the toxicity test results. See MRP Order R5-2014-0032 for detailed information.

[b,c] Sediment samples that show statistically significant toxicity to *Hyalella azteca* at the end of an acceptable test, and that exhibit ≥ 20% reduction in organism survival as compared to the control require pesticide analysis (for lambda cyhalothrin and (s)-cypermethrin) of the same sample to determine the possible cause of toxicity.

Notes:

EC = electrical conductivity
DO = dissolved oxygen
TOC = total organic carbon
TSS = total suspended solids

SECTION 4

Sampling Site Descriptions, Hydrology and Weather

This section provides descriptions of the sampling sites and information on the hydrology of the Sacramento River and weather in the Sacramento Valley during the 2015 monitoring season.

4.1 Sampling Site Description

Monitoring under the Rice WDR is conducted at primary and secondary sites. Figure 4-1 shows the locations of the primary and secondary monitoring sites; details about each site are shown in Table 4-1. Appendix A contains photos of each site taken at the first monitoring event in 2015.

Table 4-1. Rice WDR Primary and Secondary Monitoring Sites

Site Code	Site Name	CEDEN Station Code	Latitude	Longitude	Estimated Rice Area Captured by Station (acres)*	Site Type
CBD1	Colusa Basin Drain above Knights Landing	520XCBDKL	38.8125 N	-121.7731 W	171,165	Primary
CBD5	Colusa Basin Drain #5	520XCBDWR	39.1833 N	-122.0500 W	156,000	Primary
BS1	Butte Slough at Lower Pass Road	520XBTTSL	39.1875 N	-121.9000 W	183,617	Primary
SSB	Sacramento Slough Bridge near Karnak	520XSSLNK	38.7850 N	-121.6533 W	24,549	Primary
F	Lurline Creek; upstream site for CBD5	520CRCLCF	39.2184 N	-122.1512 W	--	Secondary
G	Cherokee Canal; upstream site for BS1	520CRCCCG	39.3611 N	-121.8675 W	--	Secondary
H	Obanion Outfall at DWR Pumping Plant on Obanion Road; upstream site for SSB	520CRCOOH	39.0258 N	-121.7272 W	--	Secondary

* As estimated in the "Basis for Water Quality Monitoring Program" report (CRC, 2004).

Notes:

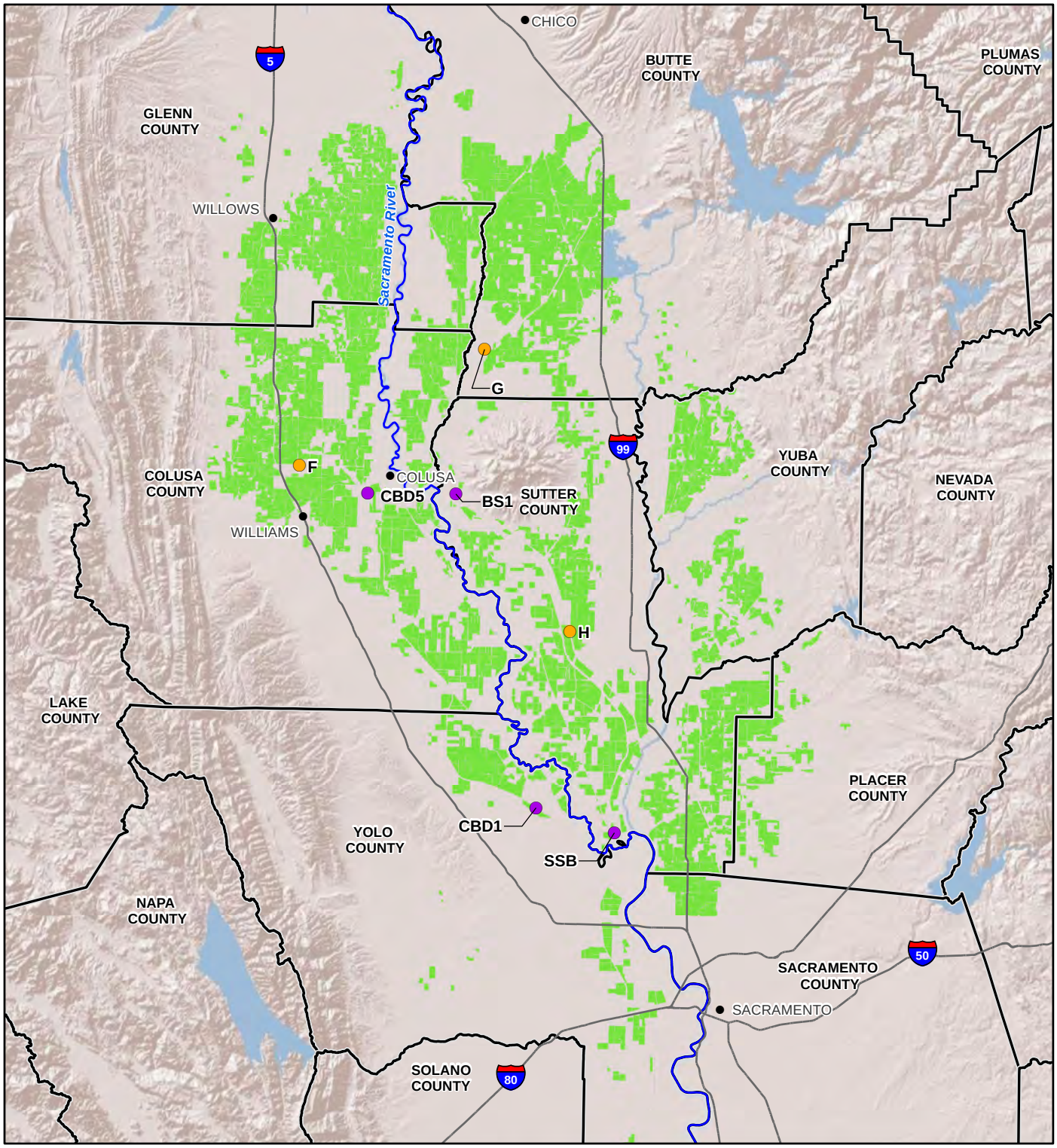
Coordinates are North American Datum of 1983 (NAD83).

DWR = California Department of Water Resources

4.2 Hydrology and Weather

Seasonal rainfall and weather conditions influence rice planting, harvest, and rice pesticide application. In 2015, fields were planted mid-April through May and drained in August and September. Rice harvest began in late August and continued through September 2015.

Flow data for the Sacramento River at Colusa (Station COL) were acquired from the California Department of Water Resources (DWR) California Data Exchange Center and precipitation and air temperature data for a sensor in Colusa (COLUSA.A) were obtained from the University of California Integrated Pest Management (UC IPM) California Weather Database. Data were collected for the 2015 Rice WDR monitoring period, November 1, 2014, through October 31, 2015. Flow and precipitation data for that time period are shown on Figure 4-2, and minimum and maximum air temperatures are shown on Figure 4-3.



LEGEND

- CITY
- COUNTY

MONITORING SITES

- PRIMARY SITE
- SECONDARY SITE
- RICE LAND 2015 PERMIT AREA

NOTES:

DATUM: NAD 1983.

SOURCES: BASEMAP (COPYRIGHT:© 2014 ESRI); RICE LANDS (CAL AG PERMIT, 2015); COUNTY (CAL FIRE 2007) ; HYDROLOGY (NHD ACCESSED MARCH 2014).

California Rice

0 6 12
Miles

N

FIGURE 4-1
2015 Sampling Sites and Rice Land Permit Areas
2015 Annual Monitoring Report
California Rice Comission

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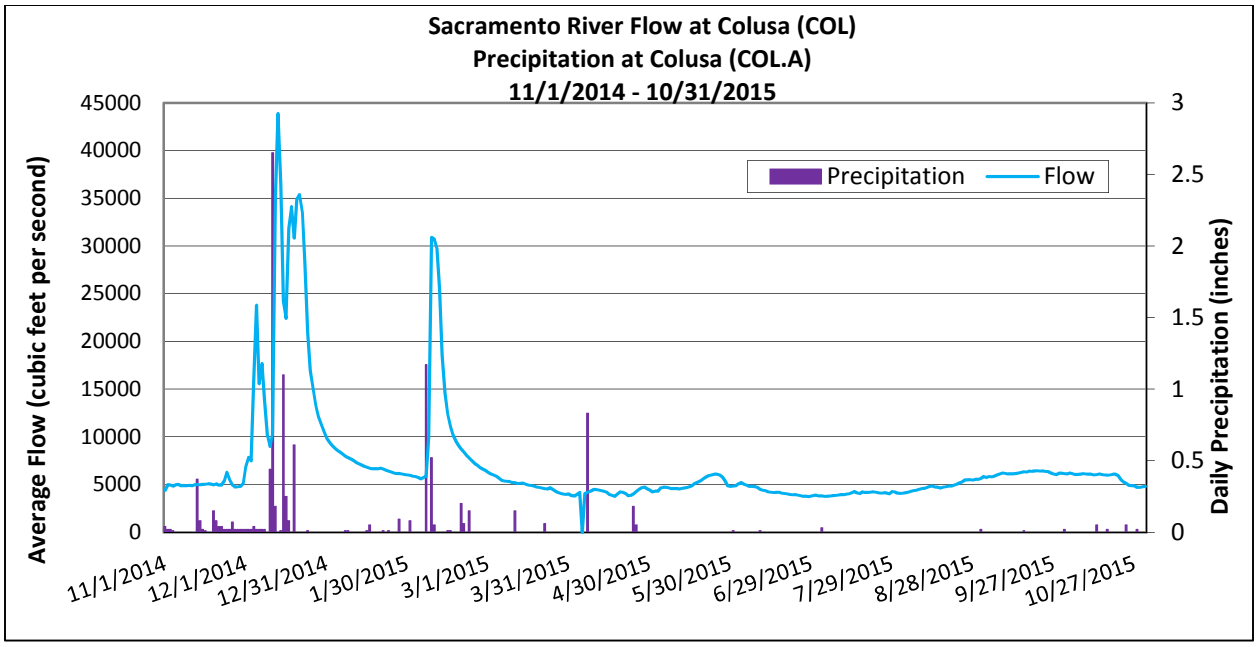


Figure 4-2. Flow and Precipitation Data, 2015

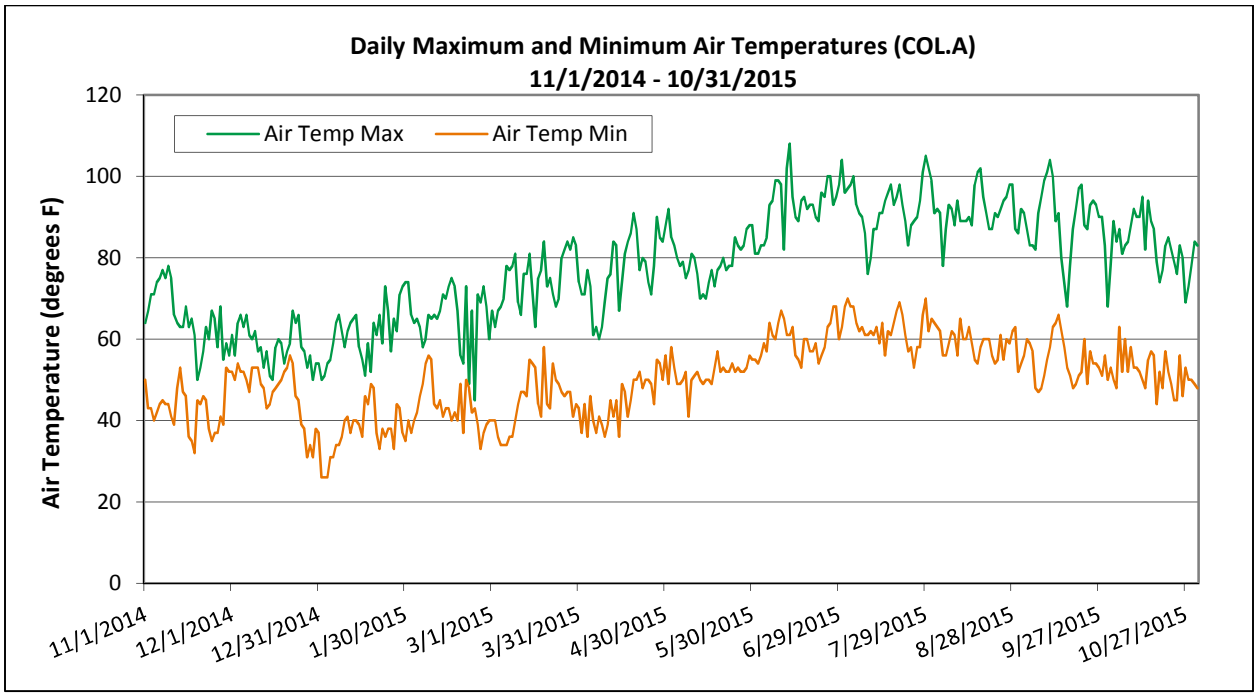


Figure 4-3. Daily Maximum and Minimum Air Temperatures, 2015

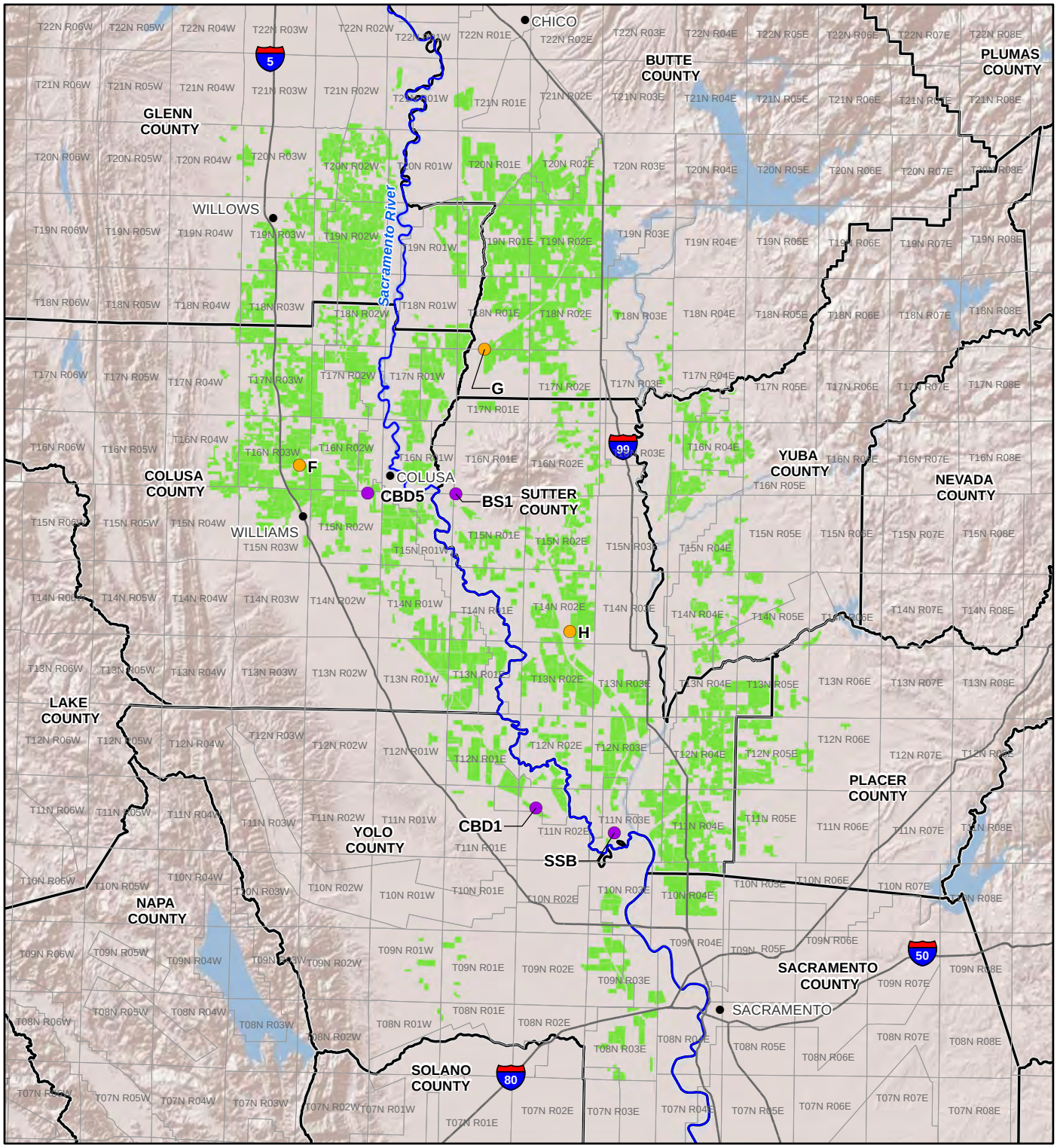
SECTION 5

Locations of Sampling Sites, Crops, and Land Uses

The extent of rice grown in the Sacramento Valley varies slightly from year to year, depending on crop prices, water availability, environmental, and other factors. Through the Farm Evaluation submittals by rice Growers in 2015, location and estimates of rice acreage grown in 2014 were compiled and mapped on Figure 5-1. A description of this data set is further provided in Section 15. Figure 5-1 includes the location of primary and secondary surface water and drain monitoring sites, major urban centers in the Sacramento Valley, counties, and the extent of rice crop grown in 2014 as reported in the Farm Evaluations. As shown on this map, rice crops cover a large portion of land uses in the Sacramento Valley. Other land uses include crops other than rice, ranches, wildlife refuges, native vegetation, and small urban areas.

The 2015 rice crop extent is shown along with the 2015 sampling locations, on Figure 4-1. This rice crop extent was compiled from the pesticide permit database (Cal Ag Permit) for the 2015 growing season. The 2015 rice extent map represents the active permits for rice growing and pesticide use for the 2015 growing season; however, some fields or portions of fields were fallowed this year, which is not reflected in this map. The 2015 Farm Evaluations will provide the actual acreage of rice planted locations, which will more closely reflect the acreage reported by the CACs. The updated map will be provided in the 2016 AMR.

The water quality results from the 2015 sampling season would reflect management practices implemented on the fields shown on Figure 4-1.



LEGEND

- CITY
- COUNTY

MONITORING SITES

- PRIMARY SITE
- SECONDARY SITE
- 2014 RICE LAND

NOTES:

DATUM: NAD 1983.

SOURCES: BASEMAP (COPYRIGHT:© 2014 ESRI); RICE LANDS (CRC, 2014); COUNTY (CAL FIRE 2007) ;HYDROLOGY (NHD ACCESSED MARCH 2014).

2014 RICE LAND: INFORMATION COLLECTED FROM FARM EVALUATIONS SUBMITTED BY GROWERS.

0 6 12
Miles
N

California Rice

FIGURE 5-1
2014 Rice Lands from Farm Evaluation and Sampling Sites
2015 Annual Monitoring Report
California Rice Comission

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SECTION 6

Summary of Pesticide Use, Application, and Acreage

The California Department of Pesticide Regulation (DPR) regulates the sale and use of pesticides in California, and enforces the agricultural uses. Growers, pesticide applicators, Pest Control Advisers (PCAs), and pest control operators report pesticide use to the CACs, and these data are included in the DPR Pesticide Use Report (PUR). DPR provides the CRC with early review/draft PUR data and enforcement data for inclusion in the annual report. Data presented in the following discussions of pesticide use and nutrient application are for the Sacramento Valley rice-growing counties.

6.1 Pesticide Use

The CACs report preliminary pesticide use information to DPR. All pesticide use numbers reported herein for 2015 are preliminary and have not been audited or quality control (QC) checked by DPR.

The pesticides with overall acreage increases in 2015 were carbaryl (+10,197 acres; increased in 2015 because of an armyworm outbreak), carfentrazone-ethyl (+1,192 acres), clothianidin (+319 acres), diflubenzuron (+183 acres), lambda cyhalothrin (+50,299 acres; increased in 2015 because of an armyworm outbreak), and pendimethalin (+8,018 acres).

The pesticides with acreage decreases in 2015 were azoxystrobin (-18,679 acres), bensulfuron-methyl (-17,742 acres), bispyribac-sodium (-6,298 acres), clomazone (-63,300 acres), cyhalofop-butyl (-4,378 acres), (s)-cypermethrin (-1,805 acres), penoxsulam (-18,845 acres), propanil (-53,230 acres), propiconazole (-15,518 acres), triclopyr TEA (-39,749 acres), and trifloxystrobin (-14,741 acres).

Thiobencarb and malathion uses and applications are discussed separately in the Rice Pesticide Program AMR.

According to the preliminary CAC data, overall planted acreage in 2015 decreased by 9,812 acres, or approximately 2.1 percent, from 462,636 acres (2014) to 452,824 acres (2015). Much of this decrease in pesticide use is due to the delay and restriction of water allocations resulting from the severe drought conditions. Pesticide use also changed in 2015 because of drought conditions. Some irrigation districts implemented no spill prohibition that caused Growers to keep water on the fields longer, making the pesticides with longer waterholding requirements an attractive option. In addition, resistance issues and an armyworm outbreak resulted in increases in the use of some insecticides.

Tables 6-1 and 6-2 show the preliminary Sacramento Valley rice herbicide data, including acres treated and pounds applied, respectively. Tables 6-3 and 6-4 show the preliminary Sacramento Valley rice insecticide data, including acres treated and pounds applied, respectively. Tables 6-5 and 6-6 show the preliminary Sacramento Valley rice fungicide data, including acres treated and pounds applied, respectively.

Table 6-1. Herbicides: Acres Treated, Sacramento Valley, 2015

	Acres Treated								
County	**Bensulfuron-methyl**	**Bispyribac-sodium**	**Carfentrazone-ethyl**	**Clomazone**	**Cyhalofop-butyl**	**Pendimethalin**	**Penoxsulam**	**Propanil**	**Triclopyr TEA**
Butte	13,407	21,666	5,681	49,017	6,231	266	28,927	58,913	53,089
Colusa	2,830	24,987	5,475	35,329	6,008	146	11,469	55,925	57,726
Glenn	3,707	21,826	8,676	20,844	2,537	0	9,336	49,999	41,725
Placer	374	1,443	1,623	4,478	2,183	298	4,604	7,511	6,643
Sacramento	0	1,380	0	1,769	2,767	1,301	2,593	7,392	5,623
Sutter	6,739	25,865	3,784	36,350	9,710	5,225	27,971	69,831	55,798
Tehama	75	0	0	0	0	0	0	75	75
Yolo	522	4,167	646	8,990	1,063	82	5,044	14,483	16,045
Yuba	494	6,672	888	28,455	1,816	700	13,824	4,629	4,384
Total acres	**28,148**	**108,006**	**26,773**	**185,232**	**32,315**	**8,018**	**103,768**	**268,758**	**241,108**

Note:

Data are preliminary and have not been audited or checked for error by DPR.

Table 6-2. Herbicides: Pounds Applied, Sacramento Valley, 2015

	Pounds Applied								
County	**Bensulfuron-methyl**	**Bispyribac-sodium**	**Carfentrazone-ethyl**	**Clomazone**	**Cyhalofop-butyl**	**Pendimethalin**	**Penoxsulam**	**Propanil**	**Triclopyr TEA**
Butte	717	709	840	19,970	2,081	264	1,034	315,795	8,377
Colusa	125	673	669	14,862	2,020	29	391	319,378	11,182
Glenn	220	778	1,296	9,367	853	0	321	270,146	6,852
Placer	21	37	306	1,620	676	282	172	39,279	1,470
Sacramento	0	43	0	699	956	1,276	91	38,791	1,147
Sutter	272	845	640	15,194	3,222	4,658	990	345,711	11,841
Tehama	4	0	0	0	0	0	0	450	7
Yolo	21	124	65	4,073	370	16	190	83,071	3,075
Yuba	29	220	153	10,817	633	496	478	24,336	958
Total pounds	**1,409**	**3,429**	**3,969**	**76,602**	**10,811**	**7,021**	**3,667**	**1,436,957**	**44,909**

Note:

Data are preliminary and have not been audited or checked for error by DPR.

Table 6-3. Insecticides: Acres Treated, Sacramento Valley, 2015

County	Acres Treated					
	Carbaryl	(s)-Cypermethrin	Clothianidin	Diflubenzuron	Lambda Cyhalothrin	Malathion*
Butte	2,347	40	416	138	61,467	416
Colusa	844	2,457	0	0	27,447	0
Glenn	959	6,133	0	183	31,357	671
Placer	0	636	0	255	5,840	0
Sacramento	85	84	0	0	4,556	1,188
Sutter	5,962	2,889	0	52	36,902	314
Tehama	0	0	0	0	0	0
Yolo	0	0	0	0	5,830	0
Yuba	0	388	0	0	21,706	0
Total acres	**10,197**	**12,627**	**416**	**628**	**195,105**	**2,589**

* Malathion use is addressed in the Rice Pesticides Program (RPP) AMR.

Note:

Data are preliminary and have not been audited or checked for error by DPR.

Table 6-4. Insecticides: Pounds Applied, Sacramento Valley, 2015

County	Pounds Applied					
	Carbaryl	(s)-Cypermethrin	Clothianidin	Diflubenzuron	Lambda Cyhalothrin	Malathion*
Butte	2,903	2	32	14	1,961	521
Colusa	1,073	113	0	0	812	0
Glenn	1,337	304	0	30	1,103	845
Placer	0	27	0	48	163	0
Sacramento	89	3	0	0	129	1,438
Sutter	6,838	122	0	10	1,213	380
Tehama	0	0	0	0	0	0
Yolo	0	0	0	0	185	0
Yuba	0	13	0	0	597	0
Total pounds	**12,240**	**584**	**32**	**102**	**6,163**	**3,184**

* Malathion use is addressed in the RPP AMR.

Note:

Data are preliminary and have not been audited or checked for error by DPR.

Table 6-5. Fungicides: Acres Treated, Sacramento Valley, 2015

	Acres Treated		
County	**Azoxystrobin**	**Propiconazole**	**Trifloxystrobin**
Butte	57,994	0	0
Colusa	46,289	240	240
Glenn	46,159	0	0
Placer	4,255	190	190
Sacramento	2,615	445	445
Sutter	28,424	6,657	6,657
Tehama	0	0	0
Yolo	9,502	601	601
Yuba	2,660	123	0
Total acres	**197,898**	**8,256**	**8,133**

Note: Data are preliminary and have not been audited or checked for error by DPR.

Table 6-6. Fungicides: Pounds Applied, Sacramento Valley, 2015

	Pounds Applied		
County	**Azoxystrobin**	**Propiconazole**	**Trifloxystrobin**
Butte	9,560	0	0
Colusa	8,177	35	35
Glenn	7,723	0	0
Placer	821	25	25
Sacramento	524	35	35
Sutter	5,453	628	628
Tehama	0	0	0
Yolo	1,908	74	74
Yuba	519	27	0
Total pounds	**34,685**	**824**	**797**

Note: Data are preliminary and have not been audited or checked for error by DPR.

SECTION 7

2015 Monitoring Results and Data Discussion

This section provides the 2015 sampling schedule, surface water sampling monitoring results, and a discussion of the data relative to water quality objectives (WQOs).

7.1 Sampling Schedule and Constituents

A rice-specific 2015 monitoring calendar was developed to sample water quality during the April through early August "irrigation season" and the late-August "drainage season." Table 7-1 lists the monitoring dates for 2015 and the constituents sampled at each event. No resampling was required in 2015.

Table 7-1. 2015 Sampling Calendar and Constituents

Sample Event	Sample Dates	Field Parameters	General Physical Parameters	Nutrients	Pesticides (as noted)	Toxicity	Sediment
April Event (SE1)	4/28/2015 and 4/29/2015	✓	-	-	Clomazone	-	-
May Event 1 (SE2)	5/12/2015 and 5/13/2015	✓	✓	✓	Clomazone	✓	-
May Event 2 (SE3)	5/26/2015 and 5/27/2015	✓	-	-	Clomazone	-	-
June Event 1 (SE4)	6/9/2015 and 6/10/2015	✓	✓	-	Clomazone, Propanil	✓	-
June Event 2 (SE5)	6/23/2015 and 6/24/2015	✓	-	-	Propanil	-	-
July Event 1 (SE6)	7/7/2015 and 7/8/2015	✓	-	✓	Propanil	✓	-
July Event 2 (SE7)	7/21/2015 and 7/22/2015	✓	-	-	Propanil	-	-
August Event (SE8)	8/25/2015 and 8/26/2015	✓	-	-	-	-	✓

Notes:

Field parameters include pH, electrical conductivity, dissolved oxygen, temperature, turbidity, and flow.

General physical parameters include total suspended solids and total organic carbon.

Nutrient parameters include nitrate/nitrite as N, and total ammonia as N.

Toxicity parameters include *Selenastrum capricornutum*, *Ceriodaphnia dubia*, and *Pimepahles promelas*

Sediment parameters include sediment toxicity, sediment TOC, grain size, and sediment pesticides.

7.2 Sample Results – Field Parameters

As described previously, field parameters collected in 2015 included pH, electrical conductivity (EC), dissolved oxygen (DO), water temperature, turbidity, and flow.

7.2.1 Water Temperature Measurements

Figure 7-1 shows the results of the 2015 field water temperature measurements. Temperatures in water bodies are typically lowest in the winter and highest in the summer; however, in 2015 that trend did not hold true. Sample Event 4 (SE4) had the highest average water temperature (80.9 degrees Fahrenheit [°F]), and the highest observed reading was at CBD1 during SE4 (84.8°F). This may be attributed to the higher temperatures experienced in the year 2015. According to the National Oceanic and Atmospheric Administration's (NOAA's) Climate Monitoring National Overview, California had a record-breaking warm period from January 2015 to May 2015, with temperatures 5.1°F above the average (NOAA, 2015).

Table 7-2 presents the temperature results and ranges for each event and site.

As in previous years, water temperature readings in these drains were generally above the *Water Quality Control Plan for the Sacramento and San Joaquin River Basins* (Basin Plan) WQO for the lower Sacramento River (68°F). During peak temperatures, these drain sites would not provide habitat for coldwater fisheries. Warmer temperatures in the drains are expected during times of drought, when longer hold requirements cause water to remain in shallow flooded fields for longer periods of time, raising temperatures. The warmer air temperatures in early 2015 likely influenced the temperatures in these shallow systems as well.

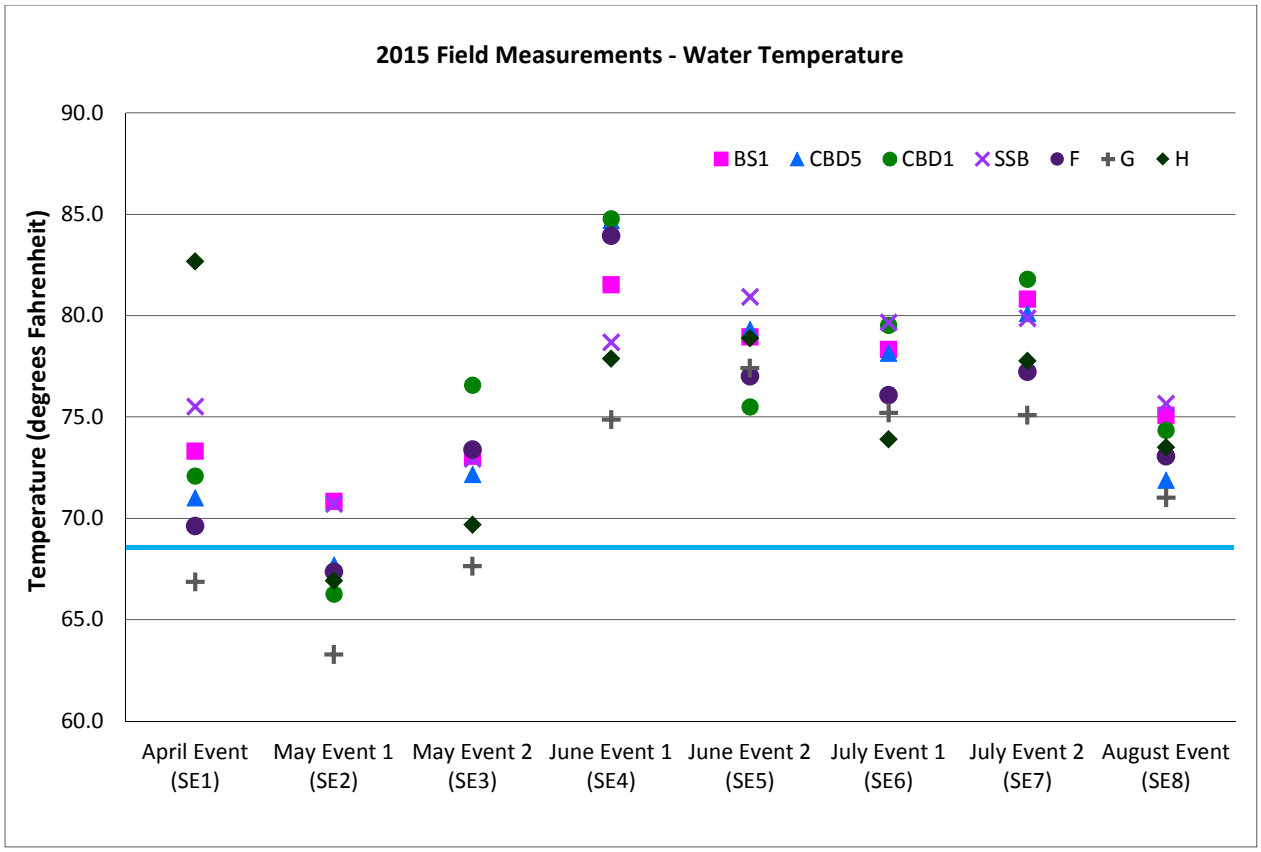

Figure 7-1. Water Temperature Measurements, 2015

Table 7-2. Water Temperature Measurement Results, 2015

Sample Event	Sample Dates	Water Temperature (°F)							Event Average (°F)	Event Temperature Range (°F)
		BS1	CBD5	CBD1	SSB	F	G	H		
April Event (SE1)	4/28/2015 and 4/29/2015	73.3	71.0	72.1	75.5	69.6	66.9	82.7	73.0	66.9–82.7
May Event 1 (SE2)	5/12/2015 and 5/13/2015	70.8	67.7	66.3	70.7	67.4	63.3	66.9	67.6	63.3–70.8
May Event 2 (SE3)	5/26/2015 and 5/27/2015	73.1	72.2	76.6	72.9	73.4	67.6	69.7	72.2	67.6–76.6
June Event 1 (SE4)	6/9/2015 and 6/10/2015	81.5	84.7	84.8	78.7	83.9	74.9	77.9	80.9	74.9–84.8
June Event 2 (SE5)	6/23/2015 and 6/24/2015	78.9	79.3	75.5	80.9	77.0	77.4	78.9	78.3	75.5–80.9
July Event 1 (SE6)	7/7/2015 and 7/8/2015	78.3	78.1	79.5	79.7	76.1	75.2	73.9	77.3	73.9–79.7
July Event 2 (SE7)	7/21/2015 and 7/22/2015	80.8	80.1	81.8	79.9	77.2	75.1	77.8	79.0	75.1–81.8
August Event (SE8)	8/25/2015 and 8/26/2015	75.1	71.9	74.3	75.7	73.1	71.0	73.5	73.5	71.0–75.7
Site Average (°F)		76.5	75.6	76.4	76.7	74.7	71.4	75.2		
Site Temperature Range (°F)		70.8–81.5	67.7–84.7	66.3–84.8	70.7–80.9	67.4–83.9	63.3–77.4	66.9–82.7		

7.2.2 DO Measurements

Figure 7-2 shows the results of the 2015 field DO measurements. Table 7-3 presents DO results, ranges of values, and the percentage of field DO readings less than 5 milligrams per liter (mg/L; the WARM water quality standard) and 7 mg/L (the COLD water quality standard).

DO values of less than 7 mg/L were observed at all sites, with the exception of Site F, and at all sampling events (Table 7-3).

DO values of less than 5 mg/L were observed at Sites BS1, CBD1, SSB, G, and H (Table 7-3). These observations occurred during SE4 (BS1), SE5 (CBD1 and G), SE6 (G), SE7 (CBD1, SSB, and G), and SE8 (SSB, G, and H). SE7 and SE8 had the most readings of less than 5 mg/L; both events had three sites falling below that mark. These results are consistent with prior observations, with low DO throughout the summer months.

Consistent with prior years, low DO persisted throughout the monitoring season. As is typical, the warm water temperatures in the later sampling events coincide with lower DO readings. Warm water temperatures contribute to low DO values because of the decrease in oxygen solubility with increasing temperature. Figure 7-3 shows oxygen solubility as a function of water temperature. Oxygen solubilities on the graph are approximate because additional factors, such as salinity, influence oxygen solubility.

As water temperature increases, oxygen solubility decreases and approaches the WQO of 7 mg/L DO (at approximately 95°F). As the oxygen solubility decreases, biological activity (such as microorganisms breaking down detritus or other organic matter) may consume enough oxygen to depress DO below the WQO, particularly under warm conditions. Water temperature is likely a main cause of the low DO in these water bodies; the recent drought conditions (causing shallower water depths) and elevated air temperatures are likely leading to higher in-stream water temperatures.

Other factors that may contribute to low DO include in-stream biological oxygen demand from high organic loads and productive algal communities (resulting from available nutrients) and the diurnal oxygen depletion resulting from nighttime algae uptake and/or uniform channel character that limits natural aeration.

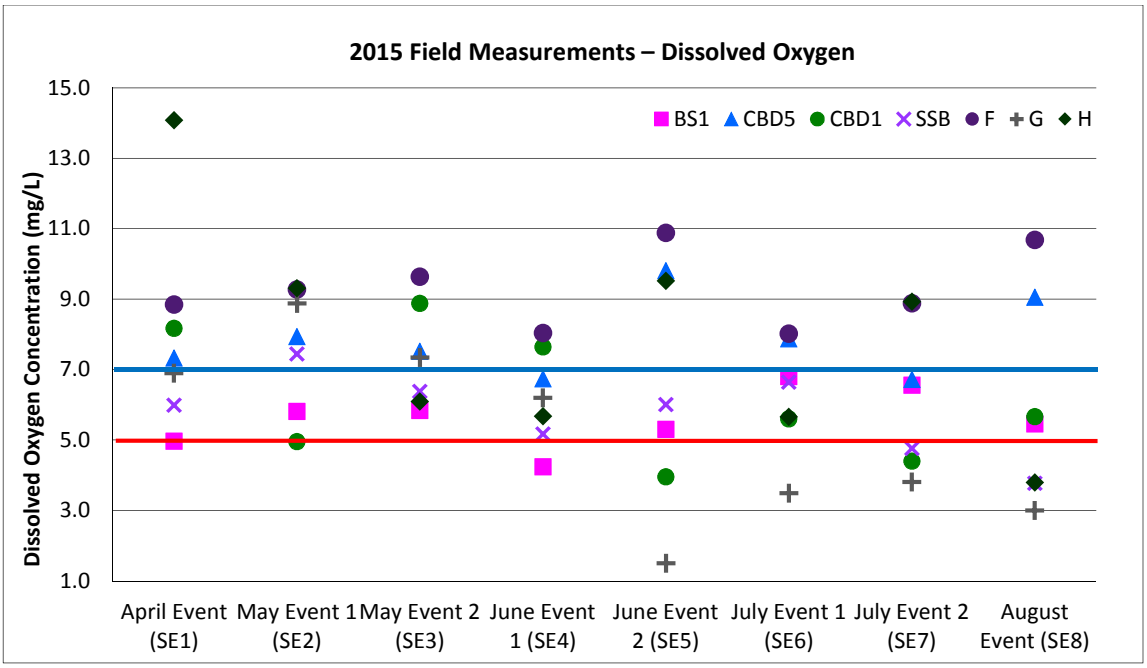

Figure 7-2. Field Measurements for Dissolved Oxygen, 2015

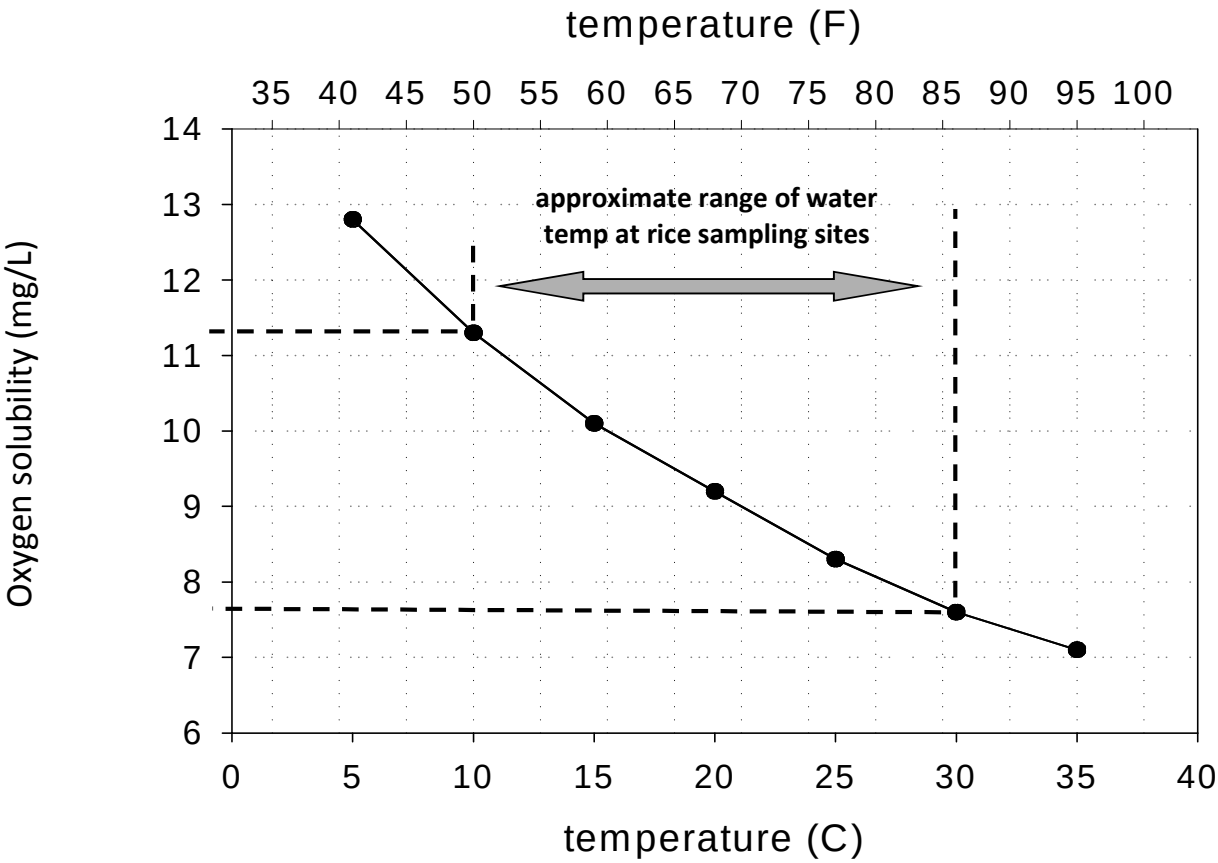

Figure 7-3. Oxygen Solubility as a Function of Temperature

Table 7-3. Dissolved Oxygen Field Measurement Results, 2015

Sample Event	Sample Dates	Dissolved Oxygen Concentration (mg/L)							Event Average, mg/L	Event DO Range, mg/L	Percent of obs. DO<7 mg/L	Percent of obs. DO<5 mg/L
		BS1	CBD5	CBD1	SSB	F	G	H				
April Event (SE1)	4/28/2015 and 4/29/2015	**4.97**	7.33	8.18	**6.00**	8.85	**6.90**	14.08	8.04	4.97–14.08	43%	14%
May Event 1 (SE2)	5/12/2015 and 5/13/2015	**5.81**	7.94	**4.96**	7.45	9.27	8.88	9.31	7.66	4.96–9.31	29%	14%
May Event 2 (SE3)	5/26/2015 and 5/27/2015	**5.84**	7.52	8.88	**6.39**	9.64	7.35	**6.09**	7.39	5.84–9.64	43%	0%
June Event 1 (SE4)	6/9/2015 and 6/10/2015	**4.24**	**6.74**	7.65	**5.18**	8.04	**6.20**	**5.68**	6.24	4.24–8.04	71%	14%
June Event 2 (SE5)	6/23/2015 and 6/24/2015	**5.31**	9.81	**3.96**	**6.02**	10.89	**1.50**	9.52	6.71	1.50–10.89	57%	29%
July Event 1 (SE6)	7/7/2015 and 7/8/2015	**6.81**	7.87	**5.61**	**6.65**	8.02	**3.49**	**5.66**	6.30	3.49–8.02	71%	14%
July Event 2 (SE7)	7/21/2015 and 7/22/2015	**6.56**	**6.72**	**4.41**	**4.77**	8.89	**3.81**	8.93	6.30	3.81–8.93	71%	43%
August Event (SE8)	8/25/2015 and 8/26/2015	**5.46**	9.06	**5.67**	**3.78**	10.69	**3.00**	**3.80**	5.92	3.00–10.69	71%	43%
Event Average, mg/L		5.62	7.87	6.16	5.78	9.28	5.14	7.88				
Site DO Range, mg/L		4.24–6.81	6.72–9.81	3.96–8.88	3.78–7.45	8.02–10.89	1.50–8.88	3.80–14.08				
Percent of obs. DO<7 mg/L		100%	25%	63%	88%	0%	75%	50%				
Percent of obs. DO<5 mg/L		25%	0%	38%	25%	0%	50%	13%				

Note:

Bold values are those less than the WQO of 7 mg/L.

7.2.3 pH Measurements

Figure 7-4 shows the results of the 2015 field pH measurements, and Table 7-5 presents pH results, site and event ranges, as well as the percentage of pH observations less than 6.5 or greater than 8.5, which are the Basin Plan WQOs for pH. In 2015, only one observation fell outside the 6.5 to 8.5 pH range, the Site H sample from SE1. This measurement was above 8.5 during the first sampling event of the season. Throughout the rest of the sampling season, the pH value at that location dropped and stayed below 8.5 (and above 6.5); therefore, this early season high pH may be an outlier or an artifact of field preparation that subsequently stabilized. The average measurement from Site F at SE3 yielded a result of 8.5, which meets the WQO.

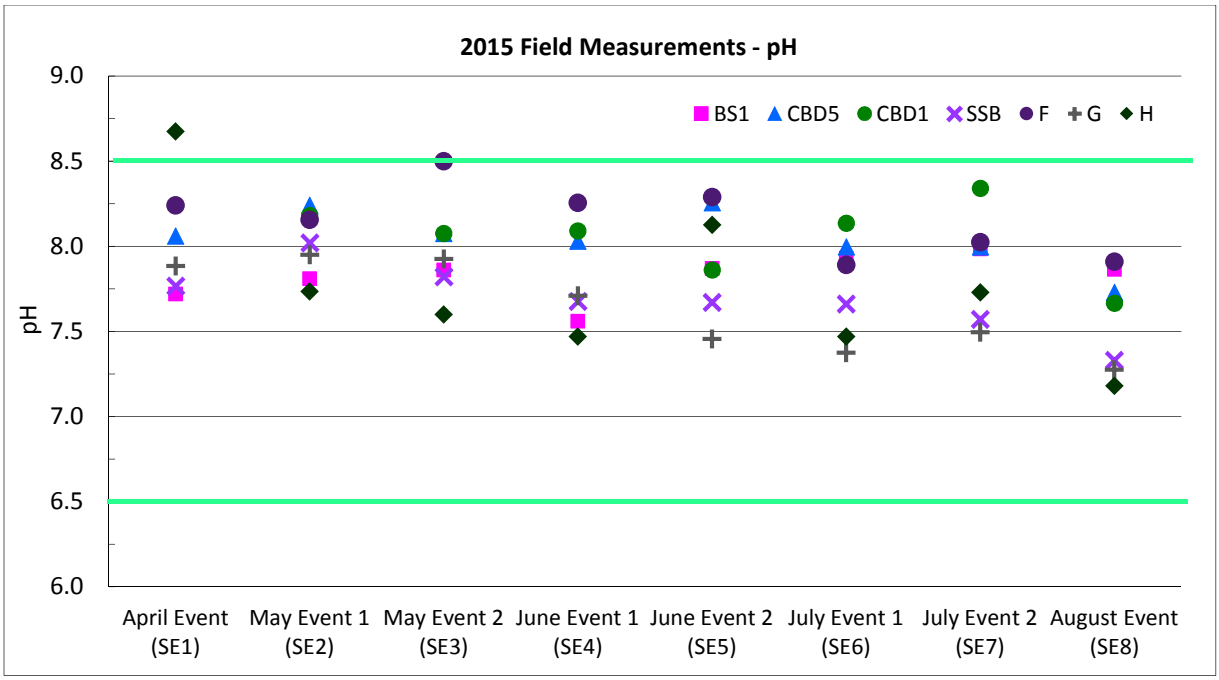

Figure 7-4. Field pH Measurements, 2015

Table 7-5. pH Field Measurement Results, 2015

Sample Event	Sample Dates	pH							Event pH Average	Event pH Range	Percent of obs. pH<6.5	Percent of obs. pH<8.5
		BS1	CBD5	CBD1	SSB	F	G	H				
April Event (SE1)	4/28/2015 and 4/29/2015	7.72	8.06	8.24	7.77	8.24	7.89	**8.68**	8.08	7.72–8.24	0%	14%
May Event 1 (SE2)	5/12/2015 and 5/13/2015	7.81	8.24	8.18	8.02	8.16	7.95	7.74	8.01	7.81–8.24	0%	0%
May Event 2 (SE3)	5/26/2015 and 5/27/2015	7.86	8.08	8.08	7.82	8.50	7.93	7.60	7.98	7.82–8.08	0%	0%
June Event 1 (SE4)	6/9/2015 and 6/10/2015	7.56	8.03	8.09	7.68	8.26	7.71	7.47	7.83	7.56–8.09	0%	0%
June Event 2 (SE5)	6/23/2015 and 6/24/2015	7.87	8.26	7.86	7.67	8.29	7.46	8.13	7.93	7.67–8.26	0%	0%
July Event 1 (SE6)	7/7/2015 and 7/8/2015	7.93	8.00	8.14	7.66	7.89	7.38	7.47	7.78	7.66–8.14	0%	0%
July Event 2 (SE7)	7/21/2015 and 7/22/2015	7.99	8.00	8.34	7.57	8.03	7.50	7.73	7.88	7.57–8.34	0%	0%
August Event (SE8)	8/25/2015 and 8/26/2015	7.87	7.73	7.67	7.33	7.91	7.28	7.18	7.57	7.33–7.87	0%	0%
Event pH Average		7.83	8.05	8.07	7.69	8.16	7.63	7.75				
Site pH Range		7.56–7.99	8.00–8.26	7.86–8.34	7.57–8.02	7.89–8.50	7.38–7.95	7.47–8.68				
Percent of obs. pH<6.5		0%	0%	0%	0%	0%	0%	0%				
Percent of obs. pH<8.5		0%	0%	0%	0%	0%	0%	13%				

Note:

Bold values are those greater than the WQO of pH 8.5.

7.2.4 Electrical Conductivity Measurements

Figure 7-5 shows the results of the 2015 EC measurements. Table 7-6 presents EC results, site and event ranges, and percentage of observations above 700 micromhos per centimeter (µmho/cm), which has been cited by CVRWQCB as a threshold for reporting. This threshold is based on the citation in Recommended Numerical Limits to Translate Water Quality Objectives (CVRWQCB, 2004) and is an agricultural water quality value (Ayers and Westcot, 1985). Inclusion of this reference value is for screening purposes only and does not imply that the CRC recognizes this value as an adopted salinity WQO.

Eight EC values of greater than 700 µmho/cm were observed during the 2015 sampling season, all measured at CBD1 and CBD5. All other samples had EC readings below 700 µmho/cm.

Water management changes due to the current drought conditions are likely impacting EC within fields and the Colusa Basin Drain. Longer water hold time requirements due to drought conditions are yielding less flow into the drains, causing an increase in EC. The CRC will continue to monitor this trend in future seasons.

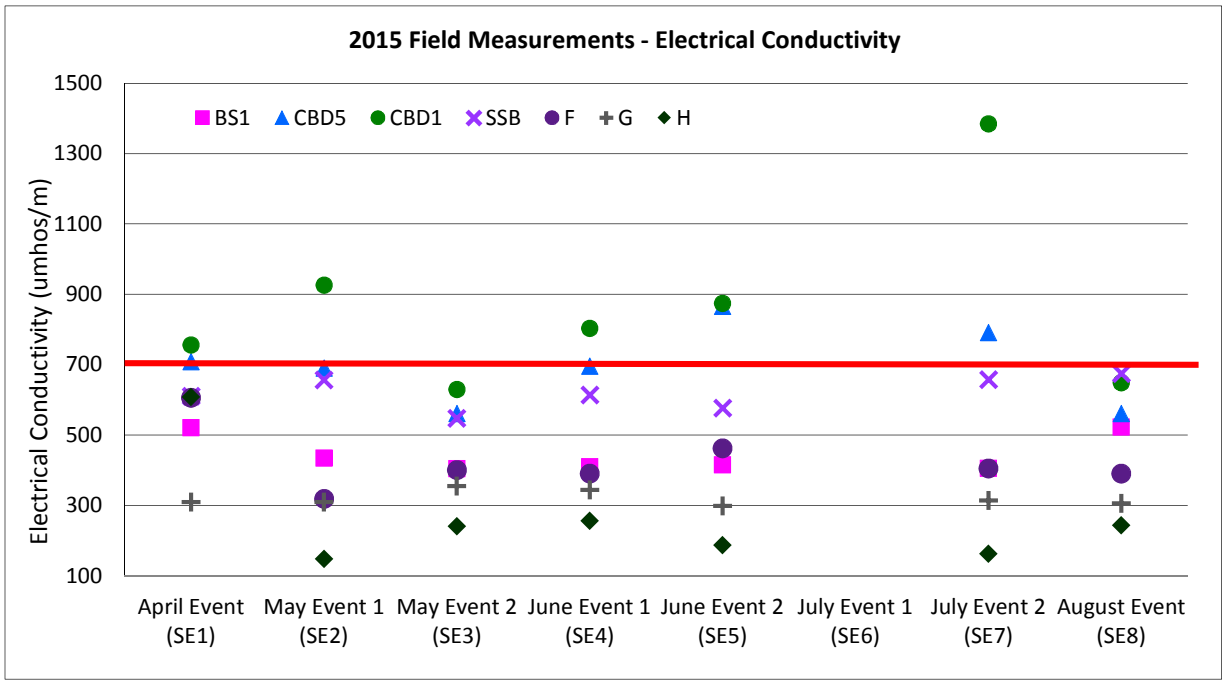

Figure 7-5. Field EC Measurements, 2015

Table 7-6. EC Field Measurement Results, 2015

Sample Event	Sample Dates	Electrical Conductivity (EC) (µmho/m)							Event EC Range	Event EC Range	Percent of obs. EC<700
		BS1	CBD5	CBD1	SSB	F	G	H			
April Event (SE1)	4/28/2015 and 4/29/2015	522	710	757	611	607	310	609	589	310–757	29%
May Event 1 (SE2)	5/12/2015 and 5/13/2015	436	691	**927**	657	319	310	149	498	149–927	14%
May Event 2 (SE3)	5/26/2015 and 5/27/2015	406	562	631	548	401	356	242	449	242–631	0%
June Event 1 (SE4)	6/9/2015 and 6/10/2015	411	697	**804**	615	391	345	257	503	257–804	14%
June Event 2 (SE5)	6/23/2015 and 6/24/2015	416	**867**	**875**	577	463	299	188	526	188–875	29%
July Event 1 (SE6)	7/7/2015 and 7/8/2015	Not collected								--	--
July Event 2 (SE7)	7/21/2015 and 7/22/2015	406	**792**	**1,386**	658	406	315	164	589	164–1,386	29%
August Event (SE8)	8/25/2015 and 8/26/2015	524	562	649	675	391	307	244	479	244–675	0%
Site EC Average		446	697	861	620	425	320	264			
Site EC Range		406–524	562–867	631–1,386	548–675	319–607	299–356	149–609			
Percent of obs. EC<700		0%	43%	71%	0%	0%	0%	0%			

Note:

Bold values are those greater than 700 µmho/m.

7.2.5 Turbidity Measurements

Figure 7-6 shows the results of the 2015 field turbidity measurements. Table 7-7 presents turbidity results and basic summary information, including site and event turbidity result ranges.

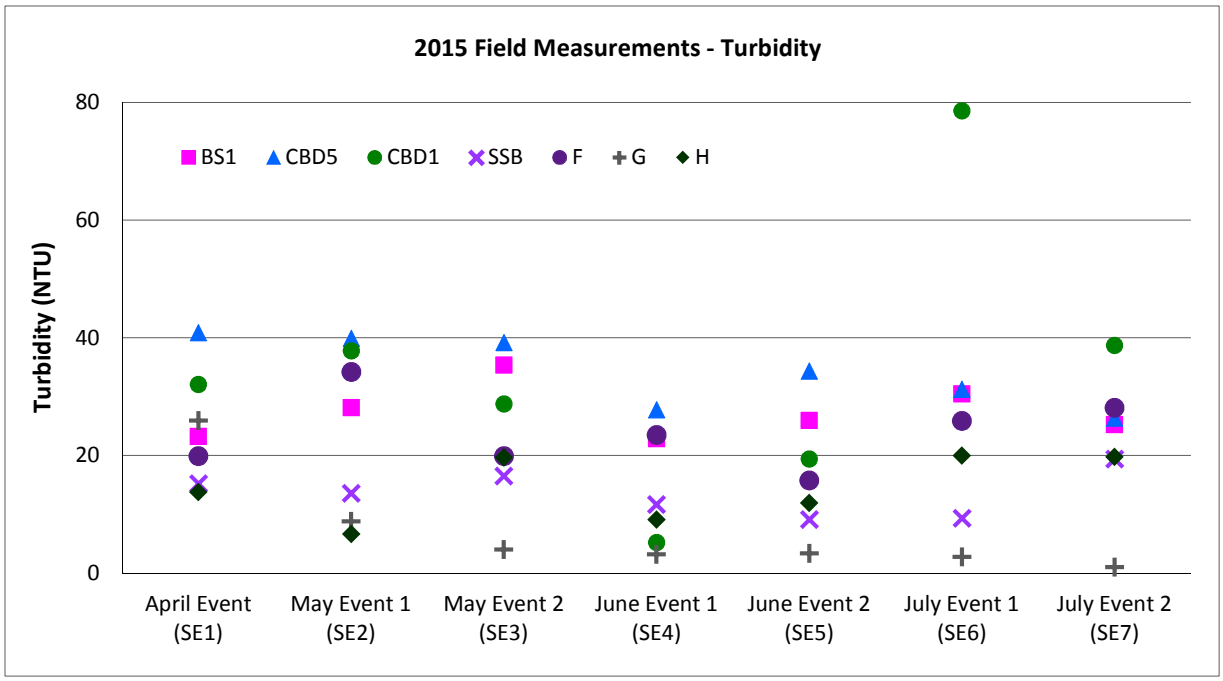

Figure 7-6. Field Turbidity Measurements, 2015

Table 7-7. Turbidity Field Measurement Results, 2015

Sample Event	Sample Dates	Turbidity (NTU)							Event Average (NTU)	Event Turbidity Range
		BS1	CBD5	CBD1	SSB	F	G	H		
April Event (SE1)	4/28/2015 and 4/29/2015	29.3	40.9	32.1	15.2	19.9	26.0	13.8	24.5	13.8–41
May Event 1 (SE2)	5/12/2015 and 5/13/2015	28.2	39.9	37.8	13.6	34.2	8.9	6.7	24.2	6.7–40
May Event 2 (SE3)	5/26/2015 and 5/27/2015	35.4	39.2	28.8	16.5	17.7	4.1	19.7	23.1	4.1–39
June Event 1 (SE4)	6/9/2015 and 6/10/2015	22.9	27.8	5.2	11.7	23.5	3.3	9.2	14.8	3.3–28
June Event 2 (SE5)	6/23/2015 and 6/24/2015	26.0	34.4	19.4	9.1	15.8	3.4	12.0	17.2	3.4–34
July Event 1 (SE6)	7/7/2015 and 7/8/2015	30.5	31.3	78.6	9.4	25.9	2.8	20.0	28.4	2.8–79
July Event 2 (SE7)	7/21/2015 and 7/22/2015	25.3	26.4	38.7	19.4	28.1	1.1	19.8	22.7	1.1–39
August Event (SE8)	8/25/2015 and 8/26/2015	Not measured							NA	NA
Site Average (NTU)		27.4	34.3	34.4	13.6	23.6	7.1	14.5		
Site Turbidity Range		22.9–35.4	26.4–40.9	5.2–78.6	9.1–19.4	15.8–34.2	1.1–26	6.7–20		

Note:

NTU = nephelometric turbidity unit(s)

7.2.6 Flow Measurements

Table 7-8 contains flow estimates derived from the flow measurements collected during the 2015 monitoring season. In instances where the flow meter malfunctioned (SE6) or was not able to register a flow reading, the stick method was used (measure the time it takes a stick floating on the surface of the stream to travel a certain distance). In these instances, NA is noted in the "flow meter" section of the table, and the "stick method" reading should be utilized. Field measurements were documented on field sheets contained in Appendix B-1.

Table 7-8. Flow Measurement Results, 2015

		Estimated Flow						
Sample Event	**Sample Dates**	**BS1**	**CBD5**	**CBD1**	**SSB**	**F**	**G**	**H**
Flow Meter (volumetric flow–cfs)								
April Event (SE1)	4/28/2015 and 4/29/2015	0.0	25.0	0.0	44.7	17.8	5.3	0.0
May Event 1 (SE2)	5/12/2015 and 5/13/2015	0.0	124.5	0.0	16.5	14.1	10.9	0.0
May Event 2 (SE3)	5/26/2015 and 5/27/2015	0.0	171.2	0.0	28.5	8.1	NA	NA
June Event 1 (SE4)	6/9/2015 and 6/10/2015	0.0	28.3	0.0	18.2	22.5	NA	NA
June Event 2 (SE5)	6/23/2015 and 6/24/2015	NA	NA	NA	7.1	1.0	0.0	NA
July Event 1 (SE6)	7/7/2015 and 7/8/2015	0.0	29.1	0.0	NA	14.1	0.0	NA
July Event 2 (SE7)	7/21/2015 and 7/22/2015	NA	55.6	NA	5.3	2.8	NA	NA
August Event (SE8)	8/25/2015 and 8/26/2015	NA	998.0	242.2	52.7	5.1	6.1	NA
Stick Method (surface velocity–feet per second)								
April Event (SE1)	4/28/2015 and 4/29/2015	NA	NA	NA	NA	NA	NA	NA
May Event 1 (SE2)	5/12/2015 and 5/13/2015	NA	NA	NA	NA	NA	NA	NA
May Event 2 (SE3)	5/26/2015 and 5/27/2015	0.0	NA	NA	NA	NA	1.37	0.47
June Event 1 (SE4)	6/9/2015 and 6/10/2015	0.0	NA	NA	NA	NA	1.08	0.65
June Event 2 (SE5)	6/23/2015 and 6/24/2015	0.25	0.25	0.48	NA	NA	0.0	0.46
July Event 1 (SE6)	7/7/2015 and 7/8/2015	0.0	NA	NA	0.34	NA	0.0	0.34
July Event 2 (SE7)	7/21/2015 and 7/22/2015	0.13	NA	0.30	NA	NA	0.36	0.25
August Event (SE8)	8/25/2015 and 8/26/2015	0.15	NA	NA	NA	NA	NA	0.0

Notes:

cfs = cubic feet per second
NA = not applicable

7.3 Sample Results – General Physical Parameters

Monitoring of general physical parameters during the 2015 season included the laboratory analysis of TSS and TOC.

7.3.1 TSS Results

Samples for TSS analysis were collected in the field and analyzed in the laboratory. Table 7-9 presents TSS results and averages for each site and event.

7.3.2 TOC Results

Samples for TOC analysis were collected in the field and analyzed in the laboratory. Table 7-10 presents the TOC results and averages for each site and event.

Table 7-9. TSS Results, 2015

Sample Event	Sample Dates	TSS (mg/L)							Event TSS Average
		BS1	CBD5	CBD1	SSB	F	G	H	
May Event 1 (SE2)	5/12/2015 and 5/13/2015	45	73	55	19	51	11	11	38
June Event 1 (SE4)	6/9/2015 and 6/10/2015	27	40	5.0	10	38	ND	7.0	21
Site TSS Average		36	57	30	15	45	11	9	

Notes:

mg/L = milligram(s) per liter
TSS = total suspended solids

Table 7-10. TOC Results, 2015

Sample Event	Sample Dates	TOC (mg/L)							Event TOC Average
		BS1	CBD5	CBD1	SSB	F	G	H	
May Event 1 (SE2)	5/12/2015 and 5/13/2015	9.3	9.6	14.3	8.9	6.8	6.6	5.4	8.7
June Event 1 (SE4)	6/9/2015 and 6/10/2015	11.0	11.1*	12.0	9.8	10.0	13.0	7.9	10.7
Site TOC Average		10.2	10.3	13.1	9.4	8.4	9.8	6.7	

* Detectable level of analyte reported in sample blank.

Notes:

mg/L = milligram(s) per liter
TOC = total organic carbon

7.4 Sample Results – Nutrient Parameters

Water samples from SE2 and SE6 were analyzed for nutrients, pursuant to the Rice WDR MRP requirements (Table 7-11). All of the nitrate results were well below the WQO (for municipal and domestic use) of 10 mg/L.

Table 7-11. Nutrient Monitoring Results, 2015

	Ammonia as N (mg/L)	Nitrate/Nitrite as N (µg/L)
Sample Site	**MRL=0.10**	**MRL = 0.10**
May Event 1 (SE2) – 5/12/2015 and 5/13/2015		
BS1	0.27	0.021j
CBD5	0.29	0.12
CBD1	0.32	0.006j
SSB	0.30	0.021j
F	0.10	0.049j
G	0.10	ND
H	0.20	ND
July Event 1 (SE6) – 7/7/2015 and 7/8/2015		
BS1	0.22	ND
CBD5	0.26	0.20
CBD1	0.38	0.038j
SSB	0.33	0.021j
F	0.26	0.045j
G	0.18	0.016j
H	0.19	0.029j

Notes:

µg/L = microgram(s) per liter
j = EPA flag for an estimated value (falls between method detection limit and MRL)
mg/L = milligram(s) per liter
MRL = method reporting limit

7.5 Sample Results – Pesticide Parameters

Two pesticides, clomazone and propanil, were selected for monitoring during the 2015 season. Both clomazone and propanil are rice herbicides; clomazone is typically applied in April-May, and propanil is typically applied in May-June. Monitoring results are provided in Table 7-12.

Clomazone was detected at all monitoring events and monitoring sites during the May events and during the June SE4 event. The highest detections were observed during the late May and early June sample dates, indicating that clomazone use trended late in 2015, with the main application period being late May into June. Propanil was detected at all events; however, the late June and early July

events had the most detections. Propanil was not detected at Sites CBD1 or H for the duration of monitoring. Complete results from the pesticide monitoring are included in Appendix B-2.

Although no WQOs or numeric standards exist for clomazone or propanil, the results can be compared to toxicological levels of concern to provide perspective. Aquatic Life Benchmarks published by the Office of Pesticide Programs can be used as a means of comparison. The acute toxicological level of concern for the most sensitive receptor, nonvascular plants, is 167 µg/L for clomazone and 16 µg/L for propanil (USEPA, 2015). All monitoring results from 2015 were below these levels.

Table 7-12. Pesticide Monitoring Results, 2015

Sample Event	Sample Date	Clomazone (µg/L)							Propanil (µg/L)						
		BS1	CBD5	CBD1	SSB	F	G	H	BS1	CBD5	CBD1	SSB	F	G	H
April Event (SE1)	4/28/2015 and 4/29/2015	ND	ND	ND	ND	ND	ND	ND	No scheduled sampling						
May Event 1 (SE2)	5/12/2015 and 5/13/2015	0.29	2.9	0.25	0.42	2.8	0.97	0.24							
May Event 2 (SE3)	5/26/2015 and 5/27/2015	2.0	4.0	8.4	1.9	12	2.0	2.6							
June Event 1 (SE4)	6/9/2015 and 6/10/2015	0.36	1.3	3.3	1.2	0.98	3.5	1.1	ND	1.0	ND	ND	ND	ND	ND
June Event 2 (SE5)	6/23/2015 and 6/24/2015	No scheduled sampling							ND	0.13	ND	7.9	0.51	0.30	ND
July Event 1 (SE6)	7/7//2015 and 7/8/2015								9.5	ND	ND	ND	1.6	ND	ND
July Event 2 (SE7)	7/21/2015 and 7/22/2015								ND	ND	ND	1.9	ND	ND	ND

Notes:

Clomazone method reporting limit (MRL) = 0.20 microgram per liter (µg/L)

Propanil MRL = 0.10 µg/L

7.6 Sample Results – Aquatic Toxicity Parameters

Aquatic toxicity analyses were conducted in accordance with the Rice WDR MRP requirements. Acute and chronic aquatic toxicity tests were performed on three test species:

- Fathead minnow (*Pimephales promelas*)
- Water flea (*Ceriodaphnia dubia*)
- Green algae (*Selenastrum capricornutum*)

The aquatic toxicity tests are performed on samples collected at each station, concurrently with tests on control samples. All aquatic toxicity tests were performed at AQUA-Science.

7.6.1 Fathead Minnow (*Pimephales promelas*)

The test species *Pimephales promelas* (*P. promelas*) is used to detect toxicity to fish species. This minnow is considered a sensitive test species, and toxicity to *P. promelas* can indicate a water quality concern.

There was no statistically significant observed toxicity to fathead minnow in 2015, and no resamples were triggered (Table 7-13). These results indicate that sampled waters were not toxic to fish species.

7.6.2 Water Flea (*Ceriodaphnia dubia*)

The test species *Ceriodaphnia dubia* (*C. dubia*) is used to detect toxicity to invertebrates. *C. dubia* is considered a sensitive test species, and toxicity to *C. dubia* can indicate a water quality concern.

As with the fathead minnow, there was no statistically significant observed toxicity to the water flea in 2015, and no resamples were triggered (Table 7-13). These results indicate that sampled waters were not toxic to invertebrates.

7.6.3 Green Algae (*Selenastrum capricornutum*)

The test species *Selenastrum capricornutum* (*Selenastrum*) is used to detect toxicity to aquatic plants. *Selenastrum* is a green algae species and is considered the most sensitive test species. Toxicity to *Selenastrum* can indicate a water quality concern.

As with the water flea and fathead minnow, there was no statistically significant observed toxicity to green algae in 2015, and no resamples were triggered (Table 7-13). These results indicate that sampled waters were not toxic to aquatic plants.

Table 7-13. Aquatic Toxicity Results, 2015

Sample Event	Sample Date	*P. promelas* 96-Hour Percent Survival (% control[a])							*C. dubia* 96-Hour Percent Survival (% control[a])							*Selanastrum* 96-Hour Percent Growth as Compared to Control (% control[b])						
		BS1	**CBD5**	**CBD1**	**SSB**	**F**	**G**	**H**	**BS1**	**CBD5**	**CBD1**	**SSB**	**F**	**G**	**H**	**BS1**	**CBD5**	**CBD1**	**SSB**	**F**	**G**	**H**
May Event 1 (SE2)	5/12/2015 and 5/13/2015	98	100	100	100	100	98	100	95	100	95	100	100	100	100	236	130	173	184	162	184	204
June Event 1 (SE4)	6/9/2015 and 6/10/2015	100	102	102	100	95	100	100	100	100	100	100	100	100	100	417	217	222	300	277	335	313
July Event 1 (SE6)	7/7//2015 and 7/8/2015	Not required at this event														255	336	254	518	479	566	247

[a] Percent control (*C.dubia* and FHM) = (sample/control) × 100
[b] Percent control (*Selenastrum*) = (sample cells/mL / control cells/mL) × 100

7.7 Sample Results – Sediment Parameters

The Rice WDR MRP requires sediment testing for toxicity, TOC, and grain size. Sediment toxicity is determined using the test species *Hyalella azteca* (*H. Azteca*) to detect toxicity to benthic organisms. The *H. azteca* is considered a sensitive test species, and toxicity can indicate a sediment quality concern. Additional sediment parameters are tested to provide information if toxicity is detected. As required, sediment toxicity, TOC, and grain size tests were performed on sediment samples collected in late August 2015.

7.7.1 Sediment Toxicity and TOC

Sediment samples that show statistically significant toxicity to *H. azteca* and exhibit a greater than 20 percent reduction in organism survival compared to the control require pesticide analysis to determine a possible cause of toxicity.

In addition, sediment samples for assessment monitoring are analyzed for TOC. Analysis for TOC is necessary to evaluate the expected magnitude of toxicity to the test species. If the toxicity criterion described previously is exceeded, the sample must be analyzed for lambda-cyhalothrin and (s)-cypermethrin, the only two pyrethoids used in rice operations.

The *H. azteca* toxicity tests performed on samples collected in August 2015 showed no statistically significant effects (Table 7-14). In fact, all sites had better survival than the control. Because no statistically significant effects were recorded, no resampling or pesticide analysis was required. Levels of TOC in the assessment sediment samples ranged from 5,500 to 7,500 mg/kg, as shown in Table 7-14. This information was not used because pesticide testing was not required.

7.7.2 Sediment Grain Size

Sediment grain size analysis was conducted on the same sediment samples that were collected for toxicity. Results of the grain size analysis are shown in Table 7-14.

Table 7-14. *H. azteca* Sediment Toxicity and TOC Results

Site	Mean Survival (%)	Survival Compared to Control (%)	TOC (mg/kg)	Grain Size Analysis
Control	74*	--	--	--
BS1	98	132	7,100	Lean Clay
CBD5	100	135	5,500	Sandy Silt
CBD1	No sample collected; too much vegetation and water too deep to collect safely by hand			
SSB	96	130	6,400	Sandy Lean Clay
F	No sample to collect; rocky bottom and concrete bank			
G	No sample to collect; bottom is cobble and concrete			
H	100	135	7,500	Sandy Silt

* Poor survival at control. Laboratory considered the results as accepted because all samples had survival well above control (see note with results in Appendix B-3).

Note:

RL for TOC = 200 mg/kg

SECTION 8

Proposed Pesticide Monitoring

The CRC has developed a matrix of pesticides used on rice to facilitate its rice pesticide evaluation process. This matrix was developed with input from scientists and in consultation with the DPR. In fact, the CRC was involved in the Pesticide Evaluation Workgroup to provide assistance to other coalitions in identifying pesticides for monitoring. Based on this rice pesticides matrix, the consistent use of clomazone and propanil from 2014 to 2015 and the expected acres treated in 2016, the CRC proposes to continue monitoring clomazone and propanil.

SECTION 9

Electronic Data Submittal

All electronic data for the 2015 monitoring season will be submitted in the required electronic format. Electronic data required for the 2015 AMR and its location within this report or submittal method are listed below. Electronic groundwater data are not available for the 2015 AMR, as groundwater sampling under this program has not yet begun.

- Electronic copies of all site photos are included in Appendix A.
- Electronic copies of all field sheets are included in Appendix B-1.
- Electronic copies of all laboratory analytical reports are included in Appendixes B-2 through B-5.
- Electronic copies of chemistry analytical reports (including QC narratives, chain-of-custody (COC) copies, and required QC results) are included with the laboratory results in Appendixes B-2 and B-4.
- Electronic copies of toxicity reports are included with the laboratory results in Appendix B-3.
- Farm Evaluation summary information is included in Appendix D.
- California Environmental Data Exchange Network (CEDEN) workbooks for field, chemistry, and toxicity data are included in Appendix E.
- The current eQAPP is included with the CEDEN workbooks in Appendix E

Sampling and Analytical Methods Used

This section provides the sampling and analytical methods used during the 2015 monitoring season.

10.1 Sampling Procedures

Sampling was conducted pursuant to the procedures described in the CRC's Quality Assurance Project Plan (QAPP) (CRC 2015), which are described briefly below.

10.1.1 Field Measurements

Field water quality parameters were measured prior to sample collection at each site, and flow was measured after samples were collected. At each site, the CEDEN field data sheet was completed; this information documents the surface water level, width of the waterway, sample depth at the middle of the water column, general weather observations, time arrived on site, and field water quality measurements. Unless otherwise noted, field measurements were taken at a depth equal to approximately half the water column.

10.1.1.1 Method Used to Obtain Estimated Flow

Flow was typically measured using a flow meter. Flow measurements were taken at 10 cross-sections at each site. The wetted width of the water body was measured, recorded, and divided by 10 to determine the width of each cross-section. The midpoint of each cross-section was calculated by dividing the cross-section width in half. Velocity was measured at the midpoint of each cross-section at 0.2 and 0.8 of the total depth from the water surface, and then averaged. Flow was then calculated using the following equation:

$$Q = \sum_{n=1}^{10} W_n D_n V_n$$

Where:

Q = estimated flow at the site (cfs)
W = section width (feet)
D = depth of measurement (feet)
V = velocity (feet per second)

If the waterway was blocked or the flow meter was not functioning, a flow estimate was taken using the stick method. For the stick method, a stick was thrown into the water body, and the length of time it took the stick to travel a measured distance was recorded. The flow method used at each site at each event is presented with the results in Table 7-8.

10.1.2 Grab Samples

A qualified, trained crew of Kleinfelder technicians collected water grab samples using a Kemmerer water sampler (stainless steel and Teflon model; approximately 1.5-liter volume) at a depth equal to one-half the water column. The Kemmerer was emptied into a stainless steel container and the process repeated until the appropriate volume of water was acquired to split into the required number of samples. This process allowed for homogenization as additional sample volume was added to the container. Certified sample containers were filled with the composite sample using disposable Tygon tubing connected to a peristaltic pump.

10.1.3 Sample Custody and Documentation

Custody of samples was maintained and documented from the time of sample collection to completion of analysis. Each sample was considered to be in the sampler's custody, and the sampler was responsible for the care and custody of the samples until they were delivered to the laboratory. Field data sheets and copies of COC forms were maintained in the project file for samples collected during each event.

A COC form, sample labels, and field documentation were cross-checked to verify sample identification, type of analyses, sample volume, and number and type of containers.

Field data sheets, COC forms, and calibration forms were scanned by Kleinfelder and submitted to the CRC and CH2M. COC forms are included in Appendix B-1.

10.1.4 Sample Delivery and Analysis

After each sampling event, Kleinfelder submitted the samples under COC to the laboratories for analyses. Sample shipments were accompanied by the original COC form, which identified contents, and were transported to the laboratory within the sample holding time.

10.2 Analytical Methods

The analytical methods used in analysis of the 2015 samples are reported in Table 10-1.

Table 10-1. Analytical Methods Used, by Parameter

Matrix	Chemical	Method
General Physical Parameters		
Water	Total organic carbon	SM5310B
	Total suspended solids	SM2540D
Nutrients		
Water	Nitrate/nitrite (as N)	SM4500 NO_3
	Total ammonia (as N)	SM4500 NH_3
Pesticides		
Water	Clomazone	EPA 8141A
	Propanil	EPA 532
Water Column Toxicity		
Water	*Selenastrum capricornutum* toxicity	EPA 821/R-02/013
	Ceriodaphnia dubia toxicity	EPA 821/R-02/012
	Pimephales promelas toxicity	EPA 821/R-02/012
Sediment Toxicity		
Sediment	10-day *Hyalella azteca*	EPA 600/R-99/064
	Total organic carbon	EPA 9060Am
	Grain size	ASTM D422
	Lambda cyhalothrin	Not required in 2015
	(s)-Cypermethrin	Not required in 2015

SECTION 11

Summary of Quality Assurance Evaluation Results

The validity of water quality monitoring results relies on defining and rigorously following a QA/QC Program. QA/QC requirements are specified in a QAPP, and the laboratory QA/QC requirements are specified in QA/QC plans for each laboratory.

QA/QC requirements for Rice WDR sampling are specified in the CRC QAPP approved in August 2015 (CRC 2015). The QAPP was prepared in accordance with Attachment C (Quality Assurance Project Plan Guidelines for California Rice Commission) of the Monitoring and Reporting Program under Order No. R5-2010-0805.

The QAPP specifies several types of QA/QC samples, including:

- Field QA/QC samples
  - Field blanks
  - Field duplicates
- Laboratory QA/QC samples
  - Method blanks
  - Matrix spike and matrix spike duplicate (MS/MSD) samples
  - Laboratory control spike and laboratory control spike duplicate (LCS/LCSD) samples

The QAPP also specifies numeric QA/QC objectives for precision, accuracy, representativeness, comparability, and completeness. This section briefly describes the QA/QC samples, presents the quality assurance objectives (QAO), and evaluates the 2015 Rice WDR QA/QC results against the objectives.

11.1 Quality Assurance Objectives

QAOs are the detailed QC specifications for precision, accuracy, representativeness, comparability, and completeness. QAOs are used as comparison criteria during data quality review to evaluate whether the minimum requirements have been met and the data can be used as planned. The basis for assessing each element of data quality for this project is discussed in the CRC's QAPP (CRC 2015) and is introduced briefly in the following subsections.

11.1.1 Precision

Precision is a measure of the reproducibility of analyses under a given set of conditions and is assessed by replicate measurements of field and laboratory duplicate samples.

The maximum acceptable relative percent difference (RPD) for all duplicates, MS/MSD samples, and LS/LSD samples is 25 percent.

11.1.2 Accuracy

Accuracy is a determination of how close the measurement is to the true value. Accuracy can be assessed using the MS/MSD, LCS/LCSD, calibration standard, and spiked environmental samples and is presented as percent recovery.

Acceptable percent recovery for this project depends on sample type, as follows:

- **Conventional Constituents (TSS, TOC, nutrients) = 80 to 120 percent**
- **Synthetic Organic Analytes (pesticides) = 50 to 150 percent**

In addition, laboratory method blanks were tested to determine levels of target compounds. If a target compound is found above the method detection limit in the method blank corresponding to a batch of samples, and the same target compound is found in a sample, then the data will not be background subtracted but will be flagged to indicate the result in the blank.

11.1.3 Representativeness

Representativeness refers to the degree to which sample data accurately and precisely describe the characteristics of a population of samples, parameter variations at a sampling point, or environmental conditions. Representativeness is a qualitative parameter that is primarily concerned with the proper design of the sampling program or of the subsampling of a given sample. Representativeness will be assessed by the use of duplicate field and laboratory samples because they provide information pertaining to both precision and representativeness.

Samples that were not properly preserved or were analyzed beyond acceptable holding times were not considered to provide representative data. Also, detection limits above applicable maximum contaminant levels (MCLs) or screening criteria will not be considered representative.

11.1.4 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. Sample data should be comparable for similar samples collected under like conditions. This goal is achieved through the use of standard techniques to collect and analyze representative samples and reporting analytical results with appropriate units.

Comparability is limited by other analytical control parameters; therefore, only when precision and accuracy are known can data sets be compared with confidence. Using standard operating procedures promotes comparability.

11.1.5 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared with the amount as expected to be obtained under normal conditions. To be considered complete, the data set must contain all analytical results and data specified for the project. Additionally, all data are compared to project requirements to ensure that specifications are met.

The requirement for completeness is 90 percent for each individual analytical method for all QC parameters except holding times.

These QC parameters include:

- Initial calibration
- Continuing calibrations
- LCS/LCSD
- MS/MSD
- Field duplicate RPDs
- Surrogate percent recoveries

The requirement for holding times is 100 percent.

11.2 QA/QC Sample Results and Analysis

One "QC set" is required for each analytical method batch per sampling event. The minimum required samples for chemical analysis include:

- Field blank
- Field duplicate
- MS/MSD
- LCS/LCSD
- Laboratory blank
- Laboratory duplicate (MS/MSD or LCS/LCSD pair may serve this function)

Field duplicates and field blanks were not required for events where only field parameters were collected.

11.2.1 Field QA/QC Samples

Field QA/QC samples collected during 2015 sampling events included field blanks and field duplicates. The dates, events, and sites of these samples are shown in Table 11-1. Results for field QA/QC samples are provided below.

Table 11-1. Field QA/QC Samples, 2015

Sample Event	Sample Date	QA/QC Sample Type(s)
April Event (SE1)	4/28/2015 and 4/29/2015	Field blank at BS1; field duplicate at BS1
May Event 1 (SE2)	5/12/2015 and 5/13/2015	Field blank at CBD1; field duplicate at CBD1
May Event 2 (SE3)	5/26/2015 and 5/27/2015	Field blank at F; field duplicate at F
June Event 1 (SE4)	6/9/2015 and 6/10/2015	Field blank at CBD5; field duplicate at CBD5
June Event 2 (SE5)	6/23/2015 and 6/24/2015	Field blank at G; field duplicate at G
July Event 1 (SE6)	7/7//2015 and 7/8/2015	Field blank at SSB; field duplicate at SSB
July Event 2 (SE7)	7/21/2015 and 7/22/2015	Field blank at H; field duplicate at H
August Event (SE8)	8/25/2015 and 8/26/2015	No scheduled QA/QC

Note:

QA/QC = quality assurance/quality control

11.2.1.1 Field Blanks

Field blank samples were collected and analyzed for the same constituents as the environmental samples. The results for the field blanks were below the method reporting limits (MRLs) for all analytes except the TOC sample from SE4 (Table 11-2). This event had a detectable amount of TOC in the field blank; CLS has been contacted about this problem, as they provide the blank water for the project.

Table 11-2. Field Blank Results, 2015

		Analyte					
Sample Event	**Sample Location**	**TOC (MRL = 1.0 mg/L)**	**TSS (MRL = 10 mg/L)**	**Clomazone (MRL = 0.20 µg/L)**	**Propanil (MRL = 0.10 µg/L)**	**Ammonia as N (MRL = 0.10 mg/L)**	**Nitrate/Nitrite as N (MRL = 0.10 mg/L)**
April Event (SE1)	BS1	-	-	ND	-	-	-
May Event 1 (SE2)	CBD1	ND	ND	ND	-	ND	ND
May Event 2 (SE3)	F	-	-	ND	-	-	-
June Event 1 (SE4)	CBD5	2.9	ND	ND	ND	-	-
June Event 2 (SE5)	G	-	-	-	ND	-	-
July Event 1 (SE6)	SSB	-	-	-	ND	ND	ND
July Event 2 (SE7)	H	-	-	-	ND	-	-
August Event (SE8)	None	-	-	-	-	-	-

Notes:

µg/L = microgram(s) per liter
mg/L = milligram(s) per liter
MRL = method reporting limit
ND = non-detect above the MRL
TOC = total organic carbon
TSS = total suspended solids

11.2.1.2 Field Duplicates

Field duplicate samples were collected and analyzed for the same constituents as the primary environmental samples. The majority of the primary and duplicate samples had similar results, as expected (Table 11-3), however, several analytes had RPD values outside the acceptable range. The out-of-range samples included: the RPDs for TOC, ammonia as N, and nitrate/nitrite as N from SE2; the RPD for clomazone from SE4; and the RPD for propanil from SE5.

Table 11-3. Field Duplicate Samples, 2015

Sample Event	Sample Location	Analyte	Primary Result	Duplicate Result	RPD (%)	RPD Limit (%)
April Event (SE1)	BS1	Clomazone (MRL = 0.20 µg/L)	ND	ND	0	25
May Event 1 (SE2)	CBD1	TOC (MRL = 1.0 mg/L)	9.8	21	**73**	25
		TSS (MRL = 10 mg)	50	54	8	25
		Clomazone (MRL = 0.20 µg/L)	0.25	0.26	4	25
		Ammonia as N (MRL = 0.10 mg/L)	0.27	0.36	**29**	25
		Nitrate/Nitrite as N (MRL = 0.10 mg/L)	0.016j	0.0030j	**137**	25
May Event 2 (SE3)	F	Clomazone (MRL = 0.20 µg/L)	12	13	8	25
June Event 1 (SE4)	CBD5	TOC (MRL = 1.0 mg/L)	12	12	0	25
		TSS (MRL = 10 mg)	47	37	24	25
		Clomazone (MRL = 0.20 µg/L)	1.3	1.7	**27**	25
		Propanil (MRL =0.10 µg/L)	0.98	1.0	2	25
June Event 2 (SE5)	G	Propanil (MRL =0.10 µg/L)	0.30	0.40	**29**	25
July Event 1 (SE6)	SSB	Propanil (MRL =0.10 µg/L)	ND	ND	0	25
		Ammonia as N (MRL = 0.10 mg/L)	0.33	0.39	17	25
		Nitrate/Nitrite as N (MRL = 0.10 mg/L)	0.023j	0.023j	0	25
July Event 2 (SE7)	H	Propanil (MRL =0.10 µg/L)	ND	ND	0	25
August Event (SE8)		NA				

Notes:

Bold values are outside recovery limits.

µg/L = microgram(s) per liter
mg = milligram(s)
mg/L = milligram(s) per liter
MRL = method reporting limit
NA = not applicable
ND = non-detect above the MRL
RPD = relative percent difference
TOC = total organic carbon
TSS = total suspended solids

11.2.2 Laboratory QA/QC Samples

Laboratory QA/QC samples used during 2015 included method blanks, laboratory duplicates, MS/MSDs, and LCS/LCSDs. The results for each follow.

11.2.2.1 Method Blanks

Method blank samples were prepared by the laboratory and tested for the same analytes as the environmental samples. The results of all the method blank samples were below the MRL (ND) for these analytes (Table 11-4).

Table 11-4. Method Blank Results, 2015

Sample Event	Analyte					
	TOC (MRL = 1.0 mg/L)	TSS (MRL = 10 mg/L)	Clomazone (MRL = 0.20 µg/L)	Propanil (MRL = 0.10 µg/L)	Ammonia as N (MRL = 0.10 mg/L)	Nitrate/Nitrite as N (MRL = 0.10 mg/L)
April Event (SE1)	-	-	ND	-	-	-
May Event 1 (SE2)	ND	ND	ND	-	ND	ND
May Event 2 (SE3)	-	-	ND	-	-	-
June Event 1 (SE4)	ND	ND	ND	ND	-	-
June Event 2 (SE5)	-	-	-	ND	-	-
July Event 1 (SE6)	-	-	-	ND	ND	ND
July Event 2 (SE7)	-	-	-	ND	-	-
August Event (SE8)	NA					

Notes:

µg/L = microgram(s) per liter
mg/L = milligram(s) per liter
MRL = method reporting limit
NA = not applicable
ND = non-detect above the MRL
TOC = total organic carbon
TSS = total suspended solids

11.2.2.2 MS/MSD Samples

MS and MSD samples were prepared and analyzed for each sampling event (Table 11-5). The majority of the MS/MSD recoveries were within the QAPP limits; however, a few samples had recoveries outside the limits. In all cases, the QC sample batch was accepted because the LCS/LCSD recoveries or duplicate QC samples were within range. Because of this, no corrective actions were taken. The out-of-range samples included the RPD for clomazone in SE1, the MS/MSD recoveries for nitrate/nitrite as N in SE2, the MS/MSD recoveries and RPD for clomazone in SE3, the MSD recovery for TOC in SE4, and the clomazone RPD in SE4. All except for the MS/MSD in SE2 were over the QAPP limit/over-recovered. The MS/MSD in SE2 were under the QAPP limit/under-recovered.

Table 11-5. Laboratory MS/MSD Samples, 2015

Sample Event	Analyte	Spike Level (mg/L)	Spike Recovery (%)	Duplicate Recovery (%)	Recovery Limits (%)	RPD (%)	RPD Limit (%)
April Event (SE1)	Clomazone	1.25	90	130	50-150	**36**	25
May Event 1 (SE2)	Ammonia as N	0.500	104	105	80-120	0.6	25
	Nitrate/Nitrite as N	0.250	**79**	**76**	80-120	4	25
	TOC	10.0	116	112	80-120	4	25
	Clomazone	1.25	89	79	50-150	12	25
May Event 2 (SE3)	Clomazone	1.25	**278**	**180**	50-150	**43**	25
June Event 1 (SE4)	TOC	10.0	113	**137**	80-120	19	25
	Clomazone	1.25	61	95	50-150	**44**	25
	Propanil	1	111	104	50-150	7	25
June Event 2 (SE5)	Propanil	1	112	113	50-150	1	25
July Event 1 (SE6)	Ammonia as N	0.500	94	95	80–120	1	25
	Nitrate/Nitrite as N	0.250	86	89	80–120	3	25
	Propanil	1	90	106	50-150	16	25
July Event 2 (SE7)	Propanil	1	102	113	50-150	10	25
August Event (SE8)	NA						

Notes:

Bold values are outside recovery limits.

mg/L = milligram(s) per liter
NA = not applicable
RPD = relative percent difference
TOC = total organic carbon

11.2.2.3 LCS/LCSD Samples

LCS and LCSD samples were prepared and analyzed for each sampling event. The LCS/LCSD recoveries and RPD percentages for all but one set of samples were within the QAPP limits (Table 11-6). The set of samples outside QAPP limits were the LCS/LCSD recoveries for TOC in SE4. Both recoveries were slightly below the QAPP limit, indicating that TOC was under-recovered in that sample.

Table 11-6. Laboratory LCS/LCSD Samples, 2015

Sample Event	Analyte	Spike Level (mg/L)	Spike Recovery (%)	Duplicate Recovery (%)	Recovery Limits (%)	RPD (%)	RPD Limit (%)
April Event (SE1)	Clomazone	1.25	123	118	50-150	4	25
May Event 1 (SE2)	Ammonia as N	0.500	88	87	80–120	2	25
	Nitrate/Nitrite as N	0.250	98	95	80–120	2	25
	TOC	10.0	103	102	80–120	0.6	25
	Clomazone	1.25	99	87	50-150	13	25
May Event 2 (SE3)	Clomazone	1.25	101	107	50-150	6	25
June Event 1 (SE4)	TOC	10.0	**75**	**78**	80–120	4	25
	Clomazone	1.25	111	102	50-150	9	25
	Propanil	1	93	-	50-150	NA	25
June Event 2 (SE5)	Propanil	1	118	113	50-150	4	25
July Event 1 (SE6)	Ammonia as N	0.500	112	104	80–120	8	25
	Nitrate/Nitrite as N	0.250	88	89	80–120	1	25
	Propanil	1	95	96	50-150	1	25
July Event 2 (SE7)	Propanil	1	113	117	50-150	4	25
August Event (SE8)				NA			

Notes:

Bold values are outside recovery limits.

mg/L = milligram(s) per liter
NA = not applicable
RPD = relative percent difference
TOC = total organic carbon

11.2.2.4 Surrogate Standard

Surrogate standard samples were prepared for analysis with each pesticide (clomazone and propanil) sample batch. The majority of the surrogate standard samples had acceptable recoveries, with three results out of range (Table 11-7). The out-of-range samples were all for EPN, the surrogate for clomazone, and included the Site BS1-MS sample from SE1, and the Sites F and H samples from SE3.

Table 11-7. Surrogate Standard Sample Results, 2015

		Surrogate Recovery Results (%)	
Sample Event	**Sample Location**	**EPN (65-135)***	**Carbazole (65-135)***
April Event (SE1)	F	75	NA
	CBD5	92	NA
	CBD1	68	NA
	G	76	NA
	BS1	67	NA
	BS1-Dup	72	NA
	BS1-FBL	75	NA
	BS1-MS	**63**	NA
	H	83	NA
	SSB	84	NA
May Event 1 (SE2)	F	121	NA
	CBD5	94	NA
	CBD1	128	NA
	CBD1-Dup	127	NA
	CBD1-FBL	116	NA
	CBD1-MS	112	NA
	G	113	NA
	BS1	115	NA
	H	115	NA
	SSB	117	NA
May Event 2 (SE3)	F	**147**	NA
	F-Dup	94	NA
	F-FBL	71	NA
	F-MS	74	NA
	CBD5	106	NA
	CBD1	76	NA
	G	135	NA
	BS1	88	NA
	H	**141**	NA
	SSB	88	NA
June Event 1 (SE4)	F	92	102
	CBD5	89	96
	CBD5-Dup	93	95
	CBD5-FBL	80	98
	CBD5-MS	81	97
	CBD1	68	100
	G	108	103
	BS1	85	102
	H	95	101
	SSB	101	103

Table 11-7. Surrogate Standard Sample Results, 2015

		Surrogate Recovery Results (%)	
Sample Event	**Sample Location**	**EPN (65-135)***	**Carbazole (65-135)***
June Event 2 (SE5)	F	NA	100
	CBD5	NA	105
	CBD1	NA	99
	G	NA	101
	G-Dup	NA	104
	G-FBL	NA	100
	BS1	NA	98
	H	NA	103
	SSB	NA	102
July Event 1 (SE6)	F	NA	105
	CBD5	NA	104
	CBD1	NA	99
	G	NA	104
	BS1	NA	112
	H	NA	107
	SSB	NA	105
	SSB-Dup	NA	108
	SSB-FBL	NA	104
	SSB-MS	NA	105
July Event 2 (SE7)	F	NA	101
	CBD5	NA	104
	CBD1	NA	74
	G	NA	102
	BS1	NA	104
	H	NA	105
	H-Dup	NA	102
	H-FBL	NA	101
	H-MS	NA	103
	SSB	NA	104

*Control limits

Notes:

EPN is the surrogate for clomazone. Both were analyzed via EPA 8141A.

Carbazole is the surrogate for propanil. Both were analyzed via EPA 532.

11.2.3 Analysis of Precision

Field duplicate samples were collected during each sampling event and were analyzed for each primary analyte. The majority of the duplicate samples had results consistent with the original matrix results. In a few instances, the results were different across the primary and secondary sample (SE2 TOC and Nitrate/Nitrite as N); however, the differences can be attributed to the organic carbon not being well

distributed (for TOC) and natural variation at the low testing magnitudes (for nitrate/nitrite as N). Field duplicate results are presented in Table 11-3.

MS/MSD sample sets were prepared and analyzed for every sampling event. The majority of the sample sets had acceptable RPD limits, with the exception of the SE1 clomazone sample, the SE3 clomazone sample, and the SE4 clomazone sample. MS/MSD results and RPD values are presented in Table 11-5.

LCS/LCSD samples were prepared and analyzed for every sampling event. The RPD percentages for all samples were within the acceptable limits. LCS/LCSD results and RPD values are presented in Table 11-6.

11.2.4 Analysis of Accuracy

Field blank samples were used during each sampling event and were analyzed for each primary analyte. All field blank samples were found to have detectable analyte levels below the MRLs except for the TOC sample from SE4. Field blank results are presented in Table 11-2.

Method blank samples were run with every batch of analytical samples. All method blank samples were found to have analyte levels below the MRLs. Method blank results are presented in Table 6-4.

MS and MSD samples were prepared and analyzed for every sampling event. The majority of the MS/MSD results were within the QAPP recovery limits (Table 11-5). Five samples had analyte recoveries outside the limits: the MS/MSD nitrate/nitrite as N samples from SE2 (below the QAPP limit), the MS/MSD clomazone samples from SE3 (above the QAPP limit), and the MSD TOC sample from SE4 (above the QAPP limit). In each case, the QC sample batch was accepted because the LCS/LCSD recoveries were within range.

LCS/LCSD samples were prepared and analyzed for every sampling event. Nearly all of the LCS/LCSD results were within the QAPP recovery limits (Table 6-6), with the exception of the LCS/LCSD recoveries for TOC in SE4.

Surrogate standard samples were prepared and analyzed for all events where pesticide sampling occurred. The majority of the surrogate standard results fell within QAPP recovery limits; however, three samples had results outside the limits (Table 11-7). The three samples with surrogate recoveries outside the QAPP limits were all EPN, the surrogate for clomazone, and included the Site BS1-MS sample from SE1 and the Site F and H samples from SE3.

11.2.5 Analysis of Completeness

Field and transport completeness refers to the complete event process of all field activities and successful transport of samples to the receiving agencies. In 2015, all field and transport activities were successful; therefore, field completeness was greater than 90 percent.

Laboratory completeness refers to the complete event process, from sample reception to analysis, at the laboratory. In 2015, all samples were transported and received by the laboratory under COC (Appendix B-1), all storage times were met, and in-house preservation methods were correctly applied. Extraction and analysis of samples were completed successfully, with no missing QA/QC samples. A few laboratory QC samples had results out of acceptable ranges (as discussed in previous sections), including the following:

- SE1: MS/MSD RPD for clomazone; surrogate recovery (EPN) at BS1-MS
- SE2: field duplicate RPD for TOC, ammonia as N, and nitrate/nitrite as N; MS and MSD recoveries for nitrate/nitrite as N
- SE3: MS and MSD recoveries and RPD for clomazone; surrogate recovery (EPN) at Sites F and H

- SE4: field duplicate RPD for clomazone; MSD for TOC and MS/MSD RPD for clomazone; LCS and LSCD recoveries for TOC
- SE5: field duplicate RPD for propanil

A calculation of laboratory completeness based on the QC samples (Table 11-8) yields a result of 86 percent. This coupled with the acceptable COC process, storage times, in-house sample preservation, and extraction and analysis of samples yields total laboratory completeness of greater than 90 percent.

Table 11-8. Laboratory Completeness, 2015

		Number of QC Samples		
Sample Event	**Analyte**	**Acceptable QC**	**Unacceptable/ Incomplete**	**% Completeness**
April Event (SE1)	Clomazone	5	1	83.3
May Event 1 (SE2)	TOC	5	1	83.3
	TSS	6	0	
	Clomazone	6	0	
	Ammonia as N	5	1	
	Nitrate/Nitrite as N	3	3	
May Event 2 (SE3)	Clomazone	3	3	50
June Event 1 (SE4)	TOC	4	3	85.7
	TSS	7	0	
	Clomazone	6	1	
	Propanil	7	0	
June Event 2 (SE5)	Propanil	5	1	83.3
July Event 1 (SE6)	Propanil	6	0	100
	Ammonia as N	6	0	
	Nitrate/Nitrite as N	6	0	
July Event 2 (SE7)	Propanil	6	0	100
August Event (SE8)		Sediment sampling event		
Overall laboratory completeness		86	14	86

Note:

QC = quality control

11.2.6 Analysis Summary

The following list summarizes the results of the QA/QC analysis performed on the 2015 sampling data:

- The majority of the field blank samples had analyte levels below the MRLs.
- Field duplicate sample results were generally consistent with primary sample results.
- Method blank samples had results below the MRLs for all analytes.
- The majority of the MS/MSD samples had RPD values within QAPP limits, with the exception of three clomazone samples (SE1, SE3, and SE4). Three events had analyte recoveries outside QAPP limits: SE2 for nitrate/nitrite as N, SE3 for clomazone, and SE4 for TOC.

- The LCS/LCSD samples had RPD values within QAPP limits. All sample recoveries fell within the QAPP recovery limits, with the exception of the TOC spike and spike duplicate samples from SE4.
- Field and laboratory completeness were calculated and determined to be at least 90 percent.

11.3 Chain-of-Custody Forms

COC forms documented sample possession from the time of field sampling until the time of laboratory analysis. A COC form was completed after sample collection at each sample event and prior to sample shipment or release. The COC forms were completed with indelible ink. Unused portions of the form were crossed out and initialed by the sampler. The COC form, sample labels, and field documentation were crosschecked to verify sample identification, type of analyses, sample volume, and number and type of containers.

COC forms for the Rice WDR monitoring program are included in Appendix B-1.

SECTION 12

Monitoring Data Trend Evaluation

The monitoring data trend evaluation is required every 3 years to identify spatial trends and patterns. Because 2015 was the first monitoring year under the Rice WDR, this trend evaluation will be completed for the 2017 AMR.

SECTION 13

Summary of Water Quality Exceedances and Actions Taken

This section contains a summary of water quality exceedances measured during the 2015 monitoring season, and the actions taken to prevent future exceedances.

13.1 Summary of 2015 Exceedance Reports

Exceedance reports are required after each event if a parameter exceeds water quality standards. For DO, the COLD (cold water habitat) beneficial use standard is 7.0 mg/L DO, and the WARM (warm water habitat) standard is 5.0 mg/L DO. For EC, the CVRWQCB threshold for reporting is 700 µmho/cm. The water quality standard for pH is 6.5 to 8.5.

Exceedance reports were issued after each monitoring event in 2015 for DO, EC, and pH (Appendix C). Low DO was experienced at all events and at all sites during at least one event, with the exception of Site F (Table 13-1). Low DO persisted at Sites BS1, CBD1, SSB, and G, with two or less events having acceptable DO levels. This is typical of these sites, which experience low DO as water temperatures rise.

High EC was measured throughout the monitoring season at Sites CBD5 and CBD1 (Table 4-12). In addition, high pH was experienced once each at Sites F and H, both at events early in the season (Table 13-1).

Table 13-1. Exceedance Reports Issued, 2015

	Site with Exceedance and Reading						
Sample Event	**BS1**	**CBD5**	**CBD1**	**SSB**	**F**	**G**	**H**
Dissolved Oxygen (mg/L)							
April Event (SE1)	5.34 / 4.60	ok	9.97 / 6.38	6.33 / 5.66	ok	6.97 / 6.82	ok
May Event 1 (SE2)	6.09 / 5.53	ok	4.85 / 5.07	ok	ok	ok	ok
May Event 2 (SE3)	5.84 / 5.83	ok	ok	6.41 / 6.36	ok	ok	5.77 / 6.41
June Event 1 (SE4)	4.51 / 3.97	6.70 / 6.77	ok	5.49 / 4.86	ok	6.60 / 5.79	6.03 / 5.32
June Event 2 (SE5)	5.24 / 5.37	ok	4.02 / 3.90	6.00 / 6.03	ok	1.51 / 1.49	ok
July Event 1 (SE6)	6.67/6.94	ok	5.32/5.89	6.61/6.69	ok	3.46/3.52	5.61/5.70
July Event 2 (SE7)	6.67 / 6.44	6.48 / 6.96	4.10 / 4.71	4.79 / 4.75	ok	3.87 / 3.75	ok
August Event (SE8)	4.84 / 6.07	ok	5.33 / 6.01	3.36 / 4.19	ok	2.66 / 3.34	3.31 / 4.29
Electrical Conductivity (µmho/cm)							
April Event (SE1)	ok	703 / 716	748 / 766	ok	ok	ok	ok
May Event 1 (SE2)	ok	ok	924 / 929	ok	ok	ok	ok
May Event 2 (SE3)	ok	ok	ok	ok	ok	ok	ok
June Event 1 (SE4)	ok	ok	803 / 804	ok	ok	ok	ok
June Event 2 (SE5)	ok	867 / 867	877 / 873	ok	ok	ok	ok
July Event 1 (SE6)	NR	NR	NR	NR	NR	NR	NR
July Event 2 (SE7)	ok	785 / 799	1,372 / 1,399	ok	ok	ok	ok
August Event (SE8)	ok	ok	ok	ok	ok	ok	ok

Table 13-1. Exceedance Reports Issued, 2015

	Site with Exceedance and Reading						
Sample Event	**BS1**	**CBD5**	**CBD1**	**SSB**	**F**	**G**	**H**
pH							
April Event (SE1)	ok	ok	ok	ok	ok	ok	8.64 / 8.71
May Event 1 (SE2)	ok	ok	ok	ok	ok	ok	ok
May Event 2 (SE3)	ok	ok	ok	ok	8.48 / 8.52	ok	ok
June Event 1 (SE4)	ok	ok	ok	ok	ok	ok	ok
June Event 2 (SE5)	ok	ok	ok	ok	ok	ok	ok
July Event 1 (SE6)	ok	ok	ok	ok	ok	ok	ok
July Event 2 (SE7)	ok	ok	ok	ok	ok	ok	ok
August Event (SE8)	ok	ok	ok	ok	ok	ok	ok

*Only one instrument measured DO correctly during this sampling event.

Notes:

Two instruments were used for sampling; results shown as Instrument 1 / Instrument 2.

NR = not recorded

Several of the monitored drains had low DO levels during the monitoring season. Drought conditions, along with longer required water holds, have resulted in drains with decreased water volumes and higher in-stream water temperatures, both conditions that can lead to decreased DO.

13.2 Actions Taken to Address Water Quality Exceedances

A DO management plan was developed in 2007 and was updated in May 2015. An updated DO management plan will be developed under the requirements of the 2014 Rice WDR Order.

SECTION 14

Management Plan and Other Special Projects Update

The CRC has a current DO Management Plan, submitted in May 2015. The history and status of this Management Plan is discussed below.

14.1.1 DO Management Plan History and Status

A DO Management Plan was submitted to Water Board staff in December 2007. The Management Plan recognized the University of California at Davis (UC Davis) edge-of-field study (which sampled field outflows and peripheral drains) as the appropriate plan to identify rice-farming practices that might contribute to DO issues in drainages. This study was conducted in 2006-2008 and results were summarized as part of the source identification analysis within the Management Plan.

It was determined that because a detailed analysis of field outflows and peripheral drains was conducted, and because the CRC continued to rigorously monitor discharge to surface waters from rice fields, a new DO Management Plan was not warranted. Rather, the information contained in the DO Management Plan provided sufficient evidence that no additional management practices were available for rice fields to help remedy DO issues in drainages.

An updated DO Management Plan was submitted in May 2015, and included detailed analysis of 10 years of monitoring data. The 2015 DO Management Plan determined that low flow due to the drought allocation of irrigation water was a factor in the more recent low DO readings. This is expected to continue as drought conditions persist. The two versions of the submitted DO Management Plan for rice fields are in review by Regional Board staff.

SECTION 15

Summary of Farm Evaluation Management Practice Information

This section discusses the Farm Evaluation Management Practice Information collected from Growers during 2015. This information reflects the 2014 growing season.

15.1 Background on Farm Evaluation Data Collection

The CRC developed a web-based Farm Evaluation template that was approved by the CVRWQCB. The web-based template provides a convenient and streamlined approach to completing the Farm Evaluation, with easy navigation between various sections.

To complete this web-based form, the Growers enter a personalized number. The Farm Evaluation database is pre-populated with the individual Grower's field information to simplify the data entering process and avoid data redundancies and discrepancies between various programs.

Once the Farm Evaluation is filled out with all the required information, Growers can print a summary report of the information provided for their records. Per the Rice WDR requirements, a copy of the rice-specific Farm Evaluation shall be maintained on site or be available electronically at the rice Grower's farming headquarters or primary place of business. A hard copy of the Farm Evaluation must be produced, if requested, should CVRWQCB staff conduct an inspection of the rice operation.

All Farm Evaluation data are submitted electronically to the CRC for summarizing into a report to the CVRWQCB. Therefore, reporting in an electronic format allows rice Growers to submit in one step without follow-up confirmation for verification.

15.2 Types of Data Collected and Summarized

The primary datasets collected are the acreage of rice grown on each field during the 2014 growing season and the management practices employed on each field. Other information was collected, such as Landowner Rice WDR Acknowledgement, Locations Water Leaving Property, Well Information, and Farm Maps. This information is to be maintained by the Grower for their records, for the CRC to summarize into a report, to facilitate identification of a target area for a Surface Water/Groundwater Quality Management Plan (should an exceedances of the WQOs occur), and potential review by CVRWQCB staff during an inspection of the rice operation.

15.2.1 Rice Acres Grown

The field acreages available in the pesticide permit database was available for review in the template; if the entire field was planted in rice, that acreage was used for the acreage number reporting. If that acreage was incorrect or the field was not entirely planted in rice, the number could be corrected by the Grower. For the rice acreage summary, the total acreage was aggregated for each township in which rice was grown in 2014 (see Appendix D). A summary by county is provided in Table 15-1.

15.2.2 Farm Management Practices

The Grower requirements of the Rice WDR Order include the following:

- Growers shall, at a minimum, implement water quality management practices that meet the following farm management performance standards:
  - Minimize waste discharge offsite in surface water.
  - Minimize percolation of waste to groundwater.
  - Protect wellheads from surface water intrusion.

The rice industry has used vetted farming practices for over three decades to implement management practices that address these performance standards. Therefore, the Farm Evaluation template was developed to include the regulatory and non-regulatory (voluntary) practices the rice Growers employ to comply with water quality management practices. Growers were asked to check each practice used on their fields. The farm management practices were split into 13 regulatory practices and 13 voluntary practices. A summary of the farm management practices used on rice fields in 2014 by township is shown in Appendix D. The average response for all townships for regulatory and voluntary practices are provided in Tables 15-2 and 15-3, respectively.

15.3 Rice Acreage Summary

The aggregated rice acreage grown by township, and as reported by the Growers in the web template, is summarized by county in Table 15-1.The CAC reports show that approximately 464,636 acres of rice were grown in the Sacramento Valley in 2014. However, the CAC acreage reporting is usually high due to the correlation with the pesticide applications that can occur more than once on the field. The NASS/USDA annual acreage report shows 431,000 acres of rice were grown in the Sacramento Valley in 2014.

Table 15-1. Rice Acreage Summary by County

County	Acres Grown
Butte	118,469
Colusa	112,243
Glenn	59,199
Placer	12,120
Sacramento	5,852
Sutter	90,627
Yolo	24,358
Yuba	32,252
Total	**455,120**

Note:

Rice acreage is summarized from Grower input into the Farm Evaluation template.

From the Farm Evaluation, the apparently over-reporting of rice acreage grown results from two main reasons:

- Incorrect field data in the rice pesticide permit database that is not corrected by the Grower in the template
- Grower mistakenly reported the total farm acreage at the rice field level

Based on the high level of acreage reporting, it can be inferred that within the CRC Coalition, there was close to 100 percent reporting compliance for the 2014 growing season.

15.4 Regulatory Farm Evaluation Management Practices Summary

The Regulatory Farm Evaluation Management practice data collected and aggregated by township are summarized in Table 15-2. As shown with these data, most practices had near 100 percent implementation in the fields. Participation for each regulatory farm management practice ranged between 80 to 99 percent. On average, 99 percent of farms followed the label restrictions and 97 percent of farms followed county permit conditions, monitored wind conditions, and used PCA recommendations. In addition, an average of 96 percent of fields followed the water-holding requirements, which is high considering the condition is not necessary for all rice pesticides. Across the industry, Growers in 80 percent of fields avoided surface water when spraying, and where applicable.

15.5 Voluntary Farm Evaluation Management Practices Summary

The Voluntary Farm Evaluation Management practice data are summarized in Table 15-3. Although these practices are not regulatory, the percent participation range for each voluntary farm management practice was from 46 to 94 percent, not including organic-specific practices. On average, 94 percent of fields were land leveled and/or used precise technology, which increases the irrigation efficiency of the field and allows the farmer to have greater control of water application. There was a 72 percent participation in variable timing of water release before harvest and an 84 percent participation in slow release of water from fields.

Table 15-2. Regulatory Farm Management Practices Summary

	Follow Label Restrictions	Follow County Permit Conditions	Water-holding Requirements	Monitor Wind Conditions	Use Appropriate Buffer Zones	Attend Mandatory Trainings	Use Low-Drift Nozzles	Use PCA Recommendations	End of Row Shutoff When Spraying	Avoid Surface Water When Spraying	Compliance with PPE	Use Drift Control Agents	Provide Employee Safety Training
	Percent Response from Farm Evaluation												
Average across townships	99%	97%	96%	96%	93%	92%	91%	95%	85%	80%	90%	89%	88%

Notes:

PCA = pest control adviser
PPE = personal protective equipment

Table 15-3. Voluntary Farm Management Practices Summary

	Land Leveling/ Precision Technology	Use Tailwater Return	Utilize Peripheral Drains	Monitor Rain Forecasts	Crop Rotation (organic)	Cover Cropping (organic)	Strip Cropping (organic)	Compacting Levees	Variable Timing of Water Release (Pre-field prep)	Variable Timing of Water Release (Pre-harvest)	Slow Release of Water from Fields	Crop Rotation (non-organic)	Voluntary Trainings (Spray Safe, etc.)
	Percent Response from Farm Evaluation												
Average across townships	94%	46%	60%	83%	5%	5%	3%	63%	64%	72%	84%	11%	69%

15.6 Quality Assessment of the Collected Information

When a Grower enters their individual number into the web-based Farm Evaluation, the field level information they provided with their pesticide permit information is presented. The rice Grower is responsible for verifying whether the information is correct, since the CRC is not responsible for editing the submitted information. However, an evaluation of the 2014 Grower-submitted Farm Evaluation data revealed a few data quality issues. For example, patterns emerged on some of the data entries, resulting from primarily two reasons:

- Source data from the pesticide permit database were incorrect or contained errors. The most common issues with the permit data included:
  - The database used by the Growers is fairly new with some minor data entry errors
  - Incorrect date ranges associated with the Grower provided data
  - Rice was not listed as the crop
- Grower data entry errors when completing the Farm Evaluations
  - The web-based Farm Evaluation template provided the ability to select all fields and apply global updates to these fields. In three cases, a Grower entered what appeared to be the total acreage of rice grown, but applied that change to all fields associated with the permit number.

Some corrective actions include:

- Communicate with the Growers, CACs and PCAs on the pesticide permit database data issues and quality control suggestions
- Improve instructions for 2015 web-based Farm Evaluation template
- Implement Grower outreach and education
- Create additional domain value and data range checks to reduce Grower data entry errors
- Remove the ability to bulk update rice acreage for all fields. This change to the web template will require Growers to review and/or edit the rice acreage grown for each field associated with the Farm Evaluation.

SECTION 16

Summary or Update of Mitigation Monitoring

The CRC was not required to implement mitigation measures in 2015.

SECTION 17

Education and Outreach Activities

Education and outreach activities in 2015 included newsletters and Grower meetings, stakeholder involvement with enforcement actions, and coordination with the University of California Cooperative Extension, UC Davis, and the Rice Research Board. Additionally, the CRC has the ability to contact each of its members directly and is committed to using its outreach capabilities to address water quality concerns when they are identified.

SECTION 18

Summary of Nitrogen Management Plan Reporting

Nitrogen management plan reporting information is not required for rice Growers at this time, as there are no identified areas of high vulnerability to nitrate. In addition, the Nitrogen Management Plan reporting was not a requirement in the Rice WDR Order for 2015.

SECTION 19

Conclusions and Recommendations

The CRC implemented water quality monitoring and reporting activities in compliance with the Rice WDR Order R5-2014-0032 (CVRWQCB 2014), as specified in the MRP.

In 2015, monitoring under the Rice WDR included assessment of field parameters, including water temperature, DO, pH, EC, turbidity, and flow. Laboratory analyses were conducted on samples, as required, for TSS, TOC, nutrients (including nitrate/nitrite as N and ammonia as N), pesticides (including clomazone and propanil), and toxicity (including fathead minnow [*Pimephales promelas*], water flea [*Ceriodaphnia dubia*], and green algae [*Selenastrum capricornutum*]. In addition, sediment monitoring was conducted in 2015, with samples analyzed for toxicity (*Hyalella azteca)*, TOC, and grain size. The following summarizes the 2015 Rice WDR water quality results:

- **Water Temperature:** Temperature results indicate warm water conditions during the monitoring season. Water temperatures generally tracked with observed air temperatures, as seen in previous years; however, the peak temperature (84.8°F) was observed during SE4 (June Event 1). Water temperatures reflect the warm spring and early summer in 2015.
- **DO:** DO results were lower than in previous years. As in 2014, many of the readings were below the 7 mg/L COLD water quality standard; only Site F stayed consistently above 7 mg/L. CBD5 also had fair DO readings, with only two readings slightly below the COLD standard of 7 mg/L. Low DO (less than the WARM water quality standard of 5 mg/L) was observed at each site during at least one event, with the exception of CBD5 and Site F. SE7 (July Event 2) had the most sites with low DO, including CBD1, SSB, and Site G. Low DO persisted at Site G from SE5 (June Event 2) through SE8 (August Event), with four readings below the WARM standard. CBD1 had three readings with low DO, though these readings were spaced throughout the season.
- **pH:** Only the SE1 (April Event) sample at Site F was recorded outside the 6.5 to 8.5 pH range during the 2015 monitoring season and it appears to be an outlier, as the pH levels were within range for the rest of the season.
- **EC:** Several observations of EC greater than 700 µmho/cm were made during the 2015 monitoring season. These readings were recorded at CBD1 and CBD5, with CBD1 having high EC at five of the seven sampling events where EC was recorded. CBD5 had high EC at three of the seven sampling events where EC was recorded. The remainder of the sites had EC readings below the threshold for reporting during the 2015 monitoring season.
- **TSS:** TSS samples were collected at SE2 (May Event 1) and SE4 (June Event 1). The observations ranged from ND (at Site G during SE4) to 73 mg/L (detected at CBD5 during SE2).
- **TOC:** TOC samples were collected at SE2 (May Event 1) and SE4 (June Event 1). The observations ranged from 5.4 mg/L (detected at Site H during SE2) to 14.3 mg/L (detected at CBD5 during SE2).
- **Nutrients:** Nutrient samples were collected at SE2 (May Event 1) and SE6 (July Event 1). Detections of ammonia as N ranged from 0.10 mg/L (detected at Sites F, G, and H during SE2) to 0.38 mg/L (detected at CBD1 during SE6). Detections of nitrate/nitrite as N ranged from ND (at Sites G and H during SE2, and BS1 during SE6) to 0.20 mg/L (detected at CBD5 during SE6), well below the MCL of 10 mg/L.
- **Pesticides – Clomazone:** Samples were tested for clomazone at each of the first four sampling events. Concentrations ranged from ND (at all sites during SE1) to 12 µg/L (detected at Site F during SE3). The highest detections were observed during SE3 and SE4, indicating that clomazone use trended later in 2015.

- **Pesticides – Propanil:** Samples were tested for propanil at each of the last four sampling events. Concentrations ranged from ND (at many of the sites and dates) to 9.5 µg/L (detected at BS1 during SE6). The highest propanil detections were observed during SE5 and SE6, indicating that propanil use trended later in 2015.
- **Aquatic Toxicity:** Aquatic toxicity analyses were conducted on samples collected during the SE2, SE4, and SE6 sampling events. Acute and chronic aquatic toxicity tests were performed on three test species: fathead minnow (*Pimephales promelas*), water flea (*Ceriodaphnia dubia*), and green algae (*Selenastrum capricornutum*). None of the samples had statistically significant toxicity, indicating that sampled waters were not toxic to these indicator organisms.
- **Sediment Parameters:** A sediment-specific sampling event was held in August 2015 (SE8). Sediment samples were collected from sites with adequate bottom sediment and were analyzed for toxicity and TOC. None of the sediment samples had statistically significant toxicity to the test species (*Hyalella Azteca).* Because of this, pesticide analysis was not required for these samples. Levels of TOC in the assessment sediment samples ranged from 5,500 to 7,500 mg/kg, and grain size analysis revealed textures ranging from lean clay to sandy silt.

19.1 Assessment of the 2015 Program

This year represents the first full year of monitoring under the Rice WDR Order, after 10 years of CWFR monitoring and program implementation. The key successes and challenges faced during 2015 program implementation are summarized as follows:

- Monitoring and assessment were conducted in accordance with the requirements of the Rice WDR MRP. Sampling included primary and secondary site analysis for field parameters (water temperature, DO, pH, EC, turbidity, and flow), laboratory parameters (TOC, TSS, and nutrients), pesticides (clomazone and propanil), toxicity, and sediment parameters.
- The CRC implemented a CEDEN-compliant electronic data submittal system, including laboratory prepared CEDEN-compliant electronic data reports for field, chemistry, and toxicity analyses.
- Review of field and laboratory QA/QC samples indicates substantial achievement of quality objectives:
  - All field blank samples, with the exception of one, were found to have analyte levels below the MRLs. Field duplicate sample results were consistent with primary sample results.
  - Laboratory QA/QC substantially achieved data quality objectives. Method blanks achieved data quality objectives, with all results non-detect, as expected. Although a few of the MS/MSD and LCS/LCSD samples were outside data quality objectives, most samples had recoveries and RPD values within the target range.
- Core monitoring sites for the surface water monitoring of rice impacts continue to be appropriate because of the uniformity of rice farming practices across the valley. Rice water quality management practices are relatively consistent throughout the valley; similar methods of field preparation, irrigation, and harvest practices are available to Growers. Additionally, the water hold requirements apply to all rice Growers, leaving little variation in the methods of rice farming from the various drainage areas.
- In 2015, rice Growers completed the Farm Evaluations to report the rice acreages planted and the management practices used on rice fields during the 2014 growing season. Overall, the participation of rice Growers in this program is strong with nearly 100 percent compliance with the Farm Evaluation reporting.

- Implementation of management practices continued in 2015, including water hold requirements; education and outreach (newsletters and Grower meetings); stakeholder involvement with enforcement activities; and coordination with the University of California Cooperative Extension, UC Davis, and the Rice Research Board. Additionally, the CRC has the ability to contact each of its members directly and is committed to using its outreach capabilities to address water quality concerns when they are identified.
- The CRC continues to be engaged in the CVRWQCB's efforts to refine the Irrigated Lands Regulatory Program through its regular consultation with CVRWQCB staff and through its development of technical documentation in support of the Long-Term Irrigated Lands Program and participation in the CVRWQCB's Technical Issues Committee, CV-SALTS Salinity Coalition, Central Valley Pesticide Total Maximum Daily Load and Basin Plan Amendment, the Drinking Water Policy Workgroup, and the Pesticide Evaluation Workgroup.

19.2 Recommendations for 2016

Activities for the 2016 monitoring year will include implementation of the groundwater trend monitoring program, unless the CRC and CVRWQCB agree to a modified approach for enhanced coordination with the U.S. Geological Society. The Nitrogen Management Plan will be first implemented in 2016. Lessons learned from this first year of the Rice WDR implementation will be applied to ensure a smooth transition from a surface water monitoring program to including groundwater trend monitoring with farm-scale reporting and management planning.

SECTION 20

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