Contents

Section **Page**

1 Introduction 1-1
Program Administration 1-2
California Rice 1-2
Rice Farming's Influence on Water Quality 1-3
History of Rice Water Quality Efforts 1-3
RPP 1-3
Conditional Waiver of Waste Discharge Requirements for Rice 1-7
AMR Requirements 1-7

2 Growing Season, Hydrology, and Applied Materials 2-1
Rice Farming in the Sacramento Valley 2-1
Hydrology 2-2
Applied Materials 2-2
Pesticide Use 2-3
Nutrient Use 2-6

3 Management Practices 3-1
Pesticide Use Calendar 3-1
Role of Management Practices in Attaining Water Quality Protection 3-5
Water Holds 3-5
Actions Taken to Address Identified Water Quality Impacts 3-5

4 Monitoring and Reporting Requirements 4-1
Monitoring Purpose and Objectives 4-1
CWFR 4-1
RPP 4-2
Overview of Requirements 4-2
CWFR 4-2
Core Monitoring 4-4
Assessment Monitoring 4-5
Special Project Monitoring 4-6
RPP 4-6
Monitoring Sites 4-6
CWFR Sites 4-7
RPP Sites 4-7
CBD1 4-11
CBD5 4-11
BS1 4-12
SSB 4-12
F 4-13
G 4-13

H 4-14
SR1 4-14
Schedule and Constituents 4-14
CWFR 4-15
RPP 4-16
2010 Monitoring Calendar 4-16
Administration and Execution 4-17
Sampling Procedures 4-17
Field Measurements 4-17
Grab Samples 4-18
Sample Custody and Documentation 4-18
Sample Delivery and Analysis 4-19

5 2010 Monitoring 5-1
CWFR Monitoring 5-1
Sampling Schedule 5-1
Field Parameter Results 5-1
Lab Parameter Results 5-19
2010 Flow Data 5-23
Dissolved Copper and Hardness Analysis 5-23
Management Plans 5-25
RPP Monitoring 5-26
RPP Performance Goals 5-27
Water Holds 5-27
Pesticides Monitored 5-28
Sampling Schedule 5-28
Sample Collection, Delivery, and Analysis 5-28
Results 5-29

6 Review of Quality Assurance/Quality Control 6-1
Internal QC 6-1
Field QA/QC Samples 6-2
Laboratory QA/QC Samples 6-2
Quality Assurance Objectives 6-3
Precision 6-3
Accuracy 6-4
Representativeness 6-4
Comparability 6-4
Completeness 6-5
CWFR QA/QC Sample Results and Analysis 6-5
Field QA/QC Samples 6-6
Laboratory QA/QC Samples 6-8
Analysis of Precision 6-10
Analysis of Accuracy 6-13
Analysis Summary 6-13
RPP QA/QC Sample Results and Analysis 6-13
Field QA/QC Samples 6-14
Laboratory QA/QC Samples 6-16

Analysis of Precision 6-17
Analysis of Accuracy 6-18
Analysis Summary 6-18
Chains of Custody 6-19

7 Summary and Recommendations 7-1
CWFR 7-1
Assessment of the 2010 CWFR Program 7-2
CWFR Recommendations for 2011 7-4
RPP 7-4
Assessment of the 2009 RPP Program 7-5
RPP Recommendations for 2010 7-6

8 References 8-1

Tables

1-1 Location of Required AMR Information in this Report 1-8

2-1 Herbicides: Acres Treated, Sacramento Valley, 2010 2-7
2-2 Herbicides: Pounds Applied, Sacramento Valley, 2010 2-7
2-3 Insecticides: Acres Treated, Sacramento Valley, 2010 2-9
2-4 Insecticides: Pounds Applied, Sacramento Valley, 2010 2-9
2-5 Fungicides: Acres Treated, Sacramento Valley, 2010 2-10
2-6 Fungicides: Pounds Applied, Sacramento Valley, 2010 2-10
2-7 Acres Treated with Molinate and Thiobencarb, 2006 through 2010 2-11
2-8 Pounds of Molinate and Thiobencarb Applied, 2006 through 2010 2-12
2-9 Range of Fertilizer Components Applied to Rice 2-13

3-1 Timing of Specific Rice Herbicide Applications 3-2
3-2 Examples of the Timing of Herbicide Tank Mix Combinations as Provided by Dr. Albert Fischer, UC Davis 3-3
3-3 Timing of Specific Rice Insecticide Applications 3-3
3-4 Timing of Sequential Rice Herbicide Applications 3-4
3-5 Water Hold Requirements in Days for Thiobencarb 3-6
3-6 Hold Times for Insecticides, Fungicides, and Herbicides Not Covered by RPP 3-7
3-7 Thiobencarb Water Seepage Inspections in 2010 3-10
3-8 Thiobencarb Water Hold, Application, and Mix/Load Inspections in 2010 3-11

4-1 Assessment and Core Monitoring Cycle[a] 4-4
4-2 2010 CWFR and RPP Monitoring Sites 4-6
4-3 CWFR Monitoring Requirements, 2010 4-15
4-4 RPP Monitoring and Reporting Requirements, 2010 4-16
4-5 Analytical Laboratories and Methods, 2010 4-21

Tables (continued)

5-1 2010 Sampling Calendar 5-2
5-2 Field Temperature Measurements—Tabulated Results, 2010 (RPP results included to provide additional monitoring information) 5-5
5-3 Dissolved Oxygen Field Measurements—Tabulated Results, 2010 (RPP results included to provide additional monitoring information) 5-7
5-4 pH Field Measurements—Tabulated Results, 2010 5-11
5-5 Electrical Conductivity Field Measurements—Tabulated Results, 2010 5-15
5-6 Turbidity Field Results—Tabulated Results, 2010 5-17
5-7 TDS Lab Results —Tabulated Results, 2010 5-21
5-8 TOC Lab Results —Tabulated Results, 2010 5-22
5-9 Flow Data for the 2010 Monitoring Season 5-23
5-10 2010 Copper and Hardness Results 5-24
5-11 Hardness adjusted CTR Copper Water Quality Criteria (1h and 4 day maximum) 5-24
5-12 2010 Propanil Monitoring Results 5-26
5-13 Basin Plan Performance Goals for the Five RPP Pesticides 5-27
5-14 RPP Sampling Schedule, 2010 5-28
5-15 Summary of Detections (RPP and City Monitoring), 2010 5-29
5-16 Thiobencarb Monitoring Results, RPP 2010 5-31
5-17 Cities of Sacramento and West Sacramento Thiobencarb Results, 2010 5-33

6-1 CWFR Field QA/QC Samples, 2010 6-6
6-2 2010 CWFR Field Blank and Field Duplicate Results 6-7
6-3 2010 CWFR Method Blank Results 6-8
6-4 2010 Laboratory MS/MSD Samples 6-9
6-5 2010 CWFR Lab Control Spikes (LCS) 6-10
6-6 2010 CWFR Surrogate Standard Sample Results 6-11
6-7 QA/QC Samples, RPP 2010 6-13
6-8 2010 RPP Comparison of Rinse Blank Samples to Primary Samples 6-14
6-9 2010 RPP Field Duplicate Results 6-14
6-10 Matrix Spike Sample Results, RPP 2010 6-15
6-11 Method Blank Results (MAI and CLS), RPP 2010 6-16
6-12 Surrogate Standard Results, RPP 2010 6-17

Figures

1-1 Sacramento Valley Rice Acres, 2010 1-5

2-1 Key Events in a Typical Rice Year 2-2
2-2 2010 Flow and Precipitation Data 2-4
2-3 2010 Daily Maximum and Minimum Air Temperatures 2-5

3-1 Rice Growth Stages 3-1

4-1 2010 CWFR Assessment and Core Monitoring Sites and RPP Monitoring Sites 4-9

Figures (continued)

5-1 Field Temperature Measurements, 2010 5-3
5-2 Dissolved Oxygen Field Measurements, 2010 5-4
5-3 Oxygen Solubility as a Function of Temperature 5-9
5-4 pH Field Measurements, 2010 5-10
5-5 Electrical Conductivity Field Measurements, 2010 5-13
5-6 Turbidity Field Measurements, 2010 5-14
5-7 TDS Results, 2010 5-19
5-8 TOC Results, 2010 5-20
5-9 Thiobencarb Results, RPP, 2010 5-30

Photos

1 CBD1: Colusa Basin Drain #1 4-11
2 CBD5: Colusa Basin Drain #5 4-11
3 BS1: Butte Slough #1 4-12
4 SSB: Sacramento Slough Bridge 4-12
5 F: Lurline Creek 4-13
6 G: Cherokee Canal 4-13
7 H: Obanion Outfall 4-14
8 SR1: Sacramento River Village Marina 4-14

CHAPTER 1

Introduction

The California Rice Commission (CRC) is a statutory organization representing about 2,500 rice farmers who farm approximately 500,000 acres of California 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. Rice produced in the United States provides 1.5 to 2 percent of global production, competes in the global market, and constitutes a large proportion of internationally traded medium-grain (north Asian) rice.

The CRC implements water quality monitoring and reporting activities in compliance with the following two programs of the Central Valley Regional Water Quality Control Board (CVRWQCB):

- Conditional Waiver for Rice (CWFR) monitoring and reporting, a rice-specific Monitoring and Reporting Program (MRP) under the CVRWQCB's *Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands*
- Rice Pesticides Program (RPP) monitoring and reporting, pursuant to the Conditional Prohibition of Discharge requirements specified in the *Water Quality Control Plan for the Sacramento and San Joaquin River Basins* (Basin Plan).

This report serves as the 2010 Annual Monitoring Report (AMR) for both the CWFR and RPP efforts, and describes the CRC-conducted program activities for the calendar year 2010.

Key CWFR activities include the following:

- Reporting of rice acreage information
- Reporting of rice pesticide use information
- Water quality monitoring
- Toxicity testing
- Laboratory coordination
- Laboratory analysis and reporting
- Data validation and review
- Coordination of early-season data submittals between the County Agricultural Commissioners (CACs) and the California Department of Pesticide Regulation (DPR)
- Interaction with pesticide registrants to support the development of reduced-risk pesticides
- Annual reporting and review

Key RPP activities include the following:

- Reporting of rice acreage information
- Reporting of rice pesticide use information
- Water quality monitoring
- Laboratory coordination
- Laboratory analysis and reporting
- Data validation and review
- Coordination of early-season data submittals between the CACs and the DPR
- Pesticide use compliance inspections and enforcement
- Communications with the City of Sacramento and City of West Sacramento, enhanced through the activities of the Storm Event Work Group
- Interaction with pesticide registrants to support the development of reduced-risk pesticides
- Triennial reporting and review

Program Administration

The CRC has long been recognized by the CVRWQCB as an entity with the authority and capacity to implement water quality program activities to achieve water quality protection. The CRC is a statutory organization with authorities and restrictions as established in the California Food and Agricultural Code. In July 2003, the CRC was issued a Notice of Applicability (NOA) as a watershed coalition under the CVRWQCB's Conditional Waiver for Discharges from Irrigated Lands and has implemented rice-specific program activities since then.

Kleinfelder was contracted by the CRC to collect water samples at specified sites to obtain data to characterize water quality. CH2M HILL prepared this AMR under contract to the CRC.

California Rice

Rice is grown in nine Sacramento Valley 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 these areas. For the purposes of the rice-specific MRP, the monitoring area is defined as the nine rice-producing counties in the Sacramento Valley.

Rice fields provide numerous environmental and commercial advantages that no alternative land use would, including a variety of upland and shallow aquatic habitat. In their efforts to reduce rice straw burning and to improve wildlife habitat, rice farmers routinely flood their

fields in the winter (when no rice is present) to degrade the straw and reduce the need for rice straw burning.

Rice farming requires flooded field conditions that contribute 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 2010, an estimated 565,531 acres of rice (as reported by the CACs) were planted in the nine rice-growing counties of the Sacramento Valley.[1] The CAC acreage numbers are usually higher than actual planted acres because of accounting through pesticide applications; multiple applications on single acres can result in double counting of acreage under the CAC method. Figure 1-1 shows the distribution of acreage within the Sacramento Valley (as reported by the CACs). The U.S. Department of Agriculture, National Agricultural Statistics Services no longer provides current year acreage estimates; they now produce an annual report that will be available in June 2011.

Rice Farming's Influence on Water Quality

Because rice is farmed in standing water, the importance of good farming practices to water quality is evident. However, water quality problems associated with other crops and locales (such as soil erosion and sediment transport, saline drainage waters, and high concentrations of trace elements in subsurface drainage) are typically not problems associated with rice drainage. The generally slow rate of flow through rice fields and the controlled rate of water release tend to minimize significant soil erosion. With regard to salinity, much of the water used to irrigate rice fields initially has a low salt concentration and there is little possibility for salt accumulation in a continuously flooded system, so salt concentration in return flows is usually relatively low.

History of Rice Water Quality Efforts

The CRC has undertaken water quality management activities since the 1980s. The efforts began under the RPP and, beginning in 2004, included efforts under the CWFR.
A description of the historical context of rice water quality management efforts in the Sacramento Valley follows.

RPP

A rice pesticide regulatory program has been in place since the 1980s. Implementation of the program included a proactive, industry-led effort to meet water quality objectives. The rice industry not only met the challenge, but also created an example for other commodity groups and coalitions to follow.

In the early 1980s, fish losses occurred in Sacramento Valley agricultural drains dominated by rice drainage. Because of these losses, the California Department of Fish and Game

[1] Figures from the National Agricultural Statistics Service (NASS) have been provided in previous years. NASS was contacted and it reported that county level figures will be available in June 2011.

(DFG) conducted investigations that indicated molinate was responsible for some fish losses. In response, increased in-field holding times for irrigation waters containing molinate were implemented, and no additional fish losses have been documented since June 1983. At approximately the same time, monitoring studies found that thiobencarb concentrations as low as 1 microgram per liter (µg/L) at the city intakes resulted in increases in water taste complaints from people whose drinking water was supplied by the Sacramento River downstream of agricultural drain inputs.

CVRWQCB monitoring studies in the early 1980s determined that molinate, thiobencarb, carbofuran, malathion, and methyl parathion were present in agricultural drains dominated by rice drainage. As a result of studies and chemical monitoring in the early 1980s, the rice industry worked collaboratively with the registrants, CACs, Rice Research Board, University of California (UC) at Davis, UC Cooperative Extension, DFG, CVRWQCB, State Water Resources Control Board (SWRCB), and the California Department of Food and Agriculture (now DPR) initiated the Rice Pesticide Control program, the precursor to today's RPP, in 1984 to manage and regulate the discharge of pesticides from rice fields.

Findings by DFG and the CVRWQCB further moved the SWRCB to contract for scientific studies to develop a toxicity database and to suggest limits for pesticide levels in the Sacramento Valley's rivers and agricultural drains.

A review of information on the effects of molinate and thiobencarb was conducted by the SWRCB (1984). This review was used to develop specific water quality criteria and performance goals for those pesticides. In 1990, the CVRWQCB amended the Basin Plan for the Central Valley Region to include a conditional prohibition of discharge for irrigation return flows containing molinate and thiobencarb, and in 1991, carbofuran, malathion, and methyl parathion. The conditional prohibition of discharge required thata CVRWQCB-approved management practice be followed as a condition of pesticide discharge. Proposed management practices are intended to control pesticide concentrations in return flows from rice fields so that specific performance goals are met.

Environmental monitoring in the RPP was among the most intense ever undertaken by California's agricultural producers and resulted in a substantial knowledge base regarding the movement of rice pesticides in the Sacramento Valley. Through the implementation of industry-wide Best Management Practices (BMPs), the rice industry has been successful in meeting water quality performance goals set by the CVRWQCB.

The RPP undergoes annual CVRWQCB review, at which time the CVRWQCB considers re-certifying the program through Board approval of management practices. Annual reports are due to the CVRWQCB each December.

It is noted that the 2010 RPP includes only thiobencarb, pursuant to CVRWQCB Resolution No. R5-2010-9001. Of the five rice pesticides originally specified in the Basin Plan performance goals, a review of water quality data and pesticide use trends indicates that only thiobencarb is still used on rice in quantities that could potentially result in exceedances of performance goals or water quality objectives, absent implementation of CVRWQCB-approved management practices.

This is the fourth year that the CRC has submitted a single report combining information for the CWFR and RPP programs.

FIGURE 1-1
Sacramento Valley Rice Acres, 2010

Conditional Waiver of Waste Discharge Requirements for Rice

The CRC was granted an NOA to serve as a watershed coalition group under the CVRWQCB Resolution R5-2003-0105, *Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands within the Central Valley* (Irrigated Lands Conditional Waiver) and Monitoring and Reporting Program Order No. R5-2003-0826 (MRP Order).

In October 2004, the CRC submitted a technical report entitled *Basis for Water Quality Monitoring Program: Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands for Rice* (CWFR) to the CVRWQCB. The report served as the basis for the CVRWQCB's rice-specific MRP. The report presented mapping information, including subwatersheds and drainages, rice acreage, and hydrography (lakes, reservoirs, rivers, creeks, canals, and drains); an overview of rice cultural practices; information on the usage and a review of historical data for pesticides and nutrients; a discussion of other potential constituents of concern; a proposed future rice-specific sampling program, including sample locations, sample parameters, and sample timing; and a discussion of the framework for future program review. The geographic and historical data were analyzed and employed to select appropriate water quality monitoring sites. Specifically, the report included information on the following subjects:

- Study area
- Rice pesticide use and water quality data
- Nutrient use and water quality data
- Copper use and water quality data
- Proposed future sampling
- Framework for program review and update

AMR Requirements

The AMR for the CWFR program is to be submitted by December 31 of each year. The AMR is to include the following components:

1. Title page
2. Table of contents
3. Description of the watershed
4. Monitoring objectives
5. Sample site descriptions
6. Location map of sampling sites and land use
7. Tabulated results of analyses
8. Sampling and analytical methods used
9. Copies of chains of custody
10. Associated laboratory and field quality control sample results

11. Summary of precision and accuracy
12. Pesticide use information
13. Data interpretation, including an assessment of data quality objectives
14. Summary of management practices used
15. Actions taken to address water quality impacts identified, including but not limited to revised or additional management practices to be implemented
16. Communication reports
17. Conclusions and recommendations

Table 1-1 shows the location of each piece of the required above listed information within this report.

TABLE 1-1
Location of Required AMR Information in this Report

Required Information	Location in this Report
Table of contents	Page iii
Description of the watershed	Chapter 2
Monitoring objectives	Chapter 4
Sample site descriptions	Chapter 4
Location map of sampling sites and land use	Appendix A
Tabulated results of analyses	Chapter 5
Sampling and analytical methods used	Chapter 4
Copies of chains of custody	Appendixes B and C
Associated laboratory and field quality control sample results	Appendixes B and C
Summary of precision and accuracy	Chapter 6
Pesticide use information	Chapter 2
Data interpretation, including an assessment of data quality objectives	Chapter 5
Summary of management practices used	Chapter 3
Actions taken to address water quality impacts identified, including but not limited to revised or additional management practices to be implemented	Chapter 3
Communication reports	The information herein supersedes the communication reports.
Conclusions and recommendations	Chapter 7
Field documentation	Appendixes B and C
Laboratory original data	Appendixes B and C
Summary of field conditions, including a description of the weather, rainfall, stream flow, color of the water, odor, and other relevant information that can help in data interpretation	Chapter 2 and field sheets

CHAPTER 2

Growing Season, Hydrology, and Applied Materials

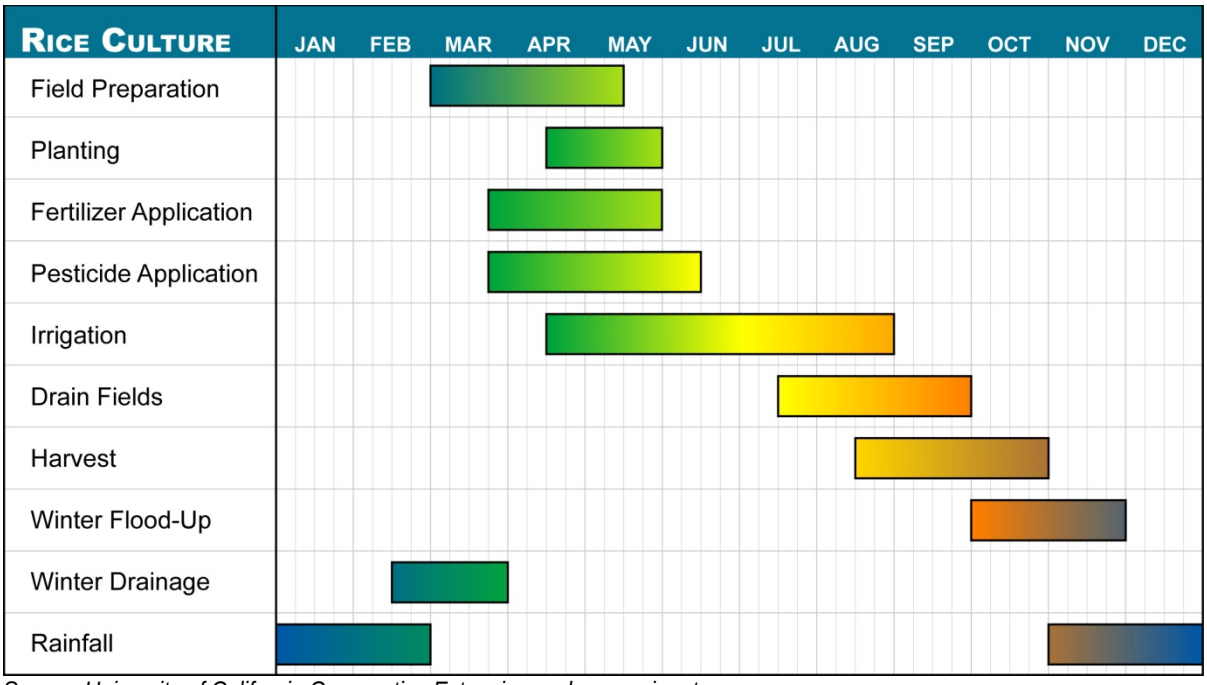
The rice water quality monitoring programs are based on a thorough understanding of how rice is grown in the Sacramento Valley, including key events such as irrigation, drainage, and runoff, and an understanding of when and how products such as pesticides and nutrients are applied. Hydrologic conditions during the year can also influence the timing of key events. This chapter includes descriptions of the "typical" Sacramento Valley rice farming calendar and the 2010 rice growing season (including 2010 Sacramento River hydrology), and includes data on the materials applied to rice during the 2010 growing season.

Rice Farming in the Sacramento Valley

Most California rice is produced by direct seeding into standing water, and a continuous flood is maintained for most of the season. Limited acreage is drill seeded (planted with ground equipment), which also uses permanent flood after stand establishment. Key events in the rice farming cycle are:

- Field preparation
- Planting
- Fertilizer application
- Pesticide application
- Irrigation
- Drainage
- Harvest
- Winter flood-up
- Winter drainage

Figure 2-1 illustrates the timeline for these key events.



Source: University of California Cooperative Extension and grower input

FIGURE 2-1
Key Events in a Typical Rice Year

Hydrology

Seasonal rainfall and weather conditions influence rice planting and rice pesticide application. The 2010 rice farming year was atypical, with rains and unseasonably cooler weather. Heavy rains extended into April, resulting in delayed field preparation and planting. As a result, peak pesticide use shifted to June. After planting, rice growth and development was delayed by the cooler weather, and as a result, harvest was delayed until October and extended until the end of November.

Flow data for the Sacramento River and Butte Slough were acquired from the California Data Exchange Center (CDEC), and precipitation data for a sensor in Colusa were obtained from the University of California Integrated Pest Management (UC IPM) California Weather Database. Data were collected for the period January 1, 2010, through September 1, 2010.

The California Department of Water Resources (DWR) provides flow data (station COL) and the UC IPM California Weather Database provides precipitation and air temperature data for a station near the Sacramento River at Colusa (station COL.A). Flow and precipitation data for the 2010 growing season are shown in Figure 2-2, and minimum and maximum air temperatures are shown in Figure 2-3.

Applied Materials

Agricultural use of pesticides in California is regulated by DPR. Growers, pesticide applicators, pest control advisors, and pest control operators report pesticide use to CACs for inclusion in the DPR Pesticide Use Report (PUR). DPR provides the CRC with early review/draft PUR data and enforcement data for inclusion in the CRC's annual report.

Data presented in the following discussions of pesticide use and nutrient application are usage data for the Sacramento Valley rice-growing counties.

Pesticide Use

The pesticides with acreage increases in 2010 were bensulfuron-methyl (+22,878 ac), bispyribac-sodium (+15,861 ac), clomazone (+57,514 ac), cyhalofop-butyl (+10,387 ac), penoxsulam (+57,943 ac), propanil (+37,207 ac), thiobencarb (+11,505 ac), triclopyr TEA (+37,734 ac), diflubenzuron (+414 ac), and lambda cyhalothrin (+32,881 ac).

The pesticides with acreage decreases in 2010 were carfentrazone-ethyl (-1,583 ac), molinate (-824 ac), (s)-cypermethrin (-8,567 ac), malathion (-60 ac), azoxystrobin (-31,722 ac), propiconazile (-2,888 ac), and trifloxystrobin (-2,888 ac).

Treated acreage has a direct correlation to pounds of active ingredient applied. Planted acreage in 2010 (565,531 acres [CACs]) decreased by 3,789 acres, or approximately 0.7 percent, from 2009 (569,320 acres [CACs]).

Tables 2-1 and 2-2 show the Sacramento Valley rice acres treated and pounds applied, respectively, with herbicides. Tables 2-3 and 2-4 show the Sacramento Valley rice acres treated and pounds applied, respectively, with insecticides. Tables 2-5 and 2-6 show the Sacramento Valley rice acres treated and pounds applied, respectively, with fungicides. Sacramento Valley acres treated with thiobencarb for the time period 2006 through 2010 are listed in Table 2-7, and pounds of thiobencarb applied during this same time are listed in Table 2-8.

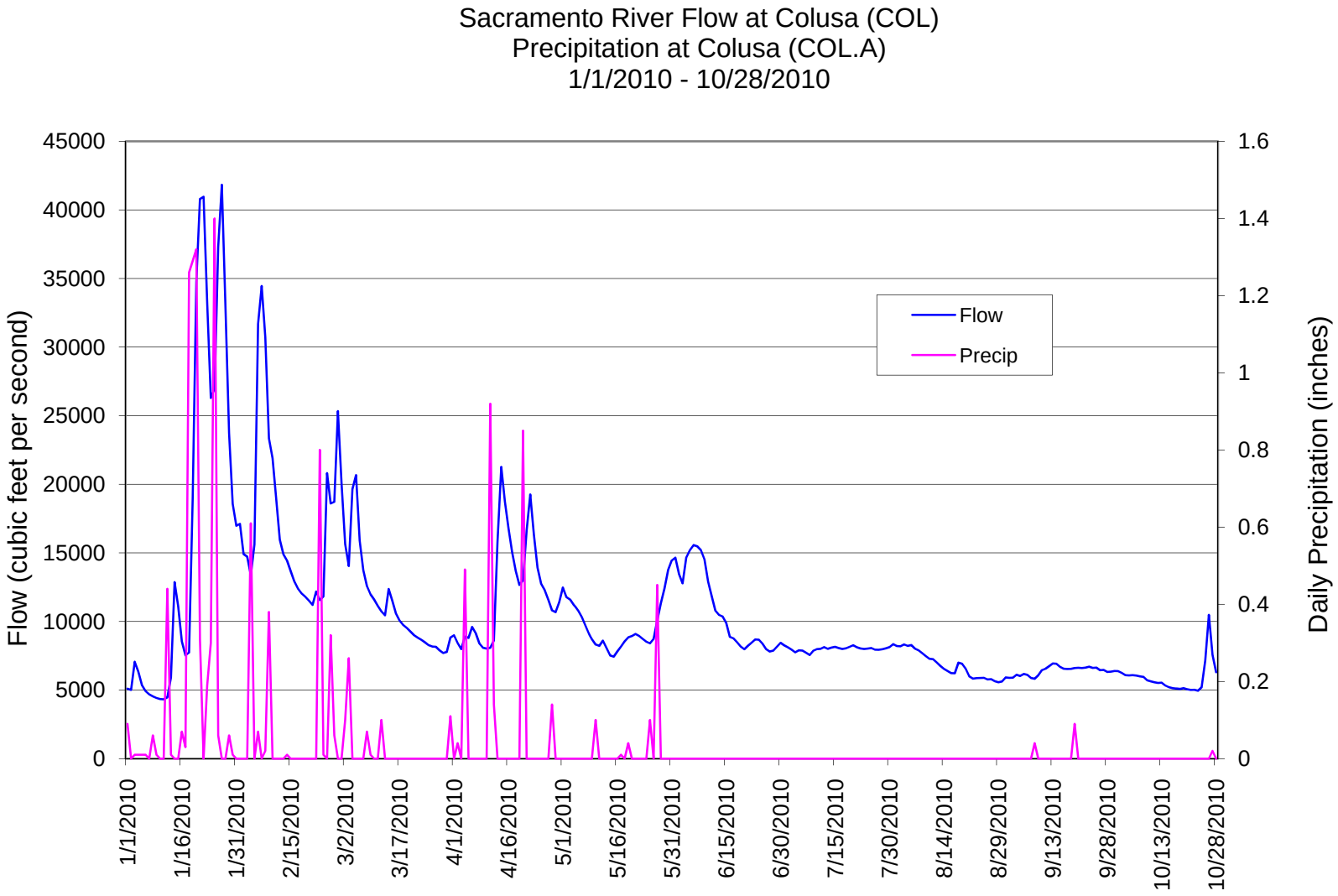


FIGURE 2-2
2010 Flow and Precipitation Data

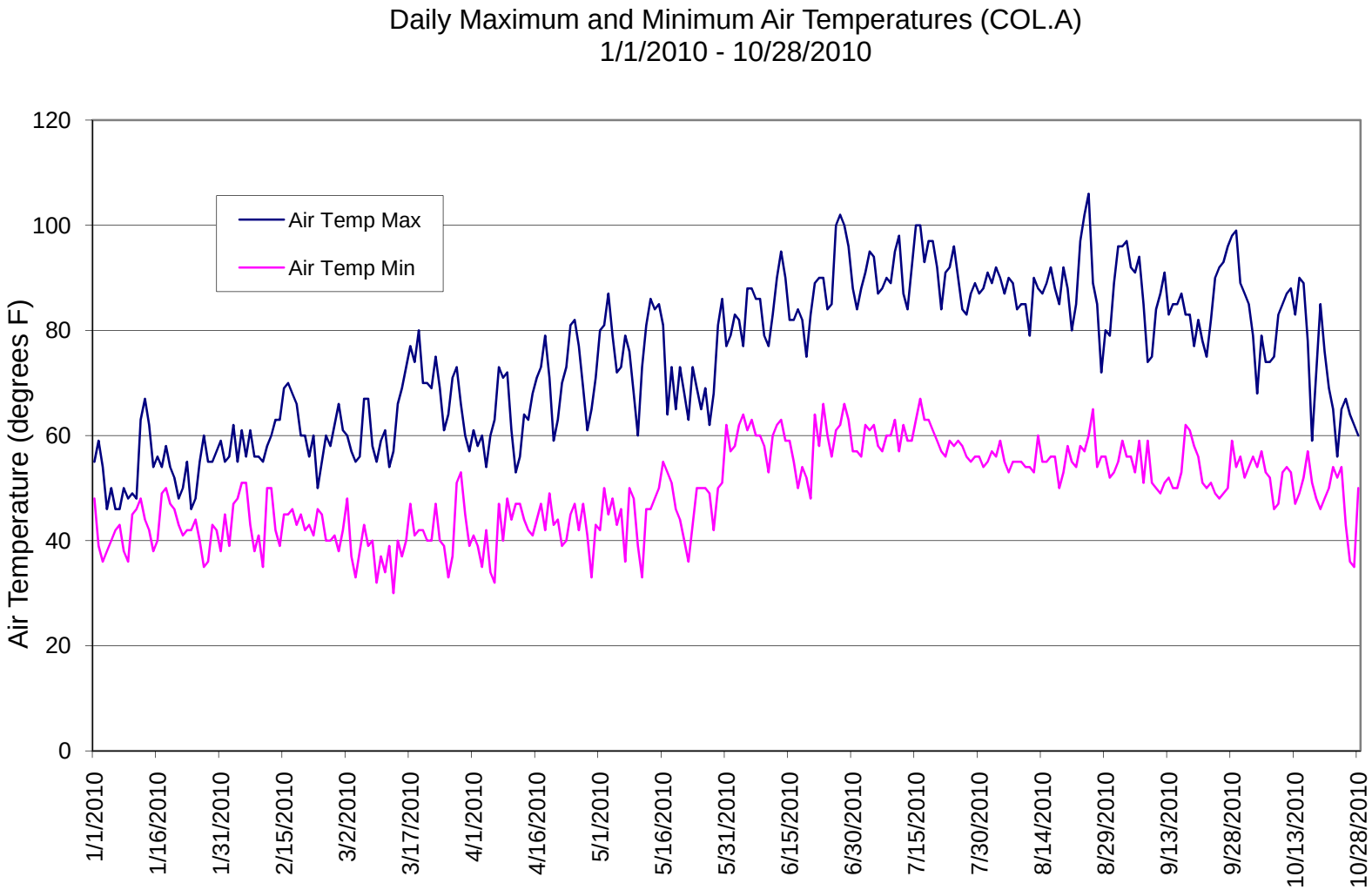


FIGURE 2-3
2010 Daily Maximum and Minimum Air Temperatures

Nutrient Use

Like most other farmland, rice acreage is fertilized annually. Fertilizer suppliers are the best source of information regarding the rates of fertilizer application. Suppliers were consulted to determine the range of fertilizer rates commonly applied to rice in the Sacramento Valley. The information obtained from the suppliers is summarized in Table 2-9. The table shows that fertilizer may be applied to rice before planting (granular starter, aqua ammonia, zinc) and later in the season (topdressing). The totals for the high and low ends of the reported range are shown for each element in the lower section of Table 2-9.

Nitrogen (N) is essential for all commercial rice production in California. The general rate is 120 to 150 pounds per acre. Specific N requirements vary with soil type, variety, cropping history, planting date, herbicide used, and the kind and amount of crop residue incorporated during seedbed preparation. Winter flooding for straw decomposition and waterfowl management has greatly reduced N use in some rice fields. Most N is applied preplant and either soil incorporated or injected 2 to 4 inches before flooding. Some N may be topdressed mid-season (panicle differentiation) to correct deficiencies and maintain plant growth and yield.

Phosphorus (P) is applied at a rate of 18 to 26 pounds per acre and is incorporated into the seedbed before flooding. Most rice fields are above a critical need for P and do not require repeated use of this fertilizer. Phosphate fertilizer also may be topdressed when a deficiency occurs, usually in the early seedling stage.

Potassium (K) is generally unnecessary in California.

Zinc (Zn) deficiency or “alkali disease” is common in alkaline soils and areas where topsoil has been removed. If Zn is used, the rate is 2 to 16 pounds per acre at preflood, and it is not incorporated into the soil. Zinc deficiencies most commonly occur in cool weather during stand establishment (early season).

Iron deficiency is rare in California and can usually be corrected by lowering the soil pH.

TABLE 2-1
Herbicides: Acres Treated, Sacramento Valley, 2010

	Acres Treated									
County	**Bensulfuron-methyl**	**Bispyribac-sodium**	**Carfentrazone-ethyl**	**Clomazone**	**Cyhalofop-butyl**	**Molinate**	**Penoxsulam**	**Propanil**	**Thiobencarb**	**Triclopyr TEA**
Butte	17,080	18,893	2,241	16,085	5,677	0	16,932	54,464	9,624	43,126
Colusa	8,241	20,936	1,470	48,909	46,135	0	25,130	95,052	22,629	91,364
Glenn	6,538	14,714	797	45,481	8,324	0	12,153	70,757	4,089	51,035
Placer	422	0	0	1,859	0	0	0	0	0	0
Sacramento	0	0	134	299	0	0	99	0	99	0
Sutter	8,093	19,537	2,796	57,115	11,539	0	42,909	84,254	15,529	68,771
Tehama	0	0	0	0	0	0	0	0	0	0
Yolo	205	5,195	0	6,064	10,484	0	6,061	26,599	14,863	28,207
Yuba	5,041	5,208	2,540	22,058	1,564	0	15,697	16,645	5,105	7,926
Total acres	**45,620**	**84,483**	**9,978**	**197,870**	**83,723**	**0**	**118,981**	**347,771**	**71,938**	**290,429**

TABLE 2-2
Herbicides: Pounds Applied, Sacramento Valley, 2010

	Pounds Applied									
County	**Bensulfuron-methyl**	**Bispyribac-sodium**	**Carfentrazone-ethyl**	**Clomazone**	**Cyhalofop-butyl**	**Molinate**	**Penoxsulam**	**Propanil**	**Thiobencarb**	**Triclopyr TEA**
Butte	898	563	365	6,720	1,833	0	609	254,080	32,642	8,466
Colusa	423	574	62	22,041	14,158	0	755	501,189	81,908	15,927
Glenn	358	510	109	22,402	2,766	0	435	382,492	14,148	7,684
Placer	1	0	0	648	0	0	0	0	0	0
Sacramento	0	0	2	135	0	0	4	0	297	0
Sutter	400	549	327	24,161	3,664	0	1,580	420,215	50,340	12,188
Tehama	0	0	0	0	0	0	0	0	0	0
Yolo	34	156	0	2,795	3,472	0	191	137,557	52,269	5,232
Yuba	354	137	384	8,779	500	0	570	77,988	16,302	1,494
Total pounds	**2,468**	**2,489**	**1,249**	**87,681**	**26,393**	**0**	**4,144**	**1,773,521**	**247,906**	**50,991**

TABLE 2-3
Insecticides: Acres Treated, Sacramento Valley, 2010

	Acres Treated			
County	**Diflubenzuron**	**(s)-Cypermethrin**	**Lambda Cyhalothrin**	**Malathion**
Butte	132	637	11,857	0
Colusa	0	3,707	24,336	0
Glenn	86	11,130	8,283	0
Placer	0	0	1,258	0
Sacramento	0	0	0	0
Sutter	0	4,578	34,411	0
Tehama	0	0	0	0
Yolo	0	0	2,325	0
Yuba	1,067	3,133	11,115	0
Total acres	**1,285**	**23,185**	**93,585**	**0**

TABLE 2-4
Insecticides: Pounds Applied, Sacramento Valley, 2010

	Pounds Applied			
County	**Diflubenzuron**	**(s)-Cypermethrin**	**Lambda Cyhalothrin**	**Malathion**
Butte	20	31	355	0
Colusa	0	162	740	0
Glenn	8	514	278	0
Placer	0	0	38	0
Sacramento	0	0	2	0
Sutter	0	190	1,198	0
Tehama	0	0	0	0
Yolo	0	0	75	0
Yuba	575	135	300	0
Total pounds	**603**	**1,032**	**2,986**	**0**

TABLE 2-5
Fungicides: Acres Treated, Sacramento Valley, 2010

	Acres Treated		
County	**Azoxystrobin**	**Propiconazole***	**Trifloxystrobin***
Butte	8,551	995	995
Colusa	64,929	0	0
Glenn	49,873	0	0
Placer	0	0	0
Sacramento	387	0	0
Sutter	34,987	8,208	8,208
Tehama	0	0	0
Yolo	10,648	683	683
Yuba	5,640	0	0
Total acres	**175,015**	**9,886**	**9,886**

NOTE:
*Propiconazole and trifloxystrobin constitute the product Stratego

TABLE 2-6
Fungicides: Pounds Applied, Sacramento Valley, 2010

	Pounds Applied		
County	**Azoxystrobin**	**Propiconazole***	**Trifloxystrobin***
Butte	1,467	133	133
Colusa	10,600	0	0
Glenn	7,893	0	0
Placer	0	0	0
Sacramento	63	0	0
Sutter	6,247	1,218	1,218
Tehama	0	0	0
Yolo	1,933	92	92
Yuba	1,062	0	0
Total pounds	**29,265**	**1,443**	**1,443**

NOTE:
*Propiconazole and trifloxystrobin constitute the product Stratego

TABLE 2-7
Acres Treated with Molinate and Thiobencarb, 2006 through 2010

	Acres Treated									
	Molinate					Thiobencarb				
County	**2006**	**2007**	**2008**	**2009**	**2010**	**2006**	**2007**	**2008**	**2009**	**2010**
Butte	21,571	10,965	2,528	45	0	20,353	13,099	11,113	1,923	9,624
Colusa	880	340	0	40	0	24,384	24,094	22,714	35,201	22,629
Glenn	1,845	701	100	520	0	4,952	1,140	472	4,660	4,089
Placer	2,173	437	462	45	0	367	813	456	0	0
Sacramento	0	0	0	0	0	1,158	0	0	0	99
Sutter	4,675	2,036	506	174	0	17,359	13,018	18,544	859	15,529
Tehama	0	148	0	0	0	0	148	261	0	0
Yolo	414	666	0	0	0	6,200	8,321	7,518	14,698	14,863
Yuba	0	0	476	0	0	656	1,194	916	3,092	5,105
Total treated acres	**31,588**	**15,293**	**4,072**	**824**	**0**	**75,429**	**61,827**	**61,994**	**60,433**	**71,938**
Total planted acres	**526,000**	**522,000**	**571,987**	**569,320**	**565,531**	**526,000**	**522,000**	**571,987**	**569,320**	**565,531**

TABLE 2-8
Pounds of Molinate and Thiobencarb Applied, 2006 through 2010

	Pounds Applied									
	Molinate					Thiobencarb				
County	**2006**	**2007**	**2008**	**2009**	**2010**	**2006**	**2007**	**2008**	**2009**	**2010**
Butte	92,930	47,730	11,527	180	0	81,722	51,149	43,655	7,265	32,642
Colusa	3,551	1,467	0	160	0	96,106	95,684	89,641	137,420	81,908
Glenn	7,631	2,839	405	1,563	0	18,611	4,201	1,866	17,806	14,148
Placer	9,978	1,690	1,727	180	0	1,114	2,694	1,664	0	0
Sacramento	0	0	0	0	0	4,243	0	0	0	297
Sutter	20,545	9,188	2,286	661	0	66,765	49,199	71,773	2,843	50,340
Tehama	0	525	0	0	0	0	450	783	0	0
Yolo	1,561	2,937	0	0	0	24,761	33,315	29,562	58,152	52,269
Yuba	0	0	2,148	0	0	2,480	4,483	2,853	9,868	16,302
Total pounds	**136,196**	**66376**	**18,093**	**2,744**	**0**	**295,802**	**241,175**	**241,797**	**233,354**	**247,906**
Total planted acres	**526,000**	**522,000**	**571,987**	**569,320**	**565,531**	**526,000**	**522,000**	**571,987**	**569,320**	**565,531**

TABLE 2-9
Range of Fertilizer Components Applied to Rice

Material/Element	Pounds per Acre		Form and Method
	Low	High	
N	80	120	Injected aqua
16-20	150	200	
N	24	32	Solid 16-20-0-13 starter
P	30	40	Solid 16-20-0-13 starter
K	0	0	Solid 16-20-0-13 starter
S	19.5	26	Solid 16-20-0-13 starter
Zn	1	5	Metallic
NH_4SO_4	0	200	
N	0	42	Topdressed
S	0	49	Topdressed
Total for all application methods			
N	104	194	
P	30	40	
K	0	0	
S	20	75	
Zn*	1	5	

NOTE:
*Seldom applied

CHAPTER 3

Management Practices

Management practices are a key component of the rice water quality programs. During the early phases of the RPP, management practices were developed to increase efficacy and ultimately to protect water quality. The cornerstone of rice management practices is a thorough understanding of the rice calendar, including the application methods and timing of pesticide use.

Management practices include field-level management of rice pesticides and discharges, CAC enforcement programs, grower education efforts, and communication programs. This chapter includes the pesticide use calendar, general information on rice water quality management practices, and specific 2010 enforcement data.

Pesticide Use Calendar

The following tables depict the season or timing of pesticide applications to rice. Included are separate tables for herbicide applications (Table 3-1), tank mix combinations (Table 3-2), insecticide applications (Table 3-3), and sequential herbicide applications (Table 3-4). A "sequential" is the application of an herbicide followed by another herbicide with a different mode of action. Sequential applications are used to achieve better coverage and efficacy for weed control. The second application usually occurs in the next growth stage of the rice plant. For example, clomazone is applied at germination. A sequential application of bispyribac-sodium is applied at tiller initiation. Figure 3-1 provides illustrations of rice's growth stages.

Rice pesticide applications are timed for specific growth stages of the rice plant. To simplify the rice growth schedule, the following tables group pre-flood and germination into early season; tiller initiation and tillering are mid-season, and panicle initiation and flower are late season.

This calendar of applications provides information that is useful for understanding potential water quality concerns relative to particular times during the year.

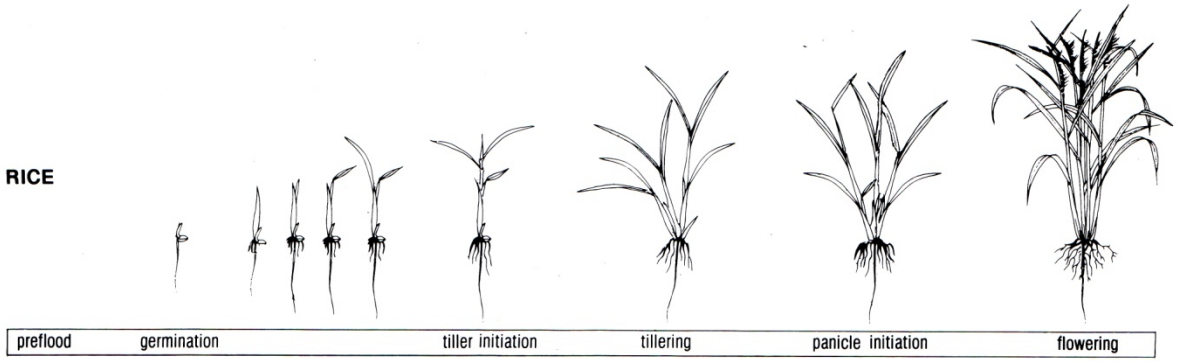


FIGURE 3-1
Rice Growth Stages

TABLE 3-1
Timing of Specific Rice Herbicide Applications

Early Season (March–April)		Mid Season (May–June)		Late Season (June–July)	
Pre-Flood	**Germination**	**Tiller Initiation**	**Tillering**	**Panicle Initiation**	**Flowering**
	Bensulfuron-methyl Permanent flood				
		Bensulfuron-methyl Pinpoint flood			
		Bispyribac-sodium Pinpoint flood			
	Carfentrazone-ethyl Permanent flood 5-day static; 30-day release				
	Clomazone Permanent flood 14-day water hold				
		Cyhalofop-butyl Pinpoint flood 7-day water hold			
		Propanil Pinpoint flood			
	Thiobencarb (Bolero and Abolish) Permanent flood 30-day water hold				
		Triclopyr TEA Pinpoint flood 20-day water hold			

TABLE 3-2
Examples of the Timing of Herbicide Tank Mix Combinations as Provided by Dr. Albert Fischer, UC Davis

Early Season (March–April)		**Mid Season (May–June)**		**Late Season (June–July)**	
Pre-Flood	**Germination**	**Tiller Initiation**	**Tillering**	**Panicle Initiation**	**Flowering**
		Bispyribac-sodium/Thiobencarb (Abolish) Pinpoint flood 30-day water hold **Propanil/Thiobencarb** (Abolish) Permanent flood 30-day water hold			

TABLE 3-3
Timing of Specific Rice Insecticide Applications

Early Season (March–April)		**Mid Season (May–June)**		**Late Season (June–July)**	
Pre-Flood	**Germination**	**Tiller Initiation**	**Tillering**	**Panicle Initiation**	**Flowering**
	Lambda cyhalothrin Border treatment 7-day water hold **(s)-cypermethrin** Border treatment 7-day water hold				**Lambda cyhalothrin** Border treatment 7-day water hold **(s)-cypermethrin** Border treatment 7-day water hold

TABLE 3-4
Timing of Sequential Rice Herbicide Applications

Early Season (March–April)		Mid Season (May–June)		Late Season (June–July)	
Pre-Flood	**Germination**	**Tiller Initiation**	**Tillering**	**Panicle Initiation**	**Flowering**
	Bispyribac-sodium, Thiobencarb (Bolero) 30-day water hold Permanent Flood				
		Bispyribac-sodium, Propanil Pinpoint flood			
	Clomazone, Bensulfuron-methyl 14-day water old Permanent flood				
	Clomazone, Bispyribac-sodium 14-day water hold Permanent flood				
	Clomazone, Carfentrazone-ethyl up to 30-day water hold Permanent flood				
	Clomazone, Propanil 14-day water hold Permanent flood				
	Clomazone, Propanil/Triclopyr TEA 20-day water hold				
		Cyhalofop-butyl, Bensulfuron-methyl 7-day water hold Pinpoint flood			
		Cyhalofop-butyl, Bispyribac-sodium 7-day water hold Pinpoint flood			
		Cyhalofop-butyl, Propanil 7-day water hold Pinpoint flood			
		Propanil, Cyhalofop-butyl 7-day water hold Pinpoint flood			
	Carfentrazone-ethyl, Cyhalofop-butyl 30-day water hold, 7-day water hold Pinpoint flood				

Role of Management Practices in Attaining Water Quality Protection

Over the years, BMPs such as water hold requirements, grower information meetings, and inspection/enforcement were implemented to ensure compliance with performance goals and attainment of water quality objectives and maximum contaminant level (MCLs) for the RPP. The water holds, which are specified on pesticide use labels and through permit conditions, were developed to provide for in-field degradation of pesticides prior to the release of treated water to drains and other surface waters. For 2010, required water holds were the same as those required during the 2005 to 2009 growing seasons.

Water Holds

The primary field-level water quality management practice is the water hold. The nature of rice farming, which requires standing water during the growing season, provides rice farmers with a unique opportunity to manage water flow. Water hold durations vary based on requirements that are adopted in consideration of the persistence of specific registered rice pesticides in the environment, and are used to provide time for the applied product to degrade in the field. The goal of this strategy is to discharge rice drainage water that meets Basin Plan Performance Goals or other benchmarks.

The management practices developed under the RPP have been the foundation for development and implementation of water hold requirements for other pesticides. Over the years, water holds have become industry standard practice to address aquatic toxicity, taste complaints, environmental fate, and product efficacy. Water holds were developed with input from technical resources such as the University of California Cooperative Extension (UCCE) and pesticide registrants. In the early 1980s, when the RPP began, water holds were generally not a pesticide-use label requirement. Over time, rice-specific registrations of pesticides were developed to require specified water holds as a condition of the permitted use of these products. Additionally, DPR and the CACs have the authority to impose additional water hold requirements necessary to protect water quality.

Water hold requirements for thiobencarb and molinate are pesticide-use permit conditions under the RPP. Table 3-5 specifies the water hold requirements for the four currently registered pesticides regulated under the CVRWQCB's RPP Conditional Prohibition of Discharge. These water hold requirements are the same as those required during the 2005 to 2010 growing seasons. Table 3-6 lists the water holds for other products registered for use on rice.

Actions Taken to Address Identified Water Quality Impacts

The CACs are the local enforcement agencies working with DPR to enforce the California Food and Agricultural Code and the California Code of Regulations pertinent to pesticide use. CACs issue restricted materials permits to growers purchasing and using California-restricted materials in their respective counties. Thiobencarb is a restricted material with additional use restrictions (permit conditions) not found on the registered product label. The most common permit conditions for thiobencarb are water holds. Since 2003, the CVRWQCB RPP authorizing resolutions have included permit conditions that

required increased inspections for seepage control; buffer zones during application; a pre-season mandatory meeting for growers, pest control advisors, and applicators; and formation of a Storm Event Work Group. The resolution authorizing the 2010 RPP (R5-2010-9001) adopted additional conditions recommended by the CRC. The conditions included in the 2010 authorization of the program are summarized below:

- Continuation of the management practices incorporated in the 2009 use permit conditions, including water-holding requirements for thiobencarb, drift minimization, mandatory preseason thiobencarb stewardship training, water management (including emergency releases), and seepage mitigation measures [R5-2010-9001 (1)(a)].
- Additional outreach on results of the 2009 thiobencarb results and required management practices to applicators, including clarification of hold time requirements, application procedures, and notification requirements associated with elevated results near the Sacramento River drinking water intakes [R5-2010-9001 (1)(b)].
- Consultation with the ten thiobencarb dealers and distributors in the Sacramento River Basin [R5-2010-9001 (1)(b)].
- Funding of additional county surveillance at non-traditional hours to double the level of 2009 and extension of the program to counties not previously funded, resulting in surveillance inspections increase to approximately 1.5 times the 2009 level [R5-2010-9001 (1)(c)].
- In the event of flooding from a storm event, the CRC would coordinate with the reclamation district previously operating as a closed system just north of Sacramento to collect and analyze samples [R5-2010-9001 (1)(d)].
- If the performance goal or water quality objective for thiobencarb is not met or increasing thiobencarb concentrations are observed in waters designated for municipal or domestic water supply, the CRC, after consultation with DPR, will submit to the Executive Officer proposed actions to be implemented to achieve the performance goal or water quality objective. [R5-2010-9001 (1)(e)]

TABLE 3-5
Water Hold Requirements in Days for Thiobencarb

Release Type	Thiobencarb	
	Bolero® 15-G and Bolero® UltraMax	**Abolish™ 8EC**
Single field	30	19
Single field southern area only[a]	19	—
Release into tailwater recovery system or pond onto fallow field (except southern area)[b]	14[b]	14[b]
Multi-growers and district release onto closed recirculating systems	6	6
Multi-growers and district release onto closed recirculating systems in southern area	6	—

TABLE 3-5
Water Hold Requirements in Days for Thiobencarb

Release Type	Thiobencarb	
	Bolero® 15-G and Bolero® UltraMax	Abolish™ 8EC
Release into areas that discharge negligible amounts to perennial streams	19	6[c]
Pre-flood application: release onto tailwater recovery system	—	—
Emergency release of tailwater	19	19
Commissioner verifies the hydrologic isolation of the fields	6	6

NOTES:

[a] Sacramento–San Joaquin Valley defined as south of the line defined by Roads E10 and 116 in Yolo County and the American River in Sacramento County
[b] Thiobencarb permit condition allowed Bolero® 15-G label hold period of 14 days
[c] Applies to verified hydrologically isolated fields

TABLE 3-6
Hold Times for Insecticides, Fungicides, and Herbicides Not Covered by RPP

Active Ingredient	Trade Name	Water Hold Time	Provisions
Insecticides			
Diflubenzuron	Dimlin® Insect Growth Regulator	14 days	None
(s)-cypermethrin	Mustang® 1.5 EW Insecticide	7 days	None
Lambda-cyhalothrin	Warrior® Insecticide	7 days	None
Methyl Parathion	None	24 days	None
Malathion	None	4 days*	None
Fungicides			
Azoxystrobin	Quadris® Flowable Fungicide	14 days	None
Herbicides			
Carfentrazone-ethyl	Shark®	5-day static 30-day release	None
Clomazone	Cerano™	14 days	Less if closed system
Cyhalofop-butyl	Clincher™	7 days	None
Propanil	Stam™ 80 EDF	7 days	None
Triclopyr TEA	Grandsand™ CA Herbicide	20 days	Less if closed system
Molinate	Ordram®	28 days	

NOTE:
* Voluntary hold

The restricted materials permits require the CACs to keep records of pesticides applied to rice acreage, while full use reporting documents all agricultural use pesticides. The CACs meet the notification requirements by utilizing the Notice of Intent (NOI) and NOA process. Rice growers or pest control operators submit NOIs to the CACs at least 24 hours prior to application so that CAC staff can observe applications. NOAs are reported 24 hours after an application occurs so that water holding times can be recorded, inspected, and tracked.

Compliance with pesticide-use restrictions is a critical component of the RPP's ability to achieve water quality protection. A range of label restrictions and permit conditions apply to the use of rice pesticides, including mix/load, application, and water hold requirements. CACs perform inspections to enhance compliance with each of the label restrictions and permit conditions. Mix/load inspections are performed primarily for worker protection and to evaluate whether proper handling and containment of pesticides is being implemented to prevent releases to the environment. Application inspections are performed to evaluate label and permit condition application restrictions such as buffer zones, adherence to rate and wind speed and other local requirements, and water management. Seepage inspections evaluate the efficacy of farm water management levees to hold water in-field throughout the duration of water holds.

Release Inquiries and Emergency Releases

In 2010, there were two release inquiries and no reported emergency releases. Both release inquiries occurred in Colusa County.

Seepage Control and Inspections

Seepage is a water quality concern because rice field water can move laterally through levees bordering rice fields, especially when levees are constructed in a manner that does not prevent water seepage. Often, levee borrow pits, commonly called "sweat ditches," are used to contain this water. When water gets high enough, it can flow into local agricultural drainage conveyances. The CVRWQCB expressed concern that seepage was a contributing factor to increased thiobencarb concentrations in the Sacramento River in the past.

Current program recommendations require securing weir boxes in rice fields with a soil barrier to a depth higher than the water level. At rice pesticide permit issuance, the CACs provide rice growers with a handout entitled *Closed Rice Water Management Systems*, prepared by the U.S. Department of Agriculture (USDA) and the UCCE. In addition, the CACs provide the growers a brochure entitled *Seepage Water Management – Voluntary Guidelines for Good Stewardship in Rice Production*, cooperatively developed by the UC Davis Department of Agronomy and Range Science, DPR, and UCCE. The brochure is also distributed at the thiobencarb mandatory meetings. The brochure explains the causes of seepage and identifies voluntary management activities that growers should use to minimize and prevent seepage.

For several years, the CRC has contracted with three CACs to fund CAC "off duty" enforcement activity on weekends and holidays during RPP pesticide use season. In 2010, the CRC increased funding to double the level of 2009 and extended the program to counties not previously funded. Surveillance inspections increased to 1.5 times, to include seven of the nine counties in the RPP.

In 1998, DPR and the CACs implemented a Prioritization Plan and a Negotiated Work Plan. One component of both plans was to negotiate a number of water hold inspections. The plans allow the counties to set priorities within the Pesticide Use Enforcement Program Standard Compendium under the Restricted Materials and Permitting manual. All rice pesticide water holding requirements are ranked as high-priority inspections when rice pesticides are used as restricted materials.

Some pre-flood inspections were per grower request, while most inspections were in response to an NOI filed at the CAC office. Some permits were denied due to seepage conditions upon inspection. Information was gathered from the CACs on number of inspections, types of inspections, violations, agricultural civil penalties (ACPs), and water seepage inspection activities in 2010. The CRC provided the CAC offices with weekly updates of the rice herbicide monitoring results in order to coordinate water quality protection activities.

CACs conducted seepage inspections, as summarized in Table 3-7. Based on the inspection data provided to the DPR by the CACs, 964 thiobencarb use sites were inspected for seepage. Of these inspected sites, 918 sites reported no discharge, 46 had reported discharges of less than 5 gallons per minute (gpm). In addition, four sites had reported discharges of greater than 5 gpm. Of these, two were issued enforcement issues. These four sites with flow greater than 5 gpm constitute 0.2 percent of inspected sites.

Water Hold Inspections

CACs conducted water hold inspections of 1,036 thiobencarb use sites in 2010 (Table 3-8). Reporting was recorded for two formulations of thiobencarb (Bolero and Abolish). There were two release inquiries and no reported emergency releases. Of the 1,036 use sites inspected, three water hold violation county ACPs were issued, including one in Colusa County and two in Glenn County.

The Colusa County ACP was issued on June 10, 2010. The Colusa CAC assumes the grower was probably draining a few days before that date. The Abolish was applied on May 27, 2010, and therefore release on or prior to June 10 did not comply with water hold requirements. Additional detail regarding this ACP is included in Section 7. Two additional farmers called to request emergency releases on June 1 and June 4. No emergency releases were granted by Colusa County.

The two Glenn County ACPs were issued to a single grower. The application took place on April 26 and the inspection was on April 29. The Abolish was applied in a dry-seeded process. The farmer did not properly prepare the field to hold water, so water flowed over the check boards at two different sites at the time of the inspections.

Application and Mix/Load Inspections

CACs conducted application and mix/load inspections, as summarized in Table 3-8. Based on the inspection data the CACs provided to the DPR, a total of 24 application inspections and 28 mix/load event inspections were performed. No enforcement actions were issued as a result of these inspections.

TABLE 3-7
Thiobencarb Water Seepage Inspections in 2010

County	Chemical	Number of Seepage Inspections	Number of Sites with No Seepage	Number of Sites w/ Less than 5 gpm Seepage	Number of Sites w/ More than 5 gpm Seepage	Enforcement Actions
Butte	Bolero	0	0	0	0	0
	Abolish	0	0	0	0	0
	County Total	0	0	0	0	0
Colusa	Bolero	203	202	0	0	0
	Abolish	55	55	1	0	1
	County Total	258	257	1	0	1
Glenn	Bolero	135	113	19	3	0
	Abolish	10	7	2	1	2
	County Total	145	120	21	4	2
Placer	Bolero	16	16	0	0	0
	Abolish	0	0	0	0	0
	County Total	16	16	0	0	0
Sacramento	Bolero	18	18	0	0	0
	Abolish	0	0	0	0	0
	County Total	18	18	0	0	0
Sutter	Bolero	189	189	5	0	0
	Abolish	20	20	0	0	0
	County Total	209	204	5	0	0
Tehama	Bolero	1	1	0	0	0
	Abolish	0	0	0	0	0
	County Total	1	0	0	0	0
Yolo	Bolero	99	97	2	0	0
	Abolish	0	0	0	0	0
	County Total	99	97	2	0	0
Yuba	Bolero	25	25	0	0	0
	Abolish	193	176	17	0	0
	County Total	218	201	17	0	0
Total		**964**	**918**	**46**	**4**	**3**

TABLE 3-8
Thiobencarb Water Hold, Application, and Mix/Load Inspections in 2010

County	Chemical	Water Hold Inspections	Release Inquiries	Emergency Releases	Water Hold ACPs	Appl. Inspections	Mix-Load Inspections	ACPs
Butte	Bolero 15G	220	0	0	0	9	9	0
	Abolish EC	4	0	0	0	3	3	0
	County Total	224	0	0	0	12	12	0
Colusa	Bolero 15G	203	0	0	0	2	0	0
	Abolish EC	55	2	0	1	4	2	0
	County Total	258	2	0	1	6	2	0
Glenn	Bolero 15G	135	0	0	0	0	0	0
	Abolish EC	10	0	0	2	0	0	0
	County Total	145	0	0	2	0	0	0
Placer	Bolero 15G	16	0	0	0	0	0	0
	Abolish EC	0	0	0	0	0	0	0
	County Total	16	0	0	0	0	0	0
Sacramento	Bolero 15G	18	0	0	0	0	0	0
	Abolish EC	0	0	0	0	0	0	0
	County Total	18	0	0	0	0	0	0
Sutter	Bolero 15G	189	0	0	0	1	4	0
	Abolish EC	20	0	0	0	3	0	0
	County Total	209	0	0	0	4	4	0
Tehama	Bolero 15G	0	0	0	0	1	0	0
	Abolish EC	0	0	0	0	0	0	0
	County Total	0	0	0	0	1	0	0
Yolo	Bolero 15G	99	0	0	0	3	3	0
	Abolish EC	12	0	0	0	2	2	0
	County Total	111	0	0	0	5	5	0
Yuba	Bolero 15G	25	0	0	0	1	1	0
	Abolish EC	193	0	0	0	4	4	0
	County Total	218	0	0	0	5	5	0
Total		**1,036**	**2**	**0**	**3**	**24**	**28**	**0**

NOTES:

ACP = Agricultural Civil Penalty
Bolero includes Bolero 15G and Bolero UltraMax; the counties did not differentiate between the products.

CHAPTER 4

Monitoring and Reporting Requirements

The monitoring and reporting requirements for the CWFR are specified in the MRP Order R5-2010-0805 (CRC MRP), under Resolution No. R5-2006-0053 as amended by R5-2006-0077. Monitoring and reporting requirements for the 2010 RPP are specified in CVRWQCB Resolution No. R5-2010-9001. This chapter provides an overview of the monitoring and reporting requirements of each program, including the overall purpose and objectives; monitoring periods, sites, and constituents; program administration; sampling procedures; and analytical labs and methods used to assess water quality.

Monitoring Purpose and Objectives

Although similar, the CWFR and RPP programs each have different purposes and objectives for monitoring and reporting.

CWFR

The purpose of the CRC 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's Nonpoint Source (NPS) Policy and include the following:

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

RPP

The purpose of the RPP is to achieve compliance with Performance Goals and attainment of the thiobencarb water quality objective established in the Basin Plan. Monitoring is conducted under the RPP to determine attainment of Performance Goals and the water quality objective. Similar to the CWFR, though not specifically stated in regulatory documents, the purposes of the monitoring under the RPP are:

1. Assess the impacts of the rice pesticides regulated under the Basin Plan.
2. Determine the degree of implementation of rice pesticide management practices.
3. Monitor the effectives of management practices and strategies to attain Performance Goals.
4. Determine concentration of Basin Plan rice pesticides at specific sites.
5. Evaluate compliance with Performance Goals and attainment of the thiobencarb water quality objective to determine whether additional management practices are necessary to improve and/or protect water quality.

Overview of Requirements

The monitoring requirements for both programs define the types of monitoring, monitoring schedule, sites, constituents, program administration, and quality control and quality assurance requirements. The details of each program are described below.

CWFR

In January 2008, the CVRWQCB adopted Order No. R5-2008-0005 (2008 Coalition MRP), which required Coalition Groups to revise their MRP plans to incorporate refined approaches to implementation of the Irrigated Lands Program. The 2009 and 2010 CRC MRPs were developed to be functionally equivalent to the 2008 Coalition MRP.

Monitoring requirements defined by the 2008 Coalition MRP incorporate a 3-year cycle of assessment monitoring and core monitoring. Core monitoring is conducted at a subset of core sites considered representative of the Coalition Group's area, and for a reduced set of parameters. Assessment monitoring is to include an expanded suite of parameters and may include an expanded list of sites, including assessment sites and core sites. The purposes of the expanded suite are to confirm that core monitoring continues to adequately characterize water quality conditions or identify changed conditions and to provide the technical basis for use of core sites.

CWFR assessment monitoring was conducted in 2009. The current CWFR requirements span a 3-year monitoring schedule, which includes 2 years of core monitoring (2010 and 2011), followed by a year of assessment monitoring (2012). Table 4-1 provides the sequential schedule for assessment and core monitoring.

Both core and assessment monitoring can include special project monitoring. Special project monitoring includes monitoring and reporting implemented pursuant to approved and

proposed management plans, as well as other focused investigations that may assist in addressing data gaps or other technical evaluations.

TABLE 4-1
Assessment and Core Monitoring Cycle[a]

Monitoring Type	2009	2010	2011	2012
Assessment[b]	✓	✓[c]		✓
Core[d]		✓	✓	

NOTES:
[a] Repeat cycle every 3 years, or as specified in an approved MRP plan.
[b] Assessment monitoring is conducted at core sites and assessment sites. Site-specific monitoring requirements may be included.
[c] Assessment sites were monitored during the initial two events of 2010 to report dissolved copper (total copper was reported in 2009).
[d] Core monitoring is conducted only at core sites.

Consistent with the approach outlined in the MRP, the CRC's approach for its monitoring program includes three types of monitoring:

- Core monitoring to track trends
- Assessment monitoring to determine the condition of a water body
- Special project monitoring for source identification and other problem solving

Core Monitoring

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

- Focus on a diversity of monitoring sites across the Coalition Group's area (hydrology, size, and flow).
- Include sites that through assessment monitoring or other information have been shown to be characteristic of key crop types, topography, and hydrology within the Coalition Group's boundaries.
- Provide scientific rationale for the site selection process based on the assessment monitoring, existing monitoring projects, or historical information.
- Discuss the criteria for the selection of each monitoring site.
- Propose the approach, including schedule, to sampling core monitoring sites.
- Include water bodies that carry agricultural drainage, are dominated by agricultural drainage, or are otherwise affected by other irrigated agriculture activities.
- Have management practice information provided in order to establish relationships (status and trends) with water quality monitoring information.
- In conjunction with assessment monitoring, demonstrate the effectiveness of management practices and implement new management practices as needed.
- Use data generated from the core monitoring sites to establish trend information about the effectiveness of the Coalition Group's efforts to reduce or eliminate the impact of irrigated agriculture on surface waters.

The 2010 MRP includes monitoring at the four core sites monitored in previous Irrigated Lands Program monitoring efforts.

Assessment Monitoring

Assessment monitoring is to be used to provide supporting data for sites that a Coalition Group wishes to select as core monitoring sites for trends. Supporting data also may allow consideration for the use of some monitoring sites to be representative of other locations within the CRC study area.

The January 2008 Coalition MRP describes the technical requirements of the proposed assessment monitoring. These requirements include:

- Focus on a diversity of monitoring sites across the Coalition Group's area (hydrology, size, and flow).
- Evaluate different types of water bodies for assessment.
- Include a sufficient number of sampling sites to assess the entire Coalition Group area and all drainages.
- Propose the approach, including schedule, to sampling assessment monitoring sites.
- 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 implementation is conducted by the Coalition Group.
- 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.
- Discuss the criteria for the selection of each monitoring site.
- Conduct the initial focus of monitoring on water bodies that carry agricultural drainage or are dominated by agricultural drainage.
- Identify priorities with respect to work on 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.
- Include the requirements provided in Parts I through III of the 2008 Coalition MRP.

Three assessment sites, shown in Table 4-2 and described in the following sections, were included in the 2010 MRP.

Special Project Monitoring

Special project monitoring is to be established on water bodies where waste-specific monitoring or targeted source identification studies are needed. The CRC's Algae and Propanil Management Plans are considered special project monitoring (Appendixes B-4 and B-5). The 2010 MRP incorporates propanil special project monitoring. No additional monitoring is included in the 2010 MRP for algae.

RPP

The RPP requires that the following types of water quality monitoring and evaluation be conducted:

- Field parameter water quality monitoring
- Thiobencarb water quality monitoring
- Pesticide use reporting

Monitoring Sites

Monitoring under both the CWFR and the RPP is conducted at specific sites. Table 4-2 lists site names, locations, and drainage area for each of the sites under the CWFR and RPP monitoring programs. Figure 4-1 shows the locations of the CWFR assessment and core monitoring sites, and the locations of the RPP monitoring sites.

TABLE 4-2
2010 CWFR and RPP Monitoring Sites

Site Code	Site Name	Latitude	Longitude	Estimated Rice Area Captured by Station (acres)	Program(s)	Site Type
CBD1	Colusa Basin Drain above Knights Landing	38.81255	-121.775	171,165	CWFR, RPP	Core
CBD5	Colusa Basin Drain #5	39.18648	-122.045	156,000	CWFR, RPP	Core
BS1	Butte Slough at Lower Pass Road	39.18763	-121.908	183,617	CWFR, RPP	Core
SSB	Sacramento Slough Bridge near Karnak	38.7842	-121.654	24,549	CWFR, RPP	Core
F	Lurline Creek; upstream site of CBD5	39.21838	-122.151	--	CWFR	Assessment
G	Cherokee Canal; upstream site for BS1	39.362	-121.868	--	CWFR	Assessment
H	Obanion Outfall at DWR PP on Obanion Road	39.02536	-121.728	--	CWFR	Assessment
SR1	Sacramento River at Village Marina/ Crawdads Cantina	38.60359	-121.518	~500,000	RPP	River

NOTES:
DWR PP = California Department of Water Resources pumping plant
LAT/LON coordinates are NAD83 datum.

CWFR Sites

The 2010 monitoring season was a "core only" monitoring season (Table 4-1); however, the assessment sites were included in the first two monitoring events in order to gather dissolved copper data (not collected in 2009). Figure 4-1 shows the four CWFR core sites and three CWFR assessment sites.

RPP Sites

Under the RPP, the CRC performs water quality and flow monitoring at five sites. Four of these sites (CBD1, CBD5, BS1, and SSB) are also monitored under the CWFR, while the fifth site (SR1) is monitored only under the RPP. Figure 4-1 shows the five RPP monitoring sites.

FIGURE 4-1
2010 CWFR Assessment and Core Monitoring Sites and RPP Monitoring Sites

CBD1

CBD1 is located on the Colusa Basin Drain. Water samples at CBD1 were collected from the middle of the bridge along Road 99E as it crosses Colusa Basin Drainage Canal near Road 108 west of Knights Landing. CBD1 is monitored under both the CWFR (core) and the RPP.

PHOTO 1
CBD1: Colusa Basin Drain #1

CBD5

CBD5 is located on the Colusa Basin Drain within the Colusa National Wildlife Refuge. Water samples at CBD5 were collected from the middle of the second bridge at the Colusa National Wildlife Refuge south of Highway 20. CBD5 is monitored under both the CWFR (core) and the RPP.

PHOTO 2
CBD5: Colusa Basin Drain #5

BS1

BS1 is located on Butte Slough. Water samples at BS1 were collected from the middle of the bridge along Lower Pass Road, which crosses Butte Sough northeast of Meridian, California. In 1995 and 1996, samples were collected at the west end of the washed out bridge. Sampling at the new bridge site started in 1997. BS1 is monitored under both the CWFR (core) and the RPP.

PHOTO 3
BS1: Butte Slough #1

SSB

The RPP historically monitored Sacramento Slough at a location known as Sacramento Slough 1 (SS1), which was located at the DWR gauging station downstream of the Karnak pumps. Beginning in 2006, the monitoring site for Sacramento Slough was moved slightly upstream to a location named Sacramento Slough Bridge (SSB) to provide improved safety for field technicians accessing the site. SSB is monitored under both the CWFR (core) and the RPP.

PHOTO 4
SSB: Sacramento Slough Bridge

F

Site F is located on Lurline Creek. Water samples on Site F were collected from the middle of the bridge located along Lurline Avenue between San Jose Road and Two Mile Road, northwest of Colusa, east of Interstate 5. This site serves as the upstream assessment site for core site CBD5. Site F is monitored under the CWFR (assessment).

PHOTO 5
F: Lurline Creek

G

Site G is located on Cherokee Canal. Water samples on Site G were collected from the middle of the bridge located along Colusa Highway, west of Hatch Road and east of Gridley Road and Butte Creek. This site serves as the upstream assessment site for ore site BS1. Site G is monitored under the CWFR (assessment).

PHOTO 6
G: Cherokee Canal

H

Site H is located at the Obanion Outfall at DWR pumping plant (DWR PP) on Obanion Road. Water samples on Site H were collected from the middle of the bridge along Obanion Road west of Boulton Road and immediately east of the Sutter Bypass levee. Site H is monitored under the CWFR (assessment).

PHOTO 7
H: Obanion Outfall

SR1

SR1 is located on the Sacramento River. Water samples at SR1 were collected from the Sacramento River at the Village Marina along the Garden Highway in Sacramento. The SR1 water samples were collected from the edge of a floating dock near the entrance of a restaurant along the east bank of the Sacramento River. Kleinfelder noted the river level on a staff gauge located along a middle dock between the sampling point and the riverbank. SR1 is monitored under only the RPP.

PHOTO 8
SR1: Sacramento River Village Marina

Schedule and Constituents

The monitoring schedules for CWFR and RPP sampling are based on the timing and frequency of discharge from rice fields that may contain constituents that affect water quality. The current monitoring periods for the CWFR were developed based on the

understanding of the rice growing season and analysis of historical data, including data collected since 2004 under the CWFR.

The period with the greatest risk to water quality occurs during the peak pesticide application period from April through June. During this period into July, water may be released from the field. From mid- July to mid-August, water is held on rice fields to protect grain development. A top-dressing of nutrients may be added during the water hold. Rice drainage season, when the rice fields are drained prior to harvest, typically occurs from mid-August through September. After harvest, rice fields are generally flooded to decompose rice straw and to provide waterfowl habitat. No application of fertilizers or pesticides occurs on rice fields during the winter until the fields are drained in mid-February or March. Field preparation for the next season may include applications of fertilizers.

Past monitoring has led to refinement in the monitoring calendar, with monitoring requirements focused on the periods of risk to water quality. Monitoring is scheduled to provide for water quality assessment during the peak application period. Factors, such as weather conditions, may affect planting and pesticide application. Timing of monitoring takes into account these factors and may vary from year to year, and 2010 weather conditions required adjustments to the calendar. CRC water quality monitoring for 2010 generally includes:

- Monthly CWFR sampling of general parameters at core sites, April through August
- Monthly CWFR dissolved copper sampling at core and assessments sites, April and May
- Weekly CWFR special project monitoring for propanil, June to August
- RPP sampling for 9 weeks, with weekly samples during weeks 1, 2, 8, and 9, and more intensive biweekly sampling conducted during weeks 3, 4, 5, 6, and 7, April through July

CWFR

The MRP specifies the constituents for which field monitoring and laboratory analysis are to be conducted. Table 4-3 presents the constituents for which monitoring was required during 2010.

TABLE 4-3
CWFR Monitoring Requirements, 2010

Constituent	Units	Sample Type	Type of Monitoring	Irrigation Season Sampling Frequency (April to August)
Flow	cfs	Field[a]	Core	Monthly
pH	pH units	Field	Core	Monthly
Electrical conductivity	µmhos/cm	Field	Core	Monthly
Dissolved oxygen	mg/L	Field	Core	Monthly
Temperature	degrees C	Field	Core	Monthly
Turbidity	NTUs	Field	Core	Monthly
Total dissolved solids	mg/L	Field	Core	Monthly
Total organic carbon (TOC)	mg/L	Field	Core	Monthly

Hardness	mg/L	Grab	Core and assessment[b]	Monthly
Dissolved copper	µg/L	Grab	Core and assessment[b]	Monthly, April and May
Propanil management plan	µg/L	Grab	Core + assessment site F	Weekly, June15 – August 3

NOTES:

[a] Flow also may be obtained from DWR monitoring stations, where available.
[b] Only monitored during the first two events, as required in the MRP.
µg/L = micrograms per liter
µmhos/cm = micromhos per centimeter
cfs = cubic feet per second
mg/L = milligrams per liter
NTU = nephelometric turbidity unit

RPP

Monitoring for the RPP is conducted during the period of peak rice pesticide use. Monitoring is conducted once per week for the first 2 weeks, then is increased to twice per week for the following 5 weeks (corresponding with peak usage), and is then decreased to once per week for the final 2 weeks. Field parameters are recorded, and samples are taken for thiobencarb analysis. The constituents and their monitoring requirements are shown in Table 4-4.

TABLE 4-4
RPP Monitoring and Reporting Requirements, 2010

Constituent	Units	Sample Type	Sampling Frequency		
			Weeks 1–2	Weeks 3–7	Weeks 8–9
pH	pH units	Field	Weekly	Biweekly	Weekly
Electrical conductivity	µmhos/cm	Field	Weekly	Biweekly	Weekly
Dissolved oxygen	mg/L	Field	Weekly	Biweekly	Weekly
Temperature	degrees C	Field	Weekly	Biweekly	Weekly
Turbidity	NTUs	Field	Weekly	Biweekly	Weekly
Thiobencarb	µg/L	Grab	Weekly	Biweekly	Weekly

2010 Monitoring Calendar

Due to the atypical weather conditions in 2010, rice planting was delayed. As a result, the typical April start-date for monitoring would not have captured pesticide use. Therefore, the first week of monitoring was delayed to better coincide with the peak use season. This decision was made in consultation with the CACs and CVRWQCB staff.

CWFR

CWFR monitoring was conducted May through August. The first sample data was May 11, and the sampling concluded on August 24. Dissolved copper, which is specified in the MRP for monitoring in April and May, was sampled in May and June to provide for sampling during the peak copper use period.

Propanil special project monitoring was conducted weekly for 8 weeks, from June 15 through August 3. This sampling duration exceeds the requirements of the MRP and was implemented at the CRC's discretion due to the unusual weather and planting conditions.

RPP

RPP sampling was conducted for 9 weeks, beginning on May 11 and concluding with the sampling event on July 6, 2010.

Administration and Execution

For both the CWFR and the RPP, the CRC contracted with Kleinfelder to collect water samples and coordinate with laboratories. Following each monitoring event, field data sheets, chain-of-custody (COC) forms, and calibration logs were scanned and e-mailed to CH2M HILL. Kleinfelder was the primary contact for all laboratory services. After analysis, the labs submitted data to Kleinfelder, which then forwarded the data to CH2M HILL for review and analysis.

Sampling Procedures

Sampling was conducted pursuant to the procedures described in the CWFR and RPP Quality Assurance Project Plan (CH2M HILL, 2010), unless otherwise noted.

Field Measurements

Field water quality parameters for the CWFR and RPP, provided in Tables 4-3 and 4-4, respectively, were measured prior to sample collection at each site, and flow was measured after samples were collected. At each site, a water quality sheet was completed; this documented the surface water level, width of the waterway, sample depth at the middle of the water column, total depth to sediment, 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.

Flow

Flow is measured only under the CWFR. Measurements are 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)

Electrical Conductivity, Dissolved Oxygen, Temperature, and pH

Electrical conductivity (EC), dissolved oxygen (DO), temperature, and pH measurements are taken for both the CWFR and RPP monitoring programs. These parameters were measured using a multiprobe instrument that was lowered directly into the water column. The meter was allowed to equilibrate for at least 90 seconds before data were recorded. The meter was calibrated at the beginning of the sampling day. Calibration logs for the CWFR monitoring events are included in Appendix B-1 and the logs for the RPP monitoring events are included in Appendix C-1.

Turbidity

Turbidity was measured using a turbidity meter. Turbidity measurements were recorded for both the CWFR and the RPP.

Grab Samples

For both the CWFR and the RPP, grab samples were collected by a qualified and trained crew of Kleinfelder technicians. The water grab samples were collected using a Kemmerer water sampler (either stainless steel and Teflon model or clear acrylic and PVC 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 a stainless steel funnel, with an additional bottle filled to be held in sample control as a back-up sample.

Non-disposable equipment used in sample collection was decontaminated after each use by rinsing thoroughly with distilled water. The sample equipment was also rinsed at each site with water from the middle of the water column before sample collection. Clean sampling equipment was not allowed to touch the ground, and field personnel wore clean, disposable gloves. New, clean sample bottles and jars were provided by the analytical laboratories or purchased from a supply company.

Sample containers were labeled at the time of sample collection with a unique sample ID number. The label also contained the following information:

- Sample ID
- Sample location
- Date and time of sample collection
- Kleinfelder project number
- Sampling technician identification

Samples were held on wet or blue ice at 4°C until delivered to the laboratory for analysis.

Sample Custody and Documentation

For both the CWFR and the RPP, 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 crosschecked 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 CH2M HILL. CWFR and RPP COC forms are included in Appendixes B-1 and C-1, respectively.

Sample Delivery and Analysis

For both the CWFR and the RPP, after each sampling event, Kleinfelder submitted the samples under COC to the laboratories. Sample shipments were accompanied by the original COC form, which identified contents. Samples were transported after sample collection to the lab for analysis within the sample holding time. The laboratories performing the analyses and the methods used are listed in Table 4-5.

TABLE 4-5
Analytical Laboratories and Methods, 2010

Laboratory	Analytes/Analytical Method(s)	Analytical Method(s) Standard Operating Procedures	Notes
McCampbell Analytical, Inc. 1534 Willow Pass Road Pittsburg, CA 94565 main@mccampbell.com (925) 252-9262	Copper and hardness	EPA 200.8 and SM2340B	
	TDS	EPA 160.1/SM2540C	
	TOC	EPA 415.3	
	Propanil	EPA 532	
	Thiobencarb (QC samples)	EPA 8141A	
California Laboratory Services 3249 Fitzgerald Road Rancho Cordova, CA 95742	Thiobencarb (QC samples)	EPA 507	
Valent Dublin Laboratory (Registrant Laboratory) 6560 Trinity Court Dublin, CA 94568	Thiobencarb	Registrant method	Analyzed under the RPP

CHAPTER 5

2010 Monitoring

The 2010 CWFR and RPP monitoring season information and results are provided separately according to the relevant required information for each program. CWFR monitoring information is provided in the following manner:

- Sampling schedule
- Field parameter results
- 2010 flow data
- Dissolved copper and hardness analysis
- Algae Management Plan (AMP)
- Propanil Management Plan

RPP monitoring information is provided in this manner:

- RPP Performance Goals
- Water holds
- Pesticides monitored
- Sampling schedule
- Sampling collection, delivery, and analysis
- Results

CWFR Monitoring

Monitoring is conducted under the CWFR according to the MRP. Monitoring at the four core sites included measurement of general physical parameters (including lab analysis of dissolved copper, total dissolved solids [TDS], and total organic carbon [TOC]). Monitoring at the three assessment sites included only dissolved copper and hardness; this monitoring was included to complete the assessment monitoring from 2009. The 2010 CWFR monitoring requirements and results follow.

Sampling Schedule

The MRP specifies the general calendar for monitoring. Based on an understanding of the rice growing season, a rice-specific monitoring calendar was developed to sample the April through August "irrigation season," with an event in August to sample a typical drainage event. In 2010, sampling was conducted as shown in Table 5-1, which lists regularly scheduled monitoring. No resampling was required in 2010.

Field Parameter Results

The following field parameters were measured as part of the 2010 sampling effort: temperature, DO, pH, electrical conductivity (EC), turbidity, and flow.

TABLE 5-1
2010 Sampling Calendar

Event Type	Month	Date	Field	Copper	Hardness	TDS	TOC	QC Samples	Assessment Sites – Dissolved Copper
Irrigation	May	5/11 and 5/12/2010	✓	✓	✓	✓	✓	CBD5	✓
	June	6/15 and 6/16/2010	✓	✓	✓	LE	✓	CBD1	✓
	July	7/20/2010	✓	NR	NR	✓	✓	NA	NR
	August	8/24/2010	✓	NR	NR	✓	✓	NA	NR

NOTES:
No resampling was required during the 2010 monitoring season.
NR = not required by the MRP
LE = omitted by the lab; lab error in reading Chain of Custody form and sample was outside of holding time upon detection of omission
NA = not applicable

Temperature Measurements

Temperature measurements were taken during field sampling using the multiprobe instrument. Figure 5-1 shows the field temperature results from the 2010 season. Temperatures in water bodies are typically lowest in the winter and highest in the summer. In 2010, peak water temperatures were observed during the July sampling event, with a high of 83.1°F. As seen in previous years, water temperature in these water bodies essentially tracks with ambient air temperatures. During the peak temperatures, these bodies of water would not provide habitat for coldwater fisheries, although they may provide coldwater habitat during other times of the year.

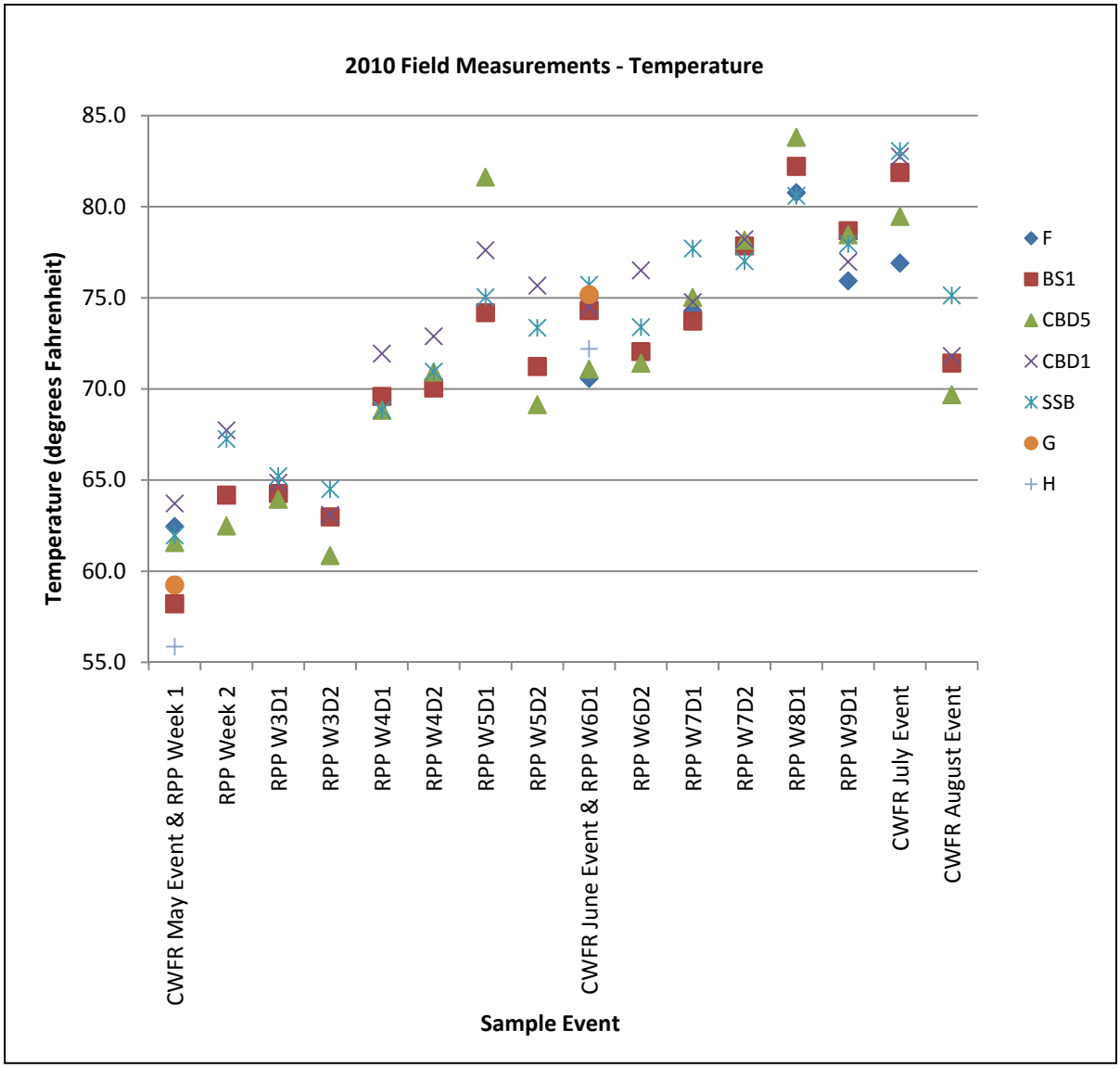


FIGURE 5-1
Field Temperature Measurements, 2010

Table 5-2 presents tabulated temperature results and basic summary information, including site minimum, maximum, mean, and median observed temperatures, as well as event minimum, maximum, mean, and median observed temperatures. Table 5-2 also includes an evaluation of the number of times and the frequency with which the observed field temperature exceeded 68°F, which is the Basin Plan water quality objective (WQO) for the lower Sacramento River.

DO Measurements

The multiprobe instrument was used to take field DO measurements. Figure 5-2 shows the results of DO measurements taken during the 2010 monitoring season. Table 5-3 presents tabulated DO results and basic summary information, including site minimum, maximum, mean, and median observed DO, as well as event minimum, maximum, mean, and median observed DO. Table 5-3 also includes an evaluation of the number of times and the frequency with which the observed field DO values were less than 5 mg/L, 6 mg/L, and 7 mg/L.

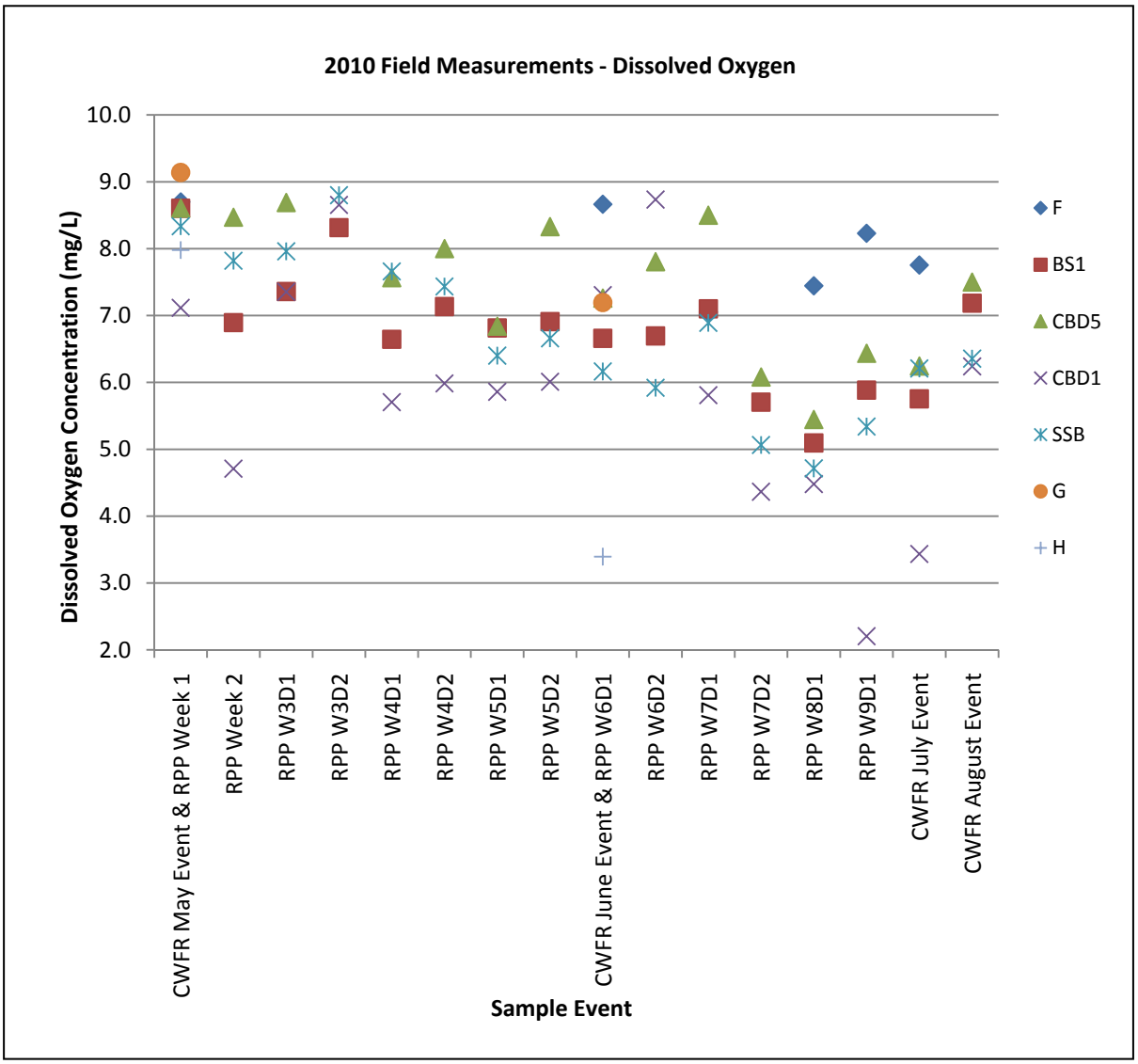


FIGURE 5-2
Dissolved Oxygen Field Measurements, 2010

TABLE 5-2
Field Temperature Measurements—Tabulated Results, 2010 (RPP results included to provide additional monitoring information)

Event	Date	Temperature (°F)							Event Low	Event Mean	Event Median	Event High	Event Variance	Event Standard Deviation	N
		BS1	CBD5	CBD1	SSB	H	G	F							
CWFR May Event and RPP Week 1	5/11 and 5/12/2010	58.2	61.6	63.7	62.0	55.9	59.2	62.4	55.9	60.4	61.6	63.7	7.6	2.8	7
RPP Week 2	5/18/2010	64.2	62.5	67.7	67.3	NR	NR	NR	62.5	65.4	65.7	67.7	6.3	2.5	4
RPP W3D1	5/25/2010	64.3	64.0	64.9	65.2	NR	NR	NR	64.0	64.6	64.6	65.2	0.3	0.6	4
RPP W3D2	5/27/2010	63.0	60.9	63.1	64.5	NR	NR	NR	60.9	62.9	63.0	64.5	2.3	1.5	4
RPP W4D1	6/1/2010	69.6	68.8	71.9	68.8	NR	NR	NR	68.8	69.8	69.2	71.9	2.2	1.5	4
RPP W4D2	6/3/2010	70.1	70.9	72.9	71.0	NR	NR	NR	70.1	71.2	70.9	72.9	1.4	1.2	4
RPP W5D1	6/8/2010	74.2	81.6	77.6	75.0	NR	NR	NR	74.2	77.1	76.3	81.6	11.1	3.3	4
RPP W5D2	6/10/2010	71.2	69.1	75.7	73.4	NR	NR	NR	69.1	72.3	72.3	75.7	7.9	2.8	4
CWFR June and RPP W6D1	6/15 and 6/16/2010	74.3	71.1	74.5	75.7	72.2	75.2	70.6	70.6	73.4	74.3	75.7	4.2	2.1	7
RPP W6D2	6/17/2010	72.1	71.4	76.5	73.4	NR	NR	NR	71.4	73.3	72.7	76.5	5.1	2.3	4
RPP W7D1	6/22/2010	73.7	75.0	74.8	77.7	NR	NR	74.2	73.7	75.1	74.8	77.7	2.4	1.5	5
RPP W7D2	6/24/2010	77.8	78.2	78.2	77.0	NR	NR	NR	77.0	77.8	78.0	78.2	0.3	0.6	4
RPP W8D1	6/29/2010	82.2	83.8	86.2	80.6	NR	NR	80.8	80.6	82.7	82.2	86.2	5.4	2.3	5
RPP W9D1	7/6/2010	78.7	78.5	77.0	77.9	NR	NR	75.9	75.9	77.6	77.9	78.7	1.3	1.1	5
CWFR July Event	7/20/2010	81.9	79.5	82.8	83.1	NR	NR	76.9	76.9	80.8	81.9	83.1	6.8	2.6	5
CWFR August Event	8/24/2010	71.4	69.7	71.8	75.1	NR	NR	NR	69.7	72.0	71.6	75.1	5.2	2.3	4
Site Low		58.21	60.85	63.09	61.96	55.86	59.24	62.45							
Site Mean		71.67	71.65	73.70	72.98	64.03	67.21	73.48							
Site Median		71.74	71.01	74.62	74.21	64.03	67.21	75.08							
Site High		82.21	83.80	86.19	83.06	72.19	75.17	80.77							
Site Variance		46.35	52.57	42.09	36.46	133.42	126.88	40.32							
Site Standard Deviation		6.81	7.25	6.49	6.04	11.55	11.26	6.35							
N		16	16	16	16	2	2	6							
Number of obs. Temp >68°F		12	12	12	12	1	1	5							
Number of obs. Temp <68°F		4	4	4	4	1	1	1							
Percent of obs. where Temp >68°F		75%	75%	75%	75%	50%	50%	83%							
Percent of obs. where temp <68°F		25%	25%	25%	25%	50%	50%	17%							

NOTE:
NR = not required

TABLE 5-3
Dissolved Oxygen Field Measurements—Tabulated Results, 2010 (RPP results included to provide additional monitoring information)

Event	Date	Dissolved Oxygen Concentration (mg/L)							Event Low	Event Mean	Event Median	Event High	Event Variance	Event Standard Deviation	N	Number of obs. DO<7	Number of obs. DO<6	Number of obs. DO<5	Percent of obs. DO<7	Percent of obs. DO<6	Percent of obs. DO<5
		BS1	CBD5	CBD1	SSB	H	G	F													
CWFR May Event and RPP Week 1	5/11 and 5/12/2010	8.61	8.61	7.12	8.34	7.98	9.14	8.70	7.12	8.35	8.61	9.14	0.42	0.65	7	0	0	0	0%	0%	0%
RPP Week 2	5/18/2010	6.90	8.47	4.71	7.82	NR	NR	NR	4.71	6.97	7.36	8.47	2.70	1.64	4	2	1	1	50%	25%	25%
RPP W3D1	5/25/2010	7.36	8.69	7.36	7.96	NR	NR	NR	7.36	7.84	7.66	8.69	0.40	0.63	4	0	0	0	0%	0%	0%
RPP W3D2	5/27/2010	8.32	10.40	8.66	8.80	NR	NR	NR	8.32	9.04	8.73	10.40	0.86	0.93	4	0	0	0	0%	0%	0%
RPP W4D1	6/1/2010	6.65	7.57	5.71	7.66	NR	NR	NR	5.71	6.89	7.11	7.66	0.84	0.92	4	2	1	0	50%	25%	0%
RPP W4D2	6/3/2010	7.14	8.00	5.99	7.44	NR	NR	NR	5.99	7.14	7.29	8.00	0.72	0.85	4	1	1	0	25%	25%	0%
RPP W5D1	6/8/2010	6.82	6.84	5.86	6.40	NR	NR	NR	5.86	6.48	6.61	6.84	0.21	0.46	4	4	1	0	100%	25%	0%
RPP W5D2	6/10/2010	6.91	8.33	6.01	6.66	NR	NR	NR	6.01	6.98	6.79	8.33	0.96	0.98	4	3	0	0	75%	0%	0%
CWFR June and RPP W6D1	6/15 and 6/16/2010	6.66	7.26	7.31	6.17	3.40	7.20	8.67	3.40	6.66	7.20	8.67	2.66	1.63	7	3	1	1	43%	14%	14%
RPP W6D2	6/17/2010	6.70	7.81	8.74	5.92	NR	NR	NR	5.92	7.29	7.25	8.74	1.53	1.24	4	2	1	0	50%	25%	0%
RPP W7D1	6/22/2010	7.10	8.50	5.81	6.89	NR	NR	7.05	5.81	7.07	7.05	8.50	0.92	0.96	5	2	1	0	40%	20%	0%
RPP W7D2	6/24/2010	5.71	6.08	4.37	5.07	NR	NR	NR	4.37	5.30	5.39	6.08	0.57	0.75	4	4	3	1	100%	75%	25%
RPP W8D1	6/29/2010	5.10	5.45	4.48	4.72	NR	NR	7.45	4.48	5.44	5.10	7.45	1.40	1.18	5	4	4	2	80%	80%	40%
RPP W9D1	7/6/2010	5.89	6.44	2.21	5.34	NR	NR	8.23	2.21	5.62	5.89	8.23	4.82	2.20	5	4	3	1	80%	60%	20%
CWFR July Event	7/20/2010	5.76	6.25	3.44	6.21	NR	NR	7.76	3.44	5.88	6.21	7.76	2.44	1.56	5	4	2	1	80%	40%	20%
CWFR August Event	8/24/2010	7.19	7.50	6.24	6.36	NR	NR	NR	6.24	6.82	6.77	7.50	0.38	0.62	4	2	0	0	50%	0%	0%
Site Low		5.10	5.45	2.21	4.72	3.40	7.20	7.05													
Site Mean		6.80	7.64	5.87	6.73	5.69	8.17	7.97													
Site Median		6.86	7.69	5.92	6.53	5.69	8.17	7.99													
Site High		8.61	10.40	8.74	8.80	7.98	9.14	8.70													
Site Variance		0.82	1.54	3.13	1.41	10.51	1.89	0.45													
Site Standard Deviation		0.91	1.24	1.77	1.19	3.24	1.38	0.67													
N		16	16	16	16	2	2	6													
Number of obs. DO<7		10	5	11	10	1	0	0													
Number of obs. DO<6		4	1	9	4	1	0	0													
Number of obs. DO<5		0	0	5	1	1	0	0													
Percent of obs. DO<7		63%	31%	69%	63%	50%	0%	0%													
Percent of obs. DO<6		25%	6%	56%	25%	50%	0%	0%													
Percent of obs. DO<5		0%	0%	31%	6%	50%	0%	0%													

NOTE:
NR = not required

DO values of less than 6 mg/L were observed at H, BS1, and CBD1 (Table 5-3). Sites H and CBD1 had low DO readings of less than 5 mg/L during the 2010 sampling season.

Occurrences of low DO (<6 mg/L) were observed at only one monitoring event per site during the 2010 monitoring season (June event for site H, July event for sites CBD1 and BS1). Site CBD1 historically has had low DO throughout the summer months. The one event with low DO in 2010 is an improvement on previous years; low DO occurred at two events in 2009 and three events in 2008. Site BS1 has typically had low DO later in the season (August-September), with summer DO values in the 6 mg/L range. In 2010, the one low DO reading occurred during the July event, and was close to 6 mg/L. The low late-season DO readings found at site BS1 in the past did not occur during the 2010 monitoring season. Assessment site H has only been monitored for one season (2009) prior to the 2010 season; during the 2009 season, low DO was recorded three times (June, July, and August events). Low DO was only recorded at the June event during the 2010 season.

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 resulting diurnal oxygen depletion resulting from nighttime algae uptake and/or uniform channel character that limits natural aeration.

Warm water temperatures also can contribute to low DO values. As temperature increases, oxygen solubility decreases and approaches the WQO of 7 mg/L DO. This means that biological activity (such as from microorganisms breaking down detritus or other organic matter) can easily consume enough oxygen to depress DO below the WQO, particularly under warmer conditions. Figure 5-3 shows oxygen solubility as a function of temperature. Oxygen solubilities on the graph are approximate because additional factors, such as salinity, influence oxygen solubility.

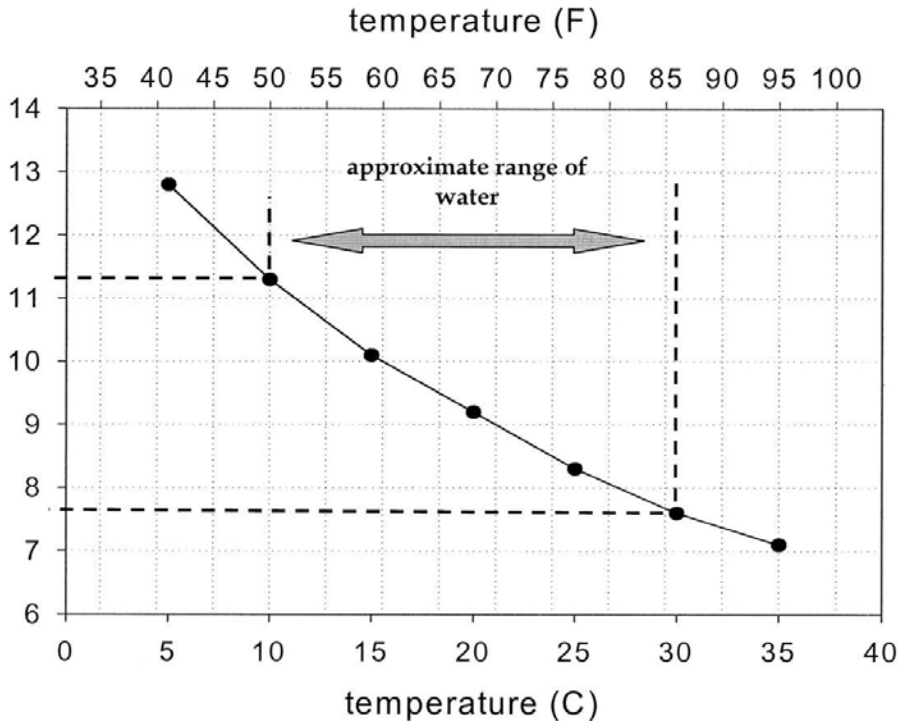


FIGURE 5-3
Oxygen Solubility as a Function of Temperature

pH Measurements

The multiprobe instrument was used to measure pH in the field. Figure 5-4 shows the results of pH measurements taken during the 2010 monitoring season. Table 5-4 presents tabulated pH results and basic summary information, including site minimum, maximum, mean, and median observed pH, as well as event minimum, maximum, mean, and median observed pH. Table 5-4 also includes an evaluation of the number of times and the frequency with which the observed field pH was less than 6.5 or greater than 8.5 (WQOs). There were no observations that fell outside the 6.5 to 8.5 pH range in 2010; all samples showed achievement of water quality standards.

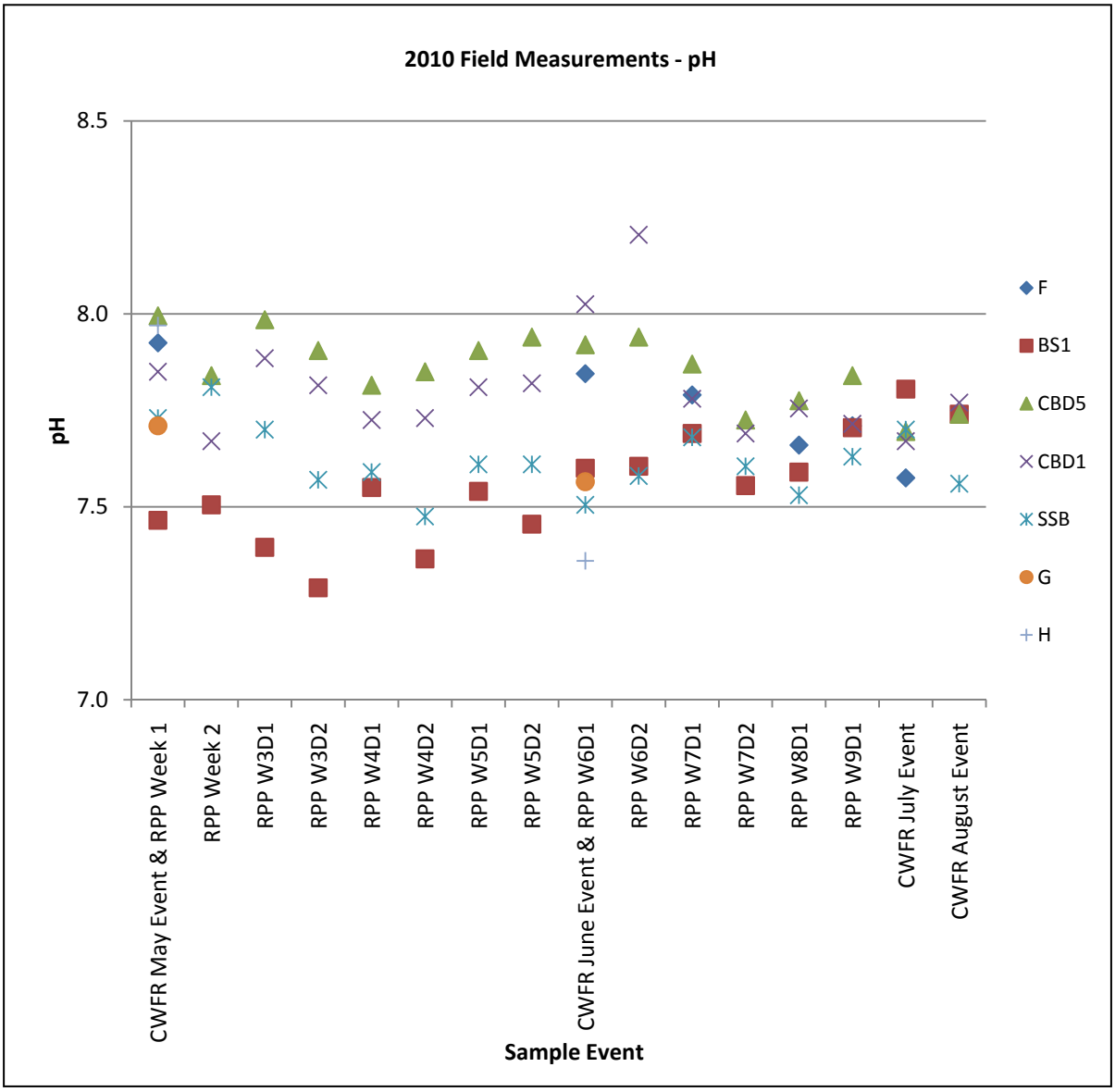


FIGURE 5-4
pH Field Measurements, 2010

TABLE 5-4
pH Field Measurements—Tabulated Results, 2010

Event	Date	pH							Event Low	Event Mean	Event Median	Event High	Event Variance	Event Standard Deviation	N	Number of obs. pH<6.5	Number of obs. pH>8.5	Percent of obs. pH<6.5	Percent of obs. pH>8.5
		BS1	CBD5	CBD1	SSB	H	G	F											
CWFR May Event and RPP Week 1	5/11 and 5/12/2010	7.47	8.00	7.85	7.73	7.97	7.71	7.93	7.47	7.81	7.85	8.00	0.03	0.19	7	0	0	0%	0%
RPP Week 2	5/18/2010	7.51	7.84	7.67	7.81	NR	NR	NR	7.51	7.71	7.74	7.84	0.02	0.15	4	0	0	0%	0%
RPP W3D1	5/25/2010	7.40	7.99	7.89	7.70	NR	NR	NR	7.40	7.74	7.79	7.99	0.07	0.26	4	0	0	0%	0%
RPP W3D2	5/27/2010	7.29	7.91	7.82	7.57	NR	NR	NR	7.29	7.65	7.69	7.91	0.08	0.28	4	0	0	0%	0%
RPP W4D1	6/1/2010	7.55	7.82	7.73	7.59	NR	NR	NR	7.55	7.67	7.66	7.82	0.01	0.12	4	0	0	0%	0%
RPP W4D2	6/3/2010	7.37	7.85	7.73	7.48	NR	NR	NR	7.37	7.61	7.60	7.85	0.05	0.22	4	0	0	0%	0%
RPP W5D1	6/8/2010	7.54	7.91	7.81	7.61	NR	NR	NR	7.54	7.72	7.71	7.91	0.03	0.17	4	0	0	0%	0%
RPP W5D2	6/10/2010	7.46	7.94	7.82	7.61	NR	NR	NR	7.46	7.71	7.72	7.94	0.05	0.22	4	0	0	0%	0%
CWFR June and RPP W6D1	6/15 and 6/16/2010	7.60	7.92	8.03	7.51	7.36	7.57	7.85	7.36	7.69	7.60	8.03	0.06	0.24	7	0	0	0%	0%
RPP W6D2	6/17/2010	7.61	7.94	8.21	7.58	NR	NR	NR	7.58	7.83	7.77	8.21	0.09	0.30	4	0	0	0%	0%
RPP W7D1	6/22/2010	7.69	7.87	7.78	7.68	NR	NR	7.79	7.68	7.76	7.78	7.87	0.01	0.08	5	0	0	0%	0%
RPP W7D2	6/24/2010	7.56	7.73	7.69	7.61	NR	NR	NR	7.56	7.64	7.65	7.73	0.01	0.08	4	0	0	0%	0%
RPP W8D1	6/29/2010	7.59	7.78	7.76	7.53	NR	NR	7.66	7.53	7.66	7.66	7.78	0.01	0.10	5	0	0	0%	0%
RPP W9D1	7/6/2010	7.71	7.84	7.72	7.63	NR	NR	7.71	7.63	7.72	7.71	7.84	0.01	0.08	5	0	0	0%	0%
CWFR July Event	7/20/2010	7.81	7.70	7.67	7.70	NR	NR	7.58	7.58	7.69	7.70	7.81	0.01	0.08	5	0	0	0%	0%
CWFR August Event	8/24/2010	7.74	7.74	7.77	7.56	NR	NR	NR	7.56	7.70	7.74	7.77	0.01	0.10	4	0	0	0%	0%
Site Low		7.29	7.70	7.67	7.48	7.36	7.57	7.58											
Site Mean		7.55	7.86	7.81	7.62	7.67	7.64	7.75											
Site Median		7.55	7.86	7.78	7.61	7.67	7.64	7.75											
Site High		7.81	8.00	8.21	7.81	7.97	7.71	7.93											
Site Variance		0.02	0.01	0.02	0.01	0.19	0.01	0.02											
Site Standard Deviation		0.14	0.09	0.14	0.09	0.43	0.10	0.13											
N		16	16	16	16	2	2	6											
Number of obs. pH<6.5		0	0	0	0	0	0	0											
Number of obs. pH>8.5		0	0	0	0	0	0	0											
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%	0%											

NOTE:
NR = not required

Electrical Conductivity Measurements

The multiprobe instrument was used to take field EC measurements. Figure 5-5 shows the results of EC measurements collected during the 2010 monitoring season. Table 5-5 presents tabulated EC results and basic summary information, including site minimum, maximum, mean, and median observed EC, as well as event minimum, maximum, mean, and median observed EC. Table 5-5 also includes an evaluation of the number of times and the frequency with which the observed field EC exceeded 700 µmhos/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.

There were two samples with an EC greater than 700 µmhos/cm during the 2010 sampling season, the June samples from CBD5 and CBD1. During previous sampling seasons there have been several samples with EC values greater than 700 µmhos/cm; however, those samples were typically collected during storm event sampling.

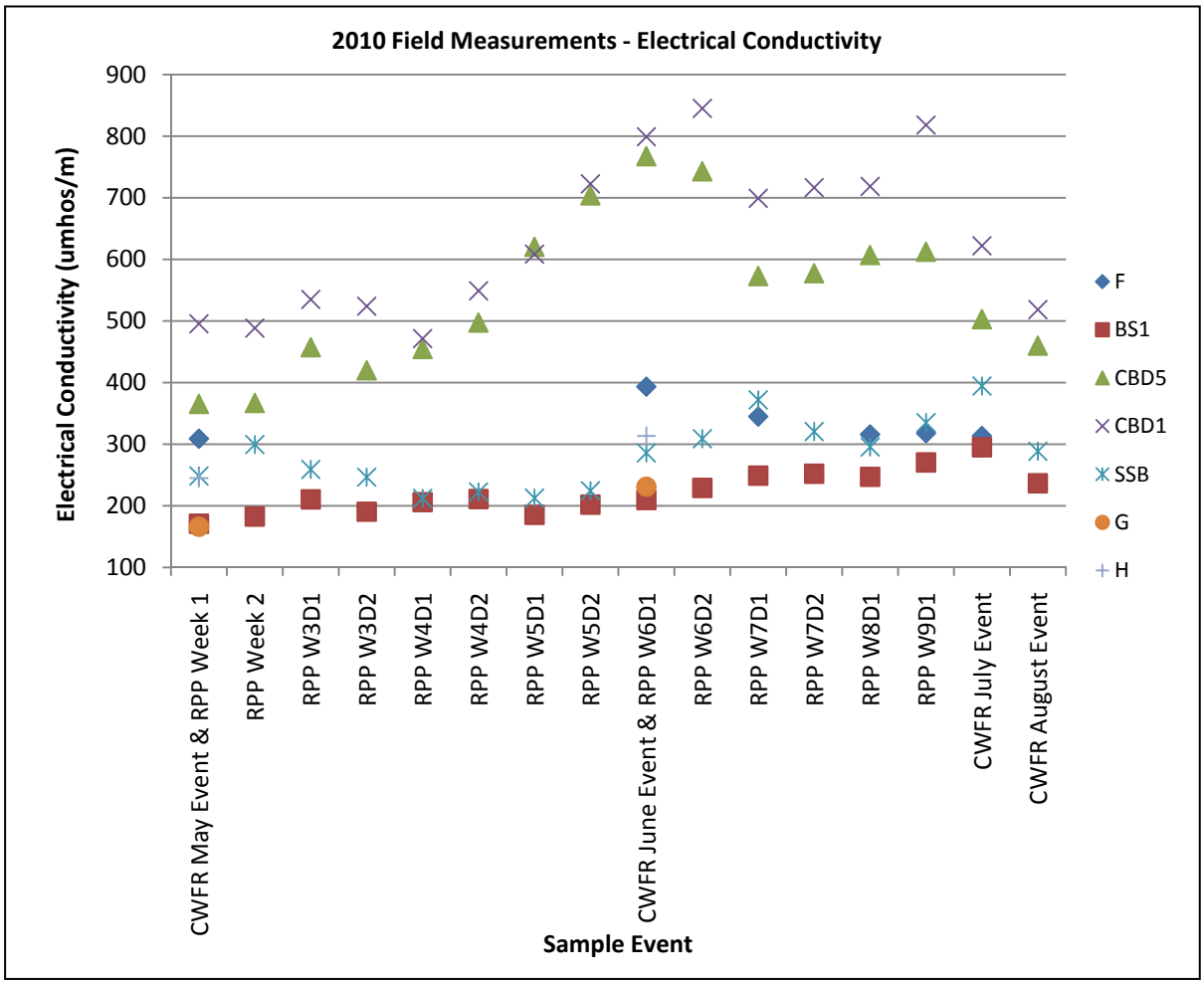
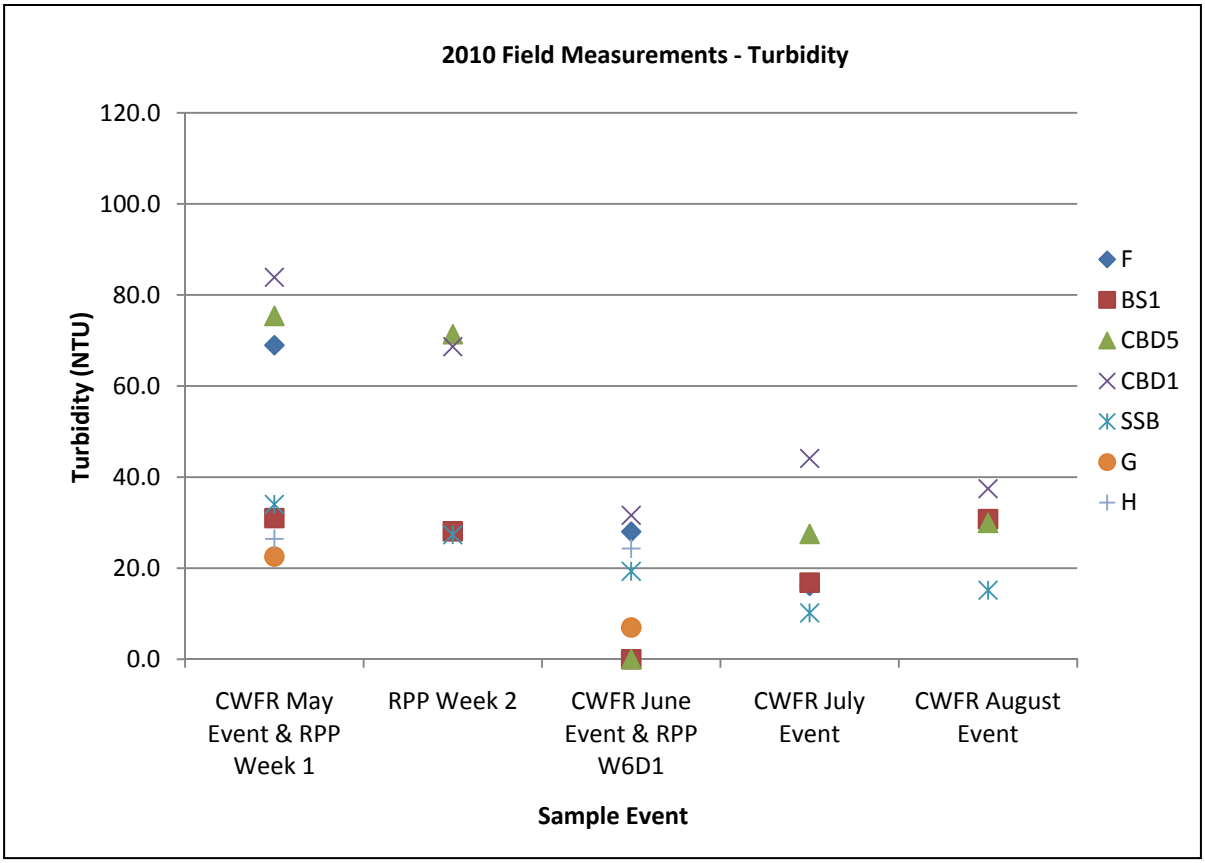


FIGURE 5-5
Electrical Conductivity Field Measurements, 2010

Turbidity

Turbidity measurements are taken in the field using the multiprobe instrument. Figure 5-6 shows the results of turbidity measurements taken during the 2010 monitoring season. Table 5-6 presents tabulated turbidity results and basic summary information, including site minimum, maximum, mean, and median observed turbidity, as well as event minimum, maximum, mean, and median observed turbidity.



NOTE:
NTU = nephelometric turbidity unit

FIGURE 5-6
Turbidity Field Measurements, 2010

TABLE 5-5
Electrical Conductivity Field Measurements—Tabulated Results, 2010

Event	Date	Electrical Conductivity (µS/cm)							Event Low	Event Mean	Event Median	Event High	Event Variance	Event Std. Deviation	N	Number of obs. EC>700	Percent of obs. EC>700
		BS1	CBD5	CBD1	SSB	H	G	F									
CWFR May Event and RPP Week 1	5/11 and 5/12/2010	171	366	496	249	245	166	309	166	286	249	496	13,575	117	7	0	0%
RPP Week 2	5/18/2010	183	367	489	300	NR	NR	NR	183	334	333	489	16,367	128	4	0	0%
RPP W3D1	5/25/2010	211	458	535	259	NR	NR	NR	211	366	358	535	24,187	156	4	0	0%
RPP W3D2	5/27/2010	191	420	524	247	NR	NR	NR	191	345	333	524	23,746	154	4	0	0%
RPP W4D1	6/1/2010	206	455	472	212	NR	NR	NR	206	336	333	472	21,560	147	4	0	0%
RPP W4D2	6/3/2010	211	498	549	223	NR	NR	NR	211	370	360	549	31,778	178	4	0	0%
RPP W5D1	6/8/2010	186	621	609	213	NR	NR	NR	186	407	411	621	57,692	240	4	0	0%
RPP W5D2	6/10/2010	202	704	723	225	NR	NR	NR	202	463	464	723	83,475	289	4	2	50%
CWFR June and RPP W6D1	6/15 and 6/16/2010	210	768	799	286	314	231	394	210	429	314	799	62,319	250	7	2	29%
RPP W6D2	6/17/2010	229	743	845	309	NR	NR	NR	229	532	526	845	94,676	308	4	2	50%
RPP W7D1	6/22/2010	249	573	699	372	NR	NR	345	249	448	372	699	33,653	183	5	0	0%
RPP W7D2	6/24/2010	252	578	717	321	NR	NR	NR	252	467	449	717	47,382	218	4	1	25%
RPP W8D1	6/29/2010	247	607	719	296	NR	NR	316	247	437	316	719	44,726	211	5	1	20%
RPP W9D1	7/6/2010	271	613	818	335	NR	NR	318	271	471	335	818	55,634	236	5	1	20%
CWFR July Event	7/20/2010	295	503	622	395	NR	NR	314	295	426	395	622	18,788	137	5	0	0%
CWFR August Event	8/24/2010	237	460	519	289	NR	NR	NR	237	376	374	519	18,160	135	4	0	0%
Site Low		171	366	472	212	245	166	309									
Site Mean		222	546	633	283	279	199	333									
Site Median		211	538	615	287	279	199	317									
Site High		295	768	845	395	314	231	394									
Site Variance		1,183	15,770	16,108	3,053	2,346	2,113	1,055									
Site Std. Deviation		34.4	125.6	126.9	55.3	48.4	46.0	32.5									
N		16	16	16	16	2	2	6									
Number of obs. EC>700		0	3	6	0	0	0	0									
Percent of obs. EC>700		0%	19%	38%	0%	0%	0%	0%									

NOTE:
NR = not required

TABLE 5-6
Turbidity Field Results—Tabulated Results, 2010

Event	Date	Turbidity (NTU)							Event Low	Event Mean	Event Median	Event High	Event Variance	Event Standard Deviation	N
		BS1	CBD5	CBD1	SSB	H	G	F							
CWFR May Event and RPP Week 1	5/11 - 5/12/2010	30.99	75.38	83.87	34.01	26.43	22.53	68.95	22.53	48.88	34.01	83.87	678.14	26.04	7
RPP Week 2	5/18/2010	28.10	71.35	68.65	27.33	NR	NR	NR	27.33	48.86	48.38	71.35	597.32	24.44	4
CWFR June Event and RPP W6D1	6/15 - 6/16/2010	TE	TE	31.60	19.30	24.30	6.98	28.00	6.98	22.04	24.30	31.60	91.58	9.57	5
CWFR July Event	7/20/2010	16.80	27.50	44.10	10.17	NR	NR	16.10	10.17	22.93	16.80	44.10	179.02	13.38	5
CWFR August Event	8/24/2010	30.75	29.92	37.45	15.14	NR	NR	NR	15.14	28.32	30.34	37.45	88.51	9.41	4
Site Low		16.80	27.50	31.60	10.17	24.30	6.98	16.10							
Site Mean		26.66	51.04	53.13	21.19	25.37	14.76	37.68							
Site Median		29.43	50.64	44.10	19.30	25.37	14.76	28.00							
Site High		30.99	75.38	83.87	34.01	26.43	22.53	68.95							
Site Variance		44.92	668.37	494.19	90.92	2.27	120.90	768.61							
Site Standard Deviation		13.26	31.97	22.23	9.54	1.51	11.00	27.72							
N		4	4	5	5	2	2	3							

NOTES:
NR = not required
TE = Technician error. Turbidity not recorded on field sheet.

Lab Parameter Results

The following parameters were measured at the lab as part of the 2010 sampling effort: TDS and TOC.

TDS Measurements

TDS samples were collected in the field and analyzed in the lab. Figure 5-7 shows the results of TDS samples taken during the 2010 monitoring season. Table 5-7 presents tabulated TDS results and basic summary information, including site minimum, maximum, mean, and median observed TDS, as well as event minimum, maximum, mean, and median observed TDS.

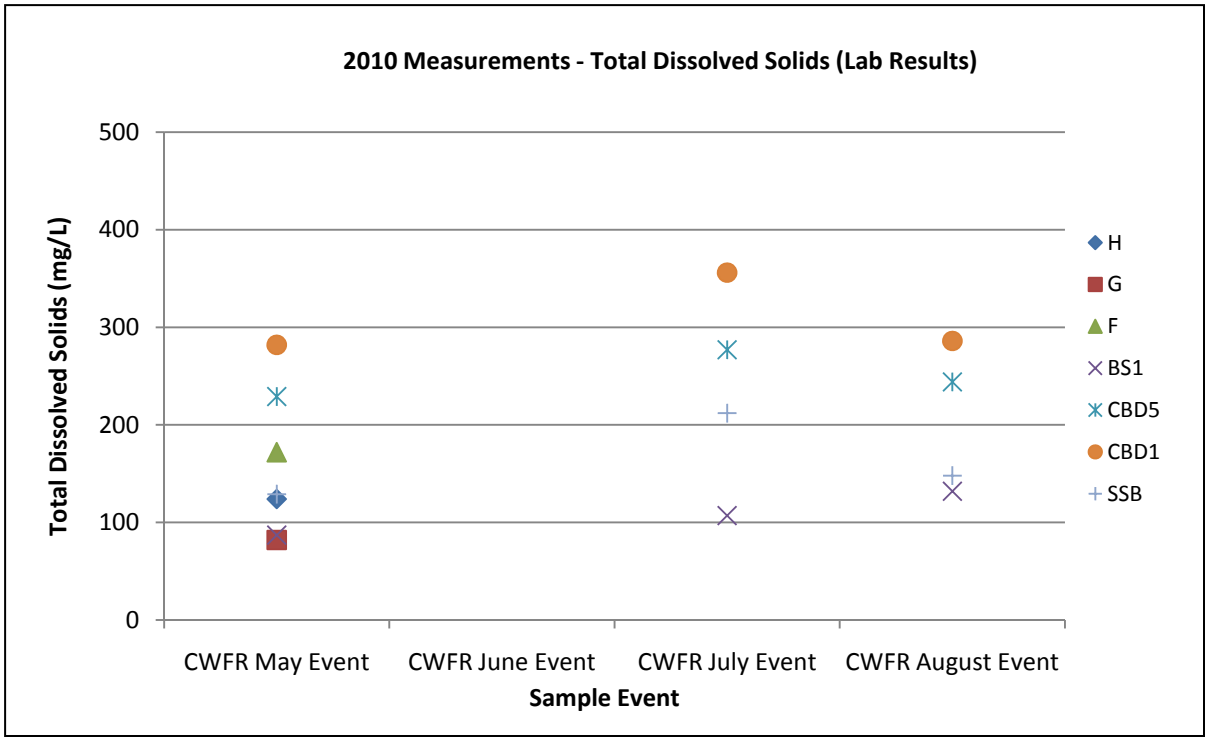


FIGURE 5-7
TDS Results, 2010

TOC Measurements

TOC samples were collected in the field and analyzed in the lab. Figure 5-8 shows the results of TOC samples taken during the 2010 monitoring season. Table 5-8 presents tabulated TOC results and basic summary information, including site minimum, maximum, mean, and median observed TOC, as well as event minimum, maximum, mean, and median observed TOC.

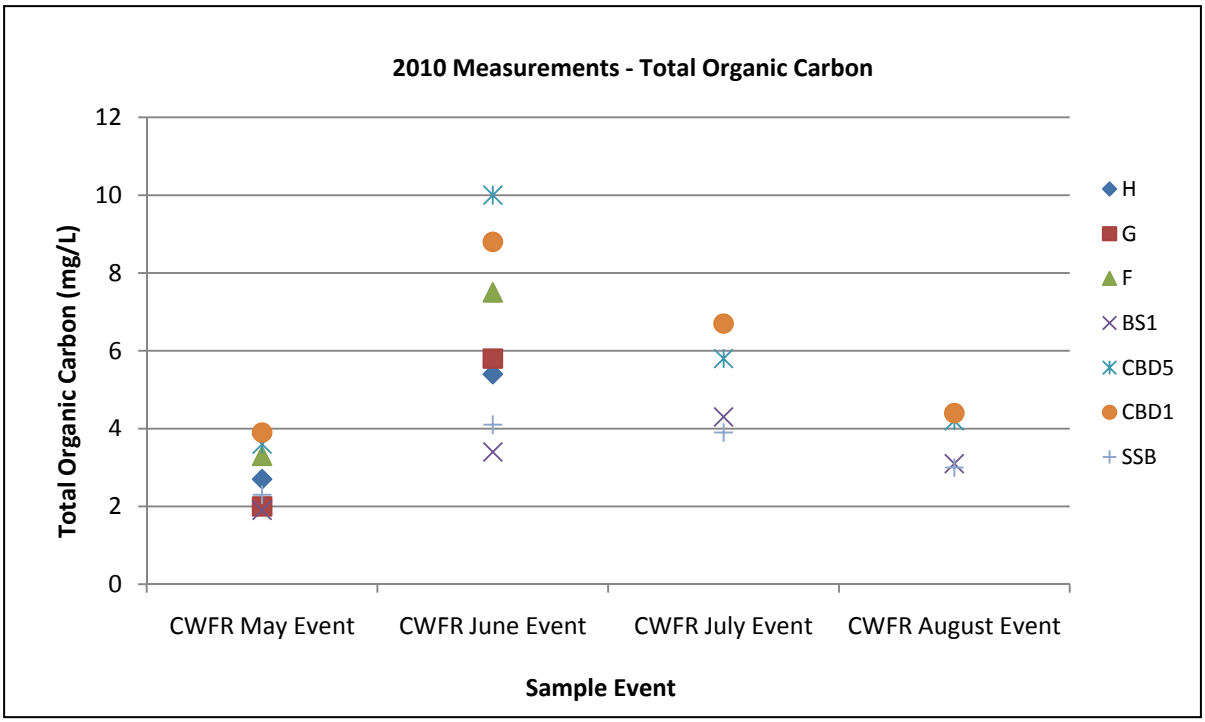


FIGURE 5-8
TOC Results, 2010

TABLE 5-7
TDS Lab Results —Tabulated Results, 2010

Event	Date	Total Dissolved Solids (mg/L)							Event Low	Event Mean	Event Median	Event High	Event Variance	Event Standard Deviation	N
		BS1	CBD5	CBD1	SSB	H	G	F							
CWFR May Event	5/11 - 5/12/2010	87.0	229	282	129	124	82.0	172	82	158	129	282	5571	75	7
CWFR June Event	6/15 - 6/16/2010	LE	LE	LE	LE	NR	NR	NR	NA	NA	NA	NA	NA	NA	0
CWFR July Event	7/20/2010	107	277	356	212	NR	NR	NR	107	238	245	356	11094	105	4
CWFR August Event	8/24/2010	132	244	286	148	NR	NR	NR	132	203	196	286	5545	74	4
Site Low		87	229	282	129	NA	NA	NA							
Site Mean		109	250	308	163	NA	NA	NA							
Site Median		107	244	286	148	NA	NA	NA							
Site High		132	277	356	212	NA	NA	NA							
Site Variance		508	603	1732	1891	NA	NA	NA							
Site Standard Deviation		22.55	24.56	41.62	43.49	NA	NA	NA							
N		3	3	3	3	1	1	1							

NOTES:
LE = omitted by the lab; lab error in reading Chain of Custody form and sample was outside of holding time upon detection of omission
NR = not required
NA = not applicable

TABLE 5-8
TOC Lab Results —Tabulated Results, 2010

Event	Date	Total Organic Carbon (mg/L)							Event Low	Event Mean	Event Median	Event High	Event Variance	Event Standard Deviation	N
		BS1	CBD5	CBD1	SSB	H	G	F							
CWFR May Event	5/11 - 5/12/2010	1.9	3.6	3.9	2.3	2.7	2.0	3.3	1.9	2.8	2.7	3.9	1	1	7
CWFR June Event	6/15 - 6/16/2010	3.4	10	8.8	4.1	5.4	5.8	7.5	3.4	6.4	5.8	10.0	6	2	7
CWFR July Event	7/20/2010	4.3	5.8	6.7	3.9	NR	NR	NR	3.9	5.2	5.1	6.7	2	1	4
CWFR August Event	8/24/2010	3.1	4.2	4.4	3.0	NR	NR	NR	3.0	3.7	3.7	4.4	1	1	4
Site Low		1.9	3.6	3.9	2.3	2.7	2.0	3.3							
Site Mean		3.2	5.9	6.0	3.3	4.1	3.9	5.4							
Site Median		3.3	5.0	5.6	3.5	4.1	3.9	5.4							
Site High		4.3	10.0	8.8	4.1	5.4	5.8	7.5							
Site Variance		1	8	5	1	4	7	9							
Site Standard Deviation		0.99	2.89	2.26	0.83	1.91	2.69	2.97							
N		4	4	4	4	2	2	2							

NOTE:
NR =not required

2010 Flow Data

Table 5-9 contains the flow data collected during the 2010 monitoring season. Flow measurements were taken at 10 cross-sections at each CWFR core and assessment monitoring site. The wetted width of the waterbody 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. Field measurements were documented on field sheets contained in Appendix B-1.

TABLE 5-9
Flow Data for the 2010 Monitoring Season

Event	Date	Estimated Flow (cubic feet per second)						
		BS1	CBD5	CBD1	SSB	H	G	F
May Irrigation Event	5/11 and 5/12/2010	40.5	512.8	35.8	131.5	0.0	91.8	54.5
June Irrigation Event	6/15 and 6/16/2010	67.0	82.2	0.0	149.5	1.5	69.7	41.0
July Irrigation Event	7/20/2010	19.4	613.9	87.9	19.5	NR	NR	50.4
August Irrigation Event	8/24/2010	95.9	952.6	490.2	307.1	NR	NR	NR

NOTE:
NR = not required

Dissolved Copper and Hardness Analysis

Samples were collected for copper and hardness analysis during the first two events of the season, in accordance with the MRP. The first two events were chosen because they represent the time of application and possible release in rice drainage waters. Samples were analyzed for copper using U.S. Environmental Protection Agency (EPA) Method 200.8, and hardness using EPA Method 200.7 and calculation SM2340B. Results are shown in Table 5-10.

The California Toxics Rule (CTR) 1-hour maximum criterion for dissolved copper is:

$$\text{1-hour maximum copper concentration } (\mu g/L) = (e^{0.9422[\ln(\text{hardness})]-1.700}) \times 0.960$$

The CTR 4-day maximum criterion for dissolved copper is:

$$\text{4-day maximum copper concentration } (\mu g/L) = (e^{0.8545[\ln(\text{hardness})]-1.702}) \times 0.960$$

The hardness-adjusted copper criteria, based on the actual hardness measured for the sample location and date, are shown in Table 5-11. All of the copper samples taken during the 2010 monitoring season fell below the 1-hour copper criterion. All of the samples fell below the 4-day criterion, with the exception of the Site F sample from the June event. Based on consultation with CVRWQCB staff, it is not thought that this concentration would persist over a 4-day period at the site.

TABLE 5-10
2010 Copper and Hardness Results

Event	Date	Dissolved Copper Concentration (µg/L)							Hardness as $CaCO_3$ (mg/L)						
		CBD5	BS1	CBD1	SSB	F	G	H	CBD5	BS1	CBD1	SSB	F	G	H
May Irrigation Event	5/11 and 5/12/2010	2.45	ND	1.7	0.54	2.7	ND	ND	110	63.0	140	95.0	81.0	71.0	97.0
June Irrigation Event	6/15 and 6/16/2010	5.9	1.7	6.0	2.3	9.0	3.7	2.1	200	92.0	210	120	87.0	110	150

TABLE 5-11
Hardness adjusted CTR Copper Water Quality Criteria (1h and 4 day maximum)

Event	Date	1 hr maximum copper concentration (µg/L)							4 day maximum copper concentration (µg/L)						
		CBD5	BS1	CBD1	SSB	F	G	H	CBD5	BS1	CBD1	SSB	F	G	H
May Irrigation Event	5/11 and 5/12/2010	14.7	8.7	18.5	12.8	11.0	9.7	13.1	9.7	6.0	11.9	8.6	7.5	6.7	8.7
June Irrigation Event	6/15 and 6/16/2010	25.8	12.4	27.0	16.0	11.8	14.7	19.7	16.2	8.3	16.9	10.5	8.0	9.7	12.7

Management Plans

CVRWQCB Resolution No. R5-2006-0077 requires that coalitions implementing water quality control programs under the Conditional Waiver submit management plans when monitoring results show two or more observed "exceedances" over a 3-year period. Past results have triggered requirements for an Algae Management Plan and a voluntary Propanil Management Plan resulting from one high monitoring result. Both final plans were submitted to the CVRWQCB in April 2010, in compliance with the 2010 MRP.

Algae Management Plan

Results obtained during CRC's 2005 through 2008 monitoring showed aquatic toxicity for *Selenastrum capricornutum*, an algae specified by the U.S. Environmental Protection Agency (EPA) to determine chronic aquatic toxicity of receiving waters, triggering the submittal of a Management Plan (AMP). Monitoring continued during 2009 under the 2009 Algae Management Plan. Observed toxicity for *Selenastrum capricornutum* was much lower during 2009 monitoring, and the frequency and magnitude of algae reductions showed a general downward trend. The 2010 AMP evaluated the toxicity and rice pesticides data collected to date, and the decision was made to commence monitoring under a core monitoring program regime and suspend additional algae toxicity testing and herbicides analysis under an AMP. The 2010 AMP, including background information on monitoring during Years 1 through 5, is attached as Appendix B-3. No algae-specific monitoring was required in 2010.

Propanil Management Plan

Propanil monitoring at both assessment and core was included in 2009. The CRC surpassed the monitoring requirements by conducting additional core site propanil monitoring on a weekly basis, June through July (peak use). Results from 2009 included a detection (47 µg/L) of propanil at the assessment site location on Lurline Creek, Colusa County, California. Two additional detections of 11 and 12 µg/L (CBD5 and SSB, respectively) were noted by CVRWQCB staff. As a result, CVRWQCB staff proposed that propanil monitoring be conducted at assessment and core monitoring sites on a weekly basis during June 2010. The CRC voluntarily proposed a Propanil Management Plan in order to trigger support for additional grower education and outreach. This monitoring is considered "special project monitoring" under the conditions of the Irrigated Lands Program.

Monitoring was conducted at core sites and Lurline Creek (Assessment site F), during June, July and the first week of August. This coordinates with the typical application period for propanil. In addition to the monitoring, requirements included implementation of additional outreach activities.

Outreach activities included providing propanil use information in the CRC newsletter and grower letter, including links to the regulations, and coordination with the registrants on a brochure, *Propanil Rice Herbicide: Stewardship Practices for Protecting Water Quality*.

The 2010 Propanil Management Plan is attached as Appendix B-4. The management plan includes background information on water quality objectives and propanil results from the 2006 through 2009 monitoring seasons.

Results

Field sheets and results for the propanil sampling are located in Appendix B-3.

Eight consecutive weeks of propanil sampling were completed in 2010 (Table 5-12). The highest detections were from the June 22 event at site CBD5 (5.0 µg/L), the June 29 event at site F (10 µg/L), and the July 6 event at site BS1 (4.4 µg/L). Results of the order of magnitude detected at site F may indicate additional assessment monitoring per discussion with the CVRWQCB staff.

The June 22 and July 6 sampling events had the most detections. The June 22 event showed concentrations above the laboratory reporting limit at three out of five sites, and the July 6 event showed concentrations about the laboratory reporting limit at four out of five sites. The last two sampling weeks (July 27 and August 3) had no detections at any of the sampling locations.

TABLE 5-12
2010 Propanil Monitoring Results

	Monitoring Results (µg/L) ***(Reporting Limit for McCampbell Analytical <0.50 µg/L)***				
Sampling Date	**CBD5**	**BS1**	**CBD1**	**SSB**	**F**
6/15/2010	**3.8**	ND	ND	ND	ND
6/22/2010	**5.0**	**0.65J**	**2.7**	ND	ND
6/29/2010	**2.2J**	**2.8**	ND	ND	**10**
7/6/2010	**1.7**	**4.4**	**2.0**	ND	**0.65**
7/13/2010	ND	**0.65**	ND	**0.97**	ND
7/20/2010	ND	ND	**0.67**	ND	**1.2**
7/27/2010	ND	ND	ND	ND	ND
8/3/2010	ND	ND	ND	ND	ND

NOTES:
Concentrations are reported in µg/L (parts per billion)
ND = Not detected above laboratory reporting limits
J = Analyte detected below quantitation limits
No numeric standard exists for propanil, so the laboratory reporting limit is used as a guideline in analyzing sampling results

RPP Monitoring

Monitoring is conducted under the RPP according CVRWQCB Resolution No. R5-2007-0018. Monitoring at the five RPP sites included measurement of general field parameters and laboratory analysis of the chemical thiobencarb.

The RPP is reviewed by the CVRWQCB, which has authority to authorize the program or use another regulatory approach to achieve water quality protection, including compliance with Performance Goals and attainment of the thiobencarb water quality objective established in the Basin Plan. The RPP has achieved substantial improvements in water

quality and an increased understanding of rice water quality concerns and serves as a model of grower engagement and follow through.

RPP Performance Goals

Since 1990, Sacramento Valley rice farmers have operated pursuant to water quality regulations that prohibit the discharge of irrigation return flows containing carbofuran, malathion, methyl parathion, molinate, and thiobencarb unless the discharger is following management practices approved by the CVRWQCB. The Basin Plan requires that practices only be approved if implementation of such practices can be expected to result in compliance with adopted numeric performance goals and narrative toxicity standards. The Basin Plan was amended to establish performance goals for the five pesticides. The goals were established to be protective of the aquatic ecosystem. The established performance goals for the five pesticides regulated under the conditional prohibition of discharge are shown in Table 5-13. Of these pesticides, only thiobencarb is still used on rice in quantities that could potentially result in exceedances of performance goals or water quality objectives, absent implementation of CVRWQCB-approved management practices.

TABLE 5-13
Basin Plan Performance Goals for the Five RPP Pesticides

Pesticide	Basin Plan Performance Goal
Molinate	10.0 ppb
Thiobencarb	1.5 ppb
Malathion	0.1 ppb
Methyl parathion	0.13 ppb
Carbofuran	0.4 ppb

NOTE:
ppb = parts per billion

In addition to achieving the Basin Plan performance goal, RPP levels in drinking water delivered to municipal customers must meet enforceable MCLs. MCLs are enforceable drinking water standards set by the EPA and the California Department of Public Health (CDPH, formerly the California Department of Health Services). Primary MCLs are health-based standards, and secondary MCLs are based on aesthetic properties such as taste, color, odor, and appearance. The primary MCL for thiobencarb is 70.0 ppb (toxicity), and the secondary MCL is established for nuisance at 1.0 ppb (off-taste).

Water Holds

Over the years, best management practices such as water hold requirements, grower information meetings, and inspection and enforcement were implemented to ensure compliance with performance goals and attainment of water quality objectives and MCLs. The water holds, which are specified in the Department of Pesticide Regulation (DPR) permit conditions, were developed to provide for in-field degradation of pesticides prior to the release of treated water to drains and other surface waters. Thiobencarb water hold requirements were the same during 2010 as during previous growing seasons.

Pesticides Monitored

RPP samples were analyzed for thiobencarb during the 2010 monitoring season. As in recent years past, samples were *not* analyzed for carbofuran, malathion, and methyl-parathion because of registration cancellation, decrease in use, and no reportable applications to rice. Specifically, carbofuran is no longer registered for use on rice and has had no reportable use since 2000. Malathion has not been monitored since 2003 because of a dramatic decrease in its use. Historical information indicates that the maximum rice acreage treated with malathion was 9,278 acres in 1991. Annual malathion use on rice has been less than 1,000 acres since 2001. The preliminary 2010 DPR PUR documented no acres of malathion usage. Molinate was removed from monitoring during 2010 because it is now a prohibited pesticide and is no longer applied to rice.

Sampling Schedule

The sampling calendar was developed based on historical data, rice pesticide use and drainage patterns, and actual 2010 conditions. The sampling start date was selected in consultation with growers, CACs, and CVRWQCB staff. Sampling was conducted for 9 weeks according to the schedule listed in Table 5-14. Sampling was initiated on May 11, 2010, at sites SR1, CBD1, CBD5, BS1, and SSB.

Weekly samples were collected on Tuesdays during weeks 2, 8, and 9. Samples were collected over a 2-day period (Tues/Wed) during week 1 in order to accommodate CWFR sampling. During weeks 3, 4, 5, 6, and 7, samples were collected on Tuesdays and Thursdays. The CVRWQCB requested this sampling frequency to monitor attainment of water quality performance goals established for rice pesticides; this sampling frequency provides a sound technical basis for screening for water quality concerns in order to inform prompt follow-up.

TABLE 5-14
RPP Sampling Schedule, 2010

Date	Event
5/11 and 5/12/10	W1
5/18/10	W2
5/25/10	W3D1
5/27/10	W3D2
6/01/10	W4D1
6/03/10	W4D2
6/08/10	W5D1
6/10/10	W5D2
6/15/10	W6D1
6/17/10	W6D2
6/22/10	W7D1
6/24/10	W7D2
6/29/10	W8
7/6/10	W9

Sample Collection, Delivery, and Analysis

During the 2010 sampling season water samples were collected to measure whether Basin Plan water quality performance goals were being attained. Sample analysis was conducted by the registrant laboratory, with additional samples submitted to a third-party laboratory for analysis.

Water samples were collected from specified surface water locations within the Sacramento River Basin. Each site serves as an end-of-basin drainage point designed to trigger further study and potential scrutiny, should measured conditions indicate an impact to existing (non-toxic event) in-stream habitat suitability. Sites included one river site and four drain sites, as shown on Figure 4-1. Samples were collected, split if necessary, and submitted under chain of custody directly to the analytical laboratories for thiobencarb analysis. Detailed maps of each station are included in Appendix A; field sheets and COCs are included in Appendix C-1.

Thiobencarb analyses were performed by the registrant laboratory Valent Dublin Laboratory. McCampbell Analytical, Inc. and California Laboratory Services were used as secondary laboratories for the thiobencarb analysis. Contact information for these laboratories is included in Chapter 4, and full laboratory results are included in Appendixes C-2 through C-4.

Results

The 2010 RPP water quality results and city results are summarized in Table 5-15. In 2010, there was one measured exceedance of thiobencarb at the five primary monitoring locations. All samples collected at City drinking water intakes were non-detect (ND). Field data sheets and COC forms are presented in Appendix C-1, and laboratory data sheets are presented in Appendixes C-2 through C-4.

TABLE 5-15
Summary of Detections (RPP and City Monitoring), 2010

	Thiobencarb		
Site	**Detections**	**Detections Greater than Performance Goal**	**Range of Detected Concentrations**
CBD5[a]	10	0	ND – 1.5 µg/L
BS1[a]	7	0	ND – 0.80 µg/L
CBD1[a]	9	1	ND – 1.8 µg/L
SSB[a]	5	0	ND – 0.26 µg/L
SR1[a]	1	0	ND – 0.08 µg/L
SRR[b]	0	0	ND
WSR[c]	0	0	ND
Drain Site Totals	**31**	**1**	
River Site Totals	**1**	**0**	
Totals	**32**	**1**	**-**

NOTES:
ND = non-detect (below the method reporting limit)
[a]RPP site
[b]City of Sacramento intake site (as reported by the city)
[c]City of West Sacramento intake site (as reported by the city)

RPP Thiobencarb Results

During the 9 weeks of sampling, thiobencarb was detected 32 times. One detection above the 1.5 µg/L performance goal was observed, one CBD1 on June 8. The performance goal was met, but not exceeded at CBD5 on June 10. The highest measured concentration, which occurred at CBD1 on June 8, was 1.8 µg/L. This was lower than the highest measured concentration in 2009 (CBD1, May 26, 2009, 1.84 µg/L) and in 2008 (BS1, May 27, 2008, 1.99 µg/L). The average concentration (counting non-detects equivalent to zero) was 0.18 µg/L for the period of monitoring, which is lower than the 2008 and 2009 average of 0.30 µg/L. Graphical results are shown in Figure 5-9, and tabulated results are shown in Table 5-16.

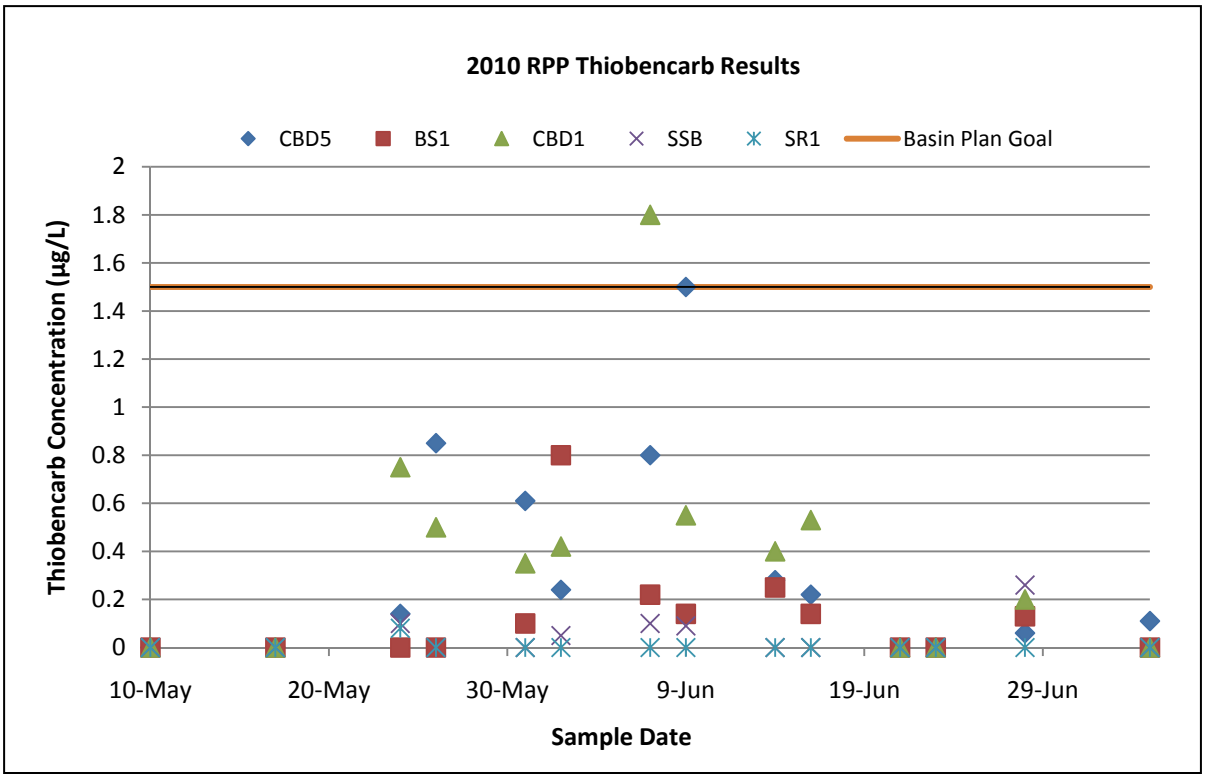


FIGURE 5-9
Thiobencarb Results, RPP, 2010
Non-detects are shown as zero (0) on the graph, and only the highest value of a reported duplicate sample is shown

TABLE 5-16
Thiobencarb Monitoring Results, RPP 2010

	Concentrations at Monitoring Sites (µg/L [ppb])				
Sampling Dates	**CBD5**	**BS1**	**CBD1**	**SSB**	**SR1**
May 11	ND	ND	ND	ND	ND
May 18	ND	ND	ND	ND	ND
May 25	0.14	ND	0.75	0.10	0.08
May 27	0.85	ND	0.50	ND	ND
June 1	0.61	0.10	0.35	ND	ND (V) ND (M)
June 3	0.24	0.28 (V) 0.80 (M)	0.42	0.05	ND
June 8	0.80	0.22	**1.58 (V)** **1.8 (M)**	0.10	ND
June 10	1.12 (V) 1.5 (M)	0.14	0.55	0.09	ND
June 15	0.28	0.25	0.4	ND	ND
June 17	0.22	0.14	0.53	ND (V) ND (CLS)	ND
June 22	ND	ND	ND	ND	ND
June 24	ND	ND	ND	ND	ND (V) ND (CLS)
June 29	0.06	0.13	0.20	0.26	ND
July 6	0.11	ND	ND	ND	ND

NOTES:
ND = not detected above laboratory reporting limits
ppb = parts per billion
If a sample was tested at the primary and secondary laboratories, each result is provided with the respective laboratory's name (V = Valent; M = McCampbell; CLS = California Laboratory Services)
Detection limit for all three labs is <0.5 µg/L
The Basin Plan performance goal for thiobencarb is 1.5 µg/L (ppb)

The cause of the thiobencarb exceedance in the Colusa Basin Drain is likely attributable to conditions associated with the ACP issued by the Colusa CAC on June 10. In assessing the conditions associated with the ACP, Colusa CAC estimated that the grower was probably draining the field a few days prior to issuance of the ACP. On May 27, Abolish was applied to the fields subject to the ACP. The CAC also reported that two additional farmers called to request emergency releases on June 1 and June 4. No emergency releases were granted by Colusa County, so any releases would have been unauthorized.

The field that was issued the ACP is located toward the southern part of Colusa County. The grower was using a recirculating system to pump water from the bottom of the field to the top. The water got too deep in the bottom rice check. The CAC biologist reported that

the drain valve was partially open, as the farmer was releasing water in order to avoid blowing out the bottom check. The farmer did not drain the field, but rather released just enough water to relieve pressure on the check. The surrounding area is all rice. The June 10 unauthorized emergency release, combined with the two requests, led the DPR Senior Inspector and the CAC Biologist to hypothesize that other growers may have had to release water during that same time frame.

The DPR Senior Inspector reviewed the Yolo County thiobencarb notices of intent and use reports. There were no Yolo County applications of thiobencarb before June 8. Therefore, the source of the exceedance at CBD1 came entirely from Colusa County.

Communication between the CRC, CACs, and DPR was even greater during the rice pesticide application season as a result of the efforts from 2009. The exceedance at the CBD1 drain site resulted from an Abolish application. The grower was using a recirculating system for pumping water from the bottom of the field to the top. The water got too deep in the bottom rice check, so the grower requested an emergency release. Two other growers requested emergency releases at this time and were denied. Unfortunately the emergency release request did not fulfill the requirement of 19 days for Abolish. The DPR Senior Inspector determined the source of the exceedance at CBD1 came entirely from Colusa County. Fortunately, the monitoring results and followup investigation gave the Colusa CAC an area to target with additional outreach and inspection.

City Intake Results

The City of Sacramento provided the CRC with analytical results for drinking water intake sampling for Sacramento and West Sacramento. The cities of Sacramento and West Sacramento monitor at two separate locations:

- **SRR:** Sacramento River at the intake to the water treatment facility in Sacramento, California, approximately 0.3 kilometer downstream from the confluence with the American River in Sacramento County
- **WSR:** Sacramento River at the intake to the water treatment facility in West Sacramento, California, approximately 100 yards west of Bryte Bend Bridge in West Sacramento

City sampling was performed from April 29 through July 6, 2010. The intake results for thiobencarb, as provided to the CRC, are detailed in Table 5-17. All of the drinking water samples showed results below the reporting limit.

TABLE 5-17
Cities of Sacramento and West Sacramento Thiobencarb Results, 2010

Sample Date	Thiobencarb Concentration (µg/L)		Percent Sacramento River Water at SRR*
	WSR	SRR*	
April 29	< 0.1	< 0.1	78.2
May 11	< 0.1	< 0.1	71.1
May 18	< 0.1	< 0.1	70.6
May 20	< 0.1	< 0.1	49.5
May 26	< 0.1	< 0.1	47.6
May 27	< 0.1	< 0.1	48.6
May 29	< 0.1*	< 0.1	49.0
May 31	< 0.1^	< 0.1	60.5
June 7	< 0.1	< 0.1	58.4
June 9	< 0.1	< 0.1	56.2
June 16	< 0.1	< 0.1	56.6
June 21	< 0.1	< 0.1	56.0
July 1	< 0.1	< 0.1	80.8
July 6	< 0.1	< 0.1	74.2

NOTES:

Monitoring Site Locations:

SRR = Sacramento River Water Treatment Plant Intake

WSR = Bryte Bend Water Treatment plant Intake (except for * = sample taken at Crawdad's Marina, slightly downstream from the water treatment plant, and ^ = sample taken at Sand Cove park)

* The sampling location SRR, which is located on the Sacramento River at the City of Sacramento's municipal water treatment intake, is downstream of the confluence of the Sacramento and American rivers. Based on the daily flows of the two rivers, the sample taken at SRR will represent varying proportions of Sacramento and American river water. This column represents the City of Sacramento's reported information regarding the blending ration of Sacramento River and American River water on the day of sampling

SRR Results. Prior to the City of Sacramento drinking water intake, some water mixing occurs from the American River at the Sacramento River confluence. Concentrations of thiobencarb continued to be less than 1 µg/L at SRR; in 2010 there were no detections above the detection level.

WSR Results. WSR is located upstream from the confluence of the American River, so the mixing and dilution prior to the drinking water intake that occurs at the City of Sacramento water intake (SRR) does not occur at WSR. Concentrations of thiobencarb continued to be less than 1 µg/L at WSR; in 2010 there were no detections above the detection level. These results demonstrate achievement of both the RPP Basin Plan Performance Goals and the drinking water MCLs.

CHAPTER 6

Review of Quality Assurance/Quality Control

The validity of water quality monitoring results relies on defining and rigorously following a Quality Assurance/Quality Control (QA/QC) Program. QA/QC requirements are specified in a Monitoring Quality Assurance Project Plan (QAPP), and the laboratory QA/QC requirements are specified in QA/QC plans for each lab.

QA/QC requirements for the CWFR sampling are specified in a QAPP submitted July 2010. QA/QC requirements for the RPP sampling are specified in the same QAPP. Project schedules (sampling dates, parameters, and sites) specified for each program are revised at the beginning of each monitoring year based on actual weather conditions and grower schedules. The sampling calendars for CWFR and RPP monitoring are included in Chapter 5 (Table 5-1).

The QAPPs were 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
- Lab QA/QC samples:
  - Method blanks
  - Matrix spikes and matrix spike duplicates (MS/MSDs)
  - Laboratory control spikes (LCSs)
  - Surrogate samples

The QAPP also specifies numeric QA/QC objectives for precision, accuracy, representativeness, comparability, and completeness.

This section describes the QA/QC samples and their purposes, presents the quality assurance objectives, and then evaluates the 2010 CWFR and RPP QA/QC results against the objectives.

Internal QC

Internal QC is achieved by collecting and analyzing a series of duplicate, blank, spike, and spike duplicate samples to confirm that analytical results are within the specified QC objectives. The QC sample results are used to qualify precision and accuracy, and to identify any problem or limitation in the associated sample results. The internal QC components of a sampling and analysis program ensure that data of known quality are produced and documented.

Field QA/QC Samples

Field QA/QC samples are used to assess the influence of sampling procedures and equipment used in sampling. The results from these samples are examined to ensure that field procedures yield acceptable results. Two types of field quality control samples were used during the 2010 sampling, field blanks and field duplicates.

Field Blanks

A field blank is a bottle of reagent water that is exposed to sampling conditions, returned to the laboratory, and treated as an environmental sample. This blank is used to provide information about contaminants that may be introduced during sample collection, storage, and transport.

Field Duplicates

Field duplicates, or split samples, consist of an additional bottle of sample collected at a randomly selected sample location. The results from the duplicate sample are compared to the results from the primary sample; if the relative percent difference (RPD) between the samples is greater than 35 percent, a thorough evaluation of the samples will be performed to determine whether to take corrective action (to either report the data or resample). Duplicate samples provide precision information for the entire measurement system, including sample acquisition, homogeneity, handling, shipping, storage, laboratory sample preparation, and laboratory analysis.

QC samples from the W6D2 and W7D2 events were analyzed at California Laboratory Services, Inc (CLS). The CRC elected to change to CLS to address reporting limit requirements for thiobencarb QC samples. Subsequent analysis of previous events by McCampbell Analytical, Inc. (MAI) ensured that the samples were reportable to the required reporting limits; however, it was decided that CLS would be used for the QC samples for the remainder of the monitoring season in 2010.

Laboratory QA/QC Samples

Laboratory QA/QC samples are prepared to ensure that the required level of laboratory accuracy is being achieved. Four types of quality control samples are used to determine laboratory accuracy: method blanks, matrix spikes, LCSs, and surrogate standards.

Method Blanks

Method blanks consist of deionized water that is run through all of the same steps as the environmental samples at the lab. These samples are used to determine the existence of any laboratory sources of contamination.

Matrix Spikes and Matrix Spike Duplicates

MS/MSD samples are collected at the same time as the environmental samples and are spiked at the laboratory with known concentrations of the analyte(s) to be measured. These samples are used to evaluate the effect a particular sample matrix has on the accuracy of the measurement. The MSD sample serves as another check of accuracy and allows calculation of the analysis method's precision. The difference in the measured concentrations of the original sample and the spiked sample is compared with the spike concentration, and a

percent recovery (the concentration that the laboratory measures divided by the known concentration of a spiked sample multiplied by 100) of the spiked concentration is reported.

Laboratory Control Spikes

LCSs consist of known concentrations of a constituent in distilled water. The measured concentrations are compared with the spike concentration, and a percent recovery can be determined. Results are acceptable if the percent recovery falls within a predetermined range.

Surrogate Standards

Surrogate standards are samples that have been spiked with an organic compound that is chemically similar to the analyte of interest, but is not expected to occur in the environmental sample. The recovery of the surrogate standard is used to monitor for errors, unusual effects, and other anomalies. Surrogate recovery is evaluated by comparing the measured concentration with the amount added to the sample.

Quality Assurance Objectives

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 following subsections.

Precision

Precision is a measure of the reproducibility of analyses under a given set of conditions. Precision will be assessed by replicate measurements of field and laboratory duplicate samples. The routine comparison of precision is measured by the RPD between duplicate sample measurements. The overall precision of a sampling event is determined by a sampling component and an analytical component.

The following formula determines the RPD between two samples:

$$RPD = \frac{|D1 - D2|}{(D1 + D2)/2} x100$$

Where:

RPD = relative percent difference
D1 = first sample value
D2 = second sample value (duplicate)

The maximum acceptable RPD for this project is 35 percent.

Accuracy

Accuracy is a determination of how close the measurement is to the true value. Accuracy can be assessed using MS/MSD, LCS, calibration standard, and spiked environmental samples. The accuracy of the data submitted for this project will be assessed in the following manner:

- The percent recovery of LCS, MS/MSD, and spiked surrogates will be calculated and evaluated against established laboratory recovery limits. **Acceptable laboratory recovery limits for this project are 75 to 120 percent.**

Laboratory method blanks will be tested to determine levels of target compounds. If a target compound is found above the method detection limit (MDL) 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.

Accuracy is presented as percent recovery. Because accuracy is often evaluated from spiked samples, laboratories commonly report accuracy using this formula:

$$\% \text{ Recovery} = R / S * 100$$

Where:

S = spiked concentration
R = reported concentration

The laboratory shall monitor accuracy by reviewing MS/MSD, LCS, calibration standard, and surrogate spike recovery results.

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 are not properly preserved or are analyzed beyond acceptable holding times will not be considered to provide representative data. Also, detection limits above applicable MCLs or screening criteria will not be considered representative.

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 (SOPs) promotes comparability.

Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared with the amount that was 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. In addition, all data are compared to project requirements to ensure that specifications are met. Completeness is evaluated by comparing the project objectives to the quality and quantity of the data collected to assess if any deficiencies exist. Missing data can result from any number of circumstances ranging from sample acquisition and accessibility problems to sample breakage and rejection of analytical data because of quality control deficiencies. Completeness is quantitatively assessed as the percent of controlled QC parameters that are within limits. Percent completeness for each set of samples for each individual method can be calculated as follows:

$$Completeness = \frac{\text{valid data obtained}}{\text{total data analyzed}} \times 100\%$$

Where:

Valid data are defined as those data points that are not qualified as rejected.

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

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

The requirement for holding times will be 100 percent. Any deviations are reported in the report narrative.

CWFR QA/QC Sample Results and Analysis

In 2010, one "QC set" was required for each analytical method batch per sampling event. The minimum required samples for chemical analysis were:

- Field blank
- Field duplicate
- MS/MSD
- LCS and laboratory control spike duplicate (LCSD)
- Laboratory blank
- Laboratory duplicate (MS/MSD or LS/LSD pair may serve this function). (Note that field duplicates and field blanks are not required for general parameters.)

Field QA/QC Samples

Field CWFR QA/QC samples collected during 2010 sampling included field blanks and field duplicates. The dates, events, and sites of these samples are shown in Table 6-1. Results for field QA/QC samples are provided below.

TABLE 6-1
CWFR Field QA/QC Samples, 2010

Date	Event	QA/QC Sample Type(s)
5/12/2010	CWFR Event 1	Field Blank at CBD5 Field Duplicate at CBD5
6/16/2010	CWFR Event 2	Field Blank at CBD1 Field Duplicate at CBD1
	Propanil 1	Field Blank at F Field Duplicate at F
6/22/2010	Propanil 2	Field Blank at SSB Field Duplicate at SSB
6/29/2010	Propanil 3	Field Blank at BS1 Field Duplicate at BS1
7/6/2010	Propanil 4	Field Blank at CBD5 Field Duplicate at CBD5
7/13/2010	Propanil 5	Field Blank at CBD1 Field Duplicate at CBD1
7/20/2010	CWFR Event 3	None (Sampling event was for general parameters only.)
	Propanil 6	Field Blank at F Field Duplicate at F
7/27/2010	Propanil 7	Field Blank at SSB Field Duplicate at SSB
8/3/2010	Propanil 8	Field Duplicate at CBD5 Field Duplicate at CBD5
8/25/2010	CWFR Event 4	None (Sampling event was for general parameters only.)

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 (Table 6-2).

Field Duplicates

Field duplicate samples were collected and analyzed for the same constituents as the primary environmental samples. Results between primary and duplicate samples were similar, as was expected (Table 6-2).

TABLE 6-2
2010 CWFR Field Blank and Field Duplicate Results

Field Blank Results

Event	Sampling Location	Analyte: Dissolved Copper (MRL = 0.5 µg/L)	Analyte: Propanil (MRL = 0.5 µg/L)
CWFR Event 1	CBD5	ND	NA
CWFR Event 2	CBD1	ND	NA
Propanil 1	F	NA	ND
Propanil 2	SSB	NA	ND
Propanil 3	BS1	NA	ND
Propanil 4	CBD5	NA	ND
Propanil 5	CBD1	NA	ND
Propanil 6	F	NA	ND
Propanil 7	SSB	NA	ND
Propanil 8	CBD5	NA	ND

Primary and Duplicate Results

Event	Sampling Location	Analyte: Dissolved Copper (MRL = 0.5 µg/L)		Analyte: Propanil (MRL = 0.5 µg/L)	
		Primary	*Duplicate*	*Primary*	*Duplicate*
CWFR Event 1	CBD5	2.3	2.6	NA	NA
CWFR Event 2	CBD1	5.4	6.5	NA	NA
Propanil 1	F	NA	NA	ND <0.50	ND <0.50
Propanil 2	SSB	NA	NA	ND <0.50	ND <0.50
Propanil 3	BS1	NA	NA	2.8	2.8
Propanil 4	CBD5	NA	NA	1.4	1.7
Propanil 5	CBD1	NA	NA	ND <0.50	ND <0.50
Propanil 6	F	NA	NA	1.2	1.1
Propanil 7	SSB	NA	NA	ND <0.50	ND <0.50
Propanil 8	CBD5	NA	NA	ND <0.50	ND <0.50

Laboratory QA/QC Samples

The laboratory QA/QC samples included method blanks, matrix spikes, LCSs, and surrogate standard samples; the results for each follow.

Method Blank

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 (non-detect) for these analytes (Table 6-3).

TABLE 6-3
2010 CWFR Method Blank Results

	Analyte (MRL)			
Event	**Hardness (1.0 mg $CaCO_3$/L)**	**Copper (0.1 µg/L)**	**TOC (0.3 mg/L)**	**Propanil (0.05 µg/L)**
CWFR Event 1	ND	ND	ND	NA
CWFR Event 2	ND	ND	ND	NA
Propanil 1	NA	NA	NA	ND
Propanil 2	NA	NA	NA	ND
Propanil 3	NA	NA	NA	ND
Propanil 4	NA	NA	NA	ND
Propanil 5	NA	NA	NA	ND
CWFR Event 3	NA	NA	ND	NA
Propanil 6	NA	NA	NA	ND
Propanil 7	NA	NA	NA	ND
Propanil 8	NA	NA	NA	ND
CWFR Event 4	NA	NA	ND	NA

NOTES:
ND = non-detect at the MRL
NA = not scheduled during that sampling event

MS/MSD

MS and MSD samples were prepared and analyzed for every sampling event during the 2010 season (Table 6-4). All the recoveries and RPD values were within the acceptable range.

LCS

LCS samples were prepared and analyzed for every sampling event during the 2010 season. The recoveries and RPD percentages for all of the samples were within the acceptable limits (Table 6-5).

TABLE 6-4
2010 Laboratory MS/MSD Samples

Event	Analyte	Spike Level (µg/L)	Matrix Result (µg/L)	SPK Recovery (%)	DUP Recovery (%)	Recovery Limits	RPD (%)	RPD Limits
CWFR Event 1	Hardness	29.1	160	NR	NR	75-120	NR	35
	Copper (Day 1)	10	7.4	89.4	90.9	75-120	0.912	35
	Copper (Day 2)	10	42	95.1	91.5	75-120	0.707	35
	TOC	50	ND	101	102	75-120	0.909	35
	TOC	50	3.3	104	103	75-120	0.818	35
CWFR Event 2 and Propanil 1	Hardness	29.1	140	NR	NR	75-120	NR	35
	Copper (Day 1)	10	4.9	94.4	94.2	75-120	0.140	35
	TOC (Day 1)	50	5.4	103	105	75-120	1.42	35
	Propanil	1	NA	NA	NA	75-120	NA	35
	Copper (Day 2)	10	94	NR	NR	75-120	NR	35
	TOC (Day 2)	50	5.4	103	105	75-120	1.42	35
Propanil 2	Propanil	1	ND<2.5	108	107	75-120	1.25	35
Propanil 3	Propanil	1	2.8	99.2	95.8	75-120	0.903	35
Propanil 4	Propanil	1	1.4	107	105	75-120	0.671	35
Propanil 5	Propanil	1	ND<0.50	103	106	75-120	2.77	35
CWFR Event 3 and Propanil 6	Propanil	1	1.2	88.5	96.9	75-120	3.94	35
	TOC	50	1.2	101	101	75-120	0	35
Propanil 7	Propanil	1	ND<0.50	109	111	75-120	1.77	35
Propanil 8	Propanil	1	ND<0.50	103	101	75-120	2.86	35
CWFR Event 4	TOC	50	21	108	104	75-120	2.88	35

NOTES:
ND = non-detect at the MRL
NR = no value reported
NA = not enough sample to perform MS and MSD

TABLE 6-5
2010 CWFR Lab Control Spikes (LCS)

Event	Analyte	Spike Level (µg/L)	SPK Recovery (%)	DUP Recovery (%)	Recovery Limits	RPD (%)	RPD Limits
CWFR Event 1	Hardness	29.1	99.7	99.7	75-120	0	35
	Copper (Day 1)	10	96.2	91.6	75-120	4.90	35
	Copper (Day 2)	10	102	106	75-120	3.36	35
	TOC	50	103	103	75-120	0	35
	TOC	50	102	102	75-120	0	35
CWFR Event 2 and Propanil 1	Hardness	29.1	99.7	99.7	75-120	0	35
	Copper (Day 1)	10	96.5	96.1	75-120	0.396	35
	TOC (Day 1)	50	102	103	75-120	0.880	35
	Propanil	1	102	107	75-120	4.51	35
	Copper (Day 2)	10	103	103	75-120	0	35
	TOC (Day 2)	50	102	103	75-120	0.880	35
Propanil 2	Propanil	1	102	107	75-120	4.51	35
Propanil 3	Propanil	1	105	105	75-120	0	35
Propanil 4	Propanil	1	109	118	75-120	7.67	35
Propanil 5	Propanil	1	106	102	75-120	3.72	35
CWFR Event 3 and Propanil 6	Propanil	1	96.9	99.6	75-120	2.78	35
	TOC	50	100	101	75-120	0.576	35
Propanil 7	Propanil	1	105	106	75-120	1.18	35
Propanil 8	Propanil	1	109	108	75-120	0.963	35
CWFR Event 4	TOC	50	106	106	75-120	0	35

Surrogate Standard

Surrogate standard samples were prepared for analysis for each of the propanil samples. All the surrogate standards fell within the QAPP recovery limits (Table 6-6).

Analysis of Precision

Field duplicate samples were collected during the first two CWFR events and all of the Propanil events for each matrix and analyzed for each primary analyte. Duplicate results were found to be consistent with the original matrix results. Field duplicate results are presented in Table 6-2.

MS/MSD sample sets were prepared for every sampling event during the 2010 season. All the sample sets had acceptable RPD limits for all analytes. MS/MSD results and RPD values are presented in Table 6-6.

TABLE 6-6
2010 CWFR Surrogate Standard Sample Results

		Surrogate Recovery Results (%)
Sampling Event	**Sample Location**	**Carbazole (EPA 532) (65-135)***
Propanil 1	F	101
	F –Dup	110
	F-FBL	98
	F-MS	103
	CBD5	83
	F-MSD	85
	CBD1	97
	BS1	95
	SSB	88
Propanil 2	CBD1	84
	SSB	91
	SSB-Dup	80
	SSB-FBL	84
	BS1	87
	CBD5	85
	F	87
Propanil 3	SSB	83
	BS1	84
	BS1-Dup	83
	BS1-MS	80
	BS1-MSD	85
	BS1-FBL	91
	CBD5	73
	F	81
	CBD1	81
Propanil 4	SSB	73
	BS1	75
	CBD5	71
	CBD5-Dup	72
	CBD5-FBL	81
	CBD5-MS	76
	CBD5-MSD	74
	CBD1	78
	F	73

TABLE 6-6
2010 CWFR Surrogate Standard Sample Results

		Surrogate Recovery Results (%)
		Carbazole (EPA 532)
Sampling Event	**Sample Location**	**(65-135)***
Propanil 5	SSB	75
	BS1	92
	CBD5	93
	F	96
	CBD1	81
	CBD1-Dup	87
	CBD1-FBL	92
Propanil 6	BS1	90
	CBD5	90
	F	90
	F-Dup	90
	F-FBL	100
	CBD1	89
	SSB	90
Propanil 7	BS1	89
	CBD5	91
	F	87
	CBD1	90
	SSB	92
	SSB-Dup	91
	SSB-FBL	89
Propanil 8	SSB	81
	BS1	78
	CBD5	81
	CBD5-Dup	81
	CBD5-FBL	85
	CBD1	86
	F	83

NOTE:
*Control limits

LCS samples were prepared and analyzed for every sampling event during the 2010 season. The RPD percentages for all the samples were within the acceptable limits. LCS results and RPD values are presented in Table 6-7.

TABLE 6-7
QA/QC Samples, RPP 2010

Date	Event	QA/QC Sample Type
5/18	W2D1	RB at SSB
6/1	W4D1	Dup at SR1
6/3	W4D2	Dup at BS1, blind spikes
6/8	W5D1	Dup at CBD1
6/10	W5D2	Dup and RB at CBD5
6/17	W6D2	Dup at SSB
6/24	W7D2	Dup at SR1, blind spikes

NOTE:
RB = Rinse blank

Analysis of Accuracy

Field blank samples were utilized during each sampling event, and were analyzed for each primary analyte. All field blank samples were found to have analyte levels below the MRLs. Field blank results are presented in Table 6-2.

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 6-3.

MS and MSD samples were prepared and analyzed for every sampling event during the 2010 season. All of the MS/MSD results were within the acceptable recovery limits (Table 6-4).

LCS samples were prepared and analyzed for every sampling event during the 2010 season. All the LCS results were within the acceptable recovery limits (Table 6-5).

Surrogate standard samples were prepared for analysis with the environmental samples. All the surrogate standards fell within the required recovery limits (Table 6-6).

Analysis Summary

The following summarizes the results of the QA/QC analysis performed on the CWFR data:

- All QA/QC samples were within acceptable limits during 2010.

RPP QA/QC Sample Results and Analysis

As described in Chapter 5, thiobencarb samples are analyzed by the Valent Dublin Laboratory registrant laboratory. In addition, the CRC submits QA/QC samples to MAI throughout the monitoring season.

During each QC sampling event, two sets of samples were collected. One set was sent to the analyte-specific laboratory (Valent), and the other set was sent to the MAI laboratory for comparison.

The field RPP QA/QC samples are shown in Table 6-7. In addition to the field QA/QC samples, analytical laboratories typically perform method blank, LCS, and surrogate standard analyses with each event.

Field QA/QC Samples

Field QA/QC samples included rinse blank, field duplicate, and MS/MSD samples; the results for each follow.

Rinse Blank

Rinse blank samples were collected twice during the sampling season, at the W2D1 and W5D2 sampling events. The results for all rinse blank samples were below the MDL for thiobencarb (Table 6-8).

TABLE 6-8
2010 RPP Comparison of Rinse Blank Samples to Primary Samples

Date	Sample Event	Monitoring Site	Sample Type*	Thiobencarb (µg/L)
5/18	W2D1	SSB	Primary	ND
			Rinse	ND
6/10	W5D2	CBD5	Primary	1.12
			Rinse	ND<0.05

NOTE:
*Primary thiobencarb samples analyzed at Valent Laboratories, and rinse samples analyzed at McCampbell Analytical, Inc.

Field Duplicate

Field duplicate samples were collected during 6 weeks of RPP sampling (Table 6-9). Although the primary and duplicate samples are analyzed at two different labs, the majority of the sample pairs yielded similar results for the primary and duplicate samples.

TABLE 6-9
2010 RPP Field Duplicate Results

Date	Sample Event	Monitoring Site	Sample Type*	Thiobencarb (µg/L)
6/1	W4D1	SR1	Primary	ND
			Duplicate	ND
6/3	W4D2	BS1	Primary	0.28
			Duplicate	0.80
6/8	W5D1	CBD1	Primary	1.58
			Duplicate	1.8

TABLE 6-9
2010 RPP Field Duplicate Results

Date	Sample Event	Monitoring Site	Sample Type*	Thiobencarb (µg/L)
6/10	W5D2	CBD5	Primary	1.12
			Duplicate	1.5
6/17	W6D2	SSB	Primary	ND
			Duplicate	ND
6/24	W7D2	SR1	Primary	ND
			Duplicate	ND

NOTE:
*Primary samples are analyzed at Valent, and duplicate samples were analyzed at either McCampbell Analytical or California Laboratory Services (W6D2 and W7D2 samples).
Reporting limit for all labs is 0.5 µg/L

Samples collected during W4D2, W5D1, and W5D2 had detectable levels of thiobencarb; the results from the different labs are remarkably similar. This shows good correlation between the labs used for this analysis.

MS/MSD

Matrix (environmental) spike samples were collected during the W4D2 and W7D2 sampling events. These samples were spiked by Kleinfelder and submitted to the laboratory with fictitious sample site identification for analysis for thiobencarb (Table 6-10).

TABLE 6-10
Matrix Spike Sample Results, RPP 2010

Date	Sample Event	Sample Location	Laboratory	Spike Level (µg/L)	SPK Result (µg/L)	SPK Recovery (Percent)	Recovery Limits
6/3	W4D2	CRC1*	Valent	1.5	1.56	104	75–120
			MAI	1.5	0.99J	**66**	75–120
6/24	W7D2	CRC1*	Valent	1.0	1.06	106	75–120
			CLS	1.0	1.2	120	75–120

NOTES:
Bold indicates values that do not meet acceptable recovery limits.
Reporting limit for all labs = 0.5 µg/L.
J = analyte detected below quantitation limits
*CRC1 is a fictitious sample location name given to the spike samples for laboratory analysis.

An RPD value could not be calculated for these samples because the two sets of values for each analyte were spiked and analyzed at different laboratories.

One sample had a recovery percentage outside of the acceptable range for recovery limits: the MAI sample from the W4D2 sampling event. The recovery for that sample was below the acceptable recovery range.

Laboratory QA/QC Samples

The laboratory QA/QC samples included method blanks, LCSs, and surrogate standard samples; the results for each follow.

Method Blank

Method blank samples were prepared and tested for the same analytes as the environmental samples. The values below are for the MAI laboratory analysis. All samples had values below the MRL for thiobencarb (Table 6-11).

TABLE 6-11
Method Blank Results (MAI and CLS), RPP 2010

Sample Date	Event	Thiobencarb (RL = 0.50)
5/18	W2D1	ND
6/1	W4D1	ND
6/3	W4D2	ND
6/8	W5D1	ND
6/10	W5D2	ND
6/17	W6D2*	ND
6/24	W7D2*	ND

NOTES:
*Sample run at CLS lab; the rest were run at MAI.

Laboratory Control Spikes

LCS samples were utilized at all three analytical laboratories as an internal QC for the data. The results of all three laboratories' LCS samples are included in Appendix B-2.

Valent Laboratories. LCS samples were spiked with thiobencarb and analyzed at Valent Laboratories for selected sampling events. The RPD percentages and recovery limits for all samples were within acceptable limits

MAI and CLS Laboratories. LCS samples were analyzed at the secondary QA/QC laboratories MAI and CLS, for selected sampling events. The CLS LCS samples were spiked with thiobencarb, while MAI spiked their LCS samples with other compounds representative of the extraction efficiency of the method. The thiobencarb method does not dictate a QC compound list; therefore, the labs select nitrogen or sulfur-phosphorus containing compounds to achieve a good representative sub-list for the 8141A method. The labs reported RPD results for three or more method compounds, representing a range of degradation characteristics (e.g. mid retention time, late retention time, and early retention time). The chemicals reported for the LCS results are not used on rice nor were they analyzed in any of the environmental samples required by the MRP; they are reported by the laboratories per their standard methods solely for the purpose of demonstrating the ability of their methods to achieve QA/QC requirements for extraction efficiencies. The RPD percentages for all samples were within acceptable limits; however, some samples had

recovery limits outside the QAPP acceptable range. These samples included: a single result from the W2D1 and W4D1/W4D2 events; two results from the W2D1, W4D1/W4D2 and W5D1/W5D2 events; one result from the W6D2 event; and one result from the W7D2 event. As a followup, the labs have been requested to report out thiobencarb LCS results. These revised lab reports will be provided as an addendum appendix to this report.

Surrogate Standard

Surrogate standard samples were prepared by MAI and CLS for analysis with the environmental samples. All sample results were within the required recovery limits (Table 6-12).

TABLE 6-12
Surrogate Standard Results, RPP 2010

		Surrogate Recovery Results (%)	
Sample Event/Date	**Sample Location**	**Triphenylphosphate (65–135)[a]**	**EPN (65-135)[a]**
W2D1 5/18	SSB	87	
W4D1 6/1	SR1	NRb	
W4D2 6/3	CRC1	77	
	BS1	65	
W5D1 6/8	CBD1	75	
W5D2 6/10	CBD5-Dup	75	
	CBD5-RB	98	
W6D2 6/17	SSB		76
W7D2 6/24	SR1		79
	CRC1		81

NOTES:
[a]Control limits
[b]Surrogate was diminished by dilution of original extract.
NR = not reported
Triphenylphosphate is MAI's surrogate; EPN is CLS's surrogate.

Analysis of Precision

Duplicates for the RPP sampling were uniquely processed, with the primary and duplicate samples analyzed at different laboratories (primary samples at Valent, duplicate samples at MAI or CLS). Although this prevents a direct comparison of results from within a site, it allows a comparison of laboratories.

A field duplicate sample was collected during six of the fourteen sampling events. Although the primary and duplicate samples were analyzed at two different labs, the majority of the sample pairs yielded similar results for the primary and duplicate samples. Samples collected during W4D2, W5D1 and W5D2 had detectable levels of thiobencarb; the results from the two different labs are remarkably similar. This shows good correlation between the two labs used for this analysis. Field duplicate results are presented in Table 6-9.

MS/MSD samples were utilized for each matrix during the W4D2 and W7D2 sampling events. Although two samples for each analyte were taken at each event, the samples were spiked and analyzed at different laboratories, making an RPD comparison inappropriate. MS/MSD results are presented in Table 6-10.

LCS samples were prepared at MAI and CLS for the W2D1, W4D1&D2, W5D1&D2, W6D2 and W7D2 sampling events. All of the LCS sample results fell within the acceptable RPD limits. LCS samples were analyzed at Valent for all analysis dates. All samples from all dates were within RPD limits for thiobencarb.

Analysis of Accuracy

Rinse blank samples were collected twice during the 2010 sampling season, at the W2D1 and W5D2 sampling events. All rinse blank samples were found to have analyte levels below the MRLs. Rinse blank results are presented in Table 6-8.

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 6-11.

MS/MSD samples were prepared for the W4D2 and W7D2 sampling events. One sample had a recovery percentage outside of the acceptable range for recovery limits: the MAI sample from the W4D2 sampling event. The recovery for that sample was below the acceptable recovery range. MS results and recovery limits are presented in Table 6-10.

Some LCS samples prepared at MAI and CLS reported recovery limits outside the acceptable range for several non-rice products being used as QC indicator values for extraction efficiency. As a followup, the labs have been requested to report out thiobencarb LCS results. These revised lab reports will be provided as an addendum appendix to this report. It is noted that the Valent samples met the LCS requirements, and should be considered the primary dataset for the events flagged above.

LCS samples for all analysis dates were analyzed at Valent. All samples from all dates were within the acceptable recovery limits for thiobencarb. Surrogate standards were evaluated with the analytical samples at MAI and CLS. All of the sample results were within the acceptable recovery limits. Surrogate standard results and recovery limits are presented in Table 6-12.

Analysis Summary

The following summarizes the results of the QA/QC analysis performed on the RPP data:

- Primary and duplicate samples were analyzed at two different laboratories, making a comparison for RPD inappropriate.
- MSD samples were not submitted for analysis to each laboratory in conjunction with MS samples. Rather, the submittal of MS samples to MAI and CLS provided an in-lieu MSD for the MS samples submitted to Valent.
- One MS sample had a recovery percentage outside of the acceptable range: the MAI sample from the W4D2 sampling event. The recovery for that sample was below the acceptable recovery range.

- Some of the LCS samples from the secondary QA/QC laboratories MAI and CLS had recovery limits outside the acceptable range. It is noted that the primary Valent samples met the LCS requirements, and should be considered the primary dataset for the events flagged above.
- Surrogate standard samples were run at MAI and CLS. All samples had recoveries within acceptable limits.

Chains of Custody

Chains of custody (COCs) were utilized to document 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 record 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 cross-checked to verify sample identification, type of analyses, sample volume, and number and type of containers.

COC forms for the CWFR and RPP monitoring programs are included in Appendixes B-1 and C-1, respectively.

CHAPTER 7

Summary and Recommendations

The CRC implemented water quality monitoring and reporting activities in compliance with the following two programs of the CVRWQCB:

- CWFR monitoring and reporting, pursuant to the MRP issued under the CVRWQCB's *Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands.* The monitoring and reporting requirements for the 2010 CWFR are specified in the MRP Order R5-2010-0805 (CRC MRP), under Resolution No. R5-2006-0053 as amended by R5-2006-0077.
- RPP pursuant to the Conditional Prohibition of Discharge requirements specified in the *Water Quality Control Plan for the Sacramento and San Joaquin River Basins* (Basin Plan). Monitoring and reporting requirements for the 2010 RPP are specified in CVRWQCB Resolution No. R5-2010-9001.

Each program is summarized below, and recommendations are included.

CWFR

CWFR monitoring included field assessment of field parameters, including temperature, DO, pH, and EC. Lab analyses were conducted as required for TDS, TOC, hardness, dissolved copper. Propanil monitoring was conducted under the Propanil Monitoring Plan.

- **Temperature:** Temperature results indicate warm water conditions during the monitoring season. Core and assessment site temperatures were consistent with results observed in previous years. Water temperatures track with observed air temperatures. Peak temperatures were observed during the July monitoring event, with a high of 83.1°F.
- **DO:** DO results were generally consistent with observations in previous years. DO typically trended above the 6 mg/L warm water standard. Low DO (less than the WARM WQO of 5 mg/L) was observed at two events in 2010: Site H at the June event, and Site CBD1 at the July event.
- **pH:** There were no observations outside the 6.5 to 8.5 WQO range during 2010.
- **EC:** The 2010 sampling season yielded two samples with an EC greater than 700 µmhos/cm. These samples were both from the June event, at Sites CBD1 and CBD5.
- **TDS:** TDS samples were collected at core sites from May through August, and at assessment sites in May. June results were not reported by the lab due to an error in reading the COC form. TDS was generally highest in July, possibly due to lower rice discharges and overall lower flows observed during July. The maximum observed TDS was 356 mg/L, at CBD1 in July.

- **TOC:** TOC samples were collected at core sites from May through August, and at assessment sites in May and June. TOC was generally lowest and May, and highest in June. The maximum observed TOC was 10 mg/L at CBD1 in July, while all other observed TOC values were less than 6.4 mg/L.
- **Copper and Hardness:** Samples from the first two events were analyzed for hardness and dissolved copper, in accordance with the MRP. The 1 –hour and 4-day California Toxics Rule (CTR) hardness-adjusted copper criteria also were calculated based on the actual hardness measured for the sample location and date. All the copper samples taken during the 2010 monitoring season fell below the 1-hour maximum copper criterion. One sample was above the 4-day criterion: Event 2, Site F (Lurline Creek). This sample had a concentration of 9 µg/L; 8 µg/L was the hardness-adjusted criterion level.
- **Propanil Management Plan – Propanil Analysis:** Eight consecutive weeks of propanil sampling were completed in 2010 (Table 5-10). The highest detections were from the June 22 event at site CBD5 (5.0 µg/L), the June 29 event at Site F (10 µg/L), and the July 6 event at site BS1 (4.4 µg/L). Results from the 2010 monitoring indicate effectiveness of the Propanil Management Plan.

  The June 22 and July 6 sampling events had the most detections, as would be anticipated due to monitoring during the peak use season. The June 22 event showed detectable concentrations at three out of five sites, and the July 6 event showed concentrations about the detection limit at four out of five sites. The last two sampling weeks (July 27 and August 3) had no detections at any of the sampling locations.

Assessment of the 2010 CWFR Program

This year represents the sixth full year of the CWFR program. The key successes and challenges faced during 2010 program implementation are summarized as follows:

- Late rains and unseasonable cool weather resulted in an atypical year for rice production. Late rains delayed planting, and cool weather postponed plant maturity, resulting in a later harvest, poor quality rice, and low yields.
- Monitoring and assessment were conducted in accordance with the requirements of the MRP and Propanil Management Plan. Regularly scheduled CWFR sampling was conducted as required under the MRP. This sampling included core site analysis for field parameters (temperature, DO, pH, electrical conductivity, and flow), core sampling for lab parameters (TOC and TDS), core and assessment site analysis for dissolved copper and hardness during the first two events, and propanil sampling and analysis during a eight week period consistent with the use period.
- CWFR water quality monitoring was conducted at four core sites. The three assessment sites were sampled during the first two events. Total copper was reported for this assessment monitoring in 2009; dissolved copper was included in 2010 to provide for comparison to CTR criteria, which use dissolved copper as the basis of calculation. This effort satisfies the MRP requirement for implementation of a phased core/assessment monitoring regime, which includes assessment monitoring on a 3-year cycle. Assessment monitoring at core and assessment sites will next take place in 2012.

- The CRC continued to implement a SWAMP-compliant electronic data submittal system, including laboratory prepared SWAMP-compliant Electronic Data Reports for chemistry analyses. The CRC submitted results to the CVRWQCB on a regular basis to provide for real-time discussion of results, their potential implications, and appropriate management actions.
- The CRC's SWAMP-compliant QAPP was updated to include 2010 requirements, and was implemented. As part of the SWAMP submittal, lab MDL studies for modified EPA analysis methods were submitted to the CVRWQCB. The MDL studies provide technical confirmation of the detection limits reported by McCampbell Analytical.
- Review of field and laboratory QA/QC samples indicates substantial achievement of quality objectives.
  - All field blank samples 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 nondetect, as expected. MS/MSD and LCS samples achieved data quality objectives, with all recoveries and RPD values within the target range.
- Propanil analysis demonstrated that management practices are substantially protecting water quality, with the majority of the results below magnitude that would indicate continued assessment monitoring. The June 29 Site F sample had a result of 10 mg/L. Based on these results, it is recommended that the Propanil Management Plan be discussed with the CVRWQCB staff to consider whether to include 8 weeks of assessment monitoring at sites CBD5, BS1, and F.
- Core monitoring sites for trend monitoring of rice water quality impacts continue to be appropriate because of the uniformity of rice farming practices across the valley. Rice water management and rice water quality management practices are relatively consistent throughout the valley: The same set 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.
- Implementation of management practices continued in 2010, including water hold requirements; education and outreach (newsletters and grower meetings); stakeholder involvement with enforcement activities; and coordination with the UC Cooperative Extension, UC Davis, and the Rice Research Board. Additionally, the CRC has the ability to directly contact each of its members 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 conditional waiver program through its regular consultation with CVRWQCB staff and through its participation in the CVRWQCB's Technical Issues Committee, CV-SALTS Salinity Coalition, Central Valley Pesticide Total Maximum Daily Load and Basin Plan Amendment, and Drinking Water Policy Workgroup.

CWFR Recommendations for 2011

- The CRC's 2010 monitoring satisfies the MRP requirements for a phased monitoring regime that includes assessment and core monitoring on a 3-year cycle. It is recommended that monitoring in 2011 include core monitoring parameters at core sites.
- It is recommended the results of the Propanil Monitoring Plan be evaluated collaboratively with CVRWQCB staff in order to develop an appropriate recommendation for continued monitoring.
- Close consultation with CVRWQCB staff regarding the program should continue in an effort to refine the program to focus on identified water quality concerns and appropriate implementation actions, if warranted. The CVRWQCB is developing a Long-Term Irrigated Lands Regulatory Program (LT-ILRP), scheduled for Board consideration in 2011. The CRC anticipates developing a rice-specific MRP under the LT-ILRP.

RPP

The results of all monitoring of drinking water intakes and the SR1 river site during 2010, including intake monitoring conducted by the cities of Sacramento and West Sacramento and RPP monitoring conducted by CRC, showed thiobencarb concentrations below the drinking water maximum contaminant level and Basin Plan Performance Goals. One Colusa Basin Drain monitoring location had a measured exceedance of the 1.5 µg/L Basin Plan Performance Goals for thiobencarb during the 2010 monitoring season. The exceedance was at Site CBD1 (June 8), and Site CBD5 (June 10) met, but did not exceed the performance goal.

The CRC initiated its communication strategy in 2009, which includes outreach to its grower membership, CVRWQCB staff, the Cities of Sacramento and West Sacramento, and the CACs. The CRC sent letters to all growers and the rice CACs on June 5, 2009, as notification of the 2009 thiobencarb exceedances and asking for their assistance in remedying the problem. The grower letter included complete pesticide regulation information, including water hold information for Bolero UltraMax. Following the aggressive outreach to grower membership, no further exceedances were detected.

Communication among the CRC, CACs, and DPR was even greater during the 2010 rice pesticide application season as a result of the efforts from 2009. The exceedance at the CBD1 drain site resulted from an Abolish application. The grower was using a recirculating system for pumping water from the bottom of the field to the top. The water got too deep in the bottom rice check, so the grower requested an emergency release. Two other growers requested emergency releases at this time and were denied. Unfortunately the emergency release request did not fulfill the requirement of 19 days for Abolish. The DPR Senior Inspector determined the source of the exceedance at CBD1 came entirely from Colusa County. Fortunately, the monitoring results and followup investigation gave the Colusa CAC an area to target with additional outreach and inspection.

Assessment of the 2010 RPP Program

- The RPP continues to be an example of an effective agricultural water quality regulatory program. The RPP implements an aggressive monitoring schedule designed to focus sampling activities during the 9 weeks of peak pesticide use and on high-use products that are regulated under the Basin Plan's Conditional Prohibition of Discharge.
- The CRC's RPP monitoring schedule continues to provide a rigorous sampling regime designed to rapidly assess compliance with Performance Goals and attainment of the thiobencarb water quality objective for rice pesticides regulated under the Basin Plan Prohibition of Discharge.
- The cause of the thiobencarb exceedance in the Colusa Basin Drain is attributable to conditions associated with the ACP issued by the Colusa CAC for a field located toward the southern part of Colusa County, approximately 3 to 5 miles north of the Yolo County line. The unauthorized emergency release, combined with possible releases resulting from the two requests, led the DPR Senior Inspector and the CAC Biologist to hypothesize that other growers may have had to release water during that same time frame. The CAC has an area to target for inspections in 2011
- Water holds and other management practices implemented by rice growers and the CRC continue to be critical to protect water quality. Three CACs participate in surveillance inspections, including additional holiday and weekends, which were historically funded by the CRC. In 2010, Valent offered to match the CRC in providing funding for surveillance inspection in the nine rice counties. Four counties accepted the offer, so the surveillance program extended to seven counties in 2010. The surveillance inspections continue to be an important component of the water quality protection program.
- Two new management practices were required in 2010, pursuant to Resolution No. R5-2010-9001. These new management practices are included below and the CRC's 2010 implementation of these practices is described in the next bullet.

  "1)b). The California Rice Commission will provide additional outreach on results from 2009 thiobencarb monitoring and required management practices to pesticide applicators. This outreach will include, but not be limited to, clarification of hold time requirements, application rates, proper application procedures, and notification of the finding of elevated thiobencarb levels in the Sacramento River near drinking water intakes. The California Rice Commission will also contact ten thiobencarb dealers and distributors in the Sacramento River Basin to discuss the Rice Pesticides Program and possible areas of improvement."

  "1)c). The California Rice Commission will increase the funding of additional county surveillance at non-traditional hours to double the level of 2009 and extend the program to counties not previously funded. Surveillance inspections will increase to approximately 1.5 times the current level with the new funding."

- The new 2010 management practices were implemented as follows:

  – **1) b).** The California Rice Commission was successful in increasing outreach to the dealers and distributors in order to identify possible areas of improvement.

The dealers and distributors confirmed that they attended the Mandatory Thiobencarb Stewardship Meeting and could not identify any improvements to the Rice Pesticides Program.

– **1)c).** The additional surveillance inspections were specific to the major rice growing counties at the time of implementation: Butte, Colusa and Glenn. For the 2010 growing season, the CRC approached the additional rice growing counties to inquire about interest in participating in the surveillance program. Both Sacramento and Tehama Counties declined due to little rice acreage remaining in the county. Sutter County declined to participate directly in the surveillance program, but committed 20% inspection time to the Rice Pesticides Program through the Pesticide Use Enforcement set of goals and objectives with DPR. The counties participating in the additional inspections for 2011 include Butte, Colusa, Glenn, Placer, Yolo and Yuba.

RPP Recommendations for 2010

- The CRC continues to implement aggressive efforts to implement additional, industry outreach and education to growers, pest control advisors (PCAs), applicators, dealers, and distributors during the 2011 season, as was accomplished early in the 2010 season. Examples include the following:
  - Continuance of the mandatory thiobencarb stewardship meetings
  - Close coordination with the CACs
  - Outreach via the CRC newsletter and website
  - Maintenance of the ongoing relationships with applicators and PCAs
  - A continued outreach focus on management practices for Bolero UltraMax, which is the newer formulation of thiobencarb
  - Grower implementation of measures to effectively manage thiobencarb discharges, as detailed in the CVRWQCB Resolution and the DPR Permit Conditions
- The CRC plans to continue the approved recommendations as outlined in R5-2010-9001. From experience in managing the Rice Pesticides Program and communication with the CACs, the CRC recognizes additional refinement in the following program areas:
  - Coordination with DPR by providing feedback on updating documents that define the water holding and early/emergency release requirements to the CACs.
  - Remind the CACs to provide DPR with the rice pesticide use data by October 31.
- It is recommended that the CRC continue to implement RPP water quality monitoring and reporting activities consistent with the program implemented during 2008 and renewed and approved in 2010 through Resolution R5-2010-9001..
- The CRC will utilize the stakeholder process in gaining collaboration from DPR, the CVRWQCB, and the city utilities on the RPP recommendations through 2010.

CHAPTER 8

References

Ayers, R.S. and D.W. Wescot. 1985. Water Quality for Agriculture. Food and Agriculture Organization of the United Nations—Irrigation and Drainage Paper No. 29, Rev. 1. Rome.

CH2M HILL. 2010. Quality Assurance Project Plan for the California Rice Commission Water Quality Programs (RPP, CWFR).

CVRWQCB. 2004. Recommended Numerical Limits to Translate Water Quality Objectives. May 19, 2004. Available at: http://www.waterboards.ca.gov/centralvalley/water_issues/water_quality_standards_limits/water_quality_goals/index.shtml.