Conditional Waiver for Rice and Rice Pesticides Program

2008 Annual Monitoring Report Sacramento River Drainage Basin

Volume 1

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Acronyms and Abbreviations

µmhos/cm	micromhos per centimeter
ACP	agricultural civil penalties
AMR	Annual Monitoring Report
Basin Plan	Water Quality Control Plan for the Sacramento and San Joaquin River Basins
BMP	Best Management Practice
CAC	County Agricultural Commissioner
CDEC	California Data Exchange Center
CDFG	California Department of Fish and Game
CDPH	California Department of Public Health
COC	chain of custody
CRC	California Rice Commission
CTR	California Toxics Rule
CVRWQCB	Central Valley Regional Water Quality Control Board
CWFR	Conditional Waiver for Rice
DOC	dissolved organic carbon
DO	dissolved oxygen
DPR	California Department of Pesticide Regulation
DWR	California Department of Water Resources
EC	electrical conductivity
EMA	Environmental Micro Analysis, Inc.
gpm	gallons per minute
K	potassium
LCS	lab control spike
L	liter
mg/L	milligrams per liter
MS/MSD	matrix spike and matrix spike duplicate

MCL	maximum contaminant level
MDL	minimum detection limit
MRL	minimum reportable limit
MRP	Monitoring and Reporting Program
MRP Order	Monitoring and Reporting Program Order No. R5-2003-0826
N	nitrogen
ND	non-detect
NOA	Notice of Applicability or Notice of Application
NOI	Notice of Intent
NTU	nephelometric turbidity unit
P	phosphorus
ppb	parts per billion
PUR	Pesticide Use Report
QAO	quality assurance objective
QAPP	quality assurance project plan
QA/QC	quality assurance/quality control
ROD	record of decision
RPD	relative percent difference
RPP	Rice Pesticides Program
SWRCB	State Water Resources Control Board
TDS	total dissolved solids
TOC	total organic carbon
TIE	toxicity identification evaluation
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Administration
UCCE	University of California Cooperative Extension
UC IPM	University of California Integrated Pest Management
WQO	water quality objective
WET	whole effluent toxicity
Zn	zinc

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 two programs of the Central Valley Regional Water Quality Control Board (CVRWQCB). The CRC implements Conditional Waiver for Rice (CWFR) monitoring and reporting, pursuant to the Monitoring and Reporting Program (MRP) issued under the CVRWQCB's *Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands*. The CRC also implements the Rice Pesticides Program (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).

This report serves as the 2008 Annual Monitoring Report (AMR) for both the CWFR and RPP efforts, and describes the CRC-conducted CWFR program activities for the calendar year 2008. Key CWFR activities include the following:

- Reporting of rice acreage information
- Reporting of rice pesticide use information
- Water quality monitoring
- Toxicity testing and followup toxicity identification evaluations, if necessary
- 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

Additionally, the CRC implemented activities in compliance with the RPP for calendar year 2008. 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 RPP 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 that would help 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 quest 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 235 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 2008, between 517,000 (as reported by the National Agricultural Statistics Service) and 571,987 acres of rice (as reported by the CACs) were farmed in the nine rice-growing counties of the Sacramento Valley. Figure 1-1 shows the distribution of acreage within the Sacramento Valley (according to the CACs).

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

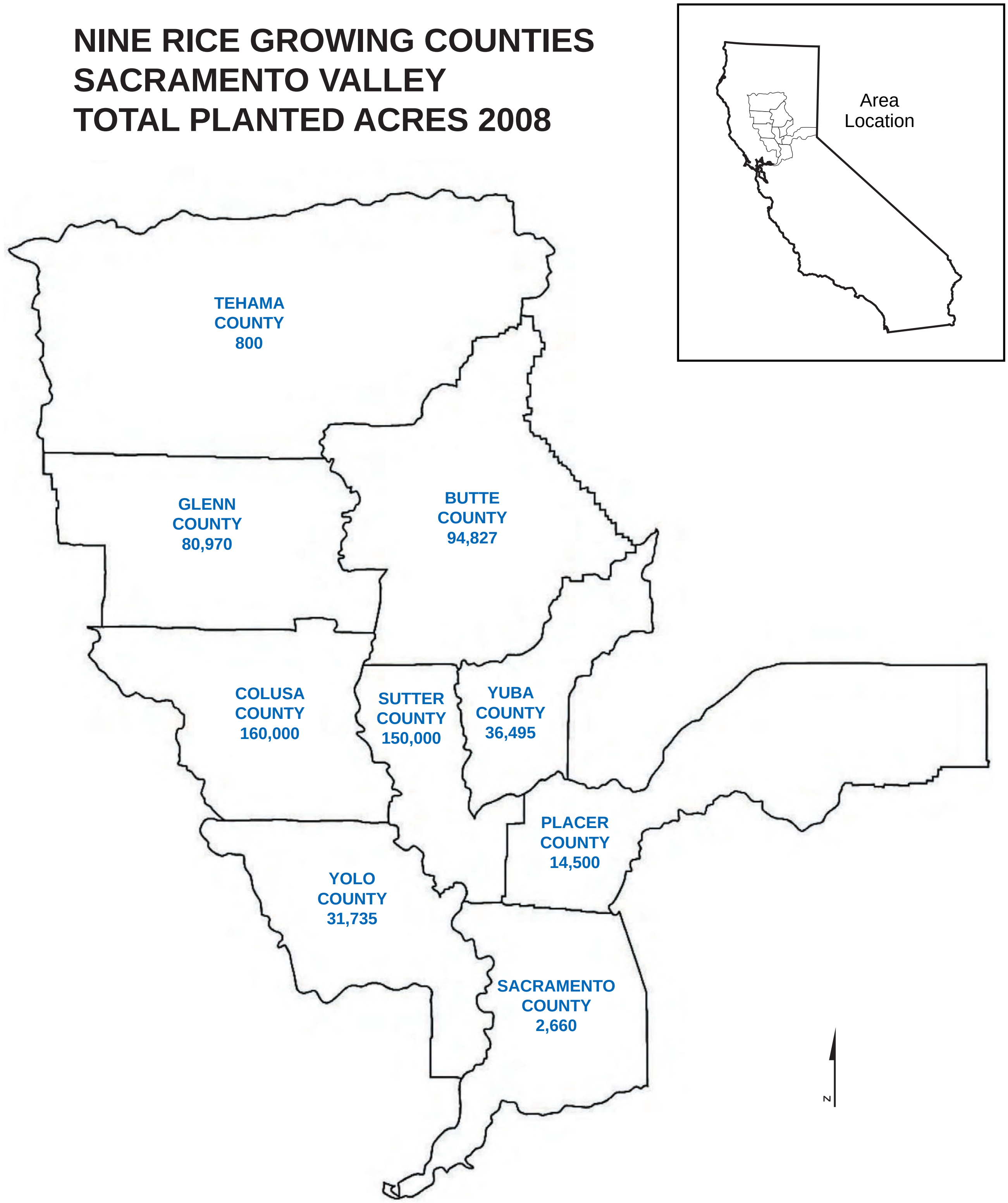
The CRC has undertaken water quality management activities since the 1980s. The efforts began under the RPP and, beginning in 2004, included efforts under the CWFR. A description of the historical context of rice water quality management efforts in the Sacramento Valley follows.

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.

Beginning in May 1980, and on a yearly basis through 1983, more than 65,000 carp, catfish, black bass, and crappie died in Sacramento Valley agricultural drains dominated by rice drainage. At approximately the same time, monitoring studies found that thiobencarb concentrations as low as 1 µg/L resulted in increases in water taste complaints from people whose drinking water was supplied by the Sacramento River downstream of agricultural drain inputs.

As a result of the fish kill events in the early 1980s, the California Department of Fish and Game (CDFG) conducted investigations that indicated molinate poisoning caused the 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.



Note: Acreage totals based on preliminary data provided by the County Agricultural Commissioners

FIGURE 1-1
Sacramento Valley Rice Acres, 2008
CRC 2008 Annual Monitoring Report

CVRWQCB monitoring studies in the early 1980s determined that molinate, carbofuran, malathion, and methyl parathion were present in agricultural drains dominated by rice drainage. The concentrations of these chemicals were determined to pose a threat to aquatic life. As a result of the fish kills and the chemical monitoring through the early 1980s, 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 CDFG and the CVRWQCB further moved the State Water Resources Control Board (SWRCB) to contract for scientific studies to develop a toxicity database and to suggest limits for pesticide levels in the Valley's rivers and agricultural drains.

A review of information on toxicity of molinate and thiobencarb was conducted by the SWRCB (1990). 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, thiobencarb, carbofuran, malathion, and methyl parathion unless a CVRWQCB-approved management practice is followed. Proposed management practices are intended to control pesticide contractions in return flows from rice fields so that specific performance goals are met.

Environmental monitoring in the RPP has been among the most intense ever undertaken by California's agricultural producers and has 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 very 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. Annual reports are due to the CVRWQCB each December.

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

Conditional Waiver of Waste Discharge Requirements for Rice

The CRC was granted a 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 are 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. Copy of chains of custody
10. Associated laboratory and field quality control samples results
11. Summary of precision and accuracy
12. Pesticide use information
13. Data interpretation including and 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 samples results	Appendixes B and C
Summary of precision and accuracy	Chapter 6
Pesticide use information	Chapter 2
Data interpretation including and 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
Perspective on field conditions including a description of the weather, rainfall, stream flow, color of the water, odor, and other relevant inform that can help in data interpretation	Chapter 2

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. Hydrological 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 2008 rice growing season (including Sacramento River 2008 hydrology), and includes data on the materials applied to rice during the 2008 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.

Hydrology

Seasonal rainfall and weather conditions influence rice planting and rice pesticide application. The 2008 rice farming year was relatively typical. Fields were planted in mid-April, and fall drainage occurred during August and September. 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 January 1, 2008, through October 31, 2008.

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 2008 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

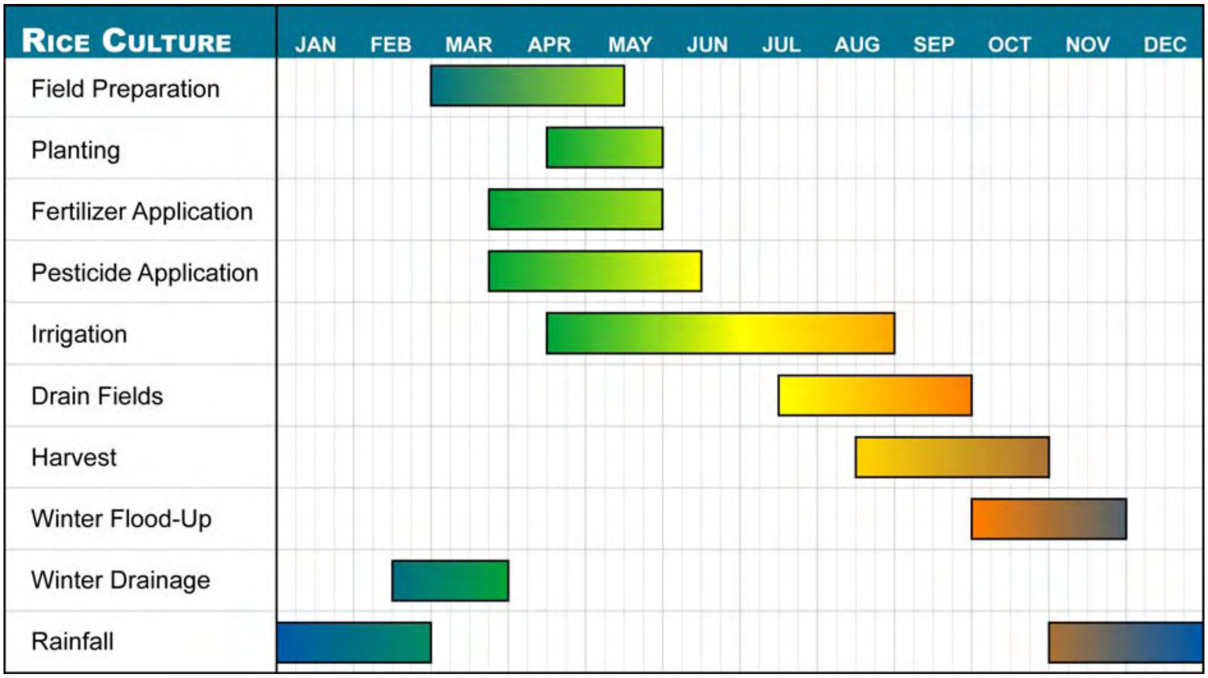
The pesticides with acreage increases were bispyribac-sodium (4,958), clomazone (30,955), propanil (11,981), thiobencarb (167), triclopyr TEA (22,194), lambda cyhalothrin (22,288), azoxystrobin (48,394), propiconazole (3,856), and trifloxystrobin (3,856).

The pesticides with acreage decreases were bensulfuron-methyl (786), carfentrazone-ethyl (184), cyhalofop-butyl (12,504), molinate (11,221), penoxsulam (3,618), (s)-cypermethrin (5,089), and malathion (37).

Treated acreage has a direct correlation to pounds of active ingredient applied. Planted acreage in 2008 (571,987 acres [CACs]) increased by 49,987 acres or 9.6 percent from 2007 (526,000 acres). This is likely because the higher-application-rate products decreased in use. The rice industry is experiencing an expansion of reduced-risk products with lower per-acre use rates.[1]

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 molinate and thiobencarb for the time period 2005 through 2008 are listed in Table 2-7, and pounds of molinate and thiobencarb applied during this same time are listed in Table 2-8.

[1] The U.S. Environmental Protection Agency (USEPA) designates pesticides as reduced-risk based the following criteria: low impact on human health, low toxicity to non-target organisms (birds, fish, and plants), low potential for groundwater contamination, lower use rates, low pest resistance potential, and compatibility with Integrated Pest Management.



Source: University of California Cooperative Extension and grower input

FIGURE 2-1
Key Events in a Typical Rice Year

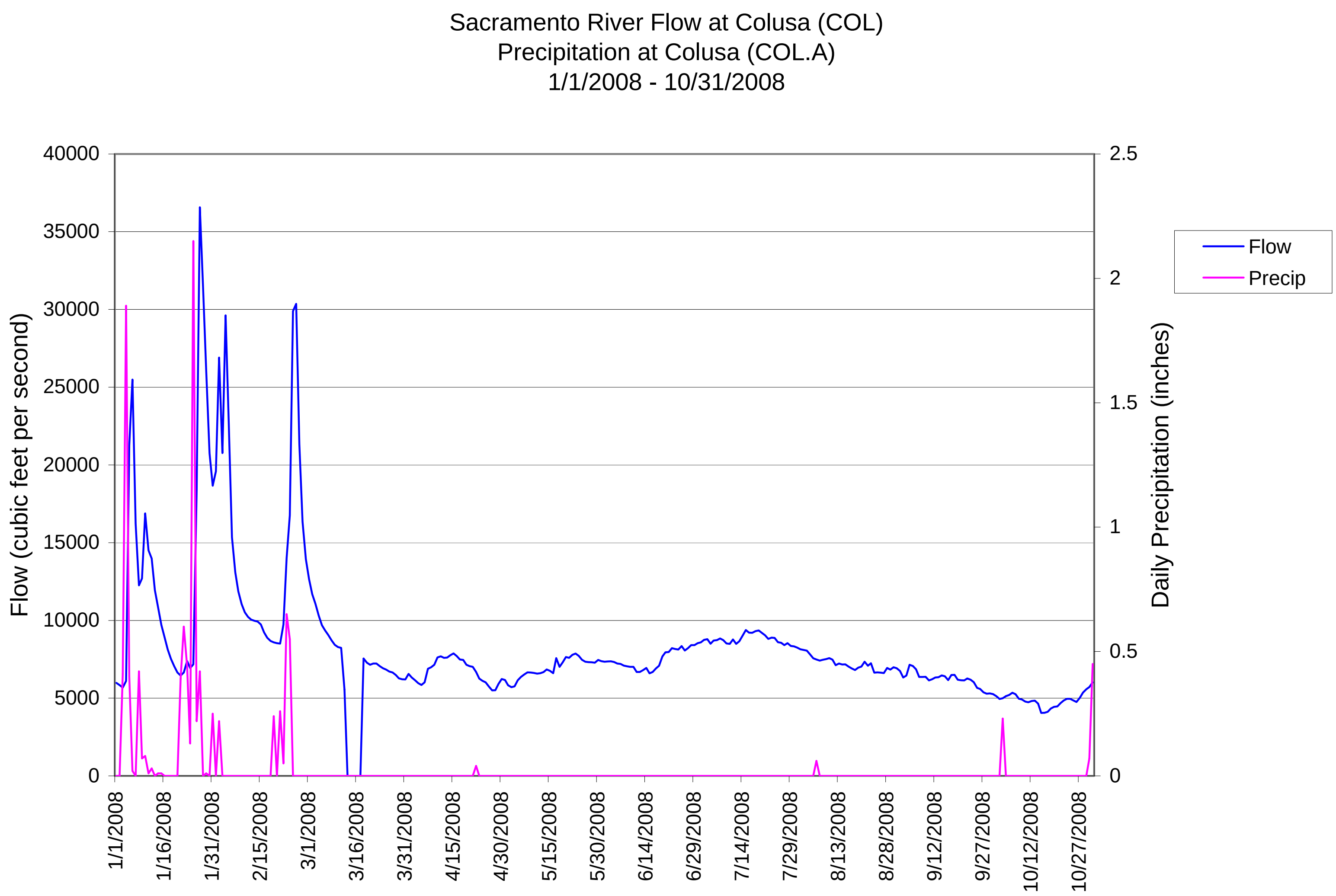


FIGURE 2-2
2008 Flow and Precipitation Data

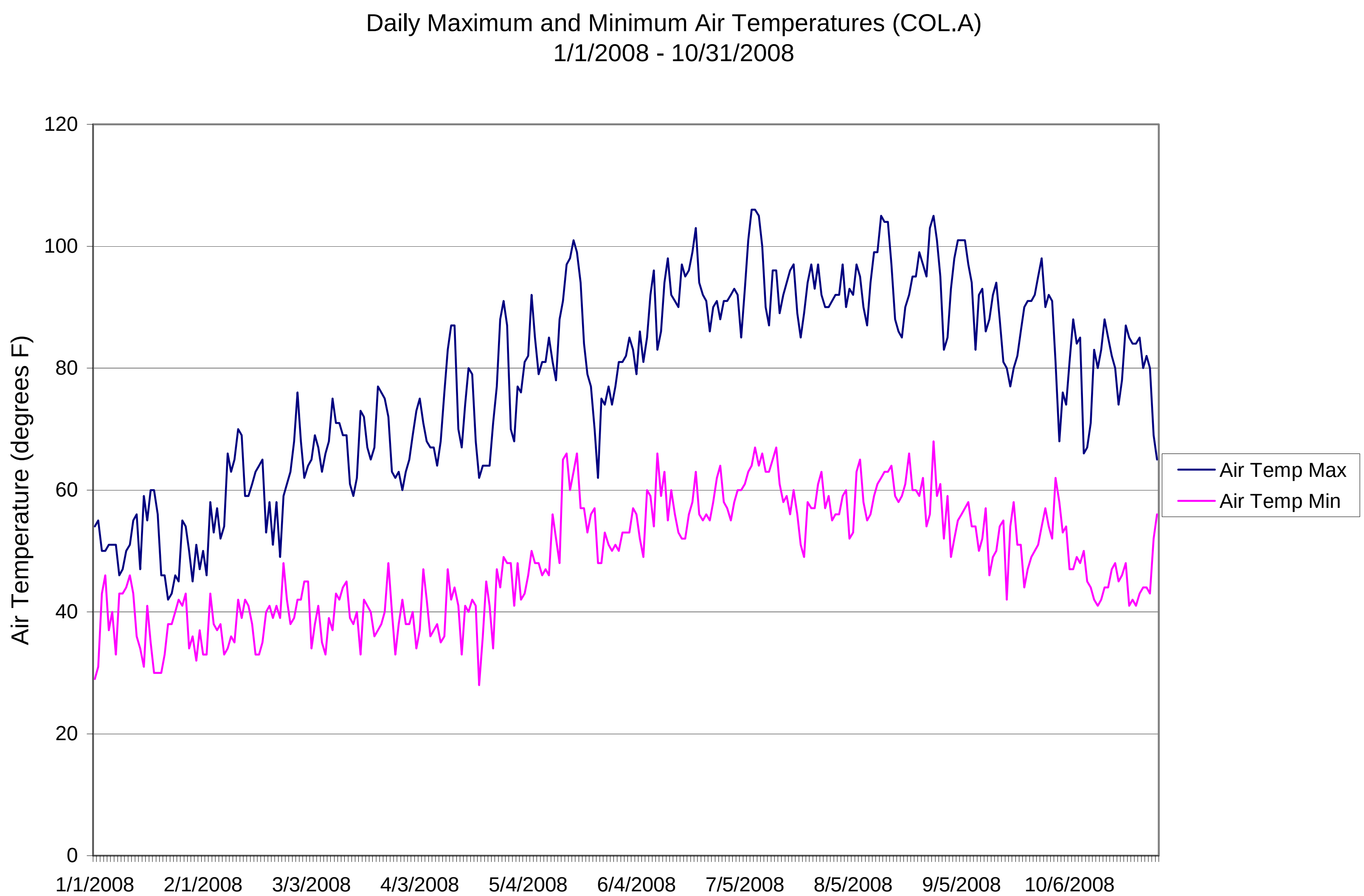


FIGURE 2-3
2008 Daily Maximum and Minimum Air Temperatures

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 total 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 may also 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, 2008

County	Acres Treated									
	Bensulfuron-methyl	Bispyribac-sodium	Carfentrazone-ethyl	Clomazone	Cyhalofop-butyl	Molinate	Penoxsulam	Propanil	Thiobencarb	Triclopyr TEA
Butte	1,333	8,673	4,223	47,487	10,285	2,528	6,677	26,931	11,113	23,570
Colusa	1,103	17,695	1,422	25,912	48,915	0	8,810	107,210	22,714	100,405
Glenn	307	0	0	30,893	2,470	100	4,258	807	472	716
Placer	155	212	685	3,346	156	462	4,098	8,327	456	456
Sacramento	0	0	0	0	0	0	0	0	0	0
Sutter	2,591	14,997	3,047	36,935	7,989	506	27,367	70,737	18,544	56,820
Tehama	0	0	0	0	0	0	275	160	261	0
Yolo	1,532	3,783	0	1,429	10,270	0	3,590	24,841	7,518	23,888
Yuba	380	1,943	3,098	18,225	493	476	9,541	6,180	916	3,938
Total acres	**7,401**	**47,303**	**12,475**	**164,227**	**80,578**	**4,072**	**64,616**	**245,193**	**61,994**	**215,876**

TABLE 2-2
Herbicides: Pounds Applied, Sacramento Valley, 2008

County	Pounds Applied									
	Bensulfuron-methyl	Bispyribac-sodium	Carfentrazone-ethyl	Clomazone	Cyhalofop-butyl	Molinate	Penoxsulam	Propanil	Thiobencarb	Triclopyr TEA
Butte	59	305	838	22,558	3,076	11,527	230	133,631	43,655	3,801
Colusa	61	523	72	12,305	14,507	0	294	551,429	89,641	17,282
Glenn	19	0	0	15,727	844	405	154	4,600	1,866	120
Placer	6	7	137	1,291	54	1,727	154	37,649	1,664	1,196
Sacramento	0	0	0	0	0	0	0	0	0	0
Sutter	119	410	417	16,760	2,612	2,286	1,118	331,717	71,773	11,584
Tehama	0	0	0	0	0	0	11	648	783	0
Yolo	61	135	0	686	3,182	0	137	119,716	29,562	4,481
Yuba	16	63	524	7,826	171	2,148	340	29,777	2,853	477
Total pounds	**341**	**1,443**	**1,988**	**77,153**	**24,446**	**18,093**	**2,438**	**1,209,167**	**241,797**	**38,941**

TABLE 2-3
Insecticides: Acres Treated, Sacramento Valley, 2008

	Acres Treated			
County	**Diflubenzuron**	**(s)-Cypermethrin**	**Lambda Cyhalothrin**	**Malathion**
Butte	423	3,583	11,483	0
Colusa	44	9,451	13,264	0
Glenn	0	3,557	1,948	0
Placer	0	531	5,740	0
Sacramento	0	0	0	0
Sutter	0	8,457	25,997	0
Tehama	0	0	327	0
Yolo	0	1,315	4,181	108
Yuba	418	4,017	9,808	0
Total acres	**885**	**30,911**	**72,748**	**108**

TABLE 2-4
Insecticides: Pounds Applied, Sacramento Valley, 2008

	Pounds Applied			
County	**Diflubenzuron**	**(s)-Cypermethrin**	**Lambda Cyhalothrin**	**Malathion**
Butte	50	228	398	0
Colusa	5	502	363	0
Glenn		169	54	0
Placer	0	24	133	0
Sacramento	0	0	0	0
Sutter	0	348	706	0
Tehama	0	0	10	0
Yolo	0	60	120	156
Yuba	78	176	1,014	0
Total pounds	**133**	**1,507**	**2,798**	**156**

TABLE 2-5
Fungicides: Acres Treated, Sacramento Valley, 2008

County	Acres Treated		
	Azoxystrobin	**Propiconazole***	**Trifloxystrobin**
Butte	1,642	0	0
Colusa	49,015	165	165
Glenn	0	0	0
Placer	2,402	0	0
Sacramento	0	0	0
Sutter	27,231	3,188	3,188
Tehama	269	0	0
Yolo	7,100	0	0
Yuba	7,242	637	637
Total acres	**94,901**	**3,990**	**3,990**

NOTE:
*Propiconazole and trifloxystrobin constitute the product Stratego

TABLE 2-6
Fungicides: Pounds Applied, Sacramento Valley, 2008

County	Pounds Applied		
	Azoxystrobin	**Propiconazole***	**Trifloxystrobin**
Butte	317	0	0
Colusa	7,768	17	17
Glenn	0	0	0
Placer	278	0	0
Sacramento	0	0	0
Sutter	5,225	368	368
Tehama	10	0	0
Yolo	1,230	0	0
Yuba	1,379	89	89
Total pounds	**16,207**	**474**	**474**

NOTE:
*Propiconazole and trifloxystrobin constitute the product Stratego

TABLE 2-7
Acres Treated with Molinate and Thiobencarb, 2005 through 2008

County	Acres Treated							
	Molinate				Thiobencarb			
	2005	2006	2007	2008	2005	2006	2007	2008
Butte	16,479	21,571	10,965	2,528	34,749	20,353	13,099	11,113
Colusa	1,084	880	340	0	18,510	24,384	24,094	22,714
Glenn	4,059	1,845	701	100	6,847	4,952	1,140	472
Placer	3,498	2,173	437	462	767	367	813	456
Sacramento	0	0	0	0	4,316	1,158	0	0
Sutter	8,668	4,675	2,036	506	26,427	17,359	13,018	18,544
Tehama	0	0	148	0	0	0	148	261
Yolo	707	414	666	0	6,067	6,200	8,321	7,518
Yuba	4,060	0	0	476	2,888	656	1,194	916
Total acres	38,555	31,588	15,293	4,072	100,571	75,429	61,827	61,994
Total planted acres	**533,648**	**526,000**	**522,000**	**571,987**	**533,648**	**526,000**	**522,000**	**571,987**

TABLE 2-8
Pounds of Molinate and Thiobencarb Applied, 2005 through 2008

County	Pounds Applied							
	Molinate				Thiobencarb			
	2005	2006	2007	2008	2005	2006	2007	2008
Butte	69,136	92,930	47,730	11,527	127,796	81,722	51,149	43,655
Colusa	4,466	3,551	1,467	0	72,891	96,106	95,684	89,641
Glenn	17,994	7,631	2,839	405	25,992	18,611	4,201	1,866
Placer	14,930	9,978	1,690	1,727	2,342	1,114	2,694	1,664
Sacramento	0	0	0	0	15,774	4,243	0	0
Sutter	36,784	20,545	9,188	2,286	98,755	66,765	49,199	71,773
Tehama	0	0	525	0	0	0	450	783
Yolo	2,943	1,561	2,937	0	23,457	24,761	33,315	29,562
Yuba	17,568	0	0	2,148	8,334	2,480	4,483	2,853
Total pounds	163,821	136,196	66,376	18,093	375,341	295,802	241,175	241,797
Total planted acres	**533,648**	**526,000**	**522,000**	**571,987**	**533,648**	**526,000**	**522,000**	**571,987**

TABLE 2-9
Range of Fertilizer Components Applied to Rice

	Pounds per Acre		
Material/Element	**Low**	**High**	**Form and Method**
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	Topdressed
N	0	42	Topdressed
S	0	49	Topdressed
Totals			
N	104	194	Total for all application methods
P	30	40	Total for all application methods
K	0	0	Total for all application methods
S	20	75	Total for all application methods
Zn*	1	5	Total for all application methods

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 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 2008 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.

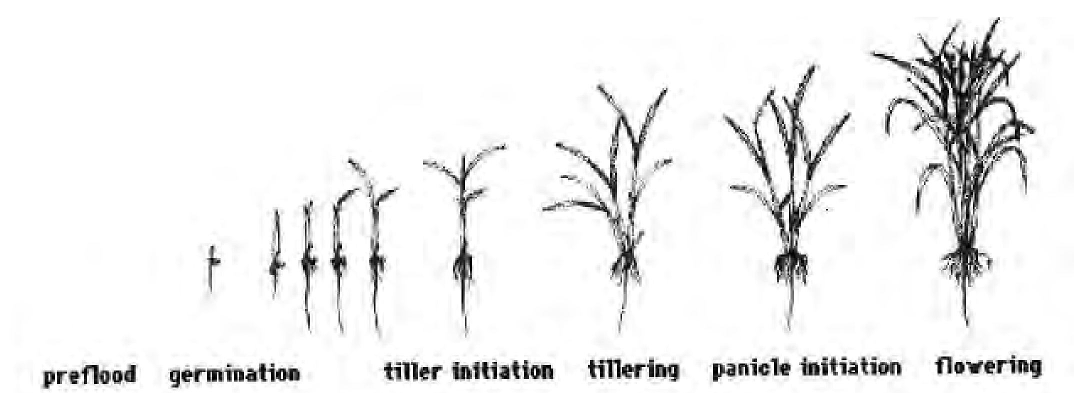


FIGURE 3-1
Rice Growth Stages

TABLE 3-1
Timing of Specific Rice Herbicide Applications

<table>
<tr><th colspan="2">Early Season
(March–April)</th><th colspan="2">Mid Season
(May–June)</th><th colspan="2">Late Season
(June–July)</th></tr>
<tr><th>Pre-Flood</th><th>Germination</th><th>Tiller Initiation</th><th>Tillering</th><th>Panicle Initiation</th><th>Flowering</th></tr>
<tr><td></td><td>Bensulfuron-methyl
Permanent flood
7-day water hold</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td>Bensulfuron-methyl
Pinpoint flood
7-day water hold</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td>Bispyribac-sodium
Pinpoint flood</td><td></td><td></td><td></td></tr>
<tr><td></td><td colspan="2">Carfentrazone-ethyl
Permanent flood
5-day static; 30-day release</td><td></td><td></td><td></td></tr>
<tr><td></td><td>Clomazone
Permanent flood
14-day water hold</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td colspan="2">Cyhalofop-butyl
Pinpoint flood
7-day water hold</td><td></td><td></td></tr>
<tr><td></td><td>Molinate
Permanent flood
28-day water hold</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td>Propanil
Pin-point flood</td><td></td><td></td><td></td></tr>
<tr><td></td><td colspan="2">Thiobencarb (Bolero and Abolish)
Permanent flood
Bolero 30-day/Abolish 19-day</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td colspan="2">Triclopyr TEA
Pinpoint flood
20-day water hold</td><td></td><td></td></tr>
</table>

TABLE 3-2
Timing of Herbicide Tank Mix Combinations

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 19-day water hold Propanil/Thiobencarb (Abolish) Permanent flood 19-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

<table>
<tr><th colspan="2">Early Season
(March–April)</th><th colspan="2">Mid Season
(May–June)</th><th colspan="2">Late Season
(June–July)</th></tr>
<tr><th>Pre-Flood</th><th>Germination</th><th>Tiller Initiation</th><th>Tillering</th><th>Panicle Initiation</th><th>Flowering</th></tr>
<tr><td></td><td colspan="2">Bispyribac-sodium, Thiobencarb (Bolero)
30-day water hold
Permanent Flood</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td colspan="2">Bispyribac-sodium, Propanil
Pinpoint flood</td><td></td><td></td></tr>
<tr><td></td><td colspan="2">Clomazone, Bensulfuron-methyl
14-day water old
Permanent flood</td><td></td><td></td><td></td></tr>
<tr><td></td><td colspan="3">Clomazone, Bispyribac-sodium
14-day water hold
Permanent flood</td><td></td><td></td></tr>
<tr><td></td><td colspan="3">Clomazone, Carfentrazone-ethyl
up to 30-day water hold
Permanent flood</td><td></td><td></td></tr>
<tr><td></td><td colspan="3">Clomazone, Propanil
14-day water hold
Permanent flood</td><td></td><td></td></tr>
<tr><td></td><td colspan="3">Clomazone, Propanil/Triclopyr TEA
20-day water hold</td><td></td><td></td></tr>
<tr><td></td><td></td><td colspan="2">Cyhalofop-butyl, Bensulfuron-methyl
7-day water hold
Pinpoint flood</td><td></td><td></td></tr>
<tr><td></td><td></td><td colspan="2">Cyhalofop-butyl, Bispyribac-sodium
7-day water hold
Pinpoint flood</td><td></td><td></td></tr>
<tr><td></td><td></td><td colspan="2">Cyhalofop-butyl, Propanil
7-day water hold
Pinpoint flood</td><td></td><td></td></tr>
<tr><td></td><td></td><td colspan="2">Propanil, Cyhalofop-butyl
7-day water hold
Pinpoint flood</td><td></td><td></td></tr>
<tr><td></td><td colspan="3">Carfentrazone-ethyl, Cyhalofop-butyl
30-day water hold, 7-day water hold
Pinpoint flood</td><td></td><td></td></tr>
</table>

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). 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 2008, all required water holds were the same as required during the 2005, 2006, and 2007 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. 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. Water hold durations vary based on 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 standard practice to address aquatic toxicity, taste complaints, environmental fate, and product efficacy. Water holds were developed with the input of 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. In addition, DPR and the CACs have the authority to impose additional water hold requirements necessary to be protective of water quality.

Water holding 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, 2006, and 2007 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. Molinate and thiobencarb are restricted materials with additional use restrictions (permit conditions) not found on the registered product label. The most common permit conditions for molinate and thiobencarb are water holds. The thiobencarb permit conditions for 2003 remained in place during 2004, 2005, 2006, 2007, and 2008. Since 2003, the CVRWQCB RPP authorizing resolutions have included thiobencarb 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.

TABLE 3-5
Water Hold Requirements in Days for Molinate, Thiobencarb, Methyl Parathion, and Malathion (RPP Pesticides)

Release Type	Molinate		Thiobencarb		Methyl Parathion	Malathion
	Ordram® 15-GM	Ordram® 8-E	Bolero® 15-G	Abolish™ 8EC		
Single field	28	4	30	19	24	4[a]
Single field southern area only[b]	—	—	19	—	—	—
Release into tailwater recovery system or pond onto fallow field (except southern area)[b]	28	4	14[c]	14[c]	—	—
Multi-growers and district release onto closed recirculating systems	8	4	6	6	—	—
Multi-growers and district release onto closed recirculating systems in southern area	—	—	6	—	—	—
Release into area that discharge negligible amounts to perennial streams	12	4	19	6[d]	—	—
Pre-flood application: release onto tailwater recovery system	4	4	—	—	—	—
Emergency release of tailwater	11	—	19	19	—	—
Commissioner verifies the hydrologic isolation of the fields	—	—	6	6	—	—

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

TABLE 3-6
Hold Times (Days) 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
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

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 Notices of Intent (NOIs) and Notices of Application (NOAs) 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 2008, there was one release inquiry and one reported emergency release. The inquiry and reported emergency release occurred in Sutter County.

Seepage Control and Inspections

Seepage is a 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 becomes high enough, it can flow into local agricultural drainage conveyances. The CVRWQCB expressed concern that seepage was a contributing factor to past increased thiobencarb concentrations in the Sacramento River.

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. Another brochure the CACs provide to rice growers, entitled *Seepage Water Management – Voluntary Guidelines for Good Stewardship in Rice Production*, was cooperatively developed by the UC Davis Department of Agronomy and Range Science, DPR, and UCCE. This 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 the CACs to fund CAC "off duty" enforcement activity on weekends and holidays during the molinate and thiobencarb use season. The CRC continued this practice during the 2008 growing season.

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. Tables 3-7 and 3-8 present enforcement activities in 2008. Information was gathered from the CACs on number of inspections, types of inspections, violations, agricultural civil penalties (ACP), and water seepage inspections. 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 CAC, 315 molinate and thiobencarb use sites were inspected. Of these inspected sites, 729 sites reported no discharge, and 30 had reported discharges of less than 5 gallons per minute (gpm). These 30 sites constitute 9.5 percent of inspected sites. Of the 315 sites inspected, 3 had reported discharges of greater than 5 gpm. These 3 sites constituted 0.95 percent of inspected sites. Three enforcement actions were issued.

TABLE 3-7
Molinate and Thiobencarb Water Seepage Inspections in 2008

County	Chemical	Seepage Inspections	Sites with No Seepage	Sites with Less than 5 gpm Seepage	Sites with More than 5 gpm Seepage	Enforcement Actions
Butte	Molinate	48	48	0	0	0
	Thiobencarb	1	182	1	0	0
Colusa	Molinate	0	0	0	0	0
	Thiobencarb	195	194	1	0	0
Glenn	Molinate	4	5	3	1	0
	Thiobencarb	18	61	16	2	2
Placer	Molinate	0	0	0	0	0
	Thiobencarb	0	0	0	0	0
Sacramento	Molinate	0	0	0	0	0
	Thiobencarb	25	25	0	0	0
Sutter	Molinate	0	0	0	0	0
	Thiobencarb	7	188	7	0	1
Tehama	Molinate	0	0	0	0	0
	Thiobencarb	0	0	0	0	0
Yolo	Molinate	0	0	0	0	0
	Thiobencarb	0	0	0	0	0
Yuba	Molinate	13	11	2	0	0
	Thiobencarb	4	15	0	0	0
Totals		**315**	**729**	**30**	**3**	**3**

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 9 mix/load events were inspected. The CACs performed 34 application inspections. Three enforcement actions were issued.

Water Hold Inspections

CACs conduct water hold inspections, as summarized in Table 3-8. A total of 829 molinate and thiobencarb use sites were inspected. Reporting was recorded for two formulations of each product. Of the 829 sites inspected, 2 were issued enforcement actions.

TABLE 3-8
Molinate and Thiobencarb Water Hold, Application, and Mix-Load Inspections in 2008

County	Chemical	Water Hold Inspections	Release Inquires	Emerg. Releases	ACPs	Appl. Insp.	Mix-Load Insp.	ACPs
Butte	Ordram 15GM	48	0	0	0	0	0	0
	Ordram 8E	0	0	0	0	0	0	0
	Bolero 15G	175	0	0	0	4	2	0
	Abolish EC	8	0	0	0	0	0	0
	County total	231	0	0	0	4	2	0
Colusa	Ordram 15GM	0	0	0	0	0	0	0
	Ordram 8E	0	0	0	0	0	0	0
	Bolero 15G	174	0	0	0	5	1	0
	Abolish EC	21	0	0	0	3	0	0
	County total	195	0	0	0	8	1	0
Glenn	Ordram 15GM	9	0	0	0	0		0
	Ordram 8E	0	0	0	0	0	0	0
	Bolero 15G	68	0	0	1	0	0	1
	Abolish EC	11	0	0	1	0	0	1
	County total	88	0	0	2	0	0	2
Placer	Ordram 15GM	2	0	0	0	5	0	0
	Ordram 8E	0	0	0	0	2	0	0
	Bolero 15G	1	0	0	0	8	0	0
	Abolish EC	0	0	0	0	0	0	0
	County total	3	0	0	0	15	0	0
Sacramento	Ordram 15GM	0	0	0	0	0	0	0
	Ordram 8E	0	0	0	0	0	0	0
	Bolero 15G	25	0	0	0	0	0	0
	Abolish EC	0	0	0	0	0	0	0
	County total	25	0	0	0	0	0	0
Sutter	Ordram 15GM	6	0	0	0	0	0	0
	Ordram 8E	0	0	0	0	0	0	0
	Bolero 15G	195	1	1	0	4	4	1
	Abolish EC	15	0	0	0	0	0	0
	County total	216	1	1	0	4	4	1

TABLE 3-8
Molinate and Thiobencarb Water Hold, Application, and Mix-Load Inspections in 2008

County	Chemical	Water Hold Inspections	Release Inquires	Emerg. Releases	ACPs	Appl. Insp.	Mix-Load Insp.	ACPs
Tehama	Ordram 15GM	0	0	0	0	0	0	0
	Ordram 8E	0	0	0	0	0	0	0
	Bolero 15G	0	0	0	0	1	1	0
	Abolish EC	0	0	0	0	0	0	0
	County total	0	0	0	0	1	1	0
Yolo	Ordram 15GM	1	0	0	0	0	0	0
	Ordram 8E	0	0	0	0	0	0	0
	Bolero 15G	40			0	1	0	0
	Abolish EC	2	0	0	0	0	0	0
	County total	43	0	0	0	1	0	0
Yuba	Ordram 15GM	13	0	0	0	0	0	0
	Ordram 8E	0	0	0	0	0	0	0
	Bolero 15G	11	0	0		0	0	0
	Abolish EC	4	0	0	0	1	1	0
	County total	28	0	0	0	1	1	0
Total		**829**	**1**	**1**	**2**	**34**	**9**	**3**

CHAPTER 4

Monitoring and Reporting Requirements

The monitoring and reporting requirements for the CWFR are specified in the MRP Order R5-2007-0835. Monitoring and reporting requirements for the 2008 RPP are specified in CVRWQCB Resolution No. R5-2007-0018. This chapter provides an overview of the monitoring and reporting requirements of each program, including the overall purpose and objectives, the sites, the program administration, sampling procedures, and analytical labs and methods utilized 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 MRP is to monitor the discharge of wastes in irrigation return flows and stormwater from irrigated rice lands. As specified in Part (I) of the MRP, the purposes of monitoring conducted under the MRP are as follows:

a. Assess the impacts of waste discharges from irrigated lands to surface water

b. Determine the degree of implementation of management practices to reduce discharges of waste that impact water quality

c. Determine the effectives of management practices and strategies to reduce discharge of wastes that impact water quality

d. Determine concentration and load of waste in these discharges to surface waters

e. Evaluate compliance with existing narrative and numeric water quality objectives to determine whether additional implementation of management practices is necessary to improve and/or protect water quality

The monitoring and reporting requirements of the 2008 (Year 4) CWFR program are specified in CVRWQCB Monitoring and Reporting Program Order No. R5-2007-0835, under Resolution No. R5-2006-0053 as amended by R5-2006-0077. Additional requirements and guidance are provided in Executive Order letters, issued under the authority granted in the Resolution.

RPP

The purpose of the RPP is to achieve attainment of Performance Goals established in the Basin Plan. Monitoring is conducted under the RPP for the purposes of determining attainment of those Performance Goals. Similar to the CWFR, though not specifically stated in regulatory documents, the purposes of the monitoring under the RPP are as follows:

a. Assess the impacts of the rice pesticides regulated under the Basin Plan Conditional

b. Determine the degree of implementation of rice pesticides management practices

c. Monitor the effectives of management practices and strategies to attain Performance Goals

d. Determine concentration of Basin Plan rice pesticides at specific sites

e. Evaluate compliance with Performance Goals to determine whether additional implementation of management practices is necessary to improve and/or protect water quality

Overview of Requirements

The CWFR and RPP programs have different requirements. The CWFR requirements are specified in the rice-specific MRP. The RPP requirements are specified in CVRWQCB Resolution R5-2007-0018.

CWFR

The MRP requires that the following types of monitoring and evaluation be conducted:

- Toxicity testing. The stated purpose of the toxicity testing is to evaluate compliance with the Basin Plan's narrative toxicity objective, to identify the causes of observed toxicity, and to determine the sources of identified toxicants.
- Water quality and flow monitoring. The stated purpose of the water quality and flow monitoring is to assess the sources of wastes and loads in discharges from irrigated lands to surface waters, and to evaluate the performance of management practice implementation efforts. Monitoring data are to be compared to existing numeric and narrative water quality objectives.
- Pesticide use evaluation. The stated purpose of the pesticide use evaluation is to provide information regarding the usage of pesticide relative to monitoring sites, including changes in pesticide use.
- Management Practice Evaluation. Evaluation of the effectiveness of management practices and tracking levels of implementation in the watershed.

RPP

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

- Field water quality monitoring
- Molinate and thiobencarb water quality monitoring
- Pesticide use reporting

Monitoring Sites

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

TABLE 4-1
CWFR and RPP 2008 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	38.8125 N	-121.7731 W	171,165	CWFR, RPP	Main
CBD5	Colusa Basin Drain #5	39.1833 N	-122.0500 W	156,000	CWFR, RPP	Main
BS1	Butte Slough at Lower Pass Road	39.1875 N	-121.9000 W	183,617	CWFR, RPP	Main
SSB	Sacramento Slough Bridge near Karnak	38.7850 N	-121.6533 W	24,549	CWFR, RPP	Main
JS	Jack Slough at Jack Slough Road (near Kimball Lane)	39.1804 N	-121.5711 W	27,741	CWFR	Rotating, Years 1, 3, and 4
SR1	Sacramento River 1	38.6039 N	-121.5189 W	~500,000	RPP	River

CWFR Sites

The MRP requires that the CRC perform water quality and flow monitoring at five sites per year. Each year, monitoring must be conducted at four main sites and one rotating site. In 2008, the rotating site was JS.

The five sites were selected because, collectively, they are estimated to capture drainage from 90 percent of the acres planted in rice. BS1, CBD1, CBD5, and SSB are historical sites. Figure 4-1 shows the five CWFR monitoring 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 monitored under the CWFR, while the fifth site, SR1, is monitored only under the RPP. Figure 4-2 shows the five RPP monitoring sites.

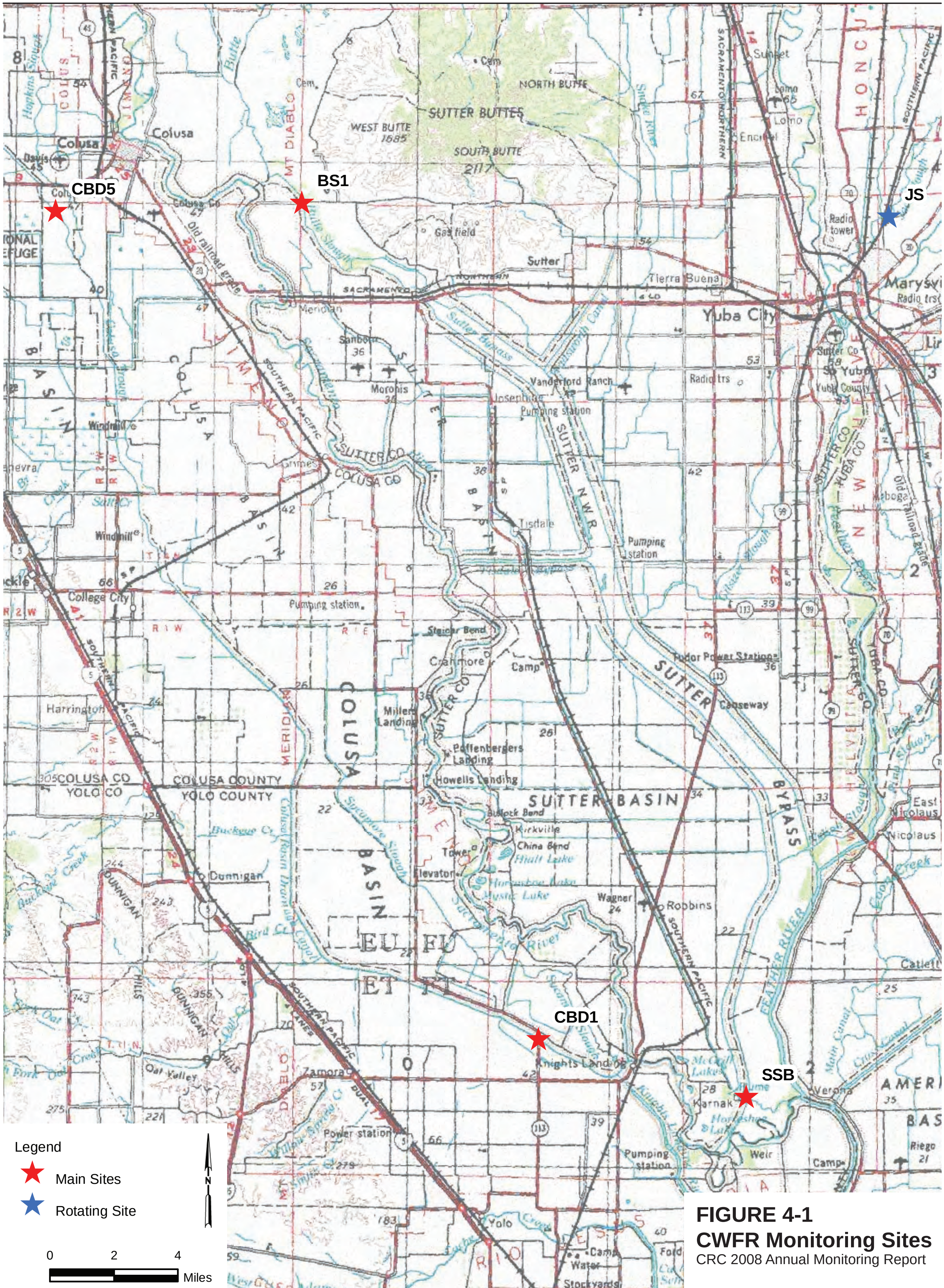


FIGURE 4-1
CWFR Monitoring Sites
CRC 2008 Annual Monitoring Report

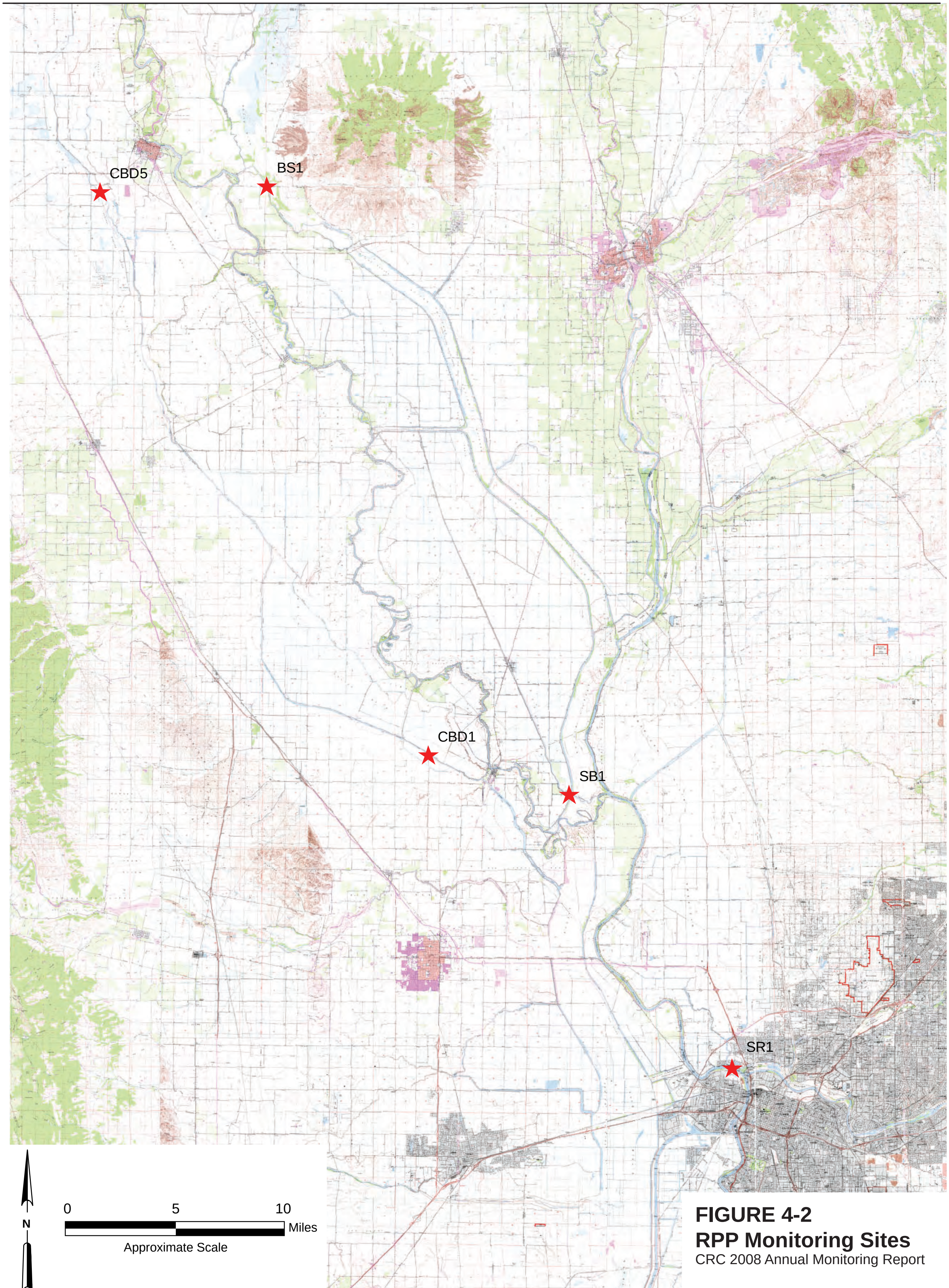


FIGURE 4-2
RPP Monitoring Sites
CRC 2008 Annual Monitoring Report

CH2MHILL

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 and 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 and 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 that crosses Butte Sough northeast of Meridian. In 1995 and 1996, samples were previously 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 and 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) in order to provide improved safety for field technicians accessing the site. SSB is monitored under both the CWFR and RPP.

PHOTO 4
SSB: Sacramento Slough Bridge

JS

Water samples at JS were collected from the middle of the bridge along Jack Slough Road near Kimball Lane, north of Marysville. JS is monitored under only the CWFR.

PHOTO 5
JS: Jack Slough

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 6
SR1: Sacramento River Village Marina

Constituents

CWFR

The MRP specifies the constituents for which field monitoring and laboratory analysis are to be conducted. Table 4-2 presents the constituents for which monitoring was required during 2008, which is considered Year 4 of the CWFR program.

The irrigation season for this monitoring program is defined as April through September. In an effort to evaluate the impacts of rice field discharges during the irrigation season, the CRC monitors throughout the defined irrigation season. In addition to monitoring for the purpose of characterizing irrigation season drainage, the MRP also requires monitoring to evaluate water quality during February or March and October, which are considered the two most significant periods of discharge outside of irrigation season. In February and March, rice growers drain their fields in preparation for the rice planting season. Unlike farming methods used for field, row, and tree crops, rice fields can capture and hold rainfall in the field, and drainage throughout the valley can be a controlled/managed event. In October, rice growers typically flood their fields to begin winter straw decomposition.

TABLE 4-2
CWFR Monitoring and Reporting Requirements, 2008

Constituent	Units	Sample Type	Irrigation Season Sampling Frequency (April to September)	Non-irrigation Season Sampling Frequency	Reporting Frequency
Flow	cfs	Field[a]	Monthly	March, October	Annually
pH	pH units	Field	Monthly	March, October	Annually
Electrical conductivity	µmhos/cm	Field	Monthly	March, October	Annually
Dissolved oxygen	mg/L	Field	Monthly	March, October	Annually
Temperature	degrees C	Field	Monthly	March, October	Annually
Color	ADMI	Field	Monthly	March, October	Annually
Turbidity	NTUs	Field	Monthly	March, October	Annually
Total dissolved solids[b]	mg/L	Field	Monthly	March, October	Annually
Aquatic toxicity[c]	% survival[d]	Grab	Monthly	March, October	Annually
Algae Management Plan—Specified pesticides[e]	µg/L	Grab	See note f	See note f	Annually
Hardness	mg/L as $CaCO_3$	Grab	Monthly	March, October	Annually
Copper	µg/L	Grab	See note f	See note f	Annually

NOTES:
Sediment toxicity sampling was not required in Year 4.
Start-up Monitoring (2004): specified pesticides were: Lambda cyhalothrin, s-cypermethrin
Year 1 (2005) specified pesticides were: Lambda cyhalothrin, s-cypermethrin
Year 2 (2006) specified pesticides were: Carfentrazone-ethyl, bispyribac-sodium
Year 3 (2007) specified pesticides were: Cyhalofop-butyl, azoxystrobin, propiconazole, and trifloxystrobin
Year 4 (2008) specified pesticides were outlined in the Algae Aquatic Toxicity Management Plan, and included atrazine, bensulfuron-methyl, bispyribac-sodium, carfentrazone, clomazone, diuron, glyphosate, halosulfuron-methyl, molinate, pendimethalin, penoxsulam, propanil, simazine, thiobencarb, and triclopyr TEA. In addition, the 2007 "specified pesticides" were again monitored. These included cyhalofop-butyl, azoxystrobin, propiconazole, and trifloxystrobin.

[a] Flow may also be obtained from Department of Water Resources (DWR) monitoring stations, where available.
[b] Calculated from electrical conductivity field measurements.
[c] Acute toxicity testing shall be conducted using the invertebrate, *Ceriodaphnia dubia*, and the larval fathead minnow, *Pimephales promelas*, according to standard U.S. Environmental Protection Administration (USEPA) acute toxicity test methods. In addition, to identify toxicity caused by herbicides, 96-hour toxicity tests with the green algae *selanastrum capricornutum* shall be conducted.
[d] To be reported as percent survival, as compared to the control.
[e] Specified pesticides are determined annually based on available water quality data, current usage trends, and aquatic toxicity considerations. These pesticides are formally included in the CRC's MRP requirement through Executive Officer communication or Board Resolution.
[f] For Year 4, copper monitoring is required in conjunction with the specified *selanastrum* pesticides study. Specifically, pesticides and copper analysis was performed at JS in March; at BS1, CBD1, CBD5, and SSB in June; at CBD1 in July; and at BS1, CBD5, and SSB in September.

RPP

Monitoring for the RPP is conducted during the 10-week period of peak rice pesticide use. Monitoring is conducted once per week for the first three weeks, then is increased to twice per week for the following four weeks (corresponding with peak usage), and is then decreased to once per week for the final three weeks. Field parameters are recorded, and samples are taken for molinate and thiobencarb analysis. The constituents and their monitoring requirements are shown in Table 4-3.

TABLE 4-3
RPP Monitoring and Reporting Requirements, 2008

Constituent	Units	Sample Type	Sampling Frequency			Reporting Frequency
			Weeks 1–3	Weeks 4–7	Weeks 8–10	
pH	pH units	Field	Weekly	Biweekly	Weekly	Annually
Electrical conductivity	µmhos/cm	Field	Weekly	Biweekly	Weekly	Annually
Dissolved oxygen	mg/L	Field	Weekly	Biweekly	Weekly	Annually
Temperature	degrees C	Field	Weekly	Biweekly	Weekly	Annually
Turbidity	NTUs	Field	Weekly	Biweekly	Weekly	Annually
Molinate	µg/L	Grab	Weekly	Biweekly	Weekly	Annually
Thiobencarb	µg/L	Grab	Weekly	Biweekly	Weekly	Annually

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. 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 Quality Assurance Project Plan (Kleinfelder, 2004) and RPP Quality Assurance Project Plan (CRC, 2006) unless otherwise noted.

Field Measurements

Field water quality parameters for the CWFR and RPP, listed in Tables 4-2 and 4-3, 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.

Total Dissolved Solids

EC is measured in the field using the multiprobe instrument as described above. These measurements are then converted to a total dissolved solids (TDS) result by using the following equation:

$$TDS = 0.77 \times EC + 36.46$$

Where:

TDS	=	Total dissolved solids (milligrams per liter [mg/L])
EC	=	electrical conductivity measurement (micromhos per centimeter [µmhos/cm])

Grab Samples

For both the CWFR and 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 (stainless steel and Teflon model, approximately 1.5-liter [L] volume) at a depth equal to one-half the water column. The sample was transferred from the Kemmerer to a stainless steel container; collection continued until approximately 13 L of sample were collected. This composite sample was homogenized and then split, using a stainless steel funnel, into the following:

- Ten 1-L amber glass bottles for toxicity analysis (CWFR only)
- Two 1-L amber glass bottles for pesticide analysis (CWFR and RPP)
- One 1-L amber glass bottle for the color analysis (RPP only)

Non-disposable equipment used in sample collection was cleaned after each use by rinsing with distilled water. At each site before sample collection, sampling equipment was rinsed with water from the middle of the water column. 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 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 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 transports after sample collection to the lab for analysis within the sample holding time. The laboratories performing analysis are provided in Table 4-4.

TABLE 4-4
Analytical Laboratories and Methods, 2008

Laboratory	Analytes/Analytical Method(s)	Analytical Method(s) Standard Operating Procedures	Notes
AQUA-Science 17 Arboretum Dr. Davis, CA 95616 aquasci@aol.com 530-753-5456	Fathead Minnow 5th edition Screen	Acute 96-Hour Percent Survival Static non-renewal, static renewal, or LC50 Test (EPA 821-R-02-012) SOP #503.3	AQUA-Science performed aquatic toxicity tests on all samples.
	c. dubia 5th ed. Screen	Acute 96-Hour Percent Survival Static non-renewal, static renewal, or LC50 Test (EPA 821-R-02-012) SOP #503.3	
	Algae Chronic Screen	Chronic Freshwater Algae (*selanastrum capricornutum)* Static non-renewal Growth Test (EPA 821-R-02-013) SOP #510	
Environmental Micro Analysis, Inc. (EMA) 40 N. East Street, Suite B Woodland, CA 95776	EPA 8081A (w)	EPA 8081A (w)	See Appendix B-4 for list of analytes included in 8081A (w) scan. Tested as part of algae toxicity study plan.
	EPA 8141A (w) ONs	EPA 8141A (w)	See Appendix B-4 for list of analytes included in 8041A (w) scan. Tested as part of algae toxicity study plan.
	Bispyribac-sodium	EPA 8151A (w) MOD	Tested as part of the algae toxicity study plan.
	Triclopyr (Garlon)	EPA 8151A (w) (RL = 0.05 µg/L)	Specified Pesticide
	Penoxsulam	EPA 632 (w) (RL = 5.0 µg/L)	
	Diuron	EPA 632 (w) (RL = 0.50 µg/L)	Not a rice pesticide. Tested as part of algae toxicity study plan.
	Glyphosate	EPA 547 (RL = 10.0 µg/L)	Used on rice only as pre-plant treatment for borders. Tested as part of algae toxicity study plan. Subcontracted to North Coast Labs

TABLE 4-4
Analytical Laboratories and Methods, 2008

Laboratory	Analytes/Analytical Method(s)	Analytical Method(s) Standard Operating Procedures	Notes
Environmental Micro Analysis, Inc. (EMA) 40 N. East Street, Suite B Woodland, CA 95776	Thiobencarb Molinate	EPA 619(w) EPA 619(w)	Analyzed under the RPP Analyzed under the RPP
California Laboratory Services (CLS) 3249 Fitzgerald Road Rancho Cordova, CA 95742	Copper Hardness Color	EPA 200.8 (RL = 1.0 µg/L) SM 2340B SM2120B	
Valent Dublin Laboratory (Registrant Laboratory) 6560 Trinity Court Dublin, CA 94568	Thiobencarb	Registrant method	Analyzed under the RPP
Syngenta Crop Protection, Inc. (Registrant Laboratory) 410 Swing Road Greensboro, NC 27419	Molinate	Registrant method	Analyzed under the RPP

NOTE:
µg/L = micrograms per liter

CHAPTER 5

2008 Monitoring

The CWFR and RPP 2008 monitoring season details 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
- Copper and hardness results
- Toxicity testing results
- Pesticides results
- Flow data
- UC Davis edge-of-field monitoring

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 five sites includes measurement of general field parameters, and laboratory analysis of aquatic toxicity, sediment toxicity, and specified pesticides. The 2008 CWFR monitoring requirements and the results follow.

Sampling Schedule

The MRP specifies the general calendar for monitoring. Based on the understanding of the rice growing season, a rice-specific monitoring calendar was developed to characterize the April through September "irrigation season," and two "storm events," which include an event in February or March (to characterize spring drainage) and an event in October (to characterize a potential storm event). In 2008, sampling was conducted as shown in Table 5-1, which lists regularly scheduled monitoring and any necessary resampling.

Field Parameters

The following field parameters were measured as part of the 2008 sampling effort: temperature, DO, pH, EC, and turbidity.

TABLE 5-1
2008 Sampling and Resampling Calendar

Event Type	Month	Date	Field	Copper	Color	Hardness	*C. dubia* Toxicity Tests	Minnow Toxicity Tests	*Selenastrum* Toxicity Tests	Pesticides Specified under *Selenastrum* Study	QC Samples
Winter drainage	March	3/12/2008	✓	JS	✓	JS			JS	JS	
Irrigation	April	4/29/2008	✓		✓		✓	✓	✓		
Irrigation	May	5/13/2008	✓		✓		✓	✓	✓		
May resample*	May	5/29/2008	JS, CBD5, CBD1						JS, CBD5, CBD1		
Irrigation	June	6/3/2008	✓	BS1, CBD5, CBD1, SSB	✓	✓	✓	✓	✓	BS1, CBD5, CBD1, SSB	Yes
June resample*	June	6/12/2008	JS						JS	JS	
Irrigation/drainage	July	7/1/2008	✓	CBD1	✓	CBD1	✓	✓	✓	CBD1	Yes
Irrigation/drainage	August	8/26/2008	✓		✓				✓		
Irrigation/drainage	September	9/16/2008	✓	BS1, CBD5, SSB	✓	✓			✓	BS1, CBD5, SSB	Yes
Winter flood-up	October	10/21/2008	✓		✓				✓		

NOTE:
*Resample requirements are based on the outcome of toxicity tests performed on samples collected during regularly scheduled monthly monitoring events.

Temperature Measurements

Temperature measurements were taken during field sampling using the multiprobe instrument. Figure 5-1 shows the field temperature measurements. Temperatures in the water bodies are typically lowest in the winter and highest in the summer. Peak temperatures were again observed during the July sampling event, with a high of 78°F. As seen in previous years, water temperature in these water bodies essentially tracks with ambient air temperatures. During this time of the year, these bodies of water are clearly not coldwater fisheries, although they may provide coldwater habitat during other times of the year.

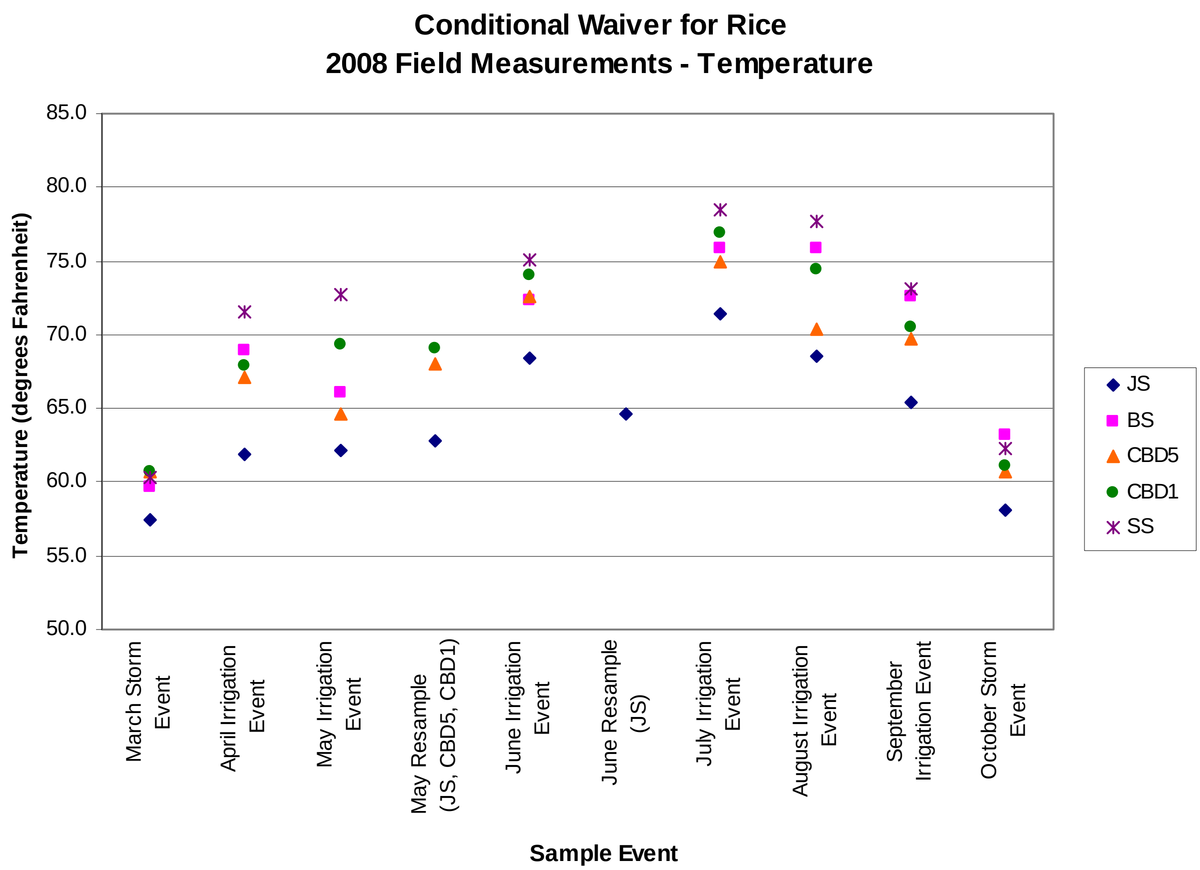


FIGURE 5-1
Field Temperature Measurements, 2008

Table 5-2 presents tabulated temperature results and basic summary information, including site minimum, maximum, mean, and median observed temperature, as well as event minimum, maximum, mean, and median observed temperature. 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 for the lower Sacramento River.

TABLE 5-2
Field Temperature Measurements—Tabulated Results, 2008

Event	Date	Temperature (°F)					Event Low	Event Mean	Event Median	Event High	Event Variance	Event std. Deviation	N
		JS	BS	CBD5	CBD1	SS							
March Storm Event	3/12/2008	57.5	59.7	60.7	60.7	60.3	57.47	59.77	60.28	60.75	1.83	1.35	5
April Irrigation Event	4/29/2008	61.9	69.0	67.0	67.9	71.6	61.86	67.47	67.89	71.56	12.71	3.56	5
May Irrigation Event	5/13/2008	62.2	66.1	64.6	69.3	72.8	62.20	67.00	66.06	72.79	17.11	4.14	5
May Resample (JS, CBD5, CBD1)	5/29/2008	62.7		68.1	69.0		62.74	66.60	68.05	69.01			3
June Irrigation Event	6/3/2008	68.4	72.4	72.6	74.0	75.0	68.36	72.49	72.63	75.04	6.50	2.55	5
June Resample (JS)	6/12/2008	64.6					64.60	64.60	64.60	64.60			1
July Irrigation Event	7/1/2008	71.4	75.8	74.9	76.9	78.4	71.38	75.49	75.81	78.44	6.99	2.64	5
August Irrigation Event	8/26/2008	68.6	75.8	70.4	74.4	77.7	68.58	73.37	74.37	77.67	14.26	3.78	5
September Irrigation Event	9/16/2008	65.4	72.6	69.7	70.6	73.1	65.43	70.27	70.56	73.15	9.38	3.06	5
October Storm Event	10/21/2008	58.0	63.2	60.7	61.1	62.3	58.05	61.06	61.11	63.19	3.80	1.95	5

	JS	BS	CBD5	CBD1	SS
Site Low	**57.47**	**59.67**	**60.69**	**60.67**	**60.28**
Site Mean	**64.07**	**69.31**	**67.65**	**69.32**	**71.40**
Site Median	**63.67**	**70.67**	**68.05**	**69.33**	**72.97**
Site High	**71.38**	**75.81**	**74.93**	**76.89**	**78.44**
Site Variance	**20.48**	**35.10**	**24.40**	**31.39**	**44.91**
Site Std. Deviation	**4.53**	**5.92**	**4.94**	**5.60**	**6.70**
n	**10**	**8**	**9**	**9**	**8**
Number of obs. Temp >68°F	**3**	**5**	**5**	**6**	**6**
Number of obs. Temp <68°F	**7**	**3**	**4**	**3**	**2**
Percent of obs. where Temp >68°F	**30%**	**63%**	**56%**	**67%**	**75%**
Percent of obs. where temp <68°F	**70%**	**38%**	**44%**	**33%**	**25%**

DO Measurements

The multiprobe instrument was used to take DO measurements in the field. Figure 5-2 shows the results of all DO measurements taken during 2008. 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.

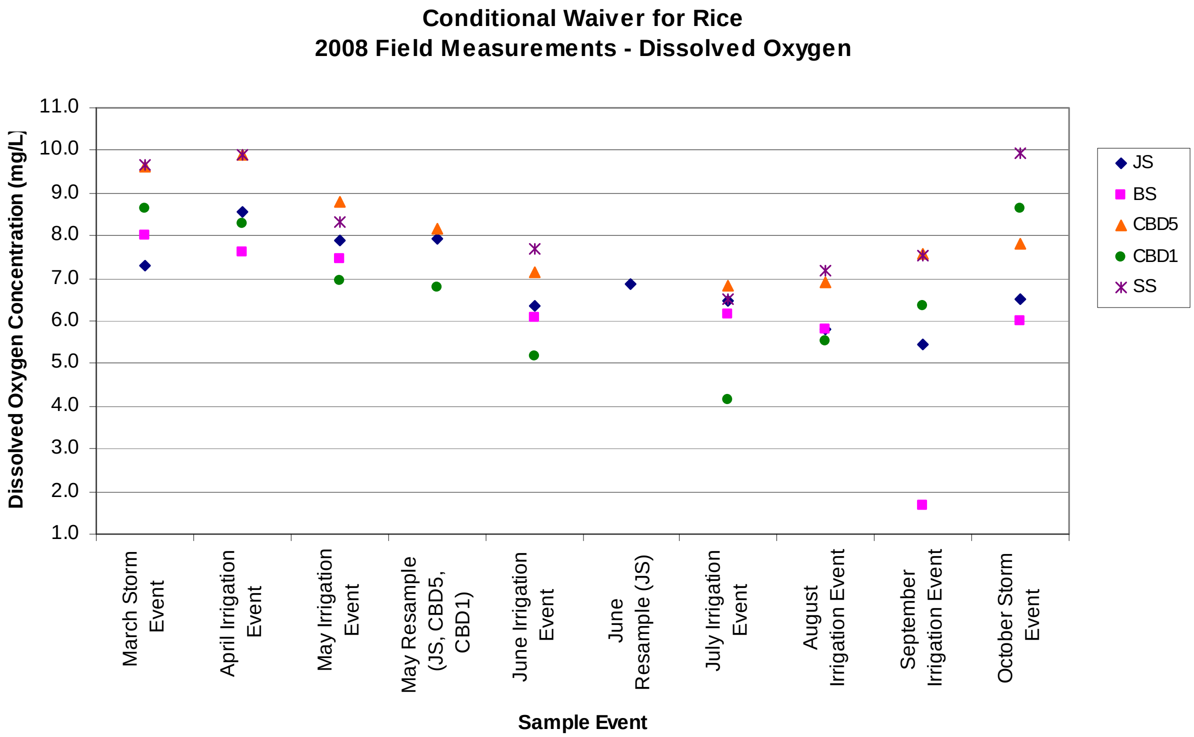


FIGURE 5-2
Dissolved Oxygen Field Measurements, 2008

DO values of less than 6 mg/L were observed at JS, BS1, and CBD1. Both BS1 and CBD1 also had one DO reading of less than 5 mg/L during the 2008 sampling season.

Low DO (<6 mg/L) was consistently observed at the CBD1 site beginning in June. This site also had low DO throughout the summer during the 2007 sampling season, and had low DO in June and July during the 2006 season. In 2008, low DO at CBD1 persisted through August. Low DO was also observed at BS1, although in 2008 only the August and September sampling events had DO values of less than 6 mg/L. This is an improvement from previous years. During the 2007 sampling season, low DO was observed at BS1 from May through August; during the 2006 sampling event, BS1 had low DO in June, July, and September. The mean DO concentration at the CBD1 site was 6.73 mg/L, and mean at the BS1 site was 6.11 mg/L. Site CBD1 experienced its lowest DO concentration during the July sampling event (4.15 mg/L), and BS1 experienced its lowest DO concentration during the September sampling event (1.69 mg/L). These means and lows are similar to those at CBD1 and BS1 during the 2007 sampling season.

TABLE 5-3
Dissolved Oxygen Field Measurements—Tabulated Results, 2008

Event	Date	Dissolved Oxygen Concentration (mg/L)					Event Low	Event Mean	Event Median	Event High	Event Variance	Event Std. 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
		JS	BS	CBD5	CBD1	SS													
March Storm Event	3/12/2008	7.31	8.02	9.62	8.64	9.65	7.31	8.65	8.64	9.65	1.03	1.02	5	0	0	0	0%	0%	0%
April Irrigation Event	4/29/2008	8.55	7.62	9.90	8.30	9.89	7.62	8.85	8.55	9.90	1.02	1.01	5	0	0	0	0%	0%	0%
May Irrigation Event	5/13/2008	7.89	7.47	8.81	6.96	8.34	6.96	7.89	7.89	8.81	0.52	0.72	5	1	0	0	20%	0%	0%
May Resample (JS, CBD5, CBD1)	5/29/2008	7.94		8.17	6.79		6.79	7.63	7.94	8.17			3	1	0	0	33%	0%	0%
June Irrigation Event	6/3/2008	6.35	6.08	7.14	5.19	7.71	5.19	6.49	6.35	7.71	0.95	0.98	5	3	1	0	60%	20%	0%
June Resample (JS)	6/12/2008	6.86					6.86	6.86	6.86	6.86			1	1	0	0	100%	0%	0%
July Irrigation Event	7/1/2008	6.46	6.17	6.81	4.15	6.52	4.15	6.02	6.46	6.81	1.15	1.07	5	5	1	1	100%	20%	20%
August Irrigation Event	8/26/2008	5.82	5.82	6.92	5.53	7.20	5.53	6.25	5.82	7.20	0.56	0.75	5	4	3	0	80%	60%	0%
September Irrigation Event	9/16/2008	5.46	1.69	7.58	6.36	7.52	1.69	5.72	6.36	7.58	5.86	2.42	5	3	2	1	60%	40%	20%
October Storm Event	10/21/2008	6.50	6.01	7.82	8.63	9.94	6.01	7.78	7.82	9.94	2.54	1.59	5	2	0	0	40%	0%	0%

	JS	BS	CBD5	CBD1	SS
Site Low	**5.46**	**1.69**	**6.81**	**4.15**	**6.52**
Site Mean	**6.91**	**6.11**	**8.09**	**6.73**	**8.35**
Site Median	**6.68**	**6.12**	**7.82**	**6.79**	**8.03**
Site High	**8.55**	**8.02**	**9.90**	**8.64**	**9.94**
Site Variance	**0.98**	**3.92**	**1.30**	**2.56**	**1.77**
Site Std. Deviation	**0.99**	**1.98**	**1.14**	**1.60**	**1.33**
N	**10**	**8**	**9**	**9**	**8**
Number of obs. DO<7	**6**	**5**	**2**	**6**	**1**
Number of obs. DO<6	**2**	**2**	**0**	**3**	**0**
Number of obs. DO<5	**0**	**1**	**0**	**1**	**0**
Percent of obs. DO<7	**60%**	**63%**	**22%**	**67%**	**13%**
Percent of obs. DO<6	**20%**	**25%**	**0%**	**33%**	**0%**
Percent of obs. DO<5	**0%**	**13%**	**0%**	**11%**	**0%**

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 can also contribute to low DO values. As temperature increases, oxygen solubility decreases and approaches the water quality objective (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.

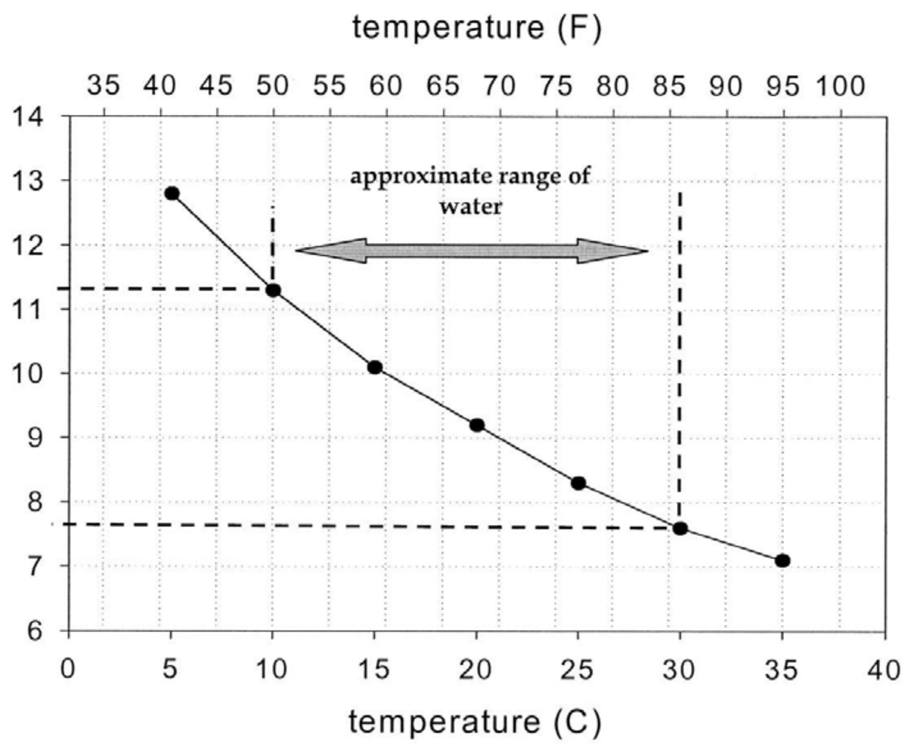


FIGURE 5-3
Oxygen Solubility as a Function of Temperature

pH

The multiprobe instrument was used to take pH measurements in the field. Figure 5-4 shows the results of all pH measurements taken during 2008. 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. There were no observations that fell outside of the 6.5 to 8.5 pH range in 2008.

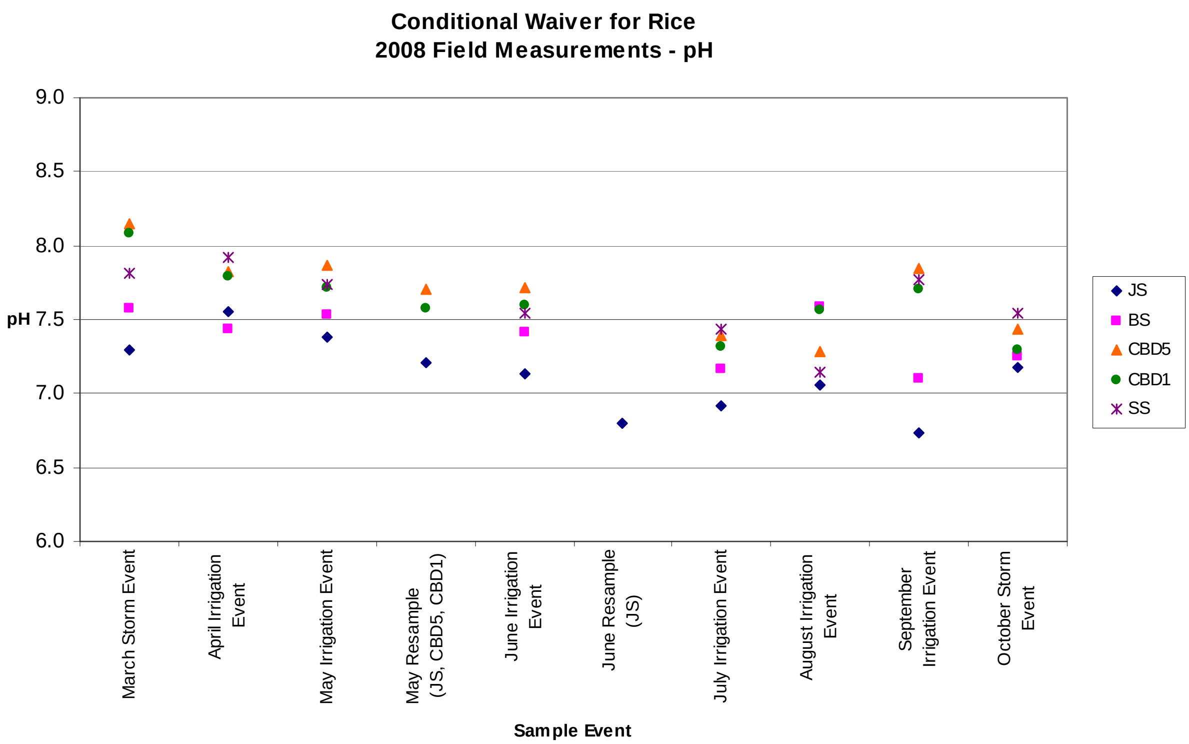


FIGURE 5-4
pH Field Measurements, 2008

TABLE 5-4
pH Field Measurements—Tabulated Results, 2008

Event	Date	pH JS	pH BS	pH CBD5	pH CBD1	pH SS	Event Low	Event Mean	Event Median	Event High	Event Variance	Event Std. 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
March Storm Event	3/12/2008	7.30	7.58	8.15	8.08	7.81	7.30	7.78	7.81	8.15	0.12	0.35	5	0	0	0%	0%
April Irrigation Event	4/29/2008	7.55	7.43	7.82	7.79	7.92	7.43	7.70	7.79	7.92	0.04	0.20	5	0	0	0%	0%
May Irrigation Event	5/13/2008	7.38	7.53	7.87	7.72	7.74	7.38	7.65	7.72	7.87	0.04	0.19	5	0	0	0%	0%
May Resample (JS, CBD5, CBD1)	5/29/2008	7.21		7.71	7.58		7.21	7.50	7.58	7.71			3	0	0	0%	0%
June Irrigation Event	6/3/2008	7.13	7.41	7.72	7.60	7.54	7.13	7.48	7.54	7.72	0.05	0.23	5	0	0	0%	0%
June Resample (JS)	6/12/2008	6.80					6.80	6.80	6.80	6.80			1	0	0	0%	0%
July Irrigation Event	7/1/2008	6.92	7.17	7.39	7.32	7.44	6.92	7.25	7.32	7.44	0.04	0.21	5	0	0	0%	0%
August Irrigation Event	8/26/2008	7.06	7.59	7.28	7.56	7.14	7.06	7.33	7.28	7.59	0.06	0.24	5	0	0	0%	0%
September Irrigation Event	9/16/2008	6.73	7.10	7.84	7.71	7.77	6.73	7.43	7.71	7.84	0.24	0.49	5	0	0	0%	0%
October Storm Event	10/21/2008	7.18	7.25	7.44	7.30	7.54	7.18	7.34	7.30	7.54	0.02	0.15	5	0	0	0%	0%

	JS	BS	CBD5	CBD1	SS
Site Low	**6.73**	**7.10**	**7.28**	**7.30**	**7.14**
Site Mean	**7.13**	**7.38**	**7.69**	**7.63**	**7.61**
Site Median	**7.16**	**7.42**	**7.72**	**7.60**	**7.64**
Site High	**7.55**	**7.59**	**8.15**	**8.08**	**7.92**
Site Variance	**0.07**	**0.04**	**0.08**	**0.06**	**0.06**
Site Std. Deviation	**0.26**	**0.19**	**0.28**	**0.24**	**0.25**
N	**10**	**8**	**9**	**9**	**8**
Number of obs. pH<6.5	**0**	**0**	**0**	**0**	**0**
Number of obs. pH>8.5	**0**	**0**	**0**	**0**	**0**
Percent of obs. pH<6.5	**0%**	**0%**	**0%**	**0%**	**0%**
Percent of obs. pH>8.5	**0%**	**0%**	**0%**	**0%**	**0%**

EC/TDS Measurements

The multiprobe instrument was used to take EC measurements in the field. Figure 5-5 shows the results of all EC measurements taken during 2008. 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, 19 May 2004, and is an agricultural water quality value (Ayers and Wescot, 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. Management of salinity with the Sacramento Valley should be undertaken in the context of the CALFED Record of Decision (ROD). The 2008 sampling season yielded three samples with an EC of greater than 700 µmhos/cm. Two of the three samples were collected during the March storm event and the third was collected during the October storm event. Storm events are not considered to be representative of rice drainage; all of the in-season samples fell below the reporting threshold.

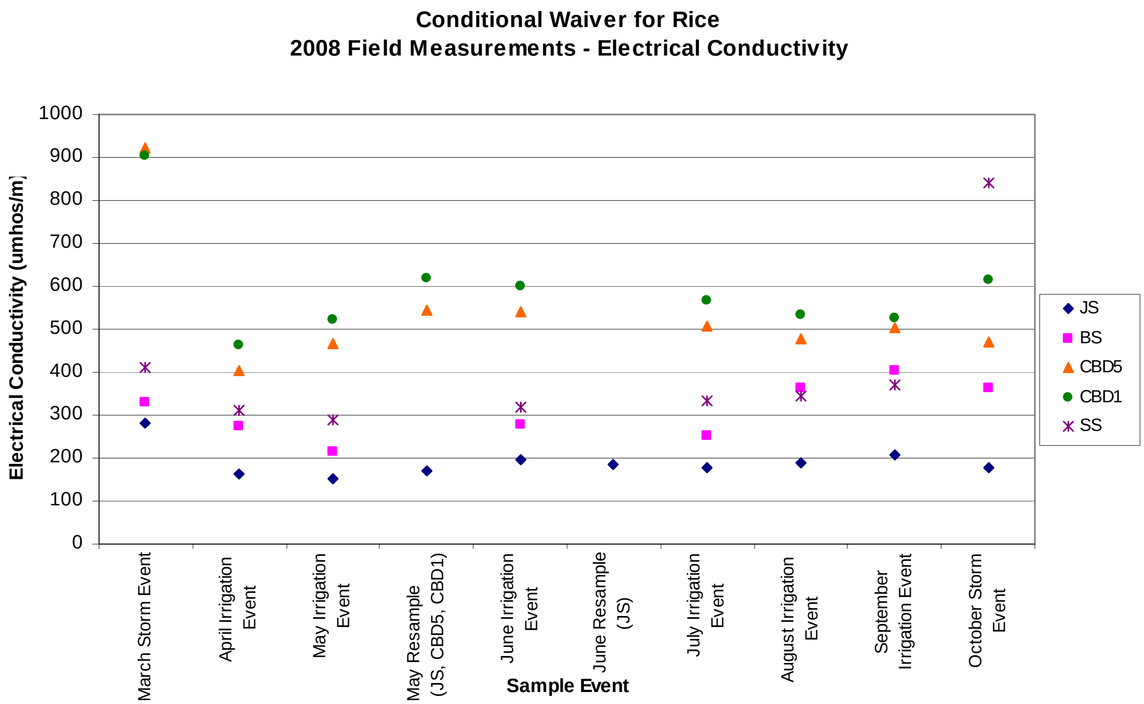


FIGURE 5-5
Electrical Conductivity Field Measurements, 2008

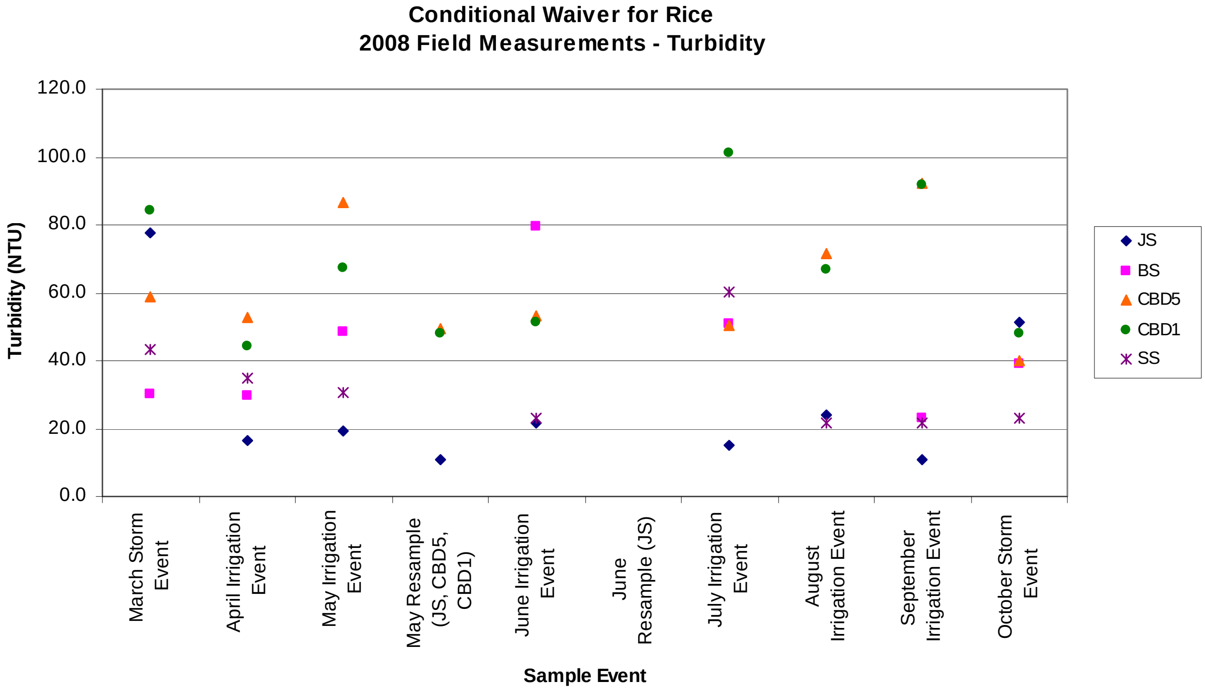
TABLE 5-5
Electrical Conductivity Field Measurements—Tabulated Results, 2008

Event	Date	Electrical Conductivity (µmhos/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
		JS	BS	CBD5	CBD1	SS									
March Storm Event	3/12/2008	280	331	922	904	410	280	569	410	922	100,569.80	317.13	5	2	40%
April Irrigation Event	4/29/2008	162	275	403	464	312	162	323	312	464	13,656.70	116.86	5	0	0%
May Irrigation Event	5/13/2008	153	215	466	523	288	153.00	329.00	288.00	523.00	25,514.50	159.73	5	0	0%
May Resample (JS, CBD5, CBD1)	5/29/2008	169		544	617		169.00	443.33	544.00	617.00			3	0	0%
June Irrigation Event	6/3/2008	196	278	542	601	319	196.00	387.20	319.00	601.00	30,701.70	175.22	5	0	0%
June Resample (JS)	6/12/2008	186					186.00	186.00	186.00	186.00			1	0	0%
July Irrigation Event	7/1/2008	179	251	508	566	332	179.00	367.20	332.00	566.00	27,376.70	165.46	5	0	0%
August Irrigation Event	8/26/2008	190	363	479	534	343	190.00	381.80	363.00	534.00	17,814.70	133.47	5	0	0%
September Irrigation Event	9/16/2008	208	404	504	527	369	208.00	402.40	404.00	527.00	16,189.30	127.24	5	0	0%
October Storm Event	10/21/2008	177	362	469	617	839	177.00	492.70	469.00	839.00	63,140.20	251.28	5	1	20%

	JS	BS	CBD5	CBD1	SS
Site Low	**153**	**215**	**403**	**464**	**288**
Site Mean	**190**	**310**	**537**	**595**	**402**
Site Median	**183**	**305**	**504**	**566**	**338**
Site High	**280**	**404**	**922**	**904**	**839**
Site Variance	**1,262**	**4221**	**22,652**	**15,999**	**32,641**
Site Std. Deviation	**35.53**	**64.97**	**150.50**	**126.49**	**180.67**
N	**10**	**8**	**9**	**9**	**8**
Number of obs. EC>700	**0**	**0**	**1**	**1**	**1**
Percent of obs. EC>700	**0%**	**0%**	**11%**	**11%**	**13%**

Turbidity

Turbidity measurements are taken in the field using the multiprobe instrument. Figure 5-6 shows the results of all turbidity measurements taken during 2008 sampling. 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, 2008

TABLE 5-6
Turbidity Field Results—Tabulated Results, 2008

Event	Date	Turbidity (NTU)					Event Low	Event Mean	Event Median	Event High	Event Variance	Event Std. Deviation	N
		JS	BS	CBD5	CBD1	SS							
March Storm Event	3/12/2008	77.79	29.90	58.87	84.12	43.07	29.90	58.75	58.87	84.12	521.09	22.83	5
April Irrigation Event	4/29/2008	16.25	29.76	52.53	44.13	34.86	16.25	35.51	34.86	52.53	192.10	13.86	5
May Irrigation Event	5/13/2008	19.36	48.54	86.45	67.26	30.46	19.36	50.41	48.54	86.45	737.10	27.15	5
May Resample (JS, CBD5, CBD1)	5/29/2008	10.83		49.50	47.94		10.83	36.09	47.94	49.50			3
June Irrigation Event	6/3/2008	21.67	79.38	53.33	51.26	23.05	21.67	45.74	51.26	79.38	578.48	24.05	5
June Resample (JS)	6/12/2008												0
July Irrigation Event	7/1/2008	14.87	50.83	50.48	101.00	60.16	14.87	55.47	50.83	101.00	947.44	30.78	5
August Irrigation Event	8/26/2008	24.10	469.10	71.55	66.78	21.42	21.42	130.59	66.78	469.10	36,351.17	190.66	5
September Irrigation Event	9/16/2008	10.83	22.99	92.13	91.91	21.76	10.83	47.92	22.99	92.13	1,642.79	40.53	5
October Storm Event	10/21/2008	51.16	38.97	39.84	48.08	23.10	23.10	40.23	39.84	51.16	1,19.07	10.91	5

Site Low	**10.83**	**22.99**	**39.84**	**44.13**	**21.42**
Site Mean	**27.43**	**96.18**	**61.63**	**66.94**	**32.24**
Site Median	**19.36**	**43.76**	**53.33**	**66.78**	**26.78**
Site High	**77.79**	**469.10**	**92.13**	**101.00**	**60.16**
Site Variance	**505.31**	**23,016.02**	**318.78**	**445.22**	**185.96**
Site Std. Deviation	**22.48**	**151.71**	**17.85**	**21.10**	**13.64**
N	**9**	**8**	**9**	**9**	**8**

Copper and Hardness Analysis—Algae Management Plan

Samples were collected for copper and hardness analysis at the same sites and events as the pesticide sampling, in accordance with the algae management plan. Selected samples collected during March (JS), June (CBD5, CBD1, BS1, SSB), July (CBD1), and September (CBD5, SSB, BS1) were analyzed for copper by using EPA Method 200.8, and hardness using EPA Method 200.7.

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

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

The hardness-adjusted copper criteria, based on the actual hardness measured for the sample location and date, are shown in Tables 5-7 and 5-8. All of the copper samples for the 2008 monitoring season fell below the copper criterion.

TABLE 5-7
Copper and Hardness Analysis

		Copper Concentration (µg/L)					Total Hardness as $CaCO_3$ (mg/L)				
Month	**Date**	**JS**	**CBD5**	**BS1**	**CBD1**	**SSB**	**JS**	**CBD5**	**BS1**	**CBD1**	**SSB**
March	3/12/2008	6.7					130				
June	6/3/2008		11	12	7.7	4.6	78	160	110	170	130
July	7/1/2008				6.3					170	
September	9/16/2008		4.8	2.9		3.5	89	190	170	190	150

TABLE 5-8
Hardness-adjusted CTR Copper Water Quality Criteria (1-hour maximum)

		Hardness-adjusted CTR Copper Water Quality Criteria (µg/L)				
Month	**Date**	**BS1**	**CBD1**	**CBD5**	**JS**	**SSB**
March	3/12/2008				17.9	
June	6/3/2008	15.3	23.1	21.8	11.1	17.9
July	7/1/2008		23.1			
September	9/16/2008	23.1	25.6	25.6	12.5	20.5

Copper results will be evaluated against algae toxicity in the following section to determine whether a discernable relationship exists between copper concentration and algae toxicity.

Aquatic Toxicity Testing

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

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

The aquatic toxicity tests are performed on samples collected at each station and are performed concurrent with tests on control samples.

The following discussion explains the methodology used to perform the required test, and then provides details and summary results for each species-specific toxicity test.

Whole Effluent Test Methodology

Whole effluent toxicity (WET) tests, or bioassays, are one approach for evaluating the quality of discharged water and its potential to adversely affect biota in receiving waters. WET tests are laboratory toxicity studies in which standard test species are exposed to field-collected water samples by using standardized protocols, and the resulting toxicity (or absence of toxicity) is observed. Suter et al. (2000) identified strengths and weaknesses of bioassays. Strengths of bioassays include the following:

- Realistic representation of the form and bioavailability of the contaminants
- Effects due to multiple contaminants or contaminants that lack toxicity data may be evaluated
- The spatial distribution of toxicity can be determined by testing multiple locations

Weaknesses of bioassays include the following:

- Test media may be modified by collection and preparation for toxicity testing
- Forms and concentrations of chemicals may be modified by sample collection and processing
- Samples may be unrepresentative
- Most media toxicity tests have short durations and test species may not adequately represent species in the field
- If toxicity is observed, the cause of the toxicity is unknown

These limitations do not negate the considerable advantages of media toxicity testing. The first three limitations can be avoided to a considerable degree by exercising care in the collection and handling of samples and in the conduct of the tests. The fourth limitation requires analysis and interpretation of the results. The fifth limitation requires additional testing to identify which components of the contaminant mixture are responsible, a process called toxicity identification evaluation (TIE) (EPA, 1998a and 1998b). In the TIE process, the toxic components of a mixture are identified by removing components of a mixture and testing the residue, fractionating the mixture and testing the fractions, or adding components of the mixture to background medium and testing the artificially contaminated medium.

Control and reference media both should be tested along with the contaminated media. Control media are laboratory media known to be appropriate for the test species. That is, control media support the maximal rates of survival, growth, and reproduction of the test species. The characteristics of control media are usually prescribed in standard test protocols. Reference media are media that come from near the site, and are physically and chemically similar to the test media except that they do not contain the site contaminants. The control tests determine whether the test was conducted properly using healthy organisms. The local reference tests provide the basis for determining how much toxicity the site adds to proximate media. If a separate clean reference is used, it provides the basis for determining whether the differences from controls are due to contaminants or to properties of the media, such as pH.

Standard toxicity tests have been developed for determining the acceptability of aqueous effluents and are widely used in effluent permitting in the United States. These tests are unique in the extent to which they have been validated against biosurvey data (Dickson et al., 1992; Grothe et al., 1996). In a number of studies, the 7-day fathead minnow and *Ceriodaphnia dubia* tests have been found to be predictive of reductions in the species richness of aquatic communities. As a result of this intensive development and validation, these tests are widely used.

In accordance with the MRP Order, acute and chronic toxicity tests were performed on three test species:

- Fathead minnow, *Pimephales promelas*
- Water flea, *Ceriodaphnia dubia*
- Green algae, *Selenastrum capricornutu*

Tests are performed on samples collected at each station and are performed concurrent with tests on control samples.

Fathead Minnow (*Pimephales promelas*)

The MRP includes toxicity tests using the test species *Pimephales promelas* to detect toxicity to fish species. This minnow is considered a sensitive test species, and toxicity to *P. promelas* can indicate a water quality concern.

2008 *P. promelas* Toxicity Testing. The AQUA-Science laboratory performed *P. promelas* toxicity tests. The detailed results of these tests are shown in Table 5-9. These tabulated results provide the sample date (or resample date), the lab report that summarizes the test results, and the test organisms' percent survival (as compared to the control). For all of the analyses conducted during Year 4, there was no statistically significant observed toxicity to fathead minnow, and no resamples were triggered. These results indicate that sampled waters were not toxic to fish species.

Water Flea (*Ceriodaphnia dubia*)

The MRP includes toxicity tests using the test species *Ceriodaphnia dubia* in order to detect toxicity to invertebrates. *C. dubia* is considered a sensitive test species, and toxicity to *C. dubia* can indicate a water quality concern.

2008 *C. dubia* Toxicity Testing

The AQUA-Science laboratory performed *C. dubia* toxicity tests. The detailed results of the daphnia toxicity tests are shown in Table 5-10. These tabulated results provide the sample date (or resample date), the lab report that summarizes the test results, the test organisms' percent survival (as compared to the control), whether resampling was triggered, and the results of any resampling. As with the fathead minnow, for all of the analyses conducted during Year 4, there was no statistically significant observed toxicity to the water flea, and no resamples were triggered. These results indicate that samples waters were not toxic to invertebrates.

Green Algae (*Selenastrum capricornutum*)

The MRP includes toxicity tests using the test species *Selenastrum capricornutum* in order to detect toxicity to aquatic plants. *Selenastrum* is a green algae species and is considered the most sensitive test species. Toxicity to *Selenastrum* can indicate a water quality concern.

Background. Monitoring conducted in Year 1 and Year 2 of the CWFR monitoring program identified *Selenastrum* reductions as on an ongoing occurrence. TIEs performed in Year 1 and Year 2 were not conclusive in determining the causal agents contributing to toxicity, although "short-lived non-polar organic herbicides" were often indicated based on the effectiveness of SPE-18 treatments in removing the toxicity. Follow-on chemistry conducted on elute derived from the SPE-18 columns resulted in a series of non-detects for various rice herbicides and non-rice products.

In 2007, an alternative study plan, included in the algae management plan, was proposed by the CRC and was endorsed by CVRWQCB staff. In an effort to improve the effectiveness of the study plan in determining the causal agent contributing to the *Selenastrum* reductions, the CRC proposed, in lieu of TIEs, to submit samples for herbicides and copper analysis concurrent with the initiation of the *Selenastrum* toxicity tests. This additional herbicide and copper analysis was conducted during the 2008 sampling season on samples collected at JS in March, at CBD5, CBD1, BS1, and SSB in June, CBD1 in July, and CBD5, SSB, and BS1 in September. This approach provided the benefit of including immediate analysis of original samples (the prior approach involved waiting for determination of toxicity prior to submitting samples for herbicide analysis). In addition, since previous TIEs had been unsuccessful in advancing the understanding of the causal agent beyond the determination of "short-lived non-polar organic herbicides," this approach was deemed more economical because it would provide up-front chemistry aimed at assessing specific herbicides and it would provide numeric results for detected pesticides.

In addition to the additional herbicide analysis, resampling is required at any site with an observed toxicity reduction of 50 percent or more (less than 50 percent survival as compared to the control).

TABLE 5-9
Minnow Toxicity Test Summary Results

Month	Event	Sample Date	Minnow 96-Hour Percent Survival as Compared to Control (Control Survival)					Resample Triggered?				
			JS	BS1	CBD5	CBD1	SSB	JS	BS1	CBD5	CBD1	SSB
March	Original	3/12/2008	–	–	–	–	–	NA	NA	NA	NA	NA
April	Original	4/29/2008	100%	97.5%	100%	100%	100%	N	N	N	N	N
May	Original	5/13/2008	100%	92.5%	100%	95%	97.5%	N	N	N	N	N
June	Original	6/3/2008	100%	97.5%	100%	100%	100%	N	N	N	N	N
July	Original	7/1/2008	97.5%	100%	100%	100%	97.5%	N	N	N	N	N
August	Original	8/26/2008	–	–	–	–	–	NA	NA	NA	NA	NA
September	Original	9/16/2008	–	–	–	–	–	NA	NA	NA	NA	NA
October	Original	10/21/2008	–	–	–	–	–	NA	NA	NA	NA	NA

NOTES:
N = resample was not triggered
NA = resample requirements are not applicable based on resample results
- = no analysis requiresd

TABLE 5-10
C. dubia Toxicity Test Summary Results

Month	Event	Sample Date	*C. dubia* 96-Hour Percent Survival as Compared to Control (Control Survival)					Resample Triggered?				
			JS	BS1	CBD5	CBD1	SSB	JS	BS1	CBD5	CBD1	SSB
March	Original	3/12/2008	–	–	–	–	–	NA	NA	NA	NA	NA
April	Original	4/29/2008	100%	95%	100%	100%	100%	N	N	N	N	N
May	Original	5/13/2008	100%	100%	100%	95%	100%	N	N	N	N	N
June	Original	6/3/2008	100%	100%	100%	100%	100%	N	N	N	N	N
July	Original	7/1/2008	100%	100%	100%	95%	100%	N	N	N	N	N
August	Original	8/26/2008	–	–	–	–	–	NA	NA	NA	NA	NA
September	Original	9/16/2008	–	–	–	–	–	NA	NA	NA	NA	NA
October	Original	10/21/2008	–	–	–	–	–	NA	NA	NA	NA	NA

NOTES:
N = resample was not triggered
NA = resample requirements are not applicable based on resample results
- = no analysis required

Based on a review of previous *Selenastrum* toxicity studies conducted by the CRC and by UC Davis and the CVRWQCB, the CVRWQCB staff, CH2M HILL, and the CRC consulted on the list of herbicides to be analyzed in 2007. This list of herbicides was used again for samples collected in 2008; these herbicides are listed in Table 5-11. The results of the herbicide analyses are included in Appendix B-4.

2008 *Selenastrum* Toxicity Testing. *Selenastrum* toxicity tests were performed by AQUA-Science. The detailed results of the *Selenastrum* toxicity tests are shown in Table 5-12. These tabulated results provide the sample date (or resample date), the lab report that summarizes the results of the tests, the test organisms' percent growth (as compared to the control), whether resampling was triggered, and the results of any resampling. Resampling is triggered if the percent growth as compared to the control is 50 percent or less. The results of the 2008 CWFR *Selenastrum* toxicity testing are summarized as follows:

March

- Only JS was sampled in March, and resulted in 92 percent growth as compared to the control. No statistically significant toxicity was observed, and no resamples were performed.

April

- All five sites were sampled in April, and statistically significant toxicity was observed at JS (52 percent growth as compared to control), CBD1 (77 percent), and SSB (69 percent). No resampling was triggered for this event.

May

- All five sites were sampled in May, and statistically significant toxicity was observed at all sites: JS (44 percent), BS1 (74 percent), CBD5 (50 percent), CBD1 (12 percent), SSB (71 percent).
- Resampling was triggered at JS, CBD5, and CBD1, and was completed 16 days following the original sampling event. The results of the resampling showed greater than 100 percent growth at CBD5 and CBD1, and 98 percent growth at JS, indicating that that the previously observed toxicity did not persist.

June

- All five sites were sampled in June, and statistically significant toxicity was observed at two sites: JS (10 percent), and CBD5 (85 percent).
- Resampling was triggered at JS. Resampling was completed 9 days following the original sampling event. The result of the resampling yielded greater than 100 percent growth, indicating that the previously observed toxicity did not persist.

July

- All five sites were sampled in July, and all resulted in greater than 100 percent growth. Statistically significant toxicity was not observed, therefore resampling was not necessary.

August

- All five sites were sampled in August, and only one site had statistically significant toxicity, JS (77 percent). Resampling was not triggered for this event.

September

- All five sites were sampled in September, and no statistically significant toxicity was observed.

October

- All five sites were sampled in October, and no statistically significant toxicity was observed.

Comparison of Algae Toxicity with Copper Results

Sampling for copper analyses occurred during the same events as the algae toxicity sampling to determine whether copper contributes to Algae toxicity. Lab results show that copper was present in all of the samples; however, there does not seem to be a relationship between copper presence/concentration and algae toxicity. Copper levels at sites with statistically significant toxicity varied, and sites with higher copper concentrations were not necessarily those with higher toxicity. This indicates that copper is not a factor in algae toxicity in these samples.

TABLE 5-11
Herbicides Identified for Analysis as Part of the *Selenastrum* Study Plan, 2008

Herbicide	EPA Method[a]	Detection (MRL)[b]	Application Period	Sequential Application	Water Hold Period	Use	Rice herbicide?	Used by other crops?
Atrazine	8141A	0.10 µg/L	–	NA	NA	Non-rice herbicide	No	Yes
Bensulfuron-methyl	8081A	0.50 µg/L	April, May–June	Yes	7 day (static)	Herbicide	Yes	Yes
Bispyribac-sodium	8151A(m)	0.50 µg/L	April–May or May–June	Yes	7 day	Herbicide	Yes	No
Carfentrazone	8081A	0.10 µg/L	April–June	Yes	5-day static, 30-day release	Herbicide	Yes	Yes
Clomazone	8141A	1.0 µg/L	April–May	No, 120-day PHI	14 day	Herbicide	Yes	Yes
Diuron	632	0.50 µg/L	–	NA	NA	Non-rice herbicide	Yes	No
Glyphosate	547	10.0 µg/L	March, if rice preplant	NA	None (preplant)	Non-rice herbicide	Yes	No
Halosulfuron	8081A	0.10 µg/L	April–May	No	None	Herbicide	No	Yes
Molinate	8141A	0.50 µg/L	April–May	No	28 day	Herbicide	No	Yes
Pendimethalin	8081A	0.20 µg/L	March–April	No	None (preplant)	Herbicide	Yes	Yes
Penoxsulam	632	5.0 µg/L[c]	April–June	No	None	Herbicide	Yes	No
Propanil	8081A	0.05 µg/L	May–July	Yes	7 day	Herbicide	Yes	Yes
Simazine	8141A	0.5 µg/L	—	NA	NA	Non-rice herbicide	Yes	No
Thiobencarb	8141A	0.50 µg/L	April–May	No	19 day	Herbicide	Yes	No
Triclopyr TEA	8151A	0.05 µg/L	May–June	Yes	20 day	Herbicide	Yes	Yes

NOTES:

[a] Modified or new EPA lab method for herbicide as specified by Environmental Micro Analysis, Inc. (CRC-contracted lab) as noted on the laboratory's Web site.
[b] Estimated minimum reportable limit (MRL), based on the results sheets received from the lab (Appendix B). The actual detection and reportable limits are to be provided by the analytical laboratory as part of QA/QC.
[c] Proprietary method used by Environmental Micro Analysis, Inc. The reported MRL is based on the laboratory results included in Appendix B.
- = no analysis required

TABLE 5-12
Selanastrum Toxicity Test Summary Results

Month	Event	Sample Date	Appendix Reference	*Selanastrum* 96-Hour Percent Growth as Compared to Control (Control Growth)					Resample Triggered?				
				JS	BS1	CBD5	CBD1	SSB	JS	BS1	CBD5	CBD1	SSB
March	Original	3/12/2008	March 21, 2008; AQUA-Science	92%	–	–	–	–	N	NA	NA	NA	NA
April	Original	4/29/2008	May 21, 2008; AQUA-Science	52%[a]	84%	111%	77%[a]	69%[a]	N	N	N	N	N
May	Original	5/13/2008	June 5, 2008; AQUA-Science	44%[b]	74%[a]	50%[b]	12%[b]	71%[a]	Y	N	Y	Y	N
	Resample	5/29/2008		98%	–	114%	102%	–	N	NA	N	N	NA
June	Original	6/3/2008	June 16, 2008; AQUA-Science	10%[b]	103%	85%[a]	87%	91%	Y	N	N	N	N
	Resample	6/12/2008		111%	–	–	–	–	N	NA	NA	NA	NA
July	Original	7/1/2008	July 15, 2008; AQUA-Science	110%	121%	118%	104%	124%	N	N	N	N	N
August	Original	8/26/2008	Sept 15, 2008; AQUA-Science	77%[a]	105%	107%	115%	115%	N	N	N	N	N
September	Original	9/16/2008	October 3, 2008; AQUA-Science	97%	116%	115%	125%	109%	N	N	N	N	N
October	Original	10/21/2008	October 27, 2008; AQUA-Science	88%	96%	93%	104%	103%	N	N	N	N	N

NOTES:
N indicates that a resample was not triggered
Y indicates that a resample was triggered
NA indicates that resample requirements are not applicable based on resample results.
[a]Statistically Significant Toxicity Observed
[b]Resample Triggered

Algae Management Plan

Samples were collected for pesticide analysis under the algae management plan. Samples were collected during March (JS), June (JS, CBD1, CBD5, BS1, SSB), July (CBD1), and September (BS1, CBD1, CBD5) and analyzed for the pesticides listed in Table 5-11. Additionally, the four "specified pesticides" from the 2007 sampling were again monitored in 2008. Table 5-13 gives the "specified pesticides" that were analyzed, the EPA methods, method reporting limits, and additional information regarding the usage of these products on rice. Results of this testing are presented in Table 5-14. Both the March event and June resample event yielded non-detect (below the MRL) results for all pesticides tested. Each of the other events had at least one detect per sampling site. The most commonly found pesticide was triclopyr, detected in five out of eight samples. Azoxystrobin and triclopyr applications take place on a multitude of crops, so the detections in September are not attributable to rice farming because the timing takes place after the rice pesticide season is complete and these product registrations are available for other crops. The raw lab results are included in the Appendix B-4.

Algae Management Plan Pesticides and Algae Toxicity

Although concentrations of the targeted pesticides listed in Tables 5-11 and 5-13 were found in several samples taken during the 2008 monitoring season, there was no relationship between pesticide presence and algae toxicity. None of the days with a pesticide concentration above the MRL were days where a resample was triggered, and only one sample with pesticides present has statistically significant toxicity. A more widespread monitoring of toxicity and pesticides may be necessary to fully determine whether there is a correlation between toxicity and the target algae management plan pesticides.

TABLE 5-13
Additional "Specified Pesticides" Analyzed, 2008

Chemical	EPA Method	Method Reporting Limit (MRL)[a]	Application Period	Sequential Application	Water Hold period	Use
Azoxystrobin	8141A	0.50 µg/L	May–June	Yes	14 day	Fungicide
Cyhalofop-butyl	8081A	0.10 µg/L	May–June	Yes	7 day	Herbicide
Propiconazole[b]	8141A	0.50 µg/L	May–June	Yes	7 day	Fungicide
Trifloxystrobin[b]	8151A	0.05 µg/L	May–June	Yes	7 day	Fungicide

NOTE:
[a]MRL as reported by the analytical laboratory
[b]The rice pesticide Stratego® is comprised of the two active ingredients propiconazole and trifloxystrobin

TABLE 5-14
2008 Pesticide Monitoring Results

Event Type	Month	Date	Sites Sampled	JS	BS1	CBD5	CBD1	SSB
Winter drainage	March	3/12/2008	JS	ND	—	—	—	—
Irrigation	June	6/3/2008	BS1, CBD5, CBD1, SSB	—	Propanil (1.94 µg/L)	Clomazone (1.13 µg/L) Triclopyr (0.29 µg/L)	Triclopyr (0.14 µg/L)	Clomazone (1.74 µg/L)
Resample*	June	6/12/2008	JS	ND	—	—	—	—
Irrigation/drainage	July	7/1/2008	CBD1	—	—	—	Triclopyr (3.35 µg/L)	—
Irrigation/drainage	September	9/16/2008	BS1, CBD5, SSB	—	Azoxystrobin (0.87 µg/L)	Azoxystrobin (0.53 µg/L) Triclopyr (0.35 µg/L)	—	Azoxystrobin (0.63 µg/L) Triclopyr (0.33 µg/L)

NOTE:
*The sample from the original sampling date arrived broken to the lab. A new sample was taken for JS during the June resample event.

2008 Flow Data

Table 5-15 contains the flow data collected under the 2008 Conditional Waiver for Rice Program. These flow estimates are calculated based on field cross-section and velocity measurements collected at the time of water quality sample collection. Field measurements are documented on field sheets contained in Appendix B-1.

TABLE 5-15
2008 Flow Data

		Estimated Flow (cubic feet per second)				
Month	Sample Date	JS	BS1	CBD5	CBD1	SSB
March	3/12/2008	0	86	243	129	37
April	4/29/2008	10	172	703	75	68
May	5/132008	16	380	400	246	388
June	6/3/2008	13	167	270	214	428
July	7/1/2008	17	164	385	184	255
August	8/26/2008	24	0	835	208	131
September	9/16/2008	0	0	308	27	119
October	10/21/2008	9	0	183	1	17

UC Davis Edge-of-Field Monitoring

The MRP requirements incorporate monitoring conducted under UC Davis CALFED Grant 384. The grant was approved for funding by the SWRCB on June 17, 2004 (Resolution No. 2004-0035) and contains four study components producing data to be submitted by UC Davis to the CVRWQCB. The grant contract is entitled "The Regents of the University of California, University of California Davis—State Water Resources Control Board Grant Agreement No. 04-183-555-0." UC Davis, with significant input and oversight by CVRWQCB staff, developed a monitoring plan that specifies the parameters of monitoring activities to be conducted under the grant. On behalf of the SWRCB, the grant is managed by a CVRWQCB staff person. The preliminary results of the UC Davis TOC and nutrient monitoring will be provided to the CVRWQCB as an addendum to this report, as the results are not currently available. Descriptions of each study component's purpose and parameters follow.

Study Component 1

Study Component 1 is focused on the evaluation of total organic carbon and dissolved organic carbon (TOC/DOC), TDS and EC, and turbidity of outflows from rice fields cultivated under differing straw decomposition and winter flood practices. This component includes the evaluation of a minimum of four fields with two plots per field. The MRP specifies the Study Component 1 monitoring.

Study Component 2

Study Component 2 is designed to measure the amount and transport of TOC and DOC, TDS and EC, and turbidity in rice field peripheral drains. Peripheral drain sites are to be located downstream of the fields used in Study Component 1. Monitoring as specified in the MRP is to be conducted as part of Study Component 2.

Study Component 3

Study Component 3 is designed to determine the impact of alternative seeding methods on pest management and pesticide outflows from rice fields, including a water seeded and conventionally farmed field, and a dry-seeded and conventionally farmed rice field. Monitoring for Study Component 3 is to be conducted as specified in the MRP.

Study Component 4

Study Component 4 is to measure the impact of alternative rice-seeding methods and irrigation management on nitrogen and phosphorus outflows from rice fields, including outflows from a water seeded and conventionally farmed field, and a dry-seeded and conventionally farmed rice field. Monitoring for Study Component 4 is to be conducted as specified in the MRP.

Study Findings

The monitoring being conducted under components 1, 2, 3, and 4 is being compiled by UC Davis and will be submitted to the CVRWQCB under the requirements of the grant reporting. In addition, the results will be reviewed in accordance with the DO and pH Management Plan, developed by the CRC and CVRWQCB.

Propanil Testing: 2006-2008

Supplemental propanil testing was initiated in collaboration with the pesticide registrants. Supplemental testing began during the 2006 monitoring season, and has continued through the 2008 season. Water samples were collected from each of the monitoring locations on a weekly basis from the beginning of June to the middle of July, which is the common application period for propanil (Table 5-11). This year, the pesticide registrants approved the release of the data, so the results from all three years will be discussed in this section. Field sheets and results are located in Appendix B-5.

The laboratory reported the MRL as 0.05 µg/L.

2006 Monitoring

Propanil sampling occurred on June 6, 20, 22, and 27 and July 5 and 11 during the 2006 monitoring season (Table 5-16). In general, propanil levels were below 1.0 µg/L, with three samples above that mark. The CBD5 sample from June 20 was the highest at 31.2 µg/L. The BS1 and CBD1 samples from the same sampling date were detected at 1.36 and 3.30 µg/L, respectively. Four out of the five sampling locations had their highest levels of propanil during the June 20 sampling event.

TABLE 5-16
2006 Propanil Monitoring Results (µg/L)

	Monitoring Sites				
Sampling Dates	**CBD5**	**BS1**	**CBD1**	**SSB**	**SR1**
6/6/06	0.08	ND	0.06	ND	ND
6/20/06	31.2	1.36	3.30	ND	0.18
6/22/06	0.35	0.45	0.67	ND	ND
6/27/06	0.24	0.88	0.18	ND	ND
7/5/06	ND	0.79	ND	ND	ND
7/11/06	0.07	0.46	0.23	ND	ND

2007 Monitoring

Propanil sampling occurred on June 5, 12, 19, and 26 and July 3, 10, 17, and 23 during the 2007 monitoring season (Table 5-17). The majority of the samples had propanil levels below 1.0 µg/L, with only three samples above that mark. The CBD5 sample from June 5 was the highest, at 2.42 µg/L. The CBD1 sample from the same sampling date had a detection of 1.60 µg/L. The BS1 sample from the following week (June 12) had a value of 1.08 µg/L. Three out of the four sampling locations had their highest levels of propanil during the June 5 sampling event.

TABLE 5-17
2007 Propanil Monitoring Results

	Monitoring Sites			
Sampling Dates	CBD5	BS1	CBD1	SSB
6/5/07	2.42	0.46	1.60	ND
6/12/07	0.85	1.08	0.64	0.20
6/19/07	0.20	0.37	0.13	0.08
6/26/07	0.14	0.14	0.11	0.29
7/3/07	0.36	0.37	0.06	0.05
7/10/07	ND	0.11	ND	ND
7/17/07	ND	ND	0.08	ND
7/23/07	ND	ND	ND	ND

2008 Monitoring

Propanil sampling occurred on June 3, 10, 17, and 24 and July 1, 15, and 22 during the 2008 monitoring season (Table 5-18). The majority of the samples had propanil levels below 1.0 µg/L, with only three samples above that mark. The SSB sample from June 22 was the highest, at 4.18 µg/L. Both the CBD5 and BS1 samples from June 17 had detections of 1.34 µg/L and 1.29 µg/L, respectively. Although both the CBD5 and SSB sampling locations had their highest levels at the June 17 event, the July 15 event had the most propanil detections, with detects at four out of the five sampled locations. No detections were observed in three of the seven weeks sampled.

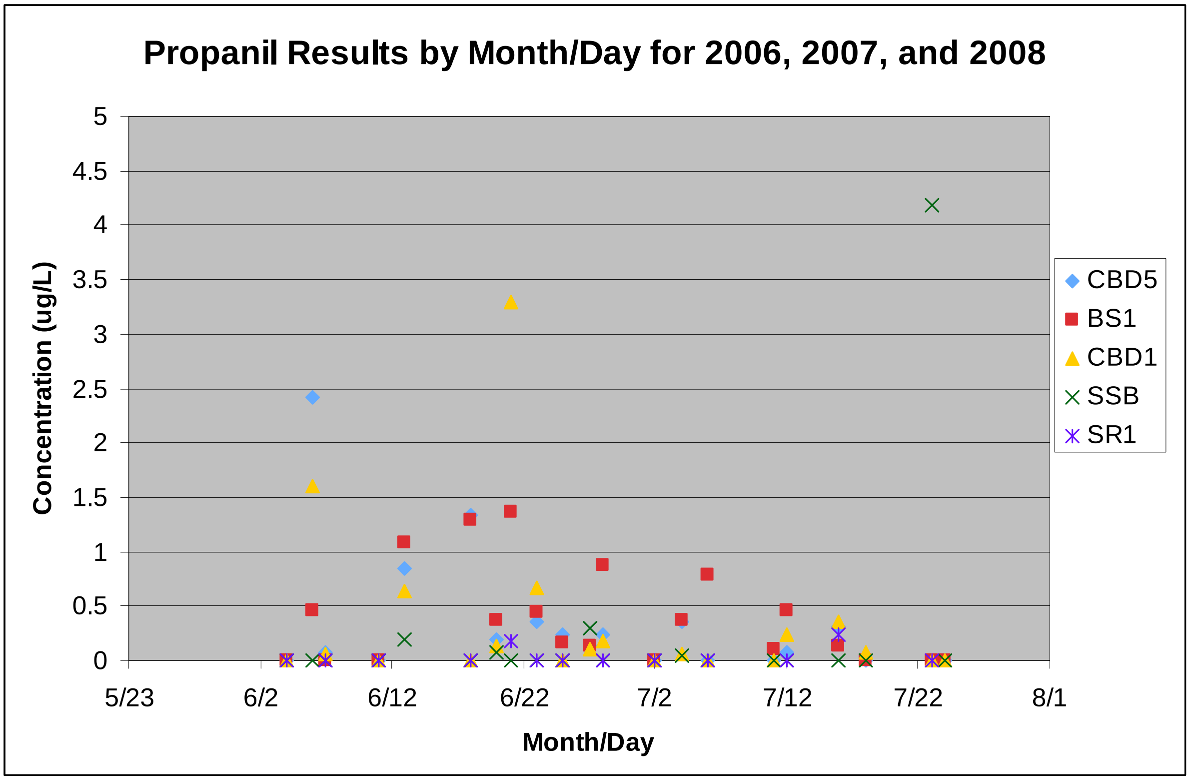
TABLE 5-18
2008 Propanil Monitoring Results

	Monitoring Sites				
Sampling Dates	CBD5	BS1	CBD1	SSB	SR1
6/3/08	ND	ND	ND	ND	ND
6/10/08	ND	ND	ND	ND	ND
6/17/08	1.34	1.29	ND	ND	ND
6/24/08	0.24	0.16	ND	ND	ND
7/1/08	ND	ND	ND	ND	ND
7/15/08	0.31	0.14	0.35	ND	0.23
7/22/08	ND	ND	ND	4.18	ND

Conclusions

In general, the majority of the locations sampled resulted in non-detect for propanil for the duration of the monitoring season. The majority of the propanil detections were grouped during a 1- or 2-week period. During 2006, this period centered around the June 20 sampling event. In 2007, this period centered around the June 5 and 12 sampling events. During 2008, there were two periods of hits, during the June 17 and July 15 sampling events.

Figure 5-7, below, shows a plot of all of the propanil data from 2006, 2007, and 2008. The year was removed from the data to enable detection of weekly trends. In general, it appears the highest levels of propanil occurs during the second week of June through the end of June.



NOTE:
The 6/20/06 result of 31.2 µg/L was removed from the data set for ease of display

FIGURE 5-7
Propanil Results by Month/Day for 2006, 2007, and 2008 Monitoring Seasons

RPP Monitoring

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

The RPP is reviewed triennially by the CVRWQCB, which has authority to authorize the program or use another regulatory approach to achieve water quality protection, including attainment of Performance Goals 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 5-19.

TABLE 5-19
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 goals, molinate and thiobencarb levels in drinking water delivered to municipal customers must meet enforceable MCLs. MCLs are enforceable drinking water standards set by the USEPA 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 1.0 ppb (off-taste). The MCL for molinate is 20.0 ppb.

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 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. For 2008, all required water hold requirements were the same as during the 2005, 2006, and 2007 growing seasons. The water holds for rice pesticides, including the four registered pesticides regulated under the Basin Plan's conditional prohibition of discharge, are listed in Chapter 3.

Pesticides Monitored

RPP laboratory analysis in 2007 included thiobencarb and molinate. The monitoring program continued to *not* include analysis for carbofuran, malathion, and methyl-parathion because of registration cancellation, decrease in use, and no reportable applications to rice. Carbofuran is no longer registered on rice with no reportable use since 2000. Malathion was not monitored in 2003, 2004, 2005, 2006, 2007, or 2008 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 2008 DPR PUR documented 108 acres of malathion usage. This small area of application is too small to be significant to warrant water quality monitoring under the RPP monitoring program.

Sampling Schedule

The sampling calendar was developed based on historical data, rice pesticide use and drainage patterns, and actual 2008 conditions. Sampling was conducted for 10 weeks according to the schedule listed in Table 5-20. Kleinfelder initiated sampling on April 29, 2008 at sites CBD5, BS1, CBD1, SSB, and SR1.

Weekly samples were collected on Tuesdays during weeks 1-3 and 8-10. During Weeks 4, 5, 6, and 7, a second round of samples was collected on Thursdays from each of the five sites. 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 5-20
RPP Sampling Schedule, 2008

Date	Event
4/29/08	W1
5/6/08	W2
5/1308	W3
5/20/08	W4D1
5/22/08	W4D2
5/27/08	W5D1
5/29/08	W5D2
6/3/08	W6D1
6/05/08	W6D2
6/10/08	W7D1
6/12/08	W7D2
6/17/08	W8D1
6/24/08	W9
7/1/08	W10

Sample Collection, Delivery, and Analysis

Sample analysis is conducted by registrant laboratories, with additional samples collected and analyzed by a third-party laboratory. Kleinfelder collected water samples to detect whether water quality performance goals were being attained. Performance goals are established in the Basin Plan and additional conditions in CVRWQCB Resolution No. R5-2007-0018.

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.

Kleinfelder collected water samples from the five sites: one river and four drain sites, as shown on Figure 4-2. Kleinfelder collected the samples and submitted them directly to the analytical laboratories for thiobencarb and molinate analysis. Detailed maps of each station are included in Appendix A, and field sheets and COCs are included in Appendix C-1.

After each sampling event at the five sites, Kleinfelder split the samples and submitted the samples under chain-of-custody to the analytical laboratories. Thiobencarb analyses were performed by the registrant laboratory Valent Dublin Laboratory. Molinate analyses were performed by the registrant laboratory Syngenta Crop Protection, Inc. Environmental Micro Analysis (EMA), Inc. was used as a secondary laboratory for both thiobencarb and molinate analysis. Contact information for these laboratories is included in Chapter 4, and the results from the laboratories are included in Appendixes C-2 through C-4.

Results

The 2008 RPP water quality results and City results are summarized in Table 5-21. In 2008, there were two measured exceedances of thiobencarb and no measured exceedances of molinate performance goals or MCLs at the five primary monitoring locations and the City drinking water intakes. 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 5-21
Summary of Detections (RPP and City Monitoring), 2008

	Molinate			Thiobencarb		
Site	**Detections**	**Detections Greater than Performance Goal**	**Range of Detected Concentrations**	**Detections**	**Detections Greater than Performance Goal**	**Range of Detected Concentrations**
CBD5[a]	0	0	ND	10	0	ND—1.02 µg/L
BS1[a]	1	0	ND—1.73 µg/L	9	1	ND—1.99 µg/L
CBD1[a]	0	0	ND	10	1	ND—1.80 µg/L
SSB[a]	0	0	ND	7	0	ND—0.32 µg/L
SR1[a]	0	0	ND	1	0	ND—0.62 µg/L
SRR[b]	0	0	ND	0	0	ND
WSR[c]	2	0	ND—0.31 µg/L	0	0	ND
Totals	**3**	**0**	**–**	**37**	**2**	**–**

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

RPP Thiobencarb Results

During the 10 weeks of sampling, thiobencarb was observed a total of 37 times (includes City sampling). Two detections above the 1.5 µg/L performance goal were observed, one at CBD1 on May 22, and the other at BS1 on May 27. The highest measured concentration, which occurred at BS1 on May 27, 2008, was 1.99 µg/L, higher than last year's high concentration of 0.76 µg/L (CBD1, May 22, 2007). The average concentration (not including City data, and assuming non-detects are equivalent to zero) was 0.30 µg/L for the period of monitoring, higher than 2007's average of 0.09 µg/L. The two thiobencarb exceedances were determined to likely result from unusually high winds that may have caused growers to relieve pressure on the levees by releasing water from the fields, preventing the levees from failing, without seeking emergency release approvals. Growers will be reminded of emergency release requirements at grower meetings held in 2009, to reinforce the importance of CAC coordination in cases requiring emergency releases. Graphical results are shown in Figure 5-8, and tabulated results are shown in Table 5-22.

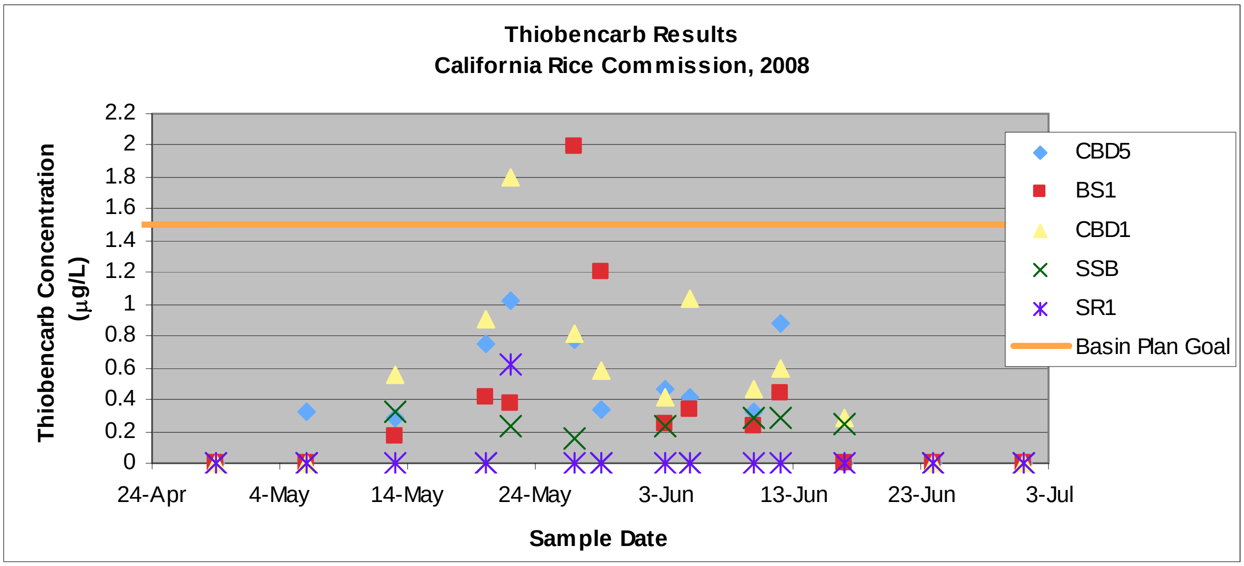


FIGURE 5-8
Thiobencarb Results, RPP, 2008
Non-detects are shown as zero (0) on the graph, and only the highest value of a reported duplicate sample is shown

TABLE 5-22
Thiobencarb Monitoring Results, RPP 2008

Sampling Dates	Concentration at each Monitoring Site µg/L (ppb)				
	CBD5	**BS1**	**CBD1**	**SSB**	**SR1**
April 29	ND	ND	ND	ND	ND
May 6	0.33	ND (Valent) ND (EMA)	ND	ND	ND
May 13	0.28	0.17	0.56	0.32	ND
May 20	0.75	0.41	0.90	ND	ND (Valent) ND (EMA)
May 22	1.02	0.38	1.80	0.23	0.62
May 27	0.78	1.99	0.81 (Valent) 0.80 (EMA)	0.16	ND
May 29	0.34	1.2	0.58	ND	ND
June 3	0.47	0.24	0.41	0.23	ND
June 5	0.42	0.34	1.04	ND (Valent) ND (EMA)	ND
June 10	0.32	0.23(Valent) ND (EMA)	0.47	0.28	ND
June 12	0.88	0.44	0.6	0.29	ND
June 17	ND	ND	0.28	0.24	ND
June 24	ND	ND	ND	ND	ND (Valent) ND (EMA)
July 1	ND (Valent) ND (EMA)	ND	ND	ND	ND

NOTES:
ND = not detected above laboratory reporting limits
If a sample was tested at the primary and secondary laboratories, each result is provided with the respective laboratory’s name
The Valent ND limit is <0.5 µg/L
The EMA ND limit is <0.5 µg/L
The Basin Plan performance goal for thiobencarb is 1.5 µg/L (ppb)

RPP Molinate Results

During the 10 weeks of sampling, molinate detections were far below the 10.0 µg/L water quality performance goal. The highest measured concentration, which occurred at BS1 on June 12, 2008, was 1.73 µg/L, similar to the high concentration in 2007 (BS1, May 22, 2007, 1.92 µg/L). The average concentration (assuming non-detects are equivalent to zero) was 0.02 µg/L for the period of monitoring, which was less than the 2007 average of 0.14 µg/L. Graphical results are shown in Figure 5-9, and tabulated results are shown in Table 5-23.

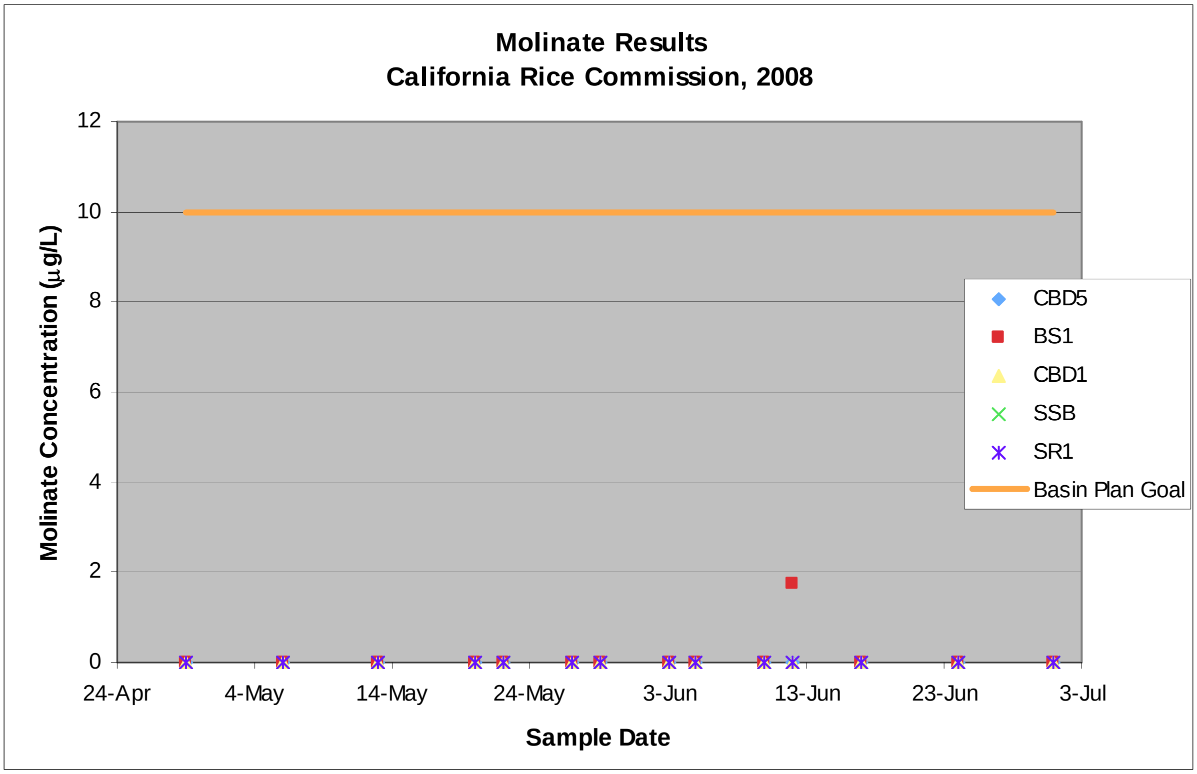


FIGURE 5-9
Molinate Results, RPP 2008
Non-detects are shown as zero (0) on the graph, and only the highest value of a reported duplicate sample is shown.

TABLE 5-23
Molinate Monitoring Results, RPP 2008

Sampling Dates	Concentration at each Monitoring Site µg/L (ppb)				
	CBD5	BS1	CBD1	SSB	SR1
April 29	ND	ND	ND	ND	ND
May 6	ND	ND (Syngenta) ND (EMA)	ND	ND	ND
May 13	ND	ND	ND	ND	ND
May 20	ND	ND	ND	ND	ND (Syngenta) ND (EMA)
May 22	ND	ND	ND	ND	ND
May 27	ND	ND	ND (Syngenta) ND (EMA)	ND	ND
May 29	ND	1.03	ND	ND	ND
June 3	ND	ND	ND	ND	ND
June 5	ND	1.13	ND	ND (Syngenta) ND (EMA)	ND
June 10	ND	ND (Syngenta) ND (EMA)	ND	ND	ND
June 12	ND	1.73	ND	ND	ND
June 17	ND	ND	ND	ND	ND
June 24	ND	ND	ND	ND	ND (Syngenta) ND (EMA)
July 1	ND (Syngenta) ND (EMA)	ND	ND	ND	ND

NOTES:
ND = not detected above laboratory reporting limits
If a sample was tested at the primary and secondary laboratories, each result is provided with the respective laboratory's name.
The Syngenta ND limit is <1.00 µg/L
The EMA ND limit is <0.5 µg/L
The Basin Plan performance goal for molinate is 10 µg/L (ppb)

City Intake Results

The City of Sacramento provided the CRC with analytical results for the 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, and approximately 0.3 kilometer downstream from the confluence with the American River in Sacramento County.

- **WRS:** 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 June 5, 2008. The intake results for thiobencarb and molinate, as provided to the CRC, are detailed in Table 5-24.

TABLE 5-24
Cities of Sacramento and West Sacramento Molinate and Thiobencarb Results, 2008

	Thiobencarb Concentration (µg/L)		Molinate Concentration (µg/L)		
Sample Date	WSR	SRR	WSR	SRR	Percent Sacramento River Water at SRR[a]
April 29, 2008	<0.10	<0.10	<0.10	<0.10	71.2
May 15, 2008	0.31	0.12	<10	<0.10	70.3
May 26, 2008	<0.10[b]	<0.10	<0.10[b]	<0.10	66.6
May 29, 2008	0.16	<0.10	<0.10	<0.10	64.2
June 5, 2008	<0.10	<0.10	<0.10	<0.10	82.8

NOTES:
[a] 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 River and the American River. 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
[b] Sample taken at Crawdad's Marina

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 and molinate continued to be low at SRR; in 2008, only one of the five SRR sampling events resulted in a detection, and that detection was below the RPP Basin Plan Performance Goals and the drinking water MCLs. These results demonstrate achievement of both the RPP Basin Plan Performance Goals and the drinking water MCLs.

WRS Results

WRS 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 WRS. Concentrations of thiobencarb and molinate continued to be low at the City of West Sacramento drinking water intake. Of the five sampling events in 2008, no molinate detections were measured, and two thiobencarb detections were measured. The highest measured concentration of thiobencarb was 0.31 µg/L on May 15, 2008. 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 dated November 3, 2004. QA/QC requirements for the RPP sampling are specified in a QAPP dated 2006. 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 EPA QA/R-5, "EPA Requirements for Quality Assurance Project Plans for Environmental Operations" (USEPA, 1998c); "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review" (USEPA, 2002); and EPA-540/R-94-012, "USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review" (USEPA, 1999).

Internal QC

Internal QC is achieved by collecting and analyzing a series of duplicate, blank, spike, and spike duplicate samples to check 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. The internal QC samples are described in the following sections.

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. Three types of quality control samples were collected in the field: rinse blanks, field duplicates, and matrix spikes.

Rinse Blanks

Rinse blanks were collected in the field and were analyzed with the environmental samples. Rinse blanks consist of distilled water processed through the sampling equipment using the same procedures used for environmental samples, after decontamination has been performed. Results from these blank samples are examined to ensure that concentrations of constituents of concern are below detection limits. If there are concentrations above the detection limit, then sampling and decontamination procedures will be reevaluated. Results from the rinse blanks represent a total of field and laboratory sources of contamination.

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.

Matrix Spikes and Matrix Spike Duplicates

Matrix spikes and matrix spike duplicate (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 the 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 QA/QC Samples

Laboratory QA/QC samples are prepared to ensure that the required level of laboratory accuracy is being achieved. Three types of quality control samples are used to determine laboratory accuracy: method blanks, laboratory control spikes (LCS), 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.

LCSs

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.

QA/QC Objectives

Quality assurance objectives (QAOs) are the detailed QC specifications for precision, accuracy, representativeness, comparability, and completeness. The group responsible for collecting data uses the QAOs as comparison criteria during data quality review to evaluate if 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.**
- The level of target compounds that are found (if any) in laboratory method blanks will be checked. If a target compound is found above the minimum 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. Since 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, since 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 are not 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. The QC parameters are as follows:

- Holding time
- 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

The 2008 QA/QC samples for the CWFR were collected during June (Irrigation Sampling Event 3), July (Irrigation Sampling Event 4), and September (Irrigation Event 6). The field CWFR QA/QC samples are shown in Table 6-1. In addition to the field QA/QC samples, analytical laboratories typically perform method blank, laboratory spike, and surrogate standard analyses with each event.

TABLE 6-1
Planned CWFR Field QA/QC Samples, 2008

Date	Event	QA/QC Sample Type(s)
6/3/2008	Irrigation Event 3	Rinse blank at CBD5 Duplicate at CBD5 MS/MSD at CBD5
7/1/2008	Irrigation Event 4	Rinse blank at CBD1 Duplicate at CBD1 MS/MSD at CBD1
9/16/2008	Irrigation Event 6	Rinse blank at CBD5 Duplicate at CBD5 MS/MSD at CBD5

Field QA/QC Samples

The 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 and analyzed for all of the pesticides identified in the algae management plan, and the additional "specified pesticides" (azoxystrobin, propiconazole, cyhalofop-butyl, and trifloxystrobin). The results for the rinse blanks were below the MRLs for all analytes (Table 6-2).

Field Duplicate

Field duplicate samples were collected and analyzed for all of the pesticides identified in the algae management plan and the additional "specified pesticides." The majority of the results for the duplicate samples and the corresponding primary samples were below the MRLs (Table 6-2). Levels of clomazone and triclopyr above the MRLs were found in the June primary and duplicate sample, levels of triclopyr above the MRL were found in the July primary and duplicate sample, and levels of azoxystrobin and triclopyr above the MRLs were found in the September primary and duplicate sample.

TABLE 6-2
Results for Primary and Duplicate Samples, 2008

Chemical	MRL (µg /L)	Irrigation Event 3 (June 3) at CBD5			Irrigation Event 4 (July 1) at CBD1			Irrigation Event 6 (September 16) at CBD5		
		Rinse	Duplicate	Primary	Rinse	Duplicate	Primary	Rinse	Duplicate	Primary
Bensulfuron-methyl	0.50	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carfentrazone	0.10	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cyhalofop-butyl	0.10	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trifloxystrobin	0.05	ND	ND	ND	ND	ND	ND	ND	ND	ND
Halosulfuron-methyl	0.10	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pendimethalin	0.20	ND	ND	ND	ND	ND	ND	ND	ND	ND
Propanil	0.05	ND	ND	ND	ND	ND	ND	ND	ND	ND
Clomazone	1.0	ND	1.33	1.13	ND	ND	ND	ND	ND	ND
Propiconazole	0.50	ND	ND	ND	ND	ND	ND	ND	ND	ND
Atrazine	0.10	ND	ND	ND	ND	ND	ND	ND	ND	ND
Azoxystrobin	0.50	ND	ND	ND	ND	ND	ND	ND	0.49*	0.53
Molinate	0.50	ND	ND	ND	ND	ND	ND	ND	ND	ND
Simazine	0.50	ND	ND	ND	ND	ND	ND	ND	ND	ND
Thiobencarb	0.50	ND	ND	ND	ND	ND	ND	ND	ND	ND
Triclopyr	0.05	ND	0.22	0.29	ND	3.60	3.35	ND	0.35	0.35
Bispyribac-sodium	0.50	ND	ND	ND	ND	ND	ND	ND	ND	ND
Penoxsulam	5.0	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diuron	0.50	ND	ND	ND	ND	ND	ND	ND	ND	ND
Glyphosate	10.0	ND	ND	ND	ND	ND	ND	ND	ND	ND

NOTE:
*Value below reporting limit—reported by lab via e-mail to confirm correlation with primary sample

MS/MSD

MS and MSD samples were spiked with several analytes and analyzed for those analytes. The results of the majority of the matrix (environmental) samples were below the MRL for these analytes (Table 6-3). A few of the matrix samples had a reported level of the spiked analyte above the MRL. For these samples, the level in the matrix sample was subtracted from the spikes by the lab technician; this adjusted value was used to determine the recovery value, as reported on the results from the lab. One of the RPDs from the June and July MS/MSD events was outside the acceptable range. This is a result of the spike and spike duplicate samples having dissimilar recovery levels. In June, the triclopyr recovery was outside the RPD. In July, the molinate recovery was outside the RPD. The September MS/MSD sample was within the acceptable range. A number of the spike and spike duplicate recovery percentages were outside the range for recovery limits. Those samples included the June triclopyr, clomazone, and bispyribac-sodium recoveries and the July clomazone and molinate recoveries. The spike recoveries for these events were all less than the acceptable range, with the exception of the June bispyribac-sodium recovery, which was greater than the acceptable range.

It is noted that EMA provided Corrective Action Reports for the June 4, 2008 and July 2, 2008 events to clarify the reported results from the initial reports. The Corrective Action Reports are provided in Appendix B-4, which includes the EMA results for the CWFR analysis.

Laboratory QA/QC Samples

The laboratory QA/QC samples included method blanks, LCS, 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 MRL (non-detect) for these analytes (Table 6-4).

LCS

LCS samples were analyzed for two sampling dates during the 2008 season: March 12, 2008, and July 1, 2008. The RPD percentages for all but one sample were within acceptable limits (Table 6-5). The sample that fell outside the acceptable limits for RPD was penoxsulam from the March 12, 2008 event.

Samples from both dates had analytes with recovery limits outside (above) the acceptable range. These included the triclopyr, alpha-BHC, penoxsulam, and diuron from the March 12, 2008 sampling event, and the bispyribac-sodium and the triclopyr from the July 1, 2008 sampling event.

Surrogate Standard

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

Analysis of Precision

Field duplicate samples were collected during the June, July, and September sampling 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.

An MS/MSD sample was collected for each matrix during the June, July, and September sampling events, and was analyzed for each primary analyte. Nearly all of the samples were within the RPD limits for all analytes. One analyte from both the June and July events was outside the RPD limits: triclopyr for the June event, and molinate for the July event. MS/MSD results and RPD values are presented in Table 6-3.

LCS samples were analyzed for two dates during the 2008 sampling season: March 12, 2008 and July 1, 2008. Nearly all samples from both dates were within the RPD limits for all analytes; only penoxsulam from the March event exceeded these limits. LCS sample results and RPD values are presented in Table 6-5.

Analysis of Accuracy

A rinse blank sample was collected during the June, July, and September sampling events and analyzed for each primary analyte. All rinse blank samples were found to have analyte levels below the MRLs. Rinse 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 method reporting limits. Method blank results are presented in Table 6-4.

MS/MSD samples were prepared for the June, July, and September sampling events and were evaluated for each of the spiked analytes. The majority of the samples were within the acceptable recovery limit. A few analytes from the June and July events had recovery percentages outside of the recovery limits. These samples included the triclopyr, clomazone, and penoxsulam spike recovery percentages from June (below the recovery limit), the bispyribac-sodium spike duplicate percent recovery from June (above the recovery limit), and the clomazone and molinate spike recovery percentage from July (below the recovery limit). MS/MSD results and recovery limits are presented in Table 6-3.

LCS samples were prepared for two sampling dates: March 12, 2008, and July 1, 2008. Many of the samples were within the acceptable recovery limit. Seven samples had results outside the acceptable range: the triclopyr spike and spike duplicate, alpha-BHC spike duplicate, penoxsulam spike, and diuron spike from the March 12, 2008 sampling event, and the bispyribac-sodium spike and triclopyr spike duplicate from the July 1, 2008 sampling event. LCS results and recovery limits are presented in Table 6-5.

Surrogate standards were evaluated with all analytical samples. Percent recovery for all samples was within the acceptable control limits. Surrogate standard results and recovery limits are presented in Table 6-6.

TABLE 6-3
MS/MSD Samples

Month	Sample Date	Sample Location	Analyte	Spike Level (μg/L)	Matrix Result (μg/L)	SPK Recovery (Percent)	DUP Recovery (Percent)	Recovery Limits	RPD (Percent)	RPD Limits
June	6/3/2008	CBD5	Triclopyr	5.0	0.29	**63.7**	115.4	75-120	**57.7**	35
			Clomazone	10.0	1.13	**65.7**	78.7	75-120	18.0	35
			Molinate	2.0	<0.50	76.3	92.3	75-120	19.0	35
			Azoxystrobin	10.0	<0.50	96.2	97.3	75-120	1.1	35
			Bispyribac-sodium	10.0	<0.50	109.9	**134.9**	75-120	20.4	35
			Penoxsulam	10.0	<5.0	**73.5**	80.3	75-120	8.8	35
July	7/1/2008	CBD1	Clomazone	10	<1.0	**70.4**	89.7	75-120	24.1	35
			Molinate	2	<0.50	**58.1**	91.7	75-120	**44.9**	35
			Azoxystrobin	10	<0.50	85.6	100.1	75-120	15.6	35
			Diuron	10.0	<0.50	95.1	114.9	75-120	18.9	35
			Penoxsulam	10.0	<5.0	105.7	107.0	75-120	1.2	35
September	9/16/2008	CBD5	Diuron	20	<0.50	97.6	108.9	75-120	10.9	35

NOTE:
Bold indicates values that do not meet acceptable recovery limits.

TABLE 6-4
Method Blank Results, CWFR 2008

Chemical	MRL (µg /L)	Date Sampled			
		3/12/2008	6/3/2008	7/1/2008	9/16/2008
Bensulfuron-methyl	0.50	ND	ND	ND	ND
Carfentrazone	0.10	ND	ND	ND	ND
Cyhalofop-butyl	0.10	ND	ND	ND	ND
Trifloxystrobin	0.05	ND	ND	ND	ND
Halosulfuron-methyl	0.10	ND	ND	ND	ND
Pendimethalin	0.20	ND	ND	ND	ND
Propanil	0.05	ND	ND	ND	ND
Clomazone	1.0	ND	ND	ND	ND
Propiconazole	0.50	ND	ND	ND	ND
Atrazine	0.10	ND	ND	ND	ND
Azoxystrobin	0.50	ND	ND	ND	ND
Molinate	0.50	ND	ND	ND	ND
Simazine	0.50	ND	ND	ND	ND
Thiobencarb	0.50	ND	ND	ND	ND
Triclopyr	0.05	ND	ND	ND	ND
Bispyribac-sodium	0.50	ND	ND	ND	ND
Penoxsulam	5.0	ND	ND	ND	ND
Diuron	0.50	ND	ND	ND	ND
Glyphosate	10.0	ND	ND	ND	ND

NOTE:
ND = Non-detect at specified method reporting limit (MRL)

TABLE 6-5
Lab Control Spikes (LCS)

Date Sampled	Analyte	Spike Level (μg /L)	SPK Recovery (Percent)	DUP Recovery Percent)	Recovery Limits	RPD (Percent)	RPD Limits
3/12/2008	Clomazone	50.0	79.9	77.9	75-120	2.5	35
	Propiconazole	50.0	83.7	91.8	75-120	9.2	35
	Simazine	50.0	103.3	111.4	75-120	7.5	35
	Triclopyr	5.0	**56.2**	**63.2**	75-120	11.7	35
	Bispyribac-sodium	10	89.8	97.0	75-120	7.7	35
	alpha-BHC	0.50	94.3	**72.3**	75-120	26.4	35
	Bensulfuron-methyl	10.0	96.3	109.8	75-120	13.1	35
	Cyhalofop-methyl	5.00	110.0	110.4	75-120	0.4	35
	Penoxsulam	5.00	**68.2**	113.5	75-120	**49.9**	35
	Diuron	10.0	**122.2**	104.6	75-120	15.5	35
7/1/2008	Bispyribac-sodium	10.0	**70.1**	77.4	75-120	9.9	35
	Triclopyr	5.00	121.6	**125.5**	75-120	3.2	35

NOTE:
Bold indicates values that do not meet acceptable recovery limits.

TABLE 6-6
Surrogate Standard Samples

		Surrogate Recovery Results (percent)		
Sample Date	**Sample Location**	**Dibutylchlordenate (DBC) (65-135)***	**Triphenylphosphate (65-135)***	**2,4-Dichlorophenylacetic acid (DCAA) (65-135)***
3/12/2008	JS	74.8	83.2	91.5
6/3/2008	BS1	80.2	95.0	73.2
	CBD5	77.9	98.6	115
	CBD5-RB	87.8	99.0	87.2
	CBD5-DUP	86.9	111	80.4
	CBD1	71.9	105	130
	SSB	76.8	91.0	93.8
7/1/2008	CBD1	79.4	128	97.0
	CBD1-RB	87.7	112	65.3
	CBD1-DUP	75.6	106	82.0
9/16/2008	BS1	87.9	96.0	92.6
	CBD5	91.7	99.3	102
	CBD5-RB	103	94.8	70.8
	CBD5-DUP	93.6	97.1	103
	SSB	89.3	102	126

NOTES:
Dibutylchlordenate (DBC) at 0.40 µg/L was the laboratory surrogate for EPA 8081.
Triphenylphosphate at 2.0 µg/L was the laboratory surrogate for EPA 8141.
2,4-Dichlorophenylacetic acid (DCAA) at 5.0 µg/L was the laboratory surrogate for EPA 8151. See Appendix B-4 for EMA results.
*Control limits

Analysis Summary

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

- Six of the MS/MSD analyses reported results outside of acceptable recovery limit range: the triclopyr, clomazone, and penoxsulam spike recovery in June; the bispyribac-sodium spike duplicate recovery in June; and the clomazone and molinate spike recovery percentages in July. In addition, two of the MS/MSD samples were outside of the RPD limits: the triclopyr in June and the molinate in July.
- Seven of the LCS analyses resulted in recovery limits outside of acceptable range. These events included: the triclopyr spike and spike duplicate, alpha-BHC spike duplicate, penoxsulam spike, and diuron spike from the March 12, 2008 sampling event, and the bispyribac-sodium spike and triclopyr spike duplicate from the July 1, 2008 sampling event. In addition, one of the LCS samples exceeded the RPD limit, the penoxsulam sample from March.

RPP QA/QC Sample Results and Analysis

As described in Chapter 5, RPP molinate samples are analyzed by the Syngenta Crop Protection, Inc. registrant laboratory, and thiobencarb samples are analyzed by the Valent Dublin Laboratory registrant laboratory. In addition, the CRC submits QA/QC samples to Environmental Micro Analysis Inc. (EMA) throughout the monitoring season.

At each sampling location, two sets of samples are taken. One set was sent to the analyte-specific laboratory (Syngenta or Valent), and the other set was sent to the EMA 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.

TABLE 6-7
Planned RPP QA/QC Samples, RPP 2008

Date	Event	QA/QC Sample Type
5/6/2008	W2D1	Duplicate at BS1
5/20/2008	W4D1	Duplicate at SR1
5/27/2008	W5D1	Duplicate at CBD1
5/29/2008	W5D2	Rinse blank at CBD5
6/05/2008	W6D2	Duplicate at SSB
		Blind spikes (except molinate)
6/10/2008	W7D1	Duplicate at BS1
6/122008	W7D2	Blind spikes
6/17/2008	W8D1	Rinse blank at SSB
		Blind spike—Molinate
6/24/2008	W9D1	Duplicate at SR1
7/01/2008	W10D1	Duplicate at CBD5

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 W5D2 and W8D1 sampling events. The results for all rinse blank samples were below the MDLs for thiobencarb and molinate (Table 6-8).

TABLE 6-8
Comparison of Rinse Blank Samples to Primary Samples, RPP 2008

Date	Sample Event	Monitoring Site	Sample Type	Thiobencarb (µg/L)	Molinate (µg/L)
5/29/2008	W5D2	CBD5	Primary*	0.34	<0.5
			Rinse*	<0.50	<0.50
6/17/2008	W8D1	SSB	Primary*	<0.50	<0.5
			Rinse*	<0.50	<0.50

NOTE:
*Primary thiobencarb samples analyzed at Valent laboratories, and primary molinate samples analyzed at Syngenta laboratories; rinse samples analyzed at EMA laboratories.

Field Duplicate

Field duplicate samples were collected nearly every week of the RPP sampling, with the exception of weeks 1, 3, 6, and 8 (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
Field Duplicate Samples, RPP 2008

Date	Sample Event	Monitoring Site	Sample Type	Thiobencarb (µg/L)	Molinate (µg/L)
5/6/2008	W2D1	BS1	Primary*	<0.5	<1.00
			Duplicate*	<0.5	<0.5
5/20/2008	W4D1	SR1	Primary*	<0.5	<1.00
			Duplicate*	<0.5	<0.5
5/27/2008	W5D1	CBD1	Primary*	0.81	<1.00
			Duplicate*	0.80	<0.5
6/05/2008	W6D2	SSB	Primary*	<0.5	<1.00
			Duplicate*	<0.5	<0.5
6/10/2008	W7D1	BS1	Primary*	0.23	<1.00
			Duplicate*	<0.5	<0.5
6/24/2008	W9D1	SR1	Primary*	<0.5	<1.00
			Duplicate*	<0.5	<0.5
7/01/2008	W10D1	CBD5	Primary*	<0.5	<1.00
			Duplicate*	<0.5	<0.5

NOTES:
*Duplicate samples analyzed at EMA laboratories, primary thiobencarb samples analyzed at Valent laboratories, and primary molinate samples analyzed at Syngenta laboratories.
EMA and Valent reporting limit is 0.5 µg/L
Syngenta reporting limit is 1.0 µg/L

Samples collected during W5D1 had a detectable level of thiobencarb; the results from the two different labs are remarkably similar. This shows good correlation between the two labs used for this analysis. Thiobencarb was again detected in the primary sample from W7D1; however, the detection was at a level below the method detection limit. No detection was reported for the duplicate sample from that event.

MS/MSD

Matrix (environmental) spike samples were collected during the W6D2, W7D2, and W8D1 sampling events. These samples were spiked by Kleinfelder and submitted to the laboratory with fictitious sample site identification. The samples were then analyzed for thiobencarb and molinate (Table 6-10).

TABLE 6-10
Matrix Spike Sample Results, RPP 2008

Date	Sample Event	Sample Location	Laboratory	Analyte	Spike Level (µg/L)	SPK Result (µg/L)	SPK Recovery (Percent)	Recovery Limits
6/5/08	W6D2	CRC1*	EMA	Thiobencarb	1.0	1.13	113	75–120
			EMA	Molinate	5	4.60	92	75–120
			Valent	Thiobencarb	1.0	0.00	**0**	75–120
			Syngenta	Molinate	5	NA	NA	75-120
6/12/08	W7D2	CRC1*	EMA	Thiobencarb	5.0	4.34	87	75–120
			EMA	Molinate	10	6.64	**66**	75–120
			Valent	Thiobencarb	5.0	4.9	98.6	75–120
			Syngenta	Molinate	10	10.9	109	75–120
6/17/2008	W8D1	CRC1*	Syngenta	Molinate	5	5.61	112	75-120

NOTES:
Bold indicates values that do not meet acceptable recovery limits.
EMA and Valent reporting limit = 0.5 µg/L.
Syngenta reporting limit = 1.0 µg/L.
*CRC1 is a fictitious sample location name given to the spike samples for laboratory analysis.
W6D2 Syngenta sample was accidently sent to the wrong lab. Another spike was collected on W8D1 to make up for the missed spike.

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.

Two samples had recovery percentages were outside of the acceptable range for recovery limits. Those samples included the Valent thiobencarb from the W6D2 event, and the EMA molinate from the W7D2 event; both resulted in percent recoveries below the acceptable recovery range. Because the recovery for the Valent thiobencarb spike from the W6D2 event was 0.00, it is suspected that there was a problem with the sample. Kleinfelder was contacted and their staff noted that the spike sample could have been mislabeled. Another sample from the W6D2 sampling event had a thiobencarb recovery of 1.04 µg/L (CBD1), which is very close to the level of the spike (1.0 µg/L). It is suspected that the samples were accidentally switched either in the field during labeling or at the lab. Because of this possibility, this sample will not be used for the analysis of precision and accuracy.

Laboratory QA/QC Samples

The laboratory QA/QC samples included method blanks, LCS, 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 EMA laboratory analysis. All samples had values below the MRLs for molinate and thiobencarb (Table 6-11).

TABLE 6-11
Method Blank Results (EMA), RPP 2008

Date	Event	Molinate (RL = 0.50)	Thiobencarb (RL = 0.50)
5/6/2008	W2D1	<0.50	<0.50
5/20/2008	W4D1	<0.50	<0.50
5/27/2008	W5D1	<0.50	<0.50
5/29/2008	W5D2	<0.50	<0.50
6/05/2008	W6D1	<0.50	<0.50
6/10/2008	W7D1	<0.50	<0.50
6/12/2008	W7D2	<0.50	<0.50
6/17/2008	W8D1	<0.50	<0.50
6/24/2008	W9D1	<0.50	<0.50
7/01/2008	W10D1	<0.50	<0.50

LCS

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 Tables 6-12, 6-13, and 6-14.

EMA Laboratories. LCS samples were analyzed at EMA laboratories for selected sampling events. The RPD percentages for all samples were within acceptable limits (Table 6-12); however, several samples had recovery limits outside the acceptable range. These samples included molinate from the W2D1 sampling event; molinate from the W6D2 event; molinate and thiobencarb from the W7D1, W7D2, and W8D1 event (samples were run in same batch, and therefore had the same LCS sample); and molinate from the W9D1 sample.

Valent Laboratories. LCSs 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 (Table 6-13).

Syngenta Laboratories. LCSs were spiked with molinate and analyzed at Syngenta laboratories for selected sampling events. The recovery limits for all samples were within acceptable limits (Table 6-14).

Surrogate Standard

Surrogate standard samples were prepared for analysis with the environmental samples. All sample results were within the required recovery limits (Table 6-15).

TABLE 6-12
LCS Sample Results (EMA), RPP 2008

Sample Event	Analyte	Spike Level (µg/L)	SPK Recovery (Percent)	DUP Recovery (Percent)	Recovery Limits	RPD (Percent)	RPD Limits
W2D1 5/6/2008	Molinate	5.0	**73.8**	**65.1**	75–120	12.5	35
	Thiobencarb	5.0	83.6	76.4	75–120	9.0	35
W6D2 6/5/2008	Molinate	5.0	82.0	**74.4**	75-120	9.7	35
	Thiobencarb	5.0	99.9	99.5	75-120	0.4	35
W7D1 6/10/2008	Molinate	5.0	**60.6**	**72.8**	75–120	18.3	35
	Thiobencarb	2.5	**73.3**	87.8	75–120	18.0	35
W7D2 6/12/2008	Molinate	5.0	**60.6**	**72.8**	75–120	18.3	35
	Thiobencarb	2.5	**73.3**	87.8	75–120	18.0	35
W8D1 6/17/2008	Molinate	5.0	**60.6**	**72.8**	75–120	18.3	35
	Thiobencarb	2.5	**73.3**	87.8	75–120	18.0	35
W9D1* 6/24/2008	Molinate	5.0	**67.3**	**70.7**	75–120	4.9	35
	Thiobencarb	5.0	109.6	107.8	75–120	1.7	35
W10D1 7/1/2008	Molinate	5.0	86.8	79.4	75–120	8.9	35
	Thiobencarb	5.0	108.0	106.7	75–120	1.2	35

NOTES:
Bold indicates values that do not meet acceptable recovery limits.
Samples from W7D1, W7D2, and W8D1 were all run in the same batch, and therefore had the same LCS.
*Surrogate recovery was found to be outside of laboratory control limits. No target compounds were found in the sample, so no corrective action was taken.

TABLE 6-13
Thiobencarb LCS Sample Results (Valent), RPP 2008

Analysis Date	Spike Level (µg/L)	SPK Result (µg/L)	DUP Result (µg/L)	SPK Recovery (Percent)	DUP Recovery (Percent)	Recovery Limits	RPD (Percent)	RPD Limits
5/6/2008	1.0	0.948	1.010	94.8	101.0	75–120	6.3	35
5/12/2008	1.0	0.995	0.988	99.5	98.8	75–120	0.7	35
5/19/2008	1.0	0.938	0.900	93.8	99.0	75–120	5.4	35
5/27/2008	1.0	1.018	1.027	101.8	102.7	75–120	0.9	35
6/2/2008	1.0	0.960	1.002	96.0	100.2	75–120	4.3	35
6/9/2008	1.0	1.014	1.037	101.4	103.7	75–120	2.2	35
6/10/2008	1.0	1.008	NA	100.8	NA	75–120	NA	35
6/16/2008	1.0	1.053	0.995	105.3	99.5	75–120	5.7	35
6/19/2008	1.0	0.997	0.984	99.7	98.4	75-120	1.3	35
6/25/2008	1.0	1.012	0.997	101.2	99.7	75-120	1.5	35
7/7/2008	1.0	1.003	0.999	100.3	99.9	75–120	0.4	35

TABLE 6-14
Molinate LCS Sample Results (Syngenta), RPP 2008

Analysis Date	Spike Level (µg/L)	SPK Recovery (Percent)	Recovery Limits
5/7/2008	1.0	101	75–120
5/12/2008	1.0	109	75–120
5/22/2008	1.0	110	75–120
5/29/2008	1.0	102	75–120
6/9/2008	1.0	104	75–120
6/11/2008	1.0	110	75–120
6/17/2008	1.0	106	75–120
6/19/2008	1.0	102	75–120
6/26/2008	1.0	107	75-120
7/14/2008	1.0	109	75-120
5/7/2008	5.0	103	75–120
5/12/2008	5.0	106	75–120
5/22/2008	5.0	112	75–120
5/29/2008	5.0	99.8	75–120
6/9/2008	5.0	107	75–120
6/11/2008	5.0	108	75–120
6/17/2008	5.0	106	75–120
6/19/2008	5.0	103	75-120
6/26/2008	5.0	110	75-120
7/14/2008	5.0	112	75–120

TABLE 6-15
Surrogate Standard Results (EMA), RPP 2008

		Surrogate Recovery Results (Percent) EMA Laboratories	
Sample Date	**Sample Location**	**Ethion (65–135)***	**Triphenylphosphate (65–135)***
5/6/2008	BS1	88.7	NA
5/20/2008	SR1	74.9	NA
5/27/2008	CBD1	74.1	NA
5/29/2008	CBD5	NA	123
6/5/2008	SSB	NA	92.3
6/5/2008	CRC1	NA	96.0
6/10/2008	BS1	NA	110
6/12/2008	CRC1	NA	106
6/17/2008	SSB	NA	117
6/24/2008	SR1	NA	104.9
7/01/2008	CBD5	NA	107

NOTES:
NA = not analyzed
Surrogate for thiobencarb and molinate for 5/6, 5/20, and 5/27 was Ethion at 1.0 μ/L.
Surrogate for molinate for the remaining dates was Triphenylphosphate at 2.0 μg/L.
*Control limits

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 or Syngenta, duplicate samples at EMA). While this prevents a direct comparison of results from within a site, it allows a comparison of laboratories.

A field duplicate sample was collected nearly every week of sampling, with the exception of weeks 1, 3, 6, and 8. 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.

Samples collected during W5D1 had a detectable level of thiobencarb; the results from the two different labs are remarkably similar. This shows good correlation between the two labs used for this analysis. Thiobencarb was again detected in the primary sample from W7D1; however, the detection was at a level below the method detection limit. No detection was reported for the duplicate sample from that event. Field duplicate results are presented in Table 6-9.

MS/MSD samples were analyzed for each matrix during the W6D2 and W7D2 sampling events and for molinate during the W8D1 sampling event. Although two samples for each analyte were taken at each event (with the exception of the W8D1 event), the samples were spiked and analyzed at different laboratories, making an RPD comparison inappropriate. MS results are presented in Table 6-10.

LCS samples were prepared at EMA for the W2D1, W6D1, W7D1, W7D2, W8D1, W9D1, and W10D1 sampling events. All samples from all dates were within RPD limits for both analytes. LCS sample results and RPD values are presented in Table 6-12.

LCS samples were analyzed at Valent for all analysis dates. All samples from all dates were within RPD limits for thiobencarb. LCS sample results and RPD values are presented in Table 6-13.

LCS samples were analyzed at Syngenta for all analysis dates. Duplicates were not run, so an RPD cannot be calculated for molinate samples from this lab. LCS sample results are presented in Table 6-14.

Analysis of Accuracy

Rinse blank samples were collected twice during the 2008 sampling season, at the W5D2 and W8D1 sampling events. All rinse blank samples were found to have analyte levels below the method reporting limits. 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 method reporting limits. Method blank results are presented in Table 6-11.

MS/MSD samples were prepared for the W6D2, W7D2, and W8D1 sampling events. The majority of the samples were within the acceptable recovery limits. The results from two samples fell outside the recovery limits; the Valent thiobencarb sample from W6D2 was zero, which is lower than acceptable limits. As mentioned previously, it is suspected that this sample was mislabeled, and should not be considered for MS/MSD analysis. The second sample outside of recovery limits was the EMA sample from W7D2, which had a 66.2 percent recovery. This recovery level is lower than the acceptable recovery limits. MS results and recovery limits are presented in Table 6-10.

LCS samples were prepared at EMA laboratories for seven sampling events; W2D1, W6D1, W7D1, W7D2, W8D1, W9D1, and W10D1. Several of these samples had recovery limits outside the acceptable range. These samples included molinate from the W2D1 and W6D2 sampling events; molinate and thiobencarb from the W7D1, W7D2, and W8D1 event (samples were run in the same batch, and therefore had the same LCS sample); and molinate from the W9D1 sample. LCS results and recovery limits are presented in Table 6-13.

LCS samples for all analysis dates were analyzed at Valent. All samples from all dates were within the acceptable recovery limits for thiobencarb. LCS sample results and recovery limit values are presented in Table 6-13.

LCS samples for all analysis dates were analyzed at Syngenta. All samples from all dates were within the acceptable recovery limits for molinate. LCS sample results and recovery limits values are presented in Table 6-14.

Surrogate standards were evaluated with the analytical samples at the EMA laboratory. All of the sample results were within the acceptable recovery limits. Surrogate standard results and recovery limits are presented in Table 6-15.

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 EMA provided an in-lieu MSD for the MS samples submitted to Valent and Syngenta.
- Two MS samples had results outside the acceptable recovery limits: the Valent thiobencarb from W6D2, and the EMA molinate from W7D2. The W6D2 sample was likely mislabeled, and should not be used for MS/MSD analysis.
- Several LCS samples had recovery limits outside the acceptable range. These samples included molinate from the W2D1, W6D2, and W9D1 sampling events, and molinate and thiobencarb from the W7D1, W7D2, and W8D1 sampling events (samples were run in the same batch, and therefore had the same LCS sample).

Chains of Custody

Chains of custody were utilized to document sample possession from the time of field sampling until the time of laboratory analysis. A chain-of-custody (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 Conclusions

This year was the fourth full year in which the CRC conducted water quality monitoring and reporting activities under the requirements of the CVRWQCB's *Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands*. The CRC also conducted monitoring and reporting activities under the requirements of the Rice Pesticides Program as required under the CVRWQCB Resolution No. R5-2007-0018.

During 2008, the CRC continued to invest significant effort and budget to comply with the requirements and intent of the CWFR's MRP and the RPP. Through this investment, the CRC has developed the capacity of its technical consultant resources and continues to refine its monitoring and reporting capabilities.

Summaries of the key successes and challenges faced during 2008 program implementation follow.

CWFR

Aquatic Toxicity Testing

In accordance with the MRP, acute and chronic toxicity tests were performed on three test species. Tests are performed on samples collected at each station and are performed concurrent with tests on control samples. The three test species are:

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

P. promelas Toxicity Testing

For all of the analyses conducted during Year 4, there was no statistically significant observed toxicity to fathead minnow, and no resampling was triggered. These results indicate that sampled waters were not toxic to fish species.

C. dubia Toxicity Testing

As with the fathead minnow, for all of the analyses conducted during Year 4, there was no statistically significant observed toxicity to the water flea, and no resamples were triggered. These results indicate that samples waters were not toxic to invertebrates.

Selenastrum Toxicity Testing

The MRP includes toxicity tests using the test species *Selenastrum capricornutum* to detect toxicity to aquatic plants. *Selenastrum* is a green algae species and is considered the most sensitive test species. Toxicity to *Selenastrum* can indicate a water quality concern.

In an effort to improve the effectiveness of the study plan in determining the causal agent contributing to the *Selenastrum* reductions, this monitoring season the CRC proposed to submit samples for herbicides and copper analysis concurrent with the initiation of the *Selenastrum* toxicity tests (in lieu of TIEs). This approach provided the benefit of including immediate analysis of original samples (the prior approach involved waiting for determination of toxicity prior to submitting samples for herbicide analysis). In addition, because previous TIEs had been unsuccessful in advancing the understanding of the causal agent beyond the determination of "short-lived non-polar organic herbicides," this approach was deemed more economical because it would provide up-front chemistry aimed at assessing specific herbicides and it would provide numeric results for detected pesticides.

In addition to the additional herbicide analysis, resampling is required at any site with an observed toxicity reduction of 50 percent or more (less than 50 percent survival as compared to the control).

The following summarizes the results of the algae toxicity testing.

March

- JS, the only site sampled in March, resulted in 92 percent growth as compared to the control. No statistically significant toxicity was observed, and no resamples were performed.

April

- All five sites were sampled in April, and statistically significant toxicity was observed at JS (52 percent growth as compared to control), CBD1 (77 percent), and SSB (69 percent). No resampling was triggered for this event.

May

- All five sites were sampled in May, and statistically significant toxicity was observed at all sites: JS (44 percent), BS1 (74 percent), CBD5 (50 percent), CBD1 (12 percent), and SSB (71 percent).
- Resampling was triggered at JS, CBD5, and CBD1, and was completed 16 days after the original sampling event. The results of the resampling showed greater than 100 percent growth at CBD5 and CBD1, and 98 percent growth at JS, indicating that that the previously observed toxicity did not persist.

June

- All five sites were sampled in June, and statistically significant toxicity was observed at two sites: JS (10 percent) and CBD5 (85 percent).
- Resampling was triggered at JS. Resampling was completed 9 days following the original sampling event. The result of the resampling yielded greater than 100 percent growth, indicating that the previously observed toxicity did not persist.

July

- All five sites were sampled in July, and all resulted in greater than 100 percent growth. Statistically significant toxicity was not observed; therefore, resampling was not necessary.

August

- All five sites were sampled in August, and only one site, JS (77 percent), had statistically significant toxicity. Resampling was not triggered for this event.

September

- All five sites were sampled in September, and no statistically significant toxicity was observed.

October

- All five sites were sampled in October, and no statistically significant toxicity was observed.

Comparison of Algae Toxicity with Copper Results

Lab results show that copper was present in all the samples; however, there was not a relationship between copper presence or concentration and algae toxicity. Copper levels at sites with significant toxicity varied, and sites with higher copper concentrations were not necessarily those with higher toxicity. This indicates that copper is not a factor in algae toxicity in these systems. All copper samples for the 2008 monitoring season fell below the copper criterion.

Algae Management Plan

An algae management plan was established in 2007 to facilitate additional pesticide testing. Samples were collected at predetermined locations during the March, June, July, and September monitoring events for pesticide analysis. Pesticide analysis was geared toward those pesticides commonly used on rice, but also included other pesticides not used on rice.

Events

Both the March event and June resample event (JS only) yielded non-detect (below the MRL) results for all pesticides tested. Each of the other events had at least one detect per sampling site. For the June event, the detects included propanil at BS1, clomazone at CBD5 and SSB, and triclopyr at CBD5 and CBD1. For the July event, detects included triclopyr at CBD1. For the September event, detects included azoxystrobin at BS1, CBD5, and SSB, and triclopyr at CBD5 and SSB; these detections are not attributable to rice because September falls outside the use season for these products. The most commonly reported pesticide was triclopyr, found above the MRL in five out of eight samples.

Algae Management Plan Pesticides and Algae Toxicity

Although concentrations of the targeted pesticides were found in several samples taken during the 2008 monitoring season, there was no relationship between pesticide presence and algae toxicity. None of the days with a pesticide concentration above the MRL were days where an algae toxicity resample was triggered, and only one sample with pesticides present had statistically significant toxicity. A more widespread monitoring of toxicity and pesticides may be necessary to fully determine whether there is a correlation between toxicity and the target algae management plan pesticides.

Propanil Testing: 2006 to 2008

Supplemental propanil testing was initiated in 2006 to determine whether propanil was contributing to algae toxicity. Testing continued in 2007 and 2008.

2006 Monitoring

In general, propanil levels were below 1.0 µg/L, with only three samples from 2006 above that mark. The CBD5 sample from June 20 was the highest, at 31.2 µg/L. The BS1 and CBD1 samples from the same sampling date were also above 1.0 µg/L, at 1.36 and 3.30 µg/L, respectively. Four out of the five sampling locations had their highest amounts of propanil during the June 20 sampling event.

2007 Monitoring

The majority of the 2007 samples had propanil levels below 1.0 µg/L, with only three samples above that mark. The CBD5 sample from June 5 was the highest, at 2.42 µg/L. The CBD1 sample from the same sampling date had a value above 1.0 µg/L, at 1.60 µg/L. The BS1 sample from the following week (June 12) had a value just above 1.0 µg/L, at 1.08 µg/L. Three out of the four sampling locations had their highest amounts of propanil during the June 5 sampling event.

2008 Monitoring

The majority of the 2008 samples had propanil levels below 1.0 µg/L, with only three samples above that mark. The SSB sample from June 22 was the highest, at 4.18 µg/L. Both the CBD5 and BS1 samples from June 17 had values above 1.0 µg/L, at 1.34 µg/L and 1.29 µg/L, respectively. Although both the CBD5 and SSB sampling locations had their highest values at the June 17 event, the July 15 event had the most propanil hits, with detects at four out of the five sampled locations.

Conclusions

In general, most of the locations sampled resulted in non-detect for propanil for the duration of the monitoring season. Most propanil hits were grouped during a 1- or 2-week period. During 2006, this period centered around the June 20 sampling event. In 2007, this period centered around the June 5 and 12 sampling events. During 2008, there were two periods of hits, during the June 17 and July 15 sampling events. In general, it appears that the highest levels of propanil occur during the second week of June through the end of June.

Field Parameters

pH

In 2008, there were no observations showing pH exceedances.

DO

There were two observations in 2008 that did not achieve the WARM WQO for DO, which is 5 mg/L:

- September at BS1
- July at CBD1

There were twenty observations in 2008 that did not achieve the COLD WQO for DO, which is 7 mg/L. In addition to the two occurrences below 5 mg/L, these occurred at the following times and sites:

- June, June resample, July, August, September, and October at JS
- June, July, August, and October at BS1
- July and August at CBD5
- May, May resample, June, August, and September at CBD1
- July sample at SSB

Assessment of the 2008 CWFR Program

This year represents the fourth full year of the CWFR program. The key successes and challenges faced during 2008 program implementation are summarized as follows:

- Management practices continued to be implemented, including water-holds, education and outreach (newsletters and grower meetings), 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.

- No new management practices were triggered as a result of the 2008 water quality monitoring results.

- Regularly scheduled sampling was conducted as required under the MRP. This sampling included analysis for field parameters (temperature, DO, pH, electrical conductivity/total dissolved solids, flow), specified pesticides, and toxicity (fathead minnow, water flea, and green algae).

- Low dissolved oxygen, particularly at the JS and CBD1 sites, was consistently measured. DO was consistently low at CBD1 in 2007 as well. Low DO was prevalent during the hot summer months. The CRC implemented DO monitoring in coordination with the UC Davis CALFED grant during 2007 in an effort to increase the understanding of rice discharges and the effects on DO.

- No fathead minnow toxicity was observed.

- No *C. daphnia* toxicity was observed.

- Based on the results of *Selenastrum* toxicity tests, resampling was triggered in May (JS, CBD5, and CBD1) and June (JS). None of the resamples showed statistically significant algae reductions.

- As required under the 2008 requirements as part of the algae management plan, additional herbicides and copper were analyzed for samples collected at JS in March, JS, BS1, CBD5, CBD1, and SSB in June, CBD1 in July, and BS1, CBD5, and SSB in September. The results of the pesticide analysis for the March and June JS samples were non-detect; all other samples had detections of pesticides. The most commonly detected pesticides were triclopyr and azoxystrobin. Results for all of the copper samples for the 2008 monitoring season fell below the copper criterion.

- Only one of the herbicide/copper samples coincided with a toxicity sample at which statistically significant reduction was observed (CBD5 sample, June event, 85 percent survival). Two pesticides were found in the sample from this event, clomazone (1.13 µg/L) and triclopyr (0.29 µg/L).
- The application of the tributary rule to drain sites may not be appropriate, though it is recognized that the protection of existing beneficial uses is an important part of water quality protection.
- 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.

CWFR Recommendations for 2008

- Chemistry analysis for rice herbicides and other herbicides used within the watershed should be continued at the initiation of the toxicity tests for select sites and months at which there is a likelihood of detecting algae toxicity. This may result in an ability to identify the toxicant contributing to *Selenastrum* toxicity. Coordination with the CACs to identify products used during specific months should continue in order to understand other (non-rice) products that may be contributing.
- Chronic concerns such as DO, pH, and algae toxicity should be monitored within the framework of a Management Plan.
- The field samplers should consider using blind naming conventions for spike, duplicate, and rinse blank samples. This would ensure that the laboratories are unaware of expected results.
- 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.

RPP

The RPP continues to be an example of an effective agricultural regulatory program. The RPP implements a monitoring schedule designed to focus sampling activities during the 10 weeks of peak pesticide use, and on high-use products that are regulated under the Basin Plan's Conditional Prohibition of Discharge. Further, the water holds and other management practices implemented by rice growers and the CRC continue to provide water quality protection.

There were two exceedances of the Basin Plan Performance Goals for thiobencarb during the 2008 sampling season. These exceedances were observed at CBD1 on May 22 1.80 µg/L), and at BS1 on May 27 (1.99 µg/L). No detections of molinate were observed at either the City of Sacramento Intake or the City of West Sacramento Intake. Three detections of thiobencarb were observed during the 2008 sampling season: one at the City of Sacramento Intake on May 15 (0.12 µg/L) and two at the West Sacramento Intake, on May 15 (0.31 µg/L) and May 29 (0.16 µg/L).

RPP Recommendations for 2008

It is recommended that the CRC continue to implement RPP water quality monitoring and reporting activities consistent with the program implemented during 2008 and approved through 2010.

CHAPTER 8

References

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