

**Draft**

# **Irrigated Lands Regulatory Program**

Program Environmental Impact Report

## **Executive Summary**

JULY 2010



PREPARED FOR:  
Central Valley Regional Water Quality Control Board  
11020 Sun Center Drive, Suite 200  
Rancho Cordova, CA 95670  
Contact: Adam Laputz



PREPARED BY:  
ICF International  
630 K Street, Suite 400  
Sacramento, CA 95814  
Contact: Mike Rushton or Megan Smith  
916.737.3000



**Linda S. Adams**  
Secretary for  
Environmental  
Protection

# California Regional Water Quality Control Board Central Valley Region

Katherine Hart, Chair

11020 Sun Center Drive, Suite 200, Rancho Cordova, California 95670-6114  
(916)464-3291 • Fax (916) 464-4645  
<http://www.waterboards.ca.gov/centralvalley>



**Arnold  
Schwarzenegger**  
Governor

## NOTICE OF AVAILABILITY

### Opportunity for Public Comment on Draft Program Environmental Impact Report for a Waste Discharge Regulatory Program for Irrigated Lands within the Central Valley Region

**NOTICE IS HEREBY GIVEN** that the California Regional Water Quality Control Board, Central Valley Region (Central Valley Water Board), as the lead agency, has released a Draft Program Environmental Impact Report (PEIR) for a waste discharge regulatory program for irrigated lands within the Central Valley Region. **The public review and comment period for the Draft PEIR is from July 28<sup>th</sup> until September 27<sup>th</sup>, 2010.** During the review period, the Central Valley Water Board will hold four public meetings to receive comments on the Draft PEIR.

#### Background

The Central Valley Water Board's Irrigated Lands Regulatory Program (ILRP) was initiated in 2003 with the adoption of the *Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands within the Central Valley Region* (Conditional Waiver). A revised Conditional Waiver was adopted in July 2006, and a workgroup assembled to develop alternatives to the ILRP for environmental analysis. Pursuant to the California Environmental Quality Act (CEQA), the Draft PEIR analyzes a full range of suggested alternatives to determine the potential environmental impacts of each.

The ILRP will involve the adoption of one or more general Waste Discharge Requirements (WDRs), Conditional Waivers of WDRs, and/or Prohibitions of Discharge to regulate the discharge of waste to ground and surface waters of the State from irrigated agricultural operations, managed wetlands, and nursery operations.

#### Significant Environmental Effects

The Draft PEIR evaluates and describes the potential environmental impacts associated with the ILRP, identifies those impacts that could be significant, and presents mitigation measures, which, if adopted by the Central Valley Water Board or other responsible agencies, could avoid or minimize these impacts. The Draft PEIR identifies significant and unavoidable impacts in the areas of climate change, from potential increase of greenhouse gas emissions; and agriculture resources, from potential loss of farmland due to increased regulatory costs. Based on information known to date, the Project site(s) are not listed toxic sites.

#### Document Availability

Hard copies of the Draft PEIR are available for review at the following locations:

|                                                                                           |                                                                       |                                                                                    |
|-------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Central Valley Water Board<br>415 Knollcrest Drive<br>Redding, CA 96002                   | CSU Chico, Meriam Library<br>400 West First Street<br>Chico, CA 95929 | CSU Bakersfield, Stiern Library<br>9001 Stockdale Highway<br>Bakersfield, CA 93311 |
| Central Valley Water Board<br>11020 Sun Center Drive, Ste 200<br>Rancho Cordova, CA 95670 | UC Davis, Shields Library<br>100 NW Quad<br>Davis, CA 95616           |                                                                                    |

|                                                                            |                                                               |  |
|----------------------------------------------------------------------------|---------------------------------------------------------------|--|
| Central Valley Water Board<br>1685 E Street, Suite 200<br>Fresno, CA 93706 | UC Merced Library<br>5200 North Lake Road<br>Merced, CA 95343 |  |
|----------------------------------------------------------------------------|---------------------------------------------------------------|--|

Electronic copies of the Draft PEIR can be downloaded in PDF format from the Central Valley Water Board website at: [http://www.swrcb.ca.gov/centralvalley/water\\_issues/irrigated\\_lands/long\\_term\\_program\\_development](http://www.swrcb.ca.gov/centralvalley/water_issues/irrigated_lands/long_term_program_development)

### Public Workshops

Four public workshops will be held to take comments on the Draft PEIR. One or more members of the Central Valley Water Board may be present at the workshops; however, no Board action will be taken. Meeting dates and locations are as follows:\*

|                                                                                                                                                                |                                                                                                                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| September 8, 5pm-8pm<br>Southern California Edison<br>Agricultural Technology Application Center<br>Learning Center<br>4175 S Laspina Street, Tulare, CA 93274 | September 9, 6pm-9pm<br>Stanislaus County Agricultural Center<br>Harvest Hall<br>3800 Cornucopia Way, Modesto, CA 95358 |
| September 10, 9:30am-12:30pm<br>Central Valley Regional Water Quality Control Board<br>11020 Sun Center Drive, Rancho Cordova, CA 95670                        | September 10, 5pm-8pm<br>Chico Holiday Inn and Conference Center<br>685 Manzanita Ct., Chico, CA 95926                  |

\*Individuals requiring special accommodations are requested to contact Adam Laputz, (916) 464-4848, at least five working days prior to the meeting. TTY users may contact the California Relay Service at (800) 735-2929 or voice line at (800) 735-2922.

### Submission of Comments

Public comments on the Draft PEIR must be received by September 27, 2010. Comments may be sent via mail, e-mail or fax (email comments are preferred) to:

|                                                                                     |                                                                                                |
|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| ILRP Comments<br>Ms. Megan Smith<br>630 K Street, Suite 400<br>Sacramento, CA 95814 | Email: <a href="mailto:ILRPcomments@icfi.com">ILRPcomments@icfi.com</a><br>FAX: (916) 456-6724 |
|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|

If you are interested in receiving future notices on the PEIR, you may sign up on the e-mail subscription list (check the box for Irrigated Lands Regulatory Program) at: [http://www.waterboards.ca.gov/resources/email\\_subscriptions/reg5\\_subscribe.shtml](http://www.waterboards.ca.gov/resources/email_subscriptions/reg5_subscribe.shtml), or call (916) 464-4611 to request to receive hard copy notices.

### Contact Information

If you have any questions regarding this notice, contact Adam Laputz at (916) 464-4848. For more information on this notice or the Draft PEIR, please visit the project website at: [http://www.swrcb.ca.gov/centralvalley/water\\_issues/irrigated\\_lands](http://www.swrcb.ca.gov/centralvalley/water_issues/irrigated_lands).

**DRAFT**

## **EXECUTIVE SUMMARY**

# **IRRIGATED LANDS REGULATORY PROGRAM PROGRAM ENVIRONMENTAL IMPACT REPORT**

**PREPARED FOR:**

Central Valley Regional Water Quality Control Board  
11020 Sun Center Drive, Suite 200  
Rancho Cordova, CA 95670  
Contact: Adam Laputz

**PREPARED BY:**

ICF International  
630 K Street, Suite 400  
Sacramento, CA 95814  
Contact: Mike Rushton or Megan Smith  
916.737.3000

**July 2010**





ICF International. 2010. *Executive Summary—Irrigated Lands Regulatory Program Program Environmental Impact Report*. Draft. July. (ICF 05508.05.) Sacramento, CA. Prepared for Central Valley Regional Water Quality Control Board, Sacramento, CA.

### 1.1 Introduction

Discharges from agricultural lands include irrigation return flow; flows from tile drains; and storm water runoff from fields, managed wetlands, nurseries, and water districts that accept agricultural discharges. These discharges can affect water quality by transporting constituents of concern including pesticides, sediment, nutrients, salts (including selenium and boron), pathogens, and heavy metals from cultivated fields into surface waters. Many surface water bodies are impaired because of pollutants from agricultural sources. Groundwater bodies also have suffered pesticide, nitrate, and salt contamination. Statewide, approximately 9,493 miles of rivers/streams and some 513,130 acres of lakes/reservoirs are listed on the Section 303(d) list as being impaired by irrigated agriculture. Of these, approximately 2,800 miles, or approximately 28 percent, have been identified as impaired by pesticides.

Since 1982, the Central Valley Regional Water Quality Control Board (Central Valley Water Board) has regulated nonpoint source (NPS) discharges from agricultural lands through a waiver of waste discharge requirements (WDRs). Senate Bill (SB) 390, signed into law on October 6, 1999, amended Section 13269 of the California Water Code (Water Code) to require the State Water Resources Control Board (State Water Board) and Regional Water Quality Control Boards (Regional Water Boards) to review their existing waivers and to renew them or replace them with WDRs. Under SB 390, waivers not reissued automatically expired on January 1, 2003. To comply with SB 390, the Regional Water Boards adopted revised waivers. To comply with the requirements of SB 390, the Central Valley Water Board adopted a Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands (Conditional Waiver).

Under the 2003 Conditional Waiver, the Central Valley Water Board directed staff to prepare an Environmental Impact Report (EIR) for a long-term Irrigated Lands Regulatory Program (ILRP). The 2003 Conditional Waiver expired in 2006, and a revised Conditional Waiver was adopted that continues the Conditional Waiver until June 2011. With adoption of the 2006 Conditional Waiver, the Central Valley Water Board reaffirmed its goal of analyzing the environmental effects of alternatives for a long-term ILRP through development and public review of a Program Environmental Impact Report (EIR or PEIR). This draft PEIR analyzes the environmental impacts of five program alternatives and will assist the Central Valley Water Board in determining which alternative, or elements of alternatives, would best meet applicable statutory requirements and the goals and objectives of the ILRP.

### 1.2 Overview of Central Valley Agriculture

The Central Valley is a large, flat, fertile valley that dominates the central portion of California. The northern half of the Central Valley is referred to as the Sacramento Valley, and the southern half is referred to as the San Joaquin Valley. The two halves meet at the shared delta of the Sacramento and San Joaquin Rivers, which flow through the northern and southern halves of the valley, respectively.

The Central Valley is one of the most productive agricultural regions in the world. Crops produced in the Central Valley include land planted to vineyard, row, pasture, field, and tree crops; commercial nurseries; nursery stock production; rice production; greenhouse operations; and livestock.

The program area encompasses the jurisdiction of the Central Valley Water Board, shown in Figure 2-1. The Central Valley Water Board's region stretches from the Oregon border to the northernmost tip of Los Angeles County. Three major watersheds have been delineated within this region: the Sacramento River Basin, the San Joaquin River Basin, and the Tulare Lake Basin. These three basins cover approximately 40 percent of the total area of the state and include approximately 75 percent of California's irrigated acreage (Central Valley Water Board 2002a). Much of the surface water supplies in the Central Valley originate north of the Sacramento–San Joaquin River Delta (Delta), while much of the water use is south of the Delta. Although the surface water in the Sacramento River Basin is adequate to meet the present level of demand, surface water supplies in the San Joaquin River and Tulare Lake Basins are inadequate to support the present level of agricultural and development use. In these basins, groundwater resources are being used to meet existing water supply demands.

## 1.3 Program Purpose and Objectives

The proposed goals and objectives of the ILRP are those recommended by the Stakeholder Advisory Workgroup (Workgroup) (Central Valley Water Board and ICF Jones & Stokes 2009). *Irrigated agricultural lands* include lands where water is applied to produce crops, fiber, or livestock for commercial sale or use. For the purposes of this draft PEIR, irrigated agricultural lands also include managed wetlands, nurseries, and water districts that accept discharges from irrigated lands. Understanding that irrigated agriculture in the Central Valley provides valuable food and fiber products to communities worldwide, the overall goals of the ILRP are to (1) restore and/or maintain the highest reasonable quality of state waters considering all the demands being placed on the water; (2) minimize waste discharge from irrigated agricultural lands that could degrade the quality of state waters; (3) maintain the economic viability of agriculture in California's Central Valley; and (4) ensure that irrigated agricultural discharges do not impair access by Central Valley communities and residents to safe and reliable drinking water. In accordance with these goals, the objectives of the ILRP are to:

- Restore and/or maintain appropriate beneficial uses established in Central Valley Water Board water quality control plans by ensuring that all state waters meet applicable water quality objectives.
- Encourage implementation of management practices that improve water quality in keeping with the first objective without jeopardizing the economic viability for all sizes of irrigated agricultural operations in the Central Valley or placing an undue burden on rural communities to provide safe drinking water.
- Provide incentives (i.e., financial assistance, monitoring reductions, certification, or technical help) for agricultural operations to minimize waste discharge to state waters from their operations.
- Coordinate with other Central Valley Water Board programs (e.g., the Grasslands Bypass Project WDRs for agricultural lands, efforts by the Westlands Water District to develop WDRs for

agricultural lands, development of total maximum daily loads [TMDLs] for Central Valley Salinity Alternatives for Long-Term Sustainability [CV-SALTS], and WDRs for dairies).

- Promote coordination with other regulatory and non-regulatory programs associated with agricultural operations to minimize duplicative regulatory oversight while ensuring program effectiveness (e.g., U.S. Department of Agriculture [USDA] National Organic Program, State Water Board Groundwater Ambient Monitoring and Assessment Program).

## 1.4 Program Description

The alternatives analyzed in this draft PEIR are the result of an intensive workgroup process described in Chapter 2, Introduction. The Central Valley Water Board intends to consider the analysis in this draft PEIR in selecting a preferred alternative, either one considered in this document directly or a staff-recommended program comprised of elements from multiple considered alternatives. Therefore, the document does not identify a “preferred alternative.” All alternatives selected for analysis are analyzed to an equal level of detail. The alternatives are described in greater detail in Chapter 3.

### 1.4.1 Alternative 1 – Full Implementation of Current Program (No Project Alternative)

Under Alternative 1, the Central Valley Water Board would renew the current program and continue to implement it into the future. This would be considered the “No Project” Alternative per California Environmental Quality Act (CEQA) guidance at Title 14 California Code of Regulations (CCR) Section 15126.6(e)(3)(A): “When the project is the revision of an existing land use or regulatory plan, policy or ongoing operation, the ‘No Project’ Alternative will be the continuation of the existing plan, policy, or operation into the future.” Given the ministerial nature of the extension or renewal of the ongoing waiver, which would allow continuation of the existing program, Alternative 1 is best characterized as the “No Project” Alternative. This approach best serves the purpose of allowing the Central Valley Water Board to compare the impacts of revising the ILRP with those of continuing the existing program (14 CCR Section 15126.6[e][1]).<sup>1</sup>

Coalition groups would continue to function as lead entities representing growers (owners of irrigated lands, wetland managers, nursery owners, and water districts). This alternative is based on continuing watershed monitoring to determine whether operations are causing water quality problems. Where monitoring indicates a problem, third-party groups and growers would be required to implement management practices to address the problem and work toward compliance with applicable water quality standards. This alternative would not establish any new Central Valley Water Board requirements for discharges to groundwater from irrigated agricultural lands.

Under this alternative, the Central Valley Water Board would renew the current program through WDRs or a waiver of the WDRs. Water quality coalition groups have formed throughout the Central Valley to function as representative or “lead” entities in administration of the current ILRP.

---

<sup>1</sup> The existing environmental setting, not the “No Project” Alternative, constitutes the baseline for determining whether a project’s environmental impacts may be significant (14 CCR Section 15126.5[e][1]). Therefore, defining the “No Project” Alternative as continuing the existing program does not change the analysis of the environmental impacts under the remaining alternatives.



Coalitions represent growers, provide education, organize monitoring, and work with the Central Valley Water Board to help ensure that the current program is effectively implemented. These third-party water quality coalition groups would continue to function as lead entities for their members to ensure that all Central Valley Water Board requirements are met.

Monitoring under this alternative would be the same as the watershed-based assessment and core monitoring required under the current ILRP. Under this monitoring scheme, coalition groups would work with the Central Valley Water Board to develop monitoring plans for Central Valley Water Board approval. These plans would specify monitoring parameters and site locations.

## **1.4.2 Alternative 2 – Third-Party Lead Entity**

Under Alternative 2, the Central Valley Water Board would develop a single mechanism or a series of regulatory mechanisms for waste discharge from irrigated agricultural lands to groundwater and surface water. The series of regulatory mechanisms would be designed to provide flexibility in establishing requirements for growers considering the variety of environmental conditions and agricultural operations throughout the Central Valley. These could include WDRs, conditional waivers of WDRs, or conditional prohibitions of discharge.

Under Alternative 2, third-party groups (e.g., water quality coalitions) would function as lead entities representing growers. Regulation of discharges to surface water would be similar to Alternative 1 (the current ILRP). However, this alternative allows for a reduction in monitoring under lower threat circumstances and where watershed or area management objective plans are being developed. This alternative also includes requirements for development of groundwater quality management plans (GQMPs) to minimize discharge of waste to groundwater from irrigated lands. However, GQMPs under this alternative would not involve monitoring of groundwater to determine the performance of these management plans. These GQMPs would be reviewed every 5 years by the Central Valley Water Board and the third-party groups to determine whether and how the GQMPs should be updated. This alternative also relies on coordination with the California Department of Pesticide Regulation (DPR) for regulating discharges of pesticides to groundwater.

Under this alternative, water quality coalitions or other third-party groups would be responsible for general administration of the ILRP and would need to agree to assume greater responsibilities than under Alternative 1. (See Chapter 3 for a detailed list of these responsibilities.)

Third-party groups would have the option of developing a watershed or area management objectives plan. The goal of this plan would be to meet source control management objectives that would reduce the threat to surface water quality from waste discharge associated with irrigated agriculture. In areas implementing a Central Valley Water Board-approved watershed or area management objectives plan, surface water monitoring would be reduced. Plans would specify optional water quality management practices that could be implemented to achieve plan objectives. Further, the plan would be developed consistent with the area or watershed commodity types, common agricultural practices, pesticides commonly used, and local land characteristics. Optional practices would be provided to allow growers to adapt to their specific conditions for compliance with the ILRP. The plan also would consider the results of previous water quality sampling.

Growers would be required to track implemented management practices and submit the results to the third-party group. The third-party group would report summary results to the Central Valley Water Board. The third-party group would be required to summarize the results of groundwater

and surface water monitoring and tracking in an annual monitoring report to the Central Valley Water Board.

### **1.4.3 Alternative 3 – Individual Farm Water Quality Management Plan**

Under Alternative 3, growers would have the option of working directly with the Central Valley Water Board or another implementing entity (e.g., county agricultural commissioners [CACs]) in development of a farm water quality management plan (FWQMP). Growers would individually apply for a conditional waiver or WDRs that would require Central Valley Water Board approval of their FWQMP.

On-farm implementation of effective water quality management practices would be the mechanism to reduce or eliminate waste discharged to state waters. This alternative would provide incentive for individual growers to participate by providing growers with Central Valley Water Board certification that they are implementing farm management practices to protect state waters. This alternative relies on coordination with DPR for regulating discharges of pesticides to groundwater.

Under Alternative 3, growers would be the lead entities working directly with the Central Valley Water Board and would be responsible for applying for coverage, developing FWQMPs, and conducting any required reporting.

Unless specifically required in response to water quality problems, owners/operators would not be required to conduct water quality monitoring of adjacent receiving waters or underlying groundwater. Required monitoring would include evaluation of management practice effectiveness. The Central Valley Water Board, or a designated third-party entity, would conduct annual site inspections on a selected number of operations. They also would review available applicable water quality monitoring data as additional means of monitoring the implementation of management practices and program effectiveness.

### **1.4.4 Alternative 4 – Direct Oversight with Regional Monitoring**

Under this alternative, the Central Valley Water Board would develop WDRs and/or a conditional waiver of WDRs for waste discharge from irrigated agricultural lands to groundwater and surface water. As in Alternative 3, growers, or legal entities responsible for waste discharges by a group of growers, would apply directly to the Central Valley Water Board in order to obtain coverage (“direct oversight”). As in Alternative 3, growers would be required to develop and implement individual FWQMPs in order to minimize discharge of waste to groundwater and surface water from irrigated agricultural lands. However, Alternative 4 would include an option for regional monitoring run by a third party instead of monitoring conducted by individual growers.

Discharge of waste to groundwater and surface water would be regulated using a tiered approach. Fields would be placed in one of three tiers based on their threat to water quality. The tiers represent fields with minimal (Tier 1), low (Tier 2), and high (Tier 3) potential threat to water quality. Requirements to avoid or minimize discharge of waste would be the least stringent for Tier 1 fields and the most stringent for Tier 3 fields. This would allow for less regulatory oversight for low-threat operations while establishing necessary requirements to protect water quality from

higher-threat discharges. This alternative relies on coordination with DPR for regulating discharges of pesticides to groundwater.

Growers would be lead entities working directly with the Central Valley Water Board; they would be responsible for applying for coverage, developing FWQMPs, and conducting any required monitoring and reporting. This alternative would allow for formation of responsible legal entities that could serve a group of growers who discharge to the same general location and thus could share monitoring locations. In such cases, the legal entity would be required to assume responsibility for the waste discharges of member growers, to be approved by the Central Valley Water Board, and ultimately to be responsible for compliance with ILRP requirements.

For monitoring, growers would have the option of enrolling in a third-party group regional monitoring program instead of conducting individual monitoring. In cases where responsible legal entities were formed, these entities would be responsible for conducting monitoring. All growers would be required to track nutrient, pesticide, and implemented management practices and submit the results to the Central Valley Water Board (or an approved third-party monitoring group) annually. Other monitoring requirements would depend on designation of the fields as Tier 1, Tier 2, or Tier 3. (See Chapter 3 for a full description of this alternative.)

## **1.4.5 Alternative 5 – Direct Oversight with Farm Monitoring**

Alternative 5 would consist of general WDRs designed to protect groundwater and surface water from discharges associated with irrigated agriculture.

All growers would be required to apply for and obtain coverage under the general WDRs. This alternative would include requirements to (1) develop and implement a FWQMP; (2) monitor (a) discharges of tailwater, drainage water, and storm water to surface water; (b) applications of irrigation water, nutrients, and pesticides; and (c) groundwater; (3) keep records of (a) irrigation water; (b) pesticide applications; and (c) the nutrients applied, harvested, and moved off the site; and (4) submit an annual monitoring report to the Central Valley Water Board.

Alternative 5 relies on coordination with DPR for regulating discharges of pesticides to groundwater. The Central Valley Water Board would develop general WDRs for irrigated agriculture. Growers would be the lead entity in working with the Central Valley Water Board. The Central Valley Water Board would adopt the WDRs, enroll individual growers under the program, provide regulatory oversight, and enforce the requirements of the program.

Each grower would be required to monitor tailwater discharges, storm water discharges, and drainage system discharges. In addition, each grower would be required to conduct nutrient and pesticide tracking as well as groundwater monitoring.

## **1.5 CEQA Process**

### **1.5.1 Purpose of This Draft PEIR**

The Lead Agency, the Central Valley Water Board, will consult this draft PEIR in determining which alternative, or elements of alternatives, would best meet applicable statutory requirements and the goals and objectives of the ILRP.

## 1.5.2 Public Outreach

As the ILRP has been developed, the Central Valley Water Board has sought public input on many occasions, as described at length in Chapter 2, Introduction. Public comment on this draft PEIR has been requested through a scoping process described below and is again invited during the public comment period.

### Notice of Preparation

The Central Valley Water Board released a Notice of Preparation (NOP) on February 14, 2003.

### Scoping

On March 5 and 6, 2003, CEQA scoping meetings were held in Fresno and Sacramento to solicit and receive public comment on the scope of the EIR as described in the NOP. Following the scoping meetings, the Central Valley Water Board began preparation of the draft *Existing Conditions Report* (ECR) in 2004 to assist in defining the baseline condition for the EIR's environmental analyses. The draft ECR was circulated in 2006, public comment on the document was received and incorporated, and it was released in 2008 (ICF Jones & Stokes 2008).

In March and April 2008, the Central Valley Water Board staff conducted [another series of CEQA scoping meetings](#) to generate recommendations on the scope and goals of the long-term ILRP. Information also was gathered as to how stakeholders would like to be involved in development of the long-term program. Stakeholders indicated in these scoping meetings that they would like to be actively involved in developing the program. To address this interest, the Central Valley Water Board initiated a series of Workgroup meetings, described below.

## 1.5.3 Scope of Draft PEIR Analysis

All CEQA-recognized environmental resources were analyzed for possible environmental impacts resulting from the ILRP alternatives. The alternatives were determined to have possible significant effects on several resource areas, which are discussed at length in Chapter 5. Likewise, the alternatives were determined to have no significant impact on other resources, which are discussed in Section 5.11, Minimally Impacted Resources.

### Resources with Potentially Significant Impacts

The Central Valley Water Board determined that the program could result in potentially significant impacts on the following resources, which thus warrant close scrutiny:

- Cultural resources
- Noise
- Air quality
- Climate change
- Vegetation and wildlife
- Fisheries
- Hydrology and water quality

- Agriculture resources

## Resources Not Significantly Impacted

The Central Valley Water Board has determined that the program will result in no or less-than-significant direct impacts and no indirect impacts on the following resources, which thus do not warrant close scrutiny:

- Aesthetics
- Geology and soils
- Hazards and hazardous materials
- Land use and planning
- Mineral resources and energy
- Population and housing
- Public services
- Recreation
- Transportation and circulation
- Utilities and service systems

## Known Areas of Controversy

In accordance with State CEQA Guidelines Section 15123(b)(2), the areas of controversy known to the lead agency, including issues raised by agencies and the public, shall be identified in the EIR. Through public scoping, the efforts of the Workgroup, and other outreach efforts, the following areas of controversy were identified:

- The costs to growers of implementing a more stringent ILRP will be prohibitive and suppress the economic sustainability or growth of agriculture.
- Adding a groundwater monitoring element to the ILRP would be unnecessarily duplicative of existing monitoring efforts.
- The alternatives do not contain a clear methodology for defining a groundwater discharger or determining the nature of discharges to groundwater.
- The program does not take adequate steps to offset the costs to rural communities for cleanup of existing water quality impairments that can be linked back to historical agricultural discharges.



### **1.5.4 Public Comment on the Draft PEIR**

This draft PEIR was made available for public review and comment on July 28, 2010. In addition, the Central Valley Water Board will conduct public hearings on the draft document. Comments received at the hearings or received in written form will be considered in development of a final PEIR.

Comments may be sent to:

ILRP Comments

Ms. Megan Smith

630 K Street, Suite 400

Sacramento, CA 95814

Email: [ILRPcomments@icfi.com](mailto:ILRPcomments@icfi.com)

Fax: (916) 456-6724

## 1.6 Summary of Program Environmental Impacts and Mitigation

Table 1-1 provides a summary of the potential impacts and mitigation measures for the ILRP.

**Table 1-1. Summary of Impacts and Mitigation Measures for the Irrigated Lands Regulatory Program**

| <b>Impact</b>                                                                                                               | <b>Applicable Alternative</b> | <b>Significance before Mitigation</b> | <b>Mitigation Measures</b>                                                                                                | <b>Significance after Mitigation</b> |
|-----------------------------------------------------------------------------------------------------------------------------|-------------------------------|---------------------------------------|---------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| <b>CULTURAL RESOURCES</b>                                                                                                   |                               |                                       |                                                                                                                           |                                      |
| CUL-1. Physical Destruction, Alteration, or Damage of Cultural Resources from Implementation of Management Practices        | 1, 2, 3, 4, 5                 | Significant                           | CUL-MM-1: Avoid Impacts to Cultural Resources                                                                             | Less than significant                |
| CUL-2. Potential Damage to Cultural Resources from Construction Activities and Installation of Groundwater Monitoring Wells | 5                             | Significant                           | CUL-MM-1: Avoid Impacts to Cultural Resources                                                                             | Less than significant                |
| <b>NOISE</b>                                                                                                                |                               |                                       |                                                                                                                           |                                      |
| NOI-1. Exposure of Sensitive Land Uses to Noise from Construction Activities in Excess of Applicable Standards              | 1, 2, 3, 4, 5                 | Potentially significant               | NOI-MM-1: Implement Noise-Reducing Construction Practices                                                                 | Less than significant                |
| NOI-2. Exposure of Sensitive Land Uses to Noise from Operational Activities in Excess of Applicable Standards               | 1, 2, 3, 4, 5                 | Potentially significant               | NOI-MM-1: Implement Noise-Reducing Construction Practices<br>NOI-MM-2: Reduce Noise Generated by Individual Well Pumps    | Less than significant                |
| <b>AIR QUALITY</b>                                                                                                          |                               |                                       |                                                                                                                           |                                      |
| AQ-1. Generation of Construction Emissions in Excess of Local Air District Thresholds                                       | 1, 2, 3, 4, 5                 | Potentially significant               | AQ-MM-1: Apply Applicable Air District Mitigation Measures to Reduce Construction Emissions below the District Thresholds | Less than significant                |
| AQ-2. Generation of Operational Emissions in Excess of Local Air District Thresholds                                        | 1, 2, 3, 4, 5                 | Potentially significant               | AQ-MM-2: Apply Applicable Air District Mitigation Measures to Reduce Operational Emissions below the District Thresholds  | Less than significant                |

| Impact                                                                                                                                               | Applicable Alternative | Significance before Mitigation | Mitigation Measures                                                                                                                                                                                                                                                                                                                             | Significance after Mitigation |
|------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| AQ-3. Elevated Health Risks from Exposure of Nearby Sensitive Receptors to TACs/HAPs                                                                 | 1, 2, 3, 4, 5          | Potentially significant        | AQ-MM-1: Apply Applicable Air District Mitigation Measures to Reduce Construction Emissions below the District Thresholds<br>AQ-MM-2: Apply Applicable Air District Mitigation Measures to Reduce Operational Emissions below the District Thresholds<br>AQ-MM-3: Apply Applicable Air District Mitigation Measures to Reduce TAC/HAP Emissions | Less than significant         |
| <b>CLIMATE CHANGE</b>                                                                                                                                |                        |                                |                                                                                                                                                                                                                                                                                                                                                 |                               |
| CC-1. Generation of Greenhouse Gas Emissions Resulting in Global Climate Change                                                                      | 1, 2, 3, 4, 5          | Less than significant          | No mitigation is required.<br>CC-MM-1: Apply Applicable Air District Mitigation Measures to Reduce Construction and Operational GHG Emissions (recommended)<br>CC-MM-2: Apply Applicable California Attorney General Mitigation Measures to Reduce Construction and Operational GHG Emissions (recommended)                                     | –                             |
| <b>VEGETATION AND WILDLIFE</b>                                                                                                                       |                        |                                |                                                                                                                                                                                                                                                                                                                                                 |                               |
| BIO-1. Loss of Downstream Habitat from Reduced Field Runoff                                                                                          | 1, 2, 3, 4, 5          | Potentially significant        | BIO-MM-2: Determine Extent of Wetland Loss and Compensate for Permanent Loss of Wetlands                                                                                                                                                                                                                                                        | Less than significant         |
| BIO-2. Improved Water Quality in Natural Communities Adjacent to Agricultural Lands and Managed Wetlands                                             | 1, 2, 3, 4, 5          | Beneficial                     | No mitigation is required.                                                                                                                                                                                                                                                                                                                      | –                             |
| BIO-3. Potential Loss of Sensitive Natural Communities and Special-Status Plants from Construction Activities                                        | 1, 2, 3, 4, 5          | Potentially significant        | BIO-MM-1: Avoid and Minimize Impacts on Sensitive Biological Resources                                                                                                                                                                                                                                                                          | Less than significant         |
| BIO-4. Potential Loss of Wetland Communities due to Loss of Existing Sedimentation Ponds                                                             | 2, 3, 4, 5             | Potentially significant        | BIO-MM-2: Determine Extent of Wetland Loss and Compensate for Permanent Loss of Wetlands                                                                                                                                                                                                                                                        | Less than significant         |
| BIO-5. Impacts to Special-Status Wildlife Species due to Loss of Existing Sedimentation Ponds                                                        | 2, 3, 4, 5             | Potentially significant        | BIO-MM-1: Avoid and Minimize Impacts on Sensitive Biological Resources                                                                                                                                                                                                                                                                          | Less than significant         |
| BIO-6. Loss of Sensitive Natural Communities and Special-Status Plants from Construction Activities and Installation of Groundwater Monitoring Wells | 5                      | Potentially significant        | BIO-MM-1: Avoid and Minimize Impacts on Sensitive Biological Resources                                                                                                                                                                                                                                                                          | Less than significant         |

| <b>Impact</b>                                                                                                                                    | <b>Applicable Alternative</b> | <b>Significance before Mitigation</b> | <b>Mitigation Measures</b>                                                    | <b>Significance after Mitigation</b> |
|--------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|---------------------------------------|-------------------------------------------------------------------------------|--------------------------------------|
| BIO-7. Loss of Special-Status Wildlife from Construction Activities and Installation of Groundwater Monitoring Wells                             | 5                             | Potentially significant               | BIO-MM-1: Avoid and Minimize Impacts on Sensitive Biological Resources        | Less than significant                |
| <b>FISHERIES</b>                                                                                                                                 |                               |                                       |                                                                               |                                      |
| FISH-1. Improvement to Surface Water Quality in Water Bodies Receiving Inputs from Agricultural Lands and Managed Wetlands                       | 1, 2, 3, 4, 5                 | Beneficial                            | No mitigation is required.                                                    | –                                    |
| FISH-2. Temporary Loss or Alteration of Fish Habitat during Construction of Facilities for Management Practices                                  | 1, 2, 3, 4, 5                 | Potentially significant               | FISH-MM-1: Avoid and Minimize Impacts to Fish and Fish Habitat                | Less than significant                |
| FISH-3. Permanent Loss or Alteration of Fish Habitat during Construction of Facilities for Management Practices                                  | 1, 2, 3, 4, 5                 | Potentially significant               | FISH-MM-2: Educate Growers on the Use of Polyacrylamides for Sediment Control | Less than significant                |
| FISH-4. Toxicity to Fish or Fish Prey from Particle-Coagulant Water Additives                                                                    | 1, 2, 3, 4, 5                 | Potentially significant               | FISH-MM-2: Educate Growers on the Use of Polyacrylamides for Sediment Control | Less than significant                |
| FISH-5. Temporary Loss or Alteration of Fish Habitat during Wellhead Protection Construction Required by Groundwater Quality Management Plans    | 2, 3, 4, 5                    | Less than significant                 | No mitigation is required.                                                    | –                                    |
| FISH-6. Temporary Loss or Alteration of Fish Habitat during Construction of Facilities for Management Practices and Groundwater Monitoring Wells | 5                             | Potentially significant               | FISH-MM-1: Avoid and Minimize Impacts to Fish and Fish Habitat                | Less than significant                |
| FISH-7. Permanent Loss or Alteration of Fish Habitat during Construction of Facilities for Management Practices and Groundwater Monitoring Wells | 5                             | Potentially significant               | FISH-MM-1: Avoid and Minimize Impacts to Fish and Fish Habitat                | Less than significant                |
| <b>HYDROLOGY AND WATER QUALITY</b>                                                                                                               |                               |                                       |                                                                               |                                      |
| SWQ = surface water quality                                                                                                                      |                               |                                       |                                                                               |                                      |
| HWQ = groundwater quality                                                                                                                        |                               |                                       |                                                                               |                                      |

| <b>Impact</b>                                                                                                                       | <b>Applicable Alternative</b> | <b>Significance before Mitigation</b>           | <b>Mitigation Measures</b>                                                                                                                                  | <b>Significance after Mitigation</b> |
|-------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|-------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| HYD-1. Change in Quality of State Waters from Agricultural Discharge or Alteration of Hydrologic Patterns of Runoff or Infiltration | 1                             | SWQ: Beneficial<br>GWQ: Potentially significant | SWQ: No mitigation is required.<br>GWQ: Mitigation Measure HYD-MM-1: Develop and Implement a Groundwater Quality Management Plan                            | SWQ: –<br>GWQ: Less than significant |
| HYD-1. Change in Quality of State Waters from Agricultural Discharge or Alteration of Hydrologic Patterns of Runoff or Infiltration | 2, 3, 4, 5                    | Beneficial                                      | No mitigation is required.                                                                                                                                  | –                                    |
| <b>AGRICULTURE RESOURCES</b>                                                                                                        |                               |                                                 |                                                                                                                                                             |                                      |
| AG-1. Conversion of Prime Farmland, Unique Farmland, and Farmland of Statewide Importance to Nonagricultural Use                    | 1, 2, 3, 4, 5                 | Significant                                     | AG-MM-1: Assist the Agricultural Community in Identifying Sources of Financial Assistance That Would Allow Growers to Keep Important Farmland in Production | Significant and unavoidable          |



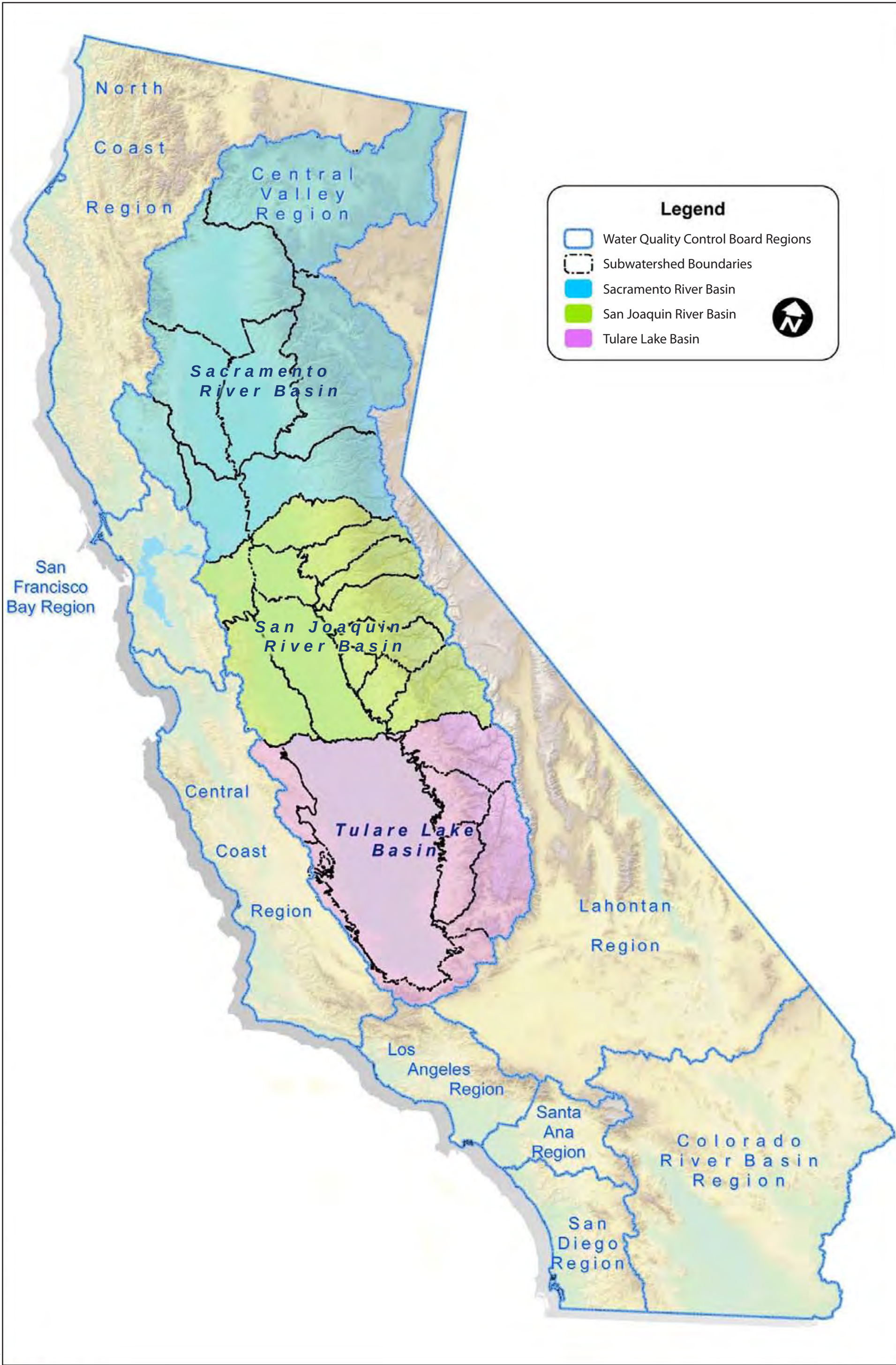


**Figure 2-1**  
**Program Boundaries and Subdivisions**





**Linda S. Adams**  
Secretary for  
Environmental  
Protection

# California Regional Water Quality Control Board Central Valley Region

Katherine Hart, Chair

11020 Sun Center Drive, Suite 200, Rancho Cordova, California 95670-6114  
(916)464-3291 • Fax (916) 464-4645  
<http://www.waterboards.ca.gov/centralvalley>



**Arnold  
Schwarzenegger**  
Governor

## NOTICE OF AVAILABILITY

### Opportunity for Public Comment on Draft Program Environmental Impact Report for a Waste Discharge Regulatory Program for Irrigated Lands within the Central Valley Region

**NOTICE IS HEREBY GIVEN** that the California Regional Water Quality Control Board, Central Valley Region (Central Valley Water Board), as the lead agency, has released a Draft Program Environmental Impact Report (PEIR) for a waste discharge regulatory program for irrigated lands within the Central Valley Region. **The public review and comment period for the Draft PEIR is from July 28<sup>th</sup> until September 27<sup>th</sup>, 2010.** During the review period, the Central Valley Water Board will hold four public meetings to receive comments on the Draft PEIR.

#### Background

The Central Valley Water Board's Irrigated Lands Regulatory Program (ILRP) was initiated in 2003 with the adoption of the *Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands within the Central Valley Region* (Conditional Waiver). A revised Conditional Waiver was adopted in July 2006, and a workgroup assembled to develop alternatives to the ILRP for environmental analysis. Pursuant to the California Environmental Quality Act (CEQA), the Draft PEIR analyzes a full range of suggested alternatives to determine the potential environmental impacts of each.

The ILRP will involve the adoption of one or more general Waste Discharge Requirements (WDRs), Conditional Waivers of WDRs, and/or Prohibitions of Discharge to regulate the discharge of waste to ground and surface waters of the State from irrigated agricultural operations, managed wetlands, and nursery operations.

#### Significant Environmental Effects

The Draft PEIR evaluates and describes the potential environmental impacts associated with the ILRP, identifies those impacts that could be significant, and presents mitigation measures, which, if adopted by the Central Valley Water Board or other responsible agencies, could avoid or minimize these impacts. The Draft PEIR identifies significant and unavoidable impacts in the areas of climate change, from potential increase of greenhouse gas emissions; and agriculture resources, from potential loss of farmland due to increased regulatory costs. Based on information known to date, the Project site(s) are not listed toxic sites.

#### Document Availability

Hard copies of the Draft PEIR are available for review at the following locations:

|                                                                                           |                                                                       |                                                                                    |
|-------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Central Valley Water Board<br>415 Knollcrest Drive<br>Redding, CA 96002                   | CSU Chico, Meriam Library<br>400 West First Street<br>Chico, CA 95929 | CSU Bakersfield, Stiern Library<br>9001 Stockdale Highway<br>Bakersfield, CA 93311 |
| Central Valley Water Board<br>11020 Sun Center Drive, Ste 200<br>Rancho Cordova, CA 95670 | UC Davis, Shields Library<br>100 NW Quad<br>Davis, CA 95616           |                                                                                    |

|                                                                            |                                                               |  |
|----------------------------------------------------------------------------|---------------------------------------------------------------|--|
| Central Valley Water Board<br>1685 E Street, Suite 200<br>Fresno, CA 93706 | UC Merced Library<br>5200 North Lake Road<br>Merced, CA 95343 |  |
|----------------------------------------------------------------------------|---------------------------------------------------------------|--|

Electronic copies of the Draft PEIR can be downloaded in PDF format from the Central Valley Water Board website at: [http://www.swrcb.ca.gov/centralvalley/water\\_issues/irrigated\\_lands/long\\_term\\_program\\_development](http://www.swrcb.ca.gov/centralvalley/water_issues/irrigated_lands/long_term_program_development)

### Public Workshops

Four public workshops will be held to take comments on the Draft PEIR. One or more members of the Central Valley Water Board may be present at the workshops; however, no Board action will be taken. Meeting dates and locations are as follows:\*

|                                                                                                                                                                |                                                                                                                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| September 8, 5pm-8pm<br>Southern California Edison<br>Agricultural Technology Application Center<br>Learning Center<br>4175 S Laspina Street, Tulare, CA 93274 | September 9, 6pm-9pm<br>Stanislaus County Agricultural Center<br>Harvest Hall<br>3800 Cornucopia Way, Modesto, CA 95358 |
| September 10, 9:30am-12:30pm<br>Central Valley Regional Water Quality Control Board<br>11020 Sun Center Drive, Rancho Cordova, CA 95670                        | September 10, 5pm-8pm<br>Chico Holiday Inn and Conference Center<br>685 Manzanita Ct., Chico, CA 95926                  |

\*Individuals requiring special accommodations are requested to contact Adam Laputz, (916) 464-4848, at least five working days prior to the meeting. TTY users may contact the California Relay Service at (800) 735-2929 or voice line at (800) 735-2922.

### Submission of Comments

Public comments on the Draft PEIR must be received by September 27, 2010. Comments may be sent via mail, e-mail or fax (email comments are preferred) to:

|                                                                                     |                                                                                                |
|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| ILRP Comments<br>Ms. Megan Smith<br>630 K Street, Suite 400<br>Sacramento, CA 95814 | Email: <a href="mailto:ILRPcomments@icfi.com">ILRPcomments@icfi.com</a><br>FAX: (916) 456-6724 |
|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|

If you are interested in receiving future notices on the PEIR, you may sign up on the e-mail subscription list (check the box for Irrigated Lands Regulatory Program) at: [http://www.waterboards.ca.gov/resources/email\\_subscriptions/reg5\\_subscribe.shtml](http://www.waterboards.ca.gov/resources/email_subscriptions/reg5_subscribe.shtml), or call (916) 464-4611 to request to receive hard copy notices.

### Contact Information

If you have any questions regarding this notice, contact Adam Laputz at (916) 464-4848. For more information on this notice or the Draft PEIR, please visit the project website at: [http://www.swrcb.ca.gov/centralvalley/water\\_issues/irrigated\\_lands](http://www.swrcb.ca.gov/centralvalley/water_issues/irrigated_lands).

**Draft**

# **Irrigated Lands Regulatory Program**

Program Environmental Impact Report

JULY 2010



PREPARED FOR:  
Central Valley Regional Water Quality Control Board  
11020 Sun Center Drive, Suite 200  
Rancho Cordova, CA 95670  
Contact: Adam Laputz



PREPARED BY:  
ICF International  
630 K Street, Suite 400  
Sacramento, CA 95814  
Contact: Mike Rushton or Megan Smith  
916.737.3000

**DRAFT**

# **IRRIGATED LANDS REGULATORY PROGRAM PROGRAM ENVIRONMENTAL IMPACT REPORT**

**PREPARED FOR:**

Central Valley Regional Water Quality Control Board  
11020 Sun Center Drive, Suite 200  
Rancho Cordova, CA 95670  
Contact: Adam Laputz

**PREPARED BY:**

ICF International  
630 K Street, Suite 400  
Sacramento, CA 95814  
Contact: Mike Rushton or Megan Smith  
916.737.3000

**July 2010**



ICF International. 2010. *Irrigated Lands Regulatory Program Program Environmental Impact Report*. Draft. July. (ICF 05508.05.) Sacramento, CA. Prepared for Central Valley Regional Water Quality Control Board, Sacramento, CA.



# Contents

|                                          |     |
|------------------------------------------|-----|
| List of Tables .....                     | vii |
| List of Figures.....                     | ix  |
| List of Acronyms and Abbreviations ..... | xi  |

|                                                                                            | Page       |
|--------------------------------------------------------------------------------------------|------------|
| <b>Chapter 1 Summary .....</b>                                                             | <b>1-1</b> |
| 1.1 Introduction.....                                                                      | 1-1        |
| 1.2 Overview of Central Valley Agriculture .....                                           | 1-1        |
| 1.3 Program Purpose and Objectives .....                                                   | 1-2        |
| 1.4 Program Description.....                                                               | 1-3        |
| 1.4.1 Alternative 1 – Full Implementation of Current Program (No Project Alternative)..... | 1-3        |
| 1.4.2 Alternative 2 – Third-Party Lead Entity .....                                        | 1-4        |
| 1.4.3 Alternative 3 – Individual Farm Water Quality Management Plan .....                  | 1-5        |
| 1.4.4 Alternative 4 – Direct Oversight with Regional Monitoring .....                      | 1-5        |
| 1.4.5 Alternative 5 – Direct Oversight with Farm Monitoring .....                          | 1-6        |
| 1.5 CEQA Process.....                                                                      | 1-6        |
| 1.5.1 Purpose of This Draft PEIR.....                                                      | 1-6        |
| 1.5.2 Public Outreach .....                                                                | 1-7        |
| 1.5.3 Scope of Draft PEIR Analysis.....                                                    | 1-7        |
| 1.5.4 Public Comment on the Draft PEIR .....                                               | 1-9        |
| 1.6 Summary of Program Environmental Impacts and Mitigation .....                          | 1-10       |
| <b>Chapter 2 Introduction.....</b>                                                         | <b>2-1</b> |
| 2.1 Introduction.....                                                                      | 2-1        |
| 2.2 Program Background .....                                                               | 2-1        |
| 2.3 Program Location .....                                                                 | 2-3        |
| 2.4 Scope and Purpose of This CEQA Document.....                                           | 2-4        |
| 2.4.1 “No Project” and “Preferred Project” Alternatives .....                              | 2-4        |
| 2.4.2 Intended Uses of This Draft PEIR.....                                                | 2-5        |
| 2.4.3 Responsible and Trustee Agencies .....                                               | 2-5        |
| 2.5 Program Goals and Objectives .....                                                     | 2-6        |
| 2.6 Development of This Draft PEIR .....                                                   | 2-7        |
| 2.6.1 Notice of Preparation .....                                                          | 2-7        |
| 2.6.2 Scoping .....                                                                        | 2-7        |
| 2.6.3 Alternatives Development Process .....                                               | 2-7        |
| 2.6.4 Known Areas of Controversy .....                                                     | 2-8        |
| 2.6.5 Public Comment on This Draft PEIR .....                                              | 2-9        |
| 2.7 Organization of This Draft PEIR .....                                                  | 2-9        |
| <b>Chapter 3 Program Description .....</b>                                                 | <b>3-1</b> |
| 3.1 Introduction.....                                                                      | 3-1        |
| 3.2 Alternative 1 – Full Implementation of Current Program (No Project Alternative).....   | 3-4        |
| 3.2.1 Introduction.....                                                                    | 3-4        |

|                                                                      |                                                                      |              |
|----------------------------------------------------------------------|----------------------------------------------------------------------|--------------|
| 3.2.2                                                                | Program Components .....                                             | 3-5          |
| 3.2.3                                                                | Regulatory Requirements and Approvals .....                          | 3-6          |
| 3.3                                                                  | Alternative 2 – Third-Party Lead Entity .....                        | 3-7          |
| 3.3.1                                                                | Introduction.....                                                    | 3-7          |
| 3.3.2                                                                | Program Components .....                                             | 3-8          |
| 3.3.3                                                                | Regulatory Requirements and Approvals .....                          | 3-12         |
| 3.4                                                                  | Alternative 3 – Individual Farm Water Quality Management Plans ..... | 3-13         |
| 3.4.1                                                                | Introduction.....                                                    | 3-13         |
| 3.4.2                                                                | Program Components .....                                             | 3-14         |
| 3.4.3                                                                | Regulatory Requirements and Approvals .....                          | 3-15         |
| 3.5                                                                  | Alternative 4 – Direct Oversight with Regional Monitoring .....      | 3-16         |
| 3.5.1                                                                | Introduction.....                                                    | 3-16         |
| 3.5.2                                                                | Program Components .....                                             | 3-20         |
| 3.5.3                                                                | Regulatory Requirements and Approvals .....                          | 3-21         |
| 3.6                                                                  | Alternative 5 – Direct Oversight with Farm Monitoring.....           | 3-26         |
| 3.6.1                                                                | Introduction.....                                                    | 3-26         |
| 3.6.2                                                                | Program Components .....                                             | 3-26         |
| 3.6.3                                                                | Regulatory Requirements and Approvals .....                          | 3-27         |
| 3.7                                                                  | Alternatives Considered and Rejected .....                           | 3-28         |
| 3.7.1                                                                | Elimination of the ILRP .....                                        | 3-29         |
| 3.7.2                                                                | Direct Permitting of Each Discharging Grower.....                    | 3-29         |
| <b>Chapter 4 Environmental Setting .....</b>                         |                                                                      | <b>4-1</b>   |
| 4.1                                                                  | Overview.....                                                        | 4-1          |
| 4.2                                                                  | Introduction.....                                                    | 4-1          |
| 4.3                                                                  | Program Boundaries and Subdivisions .....                            | 4-1          |
| 4.4                                                                  | Surface Water.....                                                   | 4-2          |
| 4.4.1                                                                | Sacramento River Basin.....                                          | 4-2          |
| 4.4.2                                                                | San Joaquin River Basin .....                                        | 4-3          |
| 4.4.3                                                                | Tulare Lake Basin .....                                              | 4-4          |
| 4.5                                                                  | Groundwater .....                                                    | 4-5          |
| 4.6                                                                  | Agriculture .....                                                    | 4-6          |
| <b>Chapter 5 Environmental Impacts and Mitigation Measures .....</b> |                                                                      | <b>5-1</b>   |
| 5.1                                                                  | Overview.....                                                        | 5-1          |
| 5.1.1                                                                | Approach to Impacts .....                                            | 5-1          |
| 5.1.2                                                                | Significance Determinations and Mitigation .....                     | 5-2          |
| 5.2                                                                  | Consistency with Plans and Policies .....                            | 5-2          |
| <b>Section 5.3 Cultural Resources .....</b>                          |                                                                      | <b>5.3-1</b> |
| 5.3.1                                                                | Introduction.....                                                    | 5.3-1        |
| 5.3.2                                                                | Regulatory Framework.....                                            | 5.3-1        |
|                                                                      | Federal.....                                                         | 5.3-1        |
|                                                                      | State .....                                                          | 5.3-2        |
| 5.3.3                                                                | Environmental Setting.....                                           | 5.3-3        |
|                                                                      | Archaeological Setting.....                                          | 5.3-3        |
|                                                                      | Historic Setting .....                                               | 5.3-6        |
| 5.3.4                                                                | Impacts .....                                                        | 5.3-9        |
|                                                                      | Assessment Methods .....                                             | 5.3-9        |

|                                                                                      |              |
|--------------------------------------------------------------------------------------|--------------|
| Significance Determinations.....                                                     | 5.3-12       |
| Alternative 1 – Full Implementation of Current Program (No Project Alternative)..... | 5.3-13       |
| Alternative 2 – Third Party Lead Entity .....                                        | 5.3-13       |
| Alternative 3 – Individual Farm Water Quality Management Plans .....                 | 5.3-14       |
| Alternative 4 – Direct Oversight with Regional Monitoring.....                       | 5.3-14       |
| Alternative 5 – Direct Oversight with Farm Monitoring.....                           | 5.3-14       |
| Mitigation and Improvement Measures .....                                            | 5.3-14       |
| <b>Section 5.4 Noise .....</b>                                                       | <b>5.4-1</b> |
| 5.4.1 Introduction.....                                                              | 5.4-1        |
| 5.4.2 Regulatory Framework.....                                                      | 5.4-3        |
| Federal.....                                                                         | 5.4-3        |
| State .....                                                                          | 5.4-3        |
| Local.....                                                                           | 5.4-3        |
| 5.4.3 Environmental Setting.....                                                     | 5.4-4        |
| Existing Noise Levels in the Program Area .....                                      | 5.4-4        |
| Noise-Sensitive Land Uses in the Program Area .....                                  | 5.4-4        |
| 5.4.4 Impacts .....                                                                  | 5.4-5        |
| Assessment Methods .....                                                             | 5.4-5        |
| Significance Determinations.....                                                     | 5.4-7        |
| Alternative 1 – Full Implementation of Current Program (No Project Alternative)..... | 5.4-7        |
| Alternative 2 – Third-Party Lead Entity .....                                        | 5.4-8        |
| Alternative 3 – Individual Farm Water Quality Management Plans .....                 | 5.4-9        |
| Alternative 4 – Direct Oversight with Regional Monitoring.....                       | 5.4-9        |
| Alternative 5 – Direct Oversight with Farm Monitoring.....                           | 5.4-10       |
| 5.4.5 Mitigation and Improvement Measures .....                                      | 5.4-11       |
| <b>Section 5.5 Air Quality .....</b>                                                 | <b>5.5-1</b> |
| 5.5.1 Introduction.....                                                              | 5.5-1        |
| 5.5.2 Regulatory Framework.....                                                      | 5.5-1        |
| 5.5.3 Environmental Setting.....                                                     | 5.5-9        |
| 5.5.4 Impacts .....                                                                  | 5.5-24       |
| Assessment Methods .....                                                             | 5.5-24       |
| Significance Determinations.....                                                     | 5.5-26       |
| Alternative 1 – Full Implementation of Current Program (No Project Alternative)..... | 5.5-27       |
| Alternative 2 – Third-Party Lead Entity .....                                        | 5.5-28       |
| Alternative 3 – Individual Farm Water Quality Management Plans .....                 | 5.5-29       |
| Alternative 4 – Direct Oversight with Regional Monitoring.....                       | 5.5-30       |
| Alternative 5 – Direct Oversight with Farm Monitoring.....                           | 5.5-31       |
| 5.5.5 Mitigation and Improvement Measures .....                                      | 5.5-33       |
| <b>Section 5.6 Climate Change.....</b>                                               | <b>5.6-1</b> |
| 5.6.1 Introduction.....                                                              | 5.6-1        |
| 5.6.2 Regulatory Framework.....                                                      | 5.6-1        |
| Federal.....                                                                         | 5.6-1        |
| State .....                                                                          | 5.6-2        |
| Local.....                                                                           | 5.6-4        |
| 5.6.3 Environmental Setting.....                                                     | 5.6-5        |
| Global Climate Change .....                                                          | 5.6-5        |

|                    |                                                                                      |              |
|--------------------|--------------------------------------------------------------------------------------|--------------|
|                    | Greenhouse Gases.....                                                                | 5.6-7        |
|                    | Greenhouse Gas Inventories .....                                                     | 5.6-9        |
| 5.6.4              | Impacts .....                                                                        | 5.6-11       |
|                    | Assessment Methods .....                                                             | 5.6-11       |
|                    | Significance Determinations.....                                                     | 5.6-12       |
|                    | Alternative 1 – Full Implementation of Current Program (No Project Alternative)..... | 5.6-13       |
|                    | Alternative 2 – Third-Party Lead Entity .....                                        | 5.6-13       |
|                    | Alternative 3 – Individual Farm Water Quality Management Plans .....                 | 5.6-14       |
|                    | Alternative 4 – Direct Oversight with Regional Monitoring.....                       | 5.6-14       |
|                    | Alternative 5 – Direct Oversight with Farm Monitoring.....                           | 5.6-14       |
| 5.6.5              | Mitigation and Improvement Measures .....                                            | 5.6-15       |
| <b>Section 5.7</b> | <b>Vegetation and Wildlife .....</b>                                                 | <b>5.7-1</b> |
| 5.7.1              | Introduction.....                                                                    | 5.7-1        |
| 5.7.2              | Regulatory Framework.....                                                            | 5.7-1        |
|                    | Federal.....                                                                         | 5.7-1        |
|                    | State .....                                                                          | 5.7-4        |
|                    | Regulatory Classification of Special-Status Species.....                             | 5.7-6        |
| 5.7.3              | Environmental Setting.....                                                           | 5.7-7        |
|                    | Agricultural Lands.....                                                              | 5.7-7        |
|                    | Managed Wetlands .....                                                               | 5.7-8        |
|                    | Special-Status Species .....                                                         | 5.7-10       |
| 5.7.4              | Effects of Existing Impaired Water Quality on Biological Resources .....             | 5.7-43       |
| 5.7.5              | Impacts .....                                                                        | 5.7-43       |
|                    | Assessment Methods .....                                                             | 5.7-43       |
|                    | Significance Determinations.....                                                     | 5.7-44       |
|                    | Alternative 1 – Full Implementation of Current Program (No Project Alternative)..... | 5.7-45       |
|                    | Alternative 2 – Third-Party Lead Entity .....                                        | 5.7-46       |
|                    | Alternative 3 – Individual Farm Water Quality Management Plans .....                 | 5.7-48       |
|                    | Alternative 4 – Direct Oversight with Regional Monitoring.....                       | 5.7-48       |
|                    | Alternative 5 – Direct Oversight with Farm Monitoring.....                           | 5.7-48       |
| 5.7.6              | Mitigation and Improvement Measures .....                                            | 5.7-50       |
| <b>Section 5.8</b> | <b>Fisheries .....</b>                                                               | <b>5.8-1</b> |
| 5.8.1              | Introduction.....                                                                    | 5.8-1        |
| 5.8.2              | Regulatory Framework.....                                                            | 5.8-1        |
|                    | Federal.....                                                                         | 5.8-1        |
|                    | State .....                                                                          | 5.8-4        |
|                    | Local.....                                                                           | 5.8-5        |
|                    | Regulatory Classification of Special-Status Species.....                             | 5.8-5        |
| 5.8.3              | Environmental Setting.....                                                           | 5.8-7        |
|                    | Waters in the ILRP Program Area.....                                                 | 5.8-7        |
|                    | Special-Status Species .....                                                         | 5.8-8        |
| 5.8.4              | Existing Effects of Impaired Water Quality on Fish .....                             | 5.8-25       |
|                    | Sources of Information.....                                                          | 5.8-25       |
|                    | Existing Effects by Key Parameters .....                                             | 5.8-30       |
| 5.8.5              | Impacts .....                                                                        | 5.8-49       |
|                    | Assessment Methods .....                                                             | 5.8-50       |
|                    | Significance Determinations.....                                                     | 5.8-50       |

|                                                                                      |               |
|--------------------------------------------------------------------------------------|---------------|
| Alternative 1 – Full Implementation of Current Program (No Project Alternative)..... | 5.8-50        |
| Alternative 2 – Third-Party Lead Entity .....                                        | 5.8-51        |
| Alternative 3 – Individual Farm Water Quality Management Plans .....                 | 5.8-52        |
| Alternative 4 – Direct Oversight with Regional Monitoring .....                      | 5.8-52        |
| Alternative 5 – Direct Oversight with Farm Monitoring.....                           | 5.8-53        |
| 5.8.6 Mitigation and Improvement Measures .....                                      | 5.8-53        |
| <b>Section 5.9 Hydrology and Water Quality.....</b>                                  | <b>5.9-1</b>  |
| 5.9.1 Introduction.....                                                              | 5.9-1         |
| 5.9.2 Regulatory Framework .....                                                     | 5.9-2         |
| Federal.....                                                                         | 5.9-2         |
| State .....                                                                          | 5.9-4         |
| 5.9.3 Environmental Setting.....                                                     | 5.9-5         |
| Sacramento River Basin.....                                                          | 5.9-5         |
| San Joaquin River Basin .....                                                        | 5.9-7         |
| Tulare Lake Basin.....                                                               | 5.9-10        |
| 5.9.4 Impacts .....                                                                  | 5.9-12        |
| Assessment Methods and Data Collection.....                                          | 5.9-12        |
| Significance Determinations.....                                                     | 5.9-14        |
| Alternative 1 –Full Implementation of Current Program (No Project Alternative).....  | 5.9-14        |
| Alternative 2 – Third-Party Lead Entity .....                                        | 5.9-16        |
| Alternative 3 – Individual Farm Water Quality Management Plans .....                 | 5.9-17        |
| Alternative 4 – Direct Oversight with Regional Monitoring .....                      | 5.9-18        |
| Alternative 5 – Direct Oversight with Farm Monitoring.....                           | 5.9-18        |
| 5.9.5 Mitigation and Improvement Measures .....                                      | 5.9-19        |
| <b>Section 5.10 Agriculture Resources .....</b>                                      | <b>5.10-1</b> |
| 5.10.1 Introduction.....                                                             | 5.10-1        |
| 5.10.2 Regulatory Framework.....                                                     | 5.10-2        |
| Federal.....                                                                         | 5.10-2        |
| State .....                                                                          | 5.10-2        |
| Local.....                                                                           | 5.10-4        |
| 5.10.3 Environmental Setting.....                                                    | 5.10-4        |
| Sacramento River Basin.....                                                          | 5.10-4        |
| San Joaquin River Basin .....                                                        | 5.10-4        |
| Tulare Lake Basin.....                                                               | 5.10-5        |
| 5.10.4 Impacts .....                                                                 | 5.10-5        |
| Significance Determinations.....                                                     | 5.10-6        |
| Assessment Methods .....                                                             | 5.10-6        |
| Alternative 1 – Full Implementation of Current Program (No Project Alternative)..... | 5.10-8        |
| Alternative 2 – Third-Party Lead Entity .....                                        | 5.10-9        |
| Alternative 3 – Individual Farm Water Quality Management Plans .....                 | 5.10-10       |
| Alternative 4 – Direct Oversight with Regional Monitoring .....                      | 5.10-11       |
| Alternative 5 – Direct Oversight with Farm Monitoring.....                           | 5.10-12       |
| 5.10.5 Mitigation and Improvement Measures .....                                     | 5.10-14       |
| <b>Section 5.11 Minimally Impacted Resources .....</b>                               | <b>5.11-1</b> |
| 5.11.1 Introduction.....                                                             | 5.11-1        |
| 5.11.2 Discussion of Minimally Impacted Resources .....                              | 5.11-1        |



|                                                               |            |
|---------------------------------------------------------------|------------|
| Aesthetics .....                                              | 5.11-1     |
| Geology and Soils .....                                       | 5.11-1     |
| Hazards and Hazardous Materials.....                          | 5.11-1     |
| Land Use and Planning .....                                   | 5.11-1     |
| Mineral Resources and Energy.....                             | 5.11-2     |
| Population and Housing .....                                  | 5.11-2     |
| Public Services .....                                         | 5.11-2     |
| Recreation .....                                              | 5.11-2     |
| Transportation and Circulation .....                          | 5.11-2     |
| Utilities and Service Systems.....                            | 5.11-2     |
| <b>Chapter 6 Cumulative and Growth-Inducing Impacts .....</b> | <b>6-1</b> |
| 6.1 Introduction.....                                         | 6-1        |
| 6.2 Cumulative Impacts.....                                   | 6-1        |
| 6.2.1 Significance Determinations and Mitigation .....        | 6-2        |
| 6.2.2 Cumulative Impacts by Resource .....                    | 6-2        |
| 6.3 Growth-Inducing Impacts.....                              | 6-4        |
| <b>Chapter 7 List of Preparers.....</b>                       | <b>7-1</b> |
| 7.1 ICF International.....                                    | 7-1        |
| 7.2 Subconsultants .....                                      | 7-2        |
| 7.3 Central Valley Regional Water Quality Control Board ..... | 7-2        |
| <b>Chapter 8 References Cited .....</b>                       | <b>8-1</b> |

**Appendix A     Draft Irrigated Lands Regulatory Program Long-Term Program  
Development Staff Report—July 2010**

# Tables

|                                                                                                                              | Page   |
|------------------------------------------------------------------------------------------------------------------------------|--------|
| 1-1 Summary of Impacts and Mitigation Measures for the Irrigated Lands Regulatory Program .....                              | 1-10   |
| 2-1 Likely Trustee Agencies for the Long-Term Irrigated Lands Regulatory Program.....                                        | 2-5    |
| 3-1 Comparison of Alternatives.....                                                                                          | 3-2    |
| 3-2 Monitoring Requirements under Alternative 1.....                                                                         | 3-7    |
| 3-3 Tier System Matrix under Alternative 4.....                                                                              | 3-19   |
| 4-1 Average Annual Groundwater Supply for the Sacramento River, San Joaquin River, and Tulare Lake Basins .....              | 4-5    |
| 5.1-1 Analyzed Management Practices.....                                                                                     | 5-1    |
| 5.3-1 Numbers of Cultural Resources Identified in Counties in the Program Area .....                                         | 5.3-10 |
| 5.3-2 CHRIS Information Centers by Program County .....                                                                      | 5.3-15 |
| 5.4-1 Definitions of Sound Measurements.....                                                                                 | 5.4-1  |
| 5.4-2 Typical A-Weighted Sound Levels .....                                                                                  | 5.4-2  |
| 5.4-3 Land Uses and Associated Ambient Noise Levels.....                                                                     | 5.4-4  |
| 5.4-4 Typical Construction Equipment Associated with Management Practices and Associated Noise Levels .....                  | 5.4-5  |
| 5.4-5 Estimated Noise Levels at Various Distances.....                                                                       | 5.4-6  |
| 5.5-1 Ambient Air Quality Standards Applicable in California.....                                                            | 5.5-4  |
| 5.5-2 Air Districts and Counties Affected by Program Alternatives and Associated Significance Thresholds .....               | 5.5-5  |
| 5.5-3 Ambient Air Quality Monitoring Data for the Mountain Counties Air Basin.....                                           | 5.5-13 |
| 5.5-4 Ambient Air Quality Monitoring Data for the Sacramento Valley Air Basin .....                                          | 5.5-14 |
| 5.5-5 Ambient Air Quality Monitoring Data for the San Joaquin Valley Air Basin.....                                          | 5.5-16 |
| 5.5-6 Criteria Pollutant Attainment Status in the Program Area.....                                                          | 5.5-18 |
| 5.5-7 Summary of Potential Impacts Relative to Baseline Conditions .....                                                     | 5.5-24 |
| 5.5-8 Summary of WQMP and Potential Construction Emissions.....                                                              | 5.5-25 |
| 5.6-1 Lifetimes and Global Warming Potentials of Several Significant Greenhouse Gases .....                                  | 5.6-8  |
| 5.6-2 Global Greenhouse Gas Emissions from the IPCC 2004 Inventory (GtCO <sub>2</sub> e).....                                | 5.6-10 |
| 5.6-3 U.S. Greenhouse Gas Emissions from the EPA 2007 Inventory (MMTCO <sub>2</sub> e).....                                  | 5.6-10 |
| 5.6-4 State Greenhouse Gas Emissions from the 2006 ARB Inventory (MMTCO <sub>2</sub> e) .....                                | 5.6-11 |
| 5.7-1a State-Listed and Federally Listed Plants with Potential to Occur in the Program Area – Sacramento Valley Basin.....   | 5.7-12 |
| 5.7-1b State-Listed and Federally Listed Plants with Potential to Occur in the Program Area – San Joaquin Valley Basin ..... | 5.7-17 |

|        |                                                                                                                                                |         |
|--------|------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| 5.7-1c | State-Listed and Federally Listed Plants with Potential to Occur in the Program Area – Tulare Lake Basin.....                                  | 5.7-22  |
| 5.7-2a | Special-Status Wildlife Species with Potential to Occur in the Program Area – Sacramento Valley Basin .....                                    | 5.7-25  |
| 5.7-2b | Special-Status Wildlife Species with Potential to Occur in the Program Area – San Joaquin Valley Basin.....                                    | 5.7-31  |
| 5.7-2c | Special-Status Wildlife Species with Potential to Occur in the Program Area – Tulare Lake Basin .....                                          | 5.7-38  |
| 5.8-1  | Special-Status Fish Species Potentially Affected by the Irrigated Lands Regulatory Program .....                                               | 5.8-8   |
| 5.8-2  | Assumed Life Stage, Timing, and Distribution of Anadromous Listed Species Potentially Affected by the Irrigated Lands Regulatory Program ..... | 5.8-10  |
| 5.8-3  | Results of Toxicity Testing of Fathead Minnows in the Program Area .....                                                                       | 5.8-30  |
| 5.8-4  | Summary of Data Review and Analyses of the Role of Contaminants in the Pelagic Organism Decline.....                                           | 5.8-36  |
| 5.8-5  | Suspended Sediment Severity-of-Ill-Effect Scores By Site .....                                                                                 | 5.8-37  |
| 5.8-6  | Overview of Seasonal Inputs of Current-Use Pesticides with Details of Detection, Transport, Fate, and Application.....                         | 5.8-44  |
| 5.8-7  | Effects Determinations for Pesticide Active Ingredients on Listed Central Valley Anadromous Salmonids.....                                     | 5.8-45  |
| 5.9-1  | Pesticide Detections in Groundwater Wells for Counties in the Sacramento River Basin (1985–2003) .....                                         | 5.9-7   |
| 5.9-2  | Pesticide Detections in Groundwater Wells for Counties in the San Joaquin River Basin (1985–2003) .....                                        | 5.9-9   |
| 5.9-3  | Pesticide Detections in Groundwater Wells for Counties in the Tulare Lake Basin (1985–2003).....                                               | 5.9-12  |
| 5.9-4  | Known Surface Water Quality Impairments in Subwatersheds in the Program Area .....                                                             | 5.9-15  |
| 5.10-1 | Crop Category Definition.....                                                                                                                  | 5.10-7  |
| 5.10-2 | Acres of Important Farmland Potentially Removed from Production under Alternative 1 .....                                                      | 5.10-9  |
| 5.10-3 | Additional Acres of Important Farmland Potentially Removed from Production under Alternative 2 .....                                           | 5.10-10 |
| 5.10-4 | Additional Acres of Important Farmland Potentially Removed from Production under Alternative 3.....                                            | 5.10-11 |
| 5.10-5 | Additional Acres of Important Farmland Potentially Removed from Production under Alternative 4.....                                            | 5.10-12 |
| 5.10-6 | Additional Acres of Important Farmland Potentially Removed from Production under Alternative 5 .....                                           | 5.10-13 |

# Figures

|                                                                    | Follows Page |
|--------------------------------------------------------------------|--------------|
| 2-1 Program Boundaries and Subdivisions .....                      | 2-4          |
| 2-2 Sacramento Valley Basin .....                                  | 2-4          |
| 2-3 San Joaquin Valley Basin.....                                  | 2-4          |
| 2-4 Tulare Lake Basin .....                                        | 2-4          |
| 4-1 Sacramento River Groundwater Subbasins.....                    | 4-6          |
| 4-2 Northern Portion of San Joaquin Valley Groundwater Basin ..... | 4-6          |
| 4-3 Groundwater Basins .....                                       | 4-6          |
| 5.5-1 Affected Air Districts .....                                 | 5.5-2        |
| 6-1 California Farmland Conversion Summary 2000–2006.....          | 6-4          |

|                                                                                                                       | On Page |
|-----------------------------------------------------------------------------------------------------------------------|---------|
| 5.8-1 Conceptual Framework Adopted by NMFS to Assess Effects of EPA Registration of Pesticide Active Ingredients..... | 5.8-29  |
| 5.8-2 Toxicity to Fathead Minnow (Pimephales promelas) in Zone 1 of the ILRP.....                                     | 5.8-32  |
| 5.8-3 Toxicity to Fathead Minnow (Pimephales promelas) in Zone 2 of the ILRP.....                                     | 5.8-33  |
| 5.8-4 Toxicity to Fathead Minnow (Pimephales promelas) in Zone 3 of the ILRP.....                                     | 5.8-34  |
| 5.8-5 Toxicity to Fathead Minnow (Pimephales promelas) in Zone 4 of the ILRP.....                                     | 5.8-35  |
| 5.8-6 Chlorpyrifos and Diazinon Use, Monitoring Data, and Management Plans.....                                       | 5.8-40  |
| 5.8-7 Diuron and Dimethoate Use, Monitoring Data, and Management Plans.....                                           | 5.8-41  |
| 5.8-8 Methyl-Parathion and Simazine Use, Monitoring Data, and Management Plans.....                                   | 5.8-42  |
| 5.8-9 Malathion and Thiobencarb Use, Monitoring Data, and Management Plans.....                                       | 5.8-43  |

|                                                                   | At End of Section |
|-------------------------------------------------------------------|-------------------|
| 5.9-1 Program Boundaries and Subdivisions                         |                   |
| 5.9-2 Sacramento River Groundwater Subbasins                      |                   |
| 5.9-3 Northern Portion of San Joaquin Valley Groundwater Subbasin |                   |
| 5.9-4 Groundwater Basins                                          |                   |
| 5.9-5 Sacramento Valley Basin                                     |                   |
| 5.9-6 Conceptual Surface Water Model                              |                   |
| 5.9-7 Butte-Sutter-Yuba Subwatershed                              |                   |

- 5.9-8 Colusa Basin Watershed
- 5.9-9 Solano-Yolo Subwatershed
- 5.9-10 San Joaquin Valley Basin
- 5.9-11 Delta-Mendota Canal Subwatershed
- 5.9-12 San Joaquin Valley Floor Subwatershed
- 5.9-13 Delta-Carbona Subwatershed
- 5.9-14 North Valley Floor Subwatershed
- 5.9-15 Tulare Lake Basin
- 5.9-16 South Valley Floor Subwatershed
- 5.9-17 Nitrate in California's Groundwater

# Acronyms and Abbreviations

---

|                            |                                                                                                |
|----------------------------|------------------------------------------------------------------------------------------------|
| °C                         | degrees Celsius                                                                                |
| °F                         | degrees Fahrenheit                                                                             |
| µg/m <sup>3</sup>          | micrograms per cubic meter                                                                     |
| µS/cm                      | microsiemens per centimeter                                                                    |
| AB                         | Assembly Bill                                                                                  |
| ARB                        | California Air Resources Board                                                                 |
| BA                         | biological assessment                                                                          |
| BAAQMD                     | Bay Area Air Quality Management District                                                       |
| Basin Plan                 | <i>Central Valley Water Board Water Quality Control Plan</i> (Central Valley Water Board 2009) |
| BAU                        | business-as-usual                                                                              |
| BMPs                       | best management practices                                                                      |
| BO                         | Biological Opinion                                                                             |
| B.P.                       | Before Present                                                                                 |
| BPS                        | Best Performance Standards                                                                     |
| Bulletin 118               | <i>California's Groundwater: Bulletin 118 – Update 2003</i> (DWR 2003)                         |
| CAA                        | federal Clean Air Act                                                                          |
| CAAA                       | 1990 amendments to the federal Clean Air Act                                                   |
| CAAQS                      | California ambient air quality standards                                                       |
| CAC                        | county agricultural commissioner                                                               |
| CCAA                       | California Clean Air Act                                                                       |
| CCR                        | California Code of Regulations                                                                 |
| CEC                        | California Energy Commission                                                                   |
| Central Valley Water Board | Central Valley Regional Water Quality Control Board                                            |
| CEQA                       | California Environmental Quality Act                                                           |
| CESA                       | California Endangered Species Act                                                              |
| CFGC                       | California Fish and Game Code                                                                  |
| cfs                        | cubic feet per second                                                                          |
| CH <sub>4</sub>            | methane                                                                                        |
| CHRIS                      | California Historical Resources Information System                                             |
| CHWP                       | California Waterfowl Habitat Program                                                           |
| cm                         | centimeter                                                                                     |
| CNDDB                      | California Natural Diversity Database                                                          |
| CNEL                       | community noise equivalent level                                                               |
| CNPPA                      | California Native Plant Protection Act                                                         |
| CNPS                       | California Native Plant Society                                                                |
| CO                         | carbon monoxide                                                                                |



|                             |                                                                                                                                       |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| CO <sub>2</sub>             | carbon dioxide                                                                                                                        |
| CO <sub>2</sub> e           | carbon dioxide equivalent                                                                                                             |
| Conditional Waiver          | Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands                                                |
| CRHR                        | California Register of Historical Resources                                                                                           |
| CVP                         | Central Valley Project                                                                                                                |
| CVMP                        | Central Valley Production Model                                                                                                       |
| CV-SALTS                    | Central Valley Salinity Alternatives for Long-Term Sustainability                                                                     |
| CWA                         | federal Clean Water Act                                                                                                               |
| CZARA                       | Coastal Zone Act Reauthorization Amendments of 1990                                                                                   |
| dB                          | decibel                                                                                                                               |
| dBA                         | A-weighted decibel                                                                                                                    |
| Delta                       | Sacramento–San Joaquin River Delta                                                                                                    |
| DO                          | dissolved oxygen                                                                                                                      |
| DPH                         | California Department of Public Health                                                                                                |
| DPM                         | diesel particulate matter                                                                                                             |
| DPR                         | California Department of Pesticide Regulation                                                                                         |
| DPS                         | distinct population segment                                                                                                           |
| Draft ILRP Economics Report | Draft <i>Technical Memorandum Concerning the Economic Analysis of the Irrigated Lands Regulatory Program</i> (ICF International 2010) |
| DWR                         | California Department of Water Resources                                                                                              |
| EC                          | electrical conductivity                                                                                                               |
| ECR                         | <i>Existing Conditions Report</i> (ICF Jones & Stokes 2008)                                                                           |
| EEC                         | estimated environmental concentration                                                                                                 |
| EFH                         | essential fish habitat                                                                                                                |
| EIR                         | Environmental Impact Report                                                                                                           |
| EPA                         | U.S. Environmental Protection Agency                                                                                                  |
| ESA                         | federal Endangered Species Act                                                                                                        |
| ESPP                        | Endangered Species Protection Program                                                                                                 |
| ESU                         | evolutionarily significant unit                                                                                                       |
| FC                          | Federal Candidate                                                                                                                     |
| FE                          | Federal Endangered                                                                                                                    |
| FIFRA                       | Federal Insecticide, Fungicide, and Rodenticide Act, as amended                                                                       |
| FMMP                        | Farmland Mapping and Monitoring Program                                                                                               |
| FMP                         | Fishery Management Plan                                                                                                               |
| FMWT                        | Fall Midwater Trawl                                                                                                                   |
| FP                          | Federal Proposed                                                                                                                      |
| FP                          | Fully Protected                                                                                                                       |
| FR                          | Federal Register                                                                                                                      |
| FREP                        | Fertilizer Research and Education Program                                                                                             |

|                             |                                                          |
|-----------------------------|----------------------------------------------------------|
| FSoC                        | Federal Species of Concern                               |
| FT                          | Federal Threatened                                       |
| FWQMP                       | farm water quality management plan                       |
| GAMA                        | Groundwater Ambient Monitoring and Assessment            |
| GBVAB                       | Great Basin Valley Air Basin                             |
| GCID                        | Glenn-Colusa Irrigation District                         |
| General Construction Permit | NPDES General Permit for Construction Activities         |
| GHG                         | greenhouse gas                                           |
| GMA                         | groundwater management area                              |
| GQMP                        | groundwater quality management plan                      |
| GtCO <sub>2</sub> e         | gigatons of CO <sub>2</sub> e                            |
| GWP                         | global warming potential                                 |
| GWPA                        | groundwater protection area                              |
| HAP                         | hazardous air pollutant                                  |
| HCP                         | Habitat Conservation Plan                                |
| HFC                         | hydrofluorocarbon                                        |
| HGWPG                       | high global warming potential gases                      |
| HR                          | hydrologic region                                        |
| Hz                          | Hertz                                                    |
| ILRP                        | Irrigated Lands Regulatory Program                       |
| IPCC                        | Intergovernmental Panel on Climate Change                |
| ITP                         | incidental take permit                                   |
| LCAB                        | Lake County Air Basin                                    |
| LCFS                        | low carbon fuel standards                                |
| L <sub>dn</sub>             | day-night level                                          |
| L <sub>eq</sub>             | equivalent sound level                                   |
| L <sub>max</sub>            | maximum sound level                                      |
| L <sub>min</sub>            | minimum sound level                                      |
| L <sub>xx</sub>             | percentile-exceeded sound level                          |
| Magnuson-Stevens Act        | Magnuson-Stevens Fishery Conservation and Management Act |
| MBPM-2                      | Migratory Bird Permit Memorandum                         |
| MBTA                        | Migratory Bird Treaty Act                                |
| MCAB                        | Mountain Counties Air Basin                              |
| MCL                         | maximum contaminant level                                |
| MDAB                        | Mojave Desert Air Basin                                  |
| mg/L                        | milligrams per liter                                     |
| mm                          | millimeter                                               |
| MLD                         | most likely descendant                                   |

|                                           |                                                                                                    |
|-------------------------------------------|----------------------------------------------------------------------------------------------------|
| MMTCO <sub>2</sub> e                      | million metric tons of CO <sub>2</sub> e                                                           |
| MOU                                       | memorandum of understanding                                                                        |
| mph                                       | miles per hour                                                                                     |
| MPO                                       | Metropolitan Planning Organization                                                                 |
| N <sub>2</sub> O                          | nitrous oxide                                                                                      |
| NAAQS                                     | national ambient air quality standards                                                             |
| NAHC                                      | Native American Heritage Commission                                                                |
| NAWQA                                     | National Water Quality Assessment                                                                  |
| NCCAB                                     | North Central Coast Air Basin                                                                      |
| NEPA                                      | National Environmental Policy Act                                                                  |
| NHPA                                      | National Historic Preservation Act                                                                 |
| NMFS                                      | National Marine Fisheries Service                                                                  |
| NO <sub>2</sub>                           | nitrogen dioxide                                                                                   |
| NOA                                       | naturally occurring asbestos                                                                       |
| NOAA                                      | National Oceanic and Atmospheric Administration                                                    |
| NOP                                       | Notice of Preparation                                                                              |
| NO <sub>x</sub>                           | oxides of nitrogen                                                                                 |
| NPAB                                      | Northeast Plateau Air Basin                                                                        |
| NPDES                                     | National Pollution Discharge Elimination System                                                    |
| NPS                                       | nonpoint source                                                                                    |
| NPS Implementation and Enforcement Policy | Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program         |
| NPS Program Plan                          | <i>Plan for California's Nonpoint Source Pollution Control Program</i><br>(State Water Board 1999) |
| NRCS                                      | Natural Resources Conservation Service                                                             |
| NRHP                                      | National Register of Historic Places                                                               |
| NSR                                       | New Source Review                                                                                  |
| NWP                                       | nationwide permit                                                                                  |
| NWR                                       | National Wildlife Refuge                                                                           |
| OHP                                       | California State Office of Historic Preservation                                                   |
| OHWM                                      | ordinary high water mark                                                                           |
| OPP                                       | Office of Pesticide Programs                                                                       |
| OPR                                       | Office of Planning and Research                                                                    |
| PAM                                       | polyacrylamides                                                                                    |
| Peak Velocity or PPV                      | peak particle velocity                                                                             |
| PEIR                                      | Program Environmental Impact Report                                                                |
| PFC                                       | perfluorocarbon                                                                                    |
| PM <sub>10</sub>                          | particulate matter less than or equal to 10 microns in diameter                                    |
| PM <sub>2.5</sub>                         | particulate matter 2.5 microns or less in diameter                                                 |
| POD                                       | Pelagic Organism Decline                                                                           |

|                      |                                                                                                                                         |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| Porter-Cologne Act   | Porter-Cologne Water Quality Control Act                                                                                                |
| ppb                  | parts per billion                                                                                                                       |
| ppm                  | parts per million                                                                                                                       |
| ppt                  | parts per thousand                                                                                                                      |
| PRC                  | Public Resources Code                                                                                                                   |
| RBDD                 | Red Bluff Diversion Dam                                                                                                                 |
| RCD                  | Resource Conservation District                                                                                                          |
| Reclamation          | U.S. Department of the Interior, Bureau of Reclamation                                                                                  |
| Regional Water Board | Regional Water Quality Control Board                                                                                                    |
| ROG                  | reactive organic gases                                                                                                                  |
| SAA                  | streambed alteration agreement                                                                                                          |
| SB                   | Senate Bill                                                                                                                             |
| SC                   | State Candidate                                                                                                                         |
| SCAB                 | South Coast Air Basin                                                                                                                   |
| SCAQMD               | South Coast Air Quality Management District                                                                                             |
| SCCAB                | South Central Coast Air Basin                                                                                                           |
| SE                   | State Endangered                                                                                                                        |
| SF <sub>6</sub>      | sulfur hexafluoride                                                                                                                     |
| SFBAAB               | San Francisco Bay Area Air Basin                                                                                                        |
| SIP                  | State Implementation Plan                                                                                                               |
| SJVAB                | San Joaquin Valley Air Basin                                                                                                            |
| SJVAPCD              | San Joaquin Valley Air Pollution Control District                                                                                       |
| SMAQMD               | Sacramento Metropolitan Air Quality Management District                                                                                 |
| SO <sub>2</sub>      | sulfur dioxide                                                                                                                          |
| SPRR                 | Southern Pacific Railroad                                                                                                               |
| SSC                  | Species of Special Concern                                                                                                              |
| ST                   | State Threatened                                                                                                                        |
| Staff Report         | <i>Draft Irrigated Lands Regulatory Program Long-Term Program Development Staff Report</i> (CalEPA and Central Valley Water Board 2010) |
| State Water Board    | State Water Resources Control Board                                                                                                     |
| SVAB                 | Sacramento Valley Air Basin                                                                                                             |
| SWANCC               | Solid Waste Agency of Northern Cook County v. United States Army Corps of Engineers (121 S. Ct. 675 [2001])                             |
| SWPPP                | stormwater pollution prevention plan                                                                                                    |
| TAC                  | toxic air contaminant                                                                                                                   |
| TCM                  | transportation control measure                                                                                                          |
| TCP                  | traditional cultural property                                                                                                           |
| TDS                  | total dissolved solid                                                                                                                   |
| the Basin Plan       | Central Valley Water Board Water Quality Control Plan                                                                                   |

|            |                                |
|------------|--------------------------------|
| TMDL       | total maximum daily load       |
| TNS        | Townet Survey                  |
| USACE      | U.S. Army Corps of Engineers   |
| USC        | United States Code             |
| USDA       | U.S. Department of Agriculture |
| USFWS      | U.S. Fish and Wildlife Service |
| USGS       | U.S. Geological Survey         |
| Water Code | California Water Code          |
| WDRs       | waste discharge requirements   |
| Workgroup  | Stakeholder Advisory Workgroup |
| YOY        | young-of-the year              |

### 1.1 Introduction

Discharges from agricultural lands include irrigation return flow; flows from tile drains; and storm water runoff from fields, managed wetlands, nurseries, and water districts that accept agricultural discharges. These discharges can affect water quality by transporting constituents of concern including pesticides, sediment, nutrients, salts (including selenium and boron), pathogens, and heavy metals from cultivated fields into surface waters. Many surface water bodies are impaired because of pollutants from agricultural sources. Groundwater bodies also have suffered pesticide, nitrate, and salt contamination. Statewide, approximately 9,493 miles of rivers/streams and some 513,130 acres of lakes/reservoirs are listed on the Section 303(d) list as being impaired by irrigated agriculture. Of these, approximately 2,800 miles, or approximately 28 percent, have been identified as impaired by pesticides.

Since 1982, the Central Valley Regional Water Quality Control Board (Central Valley Water Board) has regulated nonpoint source (NPS) discharges from agricultural lands through a waiver of waste discharge requirements (WDRs). Senate Bill (SB) 390, signed into law on October 6, 1999, amended Section 13269 of the California Water Code (Water Code) to require the State Water Resources Control Board (State Water Board) and Regional Water Quality Control Boards (Regional Water Boards) to review their existing waivers and to renew them or replace them with WDRs. Under SB 390, waivers not reissued automatically expired on January 1, 2003. To comply with SB 390, the Regional Water Boards adopted revised waivers. To comply with the requirements of SB 390, the Central Valley Water Board adopted a Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands (Conditional Waiver).

Under the 2003 Conditional Waiver, the Central Valley Water Board directed staff to prepare an Environmental Impact Report (EIR) for a long-term Irrigated Lands Regulatory Program (ILRP). The 2003 Conditional Waiver expired in 2006, and a revised Conditional Waiver was adopted that continues the Conditional Waiver until June 2011. With adoption of the 2006 Conditional Waiver, the Central Valley Water Board reaffirmed its goal of analyzing the environmental effects of alternatives for a long-term ILRP through development and public review of a Program Environmental Impact Report (EIR or PEIR). This draft PEIR analyzes the environmental impacts of five program alternatives and will assist the Central Valley Water Board in determining which alternative, or elements of alternatives, would best meet applicable statutory requirements and the goals and objectives of the ILRP.

### 1.2 Overview of Central Valley Agriculture

The Central Valley is a large, flat, fertile valley that dominates the central portion of California. The northern half of the Central Valley is referred to as the Sacramento Valley, and the southern half is referred to as the San Joaquin Valley. The two halves meet at the shared delta of the Sacramento and San Joaquin Rivers, which flow through the northern and southern halves of the valley, respectively.



The Central Valley is one of the most productive agricultural regions in the world. Crops produced in the Central Valley include land planted to vineyard, row, pasture, field, and tree crops; commercial nurseries; nursery stock production; rice production; greenhouse operations; and livestock.

The program area encompasses the jurisdiction of the Central Valley Water Board, shown in Figure 2-1. The Central Valley Water Board's region stretches from the Oregon border to the northernmost tip of Los Angeles County. Three major watersheds have been delineated within this region: the Sacramento River Basin, the San Joaquin River Basin, and the Tulare Lake Basin. These three basins cover approximately 40 percent of the total area of the state and include approximately 75 percent of California's irrigated acreage (Central Valley Water Board 2002a). Much of the surface water supplies in the Central Valley originate north of the Sacramento–San Joaquin River Delta (Delta), while much of the water use is south of the Delta. Although the surface water in the Sacramento River Basin is adequate to meet the present level of demand, surface water supplies in the San Joaquin River and Tulare Lake Basins are inadequate to support the present level of agricultural and development use. In these basins, groundwater resources are being used to meet existing water supply demands.

## 1.3 Program Purpose and Objectives

The proposed goals and objectives of the ILRP are those recommended by the Stakeholder Advisory Workgroup (Workgroup) (Central Valley Water Board and ICF Jones & Stokes 2009). *Irrigated agricultural lands* include lands where water is applied to produce crops, fiber, or livestock for commercial sale or use. For the purposes of this draft PEIR, irrigated agricultural lands also include managed wetlands, nurseries, and water districts that accept discharges from irrigated lands. Understanding that irrigated agriculture in the Central Valley provides valuable food and fiber products to communities worldwide, the overall goals of the ILRP are to (1) restore and/or maintain the highest reasonable quality of state waters considering all the demands being placed on the water; (2) minimize waste discharge from irrigated agricultural lands that could degrade the quality of state waters; (3) maintain the economic viability of agriculture in California's Central Valley; and (4) ensure that irrigated agricultural discharges do not impair access by Central Valley communities and residents to safe and reliable drinking water. In accordance with these goals, the objectives of the ILRP are to:

- Restore and/or maintain appropriate beneficial uses established in Central Valley Water Board water quality control plans by ensuring that all state waters meet applicable water quality objectives.
- Encourage implementation of management practices that improve water quality in keeping with the first objective without jeopardizing the economic viability for all sizes of irrigated agricultural operations in the Central Valley or placing an undue burden on rural communities to provide safe drinking water.
- Provide incentives (i.e., financial assistance, monitoring reductions, certification, or technical help) for agricultural operations to minimize waste discharge to state waters from their operations.
- Coordinate with other Central Valley Water Board programs (e.g., the Grasslands Bypass Project WDRs for agricultural lands, efforts by the Westlands Water District to develop WDRs for

agricultural lands, development of total maximum daily loads [TMDLs] for Central Valley Salinity Alternatives for Long-Term Sustainability [CV-SALTS], and WDRs for dairies).

- Promote coordination with other regulatory and non-regulatory programs associated with agricultural operations to minimize duplicative regulatory oversight while ensuring program effectiveness (e.g., U.S. Department of Agriculture [USDA] National Organic Program, State Water Board Groundwater Ambient Monitoring and Assessment Program).

## 1.4 Program Description

The alternatives analyzed in this draft PEIR are the result of an intensive workgroup process described in Chapter 2, Introduction. The Central Valley Water Board intends to consider the analysis in this draft PEIR in selecting a preferred alternative, either one considered in this document directly or a staff-recommended program comprised of elements from multiple considered alternatives. Therefore, the document does not identify a “preferred alternative.” All alternatives selected for analysis are analyzed to an equal level of detail. The alternatives are described in greater detail in Chapter 3.

### 1.4.1 Alternative 1 – Full Implementation of Current Program (No Project Alternative)

Under Alternative 1, the Central Valley Water Board would renew the current program and continue to implement it into the future. This would be considered the “No Project” Alternative per California Environmental Quality Act (CEQA) guidance at Title 14 California Code of Regulations (CCR) Section 15126.6(e)(3)(A): “When the project is the revision of an existing land use or regulatory plan, policy or ongoing operation, the ‘No Project’ Alternative will be the continuation of the existing plan, policy, or operation into the future.” Given the ministerial nature of the extension or renewal of the ongoing waiver, which would allow continuation of the existing program, Alternative 1 is best characterized as the “No Project” Alternative. This approach best serves the purpose of allowing the Central Valley Water Board to compare the impacts of revising the ILRP with those of continuing the existing program (14 CCR Section 15126.6[e][1]).<sup>1</sup>

Coalition groups would continue to function as lead entities representing growers (owners of irrigated lands, wetland managers, nursery owners, and water districts). This alternative is based on continuing watershed monitoring to determine whether operations are causing water quality problems. Where monitoring indicates a problem, third-party groups and growers would be required to implement management practices to address the problem and work toward compliance with applicable water quality standards. This alternative would not establish any new Central Valley Water Board requirements for discharges to groundwater from irrigated agricultural lands.

Under this alternative, the Central Valley Water Board would renew the current program through WDRs or a waiver of the WDRs. Water quality coalition groups have formed throughout the Central Valley to function as representative or “lead” entities in administration of the current ILRP.

---

<sup>1</sup> The existing environmental setting, not the “No Project” Alternative, constitutes the baseline for determining whether a project’s environmental impacts may be significant (14 CCR Section 15126.5[e][1]). Therefore, defining the “No Project” Alternative as continuing the existing program does not change the analysis of the environmental impacts under the remaining alternatives.

Coalitions represent growers, provide education, organize monitoring, and work with the Central Valley Water Board to help ensure that the current program is effectively implemented. These third-party water quality coalition groups would continue to function as lead entities for their members to ensure that all Central Valley Water Board requirements are met.

Monitoring under this alternative would be the same as the watershed-based assessment and core monitoring required under the current ILRP. Under this monitoring scheme, coalition groups would work with the Central Valley Water Board to develop monitoring plans for Central Valley Water Board approval. These plans would specify monitoring parameters and site locations.

## **1.4.2 Alternative 2 – Third-Party Lead Entity**

Under Alternative 2, the Central Valley Water Board would develop a single mechanism or a series of regulatory mechanisms for waste discharge from irrigated agricultural lands to groundwater and surface water. The series of regulatory mechanisms would be designed to provide flexibility in establishing requirements for growers considering the variety of environmental conditions and agricultural operations throughout the Central Valley. These could include WDRs, conditional waivers of WDRs, or conditional prohibitions of discharge.

Under Alternative 2, third-party groups (e.g., water quality coalitions) would function as lead entities representing growers. Regulation of discharges to surface water would be similar to Alternative 1 (the current ILRP). However, this alternative allows for a reduction in monitoring under lower threat circumstances and where watershed or area management objective plans are being developed. This alternative also includes requirements for development of groundwater quality management plans (GQMPs) to minimize discharge of waste to groundwater from irrigated lands. However, GQMPs under this alternative would not involve monitoring of groundwater to determine the performance of these management plans. These GQMPs would be reviewed every 5 years by the Central Valley Water Board and the third-party groups to determine whether and how the GQMPs should be updated. This alternative also relies on coordination with the California Department of Pesticide Regulation (DPR) for regulating discharges of pesticides to groundwater.

Under this alternative, water quality coalitions or other third-party groups would be responsible for general administration of the ILRP and would need to agree to assume greater responsibilities than under Alternative 1. (See Chapter 3 for a detailed list of these responsibilities.)

Third-party groups would have the option of developing a watershed or area management objectives plan. The goal of this plan would be to meet source control management objectives that would reduce the threat to surface water quality from waste discharge associated with irrigated agriculture. In areas implementing a Central Valley Water Board-approved watershed or area management objectives plan, surface water monitoring would be reduced. Plans would specify optional water quality management practices that could be implemented to achieve plan objectives. Further, the plan would be developed consistent with the area or watershed commodity types, common agricultural practices, pesticides commonly used, and local land characteristics. Optional practices would be provided to allow growers to adapt to their specific conditions for compliance with the ILRP. The plan also would consider the results of previous water quality sampling.

Growers would be required to track implemented management practices and submit the results to the third-party group. The third-party group would report summary results to the Central Valley Water Board. The third-party group would be required to summarize the results of groundwater

and surface water monitoring and tracking in an annual monitoring report to the Central Valley Water Board.

### **1.4.3 Alternative 3 – Individual Farm Water Quality Management Plan**

Under Alternative 3, growers would have the option of working directly with the Central Valley Water Board or another implementing entity (e.g., county agricultural commissioners [CACs]) in development of a farm water quality management plan (FWQMP). Growers would individually apply for a conditional waiver or WDRs that would require Central Valley Water Board approval of their FWQMP.

On-farm implementation of effective water quality management practices would be the mechanism to reduce or eliminate waste discharged to state waters. This alternative would provide incentive for individual growers to participate by providing growers with Central Valley Water Board certification that they are implementing farm management practices to protect state waters. This alternative relies on coordination with DPR for regulating discharges of pesticides to groundwater.

Under Alternative 3, growers would be the lead entities working directly with the Central Valley Water Board and would be responsible for applying for coverage, developing FWQMPs, and conducting any required reporting.

Unless specifically required in response to water quality problems, owners/operators would not be required to conduct water quality monitoring of adjacent receiving waters or underlying groundwater. Required monitoring would include evaluation of management practice effectiveness. The Central Valley Water Board, or a designated third-party entity, would conduct annual site inspections on a selected number of operations. They also would review available applicable water quality monitoring data as additional means of monitoring the implementation of management practices and program effectiveness.

### **1.4.4 Alternative 4 – Direct Oversight with Regional Monitoring**

Under this alternative, the Central Valley Water Board would develop WDRs and/or a conditional waiver of WDRs for waste discharge from irrigated agricultural lands to groundwater and surface water. As in Alternative 3, growers, or legal entities responsible for waste discharges by a group of growers, would apply directly to the Central Valley Water Board in order to obtain coverage (“direct oversight”). As in Alternative 3, growers would be required to develop and implement individual FWQMPs in order to minimize discharge of waste to groundwater and surface water from irrigated agricultural lands. However, Alternative 4 would include an option for regional monitoring run by a third party instead of monitoring conducted by individual growers.

Discharge of waste to groundwater and surface water would be regulated using a tiered approach. Fields would be placed in one of three tiers based on their threat to water quality. The tiers represent fields with minimal (Tier 1), low (Tier 2), and high (Tier 3) potential threat to water quality. Requirements to avoid or minimize discharge of waste would be the least stringent for Tier 1 fields and the most stringent for Tier 3 fields. This would allow for less regulatory oversight for low-threat operations while establishing necessary requirements to protect water quality from

higher-threat discharges. This alternative relies on coordination with DPR for regulating discharges of pesticides to groundwater.

Growers would be lead entities working directly with the Central Valley Water Board; they would be responsible for applying for coverage, developing FWQMPs, and conducting any required monitoring and reporting. This alternative would allow for formation of responsible legal entities that could serve a group of growers who discharge to the same general location and thus could share monitoring locations. In such cases, the legal entity would be required to assume responsibility for the waste discharges of member growers, to be approved by the Central Valley Water Board, and ultimately to be responsible for compliance with ILRP requirements.

For monitoring, growers would have the option of enrolling in a third-party group regional monitoring program instead of conducting individual monitoring. In cases where responsible legal entities were formed, these entities would be responsible for conducting monitoring. All growers would be required to track nutrient, pesticide, and implemented management practices and submit the results to the Central Valley Water Board (or an approved third-party monitoring group) annually. Other monitoring requirements would depend on designation of the fields as Tier 1, Tier 2, or Tier 3. (See Chapter 3 for a full description of this alternative.)

## **1.4.5 Alternative 5 – Direct Oversight with Farm Monitoring**

Alternative 5 would consist of general WDRs designed to protect groundwater and surface water from discharges associated with irrigated agriculture.

All growers would be required to apply for and obtain coverage under the general WDRs. This alternative would include requirements to (1) develop and implement a FWQMP; (2) monitor (a) discharges of tailwater, drainage water, and storm water to surface water; (b) applications of irrigation water, nutrients, and pesticides; and (c) groundwater; (3) keep records of (a) irrigation water; (b) pesticide applications; and (c) the nutrients applied, harvested, and moved off the site; and (4) submit an annual monitoring report to the Central Valley Water Board.

Alternative 5 relies on coordination with DPR for regulating discharges of pesticides to groundwater. The Central Valley Water Board would develop general WDRs for irrigated agriculture. Growers would be the lead entity in working with the Central Valley Water Board. The Central Valley Water Board would adopt the WDRs, enroll individual growers under the program, provide regulatory oversight, and enforce the requirements of the program.

Each grower would be required to monitor tailwater discharges, storm water discharges, and drainage system discharges. In addition, each grower would be required to conduct nutrient and pesticide tracking as well as groundwater monitoring.

## **1.5 CEQA Process**

### **1.5.1 Purpose of This Draft PEIR**

The Lead Agency, the Central Valley Water Board, will consult this draft PEIR in determining which alternative, or elements of alternatives, would best meet applicable statutory requirements and the goals and objectives of the ILRP.

## 1.5.2 Public Outreach

As the ILRP has been developed, the Central Valley Water Board has sought public input on many occasions, as described at length in Chapter 2, Introduction. Public comment on this draft PEIR has been requested through a scoping process described below and is again invited during the public comment period.

### Notice of Preparation

The Central Valley Water Board released a Notice of Preparation (NOP) on February 14, 2003.

### Scoping

On March 5 and 6, 2003, CEQA scoping meetings were held in Fresno and Sacramento to solicit and receive public comment on the scope of the EIR as described in the NOP. Following the scoping meetings, the Central Valley Water Board began preparation of the draft *Existing Conditions Report* (ECR) in 2004 to assist in defining the baseline condition for the EIR's environmental analyses. The draft ECR was circulated in 2006, public comment on the document was received and incorporated, and it was released in 2008 (ICF Jones & Stokes 2008).

In March and April 2008, the Central Valley Water Board staff conducted [another series of CEQA scoping meetings](#) to generate recommendations on the scope and goals of the long-term ILRP. Information also was gathered as to how stakeholders would like to be involved in development of the long-term program. Stakeholders indicated in these scoping meetings that they would like to be actively involved in developing the program. To address this interest, the Central Valley Water Board initiated a series of Workgroup meetings, described below.

## 1.5.3 Scope of Draft PEIR Analysis

All CEQA-recognized environmental resources were analyzed for possible environmental impacts resulting from the ILRP alternatives. The alternatives were determined to have possible significant effects on several resource areas, which are discussed at length in Chapter 5. Likewise, the alternatives were determined to have no significant impact on other resources, which are discussed in Section 5.11, Minimally Impacted Resources.

### Resources with Potentially Significant Impacts

The Central Valley Water Board determined that the program could result in potentially significant impacts on the following resources, which thus warrant close scrutiny:

- Cultural resources
- Noise
- Air quality
- Climate change
- Vegetation and wildlife
- Fisheries
- Hydrology and water quality



- Agriculture resources

## Resources Not Significantly Impacted

The Central Valley Water Board has determined that the program will result in no or less-than-significant direct impacts and no indirect impacts on the following resources, which thus do not warrant close scrutiny:

- Aesthetics
- Geology and soils
- Hazards and hazardous materials
- Land use and planning
- Mineral resources and energy
- Population and housing
- Public services
- Recreation
- Transportation and circulation
- Utilities and service systems

## Known Areas of Controversy

In accordance with State CEQA Guidelines Section 15123(b)(2), the areas of controversy known to the lead agency, including issues raised by agencies and the public, shall be identified in the EIR. Through public scoping, the efforts of the Workgroup, and other outreach efforts, the following areas of controversy were identified:

- The costs to growers of implementing a more stringent ILRP will be prohibitive and suppress the economic sustainability or growth of agriculture.
- Adding a groundwater monitoring element to the ILRP would be unnecessarily duplicative of existing monitoring efforts.
- The alternatives do not contain a clear methodology for defining a groundwater discharger or determining the nature of discharges to groundwater.
- The program does not take adequate steps to offset the costs to rural communities for cleanup of existing water quality impairments that can be linked back to historical agricultural discharges.



### **1.5.4 Public Comment on the Draft PEIR**

This draft PEIR was made available for public review and comment on July 28, 2010. In addition, the Central Valley Water Board will conduct public hearings on the draft document. Comments received at the hearings or received in written form will be considered in development of a final PEIR.

Comments may be sent to:

ILRP Comments

Ms. Megan Smith

630 K Street, Suite 400

Sacramento, CA 95814

Email: [ILRPcomments@icfi.com](mailto:ILRPcomments@icfi.com)

Fax: (916) 456-6724

## 1.6 Summary of Program Environmental Impacts and Mitigation

Table 1-1 provides a summary of the potential impacts and mitigation measures for the ILRP.

**Table 1-1. Summary of Impacts and Mitigation Measures for the Irrigated Lands Regulatory Program**

| <b>Impact</b>                                                                                                               | <b>Applicable Alternative</b> | <b>Significance before Mitigation</b> | <b>Mitigation Measures</b>                                                                                                | <b>Significance after Mitigation</b> |
|-----------------------------------------------------------------------------------------------------------------------------|-------------------------------|---------------------------------------|---------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| <b>CULTURAL RESOURCES</b>                                                                                                   |                               |                                       |                                                                                                                           |                                      |
| CUL-1. Physical Destruction, Alteration, or Damage of Cultural Resources from Implementation of Management Practices        | 1, 2, 3, 4, 5                 | Significant                           | CUL-MM-1: Avoid Impacts to Cultural Resources                                                                             | Less than significant                |
| CUL-2. Potential Damage to Cultural Resources from Construction Activities and Installation of Groundwater Monitoring Wells | 5                             | Significant                           | CUL-MM-1: Avoid Impacts to Cultural Resources                                                                             | Less than significant                |
| <b>NOISE</b>                                                                                                                |                               |                                       |                                                                                                                           |                                      |
| NOI-1. Exposure of Sensitive Land Uses to Noise from Construction Activities in Excess of Applicable Standards              | 1, 2, 3, 4, 5                 | Potentially significant               | NOI-MM-1: Implement Noise-Reducing Construction Practices                                                                 | Less than significant                |
| NOI-2. Exposure of Sensitive Land Uses to Noise from Operational Activities in Excess of Applicable Standards               | 1, 2, 3, 4, 5                 | Potentially significant               | NOI-MM-1: Implement Noise-Reducing Construction Practices<br>NOI-MM-2: Reduce Noise Generated by Individual Well Pumps    | Less than significant                |
| <b>AIR QUALITY</b>                                                                                                          |                               |                                       |                                                                                                                           |                                      |
| AQ-1. Generation of Construction Emissions in Excess of Local Air District Thresholds                                       | 1, 2, 3, 4, 5                 | Potentially significant               | AQ-MM-1: Apply Applicable Air District Mitigation Measures to Reduce Construction Emissions below the District Thresholds | Less than significant                |
| AQ-2. Generation of Operational Emissions in Excess of Local Air District Thresholds                                        | 1, 2, 3, 4, 5                 | Potentially significant               | AQ-MM-2: Apply Applicable Air District Mitigation Measures to Reduce Operational Emissions below the District Thresholds  | Less than significant                |

| Impact                                                                                                                                               | Applicable Alternative | Significance before Mitigation | Mitigation Measures                                                                                                                                                                                                                                                                                                                             | Significance after Mitigation |
|------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| AQ-3. Elevated Health Risks from Exposure of Nearby Sensitive Receptors to TACs/HAPs                                                                 | 1, 2, 3, 4, 5          | Potentially significant        | AQ-MM-1: Apply Applicable Air District Mitigation Measures to Reduce Construction Emissions below the District Thresholds<br>AQ-MM-2: Apply Applicable Air District Mitigation Measures to Reduce Operational Emissions below the District Thresholds<br>AQ-MM-3: Apply Applicable Air District Mitigation Measures to Reduce TAC/HAP Emissions | Less than significant         |
| <b>CLIMATE CHANGE</b>                                                                                                                                |                        |                                |                                                                                                                                                                                                                                                                                                                                                 |                               |
| CC-1. Generation of Greenhouse Gas Emissions Resulting in Global Climate Change                                                                      | 1, 2, 3, 4, 5          | Less than significant          | No mitigation is required.<br>CC-MM-1: Apply Applicable Air District Mitigation Measures to Reduce Construction and Operational GHG Emissions (recommended)<br>CC-MM-2: Apply Applicable California Attorney General Mitigation Measures to Reduce Construction and Operational GHG Emissions (recommended)                                     | –                             |
| <b>VEGETATION AND WILDLIFE</b>                                                                                                                       |                        |                                |                                                                                                                                                                                                                                                                                                                                                 |                               |
| BIO-1. Loss of Downstream Habitat from Reduced Field Runoff                                                                                          | 1, 2, 3, 4, 5          | Potentially significant        | BIO-MM-2: Determine Extent of Wetland Loss and Compensate for Permanent Loss of Wetlands                                                                                                                                                                                                                                                        | Less than significant         |
| BIO-2. Improved Water Quality in Natural Communities Adjacent to Agricultural Lands and Managed Wetlands                                             | 1, 2, 3, 4, 5          | Beneficial                     | No mitigation is required.                                                                                                                                                                                                                                                                                                                      | –                             |
| BIO-3. Potential Loss of Sensitive Natural Communities and Special-Status Plants from Construction Activities                                        | 1, 2, 3, 4, 5          | Potentially significant        | BIO-MM-1: Avoid and Minimize Impacts on Sensitive Biological Resources                                                                                                                                                                                                                                                                          | Less than significant         |
| BIO-4. Potential Loss of Wetland Communities due to Loss of Existing Sedimentation Ponds                                                             | 2, 3, 4, 5             | Potentially significant        | BIO-MM-2: Determine Extent of Wetland Loss and Compensate for Permanent Loss of Wetlands                                                                                                                                                                                                                                                        | Less than significant         |
| BIO-5. Impacts to Special-Status Wildlife Species due to Loss of Existing Sedimentation Ponds                                                        | 2, 3, 4, 5             | Potentially significant        | BIO-MM-1: Avoid and Minimize Impacts on Sensitive Biological Resources                                                                                                                                                                                                                                                                          | Less than significant         |
| BIO-6. Loss of Sensitive Natural Communities and Special-Status Plants from Construction Activities and Installation of Groundwater Monitoring Wells | 5                      | Potentially significant        | BIO-MM-1: Avoid and Minimize Impacts on Sensitive Biological Resources                                                                                                                                                                                                                                                                          | Less than significant         |

| <b>Impact</b>                                                                                                                                    | <b>Applicable Alternative</b> | <b>Significance before Mitigation</b> | <b>Mitigation Measures</b>                                                    | <b>Significance after Mitigation</b> |
|--------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|---------------------------------------|-------------------------------------------------------------------------------|--------------------------------------|
| BIO-7. Loss of Special-Status Wildlife from Construction Activities and Installation of Groundwater Monitoring Wells                             | 5                             | Potentially significant               | BIO-MM-1: Avoid and Minimize Impacts on Sensitive Biological Resources        | Less than significant                |
| <b>FISHERIES</b>                                                                                                                                 |                               |                                       |                                                                               |                                      |
| FISH-1. Improvement to Surface Water Quality in Water Bodies Receiving Inputs from Agricultural Lands and Managed Wetlands                       | 1, 2, 3, 4, 5                 | Beneficial                            | No mitigation is required.                                                    | –                                    |
| FISH-2. Temporary Loss or Alteration of Fish Habitat during Construction of Facilities for Management Practices                                  | 1, 2, 3, 4, 5                 | Potentially significant               | FISH-MM-1: Avoid and Minimize Impacts to Fish and Fish Habitat                | Less than significant                |
| FISH-3. Permanent Loss or Alteration of Fish Habitat during Construction of Facilities for Management Practices                                  | 1, 2, 3, 4, 5                 | Potentially significant               | FISH-MM-2: Educate Growers on the Use of Polyacrylamides for Sediment Control | Less than significant                |
| FISH-4. Toxicity to Fish or Fish Prey from Particle-Coagulant Water Additives                                                                    | 1, 2, 3, 4, 5                 | Potentially significant               | FISH-MM-2: Educate Growers on the Use of Polyacrylamides for Sediment Control | Less than significant                |
| FISH-5. Temporary Loss or Alteration of Fish Habitat during Wellhead Protection Construction Required by Groundwater Quality Management Plans    | 2, 3, 4, 5                    | Less than significant                 | No mitigation is required.                                                    | –                                    |
| FISH-6. Temporary Loss or Alteration of Fish Habitat during Construction of Facilities for Management Practices and Groundwater Monitoring Wells | 5                             | Potentially significant               | FISH-MM-1: Avoid and Minimize Impacts to Fish and Fish Habitat                | Less than significant                |
| FISH-7. Permanent Loss or Alteration of Fish Habitat during Construction of Facilities for Management Practices and Groundwater Monitoring Wells | 5                             | Potentially significant               | FISH-MM-1: Avoid and Minimize Impacts to Fish and Fish Habitat                | Less than significant                |
| <b>HYDROLOGY AND WATER QUALITY</b>                                                                                                               |                               |                                       |                                                                               |                                      |
| SWQ = surface water quality                                                                                                                      |                               |                                       |                                                                               |                                      |
| HWQ = groundwater quality                                                                                                                        |                               |                                       |                                                                               |                                      |

| <b>Impact</b>                                                                                                                       | <b>Applicable Alternative</b> | <b>Significance before Mitigation</b>           | <b>Mitigation Measures</b>                                                                                                                                  | <b>Significance after Mitigation</b> |
|-------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|-------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| HYD-1. Change in Quality of State Waters from Agricultural Discharge or Alteration of Hydrologic Patterns of Runoff or Infiltration | 1                             | SWQ: Beneficial<br>GWQ: Potentially significant | SWQ: No mitigation is required.<br>GWQ: Mitigation Measure HYD-MM-1: Develop and Implement a Groundwater Quality Management Plan                            | SWQ: –<br>GWQ: Less than significant |
| HYD-1. Change in Quality of State Waters from Agricultural Discharge or Alteration of Hydrologic Patterns of Runoff or Infiltration | 2, 3, 4, 5                    | Beneficial                                      | No mitigation is required.                                                                                                                                  | –                                    |
| <b>AGRICULTURE RESOURCES</b>                                                                                                        |                               |                                                 |                                                                                                                                                             |                                      |
| AG-1. Conversion of Prime Farmland, Unique Farmland, and Farmland of Statewide Importance to Nonagricultural Use                    | 1, 2, 3, 4, 5                 | Significant                                     | AG-MM-1: Assist the Agricultural Community in Identifying Sources of Financial Assistance That Would Allow Growers to Keep Important Farmland in Production | Significant and unavoidable          |

## 2.1 Introduction

*Irrigated agricultural lands* include lands where water is applied to produce crops, fiber, or livestock for commercial sale or use. For the purposes of this draft PEIR, irrigated agricultural lands also include managed wetlands, nurseries, and water districts that accept or receive discharges from irrigated lands. Discharges from agricultural lands can include irrigation return flow, flows from tile drains, and storm water runoff. These discharges can affect water quality by transporting constituents of concern, including pesticides, sediment, nutrients, salts (including selenium and boron), pathogens, and heavy metals, from cultivated fields into surface waters. Many surface water bodies are impaired because of pollutants from agricultural sources. Groundwater bodies also have suffered pesticide, nitrate, and salt contamination.

The Lead Agency, the Central Valley Water Board, has developed this draft PEIR in accordance with the State CEQA Guidelines to analyze the potential environmental impacts of several feasible alternatives for a long-term ILRP, to address agricultural discharges. These program alternatives were developed through cooperation with the Workgroup and represent a wide range of possible regulatory approaches, all of which are examined at an equal level of detail within this document. The Central Valley Water Board has not identified a preferred alternative from among those developed by the Workgroup. This level of analysis, which exceeds that of a typical EIR with an identified preferred project, will inform the Central Valley Water Board's decision-making process when they make their final selection of an ILRP.

The Central Valley Water Board staff-recommended ILRP will be selected from the elements of the alternatives considered in this draft PEIR. Rather than the typical EIR approach of starting with a project and then looking at alternatives to that project, this draft PEIR will be used as a tool to inform decision makers during the selection process. In addition to environmental analysis, economics and policy considerations have been evaluated. As part of the policy analysis, each alternative was evaluated to determine how well the alternative implements minimum statutory requirements and other required policy (see Section 5.2, Consistency with Plans and Policies; the *Technical Memorandum Concerning the Economic Analysis of the Irrigated Lands Regulatory Program* [ICF International 2010] [Draft ILRP Economics Report] and the *Draft Irrigated Lands Regulatory Program Long-Term Program Development Staff Report* [CalEPA and Central Valley Water Board 2010] [Staff Report] for an expanded discussion [see Appendix A]).

## 2.2 Program Background

California's Porter-Cologne Water Quality Control Act (Porter-Cologne Act) established the State Water Board and divided the state into nine regional basins, each with a Regional Water Board, of which the Central Valley Water Board is one (Water Code Section 13200). The State Water Board is the "principle state agency with the primary responsibility for the coordination and the control of water quality" in California (Water Code Section 13201).

The Porter-Cologne Act authorizes the State Water Board to draft state policies regarding water quality and, in accordance with Water Code Section 13263, to develop general WDRs and project-specific WDRs for projects that would discharge into state waters, defined by Water Code Section 13050 as any surface water or groundwater, including saline waters, within the boundaries of the state. Regional Water Boards are authorized to develop general and project-specific WDRs for projects that would discharge into waters within their jurisdiction.

The Water Code requires that Regional Water Boards adopt water quality control plans (Basin Plans) in accordance with Section 13240. The State Water Board is allowed, but not required, to adopt Basin Plans in accordance with Section 13170 of the Water Code.

In January 2000, the State Water Board—in its continuing efforts to control NPS pollution in California—adopted the *Plan for California's Nonpoint Source Pollution Control Program* (NPS Program Plan) (State Water Board 1999), and brought the State into compliance with the requirements of Section 319 of the federal Clean Water Act (CWA) and Section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA).

On May 20, 2004, the State Water Board adopted the *Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program* (NPS Implementation and Enforcement Policy). The NPS Implementation and Enforcement Policy was adopted by the State Water Board in order to comply with the 1999 amendment of the Porter-Cologne Act to enforce the State's NPS pollution control program. The policy requires the Regional Water Board to regulate all NPS pollution through a program meeting five key elements:

- The ultimate purpose of the NPS pollution control implementation program must be explicitly stated and, at a minimum, must address NPS pollution control in a manner that achieves and maintains water quality objectives.
- The NPS pollution control implementation program must include a description of the water quality management practices (management practices) and other program elements expected to be implemented, along with an evaluation program that ensures proper implementation and verification.
- The NPS pollution control implementation program should include a time schedule and quantifiable milestones, if the Regional Water Board so requires.
- The NPS pollution control implementation program must include sufficient feedback mechanisms so that the Regional Water Board, dischargers, and the public can determine whether the implementation program is achieving its stated purpose(s), or whether additional or different management practices or other actions are required.
- Each Regional Water Board must make clear, in advance, the potential consequences for failure to achieve the objectives of its NPS pollution control implementation program, emphasizing that it is the responsibility of individual dischargers to take all necessary implementation actions to meet water quality requirements.

The Regional Water Boards have primary responsibility for ensuring that appropriate NPS pollution control implementation programs are in place throughout the state. Regional Water Board responsibilities include, but are not limited to, issuing WDRs or a waiver of WDRs for individual discharges or a category of NPS discharges, or adopting a Basin Plan amendment that addresses NPS discharges.



Since 1982, the Central Valley Water Board has regulated NPS discharges from agricultural lands through a waiver of WDRs. SB 390 involved changes to Section 13269 of the Water Code relating to how the Central Valley Water Board adopts waivers. The legislative change requires that, if the Central Valley Water Board adopts waivers, they must comply with the new Section 13269—or the dischargers operating under the 1982 waivers would need to submit Reports of Waste Discharge and obtain WDRs, or comply with the Water Code. To comply with the requirements of SB 390, the Central Valley Water Board adopted a Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands (Conditional Waiver) in 2003.

As part of the 2003 Conditional Waiver, the Central Valley Water Board directed staff to prepare an EIR for a long-term ILRP. The 2003 interim waiver program expired in 2006. In 2006, the Central Valley Water Board adopted a new Conditional Waiver for discharges from irrigated agricultural lands that continues the Conditional Waiver interim program until 2011. In the 2006 Conditional Waiver, the Central Valley Water Board reaffirmed the goal to develop a long-term ILRP and EIR. This draft PEIR is the result of those efforts.

## 2.3 Program Location

The program location is described in detail in the *Existing Conditions Report* (ECR), released by the Central Valley Water Board in 2008 (ICF Jones & Stokes 2008). This report, incorporated herein by reference, comprises the baseline condition for this analysis.

The jurisdiction of the Central Valley Water Board stretches from the Oregon border to the northern tip of Los Angeles County (Figure 2-1). Three major watersheds have been delineated within this region, namely the Sacramento River Basin (Figure 2-2), the San Joaquin River Basin (Figure 2-3), and the Tulare Lake Basin (Figure 2-4). The three basins cover approximately 40 percent of the total area of the state and approximately 75 percent of the irrigated acreage (Central Valley Water Board 2002a).

The crests of the Sierra Nevada on the east and the Coast Ranges and Klamath Mountains on the west border the Sacramento and San Joaquin River Basins. The Sacramento and San Joaquin River Basins cover approximately one-fourth of the total area of the state and contain over 43 percent of the state's irrigable land. Surface waters from these two basins meet and form the Sacramento–San Joaquin River Delta (Delta), which ultimately drains to San Francisco Bay. Major groundwater resources underlie both river valley floors.

The Sacramento River Basin covers approximately 27,210 square miles. The principal streams in the basin are the Sacramento River and its larger tributaries: the Pit, Feather, Yuba, Bear, and American Rivers on the east; and Cottonwood, Stony, Cache, and Putah Creeks on the west. Major reservoirs include Shasta, Oroville, and Folsom.

The San Joaquin River Basin covers approximately 15,880 square miles. The principal streams in the basin are the San Joaquin River and its larger tributaries and the Cosumnes, Mokelumne, Calaveras, Stanislaus, Tuolumne, Merced, Chowchilla, and Fresno Rivers. Major reservoirs include Pardee, New Hogan, Camanche, Millerton, McClure, Don Pedro, and New Melones.

The Tulare Lake Basin comprises the drainage area of the San Joaquin Valley south of the San Joaquin River and encompasses approximately 17,650 square miles. The valley floor makes up slightly less than one-half the total basin land area. The Kings, Kaweah, Tule, and Kern Rivers, which

drain the west face of the Sierra Nevada, provide the bulk of the surface water supply native to the basin. Major reservoirs are Pine Flat, Kaweah, Success, and Isabella. Imported surface water enters the Tulare Lake Basin through the San Luis Canal/California Aqueduct System, Friant-Kern Canal, and Delta-Mendota Canal. This subwatershed comprises the entire valley floor and is called the South Valley Floor Subwatershed.

## 2.4 Scope and Purpose of This CEQA Document

The purpose of this draft PEIR is to support the Central Valley Water Board's development and implementation of a long-term ILRP through analysis of potential environmental impacts of the program. Unlike a project EIR, which examines the environmental impacts of a specific development project, a PEIR is prepared on a series of actions that can be characterized as one large project. Subsequent activities in the program will be examined in light of the draft PEIR to determine whether an additional environmental document must be prepared. If the lead agency finds that no new effects would occur and no new mitigation measures would be required, the agency can approve the activity as being within the scope of the project covered by the draft PEIR.

In accordance with State CEQA Guidelines Section 15126.6(a), EIRs must evaluate a "range of reasonable alternatives to the project, or to the location of the project, which would feasibly attain most of the basic objectives of the project." State CEQA Guidelines Section 21061.1 defines *feasible* as "capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, legal, social, and technological factors." Selecting a range of project alternatives for evaluation is the responsibility of the Lead Agency, which must "publicly disclose its reasoning for selecting those alternatives." (State CEQA Guidelines Section 15126.6[a]).

State CEQA Guidelines Section 15126.6(c) also directs that EIRs should "identify any alternatives that were considered... but were rejected as infeasible" and "briefly explain the reasons" for the determination. It explains that alternatives may be rejected due to "(i) failure to meet most of the basic project objectives, (ii) infeasibility, and (iii) inability to avoid significant environmental impacts." The factors that will be weighed to determine the feasibility of ILRP alternatives include economic viability, consistency with existing plans or planning documents, regulatory limitations, and jurisdictional authority.

An EIR "shall include sufficient information about each alternative to allow meaningful evaluation, analysis, and comparison with the proposed project" [State CEQA Guidelines Section 15126.6(d)]. The State CEQA Guidelines Section 15126.6(b) provides that the discussion of alternatives should focus on alternatives "which are capable of avoiding or substantially lessening any significant effects of the project, even if these alternatives could impede to some degree the attainment of the project objectives or would be more costly." The final decision regarding the feasibility of alternatives lies with the decision maker for a given project, who must make the necessary findings addressing the potential feasibility of reducing the severity of significant environmental effects. (Public Resources Code [PRC] 21081, State CEQA Guidelines Section 15091).

### 2.4.1 "No Project" and "Preferred Project" Alternatives

Considered alternatives must include the specific alternative of "No Project." When the project is the revision of an existing land use or regulatory plan, policy, or ongoing operation, the "No Project" Alternative is the continuation of the existing plan, policy, or operation into the future. (State CEQA





Graphics ...05508.05 PEIR (06/10)JD

**Figure 2-1**  
**Program Boundaries and Subdivisions**





**Legend**

- Cities
- US Highway
- Interstate
- Subwatershed Boundaries
- County Lines

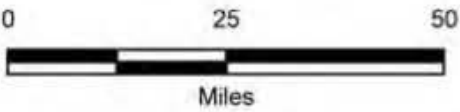


**Figure 2-2**  
**Sacramento River Basin Subwatersheds**





**Figure 2-3**  
**San Joaquin River Basin Subwatersheds**





**Legend**

- Cities
- US Highway
- Interstate
- Subwatershed Boundaries
- County Lines

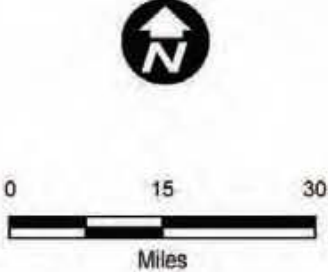


**Figure 2-4**  
**Tulare Lake Basin Subwatersheds**

Guidelines Section 15126.6[d]–[e]). In this instance, the “No Project” scenario represents Alternative 1, full implementation of the present program into the future.

In many CEQA documents, the Lead Agency has identified a “preferred project,” and thus the alternatives may typically receive a reduced level of analysis in comparison. In this document, however, no preferred project has been identified by the Lead Agency from among the considered alternatives. Consequently, each program alternative is analyzed at the same level of detail in this draft PEIR, to the extent necessary to determine and compare all anticipated impacts.

## 2.4.2 Intended Uses of This Draft PEIR

In general, a CEQA document is an informational document that informs a public agency’s decision-makers, and the public generally, of potentially significant adverse environmental effects of a program; identifies possible ways to avoid or minimize the significant effects; and describes reasonable alternatives to the program (CEQA Guidelines Section 15121). A public agency’s decision-makers must consider the information in a CEQA document prior to making a decision on the program. Accordingly, this draft PEIR is intended to:

- Provide the Central Valley Water Board and the public with information on the environmental effects of the proposed program, and
- Be used as a tool by the Central Valley Water Board to facilitate decision making on the proposed program.

## 2.4.3 Responsible and Trustee Agencies

In addition to Central Valley Water Board’s action as the Lead Agency, this draft PEIR may be used by other agencies to determine the effects of the proposed action. Responsible Agencies are those agencies subject to the jurisdiction of California with a legal responsibility to approve the program or project. These agencies are required to rely on the Lead Agency’s environmental document in acting on whatever aspect of the program or project that requires their approval but must prepare and issue their own findings regarding the program or project approval (State CEQA Guidelines Section 15096). Trustee Agencies are agencies that have jurisdiction over certain resources held in trust for the people of California but do not necessarily have legal authority over approving or carrying out the program or project.

No Responsible Agencies, with a legal responsibility to approve the ILRP, have been identified. Likely Trustee Agencies for the program are presented in Table 2-1.

**Table 2-1. Likely Trustee Agencies for the Long-Term Irrigated Lands Regulatory Program**

| <b>Agency</b>                                    | <b>Jurisdiction</b>                                                                                        |
|--------------------------------------------------|------------------------------------------------------------------------------------------------------------|
| California Department of Fish and Game           | Fish and wildlife<br>Native plants designated as rare or endangered<br>Game refuges<br>Ecological reserves |
| California Department of Pesticide Regulation    | Regulation of pesticide usage                                                                              |
| California Department of Water Resources         | State Water Project                                                                                        |
| California State Office of Historic Preservation | Historic and cultural resources                                                                            |
| California State Water Resources Control Board   | Water rights and quality oversight                                                                         |



Federal agencies that may be involved in the action include the U.S. Fish and Wildlife Service (USFWS); National Marine Fisheries Service (NMFS); U.S. Environmental Protection Agency (EPA); and U.S. Department of the Interior, Bureau of Reclamation (Reclamation).

## 2.5 Program Goals and Objectives

Prior to CEQA analysis of a proposed program, the program's goals and objectives must be identified. ILRP goals and objectives were developed through a public participation process described in Section 2.6.3, Alternatives Development Process. Understanding that irrigated agriculture in the Central Valley provides valuable food and fiber products to communities worldwide, the overall goals of the ILRP are to (1) restore and/or maintain the highest reasonable quality of state waters considering all the demands being placed on the water; (2) minimize waste discharge from irrigated agricultural lands that could degrade the quality of state waters; (3) maintain the economic viability of agriculture in California's Central Valley; and (4) ensure that irrigated agricultural discharges do not impair access by Central Valley communities and residents to safe and reliable drinking water.

In accordance with these goals, the objectives of the ILRP are to:

- Restore and/or maintain appropriate beneficial uses established in [Central Valley Water Board water quality control plans](#) by ensuring that all state waters meet applicable water quality objectives.<sup>1</sup>
- Encourage implementation of management practices that improve water quality in keeping with the first objective, without jeopardizing the economic viability for all sizes of irrigated agricultural operations in the Central Valley or placing an undue burden on rural communities to provide safe drinking water.
- Provide incentives for agricultural operations to minimize waste discharge to state waters from their operations.
- Coordinate with other Central Valley Water Board programs, such as the Grasslands Bypass Project WDRs for agricultural lands total maximum daily load development, CV-SALTS, and WDRs for dairies.
- Promote coordination with other regulatory and non-regulatory programs associated with agricultural operations (e.g., DPR, the California Department of Public Health [DPH] Drinking Water Program, the California Air Resources Board [ARB], the California Department of Food and Agriculture, Resource Conservation Districts [RCDs], the University of California Extension, the Natural Resources Conservation Service [NRCS], the USDA National Organic Program, CACs, State Water Board Groundwater Ambient Monitoring and Assessment Program, the U.S. Geological Survey [USGS], and local groundwater programs [SB 1938, Assembly Bill [AB] 3030, and Integrated Regional Water Management Plans]) to minimize duplicative regulatory oversight while ensuring program effectiveness.

---

<sup>1</sup> This objective did not receive Workgroup consensus and consequently was not recommended by the Workgroup. In general, concerns regarding this proposed objective have to do with whether there should be some qualifier that accounts for the feasibility and reasonableness of restoring all state waters to applicable water quality objectives.

## 2.6 Development of This Draft PEIR

This draft PEIR and its supporting documents were developed with extensive assistance and comment from affected agencies, the regulated industry, and the public.

### 2.6.1 Notice of Preparation

The Central Valley Water Board released an NOP on February 14, 2003.

### 2.6.2 Scoping

On March 5 and 6, 2003, CEQA scoping meetings were held in Fresno and Sacramento to solicit and receive public comment on the scope of this draft PEIR, as described in the NOP. Following the scoping meetings, the Central Valley Water Board began preparation of the draft ECR in 2004 to assist in defining the baseline condition for environmental analyses in this draft PEIR. The draft ECR was circulated in 2006, public comment on the document was received and incorporated, and the document was released by the Central Valley Water Board in 2008.

In March and April 2008, the Central Valley Water Board staff conducted [another series of CEQA scoping meetings](#) to generate recommendations on the scope and goals of the long-term ILRP. Information also was gathered as to how stakeholders would like to be involved in development of the long-term program. Stakeholders indicated in these scoping meetings that they would like to be actively involved in developing the program. To address this interest, the Central Valley Water Board initiated a series of Workgroup meetings, described below.

### 2.6.3 Alternatives Development Process

#### Stakeholder Advisory Workgroup

Alternatives to be evaluated in this draft PEIR needed to meet the goals and objectives for the ILRP and be sufficiently different to allow for a meaningful comparison of the alternatives. In fall 2008, the Central Valley Water Board convened the Workgroup to provide staff with input on development of the ILRP. The Workgroup included a range of stakeholder interests representing local government, industry, agricultural, and environmental coalitions throughout the Central Valley.

The Workgroup operated under a [charter](#) document that contains a plan for communicating Workgroup recommendations to the Central Valley Water Board, establishes the Workgroup structure, and clarifies the roles and responsibilities of its members. Workgroup meetings conducted to date are summarized here.

- October 9, 2008: [Organizational Workgroup Meeting](#).
- December 17, 2008: [Workgroup Meeting to Discuss Strategy](#).
- February 2, 2009: [Groundwater Information Session](#).
- February 17, 2009: [Workgroup Meeting to Present Participant-Proposed Alternatives](#).
- April 15, 2009: [Groundwater Nitrate Information Session](#).
- May 19, 2009: [Workgroup Meeting to Discuss Proposed Long-Term ILRP Alternatives](#).

- August 20, 2009: [Final Workgroup Meeting to Discuss Proposed Long-Term ILRP Alternatives](#).

The Workgroup meetings provided a forum for stakeholder input and deliberation. Because the ILRP is complex, information sessions were arranged to share technical information.

Central Valley Water Board staff developed a template and program matrix to assist Workgroup participants in developing alternatives. The template and matrix were included in a [Workgroup Strategy Document](#) dated January 9, 2009. The Workgroup Strategy Document included a discussion of minimum requirements for alternatives, a Workgroup meeting schedule, and a process for selecting ILRP alternatives for analysis in an EIR.

## Alternatives Screening and Program Selection

To be considered as an alternative under CEQA, ILRP alternatives must meet the goals and objectives of the project as defined above. Alternatives must also meet statutory requirements established in applicable state policy and regulations (e.g., the [Water Code](#); the [The Water Quality Control Plan \(Basin Plan\) for the California Regional Water Quality Control Board Central Valley Region](#) [Basin Plan] [Central Valley Water Board 2009], the [State Water Resources Control Board Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program](#) [State Water Board 2004], and the [State Antidegradation Policy](#) [State Water Board 1968]).

On February 17, 2009, Workgroup participants presented proposed ILRP alternatives to the Central Valley Water Board. After the February 17 Workgroup meeting, Central Valley Water Board staff began working with the Workgroup participants who proposed alternatives to develop the details of their alternatives. Central Valley Water Board staff also developed additional alternatives as necessary to represent a range of possible programs to be evaluated in this draft PEIR (per requirements of the State CEQA Guidelines). Many of the participant-proposed alternatives were combined, or additional features were added, to develop complete alternatives that could meet the goals and objectives of the program. During this process, proposed program elements that did not meet the goals and objectives were discussed and rejected.

At the final Workgroup meeting on August 20, 2009, the Workgroup voted on the proposed range of alternatives and on each program goal and objective. The Workgroup came to consensus that the proposed range of alternatives should be evaluated in this draft PEIR. The Workgroup also reached consensus on each of the proposed program goals and all but one of the proposed objectives (see the first objective listed in “Program Goals and Objectives” above). In December 2009, the Central Valley Water Board issued the [Proposed Long-Term Irrigated Lands Program Alternatives](#) (Central Valley Water Board 2009), incorporated herein by reference, which documents the decisions made by the Regional Water Board and the Workgroup regarding which alternatives should be evaluated in this draft PEIR.

As required under the State CEQA Guidelines Section 15126.6(c), this draft PEIR briefly describes those alternatives that were considered but rejected as infeasible. The reasons for their infeasibility are summarized in Chapter 3, Program Description.

### 2.6.4 Known Areas of Controversy

In accordance with State CEQA Guidelines Section 15123(b)(2), the areas of controversy known to the Lead Agency, including issues raised by agencies and the public, shall be identified in the EIR.

Through public scoping, the efforts of the Workgroup, and other outreach efforts, the following areas of controversy were identified:

- The costs to growers of implementing a more stringent ILRP will be prohibitive, and suppress the economic sustainability or growth of agriculture.
- Adding a groundwater monitoring element to the ILRP would be unnecessarily duplicative of existing monitoring efforts.
- The alternatives do not contain a clear methodology for defining a groundwater discharger or determining the nature of discharges to groundwater.
- The program does not take adequate steps to offset the costs to rural communities for cleanup of existing water quality impairments that can be linked back to historical agricultural discharges.

## 2.6.5 Public Comment on This Draft PEIR

This draft PEIR was made available for public review and comment on July 23, 2010. In addition, the Central Valley Water Board will conduct public hearings on the draft document. Comments received at the hearings or received in written form will be considered in development of a final PEIR.

Comments may be sent to:

ILRP Comments  
Ms. Megan Smith  
630 K Street, Suite 400  
Sacramento, CA 95814

Email: [ILRPcomments@icfi.com](mailto:ILRPcomments@icfi.com)

Fax: (916) 456-6724

## 2.7 Organization of This Draft PEIR

This draft PEIR contains the following chapters:

- Chapter 1, Summary
- Chapter 2, Introduction
- Chapter 3, Program Description
- Chapter 4, Environmental Setting
- Chapter 5, Environmental Impacts and Mitigation Measures
- Chapter 6, Cumulative and Growth-Inducing Impacts
- Chapter 7, List of Preparers
- Chapter 8, References

Each section in Chapter 5, Environmental Impacts and Mitigation Measures, focuses on a separate resource area and describes the regulatory and environmental setting for that resource area

pursuant to the requirements of CEQA. The State CEQA Guidelines have been considered in determining appropriate thresholds of significance for assessing environmental impacts, including direct, indirect, short- and long-term, cumulative, and unavoidable impacts. Also per the State CEQA Guidelines, feasible mitigation measures are identified wherever possible to reduce significant and potentially significant environmental impacts to a less-than-significant level. Technical information is included as appendices to provide additional details related to key topical areas.

The Central Valley Water Board determined that the program could result in potentially significant impacts on the following resources, which thus warrant close scrutiny:

- Cultural resources
- Noise
- Air quality
- Climate change
- Vegetation and wildlife
- Fisheries
- Hydrology and water quality
- Agriculture resources

The Central Valley Water Board has determined that the program will result in no or less-than-significant direct impacts and no indirect impacts on the following resources, which thus do not warrant close scrutiny:

- Aesthetics
- Geology and soils
- Hazards and hazardous materials
- Land use and planning
- Mineral resources and energy
- Population and housing
- Public services
- Recreation
- Transportation and circulation
- Utilities and service systems



## **3.1 Introduction**

This chapter presents a description of all program alternatives developed by the Workgroup and considered in this draft PEIR. Four alternatives are described in addition to the “No Project” Alternative (Alternative 1), which is defined as full implementation of the present program. In some instances, differences between the alternatives are difficult to distinguish. Table 3-1 is provided to highlight significant differences between the alternatives.

Upon consideration of the environmental and economic impact analyses of the five program alternatives, the Central Valley Water Board developed a sixth staff-recommended alternative. This alternative, a conglomeration of elements presented in the following five alternatives, is analyzed in the Staff Report, which is included in this draft PEIR as Appendix A.

Table 3-1. Comparison of Alternatives

| Alternative Description and Summary                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Lead Entity        | Lead Entity Responsibilities                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Central Valley Water Board Responsibilities                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Growers Regulatory Requirements                                                                                                                                                                                                                                                                                                         | Surface Water Monitoring                                                                                                               | Groundwater Monitoring                                                                                                                                                                                                                                                                                   | Tracking                      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| <b>Alternative 1 – Full Implementation of Current Program.</b> This is the CEQA "No Project" Alternative. Renewal and full implementation of the current program. Coalition groups would function as lead entities. Where monitoring indicates a problem, third-party groups and growers implement management practices in response.                                                                                                                                                                         | Coalition groups   | 1. Enroll member growers.<br>2. Develop monitoring plans.<br>3. Conduct surface water monitoring.<br>4. Develop and implement surface water quality management plans where monitoring data show two or more exceedances of an applicable water quality objective.<br>5. Inform/coordinate with growers.                                                                                                                                                                                                                                                                                                                                                                             | 1. Require 100% participation.<br>2. Review and approve monitoring plans.<br>3. Review monitoring reports.<br>4. Review and approve surface water quality management plans.<br>5. Review ILRP performance.<br>6. Respond to complaints.<br>7. Enforce ILRP.                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1. Submit application and pay fees.<br>2. Implement management practices.<br>3. Prevent nuisance conditions and/or exceedance of water quality objectives.<br>4. Provide requested information to coalition group.                                                                                                                      | Watershed-based (same as current ILRP)                                                                                                 | None                                                                                                                                                                                                                                                                                                     | None                          |
| <b>Alternative 2 – Third-Party Lead Entity.</b> Third-party groups would function as lead entities representing growers. Regulation of discharges to surface water would be similar to Alternative 1. This alternative allows for a reduction in surface water monitoring under lower threat circumstances and where surface water quality management plans are developed. This alternative also requires development of groundwater quality management plans to minimize discharge of waste to groundwater. | Third-party groups | 1. Enroll member growers and provide member information to the CVWB.<br>2. Provide members and CVWB an organizational or management structure.<br>3. Make ILRP expenditure summaries available to members.<br>4. Notify affected group members of CVWB enforcement against the third party.<br>5. Develop monitoring/management practice tracking plans.<br>6. Conduct monitoring.<br>7. Develop and implement surface water quality management plans where monitoring data show two or more exceedances of an applicable water quality objective.<br>8. Develop groundwater quality management plans within 4 years of adoption of the ILRP.<br>9. Inform/coordinate with growers. | 1. Require 100% participation.<br>2. Review and approve monitoring plans.<br>3. Review and approve surface water quality management plans.<br>4. Review and approve groundwater quality management plans.<br>5. Review and approve optional watershed/ area management objectives plans.<br>6. Review monitoring reports.<br>7. Review ILRP performance.<br>8. Respond to complaints.<br>9. Require additional monitoring and practices where water quality objectives are not being met.<br>10. Enforce ILRP.                                                                                                                                                                                     | 1. Submit application and pay fees.<br>2. Implement water quality management practices in accordance with any approved plans.<br>3. Prevent nuisance conditions and/or exceedance of water quality objectives.<br>4. Provide ILRP information to third-party group.                                                                     | Watershed-based (same as current ILRP) with option for reduced monitoring where optional watershed/ area management plan is developed. | Regional monitoring for, at a minimum, nitrates and salts (under a local groundwater management plan).<br><b>Or</b><br>Tracking implementation of required management practices along with a limited number of site-specific studies (under third-party developed groundwater quality management plans). | Management practice tracking. |
| <b>Alternative 3 – Individual Farm Water Quality Management Plans.</b> Individual growers would work with the CVWB, or designated implementing agency, to develop an individual farm water quality management plan. The CVWB would approve the plan.                                                                                                                                                                                                                                                         | CVWB               | See CVWB responsibilities.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1. Enroll growers.<br>2. Require 100% participation.<br>3. Review applications, prioritize review of farm water quality management plans.<br>4. Negotiation memoranda of understanding (MOUs) with technical service providers.<br>5. Conduct grower site inspections.<br>6. Coordinate with growers to ensure that plans/practices are addressing water quality problems.<br>7. Review monitoring reports.<br>8. Review ILRP performance.<br>9. Respond to complaints.<br>10. Certify that participating growers are implementing practices that protect water quality.<br>11. Require additional monitoring and practices where water quality objectives are not being met.<br>12. Enforce ILRP. | 1. Submit application and pay fees.<br>2. Within 2-years, develop and implement a farm water quality management plan.<br>3. Submit plan for CVWB approval.<br>4. Maintain and update plan as needed.<br>5. Prevent nuisance conditions and/or exceedance of water quality objectives.<br>6. Allow inspection by CVWB or representative. | Monitoring of management practices (e.g., visual monitoring, inspection of proper operation).                                          | Monitoring of management practices (e.g., visual monitoring, inspection of proper operation).                                                                                                                                                                                                            | Management practice tracking. |

| Alternative Description and Summary                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Lead Entity            | Lead Entity Responsibilities                                                                                                                                                                                                                                                                                            | Central Valley Water Board Responsibilities                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Growers Regulatory Requirements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Surface Water Monitoring                                                                                                                                                  | Groundwater Monitoring                                                                                                                                          | Tracking                                               |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|
| <b>Alternative 4 – Direct Oversight with Regional Monitoring.</b> Individual growers or "legal entities" assuming responsibility for waste discharge would work directly with the CVWB. This alternative provides the option for monitoring and reporting conducted by a third-party group. Under this approach, regulatory requirements would be scaled using tiered, threat-based criteria. Higher threat operations would be required to implement additional management practices and more extensive monitoring than lower threat operations. Under this alternative, all growers would be required to develop an individual farm water quality management plan. | CVWB or "legal entity" | Third-party monitoring group:<br>1. Provide members and CVWB an organizational or management structure.<br>2. Make ILRP expenditure summaries available to members.<br>3. Notify affected group members of CVWB enforcement against the third party.<br>4. Develop monitoring/tracking plans.<br>5. Conduct monitoring. | 1. Enroll growers or "legal entities."<br>2. Require 100% participation.<br>3. Review and approve monitoring plans.<br>4. Review monitoring reports.<br>5. Coordinate with growers to ensure that plans/practices are addressing water quality problems; assign growers to appropriate tier or tiers.<br>6. Review ILRP performance.<br>7. Respond to complaints.<br>8. Conduct grower site inspections.<br>9. Require additional monitoring and practices where water quality objectives are not being met.<br>10. Enforce ILRP. | 1. Submit application and pay fees.<br>2. Within 2 years, develop and implement a farm water quality management plan; the plan would be kept onsite and submitted to the CVWB upon request.<br>3. Maintain and update plan as needed.<br>4. Allow inspection by CVWB or representative.<br>5. Prevent nuisance conditions and/or exceedance of water quality objectives.<br>6. Maintain facility records of each field's nutrient budget.<br>7. Complete 15 hours of farm water quality education within 2 years.<br>8. Submit annual certified statement to CVWB regarding appropriate tier application.Tier 1 only: submit site-specific evaluation to CVWB demonstrating minimal potential impact of waste discharge to surface water and/or groundwater.Tier 3 only: develop a nutrient management plan and/or implement additional pesticide management practices. | Tiers 2 and 3 operations would conduct individual monitoring or would participate in regional monitoring; monitoring requirements for Tier 2 operations would be reduced. | Tier 3 operations would conduct individual monitoring and participate in regional monitoring; Tier 2 operations would choose individual or regional monitoring. | Nutrient/pesticide applications, management practices. |
| <b>Alternative 5 – Direct Oversight with Farm Monitoring.</b> Individual growers would work directly with the CVWB. Growers would be required to develop and implement a farm water quality management plan and nutrient management plan.                                                                                                                                                                                                                                                                                                                                                                                                                            | CVWB                   | See CVWB responsibilities.                                                                                                                                                                                                                                                                                              | 1. Enroll growers.<br>2. Require 100% participation.<br>3. Review monitoring reports.<br>4. Develop prioritization scheme for installation of monitoring wells.<br>5. Coordinate with growers to ensure that plans/practices are addressing water quality problems.<br>6. Review ILRP performance.<br>7. Respond to complaints.<br>8. Conduct grower site inspections.<br>9. Require additional monitoring and practices where water quality objectives are not being met.<br>10. Enforce ILRP.                                   | 1. Submit application and pay fees.<br>2. Within 2 years, develop and implement a farm water quality management plan; the plan would be kept onsite and submitted to the CVWB upon request.<br>3. Maintain and update the plan as needed.<br>4. Develop and implement a nutrient management plan if commercial fertilizer or manure are used.<br>5. Allow inspection by CVWB or representative.<br>6. Prevent nuisance conditions and/or exceedance of water quality objectives.<br>7. Maintain facility records of each field's nutrient budget.                                                                                                                                                                                                                                                                                                                       | Individual farm monitoring for constituents of concern in tailwater and stormwater.                                                                                       | Individual supply well monitoring. Installation and sampling of monitoring wells where CVWB requires, based on vulnerability factors.                           | Nutrient/pesticide applications, management practices. |

Notes: CVWB = Central Valley Regional Water Quality Control Board; ILRP = Irrigated Lands Regulatory Program.

## 3.2 Alternative 1 – Full Implementation of Current Program (No Project Alternative)

### 3.2.1 Introduction

Under Alternative 1, the Central Valley Water Board would renew the current program and continue to implement it into the future. This would be considered the “No Project” Alternative per CEQA guidance at Title 14 CCR Section 15126.6(e)(3)(A): “When the project is the revision of an existing land use or regulatory plan, policy or ongoing operation, the ‘No Project’ Alternative will be the continuation of the existing plan, policy, or operation into the future.” Given the ministerial nature of the extension or renewal of the ongoing waiver, which would allow continuation of the existing program, Alternative 1 is best characterized as the “No Project” Alternative. This approach best serves the purpose of allowing the Central Valley Water Board to compare the impacts of revising the ILRP with those of continuing the existing program (Title 14 CCR Section 15126.6[e][1]).<sup>1</sup>

Coalition groups would continue to function as lead entities representing growers (owners of irrigated lands, wetland managers, nursery owners, and water districts). This alternative is based on continuing watershed monitoring to determine whether operations are causing water quality problems. Where monitoring indicates a problem, third-party groups and growers would be required to implement management practices to address the problem and work toward compliance with applicable water quality standards.

Alternative 1 would not establish any new Central Valley Water Board requirements for discharges to groundwater from irrigated agricultural lands. Local agencies throughout the Central Valley have developed groundwater management programs pursuant to Water Code Section 10750. However, local programs in place provide varying degrees of groundwater management and oversight in the Central Valley (i.e., these programs were not developed to specifically meet the goals of this ILRP), and some areas throughout the Central Valley are not covered by local agency groundwater management plans. The following is a brief description of the local groundwater management programs.

AB 3030, which is codified in Water Code Section 10750 et seq., authorizes local agencies within groundwater basins to prepare and adopt groundwater management plans. Water Code Section 10753.8 enumerates the following recommended components:

- Control of saline water intrusion.
- Identification and management of wellhead protection areas and recharge areas.
- Regulation of the migration of contaminated groundwater.
- Administration of a well abandonment program.
- Mitigation of conditions of overdraft.

---

<sup>1</sup> The existing environmental setting, not the “No Project” Alternative, constitutes the baseline for determining whether a project’s environmental impacts may be significant (Title 14 CCR Section 15126.5[e][1]). Therefore, defining the “No Project” Alternative as continuing the existing program does not change the analysis of the significance of environmental impacts under the remaining alternatives.

- Replenishment of groundwater extracted by water producers.
- Monitoring of groundwater levels and storage.
- Facilitating conjunctive use operations.
- Identification of well construction policies.
- Construction and operation by the local agency of groundwater contamination cleanup, recharge, storage, conservation, water recycling, and extraction projects.
- Development of relationships with state and federal regulatory agencies.
- Review of land use plans and coordination with land use planning agencies to assess activities that create a reasonable risk of groundwater contamination.

SB 1938 imposed additional groundwater management program requirements on local agencies seeking state funds, administered by the California Department of Water Resources (DWR), for construction of groundwater projects. These requirements include a groundwater management plan that includes components related to monitoring and management of groundwater levels within the basin, groundwater quality degradation, inelastic land surface subsidence, and changes in surface flow and surface water quality that directly affect groundwater levels or quality.

In addition to local groundwater management plans, DPR regulates the use of pesticides that pose a threat to groundwater through its Groundwater Protection Program. This program requires that growers implement management practices to prevent pesticides from moving to groundwater. DPR also monitors groundwater for the presence of pesticides to evaluate management practices and overall program effectiveness.

Alternative 1 would not establish new Central Valley Water Board requirements for regulating irrigated agricultural discharges to groundwater. The alternative would recognize that local groundwater management programs currently exist in some localities and that DPR currently implements a Groundwater Protection Program to protect groundwater quality from pesticide impacts.

## 3.2.2 Program Components

### Implementation Mechanisms and Lead Entity Responsibilities

Under Alternative 1, the Central Valley Water Board would renew the current program through WDRs or a waiver of WDRs. Water quality coalition groups have formed throughout the Central Valley to function as representative or “lead” entities in administration of the current ILRP. Coalitions represent growers (irrigated landowners, wetland managers, nursery owners, and water districts), provide education, organize monitoring, and work with the Central Valley Water Board to help ensure that the current program is effectively implemented. These third-party water quality coalition groups would continue to function as lead entities for their members to ensure that all Central Valley Water Board requirements are met.

As in the current program, coalition groups would be approved by the Central Valley Water Board prior to functioning as a lead entity. Specifically, coalition groups would:

- Enroll member growers in the program.
- Develop monitoring plans.



- Conduct required water quality monitoring.
- Develop and implement surface water quality management plans where surface water monitoring results indicate two or more exceedances of any applicable water quality objective in a 3-year period.
- Inform growers of program requirements and provide coordination to ensure that water quality concerns are addressed.

## General Roles and Responsibilities of the Central Valley Water Board

Under Alternative 1, the Central Valley Water Board would continue to carry out the following general roles and responsibilities:

- Require 100 percent participation by discharging growers in the ILRP.
- Review and approve monitoring plans.
- Review monitoring reports.
- Review and approve surface water quality management plans.
- Review overall program performance with regard to achieving ILRP objectives.
- Respond to individual problems and complaints dealing with irrigation discharge.
- Enforce ILRP requirements.

### 3.2.3 Regulatory Requirements and Approvals

To be eligible for a conditional waiver under Alternative 1, growers would be required to:

- Submit an application to the coalition group to enroll in the program and pay applicable program fees. The coalition group would apply for coverage on behalf of members. Required application information would include name and contact information of the owner/operator and parcel numbers. Coalition groups would collect the application information for each member grower and report the information to the Central Valley Water Board.
- Implement management practices in accordance with any water quality management plans. Management practices could be instituted on an individual basis or be installed to serve a group of growers discharging to a single location (e.g., a combined tailwater return or wetlands serving a group of growers).
- Prevent nuisance conditions and/or exceedance of water quality objectives in state waters associated with waste discharge from their irrigated agricultural lands.
- Provide the coalition group with information requested for compliance with the ILRP.

Growers who do not meet these requirements would be required to work directly with the Central Valley Water Board and to obtain WDRs or an individual waiver of WDRs.

## Monitoring Provisions

Monitoring under Alternative 1 would be the same as the watershed-based assessment and core monitoring required for the current ILRP. Under this monitoring scheme, coalition groups would work with the Central Valley Water Board to develop monitoring plans for Central Valley Water

Board approval. These plans would specify monitoring parameters and site locations. Required monitoring would include the parameters and frequencies shown in Table 3-2.

**Table 3-2. Monitoring Requirements under Alternative 1**

| <b>Parameter</b>                                                                                                                   | <b>Frequency</b>              |
|------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| <b>Assessment Monitoring for 1 Year of Every 3 Years</b>                                                                           |                               |
| Section 303(d) listed constituents with agricultural source                                                                        | Monthly                       |
| Water column toxicity, pesticides, metals, nutrients, pathogens, physical parameters                                               | Monthly                       |
| Toxicity identification evaluation—as needed                                                                                       | Monthly                       |
| Sediment toxicity                                                                                                                  | Twice per year                |
| Photo monitoring                                                                                                                   | During every monitoring event |
| <b>Continuing Core Monitoring</b>                                                                                                  |                               |
| General physical parameters, nutrients, pathogens                                                                                  | Monthly                       |
| Parameters/constituents of concern as determined by the Central Valley Regional Water Quality Board                                | Monthly                       |
| Photo monitoring                                                                                                                   | During every monitoring event |
| Note: The current Irrigated Lands Regulatory Program monitoring program provides flexibility to reduce the monitoring shown above. |                               |

## 3.3 Alternative 2 – Third-Party Lead Entity

### 3.3.1 Introduction

Under Alternative 2, the Central Valley Water Board would develop a single mechanism or series of regulatory mechanisms (e.g., waivers of WDRs, WDRs, or conditional prohibitions of discharge) for waste discharge from irrigated agricultural lands to groundwater and surface water. The series of regulatory mechanisms would be designed to provide flexibility in establishing requirements for growers, considering the variety of environmental conditions and agricultural operations throughout the Central Valley.

Under this alternative, third-party groups (e.g., water quality coalitions) would function as lead entities representing growers. Regulation of discharges to surface water under Alternative 2 would be similar to Alternative 1 (the current ILRP). However, this alternative allows for a reduction in monitoring under lower threat circumstances and where watershed or area management objectives plans are developed. This alternative also includes requirements for GQMPs to minimize discharge of waste to groundwater from irrigated agricultural lands. Alternative 2 relies on coordination with DPR for regulating discharges of pesticides to groundwater.

### 3.3.2 Program Components

#### Implementation Mechanisms and Lead Entity Responsibilities

Implementation mechanisms for Alternative 2 could include WDRs, conditional waivers of WDRs, or conditional prohibitions of discharge.

Under this alternative, a coalition or other third-party group would be responsible for general administration of the ILRP. In order to be approved by the Central Valley Water Board for administration of this alternative, third-party groups would need to agree to assume the following responsibilities:

- Enroll member growers in the program. Provide summary member information to the Central Valley Water Board (see Regulatory Requirement No. 1 under “Regulatory Requirements and Approvals”).
- Provide members and the Central Valley Water Board an organizational or management structure identifying persons responsible for ensuring that program requirements are fulfilled.
- Agree to provide or make available to group members the annual summaries of expenditures of fees used to comply with the ILRP.
- Notify potentially affected third-party group members each time the group has received a notice of violation or other enforcement action from the Central Valley Water Board and provide information regarding the reason for the enforcement.
- Develop and implement monitoring/management practice tracking plans.
- Conduct required water quality monitoring.
- Develop and implement surface water quality management plans (similar to the current ILRP) where surface water monitoring results indicate two or more exceedances of any applicable water quality objective in a 3-year period.
- Develop GQMPs for third-party identified groundwater management areas within 4 years of adoption of the ILRP by the Central Valley Water Board (*except in areas where a local groundwater management plan has been developed and approved [by the Central Valley Water Board] for substitution—see the section titled “Groundwater Quality Management Plan” below*).
- Inform growers of program requirements and provide coordination to ensure that water quality concerns are addressed.

#### Optional Watershed or Area Management Objectives Plan (Surface Water)

Third-party groups would have the option of developing a watershed or area management objectives plan. The goal of this plan would be to meet source control management objectives that would reduce the threat to surface water quality from waste discharge associated with irrigated agriculture.

Throughout much of the Central Valley Water Board area, watershed management plans have been or are being developed by local management entities (RCDs, watershed alliances, and district organizations). These plans typically identify principal watershed issues and concerns, and describe appropriate actions to address those issues and concerns. While they may include water quality impacts from agricultural discharge as a watershed concern, these plans are usually more general

than envisioned for a watershed or area management objectives plan. The implementation of management practices is based on the premise that individual group members will be actively involved in implementing an area or watershed management objectives plan.

For a watershed or area management objectives plan, the expectation would be identification of a set of management objectives and management practices that, if implemented, would be effective in addressing agricultural discharge-related impacts to water quality. Typically, these management objectives and practices would be developed for crop types (e.g. wild rice, vineyards, and citrus) or general agricultural operations (e.g., livestock management with irrigated pasture and other animal forage production [ranch operations]) that are common to that geographic or watershed area. Management objectives tend to be more general (e.g., “manage irrigation water to eliminate, reduce, or slow the direct discharge of tailwater to adjacent watercourses”), while management practices are the more specific method used to achieve the management objective (e.g., collect tailwater in ponds or wetlands, recycle tailwater, discharge tailwater to vegetated buffers zones, and modify irrigation methods). The appropriate management practice is typically selected on a site-specific or property-specific basis.

The watershed or area management objectives plan would specify optional management practices that could be implemented to achieve plan objectives. The plan would be developed consistent with the area or watershed commodity types, common agricultural practices, pesticides commonly used, and local land characteristics. Optional practices would be provided to allow growers to adapt to their specific conditions for compliance with the ILRP. The plan also would consider the results of previous water quality sampling, including results from monitoring conducted under the current ILRP. This plan need not include a requirement that every grower implement a list of specific practices. It could, for example, involve implementing management practices that serve a group of growers.

The plan would be developed by local agencies with expertise in agriculture. The third-party group also would be responsible for the following when developing and implementing the watershed or area management objectives plan:

- Inform local growers of the requirements in the watershed or area management objectives plan through an education and outreach program.
- Obtain local grower input for plan development.
- Determine local needs for compliance.
- Facilitate and develop a verification program for ensuring implementation of the management plan.

In areas implementing a Central Valley Water Board–approved watershed or area management objectives plan, surface water monitoring would be reduced. The Central Valley Water Board may require revision of the plan to include additional management objectives (in an iterative approach to address identified water quality concerns), revoke approval, or decline to approve a plan and the associated reduction in monitoring for the following reasons:

- Evidence exists that effective implementation of the plan may allow an exceedance, caused by waste discharge from irrigated agricultural lands, of applicable water quality objectives in surface waters.

- Available surface water quality monitoring data show continuing exceedances of applicable water quality objectives within the area or watershed (where agriculture is a contributing source).
- Changes in agricultural operations or environmental conditions limit the plan's applicability within the area or watershed.
- Evidence exists that growers are not implementing the plan.

In summary, an area or watershed management objectives plan would include management objectives (by crop type or type of agricultural operation), common management practices that could be used to achieve the management objective, the approach to be used by the coalition (or other third party) to promote implementation of management objectives and practices, and the approach to be used to track the watershed-wide level of management practice implementation and its effectiveness.

Where watershed management plans already exist, these more specific area or watershed management practice plans could be made part of that broader watershed management plan.

### **Groundwater Quality Management Plans**

Third-party groups would be required to develop GQMPs designed to minimize waste discharge to groundwater from irrigated agricultural lands. As part of GQMP development, the third party would collect and evaluate available groundwater data, identify groundwater management areas (GMAs) of concern, identify constituents of concern within the GMAs, prioritize the GMAs and constituents of concern, identify agricultural practices that may be causing or contributing to the problem, and identify agricultural management practices that should be implemented by local growers to address the constituents of concern. Additional GQMP requirements are listed below.

Every 5 years, the Central Valley Water Board and third-party groups would meet and confer to evaluate the sufficiency of GQMPs and to determine whether and, generally, how they should be updated to reflect new priorities based on new information.

### **Additional Requirements**

GQMPs for third-party group identified GMAs would include the following:

- Identification of GMAs and constituents of concern based on available data from existing groundwater management programs, including but not limited to, the State Water Board's Groundwater Ambient Monitoring and Assessment and other agency programs (e.g., USGS, DPH, DPR, and DWR).
- Prioritization of GMAs and constituents of concern for implementation of agricultural management practices based on available data, and based on the risk of contamination due to soil type, known agricultural practices, crops grown, climate, proximity to wells, aquifer condition and uses, and other factors determined to be relevant and appropriate by the third party. Where an identified constituent of concern is a pesticide that is subject to the DPR Groundwater Protection Program, the GQMP would defer to the DPR regulatory program for that pesticide and any requirements associated with the use of that pesticide.
- Identification of appropriate agricultural practices for high-priority constituents in high-priority GMAs.



- Describe how information regarding agricultural practices would be distributed to growers in high-priority areas. For example, such information would be prepared by the third parties for distribution by the county agricultural commissioner (CAC) offices at the time that growers file pesticide use reports, when they file an application for a private applicator's license, or when they obtain a restricted materials permit. When the information is distributed by the CAC or other identified entity, growers would sign a form acknowledging that they have received information regarding agricultural management practices for the protection of groundwater in the high-priority area, and that they will implement the practices to maximum extent practicable. Once executed, the CAC or other entity would then transmit completed forms back to the third party for assembly and annual reporting purposes.
- Include a tracking and reporting program that annually documents to the Central Valley Water Board implementation of agricultural management practices within the high-priority areas. Implementation of agricultural practices would be inferred by acknowledgement forms from the CAC office.
- The GQMP may include focused studies of selected agricultural management practices, constituents, or physical settings to inform refinement of GMA and constituent prioritization or of practices that provide needed groundwater protection from degradation by constituents of concern. The results of focused studies would be documented in the annual report.
- The GQMP would not include or address issues related to groundwater supply, including issues regarding the volume of groundwater pumped or used by growers within a GMA.

### **Local Groundwater Management Plans**

Where local agencies have developed local groundwater management plans (e.g., AB 3030, SB 1938, and Integrated Regional Water Management plans) that meet the requirements listed below, the Central Valley Water Board may approve the local groundwater management plan to be substituted for the GQMP. However, growers would still be required to enroll with an approved third-party group. The third-party group would be the responsible lead entity for ILRP administration, monitoring, and reporting.

In order to be substituted for GQMPs under Alternative 2, local groundwater management plans would be required to contain the following elements:

1. Program goals that are consistent with Basin Plan water quality objectives for groundwater.
2. Monitoring for groundwater quality.
3. Reporting of monitoring results in an aggregated manner.
4. Where necessary, recommended groundwater quality management practices.
5. Evaluation of effectiveness of existing groundwater management policies/practices.
6. Ability to amend the plan if objectives are not being met.

## **General Roles and Responsibilities of the Central Valley Water Board**

Under Alternative 2, the Central Valley Water Board would assume the following general roles and responsibilities:

- Require 100 percent participation by discharging growers in the ILRP.

- Review and approve monitoring plans.
- Review and approve surface water quality management plans.
- Review and approve GQMPs (and, where applicable, local groundwater management plans requested to substitute for GQMPs) and GMAs.
- Review and approve optional area or watershed management objectives plans.
- Review monitoring reports.
- Review overall program performance with regard to achieving ILRP objectives.
- Respond to individual problems and complaints dealing with irrigation discharge and informing/coordinating with the responsible third-party group.
- In an iterative process, require additional monitoring, information, and/or management measures where applicable water quality objectives are not being met.
- Enforce ILRP requirements.

### 3.3.3 Regulatory Requirements and Approvals

In order to be eligible for a conditional waiver under Alternative 2, growers would be required to:

- Submit an application to the third-party group to enroll in the program and pay applicable program fees. The third-party group would apply for coverage on behalf of members. Required application information would include the name and contact information of the owner/operator and parcel numbers. Coalition groups would collect the application information for each member grower and report the information to the Central Valley Water Board.
- Implement management practices in accordance with any water quality management plans, including GQMPs and watershed or area management objectives plans. Management practices could be instituted on an individual basis or be installed to serve a group of growers discharging to a single location (e.g., a combined tailwater return or wetlands serving a group of growers).
- Prevent nuisance conditions and/or exceedance of water quality objectives in state waters associated with waste discharge from their irrigated agricultural lands.
- Provide the third-party group with information requested for compliance with the ILRP.

Growers who do not meet the above requirements would be required to work directly with the Central Valley Water Board and to obtain WDRs or an individual waiver of WDRs.

### Monitoring Provisions

Under Alternative 2, growers would be required to track implemented management practices and submit the results to the third-party group. The third-party group would report summary results to the Central Valley Water Board.

The third-party group would be required to summarize groundwater and surface water monitoring and tracking results in an annual monitoring report to the Central Valley Water Board.

## Surface Water Monitoring

Surface water monitoring under Alternative 2 would consist of **one** of the following options:

- Watershed-based assessment and core monitoring similar to the monitoring required under the current ILRP (Central Valley Water Board Order No. R5-2008-0005). Under this monitoring scheme, third-party groups would work with the Central Valley Water Board to develop monitoring plans for approval by a Central Valley Water Board Executive Officer. These plans would specify monitoring parameters and site locations.
- Optional watershed or area management objectives plan. Where the Central Valley Water Board has approved a watershed or area management objectives plan, monitoring would consist of tracking the progress in implementing the watershed or area management objectives plan and watershed-based assessment monitoring for 1 year of every 5 years (similar to the assessment monitoring required under the current ILRP).

## Groundwater Monitoring

Where a local groundwater management plan has been substituted for a GQMP, monitoring would consist of groundwater quality monitoring for, at a minimum, nitrates and salts. For all other cases, groundwater monitoring under Alternative 2 would consist of the following:

- Tracking the level of GQMP implementation through grower completion of acknowledgement forms. Growers completing acknowledgment forms would agree to implement GQMP-identified groundwater quality management practices to the maximum extent practicable.
- Results of any focused studies of selected agricultural management practices, constituents, or physical settings to inform refinement of GMAs and constituent prioritization or of practices that provide needed groundwater protection from degradation by constituents of concern.

## 3.4 Alternative 3 – Individual Farm Water Quality Management Plans

### 3.4.1 Introduction

Under Alternative 3, growers would have the option to work directly with the Central Valley Water Board or another implementing entity (e.g., CACs) in development of a FWQMP. Growers would individually apply for a conditional waiver or WDRs that would require they obtain Central Valley Water Board approval of their FWQMP.

On-farm implementation of effective management practices would be the mechanism to reduce or eliminate waste discharged to state waters. This alternative would provide incentive for individual growers to participate by providing growers with a Central Valley Water Board certification, verifying that they are implementing farm management practices to protect state waters.

This alternative relies on coordination with DPR for regulating discharges of pesticides to groundwater.

## 3.4.2 Program Components

### Implementation Mechanisms and Lead Entity Responsibilities

Implementation mechanisms for Alternative 3 could include conditional waivers of WDRs or WDRs.

Under this alternative, growers would be lead entities working directly with the Central Valley Water Board and would be responsible for applying for coverage, developing FWQMPs, and conducting any required reporting.

### Roles and Responsibilities of the Central Valley Water Board

Under Alternative 3, the roles and responsibilities of the Central Valley Water Board would be as follows:

- Enroll growers in the program.
- Require 100 percent participation by discharging growers in the ILRP.
- Review applications and determine priorities for FWQMP review and approval. Criteria for priority would include size of operation, likelihood for water quality impacts (potential impacts to groundwater and surface water would be considered), and operations in areas with documented problems. In the review and approval of FWQMPs, Central Valley Water Board staff would conduct inspections of ranch/farm operations, as needed, to evaluate existing irrigated production areas and management practices, and to verify that management practices referenced in the FWQMP are accurate and appropriate. Any needed changes to existing operations would be discussed, negotiated, and documented in the FWQMP.
- Negotiate and enter into a memorandum of understanding (MOU) with technical service providers wanting to assume the role of assisting growers in development of an FWQMP. The Central Valley Water Board may choose to delegate FWQMP review and approval authority to the technical service entity.
- Conduct a specified number of grower site inspections annually. Site inspection priority would be determined by the Central Valley Water Board using factors such as complaints received regarding discharge, size of operations, types of operations, and location of operations in regard to water quality problems. The Central Valley Water Board may work with, or contract with, another entity to conduct these inspections in the most efficient manner (e.g., CACs or another entity). Site inspections would include evaluation of FWQMPs and implemented management practices, among other things.
- Follow up and coordinate with growers to ensure that FWQMPs and implemented management practices are addressing identified water quality problems. This would include providing information to help focus grower-developed FWQMPs (e.g., results of monitoring and studies showing constituents of concern for different geographic areas).
- Review monitoring reports (monitoring would be specified in the FWQMP).
- Review overall program performance with regard to achieving ILRP objectives.
- Respond to individual problems and complaints dealing with irrigation discharge.
- Issue certification that the participating grower is implementing management practices that protect water quality (following FWQMP review and approval).

- In an iterative process, require additional monitoring, information, and/or management measures where applicable water quality objectives are not being met.
- Enforce ILRP requirements.

### 3.4.3 Regulatory Requirements and Approvals

#### Regulatory Requirements

In order to be eligible for a conditional waiver under Alternative 3, growers would be required to:

- Submit an application to the Central Valley Regional Water Board to enroll in the program and pay fees. Minimum required information for an application<sup>2</sup> for coverage under Alternatives 3, 4, and 5 would include:
  - Name and contact information of owner/operator.
  - Discharge location and operations.
  - Receiving water information.
  - Irrigation method(s).
  - Site map.
  - Parcel numbers, acreages, and crop types.
  - Location of any potential conduits to groundwater (e.g., active, inactive, or abandoned wells; dry wells; recharge basins; or ponds).
- Working directly with the Central Valley Water Board and/or with another implementing entity (e.g., a coalition or private consultant), within 2 years of enrollment in the program, develop and implement an FWQMP aimed to minimize waste discharge to groundwater and surface water (to include wellhead protection practices).
  - Alternatives 3, 4, and 5 would require that irrigated agricultural operations develop individual FWQMPs. For guidance and consistency, the Central Valley Water Board would develop a standard FWQMP template, but it is expected that, at a minimum, plans would describe those practices needed or currently in use to achieve water quality protection. Growers would be encouraged to work with technical service organizations such as RCDs and the University of California Cooperative Extension in development of FWQMPs.
  - FWQMP content would at a minimum include (1) name and contact information of owner/operator; (2) description of operations, including number of irrigated acres, crop types, and chemical/fertilizer application rates and practices; (3) maps showing the location of irrigated production areas, discharge points, and named water bodies; (4) applicable information on management practices used to achieve general ranch/farm management objectives and reduce or eliminate discharge of waste to groundwater and surface waters; (5) measures instituted to comply with CCR Title 3 Section 6609 requirements for wellhead protection (from pesticide contamination), along with methods for wellhead protection from fertilizer use; and (6) identification of any potential conduits to groundwater aquifers on the property (e.g., active, inactive, or abandoned wells; dry wells; recharge basins; or

---

<sup>2</sup> This “application” would be a Notice of Intent to comply with program requirements.



ponds) and steps taken, or to be taken, to ensure that all identified potential conduits do not carry contamination to groundwater.

- Management practices could be instituted on an individual basis or could be installed to serve a group of growers discharging to a single location (e.g., a combined tailwater return or wetlands serving a group of growers).
- Submit the FWQMP for review and approval by the Central Valley Water Board.
- Maintain and update the approved FWQMP as operations and conditions change.
- Prevent nuisance conditions and/or exceedance of water quality objectives in state waters associated with waste discharge from their irrigated agricultural lands.
- Allow inspection of the production area by the Central Valley Water Board, or representative, to verify satisfactory implementation of management practices and accuracy of the FWQMP.

## Monitoring Provisions

Under Alternative 3, unless specifically required in response to water quality problems, owners/operators would not be required to conduct water quality monitoring of adjacent receiving waters or underlying groundwater. Required monitoring would include evaluating the effectiveness of management practices (e.g., monitoring that an installed tailwater return system is preventing off-site discharge, review of erosion prevention practices after storm events, visual monitoring of turbidity of field discharge, and review of nutrient applications and estimated crop uptake). An annual report to the Central Valley Water Board would be required that discusses the status of management practice implementation and an evaluation of the performance of those practices.

Requirements for individual ranch/farm monitoring would be agreed to by the owner/operator and the Central Valley Water Board and would be included in the FWQMP. The Central Valley Water Board and/or the MOU entity would conduct annual site inspections on a selected number of operations and review available applicable water quality monitoring data as additional means of monitoring the implementation of management practices and program effectiveness.

## 3.5 Alternative 4 – Direct Oversight with Regional Monitoring

### 3.5.1 Introduction

Under Alternative 4, the Central Valley Water Board would develop WDRs and/or a conditional waiver of WDRs for waste discharge from irrigated agricultural lands to groundwater and surface water. Growers, or legal entities responsible for a group of growers' waste discharges, would apply directly with the Central Valley Water Board to obtain coverage ("direct oversight"). As in Alternative 3, growers would be required to develop and implement individual FWQMPs in order to minimize discharge of waste to groundwater and surface water from irrigated agricultural lands. However, this alternative also would include an option for third-party-run regional monitoring instead of individual grower monitoring.

Under this alternative, discharge of waste to surface water and groundwater would be regulated using a tiered approach. Fields would be placed in one of three tiers based on their threat to water

quality. The tiers represent fields with minimal (Tier 1), low (Tier 2), and high (Tier 3) potential threat to water quality. Requirements to avoid or minimize discharge of waste would be the least stringent for Tier 1 fields and the most stringent for Tier 3 fields. This would allow for less regulatory oversight for low-threat operations while establishing necessary requirements to protect water quality from higher-threat discharges. This alternative relies on coordination with DPR for regulating discharges of pesticides to groundwater.

## Criteria for Tier System

Table 3-3 provides a summary of the tier system.

### Tier 1 (Minimal Threat)

Tier 1 fields would have a minimal potential to affect water quality. Such fields are defined as those where the discharge is so minimal that it would not result in any detectable change in water quality.

Tier 1 applicability would be based on a site-specific evaluation of the potential impact of an agricultural waste discharge to surface water or groundwater quality, considering such factors as the existing water quality, hydrogeologic conditions, nitrogen loading, crop types, irrigation practices, pesticides used, distance to surface water bodies, and whether the field is in a DPR-designated Groundwater Protection Area (GWPA).

### Tier 2 (Low Threat)

Tier 2 fields would have a low potential to affect water quality and would meet each of the following conditions:

- Have low-threat pesticide and fertilizer use. Low-threat pesticide and fertilizer operations are those that (1) for groundwater, do not use pesticides that have been found in or have the potential to move to groundwater as evaluated by the DPR's Groundwater Protection Program (Title 3 CCR Section 6800) or for surface water, do not use pesticides with the potential to cause exceedance of applicable surface water quality objectives (defined as any pesticide for which monitoring data have shown two or more exceedances of applicable water quality objectives in three or more subbasins [Federal Watershed Boundary Dataset]); and (2) use fertilizer application rates that are not expected to result in nitrogen exceedances in a groundwater basin.
  - Are not located in a vulnerable hydrologic environment. Vulnerable hydrologic environments would be defined by:
    - **Groundwater.** Square-mile sections of land where monitoring data from one well confirms any **one** of the following: (i) nitrate concentrations are greater than the maximum contaminant level (elevated nitrate levels); (ii) have measurable levels of agriculturally used pesticides; or (iii) salts or pathogens (where manure is used) are above an applicable water quality objective. GWPAs also would be considered vulnerable hydrologic environments. Information on the GWPAs is available at:  
[http://www.cdpr.ca.gov/docs/emon/grndwtr/gwp\\_regs.htm](http://www.cdpr.ca.gov/docs/emon/grndwtr/gwp_regs.htm).
- Square-mile sections where agriculture is not a source of high levels of pesticides, salts, pathogens, or nitrate may not be considered "vulnerable hydrologic environments" under this alternative.

- **Surface Water.** Subwatersheds where monitoring data confirm two or more exceedances of an applicable water quality objective for agriculturally used pesticides, nutrients, salts, sediment, or pathogens within a 3-year period (where agriculture is a contributing source).

### **Tier 3 (High Threat)**

Tier 3 fields would have a high potential to affect surface water and/or groundwater quality and would not meet the Tier 1 or 2 criteria. Tier 3 fields would include fields with low-threat fertilizer or pesticide use but located in a vulnerable hydrologic environment. Tier 3 also would include fields that are not located in a vulnerable hydrologic environment but with high-threat fertilizer and/or pesticide use. A field may move from Tier 3 to Tier 2 or vice versa, depending on changes in fertilizer or pesticide use or available information on groundwater vulnerability.

Growers could be in different tiers for surface water and groundwater discharge. For example, a field may be in a vulnerable environment for groundwater (Tier 3) but a minimal threat to surface water (Tier 1) if all applied water immediately percolates and does not run off.

**Table 3-3. Tier System Matrix under Alternative 4**

|                                       | <b>Tier 1</b>                                                                                                   | <b>Tier 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>Tier 3</b>                                                                                                                                                                                               |
|---------------------------------------|-----------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Definition <sup>a</sup>               | Fields with minimal potential to affect water quality                                                           | Fields with low potential to affect water quality:<br>1. <i>Surface water</i> – not a potential source of a water quality problem within the subwatershed; does not use pesticides that have been identified as causing water quality problems in three or more sub-basins.<br>2. <i>Groundwater</i> – low-threat fertilizer use; no use of Title 3, California Code of Regulations Section 6800 pesticides; not within a vulnerable hydrologic 1-mile section of land as identified by well data. | Fields with waste discharge to surface water or groundwater that do not meet Tier 1 or 2 definitions                                                                                                        |
| Specific requirements <sup>b</sup>    | Submit site-specific information demonstrating minimal potential to affect surface water or groundwater quality |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Nutrient management plans and/or additional pesticide management practices                                                                                                                                  |
| Surface water monitoring <sup>b</sup> |                                                                                                                 | <i>Individual</i> tailwater, stormwater, tile drainage monitoring for constituents of concern 1 year of every 5 years<br><b>Or</b><br><i>Regional</i> ambient water quality monitoring for constituents of concern 1 year of every 5 years                                                                                                                                                                                                                                                         | <i>Individual</i> tailwater, stormwater, tile drainage monitoring for constituents of concern<br><b>Or</b><br><i>Regional</i> ambient water quality monitoring for constituents of concern                  |
| Groundwater monitoring <sup>b</sup>   |                                                                                                                 | <i>Individual</i> semi-annual monitoring of onsite wells for nitrate, phosphorus, total dissolved solids, and pathogens<br><b>Or</b><br><i>Regional</i> groundwater monitoring for constituents of concern                                                                                                                                                                                                                                                                                         | <i>Individual</i> semi-annual monitoring of onsite wells for nitrate, phosphorus, total dissolved solids, and pathogens<br><b>And</b><br><i>Regional</i> groundwater monitoring for constituents of concern |

<sup>a</sup> An operation may be in a different tier for surface water and groundwater discharges.

<sup>b</sup> The requirements summarized in this matrix are those specific to each tier. See Alternative 4, Regulatory Requirements, for requirements that apply to all tiers.

## 3.5.2 Program Components

### Implementation Mechanisms and Lead Entity Responsibilities

Implementation mechanisms for Alternative 4 could include WDRs and/or waivers of WDRs.

Under Alternative 4, growers would be lead entities in working directly with the Central Valley Water Board and would be responsible for applying for coverage, developing FWQMPs, and conducting any required monitoring and reporting. This alternative also would allow for the formation of responsible legal entities that could serve a group of growers who discharge to the same general location and share monitoring locations. In such cases, the legal entity would be required to assume responsibility for member grower waste discharge, be approved by the Central Valley Water Board, and ultimately be responsible for compliance with ILRP requirements. One example would be a Joint Powers Authority. Under the Water Code, the discharger, as the party with operational control over waste discharges, is generally the party that is accountable for compliance with permit conditions. Accordingly, any proposal for a legal entity other than the discharger to assume responsibility for waste discharges under Alternative 4 would require careful legal scrutiny of the structure and powers of the entity to ensure consistency with the Central Valley Water Board's statutory mandates.

For monitoring under this alternative, growers would have the option to enroll in a third-party group regional monitoring program instead of conducting individual monitoring. In cases where responsible legal entities are formed, these entities would be responsible for conducting regional monitoring.

Where third-party groups fail to adequately conduct monitoring, each grower would be responsible for conducting individual monitoring. Third-party monitoring groups must be approved by the Central Valley Water Board and would need to agree to assume the following responsibilities:

- Provide members and the Central Valley Water Board an organizational or management structure identifying persons responsible for ensuring that monitoring requirements are fulfilled.
- Agree to provide or make available to group members summaries of expenditures of fees for compliance with the ILRP.
- Develop monitoring plans.
- Conduct required water quality monitoring.
- Notify potentially affected third-party group members each time the group has received a notice of violation or other enforcement action from the Central Valley Water Board and provide information regarding the reason for the enforcement.

### General Roles and Responsibilities of the Central Valley Water Board

Under Alternative 4, the Central Valley Water Board would assume the following general roles and responsibilities:

- Enroll growers and or responsible legal entities (where applicable).
- Require 100 percent participation by discharging growers in the ILRP.



- Review and approve monitoring plans of third parties and any responsible legal entity.
- Review monitoring reports.
- Follow up and coordinate with growers to ensure that FWQMPs and implemented management practices are addressing identified water quality problems. This would include developing tier system information (e.g., delineating hydrologic vulnerable areas), informing the growers about the tiers that apply to them in regard to waste discharge, and providing information to help focus grower-developed FWQMPs (e.g., results of monitoring and studies showing constituents of concern for different geographic areas). Where responsible legal entities are formed, those legal entities would be responsible for follow-up and coordination with growers; the Central Valley Water Board would work with the legal entities.
- Review overall program performance in regard to achieving ILRP objectives.
- Respond to individual problems and complaints dealing with irrigation discharge.
- Conduct a specified number of grower site inspections annually. Site inspection priority would be determined by the Central Valley Water Board using factors such as complaints received regarding discharge, size of operations, types of operations, and location of operations in regard to water quality problems. The Central Valley Water Board may work with or contract with another entity to conduct these inspections in the most efficient manner (e.g., CACs). Site inspections would include evaluation of FWQMPs, nutrient management plans, management practices, monitoring information, and nutrient budgets.
- In an iterative process, require additional monitoring, information, and/or management measures where applicable water quality objectives are not being met.
- Enforce ILRP requirements.

### 3.5.3 Regulatory Requirements and Approvals

#### Regulatory Requirements

In order to be eligible for a conditional waiver under Alternative 4, growers would be required to:

- Submit an application to the Central Valley Water Board to enroll in the program or be a member of a legal entity that has assumed responsibility for their waste discharge. The legal entity would apply for coverage on behalf of members. In addition to the requirements identified under “Regulatory Requirements” for Alternative 3, required application information under Alternative 4 would include the following:
  - Available site-specific groundwater monitoring data for nitrates, salts, and pathogens.
  - Information necessary to determine whether the operation would be in Tier 1, 2, or 3 in regard to each field’s potential threat to water quality.

Where applicable, responsible legal entities would collect the application information for each member grower and report summary information to the Central Valley Water Board.

- Within 2 years of enrollment in the program, prepare and implement an FWQMP aimed to minimize waste (e.g., nutrients, pesticides, sediment, and pathogens) discharge to surface water and groundwater (to include wellhead protection practices). This plan also would be kept on the site and submitted to the Central Valley Water Board upon request. Proposed FWQMP

requirements are summarized under “Regulatory Requirements” for Alternative 3. Where applicable, the FWQMP would be submitted to responsible legal entities upon request.

Management practices could be instituted on an individual basis, or be installed to serve a group of growers discharging to a single location (e.g., a combined tailwater return or wetlands serving a group of growers).

- Maintain and update the FWQMP as operations and conditions change.
- Allow inspection of the production area by the Central Valley Water Board, or representative, to verify satisfactory implementation of management practices and accuracy of the FWQMP.
- Prevent nuisance conditions and/or exceedance of water quality objectives in state waters associated with waste discharge from their irrigated agricultural lands.
- Keep and maintain facility records of each field’s nutrient budget. These records would be made available to the Central Valley Water Board (or, where applicable, the responsible legal entity) during an inspection or upon request.
- Within 2 years of enrollment in the program, complete 15 hours of farm water quality education.
- Submit an annual certified statement to the Central Valley Water Board (or, where applicable, the responsible legal entity) indicating whether changes have been made to fertilizer or pesticide use, or if additional information is available on existing water quality that would change a field’s potential impact to surface or groundwater, thus allowing (or requiring) the field to move from one tier to another.

### **Additional Requirements – Only Tier 1 Operations**

Specific regulatory requirements for only Tier 1 operations would include the following:

- Submit a site-specific evaluation to the Central Valley Water Board or, where applicable, the responsible legal entity, demonstrating that waste discharge from irrigated agricultural operations has minimal potential impact to surface water and/or groundwater quality. The site-specific evaluation would include the following information:
  - For waste discharge to groundwater. Information on operations, existing groundwater quality, depth to groundwater, groundwater flow direction, description of subsurface sediments, and nutrient and irrigation management practices.
  - For waste discharge to surface water. Information on operations, existing surface water quality, distance to surface water bodies, identification of conduits to surface water (e.g., pipes, ditches, and canals), estimated volume and waste composition of water discharged off the site, and nutrient and irrigation management practices.

This evaluation would be tailored to the discharge considered a minimal threat. For example, where surface water discharge is considered a minimal threat, the required information would be tailored to the surface water discharge. These site-specific evaluations would be subject to Central Valley Water Board review and approval.

## Additional Requirements – Only Tier 3 Operations

Specific regulatory requirements for only Tier 3 operations would include the following:

- Where Tier 3 characterization is based on fertilizer application rate or the section of land is defined as a vulnerable hydrologic environment in regard to nitrate. If commercial fertilizers or manure are used, develop and implement a nutrient management plan that is certified by a crop specialist and that provides protection for both surface water and groundwater. *Certified crop specialist* is defined as a specialist certified in developing nutrient management plans. The definition includes professional soil scientists, professional agronomists, professional crop scientists, and crop advisors certified by the American Society of Agronomy; technical service providers certified in nutrient management in California by the Natural Resources Conservation Service; and other specialists approved by the Central Valley Water Board Executive Officer. The nutrient management plan must consider the rate, timing, and method of nutrient applications to avoid exceeding the crop's nutrient requirements considering the stage of plant growth, all nutrient sources, soil and climatic conditions, crop water use requirements, and minimum leaching requirements to reduce deep percolation of irrigation water to groundwater.

Growers would be required to update and maintain the nutrient management plan at the facility and submit it to the Central Valley Water Board upon request. Where applicable, the nutrient management plan must be submitted to the responsible legal entities upon request.

- Where the section of land is defined as a vulnerable hydrologic environment in regard to pesticides. Develop and implement management practices to minimize the potential discharge of pesticides to surface water and groundwater (e.g., DPR-recommended management practices for using the pesticide). These additional practices would be included in the FWQMP.

Growers who do not meet these requirements would work directly with the Central Valley Water Board and obtain WDRs or an individual waiver of WDRs.

## Monitoring Provisions

Under Alternative 4, all growers would be required to conduct the following tracking and submit the results to the Central Valley Water Board (or an approved third-party monitoring group) annually.

- Nutrient tracking
  - All nutrients applied (e.g., commercial fertilizers, manure, and irrigation water).
  - Ratio of nutrients applied to the needs of the crop(s) (as recommended by the *University of California Western Fertilizer Handbook* [9<sup>th</sup> Edition; California Plant Health Association 2002] or from historical crop removal rates).
- Pesticide tracking
  - The types and amounts of pesticides applied. The Central Valley Water Board would coordinate with DPR and CACs to gather this information.
- Implemented tracking of management practices

In addition to these tracking requirements, growers in Tiers 2 and 3 would have the option of conducting individual monitoring or forming third-party groups to conduct regional monitoring programs (see below).

## Surface Water Monitoring

All growers in Tiers 2 and 3 for surface water discharge may elect to conduct individual monitoring **or** participate in regional monitoring by a third-party group or responsible legal entity. Constituents of concern may be prioritized for monitoring using the tier system. For example, where a grower is in Tier 3 for nutrient use but does not have high threat pesticide use, monitoring may be reduced to Tier 2 for pesticide use.

### Individual Monitoring

Individual discharge monitoring for constituents of concern for Tier 3 operations would consist of the following:

- Tailwater discharges during the first discharge of the irrigation season and once mid-season.
- Storm water discharges during the first event of the wet season (between October 1 and May 31) and once during the peak storm season (typically February).
- Discharges of subsurface (tile) drainage systems annually.

Tier 2 operations would be required to conduct the above monitoring for 1 year of every 5 years (additional monitoring would apply where exceedances of applicable water quality objectives are found if agricultural discharges are a contributing source).

For Tier 3 operations, monitoring results would be submitted in an annual report to the Central Valley Water Board.

### Regional Monitoring

Growers could form third-party groups to conduct regional monitoring programs. These groups would work with the Central Valley Water Board to identify monitoring sites and specific monitoring parameters (e.g., visual or chemical). Growers ultimately would be responsible for ensuring that monitoring requirements are carried out according to the requirements in the regional monitoring program. If legal entities are formed that serve a group of growers, the legal entity would be responsible for regional monitoring.

Regional monitoring would include regional water quality monitoring for constituents of concern. Monitoring locations would be limited to waters of the state that are mainly runoff/discharge from irrigated agricultural operations in order to determine whether they are meeting applicable water quality objectives and whether agricultural discharges are causing or contributing to a violation of applicable water quality objectives.

Tier 2 growers would be required to participate in water quality monitoring (e.g., water chemistry monitoring) for only 1 year of every 5 years.

Monitoring also would include gathering nutrient/pesticide use and management practices tracking information from member growers and summarizing the information. Monitoring and tracking results would be submitted in an annual report to the Central Valley Water Board.

## Groundwater Monitoring

All growers in Tiers 2 and 3 for groundwater discharge would be required to conduct the following groundwater monitoring.

### Individual Monitoring

Tier 3 operations would be required to conduct individual monitoring. Individual monitoring would consist of semiannual (spring/fall) sampling of each existing domestic well and/or monitoring well present on each field parcel for nitrate, phosphorus, total dissolved solids, and pathogens (when manure is applied). Each grower would be required to submit an annual report on their monitoring results to the Central Valley Water Board.

Tier 2 operations would be required to conduct the above individual monitoring **or** participate in regional monitoring.

### Regional Monitoring

All Tier 3 operations would be required to participate in a regional monitoring program, in addition to the individual monitoring described above. Tier 2 operations that do not conduct individual monitoring also would be required to participate in a regional monitoring program. Regional monitoring would consist of the following:

- Regional monitoring for constituents of concern to provide baseline groundwater information and track trends in groundwater quality over time.
- Targeted site-specific studies to evaluate the effects of changes in management practices on groundwater quality (this would occur only at a selected number of sites—the Fertilizer Research and Education Program [FREP] would be approached as a potential funding source for this monitoring).
- Gathering nutrient/pesticide use and management practices tracking information from member growers.
- Submitting an annual report to the Central Valley Water Board summarizing nutrient, pesticide, and management practice tracking and the regional and targeted site-specific monitoring results.
- Utilizing a database system to compile existing groundwater quality data and data collected during regional and site-specific monitoring (e.g., the State Water Board's Groundwater Ambient Monitoring and Assessment [GAMA]/GeoTracker database could be used).

The Central Valley Water Board, the agricultural industry, and other stakeholders would identify organization(s) or entities, such as the USGS, University of California, Lawrence Livermore National Laboratory, or DWR, suitable to conduct the regional monitoring and the criteria for this monitoring. These organizations or entities could be funded by additional annual fees, dues, or other funding mechanisms such as grant money.

Where legal entities are formed to take responsibility of waste discharge from a group of growers, these entities would be responsible for regional monitoring.



## **3.6 Alternative 5 – Direct Oversight with Farm Monitoring**

### **3.6.1 Introduction**

Alternative 5 would consist of general WDRs designed to protect surface water and groundwater from discharges associated with irrigated agriculture.

All growers would be required to apply for and obtain coverage under the general WDRs. This alternative would include requirements to (1) develop and implement an FWQMP; (2) monitor discharges of tailwater, drainage water, and storm water to surface water; applications of irrigation water, nutrients, and pesticides; and groundwater; (3) keep records of irrigation water and pesticide applications and nutrients applied, harvested, and moved off the site; and (4) submit an annual monitoring report.

This alternative relies on coordination with DPR for regulating discharges of pesticides to groundwater.

### **3.6.2 Program Components**

#### **Implementation Mechanisms and Lead Entity Responsibilities**

Under Alternative 5, the Central Valley Water Board would develop general WDRs for irrigated agriculture.

Under this alternative, growers would be the lead entity in working with the Central Valley Water Board. The Central Valley Water Board would adopt the WDRs, enroll individual operations under the program, provide regulatory oversight, and enforce the requirements of the ILRP.

#### **General Roles and Responsibilities of the Central Valley Water Board**

Under Alternative 5, the Central Valley Water Board would assume the following general roles and responsibilities:

- Enroll growers in the program.
- Require 100 percent participation by discharging growers in the ILRP.
- Review monitoring reports.
- Develop a prioritization scheme for determining where monitoring wells would be required in order to assess potential impacts to groundwater quality and overall program effectiveness.
- Follow up and coordinate with growers to ensure that FWQMPs and implemented management practices are addressing identified water quality problems. This would include providing information to help focus grower-developed FWQMPs (e.g., results of monitoring and studies showing constituents of concern for different geographic areas).
- Review overall program performance in regard to achieving ILRP objectives.
- Respond to individual problems and complaints dealing with irrigation discharge.

- Conduct a specified number of grower site inspections annually. Site inspection priority would be determined by the Central Valley Water Board using factors such as complaints received regarding discharge, size of operations, types of operations, and location of operations in regard to water quality problems. The Central Valley Water Board may work with, or contract with, another entity to conduct these inspections in the most efficient manner (e.g., CACs). Site inspections would include evaluation of FWQMPs, nutrient management plans, management practices, monitoring information, and nutrient budgets.
- In an iterative process, require additional monitoring, information, and/or management measures where applicable water quality objectives are not being met.
- Enforce ILRP requirements.

### 3.6.3 Regulatory Requirements and Approvals

In order to be eligible for a conditional waiver under Alternative 5, growers would be required to:

- Submit an application to the Central Valley Water Board to enroll in the program. In addition to the requirements described under “Regulatory Requirements” for Alternative 3, required application information would include the following:
  - Available site-specific groundwater monitoring data for nitrates, salts, and pathogens.
  - Information to determine the whole farm nitrogen balance (estimated total nitrogen applied to crops, acreages of crops grown, and the crop nitrogen needs).
- Within 2 years of enrollment in the program, prepare and implement an FWQMP aimed to minimize waste (e.g., nutrients, pesticides, sediment, and pathogens) discharge to surface water and groundwater (to include wellhead protection practices)—this plan also would be kept on the site and submitted to the Central Valley Water Board upon request. Proposed FWQMP requirements are described under “Regulatory Requirements” for Alternative 3.
- Maintain and update the FWQMP as operations and conditions change.

If commercial fertilizers or manure are used, develop and implement a nutrient management plan that is certified by a crop specialist and that provides protection for both surface water and groundwater. *Certified crop specialist* is defined as a specialist certified in developing nutrient management plans. The definition includes professional soil scientists, professional agronomists, professional crop scientists, or crop advisors certified by the American Society of Agronomy; technical service providers certified in nutrient management in California by the NRCS; or other specialists approved by the Central Valley Water Board Executive Officer. The nutrient management plan must consider the rate, timing, and method of nutrient applications to avoid exceeding the crop’s nutrient requirements considering the stage of plant growth; all nutrient sources; soil and climatic conditions; crop water use requirements; and minimum leaching requirements to reduce deep percolation of irrigation water to groundwater. Growers would be required to update and maintain the nutrient management plan at the facility and submit it to the Central Valley Water Board upon request.

- Allow inspection of the production area by the Central Valley Water Board, or representative, to verify satisfactory implementation of management practices and accuracy of the FWQMP and nutrient management plan.

- Prevent nuisance conditions and/or exceedance of water quality objectives in state waters associated with waste discharge from their irrigated agricultural lands.
- Keep and maintain facility records of each field's nutrient budget. These records would be made available to the Central Valley Water Board during an inspection or upon request.

## Monitoring Provisions

Under Alternative 5, each operation would be required to conduct the following monitoring and tracking for each field and submit the results to the Central Valley Water Board annually.

- Discharge monitoring for constituents of concern
  - Tailwater discharges monthly.
  - Storm water discharges during the first event of the wet season (between October 1 and May 31) and once during the peak storm season (typically February).
  - Discharges of subsurface (tile) drainage systems annually.
- Nutrient tracking
  - All nutrients applied (e.g., commercial fertilizers, manure, and irrigation water).
  - Soil nitrogen and phosphorus once every 5 years.
- Pesticide tracking
  - Types and amounts of pesticides applied—The Central Valley Water Board will coordinate with DPR and the CACs to gather this information.
- Groundwater monitoring
  - Sample all supply wells annually for nitrate and electrical conductivity (or total dissolved solids) and for major cations and anions if elevated concentrations of nitrate or electrical conductivity are detected.
  - Install monitoring wells or use a Central Valley Water Board-approved alternative technology (e.g., well point or direct push method) to collect groundwater quality samples semiannually if requested by the Executive Officer. Locations chosen for groundwater monitoring would be prioritized based on Central Valley Water Board staff-developed vulnerability factors. These factors would include nitrate concentrations in the supply wells, nitrate concentrations in domestic wells adjacent to the property, location of the property relative to a GWPA, distance from an artificial recharge area as identified by DWR or the Central Valley Water Board, distance between the property and the nearest off-property domestic well, distance from the property to the nearest off-property municipal well, number of crops grown per year per field, nutrient management plan completed by deadline, and whole farm nitrogen balance.

## 3.7 Alternatives Considered and Rejected

Because of the cooperative method in which the alternatives were developed, program components were proposed, discussed, and eliminated from further consideration in a workgroup setting. Elements were removed from consideration if they were infeasible, in that they failed to meet the

program goals and objectives, or conflicted with other mandated policies of the Central Valley Water Board and its mission. Alternatives or alternative components that were rejected as infeasible are discussed below.

### **3.7.1 Elimination of the ILRP**

The Lead Agency considered and removed from further analysis any alternative representing elimination of the ILRP. This alternative would not prevent waste discharges from irrigated agricultural lands, leading to continued degradation of water quality and interfering with the recognized beneficial uses of waters of the state. Thus, this alternative does not meet the Central Valley Water Board's obligations nor the goals and objectives of the program.

The current regulatory program for irrigated agriculture, the 2006 waiver, expires at the end of June 2011. If the Central Valley Water Board fails to take the ministerial action to extend or renew the waiver program, regulation of irrigated agriculture would not cease. Rather, agricultural dischargers, as persons "discharging waste, or proposing to discharge waste, within any region that could affect the quality of the waters of the state," will have the ongoing obligation under Water Code Section 13260 to file a Report of Waste Discharge; and the Central Valley Water Board will need to issue individual or general WDRs to regulate the discharges or adopt a new waiver. As such, the scenario under which no Central Valley Water Board action is taken in June 2011 is not a stable alternative that lends itself to analysis. Accordingly, this alternative also was ruled out as the "No Project" Alternative.

### **3.7.2 Direct Permitting of Each Discharging Grower**

The Lead Agency considered and removed from further analysis any alternative representing direct regulation of all individual growers by the Central Valley Water Board. Due to the tens of thousands of growers in the region's boundaries, such an alternative would overwhelm the resources of the Central Valley Water Board and lead to an inability to meet its mission. Thus, this alternative does not meet the Central Valley Water Board's obligations nor the goals and objectives of the program.

## **4.1 Overview**

This chapter describes the environmental setting of the ILRP as it relates to surface water, groundwater, and agriculture. It briefly describes program boundaries and the watersheds and groundwater basins contained therein. It also summarizes the existing agricultural uses in the program area. The environmental setting, as it relates to specific resources, is presented in the sections of Chapter 5, Environmental Impacts and Mitigation Measures. A more detailed description of each watershed and groundwater basin can be found in the ECR. (ICF Jones & Stokes 2008).

## **4.2 Introduction**

The connection between groundwater and surface water is important to address in the development of any program designed to protect water resources, because the movement of water from one hydrologic system to another can move pollutants between the two systems. Groundwater is recharged by seepage of water moving downward from the ground surface.

Today, many cities in the San Joaquin Valley that depend on groundwater for drinking water rely on surface water delivery facilities for groundwater recharge. In wet years, many agricultural water users are encouraged to forego pumping groundwater in exchange for applying surface water, and many irrigation districts and municipal water agencies recharge groundwater through spreading basins designed to enhance recharge. This recharged water can then be used in drier years when surface water supplies are less available. This interconnectedness both supports better utilization of water resources and provides pathways for contamination to occur.

## **4.3 Program Boundaries and Subdivisions**

The jurisdiction of the Central Valley Water Board stretches from the Oregon border to the northern tip of Los Angeles County. Three major watersheds have been delineated within this region, namely the Sacramento River Basin, the San Joaquin River Basin, and the Tulare Lake Basin. The three basins cover approximately 40 percent of the total area of the state and include approximately 75 percent of the state's irrigated acreage (Central Valley Water Board 2002a).

The Central Valley is a large, flat, fertile valley that dominates the central portion of California. The northern half of the Central Valley is referred to as the Sacramento Valley. Its watershed extends out of the valley northward to the Oregon border; this entire watershed is included in the Central Valley Water Board's jurisdiction. The southern half of the Central Valley is referred to as the San Joaquin Valley. It includes both the San Joaquin River and Tulare Lake Basins. The Sacramento and San Joaquin Valleys meet at the shared delta of the Sacramento and San Joaquin Rivers, which flow through the northern (Sacramento Valley) and southern (San Joaquin Valley) halves of the valley, respectively.



The crests of the Sierra Nevada on the east and the Coast Ranges and Klamath Mountains on the west border the Sacramento and San Joaquin River Basins. The Sacramento and San Joaquin River Basins cover approximately one-fourth of the total area of the state and contain over 43 percent of the state's irrigable land. Surface waters from these two basins meet and form the Delta waterway system, which ultimately drains to San Francisco Bay. Major groundwater resources underlie both river valley floors. The Tulare Lake Basin is bounded on the east and south by the Sierra Nevada and on the west by the Coast Ranges. A low topographic rise in the floor of the San Joaquin Valley separates this basin from the San Joaquin River Basin to the north.

The Sacramento River Basin covers approximately 27,210 square miles. The principal streams in the basin are the Sacramento River and its larger tributaries: the Pit, Feather, Yuba, Bear, and American Rivers on the east; and Cottonwood, Stony, Cache, and Putah Creeks on the west. Major reservoirs include Shasta, Oroville, and Folsom.

The San Joaquin River Basin covers approximately 15,880 square miles. The principal streams in the basin are the San Joaquin River and its larger tributaries: the Cosumnes, Mokelumne, Calaveras, Stanislaus, Tuolumne, Merced, Chowchilla, and Fresno Rivers. Major reservoirs include Pardee, New Hogan, Comanche, Millerton, McClure, Don Pedro, and New Melones.

The Tulare Lake Basin comprises the drainage area of the San Joaquin Valley south of the San Joaquin River and encompasses approximately 17,650 square miles. The valley floor makes up slightly less than one-half the total basin land area. The Kings, Kaweah, Tule, and Kern Rivers, which drain the west face of the Sierra Nevada, provide the bulk of the surface water supply native to the basin. Major reservoirs are Pine Flat, Kaweah, Success, and Isabella. Imported surface water enters the Tulare Lake Basin through the San Luis Canal/California Aqueduct System, Friant-Kern Canal, and the Delta-Mendota Canal.

## 4.4 Surface Water

The Central Valley watershed is divided into three major hydrologic regions or surface water basins, which are described below and illustrated in Figures 2-2, 2-3, and 2-4. Each of the three basins is divided into subwatersheds delineated by DWR CalWater boundaries. The three surface water basins and their associated acreage, rivers/tributaries, and watersheds are described in detail in the ECR (ICF Jones & Stokes 2008).

### 4.4.1 Sacramento River Basin

The Sacramento River Basin contains the entire drainage area of the Sacramento River and its tributaries. It begins upstream of Shasta Lake near the Oregon border and extends south to the Delta, stretching roughly from the northeast corner of California to Sacramento County. The basin drains approximately one-third of total runoff in the state into the middle and lower reaches of the Sacramento River. For the purposes of this analysis, the Sacramento River Basin includes eight subwatersheds (Figure 2-2): the Pit River, Shasta-Tehama, Butte-Sutter-Yuba, Upper Feather River–Upper Yuba River, Lake-Napa, Colusa Basin, Solano-Yolo, and American River Subwatersheds.

Geologic provinces composing the Sacramento River Basin include the Sacramento Valley, the Coast Ranges, the Klamath Mountains, the Cascade Range, the Sierra Nevada, the Modoc Plateau, and the delta of the Sacramento River. Land uses in the Sacramento River Basin are principally forest and

range lands in the upper reaches, with urban development focused around the City of Sacramento. Agriculture is the dominant land use on the valley floor, followed by urban development.

Water quality concerns in the Sacramento River Basin are concentrated in the Sacramento Valley, in subwatersheds that are heavily agricultural. These include the Solano-Yolo, Colusa Basin, Butte-Sutter-Yuba Subwatersheds where agricultural land uses constitute 60, 37, and 36 percent of total acreage, respectively. Section 303(d) listings related to irrigated agriculture occur in all of these subwatersheds, as well as in the American River Subwatershed.

While some water bodies in other subwatersheds of the Sacramento River Basin are also Section 303(d) listed as impaired, these sources of impairment likely are caused by timber harvesting, grazing, and resource extraction, not irrigated agriculture. Elevated levels of diazinon in the Shasta-Tehama Subwatershed are related to pesticide use; however, water quality in this subwatershed generally meets or exceeds water quality objectives. To date, there is no associated Section 303(d) listing.

#### **4.4.2 San Joaquin River Basin**

The San Joaquin River Basin contains the entire drainage area of the San Joaquin River and its tributaries. It extends from the Delta and the Cosumnes River in the north to the southern reaches of the San Joaquin River watershed, encompassing the area from Sacramento County (including the southeast corner of the county itself) to Madera County (and portions of Fresno County). For the purposes of this analysis, the San Joaquin River Basin includes 12 subwatersheds (Figure 2-3): the Cosumnes River, Delta-Mendota Canal, San Joaquin River, San Joaquin Valley Floor, Delta-Carbona, Ahwahnee, Mariposa, Upper Mokelumne River–Upper Calaveras River, Merced River, North Valley Floor, Stanislaus River, and Tuolumne River Subwatersheds.

The San Joaquin River Basin encompasses approximately 9.8 million acres. In general, the basin is dominated by native vegetation. The primary tributaries in the basin are the Stanislaus River, Tuolumne River, and Merced River, which meet with the San Joaquin River in the valley floor at the basin's southern end. The basin is dominated by agriculture at the confluence of the San Joaquin and these various rivers. The San Joaquin River Basin includes most of the Delta as well as the Delta-Mendota Canal, a highly manipulated component of the Central Valley Project. Multiple canals in the Delta-Mendota Canal Subwatershed deliver water to agricultural operations and then back to the natural drainages. Many tributaries in the subwatershed that would otherwise be dry during the summer irrigation season flow year-round due to agricultural return flows.

The water quality of the San Joaquin River is of critical interest because it flows to the Delta, which is a primary source of drinking water, and supplies irrigation water to farms in the western San Joaquin Valley. One of the primary water quality concerns in the San Joaquin River Basin is the transport of pesticides by agricultural return flows to water bodies and transport of pesticides that are applied to orchards during the dormant growing season (November to January) that are transported to water bodies during rainfall events.

Water quality concerns in the San Joaquin River Basin are concentrated in the subwatersheds that are heavily agricultural—specifically, the Delta-Mendota Canal, San Joaquin Valley Floor, Delta-Carbona, and North Valley Floor Subwatersheds. Agricultural land constitutes one-third to one-half of the total land use in each of these subwatersheds. Correspondingly, all of these subwatersheds include water bodies impaired by Section 303(d)-listed pollutants that are associated with irrigated agriculture. Many of the rivers, creeks, and agricultural drainages in these subwatersheds contain

low dissolved oxygen (DO) (generally associated with agricultural return flows), fluctuating pH, and elevated levels of electrical conductivity (EC) (indicative of high salinity). Within each subwatershed, data indicate that chlorpyrifos, diazinon, permethrin, dieldrin, and DDT (and its breakdown products DDD and DDE) are frequently present in concentrations that exceed water quality objectives. Other pesticides are detected in these subwatersheds but not consistently in each subwatershed. In addition, elevated levels of naturally occurring metals that are mobilized and suspended in agricultural return flows are common in these subwatersheds—such as copper, arsenic, cadmium, boron, nickel, lead, and selenium.

### 4.4.3 Tulare Lake Basin

The Tulare Lake Basin includes the southern San Joaquin Valley and encompasses a drainage area from Fresno to the southern end of the Central Valley near the Grapevine (see Figure 2-4 for subwatershed boundaries). For the purposes of this analysis, the Tulare Lake Basin includes 10 subwatersheds: the Kings River, Kaweah River, Kern River, South Valley Floor, Grapevine, Coast Range, Fellows, Temblor Valley, Sunflower Valley, and Southern Sierra Subwatersheds.

Much of the topography within the upland portions of the Tulare Lake Basin is dominated by steep river canyons and large mountains, typical of the Sierra Nevada and Coast Ranges. The basin encompasses several significant land holdings, including Sequoia National Park, Sequoia National Forest, the Golden Trout Wilderness Area, and the Tule Indian Reservation. The basin also includes two Superfund cleanup sites, the Coalinga Asbestos Mine and the Atlas Asbestos Mine.

Due to the amount of land in the Tulare Lake Basin that is in the Sierra Nevada and the Coast Ranges, much of the basin is dominated by native vegetation and includes little urban development. In the upper watershed areas, irrigated agriculture accounts for less than 2 percent of land uses in the Kings River, Kaweah River, Kern River, Grapevine, Coast Range, Sunflower Valley, and Southern Sierra Subwatersheds—with just slightly more in the Temblor Subwatershed (3.3 percent). There is no agriculture in the Fellows Subwatershed.

In general, agricultural operations have a greater impact on surface water in the Central Valley between the Fresno area and the Tehachapi Mountains than other parts of the Valley. This is primarily due to the valley topography allowing for much larger agricultural operations.

Section 303d water quality concerns within the Tulare Lake Basin are limited to the South Valley Floor Subwatershed. None of the other subwatersheds include water bodies with Section 303(d)-listed pollutants; and all physical parameters such as EC, pH, temperature, and turbidity are generally within Basin Plan standards. Factors such as selenium and sedimentation are believed to be naturally occurring (with the exception of the South Valley Floor Subwatershed).

The South Valley Floor Subwatershed is the largest watershed within the Tulare Lake Basin, at approximately 5.3 million acres (approximately 8,280 square miles). The watershed is located in the southern Central Valley and is bounded to the north by the San Joaquin River, to the south by the Tehachapi Mountains, on the west by the Coast Ranges, and on the east by the Sierra Nevada. As noted, the South Valley Floor Subwatershed is relatively flat compared to the surrounding subwatersheds. Agriculture is the primary land use type in the subwatershed, encompassing approximately 66 percent (3.5 million acres) of the total land area.

Surface water in the South Valley Floor Subwatershed is not sufficient to support land uses in the subwatershed, resulting in a large proportion of water being imported from other locations. The Friant-Kern Canal, the San Luis Canal/California Aqueduct System, and the Cross-Valley Canal are

major water delivery facilities that have dramatically altered the way water is managed in the South Valley Floor Subwatershed; water is moved from one end of the valley to the next as needed. The Tulare Lake Basin is hydrologically closed except in extremely wet periods. Because of the intensive water development that has occurred in the basin, very few channels are not specifically maintained as water delivery features; there is very little monitoring or characterization of the basin's water quality.

## 4.5 Groundwater

California's groundwater is described by DWR as a "hidden resource." Management of groundwater resources is more complex than management of surface water because groundwater is not visible (DWR 2003). It is thought that California could not have achieved its agricultural economy, the fifth largest in the world, if it were not for the groundwater supply. Approximately 43 percent of the entire population of California obtains drinking water from groundwater aquifers (DWR 2003). In some areas, the use of groundwater is threatened by the high rates of extraction and inadequate recharge or contamination of aquifers from poor management practices.

The groundwater basins within the three major hydrologic regions (HRs) of the Central Valley watershed have been delineated using the boundaries in Bulletin 118 (DWR 2003), they are:

- Sacramento River Basin
- San Joaquin River Basin
- Tulare Lake Basin

Groundwater is one of California's most important natural resources, and our reliance on it continues to grow. Statewide, groundwater supplies account for approximately 30 percent of the total urban and agricultural water supply in average years, approximately 40 percent of the total water supply in dry years, and as much as 60 percent or more in some regions in dry years. Groundwater provides from 30 to 41 percent of the total water supply for urban and agricultural uses in the Sacramento River, San Joaquin River, and Tulare Lake Basins (see Table 4-1). More than 70 percent of the groundwater used in California is supplied from the Sacramento River, San Joaquin River, and Tulare Lake Basins. (DWR 2003.) With such a large amount of water coming from these basins, protection of their water resources is critical to ensure that future needs are met.

**Table 4-1. Average Annual Groundwater Supply for the Sacramento River, San Joaquin River, and Tulare Lake Basins**

| Basin             | Total Demand Volume (TAF) | Demand Met by Groundwater (TAF) | Demand Met by Groundwater (%) |
|-------------------|---------------------------|---------------------------------|-------------------------------|
| Sacramento River  | 8,720                     | 2,672                           | 31                            |
| San Joaquin River | 7,361                     | 2,195                           | 30                            |
| Tulare Lake       | 10,556                    | 4,340                           | 41                            |

TAF = thousand acre-feet.  
Source: DWR 2003.

The Sacramento River Basin consists of 90 basins and subbasins (Figure 4-1). The San Joaquin River Basin (Figure 4-2) includes nine subbasins, and the Tulare Lake Basin includes 19 basins and

subbasins (Figure 4-3). Detailed information on the quality of these groundwater basins is contained in the ECR (ICF Jones & Stokes 2008).

## 4.6 Agriculture

The lower elevations of the Central Valley have been dominated by agricultural activity for over 100 years. Over this period, crop types have changed and agricultural management practices have been altered, but intensive agriculture is still the principal land use adjacent to the valley's rivers and streams. The current status of agriculture in the three program area basins is briefly summarized below.

The Sacramento River Basin encompasses approximately 12.2 million acres. Of this amount, 2.4 million acres are classified as agricultural lands. The majority of these acres occur on the Valley floor, in the Solano-Yolo, Colusa Basin, and Butte-Sutter-Yuba Subwatersheds. Rice is the primary crop in the Sacramento River Basin, particularly in the Colusa and Butte-Sutter-Yuba Subwatersheds where poorly drained soils provide ideal conditions for this crop. Agricultural land uses account for less than 10 percent of total acreage in the Pit River, Shasta-Tehama, Upper Feather River–Upper Yuba River, American River, and Lake-Napa Subwatersheds.

The San Joaquin River Basin encompasses approximately 9.8 million acres. Of this total, approximately 2 million acres are classified as agricultural. Agricultural land uses in the basin are concentrated in the valley floor—specifically in the Delta-Mendota Canal, San Joaquin Valley Floor, Delta-Carbona, and North Valley Floor Subwatersheds. There is very little agriculture in the remaining subwatersheds—less than 1 percent in most cases. The primary crops that are produced in the San Joaquin River Basin include field crops, pasture, deciduous fruits and nuts, vineyards, and grain and hay.

The Tulare Lake Basin encompasses approximately 10.7 million acres. Of this amount, 3.6 million acres are classified as agricultural. The vast majority of this agricultural land is located in the South Valley Floor Subwatershed (3.5 million acres), largely due to topography. In comparison with other subwatersheds in the Tulare Lake Basin, the South Valley Floor Subwatershed is relatively flat. Consequently, the bulk of water quality concerns related to the Tulare Lake Basin involve agricultural operations and agricultural return flows in the South Valley Floor Subwatershed. The primary crop types within the Tulare Lake Basin as a whole are grain and hay crops, pasture, and deciduous fruits and nuts.



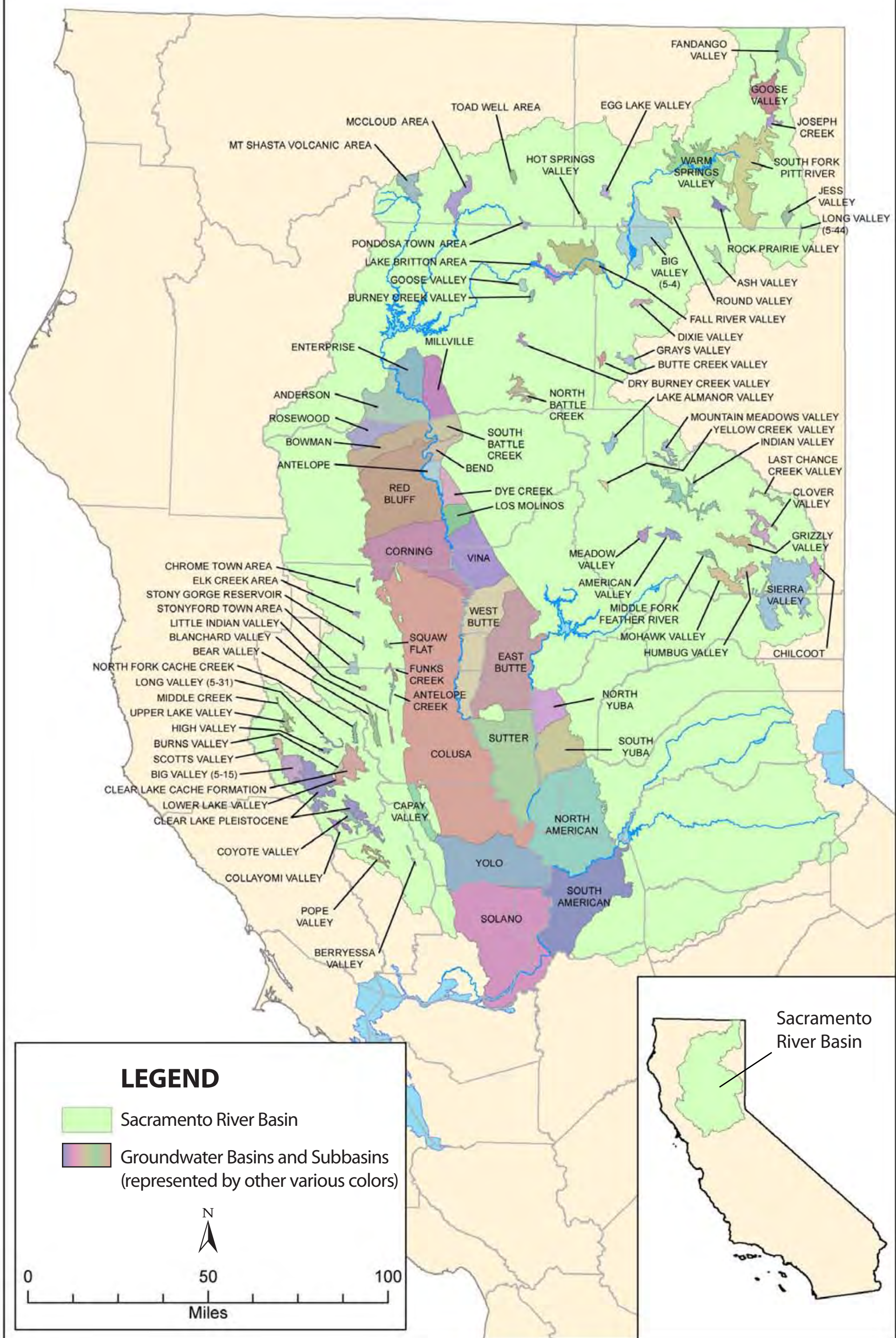
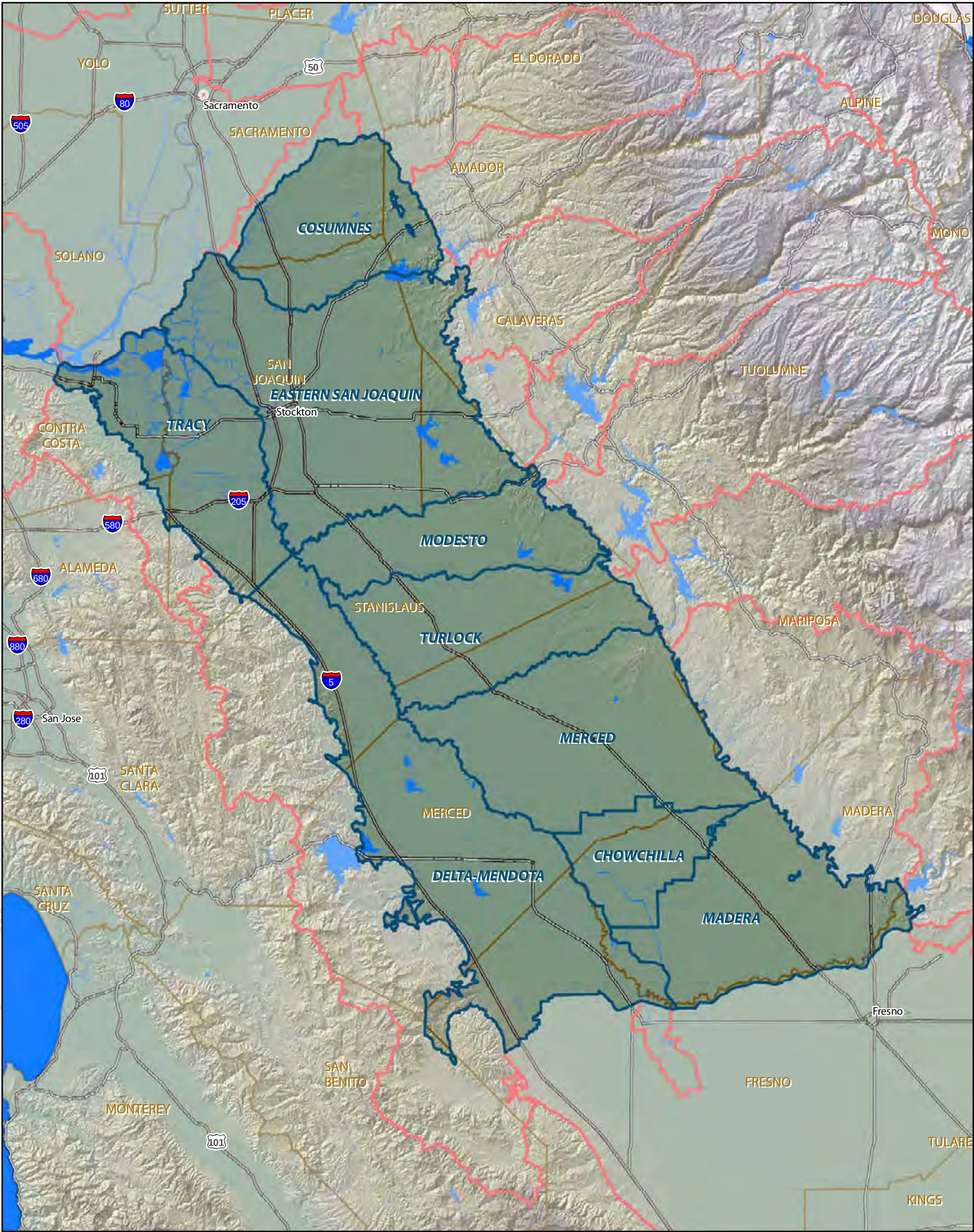


**Figure 4-1**  
**Sacramento River Basin Groundwater Basins and Subbasins**





**Legend**

- Cities
- US Highway
- Interstate
- Groundwater Subbasin Boundaries
- Subwatershed Boundaries
- County Lines

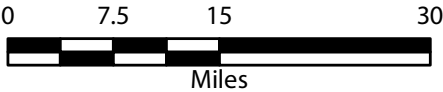


**Figure 4-2**  
**San Joaquin River Basin**  
**Groundwater Subbasins**





**Legend**

- Cities
- US Highway
- Interstate
- Subwatershed Boundaries
- Groundwater Basin and Subbasin Boundaries
- County Lines

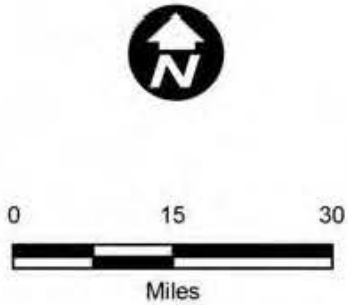


**Figure 4-3**  
**Tulare Lake Basin Groundwater**  
**Basins and Subbasins**



## Chapter 5

# Environmental Impacts and Mitigation Measures

---

## 5.1 Overview

Chapter 5 presents the environmental analysis of the program alternatives. As the Central Valley Water Board has not identified a preferred alternative, all five alternatives are discussed in an equal level of detail within each resource section. Following the analysis of impacts, suggested mitigation is delineated.

### 5.1.1 Approach to Impacts

The ILRP alternatives vary widely in monitoring requirements, lead entities, and other regulatory elements. This environmental analysis attempts to relate those regulatory distinctions to changes in the physical environment of irrigated lands that may result from implementation of an ILRP alternative. To do so, the resource analysts evaluated the possible impacts of several management practices described in the ECR and quantified by alternative in the Draft ILRP Economics Report (ICF International 2010). As is appropriate within a PEIR, the impacts identified are described generally and are not associated with a specific impact location.

The management practices analyzed, as shown in Table 5.1-1, are not a mandatory part of any alternative, but are identified in the Draft ILRP Economics Report as common practices implemented to meet water quality and other farm management goals on irrigated lands. The analyzed management practices are a sample of those most likely to cause an environmental and economic impact. However, it is foreseeable and expected that growers will choose from among the many available management practices to meet water quality goals; some practices may be inappropriate to some crop types, soil conditions, or other considerations. Most identified potential impacts are indirect and can be avoided by use of alternate practices. Where no alternate practice exists, growers who choose to use these practices can avoid impacts to sensitive resources by following the mitigation measures identified in each resource section.

**Table 5.1-1. Management Practices Analyzed for ILRP Alternatives**

| Practice                  | Description                                                                                                                                                                                                                                                                                                                                                 |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Nutrient management       | Reduced application amounts and frequency and nutrient budgeting for fertilizers. No new hardware required and no ground-disturbing likely to result. Practice reduces soluble and/or insoluble constituents moving to water bodies.                                                                                                                        |
| Improved water management | Improved management of irrigation water application (reduced over-application) and use of water additives to coagulate particles. Results in reduced sediment runoff, less deep percolation to groundwater. No new hardware required and no ground-disturbing activities likely to result.                                                                  |
| Tailwater recovery system | Use of tailwater pond to collect surface runoff and prevent flow of sediment and other constituents of concern (COCs); reduces volume of water moving to receiving surface water or groundwater. Includes significant construction effort: construction of ponds, and installation and operation of pumps, often diesel, to recirculate runoff over fields. |

| Practice                               | Description                                                                                                                                                                                                                                                                                                                                                              |
|----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Pressurized irrigation                 | Conversion from surface to pressurized irrigation. Reduces volume of water moving to receiving surface water or groundwater, thereby reducing flow of sediment and other COCs to those waters. Fieldwork involved in setting up new irrigation system does not substantially exceed usual field preparation activities.                                                  |
| Sediment trap, hedgerow, or buffer     | Sediment trap or physical barrier to reroute or capture sediment or reroute water. Water is diverted to allow sediment to settle out before water enters receiving water. Does not reduce overall surface flow or groundwater percolation. Fieldwork involved in creating traps, hedgerows, or buffers does not substantially exceed usual field preparation activities. |
| Cover cropping or conservation tillage | Use of secondary crop to reduce exposed dirt. Reduces sediment movement and increases infiltration rate of water and nutrients to root zone. Reduces use of nutrients and reduces runoff of sediment and other COCs to receiving surface water. Increases percolation, could negatively impact groundwater without proper nutrient and chemical management.              |
| Wellhead protection                    | Physical barrier that prevents contaminated surface water from entering groundwater through well shaft. Berms are constructed around wells to prevent runoff from entering, or unused wells are capped with metal welded plates. Minor implementation effort; dirt berm or cover installation does not substantially exceed usual field preparation activities.          |

Note: A more in-depth description of these management practices is available in the *Existing Conditions Report* (ICF Jones & Stokes 2008).

## 5.1.2 Significance Determinations and Mitigation

Implementation of program alternatives has been determined to result in potentially significant impacts for several resources. Such impacts are largely limited to locations where implementation of management practices has the potential to affect sensitive resources. While these practices are not mandated by the Central Valley Water Board as an element of any alternative, they represent common ways to achieve water quality goals by the regulated community. As such, it is assumed that such practices will be implemented, although the location of such implementation and the likelihood of resulting impacts are unknown at this time. The chosen ILRP enforcement mechanism will include project-level mitigation measures that provide a greater level of specificity in the avoidance of environmental impacts.

## 5.2 Consistency with Plans and Policies

CEQA Guidelines Section 15125(d) requires an EIR to discuss any inconsistencies between the proposed project and applicable general plans and regional plans. Relevant applicable plans are discussed within each resource section. Consistency of the ILRP with applicable legal and regulatory requirements, as well as other regulatory programs, is discussed in the Staff Report (CalEPA and Central Valley Water Board 2010), appended hereto as Appendix A.



#### 5.3.1 Introduction

This section describes the cultural resources setting of the program area. *Cultural resource* is the term used to describe several different types of resources, including archaeological, architectural (built environment), and traditional cultural properties. Archaeological sites include both prehistoric and historic deposits. Built environment properties include buildings, bridges, and infrastructure. Traditional cultural properties (TCPs) include those locations of importance to a particular group.

A brief prehistoric and historical background discussion is provided to better understand the context of the cultural resources associated with the program area. The federal and state regulations that apply to cultural resources in the program area are described for the purpose of analyzing potential program impacts. Finally, the chapter identifies potential impacts on cultural resources that may result from implementation of program alternatives, as well as mitigation measures to avoid or reduce potentially significant impacts.

All identified cultural resource impacts would result from the implementation of ground-disturbing management practices by growers in response to increased regulation. However, the program alternatives would not directly physically disturb any cultural resources in the program area. Management practices, which vary in terms of their physical footprint and location, could be implemented in some or all of 36 affected Central Valley counties. The establishment of a policy over the vast program area—without surveyable management practice footprints—is not amenable to a typical CEQA analysis for cultural resources. Consequently, a programmatic approach was deemed an appropriate level of analysis. No on the ground field surveys were conducted in preparation of this document.

#### 5.3.2 Regulatory Framework

The following federal and state laws and policies are relevant to cultural resources in the program area.

##### Federal

As presently formulated, the program alternatives are not subject to federal cultural resources regulations. Should the Central Valley Water Board redesign the program in such a way that funding, permits, or approval from federal sources is required, the program would become subject to federal cultural resources regulations. Such regulations could include Section 106 of the National Historic Preservation Act (NHPA), the American Indian Religious Freedom Act, and executive orders concerning cultural resources management.

## State

Actions that require funding, approval, or permits from a state agency, such as the program alternatives, are subject to CEQA. The CEQA statutes and State CEQA Guidelines require that agencies responsible for funding, permitting, or approving projects assess the potential impacts of the project on the environment, including cultural resources. Under CEQA, *cultural resources* are defined as districts, buildings, sites, structures, or objects, each of which may have historic, architectural, archaeological, cultural, or scientific importance. Under the State CEQA statutes, an impact on a cultural resource is considered significant if a project would result in an effect that may change the significance of the resource (PRC Section 21084.1). Demolition, replacement, substantial alteration, and relocation of historic properties are actions that would change the significance of a historic resource (14 CCR Section 15064.5). Before the level of significance of impacts can be determined and appropriate mitigation measures developed, the significance of cultural resources must be determined. The following steps are normally taken in a cultural resources investigation to comply with CEQA:

1. Identify cultural resources.
2. Evaluate the significance of the cultural resources based on established thresholds of significance.
3. Evaluate the effects of a project on all cultural resources.
4. Develop and implement measures to mitigate the effects of the project on significant cultural resources.

The State CEQA Guidelines define three ways that a cultural resource may qualify as an historical resource for the purposes of CEQA review.

1. The resource is listed in or determined eligible for listing in the California Register of Historical Resources (CRHR).
2. The resource is included in a local register of historical resources, as defined in PRC Section 5020.1(k), or is identified as significant in a historical resource survey meeting the requirements of PRC Section 5024.1(g) unless the preponderance of evidence demonstrates that it is not historically or culturally significant.
3. The lead agency determines the resource to be significant as supported by substantial evidence in light of the whole record (14 CCR Section 15064.5[a]).

A cultural resource may be eligible for inclusion in the CRHR if:

1. It is associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage.
2. It is associated with the lives of persons important in our past.
3. It embodies the distinctive characteristics of a type, period, region, or method of construction; represents the work of an important creative individual; or possesses high artistic values.
4. It has yielded, or may be likely to yield, information important in prehistory or history.

In addition, CEQA distinguishes between two classes of archaeological resources: archaeological resources that meet the definition of an historical resource as above, and unique archaeological resources. An archaeological resource is considered unique if:

- It is associated with an event or person of recognized significance in California or American history or of recognized scientific importance in prehistory.
- It can provide information that is of demonstrable public interest and is useful in addressing scientifically consequential and reasonable research questions.
- It has a special or particular quality such as oldest, best example, largest, or last surviving example of its kind. (PRC Section 21083.2.)

### 5.3.3 Environmental Setting

The Central Valley is comprised of three major basins regions, including the Sacramento Valley Basin, the San Joaquin Valley Basin, and the Tulare Lake Basin, which extend in a north-to-south direction through the center of the state. The three basins encompass all or portions of 36 affected counties.

## Archaeological Setting

### The Central Valley Region

The prehistory of the study area is complex, with distinct regional patterns that extend back more than 11,000 years. Due to the variability and complexity of the archaeological record, different chronologies and culture histories are associated with specific geomorphic provinces of California. The distinct geology, hydrology, and landform of each province provided the inhabitants of the area with different resources. Consequently, variations in the archaeological record point to variations in lifestyles regarding subsistence strategy, ceremonial and religious beliefs, social organization, housing, and material culture.

The study area encompasses lands occupied by more than 20 distinct Native American cultural groups. Although most California tribes shared similar elements of social organization and material culture, anthropologists used linguistic affiliation as the principal means of establishing territorial boundaries of California Indians. Prior to European settlement of California, an estimated 310,000 native Californians spoke dialects of as many as 80 mutually unintelligible languages representing six major North American linguistic stocks (Cook 1978:91; Shipley 1978:80–90).

### Sacramento Valley Basin

#### Archaeology

The southern half of the Sacramento Valley Basin is better known than the northern half, while variations also exist between the west and east side. The oldest archaeological materials identified in the Sacramento Valley Basin are fluted stone projectile points ascribed to the Paleo-Indian Period of California (12,000–10,000 B.P.<sup>1</sup>). Only about 20 such artifacts have been identified in the Sacramento Valley Basin, and association with other types of artifacts is ambiguous, such that little is known of the Paleo-Indian occupation of the basin. (Dillon 2002:112, Table 1, Figure 5.)

---

<sup>1</sup> B.P. denotes years before the present day, which is conventionally held to be A.D. 1950.

Alternatively, the southern half of the Sacramento Valley Basin is known to be a cultural complex that spans 8,000 B.P. to 10,000 B.P. It is characterized by stemmed projectile points and large basalt cores evident in the northernmost portion of the study area, indicating a shift in hunting technology. Approximately 8,000 years ago, many California cultures shifted the main focus of their subsistence strategies from primarily hunting to seed gathering. This period spans from ca. 8,000 to 3,000 B.P. and is characterized by a more diversified collection of artifacts, including fishing-related and food-grinding implements as well as a diverse collection of projectile points types and sizes. The period from 3,000 B.P. to the 18<sup>th</sup> and 19<sup>th</sup> centuries is better known in the archaeological record; it reflects a particularly specialized adaptation to locally available resources and intensification in subsistence strategy. This phase is characterized by smaller projectile points, bedrock mortars, pestles, and an expansion in the exchange system. Primarily within the last 1,000 years, the archaeological record also indicates a trend toward a more sedentary lifestyle as the population expanded.

The Sacramento Valley Basin is rich in prehistoric-period resources. More than 11,500 prehistoric archaeological sites and more than 800 multicomponent sites have been recorded within the Sacramento Valley Basin (Table 5.3-1). Of particular importance are the large, deep midden sites, which provide information on prehistoric culture extending over thousands of years. In the foothills, middens, lithic scatters, and bedrock mortars predominate. Prehistoric sites include milling stations, lithic scatters, habitation sites, artifact scatters, rock circles, burials, quarries, and animal kill sites (USBR 1996:II-18, II-22–24).

## **Ethnography**

The study area encompasses the territory of 12 California Indian groups that have been divided by anthropologists based on perceived linguistic similarities. The Sacramento Valley Basin includes territories occupied or partially occupied by the following groups: Maidu, Konkow, Nisenan, Yana, Wintu, Nomlaki, Patwin, Wappo, Achumawi, Atsugewi, Shasta, and Pomo (Heizer 1978:ix). All native Californians followed a basic hunter-gatherer lifestyle subsisting through a seasonal round of plant collecting, hunting, and fishing, and living in tribelets or semi-permanent villages. Important food sources were buckeye, seeds, bulbs, pine nuts, deer, elk, rabbits, squirrels, fowl, salmon and other fish, bear, and insects. Most groups followed an egalitarian system with a headman or woman who would speak for the tribe or help resolve conflicts. The headman position could be chosen or inherited, depending on the Indian group concerned. Inter-marriage and/or conflict was common among neighboring groups. Religious practices differed from group to group with underlying similarities like the role of shamans and healers.

## **San Joaquin Valley Basin**

### **Archaeology**

The cultural chronology of the San Joaquin Valley Basin is similar to that of the Sacramento Valley Basin. All native Californians followed a basic hunter-gatherer lifestyle subsisting through a seasonal round of plant collecting, hunting, and fishing. Chronological and cultural-historical distinctions are based on varied technological markers, such as projectile point types, shell ornaments, burial practices, and an introduction of ceramic and steatite (soapstone) industries. The valley floor of this region contains many of the same type of prehistoric resources found in the Sacramento Valley Basin. The variations between the east and west portions of the area, including artifact types and materials, are related to the different ecological opportunities present in lowland and upland settings. The region is rich in archaeological sites, with more than 10,900 prehistoric archaeological

sites and more than 700 multicomponent sites (sites with prehistoric and historic-period materials) recorded in the area (Table 5.3-1). Prehistoric site types include occupation sites with midden and house pits, temporary camps, milling stations, intaglios<sup>2</sup>, rock shelter sites, cemetery and single burials, lithic scatters, tool scatters, quarries, pictographs and petroglyphs, trails, and rock cairns. (USBR 1996:II-39)

## **Ethnography**

The program study area encompasses four linguistically distinctive cultural groups. The San Joaquin Valley Basin includes territories occupied or partially occupied by the following groups: the Yokuts, Miwok, Costanoan, and Monache (Heizer 1978:ix; Milliken 1994:165, Figure 5.1; Milliken 1995:Map 2). In general, these groups were seasonally mobile hunter-gatherers with semipermanent villages. With access to the higher elevation of the foothills, acorns were the staple food resource among all the groups. Other important food sources were buckeye, seeds, bulbs, pine nuts, deer, elk, rabbits, squirrels, fowl, salmon and other fish, bear, and insects. Trade and marriage were common among the three groups, and their social organizations were similar—with headman aiding in conflict resolution. Religious beliefs varied among the three groups. (USBR 1996.)

## **Tulare Lake Basin**

### **Archaeology**

Prehistoric resources in the Tulare Lake Basin are similar to those found in the regions described above. However, the Tulare Lake Basin is known to have some of the oldest archaeological deposits found in California (Dillon 2002:Table 1, Figure 5). The artifacts have been found in surface scatters and isolates, and consist of fluted projectile points that have been dated by typological association to the terminal Pleistocene and may be associated with Rancholabrean fossils (Moratto 1984:111). This cultural period spans between 10,900 B.P. and 11,200 B.P. It is characterized by fluted projectile points (called Clovis points) found on the same surface with the bones of animals now extinct, such as mammoths, sloths, and camels, indicating a primary large game hunting subsistence strategy. Recorded sites are found in higher density near waterways. Prehistoric sites in the lower elevations of the southern Sierra Nevada are quite similar to those in the foothills of the San Joaquin Valley and are related to resources based on higher elevations. The variation between the eastern and western portions of the basin is characterized by the trade relationship, with the coastal population represented by marine shell artifacts—mostly found with burials. In the Tulare Lake Basin, more than 8,500 prehistoric archaeological sites and over 200 sites that contain both historic and prehistoric components (Table 5.3-1) have been recorded. Prehistoric site types include occupation and burial sites, house pits, lithic scatters, milling stations, artifact scatters, quarries, rock art, trails, temporary camps, and charm stone caches (USBR 1996:II-39).

### **Ethnography**

The Tulare Lake Basin includes territories occupied or partially occupied by the following California Indian groups: Tubatulabal, Kitanemuk, Costanoan, Yokuts (discussed above), and Chumash. The Tubatulabal lived in the area from Mt. Whitney to the north, Walker Pass to the east, and the San Joaquin Valley to the west. Much of this area is extremely mountainous, and the core area of settlement was the Kern and south fork Kern River valleys. The core area of the Kitanemuk people

---

<sup>2</sup> Primarily designs made in relief on the ground surface via carving or the removal of stones (Moratto 1984:591).



was the Tehachapi Mountains at the southern end of the San Joaquin Valley. The Chumash inhabited the central coastal area of California from approximately San Luis Obispo in the north to Malibu Canyon in the south and inland as far as the west side of the San Joaquin Valley. The Southern Valley Yokuts inhabited the southern San Joaquin Valley from about Fresno to the Tehachapi Mountains (Wallace 1978b:Figure 1). The Foothill Yokuts inhabited the western slopes of the Sierra Nevada foothills from about the Fresno River to the Kern River (Spier 1978:Figure 1). Although these groups also followed a seasonal round subsistence economy, they were more diversified because of the environmental differences of each geographic region. Little is known about the Kitanemuk; it is believed that they were assimilated into various missions, which effectively destroyed their culture. The Tubatulabal exploited the resources on the east and west slopes of the Sierra Nevada, living in hamlets in winter and small temporary camps in summer. On the other hand, the Chumash are considered to have been one of the most elaborate cultures in California. Archeological evidence of Chumash culture is found in the remains of large villages with large populations, social ranking, intensive trade, craft specialization, and well-developed art styles (Moratto 1984:118–119).

## Historic Setting

Although records indicate that Pedro Fages and Colonel Juan Bautista de Anza entered portions of the Central Valley while on reconnaissance expeditions during the 1770s, much of the Central Valley was explored during the early 1800s. During that period, Spaniards guided expeditions through the area while hunters and fur trappers, including Jedediah Strong Smith and Ewing Young, traversed the region. John C. Fremont entered the area in 1845. During the 1840s, Mexican land grants were established throughout the Central Valley Region. The discovery of gold in the Sierra Foothills during the late 1840s brought an onslaught of incoming miners into the Central Valley Region by the 1850s. Although this population increase was patterned in clusters surrounding mines, all three basins experienced an increase. The subsequent development of agriculture and irrigation is discussed below for each of the three basins.

## Sacramento Valley Basin

The Sacramento Valley Basin is comprised of 20 counties, including Modoc, Siskiyou, Shasta, Lassen, Tehama, Plumas, Butte, Glenn, Sierra, Yuba, Nevada, Placer, El Dorado, Sacramento, Yolo, Sutter, Colusa, Lake, Napa, and Solano. The region is mostly characterized by flat valley lands, (part of the Great Central Valley) and is enclosed by mountain ranges on the north, east, and west sides. The Sacramento and San Joaquin Rivers run throughout the area, totaling over 430 miles long and 50 miles wide including offshoot streams.

By the 1840s, several Mexican land grants were established in the area, including the Rancho del Paso and New Helvetia. Many of these grants were used for ranching. In 1849, the discovery of gold in the region resulted in the influx of thousands of miners into the area and the sprouting of many makeshift towns. Following the decline of gold mining during the late 1800s, agriculture became a major industry in the basin. Railroad expansion into the region, including the Southern Pacific Railroad, during the mid-19<sup>th</sup> century brought on a surge of residential, commercial, and industrial development. During the mid-20<sup>th</sup> century, industry and residential development continued to expand over much of the region, while parts of the region remained relatively rural. Two military bases (Mather and McClellan), freeway development, and continual economic and population growths led to the greater development of regions such as Sacramento County; while areas such as Sutter County and Butte County developed a large agriculturally based economy, raising a variety of

crops including fruits and grain (Beck and Haase 1974:67, 87; Kyle et. al. 1990:494–495; Phillips and Miller 1915:73–75; Wells and Chambers 1973; 111, 205–208).

## Agriculture

The temperate climate of the Sacramento Valley Basin and its abundant fertile land made agricultural development a successful endeavor throughout much of the 19<sup>th</sup> century and well into the 20<sup>th</sup> century. Wheat, barley, and grain farming; vineyards; fruit orchards; and cattle ranching were commonly engaged in by settlers throughout the region. Fruit farming in particular gained prominence during the late 1880s. At the turn of the 20<sup>th</sup> century, irrigation improvements introduced new crops to the region, including rice, hay, and barley. Industrialization brought on commercial enterprises related to agriculture and livestock. Among the region's principal industries were rice mills, dried fruit companies, vegetable and fruit packing plants, and feed and barley plants. Following a lull in production during the Great Depression of the 1930s, by the mid-20<sup>th</sup> century and especially following World War II, livestock raising and fruit and nut production gained popularity. Although development has gained a foothold throughout much of the region, agricultural remains a large industry into the present day (Beck and Haase 1974:94–97; Caltrans 2007:25–27; Thompson and West 1880:190–196).

## Irrigation/Water Conveyance

Irrigation and water conveyance efforts began in the Sacramento Valley Basin during the 1850s, when residents experienced repeated droughts and floods. Settlers constructed levees to protect against flood damage and mining ditches (eventually used as canal systems) to irrigate agricultural crops. With the advent of sluicing and hydraulic mining during the 1870s, transporting water became an extremely profitable endeavor, and numerous companies quickly formed to begin construction of waterworks in order to distribute water from rivers and creeks that meandered across the slopes and ridges of the foothill region. South Yuba Water Company, formed in 1854, owned one of the largest water conveyance systems in the Placer County area. By the late 1880s, legislation, including the Wright Irrigation Act of 1887, resulted in the founding of several irrigation districts, including the Central Irrigation District in Colusa County (later absorbed by the Glenn-Colusa Irrigation District) within the region. During the early 20<sup>th</sup> century, irrigation districts completed construction of canal systems throughout the basin, including the Glenn-Colusa Canal, that irrigated thousands of acres of agricultural land. Irrigation districts such as the Solano County Irrigation District (formed in 1948) continued to organize during the mid-20<sup>th</sup> century; work was focused on dam construction and water conveyance for farming and residential uses. Also during the mid-20<sup>th</sup> century, the State Water Project (SWP) constructed several systems and canals throughout the region to irrigate over 4.5 million acres of land statewide. The successful development of these irrigation and conveyance systems helped to support the flourishing agricultural industry throughout the basin (Caltrans and JRP Historical Consulting Services 2000:80; Kyle et. al. 1990:519; Lardner and Brock 1924; 370).

## San Joaquin Valley Basin

The San Joaquin Valley Basin encompasses 14 counties, including El Dorado, Sacramento, Amador, Alpine, Calaveras, Contra Costa, San Joaquin, Stanislaus, Tuolumne, Mariposa, Merced, Madera, Fresno, and San Benito. The basin is characterized by canyons, mountain ranges, and rivers, although portions of the basin are flatlands. By the mid-19<sup>th</sup> century, property within the region was claimed through several Mexican land grants known as *ranchos*. Two of these properties were

located in Contra Costa County: Rancho San Pablo and Rancho San Ramon. During the mid-1800s, the discovery of gold in the region brought an onslaught of miners and settlers into the area. Following the decline of mining in the latter 19<sup>th</sup> century, agriculture became a major industry in the region. Railroad expansion into the region was accompanied by a surge of residential, commercial, and industrial development during this period; this trend continued through the 20<sup>th</sup> century, as highways and freeways entered the area (Kyle et. al. 1990:28–36, 53–68, 198, 209–215, 494–495).

## **Agriculture**

Euroamericans first cultivated agriculture in the San Joaquin Valley Basin during the mid-1800s, when miners and other settlers began tilling arid soil for relief from high-priced produce. Early settlers planted an increasing number of orchards and vineyards throughout the foothills region, causing the area to become an important fruit growing and processing hub. Placerville served as the center of the El Dorado County fruit packing industry. By the turn of the 20<sup>th</sup> century, lumbering, livestock raising (including cattle and sheep), and farming had joined mining as the principal industries of the county. Crops included pears, plums, apples, peaches, cherries, oranges, olives, walnuts, wheat, rye, corn, and acres of vineyards. Today, the San Joaquin Valley Basin accounts for 43 percent of the state's agriculture (Thompson 1958:309, 318, 374, 387).

## **Irrigation/Water Conveyance**

Irrigation efforts within the San Joaquin Valley Basin began during the late 1800s, when private land owners attempted to obtain water to irrigate their land for agricultural purposes. During the late 19<sup>th</sup> century, locally organized irrigation districts began constructing canals within the region, including the largest single irrigation system in California during that time, the San Joaquin and Kings River Canal. Private water companies such as the James Ben Ali Haggin's Kern County Land Company and the Miller and Lux Company worked to organize irrigation projects, dividing water between corporations and individuals in the region. These private companies reduced in size following involvement of the federal government during the 1930s with the Central Valley Project (CVP). The CVP created five umbrella units in the region to convey water throughout the state, including the Friant-Kern Canal and Contra Costa Canal. As noted above, by the mid-20<sup>th</sup> century, the SWP achieved irrigating the over 4.5 million acre region with its multitude of systems and canals (Beck and Haase 1974:76, 94–97; Caltrans and JRP Historical Consulting Services 2000:73–75).

## **Tulare Lake Basin**

The Tulare Lake Basin encompasses a large portion of Fresno, Kings, Tulare, and Kern Counties. In addition, this basin includes small southeastern segments of San Benito, and San Luis Obispo Counties, and dips into the northern tips of Ventura and Los Angeles Counties. The small portions of Los Angeles and San Luis Obispo Counties that are within the program area contain no identified irrigated lands as defined by the program. Ventura County has only a small portion of land within the program area, with a very tiny area identified as "pasture" in the DWR land-use figure (Figure 3-58 of the ECR). Consequently, a *de minimis* approach with respect to potential impacts in these counties has been taken, and the numbers of known cultural resources located in these counties is not included in this analysis.

Following early settlement, expansion of the Southern Pacific Railroad (SPRR) during the early 1900s provided access to the region, resulting in the founding of many small towns in the southern

portion of the Central Valley. These towns furnished goods and employment, and continued to flourish through the 20<sup>th</sup> century (Kyle et. al. 1990:88–97, 124–137, 139–140; Small 1926:415).

## **Agriculture**

The Tulare Lake Basin is characterized by flat, dry lands, which made early agricultural efforts difficult. Cattle, hog, and sheep ranching in the valley were dominant during the mid-1800s. The expansion of the SPRR into the area during the 1880s and a developing irrigation system resulted in a rise of agricultural production. New crops included apples, peaches, plums, apricots, nectarines, grapes, figs, oranges, and berries as well as grapes, vegetables, barley, hay, and cotton. Communities dedicated to agriculture began settling in the region during the late 1800s, developing a local raisin industry which remains today. Because of irrigation in the basin and intensive farming practices, small farming rapidly became a prominent feature of the area. In addition to the crops noted above, farmers began to plant alfalfa and corn to feed the cattle of the growing local dairy industry. Although land uses changed somewhat during the last half of the 20<sup>th</sup> century, the overall crop pattern of cotton, alfalfa, and corn remained relatively consistent in the region. Additional specialty crops such as walnuts and turf pasture mixed with the established crops between the 1950s and the 1990s. The number of dairies and farmsteads remained steady in parts of the region but were often integrated with larger and more distant corporations (Beck and Haase 1974:76, 94–97; DWR 1958, 1978, 1985, 1993; Elliot 1883:99; Tulare County Board of Trade 1915:9).

## **Irrigation/Water Conveyance**

Irrigation efforts in the Tulare Lake Basin began during the late 1850s and 1860s, when local ranchers constructed their own water conveyance systems that included ditches with rough earthen linings for conveying water over relatively short distances. The Miller and Lux Company encouraged development of the San Joaquin and Kings River Canal, which in turn promoted settlement throughout the region. During the 1930s, the CVP played a large role in irrigation and water conveyance within the region. The CVP created the Friant-Kern Dam and Madera Canal among other systems, which irrigate the eastern side of the San Joaquin Valley in the north part of the Tulare Lake Basin. As noted above, the mid-20<sup>th</sup> century, the SWP included several systems and canals throughout the region, working to irrigate over 4.5 million acres of land statewide (Caltrans and JRP Historical Consulting Services 2000:80; Kyle et al. 2002:94–95; Mitchell 1974:59; Robinson 1948:1982, 192).

## **5.3.4 Impacts**

This section describes the possible effects on cultural resources of likely management practices. As the specific nature and location of those practices is unknown, the impacts of each program alternative are discussed at a programmatic level.

## **Assessment Methods**

The assessment of potential impacts on cultural resources was qualitative by necessity, given the lack of substantial information regarding the extent of environmental changes that may arise from adoption of program alternatives. The analyzed program area consists of all or part of 36 counties, and the locations of potential ground-disturbing activities that could result from the proposed program alternatives are not known with any specificity. Consequently, it was not appropriate or

beneficial to conduct a standard records search through the California Historical Resources Information System (CHRIS) information centers, or to consult with Native American groups or regional historical societies. Furthermore, no project-level archaeological or built environment pedestrian surveys have been conducted for this analysis.

For the purpose of this analysis, the effort to identify cultural resources within the program area consisted of contacting the California State Office of Historic Preservation (OHP) to identify the numbers of cultural resources located in each county in the program area. OHP data do not indicate the exact location of each resource, so it is unknown how many resources lie within irrigated lands. The information obtained from OHP is shown in Table 5.3-1.

These data represent properties listed in, or formally determined eligible for listing in, the National Register of Historic Places (NRHP) and the CRHR, as well as properties listed as California State Landmarks and California Points of Historical Interest. Consequently, Table 5.3-1 only includes those cultural resources that have been identified, reported, and evaluated for significance according to one or more of the cultural resource management programs listed in the previous sentence. The properties include individual buildings, structures, objects, sites, and historic districts. The numbers of cultural resources are presented by county and are grossly classified as built environment or archaeological resources. For this analysis, the historic districts were counted as one resource.

These numbers do not represent an accurate accounting of resources potentially impacted by the program; rather, they are intended only to provide context to a qualitative discussion of the quantity of resources present. Numerous cultural resources identified in the program area have not been evaluated for their significance, and much of the program area has not been subjected to cultural resource surveys. However, it is reasonable to assume that many of these resources do not lie within irrigated lands where water quality impairments are present, primarily the valley floor. The figures presented in Table 5.3-1 therefore should be regarded, on balance, as minimum totals for cultural resources present throughout the affected counties; the number of cultural resources in the program area in those counties most likely is substantially less than shown in Table 5.3-1.

**Table 5.3-1. Numbers of Cultural Resources Identified in Counties in the Program Area**

| County       | Built Environment | Archaeological Sites |          |      |
|--------------|-------------------|----------------------|----------|------|
|              |                   | Prehistoric          | Historic | Both |
| Alameda      | 11,944            | 161                  | 66       | 17   |
| Alpine       | 27                | 290                  | 92       | 20   |
| Amador       | 404               | 263                  | 39       | 16   |
| Butte        | 421               | 774                  | 152      | 60   |
| Calaveras    | 249               | 998                  | 619      | 80   |
| Colusa       | 273               | 131                  | 43       | 17   |
| Contra Costa | 727               | 283                  | 100      | 21   |
| El Dorado    | 185               | 396                  | 122      | 28   |
| Fresno       | 410               | 2,278                | 314      | 64   |
| Glenn        | 19                | 49                   | 10       | 4    |
| Kern         | 253               | 2,852                | 1,202    | 142  |
| Kings        | 46                | 67                   | 7        | 4    |



| County                                 | Built Environment | Archaeological Sites |          |       |
|----------------------------------------|-------------------|----------------------|----------|-------|
|                                        |                   | Prehistoric          | Historic | Both  |
| Lake                                   | 35                | 1277                 | 126      | 71    |
| Lassen                                 | 26                | 1,100                | 94       | 47    |
| Madera                                 | 91                | 1,683                | 229      | 65    |
| Mariposa                               | 423               | 972                  | 463      | 109   |
| Merced                                 | 808               | 296                  | 77       | 53    |
| Modoc                                  | 288               | 1,525                | 90       | 54    |
| Napa                                   | 738               | 663                  | 67       | 23    |
| Nevada                                 | 372               | 259                  | 204      | 32    |
| Placer                                 | 495               | 363                  | 108      | 17    |
| Plumas                                 | 67                | 434                  | 197      | 33    |
| Sacramento                             | 1,013             | 358                  | 28       | 10    |
| San Benito                             | 452               | 153                  | 47       | 8     |
| San Joaquin                            | 2,363             | 169                  | 90       | 29    |
| Shasta                                 | 116               | 1,191                | 536      | 210   |
| Sierra                                 | 41                | 272                  | 340      | 70    |
| Siskiyou                               | 122               | 648                  | 285      | 62    |
| Solano                                 | 2,242             | 136                  | 45       | 11    |
| Stanislaus                             | 539               | 307                  | 78       | 22    |
| Sutter                                 | 21                | 56                   | 6        | 0     |
| Tehama                                 | 92                | 1,030                | 197      | 97    |
| Tulare                                 | 760               | 1,580                | 201      | 38    |
| Tuolumne                               | 474               | 2,316                | 1,302    | 248   |
| Yolo                                   | 743               | 122                  | 6        | 0     |
| Yuba                                   | 306               | 743                  | 434      | 33    |
| Totals for Counties<br>in Program Area | 27,585            | 26,195               | 8,016    | 1,815 |

## Notes:

Only small portions of Los Angeles and San Luis Obispo Counties are within the program area, and contain no irrigated lands as defined by the program. Ventura County has only a small portion of land within the program area, with a very tiny area identified as “pasture” in the DWR land-use figure (Figure 3-58 in the *Existing Conditions Report* [ICF Jones & Stokes 2008]). Consequently, a *de minimis* approach with respect to potential impacts in these counties has been taken, and the numbers of known cultural resources located in these areas are not included in this analysis.

For this analysis, the historic districts were counted as one resource.

Table 5.3-1 indicates that 26,195 prehistoric archaeological sites, 8,016 historic archaeological sites, and 1,815 archaeological sites that contain both prehistoric and historic components have been identified in the counties in the program area. Using these data to inform the impact analysis is not straightforward for two reasons. As noted, the figures presented in Table 5.3-1 generally should be regarded as minimum figures because the table accounts only for resources that have been evaluated under state and federal preservation programs. In addition, the totals and subtotals in Table 5.3-1 do not capture the distribution of archaeological resources within the counties. Some

counties may have received extensive archaeological surveys, whereas others may have seen minimal surveys. Nevertheless, when Table 5.3-1 is read in conjunction with the “Environmental Setting” herein, some consequential trends are noticeable. Counties with high acreage under cultivation or rangeland, such as Fresno, Kern, Madera, and Tulare, possess among the highest numbers of evaluated archaeological resources. Counties with high rice cultivation, like Colusa and Sutter, have low numbers of evaluated archaeological resources. These patterns are due in part to the character of agricultural production in these counties. Field disking temporarily removes vegetation from the farmed area, increasing the visibility of archaeological resources on the landscape, although the practice also results in damage to these resources. Resources are easily identified in recently disked fields because of the high-quality visibility conditions (Feder 1997:55). Rice cultivation, on the other hand, involves the wholesale removal of soil to form basins, which could easily result in the destruction of entire archaeological resources. These basins are subsequently flooded (and not surveyable) for all but 1–3 months out of the year, hampering the ability of archaeologists to identify archaeological resources (Basin Research Associates 2003:11, 15; ICF Jones & Stokes 2008:34). Table 5.3-1 indicates that archaeological resources are found with some frequency throughout the program area.

As indicated in Table 5.3-1, 27,585 eligible built environment historical resources are located in the program area. It should be noted that the numbers of built environment historical resources listed in Table 5.3-1 includes all OHP-listed historical resources for each county, including urban centers where most of these resources are likely located. These resources are all either eligible for the NRHP or the CRHR and therefore historical resources for the purposes of CEQA. These historical resources include properties such as buildings, bridges, and infrastructure. It is likely that the types of built environment historical resources found in the more specific program area will be related to agricultural development, including farmsteads with multiple buildings such as residential buildings, barns, utilitarian structures, and landscape vegetation in the form of wind breaks and tree allees (trees lining both sides of a path). Water conveyance structures such as ditches, canals, and wells are built historical resources also likely to be found in the program area. The exact numbers for the agricultural-related historical resources most likely to be found in the program area remains unknown at this time. Consequently, the overall numbers of eligible built environment historical resources was used in this analysis.

## Significance Determinations

According to the State CEQA Guidelines, a project has a significant effect on the environment when it may cause a substantial adverse change in the significance of an historic resource (14 CCR Section 15064.5[b]). CEQA further states that a *substantial adverse change in the significance of a resource* means the physical demolition, destruction, relocation, or alteration of the resource or its immediate surroundings such that the significance of an historic resource would be materially impaired. Actions that would materially impair the significance of a historic resource are those that would demolish or adversely alter those physical characteristics of an historical resource that convey its historical significance and qualify it for inclusion in the CRHR or in a local register or survey that meet the requirements of PRC Sections 5020.1(k) and 5024.1(g).

## Alternative 1 – Full Implementation of Current Program (No Project Alternative)

Alternative 1 represents full implementation of the existing regulatory program. Use of coalition groups as the lead monitoring entities would continue, and third-party entities and growers would continue to implement management practices in response to identified water quality impairments. Under this alternative, management practices would be implemented to reduce the levels of identified constituents of concern below the baseline conditions. The changes in management practices would vary, depending on choices made by individual growers for their crops, locations, and local and regional water quality concerns. However, Alternative 1 does not involve any groundwater monitoring practices. Management practices possibly implemented under Alternative 1 include nutrient management; improved water management; tailwater recovery systems; pressure irrigation; sediment traps and or buffer zones, and cover cropping.

Use of nutrient and water management would have virtually no impact on cultural resources, as resulting ground disturbance would be minimal. However, tailwater recovery systems, pressure irrigation, and sediment traps could result in construction impacts, potentially from use of heavy equipment, and could affect cultural resources.

### **Impact CUL-1. Physical Destruction, Alteration, or Damage of Cultural Resources from Implementation of Management Practices**

Growers may implement a variety of management practices that include physical and operational changes to agricultural land in the program area. Such management practices may occur near cultural resources that are historically significant and eligible for listing in the CRHR or the NRHP. Implementation of these practices may lead to physical demolition, destruction, relocation, or alteration of cultural resources.

The location, timing, and specific suite of management practices to be chosen by growers to improve water quality are not known at this time. This impact is considered significant. Implementation of **Mitigation Measure CUL-MM-1** would reduce this impact to a less-than-significant level.

## Alternative 2 – Third Party Lead Entity

Monitoring, tracking, and management plan requirements of Alternative 2 are expected to result in changes in the use of management practices by growers very similar to Alternative 1, with the additional of groundwater management practices such as wellhead protection.

### **Impact CUL-1. Physical Destruction, Alteration, or Damage of Cultural Resources from Implementation of Management Practices**

Growers may implement a variety of management practices that include physical and operational changes to agricultural land in the program area. The location, timing, and specific suite of management practices to be chosen by growers to improve water quality are not known at this time. This impact is considered significant. Implementation of **Mitigation Measure CUL-MM-1** would reduce this impact to a less-than-significant level.

## Alternative 3 – Individual Farm Water Quality Management Plans

Potential impacts related to cultural resources under Alternative 3 are expected to be as described for Alternative 2.

## Alternative 4 – Direct Oversight with Regional Monitoring

Potential impacts related to cultural resources under Alternative 4 are expected to be as described for Alternative 2.

## Alternative 5 – Direct Oversight with Farm Monitoring

The potential changes in management practices under Alternative 5 would be similar to those described for Alternative 2. Under Alternative 5, however, individual monitoring wells would be installed and monitored, which could result in direct impacts on cultural resources.

### **Impact CUL-2. Potential Damage to Cultural Resources from Construction Activities and Installation of Groundwater Monitoring Wells**

Construction impacts would result from implementation of management practices that require physical changes and from installation of groundwater monitoring wells. The location of monitoring wells, as well as the location, timing, and specific suite of management practices to be selected by growers are not known at this time, and will not be defined until GQMPs are prepared by growers and other responsible parties. This impact is considered significant. Implementation of **Mitigation Measure CUL-MM-1** would reduce this impact to a less-than-significant level.

## Mitigation and Improvement Measures

### **Mitigation Measure CUL-MM-1: Avoid Impacts to Cultural Resources**

The measure described below will reduce the severity of impacts on significant cultural resources, as defined and described in Sections 5.3.1 and 5.3.3 of this chapter. Avoidance of such impacts also can be achieved when growers choose the least impactful management practices that will effectively meet the ILRP water quality improvement goals and objectives. Note that these measures may not be necessary in cases where no ground-disturbing activities would be undertaken as a result of implementation of the ILRP.

Although cultural resource inventories and evaluations typically are conducted prior to preparation of a CEQA document, the size of the program area, the programmatic nature of the alternatives, and the lack of specificity regarding the location and type of management practice that would be implemented following adoption of an alternative render conducting inventories prior to release of this draft PEIR untenable. Therefore, where the ILRP water quality improvement goals cannot be achieved without modifying or disturbing an area of land or existing structure to a greater degree than through previously employed farming practices, individual farmers, coalitions, or third-party representatives should implement the following measures to reduce potential impacts to less-than-significant levels.

- Where construction within areas that may contain cultural resources cannot be avoided through the use of alternative management practices, conduct an assessment of the

potential for damage to cultural resources prior to construction; this may include the hiring of a qualified cultural resources specialist to determine the presence of significant cultural resources;

- Where the assessment indicates that damage may occur, submit a non-confidential records search request to the appropriate CHRIS information center(s) (see Table 5.3-2 below);
- Implement the recommendations provided by the CHRIS information center(s) in response to the records search request; and
- Where adverse effects to cultural resources cannot be avoided, undertake additional CEQA review and develop appropriate mitigation to avoid or minimize the potential impact.

**Table 5.3-2. CHRIS Information Centers by Program County**

| <b>County</b> | <b>CHRIS Information Center</b> |
|---------------|---------------------------------|
| Alpine        | Central California              |
| Amador        | North Central                   |
| Butte         | Northeast                       |
| Calaveras     | Central California              |
| Colusa        | Northwest                       |
| Contra Costa  | Northwest                       |
| El Dorado     | North Central                   |
| Fresno        | Southern San Joaquin Valley     |
| Glenn         | Northeast                       |
| Kern          | Southern San Joaquin Valley     |
| Kings         | Southern San Joaquin Valley     |
| Lake          | Northwest                       |
| Lassen        | Northeast                       |
| Madera        | Southern San Joaquin Valley     |
| Mariposa      | Central California              |
| Merced        | Central California              |
| Modoc         | Northeast                       |
| Napa          | Northwest                       |
| Nevada        | North Central                   |
| Placer        | North Central                   |
| Plumas        | Northeast                       |
| Sacramento    | North Central                   |
| San Benito    | Northwest                       |
| San Joaquin   | Central California              |
| Shasta        | Northeast                       |
| Sierra        | Northeast                       |
| Siskiyou      | Northeast                       |
| Solano        | Northwest                       |
| Stanislaus    | Central California              |
| Sutter        | Northeast                       |



| <b>County</b>                                                                                                                                                                                           | <b>CHRIS Information Center</b> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| Tehama                                                                                                                                                                                                  | Southern San Joaquin Valley     |
| Tulare                                                                                                                                                                                                  | Southern San Joaquin Valley     |
| Tuolumne                                                                                                                                                                                                | Central California              |
| Yolo                                                                                                                                                                                                    | Northwest                       |
| Yuba                                                                                                                                                                                                    | North Central                   |
| Information Center contact information is available at:<br>< <a href="http://www.ohp.parks.ca.gov/pages/1068/files/IC%20Roster.pdf">http://www.ohp.parks.ca.gov/pages/1068/files/IC%20Roster.pdf</a> >. |                                 |

In addition, California state law provides for the protection of interred human remains from vandalism and destruction. According to the California Health and Safety Code, six or more human burials at one location constitute a cemetery (Section 8100), and the disturbance of Native American cemeteries is a felony (Section 7052). Section 7050.5 requires that construction or excavation be stopped in the vicinity of the discovered human remains until the County Coroner has been notified, according to PRC Section 5097.98, and can determine whether the remains are those of Native American origin. If the coroner determines that the remains are of Native American origin, the coroner must contact the Native American Heritage Commission (NAHC) within 24 hours (Health and Safety Code Section 7050[c]). The NAHC will identify and notify the most likely descendant (MLD) of the interred individual(s), who will then make a recommendation for means of treating or removing, with appropriate dignity, the human remains and any associated grave goods as provided in PRC Section 5097.98.

PRC Section 5097.9 identifies the responsibilities of the project proponent upon notification of a discovery of Native American burial remains. The project proponent would work with the MLD (determined by the NAHC) and a professional archaeologist with specialized human osteological experience to develop and implement an appropriate treatment plan for avoidance and preservation of, or recovery and removal of, the remains.

Growers implementing management practices should be aware of the following protocols for identifying cultural resources:

- If built environment resources or archaeological resources, including chipped stone (often obsidian, basalt, or chert), ground stone (often in the form of a bowl mortar or pestle), stone tools such as projectile points or scrapers, unusual amounts of shell or bone, historic debris (such as concentrations of cans or bottles), building foundations, or structures are inadvertently discovered during ground-disturbing activities, the land owner should stop work in the vicinity of the find and retain a qualified cultural resources specialist to assess the significance of the resources. If necessary, the cultural resource specialist also will develop appropriate treatment measures for the find.
- If human bone is found as a result of ground disturbance, the land owner should notify the County Coroner in accordance with the instructions described above. If Native American remains are identified and descendants are found, the descendants may—with the permission of the owner of the land or his or her authorized representative—inspect the site of the discovery of the Native American remains. The descendants may recommend to the owner or the person responsible for the excavation work means for treating or disposing of the human remains and any associated grave goods, with appropriate dignity. The descendants will make their recommendation within 48 hours of inspection of the

remains. If the NAHC is unable to identify a descendant, if the descendants identified fail to make a recommendation, or if the landowner rejects the recommendation of the descendants, the landowner will inter the human remains and associated grave goods with appropriate dignity on the property in a location not subject to further and future subsurface disturbance.

#### 5.4.1 Introduction

This section describes potential noise impacts associated with the five program alternatives. Specifically, it summarizes relevant laws and policies, discusses the existing conditions in the program area with respect to noise, and identifies significant impacts that may result from implementation of program alternatives. Mitigation measures to avoid or reduce impacts also are presented.

In order to provide the necessary background to understand noise-related regulations and impacts, a brief discussion on noise terminology is warranted. *Sound* is mechanical energy (vibration) transmitted by pressure waves through a medium such as air or water. *Noise* is commonly defined as unwanted sound that annoys or disturbs people and can potentially cause adverse psychological or physiological effects on human health. Because noise is an environmental pollutant that can interfere with human activities, evaluation of noise is necessary when considering the environmental impacts of a proposed project.

Sound is characterized by various parameters that include the rate of oscillation of sound waves (*frequency*), the speed of propagation, and the pressure level or energy content (*amplitude*). In particular, the sound pressure level is the most common descriptor used to characterize the loudness of an ambient (existing) sound level. The decibel (dB) scale, a logarithmic scale, is used to quantify sound intensity. Because the human ear is not equally sensitive to all frequencies in the entire spectrum, noise measurements are weighted more heavily for frequencies to which humans are sensitive in a process called “A-weighting,” written as “dBA” and referred to as “A-weighted decibels.” Table 5.4-1 provides definitions of sound measurements and other terminology used in this section, and Table 5.4-2 summarizes typical A-weighted sound levels for common noise sources.

**Table 5.4-1. Definitions of Sound Measurements**

| Sound Measurements                           | Definition                                                                                                                                                                                                                                                                  |
|----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Decibel (dB)                                 | A unitless measure of sound on a logarithmic scale, which indicates the squared ratio of sound pressure amplitude to reference sound pressure amplitude. The reference pressure is 20 micro-pascals.                                                                        |
| A-weighted decibel (dBA)                     | An overall frequency-weighted sound level in decibels that approximates the frequency response of the human ear.                                                                                                                                                            |
| Maximum sound level ( $L_{\max}$ )           | The maximum sound level measured during the measurement period.                                                                                                                                                                                                             |
| Minimum sound level ( $L_{\min}$ )           | The minimum sound level measured during the measurement period.                                                                                                                                                                                                             |
| Equivalent sound level ( $L_{\text{eq}}$ )   | The equivalent steady state sound level that in a stated period of time would contain the same acoustical energy.                                                                                                                                                           |
| Percentile-exceeded sound level ( $L_{xx}$ ) | The sound level exceeded “x” percent of a specific time period. L10 is the sound level exceeded 10 percent of the time. L90 is the sound level exceeded 90 percent of the time. L90 is often considered to be representative of the background noise level in a given area. |

| Sound Measurements                            | Definition                                                                                                                                                                                                                                                                                          |
|-----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Day-night level ( $L_{dn}$ )                  | The energy average of the A-weighted sound levels occurring during a 24-hour period, with 10 dB added to the A-weighted sound levels occurring during the period from 10:00 p.m. to 7:00 a.m.                                                                                                       |
| Community noise equivalent level (CNEL)       | The energy average of the A-weighted sound levels occurring during a 24-hour period with 5 dB added to the A-weighted sound levels occurring during the period from 7:00 p.m. to 10:00 p.m. and 10 dB added to the A-weighted sound levels occurring during the period from 10:00 p.m. to 7:00 a.m. |
| Peak particle velocity (peak velocity or PPV) | A measurement of ground vibration defined as the maximum speed (measured in inches per second) at which a particle in the ground is moving relative to its inactive state. PPV is usually expressed in inches/second.                                                                               |
| Frequency: Hertz (Hz)                         | The number of complete pressure fluctuations per second above and below atmospheric pressure.                                                                                                                                                                                                       |

**Table 5.4-2. Typical A-Weighted Sound Levels**

| Common Outdoor Activities         | Noise Level (dBA) | Common Indoor Activities                             |
|-----------------------------------|-------------------|------------------------------------------------------|
|                                   | —110—             | Rock band                                            |
| Jet flyover at 1,000 feet         | —100—             |                                                      |
| Gas lawnmower at 3 feet           | —90—              |                                                      |
| Diesel truck at 50 feet at 50 mph | —80—              | Food blender at 3 feet<br>Garbage disposal at 3 feet |
| Noisy urban area, daytime         | —70—              | Vacuum cleaner at 10 feet<br>Normal speech at 3 feet |
| Gas lawnmower at 100 feet         | —60—              |                                                      |
| Commercial area                   | —50—              | Large business office<br>Dishwasher in next room     |
| Heavy traffic at 300 feet         | —40—              | Theater, large conference room (background)          |
| Quiet urban daytime               | —30—              | Library                                              |
| Quiet urban nighttime             | —20—              | Bedroom at night, concert hall (background)          |
| Quiet suburban nighttime          | —10—              | Broadcast/recording studio                           |
| Quiet rural nighttime             | —0—               |                                                      |

Source: Caltrans 1998.

In general, human sound perception is such that a change in sound level of 1 dB cannot typically be perceived by the human ear, a change of 3 dB is just noticeable, a change of 5 dB is clearly noticeable, and a change of 10 dB is perceived as doubling or halving the sound level.

As described in Table 5.4-1, different types of measurements are used to characterize the time-varying nature of sound. These measurements include the equivalent sound level ( $L_{eq}$ ), the minimum and maximum sound levels ( $L_{min}$  and  $L_{max}$ ), percentile-exceeded sound levels (such as  $L_{10}$ ,  $L_{20}$ ), and the day-night sound level ( $L_{dn}$ ).

For a point source such as a stationary compressor or construction equipment, sound attenuates based on geometry at a rate of 6 dB per doubling of distance. For a line source such as free-flowing traffic on a freeway, sound attenuates at a rate of 3 dB per doubling of distance (Caltrans 1998). Atmospheric conditions including wind, temperature gradients, and humidity can change how sound propagates over distance and can affect the level of sound received at a given location. The degree to which the ground surface absorbs acoustical energy also affects sound propagation. Sound that travels over an acoustically absorptive surface such as grass attenuates at a greater rate than sound that travels over a hard surface such as pavement. The increased attenuation is typically in the range of 1 to 2 dB per doubling of distance. Barriers such as buildings and topography that block the line of sight between a source and receiver also increase the attenuation of sound over distance. Typically, a barrier that blocks the line of sight between a noise source and a receiver will reduce sound by at least 5 dB.

## 5.4.2 Regulatory Framework

This section discusses regulations related to noise that may apply to the program alternatives.

### Federal

No federal noise regulations are applicable to the program alternatives.

### State

No state noise regulations are applicable to the program alternatives.

### Local

Noise from construction and other activities is generally regulated at the local level by cities and counties through the enforcement of adopted noise ordinances. The ordinances serve as enforcement mechanisms for controlling noise. General plan noise elements are used as planning guidelines to ensure that planned land uses are compatible with long-term noise in the area. Typically, noise ordinance standards rather than general plan noise element standards apply to noise from construction activities. In many cases, noise from construction activity is exempt from specific limits during daytime hours. Typical construction noise limits in local regulations range from 50 to 60 dBA during daytime hours and from 45 to 55 dBA during nighttime hours.



The program area encompasses all or part of 36<sup>1</sup> counties and multiple cities and towns. Many of these jurisdictions have their own noise ordinances and general plan noise elements.<sup>2</sup> Since the majority of program activities will occur on agricultural lands, which are typically located in rural areas far from densely populated cities, only those ordinances at the county level are anticipated to apply to the program alternatives.

## 5.4.3 Environmental Setting

### Existing Noise Levels in the Program Area

Ambient noise levels are to a great extent dependent on the amount of development in an area. In agricultural areas, ambient noise levels are governed primarily by farming activities and traffic on local roadways. Other less dominant sources of noise include aircraft that occasionally fly overhead and animals, such as birds and insects. Table 5.4-3 shows typical ambient noise levels based on land use type. Noise levels within the program area are expected to range between 45 and 55 dBA.

**Table 5.4-3. Land Uses and Associated Ambient Noise Levels**

| Scenario                                                      | dBA, L <sub>dn</sub> |
|---------------------------------------------------------------|----------------------|
| Rural                                                         | 40–50                |
| Suburban                                                      |                      |
| Quiet suburban residential or small town                      | 45–50                |
| Normal suburban residential                                   | 50–55                |
| Urban                                                         |                      |
| Normal urban residential                                      | 60                   |
| Noisy urban residential                                       | 65                   |
| Very noise urban residential                                  | 70                   |
| Downtown, major metropolis                                    | 75–80                |
| Under flight path at major airport, 0.5 to 1 mile from runway | 78–85                |
| Adjoining freeway or near a major airport                     | 80–90                |
| Sources: Cowan 1984; Hoover and Keith 1996.                   |                      |

### Noise-Sensitive Land Uses in the Program Area

Noise-sensitive land uses are generally considered to be places where people reside, such as residences and health care facilities. Other land uses, such as parks, where quiet can be an important part of how the area is used also can be considered sensitive to noise. Numerous small towns and major cities with residences, health care facilities, and parks are located throughout the program

<sup>1</sup> Small portions of Los Angeles and San Luis Obispo Counties are within the project boundary but have no irrigated lands as defined by the program. A small portion of land in Ventura County that is within the program boundary is identified as “pasture.” However, potential impacts caused by the proposed program in Ventura County are beyond the scope of this document and are not included in the analysis.

<sup>2</sup> Although not all are cited in this document, references to noise ordinances and general plans from each of the counties within the program area are included in Chapter 8, References.

area. However, as farms typically are located in rural areas, the number of sensitive receptors affected by the program alternatives is expected to be minimal.

## 5.4.4 Impacts

Noise impacts from the program alternatives would result from construction activities and program operation. This section describes the potential impacts related to these sources resulting from the five program alternatives. It is unlikely that the minimal amount of construction or heavy-duty equipment would cause any impacts related to vibration. Mitigation measures to reduce potentially significant impacts also are identified.

For the purposes of this analysis, the baseline conditions were assumed to be the current regulatory program as instituted at the time of the writing of the ECR (refer to Chapter 3).

## Assessment Methods

### Construction Activities

Management practices used to prevent impacts on water quality that require heavy-duty equipment would generate temporary or periodic increases in ambient noise levels. In addition, installation of monitoring wells and construction of all accessory facilities (e.g., pump houses and access roads) would result in elevated ambient noise levels. Management practices most likely requiring the use of heavy-duty equipment include sediment trap, hedgerow, or buffer; pressurized irrigation; wellhead protection; and tailwater recovery systems (see Table 5.5-8).

Table 5.4-4 identifies equipment that may be required to construct catchment ponds, berms, physical barriers, and wells associated with these management practices. The table also provides typical noise levels produced by each piece of equipment based on information developed by the Federal Highway Administration (2006).

**Table 5.4-4. Typical Construction Equipment Associated with Management Practices and Associated Noise Levels**

| <b>Equipment</b>       | <b>Typical Noise Level 50 feet<br/>from Source (dBA)</b> |
|------------------------|----------------------------------------------------------|
| Track excavator        | 81                                                       |
| Track backhoe/loader   | 79                                                       |
| Crane, mobile          | 81                                                       |
| Water truck            | 74                                                       |
| Pickup truck           | 75                                                       |
| Drill rig <sup>a</sup> | 79                                                       |

Notes:

<sup>a</sup> A drill rig may be required for installation of groundwater monitoring wells and tailwater system wells. Information obtained from Hoover & Keith 2008.

Sources: FHWA 2006; Hoover & Keith 2008.

Noise from construction activity typically attenuates at a rate of 6 dB per doubling of distance (FHWA 2006). A reasonable worst-case condition assumes that a drill rig, crane, and excavator are operating in the same location, for a combined noise level of 85 dBA at 50 feet. Table 5.4-5 illustrates predicted noise levels at various distances assuming a source noise level of 85 dBA at 50 feet as a reasonable worst-case scenario.

**Table 5.4-5. Estimated Noise Levels at Various Distances**

| <b>Distance to Receptor (feet)</b> | <b>Sound Level at Receptor (dBA)</b> |
|------------------------------------|--------------------------------------|
| 50                                 | 85                                   |
| 100                                | 79                                   |
| 200                                | 73                                   |
| 400                                | 68                                   |
| 500                                | 65                                   |
| 600                                | 63                                   |
| 800                                | 62                                   |
| 1,000                              | 59                                   |
| 1,500                              | 55                                   |
| 2,000                              | 53                                   |
| 2,500                              | 51                                   |
| 3,000                              | 49                                   |

The number and types of heavy-duty equipment would vary, depending on the management practices implemented under a program alternative. Since the selection of management practices is a function of crop type, physical setting, and economics, rather than regulatory authority, it is difficult to determine which management practices would be selected as a result of the proposed alternatives (ICF Jones & Stokes 2008). However, in general, construction required by the various management practices is expected to be minor.

With limited information on the type of management practices resulting from implementation of the program alternatives, a quantified analysis of potential noise impacts is not possible. Consequently, a qualitative assessment was performed. The qualitative analysis took into account the following:

- Interrelationship between monitoring and implementation of management practices,
- Stipulations for installation of monitoring wells,
- Anticipated equipment (Table 5.4-4), and
- Estimated noise levels at various distances (Table 5.4-5).

## **Program Operation**

Implementation of the program alternatives would result in transportation-related noise from vehicle trips for site inspections and monitoring. Individual groundwater or tailwater recovery system wells that require pump motors also would generate minor increases in noise above ambient levels. These sources are expected to be transitory and short term (e.g., semi-annual well sampling and annual inspections), but the extent of these activities is unknown at this time.

Certain management practices also may reduce noise levels relative to existing conditions. For example, improved irrigation management may reduce the amount of time that pressurized pump generators are used. Enhanced nutrient application also may minimize the number of tractors required to fertilize or plow a field. However, as discussed above, the extent and intensity of these activities are unknown. Consequently, a quantitative analysis of operations-related noise impacts is not possible, and a qualitative assessment was performed. The qualitative assessment took into account provisions for groundwater monitoring plans and wells, as well as the frequency and responsible party for site inspections.

## Significance Determinations

For this analysis, an impact pertaining to noise was considered significant under CEQA if it would result in any of the following environmental effects, which are based on professional practice and State CEQA Guidelines Appendix G (14 CCR 15000 et seq.):

- Expose persons to or generate noise levels in excess of standards established in a local general plan or noise ordinance or applicable standards of other agencies,
- Expose persons to or generate excessive ground-borne vibration or ground-borne noise levels,
- Result in a substantial permanent increase in ambient noise levels in the program vicinity above levels existing without the program, or
- Result in a substantial temporary or periodic increase in ambient noise levels in the program vicinity above levels existing without the program.

## Alternative 1 – Full Implementation of Current Program (No Project Alternative)

### Impact NOI-1. Exposure of Sensitive Land Uses to Noise from Construction Activities in Excess of Applicable Standards

Alternative 1 involves full implementation of the existing regulatory program. Coalition groups would function as the lead entities, and growers would implement management practices when surface water monitoring data show two or more exceedances of water quality objectives.

Construction noise impacts would result from implementation of management practices that require the use of heavy-duty equipment. Because management practices are a function of crop type and economics, it cannot be determined whether the management practices selected under this alternative would change relative to existing conditions. It is therefore not possible to determine construction-related effects based on a quantitative analysis. However, it is logical to assume that, as monitoring continues under Alternative 1, it would result in selection and implementation of more management plans and resulting management practices.

As shown in Table 5.4-5, noise levels from potential construction equipment are expected to range from approximately 55 to 88 dBA at 50 feet. These levels would be short term and would attenuate as a function of distance from the source. Noise from construction equipment operated within several hundred feet of noise-sensitive land uses has the potential to exceed local noise standards. This is considered a potentially significant. Implementation of **Mitigation Measure NOI-MM-1** by growers would reduce this impact to a less-than-significant level.

**Impact NOI-2. Exposure of Sensitive Land Uses to Noise from Operational Activities in Excess of Applicable Standards**

Under Alternative 1, coalition groups would perform surface water monitoring. Surface water quality monitoring is already occurring under existing conditions. Alternative 1 is therefore not expected to result in an appreciable difference in operational noise levels related to vehicle trips for monitoring.

Construction of new well pumps as part of tailwater recovery systems may result in increased noise levels relative to existing conditions. Noise generated from individual well pumps would be temporary and sporadic. Information on the types and number of pumps, as well as the number and distances of vehicle trips, is currently unavailable.

Depending on the type of management practice selected, Alternative 1 also may result in noise benefits relative to existing conditions. For example, as discussed above, improved irrigation management may reduce the amount of time that pressurized pump generators are used. Enhanced nutrient application may minimize the number of tractors required to fertilize or plow a field. Removing these sources of noise may mediate any increases related to the operation of new pumps. However, in the absence of data, a quantitative analysis of noise impacts related to operations of Alternative 1 is not possible. Potential noise from unenclosed pumps located close to noise-sensitive uses could exceed local noise standards. This is considered a potentially significant impact. Implementation of **Mitigation Measures NOI-MM-1** and **NOI-MM-2** would reduce this impact to a less-than-significant level.

**Alternative 2 – Third-Party Lead Entity****Impact NOI-1. Exposure of Sensitive Land Uses to Noise from Construction Activities in Excess of Applicable Standards**

As discussed previously, it is difficult to determine how changes in the lead entity as a result of the program alternatives would affect, if at all, the management practices used to prevent water quality impacts. Consequently, impacts related to construction noise under Alternative 2 are expected to be similar to those described for Alternative 1 (see **Impact NOI-1**). However, because wellhead protection, which requires the use of heavy-duty equipment, may be implemented by some farmers as a management practice (see Table 5.5-8), construction noise levels may be slightly greater than those anticipated for Alternative 1. Noise from construction equipment operated within several hundred feet of noise-sensitive land uses has the potential to exceed local noise standards. This is considered a potentially significant impact. Implementation of **Mitigation Measure NOI-MM-1** would reduce this impact to a less-than-significant level.

**Impact NOI-2. Exposure of Sensitive Land Uses to Noise from Operational Activities in Excess of Applicable Standards**

Under Alternative 2, third-party groups would perform surface water and groundwater monitoring. This alternative allows for a reduction in surface water quality monitoring under lower threat circumstances or when watershed or area management objective plans have been adopted. In these instances, the number of trips and related noise at sensitive receptors that are associated with surface water quality monitoring may be reduced relative to existing regulations. Although



requirements for new groundwater monitoring may result in additional vehicle trips, the vehicle trips associated with groundwater monitoring would occur less than once a month.

Noise levels associated with operation of new well pumps and implementation of conservation strategies (e.g., improved irrigation and enhanced crop management) would be similar to those described for Alternative 1. Potential noise from unenclosed pumps located close to noise-sensitive uses could exceed local noise standards. This impact is considered potentially significant. Implementation of **Mitigation Measures NOI-MM-1** and **NOI-MM-2** would reduce this impact to a less-than-significant level.

## Alternative 3 – Individual Farm Water Quality Management Plans

### **Impact NOI-1. Exposure of Sensitive Land Uses to Noise from Construction Activities in Excess of Applicable Standards**

Impacts related to construction noise under Alternative 3 are expected to be similar to those described for Alternative 2 (see **Impact NOI-1**). Construction noise impacts would result from implementation of management practices that require the use of heavy-duty equipment, and noise from construction equipment operated within several hundred feet of noise-sensitive land uses has the potential to exceed local noise standards. This is considered a potentially significant impact. Implementation of **Mitigation Measure NOI-MM-1** would reduce this impact to a less-than-significant level.

### **Impact NOI-2. Exposure of Sensitive Land Uses to Noise from Operational Activities in Excess of Applicable Standards**

Under Alternative 3, operational noise impacts would result from vehicle trips made by the Central Valley Water Board to conduct annual site inspections on a selected number of farms, as well as any new well pumps installed as part of tailwater recovery systems. This alternative does not require growers or the Central Valley Water Board to perform surface water or groundwater monitoring. Rather, individual growers would conduct visual inspections of their own farms. Consequently, there would be no exposure of sensitive land uses to increased noise levels from this activity (e.g., vehicle travel).

Vehicle trips for grower site inspections are expected to be minimal and would occur occasionally throughout the year. Noise levels associated with operation of new well pumps and the implementation of conservation strategies (e.g., improved irrigation and enhanced crop management) would be similar to those described for Alternative 1. Potential noise from unenclosed pumps located close to noise-sensitive uses could exceed local noise standards. This impact is considered potentially significant. Implementation of **Mitigation Measures NOI-MM-1** and **NOI-MM-2** would reduce this impact to a less-than-significant level.

## Alternative 4 – Direct Oversight with Regional Monitoring

### **Impact NOI-1. Exposure of Sensitive Land Uses to Noise from Construction Activities in Excess of Applicable Standards**

Impacts related to construction noise under Alternative 4 are expected to be similar to those described for Alternative 2 (see **Impact NOI-1**). Construction noise impacts would result from

implementation of management practices that require the use of heavy-duty equipment, and noise from construction equipment operated within several hundred feet of noise-sensitive land uses has the potential to exceed local noise standards. This is considered a potentially significant impact. Implementation of **Mitigation Measure NOI-MM-1** would reduce this impact to a less-than-significant level.

#### **Impact NOI-2. Exposure of Sensitive Land Uses to Noise from Operational Activities in Excess of Applicable Standards**

Operational noise impacts would result from vehicle trips made by lead entities to perform water quality monitoring, vehicle trips made by the Central Valley Water Board to perform grower site inspections, and new well pumps installed as part of tailwater recovery systems. Alternative 4 allows for individual growers to perform their own monitoring, depending on the level of threat posed by their fields to water quality. It was assumed that growers would transport water samples to the laboratory for analysis. This activity represents a minuscule source of potential traffic noise.

Vehicle trips for water quality monitoring and grower site inspections are expected to be minimal. Noise levels associated with operation of new well pumps and implementation of conservation strategies (e.g., improved irrigation and enhanced crop management) would be similar to those described for Alternative 1. Potential noise from unenclosed pumps located close to noise-sensitive uses could exceed local noise standards. This impact is considered potentially significant. Implementation of **Mitigation Measures NOI-MM-1** and **NOI-MM-2** would reduce this impact to a less-than-significant level.

## **Alternative 5 – Direct Oversight with Farm Monitoring**

#### **Impact NOI-1. Exposure of Sensitive Land Uses to Noise from Construction Activities in Excess of Applicable Standards**

Noise impacts from construction would result from installation of individual farm groundwater wells and implementation of management practices that require the use of heavy-duty equipment. Noise levels resulting from implementation of management practices are expected to be similar to those described for Alternative 2 (see **Impact NOI-1**). However, construction of individual farm groundwater wells and accessory facilities would generate increased noise levels from construction equipment, such as drill rigs.

As shown in Table 5.4-4, estimated noise levels from drill rigs are 79 dBA at 50 feet (Hoover & Keith 2008). The analysis of noise levels at various distances presented in Table 5.4-5 includes a drill rig and indicates the potential for drill rig operation to exceed local noise standards. Drill rigs are often required to operate continuously for 24 hours a day over several days, which increases the potential for nighttime noise standards to be exceeded. This impact is therefore considered potentially significant. Implementation of **Mitigation Measure NOI-MM-1** would reduce this impact to a less-than-significant level.

#### **Impact NOI-2. Exposure of Sensitive Land Uses to Noise from Operational Activities in Excess of Applicable Standards**

Operational noise impacts would result from vehicle trips made by the Central Valley Water Board to perform grower site inspections, as well as any pump motors associated with the groundwater or tailwater recovery system wells. In addition, trips made by growers to transport water samples to

the laboratory for analysis may generate additional noise from vehicle use. As discussed above, increases in noise from vehicle travel are expected to be relatively minor. Similarly, noise generated from individual well pumps would be temporary and sporadic. Information on the types and number of pumps, as well as the number and distances of vehicle trips, is currently unavailable. Consequently, a quantitative analysis of noise impacts related to operations of Alternative 5 is not possible. Potential noise from unenclosed pumps located close to noise-sensitive uses could exceed local noise standards. This impact is therefore considered potentially significant. Implementation of **Mitigation Measures NOI-MM-1** and **NOI-MM-2** would reduce this impact to a less-than-significant level.

## 5.4.5 Mitigation and Improvement Measures

### **Mitigation Measure NOI-MM-1: Implement Noise-Reducing Construction Practices**

Growers will implement noise-reducing construction practices such that noise from construction does not exceed applicable local noise standards or limits specified in the applicable county ordinances and general plan noise elements.

### **Mitigation Measure NOI-MM-2: Reduce Noise Generated by Individual Well Pumps**

If well pumps are installed, growers will ensure that they are enclosed or located behind barriers such that noise does not exceed applicable local noise standards or limits specified in the applicable county ordinances and general plan noise elements.

#### 5.5.1 Introduction

This section discusses the potential impacts of program alternatives on air quality. Specifically, it summarizes relevant federal, state, and local policies; describes existing environmental conditions in the program area with respect to air quality, and identifies potentially significant impacts that may result from implementation of program alternatives. Mitigation measures to avoid or reduce the identified impacts also are presented. Please refer to Section 5.6 for a discussion of global climate change and project-level carbon dioxide (CO<sub>2</sub>) emissions.

#### 5.5.2 Regulatory Framework

This section discusses federal, state, and local regulations related to air quality that may apply to the program alternatives.

The State of California established air pollution control programs before federal requirements were enacted. However, federal Clean Air Act (CAA) legislation in the 1970s resulted in a gradual merging of state and federal air quality programs, particularly those relating to industrial sources. Air quality management programs developed by California since the late 1980s have generally responded to requirements established by the federal CAA.

Amendments to the CAA (including the 1990 amendments known as the CAAA, which are the current governing regulations for air quality) have produced additional changes in the structure and administration of air quality management programs. The CAAA requires preparation of an air quality attainment plan for any area that violates state standards for carbon monoxide (CO), sulfur dioxide (SO<sub>2</sub>), nitrogen dioxide (NO<sub>2</sub>), or ozone. Locally prepared attainment plans are not required for areas that violate the state standards for PM<sub>10</sub> [particulate matter less than or equal to 10 microns in diameter], but the CARB is currently addressing PM<sub>10</sub> attainment issues through expanded air quality monitoring, emissions inventory improvements, and comprehensive field studies.

The federal and state air quality management agencies of direct importance within the program area are EPA and ARB. In addition, 24 local air districts have jurisdiction over activities within the 36 counties included in the program area.<sup>1</sup> These districts, as well as their judicial boundaries, are identified in Figure 5.5-1. ARB and the local air districts are responsible for ensuring that state standards are met. The local air districts are responsible for implementing strategies for air quality improvement and recommending mitigation measures for new growth and development. The local air districts are responsible for establishing and enforcing local air quality rules and regulations that address the requirements of federal and state air quality laws.

---

<sup>1</sup> Small portions of Los Angeles and San Luis Obispo Counties are within the project boundary but have no irrigated lands as defined by the program. A small portion of land in Ventura County that is within the program boundary is identified as "pasture." However, potential impacts caused by the proposed program in Ventura County are beyond the scope of this document and are not included in the analysis.

California and the federal government have established standards for several different pollutants. For some pollutants, separate standards have been set for different measurement periods. Most standards have been set to protect public health. For some pollutants, standards have been based on other values (such as protection of crops, protection of materials, or avoidance of nuisance conditions). State and federal standards for a variety of pollutants are summarized in Table 5.5-1.

## Federal

The CAA, enacted in 1963 and amended several times thereafter (including the 1990 amendments), establishes the framework for modern air pollution control. The CAA directs EPA to establish ambient air standards for six pollutants: ozone, CO, lead, NO<sub>2</sub>, PM, and SO<sub>2</sub>. The standards are divided into primary and secondary standards. Primary standards are designed to protect human health, including the health of “sensitive” populations such as asthmatics, children, and the elderly, within an adequate margin of safety. Secondary standards are designed to protect public welfare, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

The primary legislation that governs federal air quality regulations is the CAAA. The CAAA delegates primary responsibility for clean air to EPA. EPA develops rules and regulations to preserve and improve air quality, as well as delegating specific responsibilities to state and local agencies.

Areas that do not meet the federal ambient air quality standards are called *nonattainment* areas. For these nonattainment areas, the CAAA requires states to develop and adopt State Implementation Plans (SIPs), which are air quality plans showing how air quality standards will be attained. The SIP, which is reviewed and approved by EPA, must demonstrate how the federal standards will be achieved. Failing to submit a plan or secure approval could lead to denial of federal funding and permits for such improvements as highway construction and sewage treatment plants. In California, EPA has delegated authority to prepare SIPs to ARB, which, in turn, has delegated that authority to individual air districts. In cases where the SIP is submitted by the state but fails to demonstrate achievement of the standards, EPA is directed to prepare a federal implementation plan.

## State

Responsibility for achieving California’s air quality standards, which are more stringent than federal standards, is placed on ARB and local air districts, and is to be achieved through district-level air quality management plans that will be incorporated into the SIP. As noted, EPA has delegated the authority to prepare SIPs in California to ARB, which in turn has delegated that authority to individual air districts.

ARB has traditionally established state air quality standards, maintained oversight authority in air quality planning, developed programs for reducing emissions from motor vehicles, developed air emission inventories, collected air quality and meteorological data, and approved SIPs.

Responsibilities of air districts include overseeing stationary source emissions, approving permits, maintaining emissions inventories, maintaining air quality stations, overseeing agricultural burning permits, and reviewing air quality-related sections of environmental documents required by CEQA.

The California Clean Air Act (CCAA) of 1988 substantially added to the authority and responsibilities of air districts. The CCAA designates air districts as lead air quality planning agencies, requires air districts to prepare air quality plans, and grants air districts authority to implement transportation





Graphics ...05508.05 PEIR (07/10)JD

control measures (TCMs). The CCAA focuses on attainment of the state ambient air quality standards, which, for certain pollutants and averaging periods, are more stringent than the comparable federal standards.

The CCAA requires designation of attainment and nonattainment areas with respect to state ambient air quality standards. The CCAA also requires that local and regional air districts expeditiously adopt and prepare an air quality attainment plan if the district violates state air quality standards for CO, SO<sub>2</sub>, NO<sub>2</sub>, or ozone. These Clean Air Plans are specifically designed to attain these standards and must be designed to achieve an annual 5-percent reduction in district-wide emissions of each nonattainment pollutant or its precursors. Where an air district is unable to achieve a 5-percent annual reduction in district-wide emissions of each nonattainment pollutant or its precursors, the adoption of “all feasible measures” on an expeditious schedule is acceptable as an alternative strategy (Health and Safety Code Section 40914[b][2]). No locally prepared attainment plans are required for areas that violate the state PM<sub>10</sub> standards, but ARB is currently addressing PM<sub>10</sub> attainment issues.

The CCAA requires that the state air quality standards be met as expeditiously as practicable but, unlike the federal CAA, does not set precise attainment deadlines. Instead, the act established increasingly stringent requirements for areas that will require more time to achieve the standards.

The CCAA emphasizes the control of “indirect and area-wide sources” of air pollutant emissions. The CCAA gives local air pollution control districts explicit authority to regulate indirect sources of air pollution and to establish TCMs. The CCAA does not define *indirect and area-wide sources*. However, Section 110 of the federal CAA defines an *indirect source* as

a facility, building, structure, installation, real property, road, or highway, which attracts, or may attract, mobile sources of pollution. Such term includes parking lots, parking garages, and other facilities subject to any measure for management of parking supply.

TCMs are defined in the CCAA as “any strategy to reduce trips, vehicle use, vehicle miles traveled, vehicle idling, or traffic congestion for the purpose of reducing vehicle emissions.”

## Local

As previously indicated, there are 24 air districts of direct importance in the program area (Figure 5.5-1). These air districts have jurisdiction over activities within the 36 counties in the program area. The local air districts are responsible for implementing strategies for air quality improvement and recommending mitigation measures for new growth and development. At the local level, air quality is managed through land use and development planning practices, and is implemented through the general planning process. The local air districts are responsible for establishing and enforcing local air quality rules and regulations that address the requirements of federal and state air quality laws. Local air districts, counties within their jurisdiction, and applicable thresholds relevant to the program area are summarized in Table 5.5-2.

In addition to the thresholds presented in Table 5.5-2, site-specific projects may be subject to additional rules and regulations required by each of the local air districts. For more information on applicable rules and regulations, please see: <http://www.arb.ca.gov/drdb/drdbtxt.htm>.

**Table 5.5-1. Ambient Air Quality Standards Applicable in California**

| Pollutant                            | Symbol                           | Average Time           | Standard<br>(parts per million) |          | Standard<br>(micrograms<br>per cubic meter) |          | Violation Criteria     |                                                                                                                        |
|--------------------------------------|----------------------------------|------------------------|---------------------------------|----------|---------------------------------------------|----------|------------------------|------------------------------------------------------------------------------------------------------------------------|
|                                      |                                  |                        | California                      | National | California                                  | National | California             | National                                                                                                               |
| Ozone*                               | O <sub>3</sub>                   | 1 hour                 | 0.09                            | NA       | 180                                         | NA       | If exceeded            | NA                                                                                                                     |
|                                      |                                  | 8 hours                | 0.070                           | 0.075    | 137                                         | 147      | If exceeded            | If fourth highest 8-hour concentration in a year, averaged over 3 years, is greater than the standard                  |
| Carbon monoxide<br>(Lake Tahoe only) | CO                               | 8 hours                | 9.0                             | 9        | 10,000                                      | 10,000   | If exceeded            | If exceeded on more than 1 day per year                                                                                |
|                                      |                                  | 1 hour                 | 20                              | 35       | 23,000                                      | 40,000   | If exceeded            | If exceeded on more than 1 day per year                                                                                |
|                                      |                                  | 8 hours                | 6                               | NA       | 7,000                                       | NA       | If equaled or exceeded | NA                                                                                                                     |
| Nitrogen dioxide                     | NO <sub>2</sub>                  | Annual arithmetic mean | 0.030                           | 0.053    | 57                                          | 100      | If exceeded            | If exceeded on more than 1 day per year                                                                                |
|                                      |                                  | 1 hour                 | 0.18                            | 0.100    | 339                                         | NA       | If exceeded            | NA                                                                                                                     |
| Sulfur dioxide                       | SO <sub>2</sub>                  | Annual arithmetic mean | NA                              | 0.030    | NA                                          | 80       | NA                     | If exceeded                                                                                                            |
|                                      |                                  | 24 hours               | 0.04                            | 0.14     | 105                                         | 365      | If exceeded            | If exceeded on more than 1 day per year                                                                                |
|                                      |                                  | 1 hour                 | 0.25                            | NA       | 655                                         | NA       | If exceeded            | NA                                                                                                                     |
| Hydrogen sulfide                     | H <sub>2</sub> S                 | 1 hour                 | 0.03                            | NA       | 42                                          | NA       | If equaled or exceeded | NA                                                                                                                     |
| Vinyl chloride                       | C <sub>2</sub> H <sub>3</sub> Cl | 24 hours               | 0.01                            | NA       | 26                                          | NA       | If equaled or exceeded | NA                                                                                                                     |
| Inhalable particulate matter         | PM <sub>10</sub>                 | Annual arithmetic mean | NA                              | NA       | 20                                          | NA       | If exceeded            | NA                                                                                                                     |
|                                      |                                  | 24 hours               | NA                              | NA       | 50                                          | 150      | If exceeded            | If exceeded on more than 1 day per year                                                                                |
|                                      | PM <sub>2.5</sub>                | Annual arithmetic mean | NA                              | NA       | 12                                          | 15.0     | If exceeded            | If 3-year average of the weighted annual mean from single or multiple community-oriented monitors exceeds the standard |
|                                      |                                  | 24 hours               | NA                              | NA       | NA                                          | 35       | NA                     | If less than 98 percent of the daily concentrations, averaged over 3 years, are equal to or less than the standard     |
| Sulfate particles                    | SO <sub>4</sub>                  | 24 hours               | NA                              | NA       | 25                                          | NA       | If equaled or exceeded | NA                                                                                                                     |

| Pollutant      | Symbol | Average Time            | Standard<br>(parts per million) |          | Standard<br>(micrograms<br>per cubic meter) |          | Violation Criteria     |                                         |
|----------------|--------|-------------------------|---------------------------------|----------|---------------------------------------------|----------|------------------------|-----------------------------------------|
|                |        |                         | California                      | National | California                                  | National | California             | National                                |
| Lead particles | Pb     | Calendar quarter        | NA                              | NA       | NA                                          | 1.5      | NA                     | If exceeded no more than 1 day per year |
|                |        | 30-day average          | NA                              | NA       | 1.5                                         | NA       | If equaled or exceeded | NA                                      |
|                |        | Rolling 3-Month average | NA                              | NA       | NA                                          | 0.15     | NA                     | Averaged over a rolling 3-month period  |

## Notes:

National standards shown are the primary (public health) standards.

All equivalent units are based upon a reference temperature of 25°C and a reference pressure of 760 torr; *ppm* in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.

NA = not applicable.

\* The U.S. Environmental Protection Agency (EPA) recently replaced the 1-hour ozone standard with an 8-hour standard of 0.08 part per million. EPA issued a final rule that revoked the 1-hour standard on June 15, 2005. However, the California 1-hour ozone standard will remain in effect.

Source: ARB 2008a.

**Table 5.5-2. Air Districts and Counties Affected by Program Alternatives and Associated Significance Thresholds**

| Air District                   | Air Basin         | Affected Counties                   | Threshold Type | ROG                     | NO <sub>x</sub>         | PM <sub>10</sub> | CO               |
|--------------------------------|-------------------|-------------------------------------|----------------|-------------------------|-------------------------|------------------|------------------|
| Amador County APCD             | Mountain Counties | Amador                              | Construction   | N/A                     | N/A                     | N/A <sup>a</sup> | N/A              |
|                                |                   |                                     | Operational    | N/A                     | N/A                     | N/A              | N/A              |
| BAAQMD <sup>c</sup>            | San Francisco Bay | Napa, Contra Costa, Alameda, Solano | Construction   | N/A                     | N/A                     | N/A <sup>b</sup> | N/A              |
|                                |                   |                                     | Operational    | 80 lbs/day              | 80 lbs/day              | 80 lbs/day       | 550 lbs/day      |
| Butte County AQMD <sup>d</sup> | Sacramento Valley | Butte                               | Construction   | N/A <sup>e</sup>        | N/A <sup>e</sup>        | N/A <sup>e</sup> | N/A <sup>e</sup> |
|                                |                   |                                     | Operational    | 137 lbs/day             | 137 lbs/day             | 137 lbs/day      | N/A              |
| Calaveras County APCD          | Mountain Counties | Calaveras                           | Construction   | N/A                     | N/A                     | N/A              | N/A              |
|                                |                   |                                     | Operational    | N/A                     | N/A                     | N/A              | N/A              |
| Colusa County APCD             | Sacramento Valley | Colusa                              | Construction   | 25 lbs/day              | 25 lbs/day              | 80 lbs/day       | 500 lbs/day      |
|                                |                   |                                     | Operational    | 25 lbs/day              | 25 lbs/day              | 80 lbs/day       | 500 lbs/day      |
| El Dorado County AQMD          | Mountain Counties | El Dorado                           | Construction   | 82 lbs/day <sup>f</sup> | 82 lbs/day <sup>f</sup> | N/A <sup>g</sup> | CAAQS            |
|                                |                   |                                     | Operational    | 82 lbs/day              | 82 lbs/day              | N/A              | CAAQS            |
| Feather River AQMD             | Sacramento Valley | Sutter, Yuba                        | Construction   | N/A <sup>h</sup>        | N/A <sup>h</sup>        | N/A <sup>h</sup> | N/A <sup>h</sup> |

| Air District                 | Air Basin                            | Affected Counties                                                    | Threshold Type | ROG                      | NO <sub>x</sub>          | PM <sub>10</sub>           | CO                         |
|------------------------------|--------------------------------------|----------------------------------------------------------------------|----------------|--------------------------|--------------------------|----------------------------|----------------------------|
| Glenn County APCD            | Sacramento Valley                    | Glenn                                                                | Operational    | 25 lbs/day <sup>i</sup>  | 25 lbs/day <sup>i</sup>  | 80 lbs/day <sup>i</sup>    | N/A                        |
|                              |                                      |                                                                      | Construction   | N/A <sup>j</sup>         | N/A <sup>j</sup>         | N/A <sup>j</sup>           | N/A <sup>j</sup>           |
|                              |                                      |                                                                      | Operational    | N/A <sup>i</sup>         | N/A <sup>i</sup>         | N/A <sup>i</sup>           | N/A <sup>i</sup>           |
| Great Basin Unified APCD     | Great Basin Valley                   | Alpine                                                               | Construction   | N/A                      | N/A                      | N/A <sup>k</sup>           | N/A                        |
|                              |                                      |                                                                      | Operational    | N/A                      | N/A                      | N/A                        | N/A                        |
| Kern County APCD             | Mojave Desert                        | Kern                                                                 | Construction   | 25 tons/year             | 25 ton/year              | 15 tons/year               | CAAQS                      |
|                              |                                      |                                                                      | Operational    | 25 tons/year             | 25 tons/year             | 15 tons/year               | CAAQS                      |
| Lake County AQMD             | Lake County                          | Lake                                                                 | Construction   | 150 lbs/day <sup>l</sup> | 150 lbs/day <sup>l</sup> | 150 lbs/day <sup>l</sup>   | 1,500 lbs/day <sup>l</sup> |
|                              |                                      |                                                                      | Operational    | 80 lbs/day <sup>m</sup>  | 80 lbs/day <sup>m</sup>  | 80 lbs/day <sup>m</sup>    | 550 lbs/day <sup>m</sup>   |
| Lassen County APCD           | Northeast Plateau                    | Lassen                                                               | Construction   | N/A                      | N/A                      | N/A                        | N/A                        |
|                              |                                      |                                                                      | Operational    | N/A                      | N/A                      | N/A                        | N/A                        |
| Mariposa County APCD         | Mountain Counties                    | Mariposa                                                             | Construction   | 100 tons/yr              | 100 tons/yr              | 100 tons/yr                | 100 tons/yr                |
|                              |                                      |                                                                      | Operational    | 100 ton/yr               | 100 ton/yr               | 100 tons/yr                | 100 tons/yr                |
| Modoc County APCD            | Northeast Plateau                    | Modoc                                                                | Construction   | N/A <sup>n</sup>         | N/A <sup>n</sup>         | N/A <sup>n</sup>           | N/A <sup>n</sup>           |
|                              |                                      |                                                                      | Operational    | N/A <sup>n</sup>         | N/A <sup>n</sup>         | N/A <sup>n</sup>           | N/A <sup>n</sup>           |
| Monterey Bay Unified APCD    | North Central Coast                  | San Benito                                                           | Construction   | N/A <sup>o</sup>         | N/A <sup>o</sup>         | 82 lbs/day                 | N/A                        |
|                              |                                      |                                                                      | Operational    | 137 lbs/day              | 137 lbs/day              | 82 lbs/day                 | 550 lb/day                 |
| Northern Sierra AQMD         | Mountain Counties                    | Plumas, Sierra, Nevada                                               | Construction   | ≤ 137 lbs/day            | ≤ 137 lbs/day            | ≤ 137 lbs/day <sup>p</sup> | N/A                        |
|                              |                                      |                                                                      | Operational    | ≤ 137 lbs/day            | ≤ 137 lbs/day            | ≤ 137 lbs/day              | N/A                        |
| Placer County APCD           | Mountain Counties, Sacramento Valley | Placer                                                               | Construction   | 82 lbs/day               | 82 lbs/day               | 82 lbs/day                 | 550 lbs/day <sup>q</sup>   |
|                              |                                      |                                                                      | Operational    | 82 lbs/day               | 82 lbs/day               | 82 lbs/day                 | 550 lbs/day <sup>q</sup>   |
| Sacramento Metropolitan AQMD | Sacramento Valley                    | Sacramento                                                           | Construction   | N/A                      | 85 lbs/day               | CAAQS                      | CAAQS                      |
|                              |                                      |                                                                      | Operational    | 65 lbs/day               | 65 lbs/day               | CAAQS                      | CAAQS                      |
| San Joaquin Valley APCD      | San Joaquin Valley                   | San Joaquin, Stanislaus, Merced, Fresno, Kings, Kern, Madera, Tulare | Construction   | 10 tons/year             | 10 tons/year             | N/A <sup>r</sup>           | CAAQS                      |
|                              |                                      |                                                                      | Operational    | 10 tons/year             | 10 tons/year             | 15 tons/year               | CAAQS                      |
| Shasta County AQMD           | Sacramento Valley                    | Shasta                                                               | Construction   | 137 lbs/day              | 137 lbs/day              | 137 lbs/day                | CAAQS                      |
|                              |                                      |                                                                      | Operational    | 137 lbs/day              | 137 lbs/day              | 137 lbs/day                | CAAQS                      |
| Siskiyou County APCD         | Northeast Plateau                    | Siskiyou                                                             | Construction   | N/A                      | N/A                      | N/A                        | N/A                        |



| Air District         | Air Basin                               | Affected Counties | Threshold Type | ROG                      | NO <sub>x</sub>          | PM <sub>10</sub>         | CO            |
|----------------------|-----------------------------------------|-------------------|----------------|--------------------------|--------------------------|--------------------------|---------------|
|                      |                                         |                   | Operational    | N/A                      | N/A                      | N/A                      | N/A           |
| Tehama County APCD   | Sacramento Valley                       | Tehama            | Construction   | 137 lbs/day <sup>s</sup> | 137 lbs/day <sup>s</sup> | 137 lbs/day <sup>s</sup> | N/A           |
|                      |                                         |                   | Operational    | 137 lbs/day <sup>s</sup> | 137 lbs/day <sup>s</sup> | 137 lbs/day <sup>s</sup> | N/A           |
| Tuolumne County APCD | Mountain Counties                       | Tuolumne          | Construction   | 1,000 lbs/day            | 1,000 lbs/day            | 1,000 lbs/day            | 1,000 lbs/day |
|                      |                                         |                   | Operational    | 1,000 lbs/day            | 1,000 lbs/day            | 1,000 lbs/day            | 1,000 lbs/day |
| Yolo-Solano AQMD     | Sacramento Valley,<br>San Francisco Bay | Yolo, Solano      | Construction   | 10 tons/year             | 10 tons/year             | 80 lbs/day               | CAAQS         |
|                      |                                         |                   | Operational    | 10 tons/year             | 10 tons/year             | 80 lbs/day               | CAAQS         |

## Notes:

APCD = Air Pollution Control District.

AQMD = Air Quality Management District.

BAAQMD = Bay Area Air Quality Management District.

CAAQS = California Ambient Air Quality Standards.

N/A = not applicable.

ROG = reactive organic gases.

NO<sub>x</sub> = oxides of nitrogen.

CO = carbon monoxide.

lbs/day = pounds per day.

Qtr = quarter

<sup>a</sup> Although Amador County APCD does not have quantitative thresholds for PM<sub>10</sub> emissions, projects must comply with Rule 218, *Fugitive Dust Emissions*. Good housekeeping practices can be found on page 2 of Rule 218.

<sup>b</sup> Construction emissions of PM<sub>10</sub> will result in no adverse effects with implementation of the applicable control measures found in Table 2, *Feasible Control Measures for Construction Emissions of PM<sub>10</sub>* (Page 15), of the BAAQMD California Environmental Quality Act Guidelines.

<sup>c</sup> In their September 2009 draft Air Quality Guidelines, the BAAQMD proposed updated operational and construction emissions thresholds. Proposed thresholds for emissions from construction activities and project operations are 54 lbs/day of ROG, NO<sub>x</sub>, and PM<sub>2.5</sub>, and 82 lbs/day of PM<sub>10</sub>. The PM<sub>10</sub> and PM<sub>2.5</sub> thresholds for construction emissions apply only to vehicle exhaust. Proposed thresholds for CO is the exceedance of ambient air quality standards.

<sup>d</sup> District staff has indicated that operational thresholds for ozone and PM<sub>10</sub> and PM<sub>2.5</sub> will be lowered sometime in 2010. In addition, independent thresholds for construction activities will be established.

<sup>e</sup> Operational emission thresholds apply to construction if construction will last more than 1 year.

<sup>f</sup> The threshold of 82 lbs/day is a combined total. Therefore, one pollutant can be in excess of 82 lbs/day, but as long as the combined total is below 164 lbs/day, the impact is considered less than significant.

<sup>g</sup> Although El Dorado AQMD does not have quantitative thresholds for PM<sub>10</sub> emissions, it requires implementation of effective and comprehensive feasible control measures to reduce emissions. According to the El Dorado AQMD, implementation of Rule 223-1 will reduce fugitive dust emission from construction to less-than-significant levels.

<sup>h</sup> The Feather River AQMD does not require quantification of construction emissions. Instead, the District requires that all projects comply with the standard mitigation measures.

<sup>i</sup> Applies to construction activities lasting longer than 12 months.

<sup>j</sup> Although the Glenn County APCD does not have specific construction and operational emission thresholds, they require water trucks onsite during construction, and they require any earth-moving activities to be suspended during wind events exceeding 15 miles per hour.

<sup>k</sup> Although the Great Basin APCD has no established thresholds for PM<sub>10</sub>, it requires implementation of Rule 401—*Fugitive Dust*.

<sup>l</sup> Lake County AQMD staff recommend utilizing the more stringent of the following: The BAAQMD thresholds for determining significance or the Lake County AQMD New Source Review (NSR) thresholds. Since the BAAQMD does not require quantification of construction emissions, the thresholds shown are from the NSR. According to Lake County AQMD staff, even if emissions do not exceed these thresholds, some mitigation of impacts should be included and/or considered for the project.

<sup>m</sup> Since the BAAQMD thresholds are more stringent than the Lake County AQMD NSR thresholds, they should be used to determine significance of operational impacts.

<sup>n</sup> The Modoc County APCD does not have blanket thresholds for construction and operational emissions. According to the district staff, the Modoc County APCD should be contacted on a per-project basis to obtain applicable thresholds of significance.

<sup>o</sup> The Monterey Bay APCD does not require the quantification of construction-related ozone precursors (i.e., ROG or NO<sub>x</sub>), as they are accommodated in the emission inventories of state and federally required air plans.

<sup>p</sup> If more than 1 acre is altered or natural ground cover removed, the program proponent must comply with Rule 226 and submit a dust control plan.

<sup>q</sup> If CO thresholds are exceeded, modeling can be done to demonstrate that state and federal criteria will not be exceeded.

<sup>r</sup> Compliance with District Regulation VIII, including implementation of all feasible control measures specified in the *Guide for Assessing Air Quality Impacts*, constitutes sufficient mitigation to reduce construction-related PM<sub>10</sub> emissions to less-than-significant levels.

<sup>s</sup> Tehama County APCD does not have significance thresholds but recommends using the Action Level Thresholds used in Butte and Shasta Counties. The threshold shown is the Level C Threshold. In addition, if a project will be moving earth in excess of 2,000 cubic yards (yd<sup>3</sup>), the District requires (at minimum) a Fugitive Dust Permit. If a project will be moving 10,000 yd<sup>3</sup> or more of earth, it is considered a large project and requires consultation with the District before proceeding.

Sources: Amador County APCD 2000; Barber pers. comm.; BAAQMD 1999, 2009; Beck pers. comm.; Bertotti pers. comm.; Butte County AQMD 2008; Cadrett pers. comm.; Chang pers. comm.; County of Tuolumne 2000; Conway pers. comm.; El Dorado County APCD 2002; Feather River AQMD n.d., 2009; Gearhart pers. comm.; Grewal pers. comm.; Gomez pers. comm.; Haas pers. comm.; Kern County Planning Department 2004; Lake County AQMD 2006; Ledbetter pers. comm.; Monterey Bay APCD 2004; Northern Sierra AQMD 2000; Otani pers. comm.; Sacramento Metropolitan AQMD 2004; San Joaquin Valley Unified APCD 2002; Schade pers. comm.; Shasta County 2004; Sunday pers. comm.; Waldrop pers. comm.; Williams pers. comm.; Yolo-Solano AQMD 2007.

### 5.5.3 Environmental Setting

California is divided into 15 air basins to better manage air pollution. The program area encompasses the following 11 air basins: Mountain Counties (MCAB), Sacramento Valley (SVAB), San Joaquin Valley (SJVAB), Lake County (LCAB), Great Basin Valley (GBVAB), San Francisco Bay Area (SFBAAB), Northeast Plateau (NPAB), North Central Coast (NCCAB), South Central Coast (SCCAB), South Coast (SCAB), and Mojave Desert (MDAB) (see Table 5.5-2). The majority of farms, and thus potential emission sources, are located in the MCAB, SVAB, and SJVAB.

#### Regional Climate and Meteorology

The primary factors that determine air quality are the locations of air pollutant sources and the amount of pollutants emitted from those sources. Meteorological and topographical conditions are also important—atmospheric conditions, such as wind speed, wind direction, and air temperature gradients, interact with the physical features of the landscape to determine the movement and dispersal of air pollutants. In regard to the air basins discussed above, climate and meteorology vary within each. Since the majority of the program’s acreage is located in the MCAB, SVAB, and SJVAB, the following section discusses climate and meteorological information associated with these three basins.

##### Mountain Counties Air Basin

Within the MCAB, the general climate of the region varies based on elevation and proximity to the Sierra Nevada. Due to the complex features of terrain within the basin, it is possible for various climate types to exist in proximity to one another. This can be attributed to the varying patterns of mountains and hills in the basin, which result in wide variations in temperature, rainfall, and localized wind in the basin.

Areas near the Sierra Nevada are generally subject to storms moving westerly from the Pacific in winter, which results in large amounts of precipitation. During summer, precipitation is much lighter, with intermittent precipitation flowing from the south. Precipitation is generally higher near the mountain areas and decline moving westerly toward the lower areas. Rain shadow effects can vary precipitation levels between areas in proximity to one another. During winter, mountain temperatures can drop below freezing for extended periods, with high accumulations of snow; while winter temperatures in the western foothill regions usually drop below freezing at night, and precipitation is often a mixture of rain and light snow. During summer, mountain temperatures are often mild, with daytime highs in the 70s to low 80s degrees Fahrenheit (°F), while temperatures in the lower elevations often experience highs in the upper 90s°F.

Within the MCAB, meteorology and topography combine so that local conditions predominate in determining the effect of emissions in the basin. Air quality is affected by regional flow patterns, which direct pollutants downwind of polluting sources. In addition, topographical features, such as the surrounding mountain ranges, and localized meteorological conditions, such as shallow vertical mixing and light winds, create areas of high pollutant concentrations by hindering their dispersal. Inversion layers frequently occur in small valleys and trap pollutants close to the ground. This can lead to increased CO levels (“hotspots”) along heavily traveled roads and at busy intersections during winter. During summer, longer daylight hours, high temperatures, and stagnant air provide

conditions suitable for the formation of ozone through the photochemical reaction between reactive organic gases (ROG) and oxides of nitrogen (NO<sub>x</sub>).

### **Sacramento Valley Air Basin**

The SVAB has a Mediterranean climate characterized by hot, dry summers and cool, rainy winters. During winter, the North Pacific storm track intermittently dominates valley weather, and fair weather alternates with periods of extensive clouds and precipitation. Also characteristic of winter weather in the valley are periods of dense and persistent low-level fog, which is most prevalent between storms. The frequency and persistence of heavy fog in the valley diminish with the approach of spring. The average yearly temperature range for the Sacramento Valley is between 20 and 115°F, with summer high temperatures often exceeding 90°F and winter low temperatures occasionally dropping below freezing.

Prevailing wind in the Sacramento Valley is generally from the southwest due to marine breezes flowing through the Carquinez Strait, which is the major corridor for air moving into the Sacramento Valley from the west. Incoming airflow strength varies daily, with a pronounced diurnal cycle. Influx strength is weakest in the morning and increases in the evening hours. Associated with the influx of air through the Carquinez Strait is the Schultz Eddy, which is formed when mountains on the valley's western side divert incoming marine air. The eddy contributes to the formation of a low-level southerly jet between 500 and 1,000 feet above the surface that is capable of speeds in excess of 35 miles per hour (mph). This jet is important for air quality in the Sacramento Valley because of its ability to transport air pollutants over large distances.

The SVAB's climate and topography contribute to the formation and transport of photochemical pollutants throughout the region. The region experiences temperature inversions that limit atmospheric mixing and trap pollutants; high pollutant concentrations result near the ground surface. Generally, the lower the inversion base height from the ground and the greater the temperature increase from base to top, the more pronounced the inhibiting effect of the inversion will be on pollutant dispersion. Consequently, the highest concentrations of photochemical pollutants occur from late spring to early fall, when photochemical reactions are greatest because of intensifying sunlight and lowering altitude of daytime inversion layers. Surface inversions (those at altitudes of 0–500 feet above sea level) are most frequent during winter, and subsidence inversions (those at 1,000–2,000 feet above sea level) are most common in summer.

### **San Joaquin Valley Air Basin**

The SJVAB is bounded by the Sierra Nevada to the east (8,000–14,000 feet in elevation), the Coast Ranges to the west (averaging 3,000 feet in elevation), and the Tehachapi Mountains to the south (6,000–8,000 feet in elevation). The area's climate is considered "inland Mediterranean" and is characterized by warm, dry summers and cool winters. Summer high temperatures often exceed 100°F, averaging in the low 90s in the northern valley and high 90s in the southern portion.

Although marine air generally flows into the basin from the Delta, the surrounding mountain ranges restrict air movement through and out of the valley. Wind speed and direction influence the dispersion and transportation of ozone precursors, PM<sub>10</sub>, and CO—the more wind flow, the less accumulation of these pollutants.

The vertical dispersion of air pollutants in the SJVAB is limited by the presence of persistent temperature inversion (warm air over cool air). Due to differences in air density, the air above and

below the inversion do not mix. Ozone and its precursors will mix and react to produce higher concentrations under an inversion and will trap directly emitted pollutants like CO.

Precipitation and fog tend to reduce pollutant concentrations. Ozone needs sunlight for its formation, and clouds and fog block the required radiation. Because CO is slightly water-soluble, precipitation and fog tend to “reduce” CO concentrations in the atmosphere. PM10 is somewhat “washed” from the atmosphere with precipitation. Precipitation in the San Joaquin Valley decreases from north to south, with approximately 20 inches in the north, 10 inches in the middle, and less than 6 inches in the south.

## Criteria Pollutants

The federal and state governments have established ambient air quality standards for the following six criteria pollutants: ozone, CO, NO<sub>2</sub>, SO<sub>2</sub>, PM10, PM2.5 [particulate matter smaller than 2.5 microns or less in diameter], and lead. Ozone, NO<sub>2</sub>, and particulate matter are generally considered to be “regional” pollutants, as these pollutants or their precursors affect air quality on a regional scale. Pollutants such as CO, SO<sub>2</sub>, lead, and particulate matter are considered to be local pollutants that tend to accumulate in the air locally. Particulate matter is considered to be a localized pollutant as well as a regional pollutant. Within the program area, ozone, CO, PM10, and PM2.5 are of greatest concern. Toxic air contaminants (TACs) also are pollutants of concern, although no state or federal ambient air quality standards exist for these pollutants. Brief descriptions of these pollutants are provided below, and a complete summary of state and national ambient air quality standards (CAAQS and NAAQS, respectively) is provided in Table 5.5-1.

### Ozone

Ozone is a respiratory irritant that increases susceptibility to respiratory infections. It is also an oxidant that can cause substantial damage to vegetation and other materials.

Ozone is not emitted directly into the air but is formed by a photochemical reaction in the atmosphere. Ozone precursors (ROG and NO<sub>x</sub>) react in the atmosphere in the presence of sunlight to form ozone. Because photochemical reaction rates depend on the intensity of ultraviolet light and air temperature, ozone is primarily a summer air pollution problem. Off-road agricultural equipment contributes to statewide NO<sub>x</sub> emissions. ARB is committed to developing measures to “accelerate fleet turnover to equipment with engines meeting cleaner NO<sub>x</sub> and PM standards” (ARB 2008b).

State and federal standards for ozone have been set for 1- and 8-hour averaging times. The state 1-hour ozone standard is 0.09 parts per million (ppm), not to be exceeded. EPA recently replaced the 1-hour ozone standard with an 8-hour standard of 0.075 ppm. However, the California 1-hour standard will remain in effect. The state 8-hour standard is 0.070 ppm, not to be exceeded.

### Carbon Monoxide

Carbon monoxide is a public health concern because it combines readily with hemoglobin and reduces the amount of oxygen transported in the bloodstream. Carbon monoxide can cause health problems such as fatigue, headache, confusion, dizziness, and even death.

Motor vehicles are the dominant source of CO emissions in most areas. High CO levels develop primarily during winter, when periods of light winds combine with the formation of ground-level



temperature inversions (typically from the evening through early morning). These conditions result in reduced dispersion of vehicle emissions. Motor vehicles also exhibit increased CO emission rates at low air temperatures.

State and federal CO standards have been set for 1- and 8-hour averaging times. The state 1-hour standard is 20 ppm, not to be exceeded, whereas the federal 1-hour standard is 35 ppm, not to be exceeded more than 1 day per year. The state 8-hour standard is 9.0 ppm, while the federal standard is 9 ppm. This means that a monitored 8-hour CO concentration from 9.1 to 9.4 ppm violates the state but not the federal standard.

## Inhalable Particulates

Particulates can damage human health and retard plant growth. Health concerns associated with suspended particulate matter focus on those particles small enough to reach the lungs when inhaled. Particulates also reduce visibility and corrode materials. Particulate emissions are generated by a wide variety of sources, including agricultural activities, industrial operations, vehicles (e.g., dust suspended by vehicle traffic and construction equipment), and secondary aerosols (formed by reactions in the atmosphere).

The state PM10 standards are 50 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ) as a 24-hour average and 20  $\mu\text{g}/\text{m}^3$  as an annual arithmetic mean. The federal PM10 standards are 150  $\mu\text{g}/\text{m}^3$  as a 24-hour average. The federal PM2.5 standards are 15  $\mu\text{g}/\text{m}^3$  for the annual average and 35  $\mu\text{g}/\text{m}^3$  for the 24-hour average. The state PM2.5 standard is 12  $\mu\text{g}/\text{m}^3$  for the annual arithmetic mean.

## Toxic Air Contaminants/Hazardous Air Pollutants

TACs and hazardous air pollutants (HAPs) are pollutants that may result in an increase in mortality or serious illness, or that may pose a present or potential hazard to human health. The CAA identified 188 pollutants as being air toxics. Air toxics are referred to as HAPs under the CAA and are referred to as TACs under the CCAA. Health effects of TACs include cancer, birth defects, neurological damage, damage to the body's natural defense system, and diseases that lead to death.

In 1998, following a 10-year scientific assessment process, ARB identified particulate matter from diesel-fueled engines as a TAC. In the *Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles*, ARB said that "Compared to other air toxics ARB has identified and controlled, diesel particulate matter emissions are estimated to be responsible for about 70 percent of the total ambient air toxics risk" (ARB 2000).

A number of pesticides have been identified as TACs. DPR is responsible for evaluation and regulation of pesticides identified as TACs. Following DPR's determination of a pesticide as a TAC, the compound is formally listed, and appropriate control and mitigation measures are developed (DPR 2009).

Asbestos is another federally recognized TAC of concern. Naturally occurring asbestos (NOA), or ultramaif serpentinized rock closely associated with asbestos, is known to be located within several program areas. Asbestos can adversely affect humans only in its fibrous form; these fibers must be broken and dispersed into the air and then inhaled. During the geological process or through earth-moving processes (e.g., construction), the asbestos mineral found in NOA can be crushed, causing it to become airborne. Constant exposure to asbestos at high levels on a regular basis may cause cancer in humans.

## Local Area Monitoring Data

Existing conditions for air quality in the program area can be further described with summary statistics for criteria air pollutants. Tables 5.5-3, 5.5-4, and 5.5-5 summarize monitoring data for criteria air pollutant levels from all monitoring stations in the MCAB, SVAB, and SJVAB, respectively. These numbers represent air quality monitoring data for the last 3 years (2006–2008) for which complete data are available.

**Table 5.5-3. Ambient Air Quality Monitoring Data for the Mountain Counties Air Basin**

| <b>Pollutant Standards</b>                                                      | <b>2006</b> | <b>2007</b> | <b>2008</b> |
|---------------------------------------------------------------------------------|-------------|-------------|-------------|
| <b>1-Hour Ozone</b>                                                             |             |             |             |
| Maximum 1-hour concentration (ppm)                                              | 0.134       | 0.115       | 0.149       |
| 1-hour California designation value                                             | 0.14        | 0.12        | 0.13        |
| 1-hour expected peak day concentration                                          | –           | –           | –           |
| Number of days standard exceeded <sup>a</sup>                                   |             |             |             |
| CAAQS 1-hour (>0.09 ppm)                                                        | 50          | 19          | 34          |
| <b>8-Hour Ozone</b>                                                             |             |             |             |
| National maximum 8-hour concentration (ppm)                                     | 0.115       | 0.106       | 0.118       |
| National second-highest 8-hour concentration (ppm)                              | 0.111       | 0.099       | 0.114       |
| State maximum 8-hour concentration (ppm)                                        | 0.116       | 0.107       | 0.118       |
| State second-highest 8-hour concentration (ppm)                                 | 0.111       | 0.100       | 0.115       |
| 8-hour national designation value                                               | 0.097       | 0.096       | 0.098       |
| 8-hour California designation value                                             | 0.124       | 0.108       | 0.114       |
| 8-hour expected peak day concentration                                          | –           | –           | –           |
| Number of days standard exceeded <sup>a</sup>                                   |             |             |             |
| NAAQS 8-hour (>0.075 ppm)                                                       | 88          | 57          | 59          |
| CAAQS 8-hour (>0.070 ppm)                                                       | 103         | 88          | 84          |
| <b>Carbon Monoxide (CO)</b>                                                     |             |             |             |
| National <sup>b</sup> maximum 8-hour concentration (ppm)                        | 0.58        | 0.68        | –           |
| National <sup>b</sup> second-highest 8-hour concentration (ppm)                 | 0.40        | 0.59        | –           |
| California <sup>c</sup> maximum 8-hour concentration (ppm)                      | 0.58        | 0.68        | –           |
| California <sup>c</sup> second-highest 8-hour concentration (ppm)               | 0.40        | 0.57        | –           |
| Maximum 1-hour concentration (ppm)                                              | –           | –           | –           |
| Second-highest 1-hour concentration (ppm)                                       | –           | –           | –           |
| Number of days standard exceeded <sup>a</sup>                                   |             |             |             |
| NAAQS 8-hour (≥9 ppm)                                                           | 0           | 0           | 0           |
| CAAQS 8-hour (≥9.0 ppm)                                                         | 0           | 0           | 0           |
| NAAQS 1-hour (≥35 ppm)                                                          | 0           | 0           | 0           |
| CAAQS 1-hour (≥20 ppm)                                                          | 0           | 0           | 0           |
| <b>Particulate Matter (PM<sub>10</sub>)<sup>d</sup></b>                         |             |             |             |
| National <sup>b</sup> maximum 24-hour concentration (µg/m <sup>3</sup> )        | 167.1       | 127.0       | 135.7       |
| National <sup>b</sup> second-highest 24-hour concentration (µg/m <sup>3</sup> ) | 107.7       | 51.0        | 77.3        |
| State <sup>c</sup> maximum 24-hour concentration (µg/m <sup>3</sup> )           | 97.0        | 116.0       | 118.4       |
| State <sup>c</sup> second-highest 24-hour concentration (µg/m <sup>3</sup> )    | 67.0        | 45.0        | 66.3        |
| State annual average concentration (µg/m <sup>3</sup> ) <sup>e</sup>            | 17.6        | 16.3        | 15.8        |
| National annual average concentration (µg/m <sup>3</sup> )                      | 29.0        | 24.1        | 23.8        |

| <b>Pollutant Standards</b>                                                      | <b>2006</b> | <b>2007</b> | <b>2008</b> |
|---------------------------------------------------------------------------------|-------------|-------------|-------------|
| Number of days standard exceeded <sup>a</sup>                                   |             |             |             |
| NAAQS 24-hour (>150 µg/m <sup>3</sup> ) <sup>f</sup>                            | –           | –           | –           |
| CAAQS 24-hour (>50 µg/m <sup>3</sup> ) <sup>f</sup>                             | 0           | 0           | 6           |
| <b>Particulate Matter (PM<sub>2.5</sub>)</b>                                    |             |             |             |
| National <sup>b</sup> maximum 24-hour concentration (µg/m <sup>3</sup> )        | –           | –           | –           |
| National <sup>b</sup> second-highest 24-hour concentration (µg/m <sup>3</sup> ) | –           | –           | –           |
| State <sup>c</sup> maximum 24-hour concentration (µg/m <sup>3</sup> )           | –           | –           | –           |
| State <sup>c</sup> second-highest 24-hour concentration (µg/m <sup>3</sup> )    | –           | –           | –           |
| National annual designation value (µg/m <sup>3</sup> )                          | –           | –           | –           |
| National annual average concentration (µg/m <sup>3</sup> )                      | –           | –           | –           |
| State annual designation value (µg/m <sup>3</sup> )                             | –           | –           | –           |
| State annual average concentration (µg/m <sup>3</sup> ) <sup>e</sup>            | –           | –           | –           |
| Number of days standard exceeded <sup>a</sup>                                   |             |             |             |
| NAAQS 24-hour (>35 µg/m <sup>3</sup> )                                          | –           | –           | –           |

Notes: CAAQS = California ambient air quality standards.

NAAQS = national ambient air quality standards.

– = insufficient data available to determine the value.

<sup>a</sup> An exceedance is not necessarily a violation.

<sup>b</sup> National statistics are based on standard conditions data. In addition, national statistics are based on samplers using federal reference or equivalent methods.

<sup>c</sup> State statistics are based on local conditions data, except in the South Coast Air Basin, for which statistics are based on standard conditions data. In addition, State statistics are based on California-approved samplers.

<sup>d</sup> Measurements usually are collected every 6 days.

<sup>e</sup> State criteria for ensuring that data are sufficiently complete for calculating valid annual averages are more stringent than the national criteria.

<sup>f</sup> Mathematical estimate of how many days concentrations would have been measured as higher than the level of the standard, had each day been monitored. Values have been rounded.

Sources: ARB 2009a; EPA 2009a.

**Table 5.5-4. Ambient Air Quality Monitoring Data for the Sacramento Valley Air Basin**

| <b>Pollutant Standards</b>                         | <b>2006</b> | <b>2007</b> | <b>2008</b> |
|----------------------------------------------------|-------------|-------------|-------------|
| <b>1-Hour Ozone</b>                                |             |             |             |
| Maximum 1-hour concentration (ppm)                 | 0.143       | 0.138       | 0.166       |
| 1-hour California designation value                | 0.13        | 0.13        | 0.14        |
| 1-hour expected peak day concentration             | –           | –           | –           |
| Number of days standard exceeded <sup>a</sup>      |             |             |             |
| CAAQS 1-hour (>0.09 ppm)                           | 44          | 15          | 42          |
| <b>8-Hour Ozone</b>                                |             |             |             |
| National maximum 8-hour concentration (ppm)        | 0.114       | 0.122       | 0.123       |
| National second-highest 8-hour concentration (ppm) | 0.112       | 0.097       | 0.116       |
| State maximum 8-hour concentration (ppm)           | 0.115       | 0.123       | 0.123       |
| State second-highest 8-hour concentration (ppm)    | 0.112       | 0.097       | 0.116       |
| 8-hour national designation value                  | 0.097       | 0.098       | 0.102       |
| 8-hour California designation value                | 0.112       | 0.112       | 0.116       |

| <b>Pollutant Standards</b>                                                      | <b>2006</b> | <b>2007</b> | <b>2008</b> |
|---------------------------------------------------------------------------------|-------------|-------------|-------------|
| 8-hour expected peak day concentration                                          | –           | –           | –           |
| Number of days standard exceeded <sup>a</sup>                                   |             |             |             |
| NAAQS 8-hour (>0.075 ppm)                                                       | 68          | 34          | 56          |
| CAAQS 8-hour (>0.070 ppm)                                                       | 88          | 61          | 79          |
| <b>Carbon Monoxide (CO)</b>                                                     |             |             |             |
| National <sup>b</sup> maximum 8-hour concentration (ppm)                        | 4.19        | 5.58        | 2.84        |
| National <sup>b</sup> second-highest 8-hour concentration (ppm)                 | 3.51        | 4.10        | 2.74        |
| California <sup>c</sup> maximum 8-hour concentration (ppm)                      | 4.19        | 5.58        | 2.84        |
| California <sup>c</sup> second-highest 8-hour concentration (ppm)               | 3.51        | 3.20        | 2.74        |
| Maximum 1-hour concentration (ppm)                                              | 3.50        | 3.50        | 2.38        |
| Second-highest 1-hour concentration (ppm)                                       | 3.15        | 3.23        | 2.23        |
| Number of days standard exceeded <sup>a</sup>                                   |             |             |             |
| NAAQS 8-hour (≥9 ppm)                                                           | 0           | 0           | 0           |
| CAAQS 8-hour (≥9.0 ppm)                                                         | 0           | 0           | 0           |
| NAAQS 1-hour (≥35 ppm)                                                          | 0           | 0           | 0           |
| CAAQS 1-hour (≥20 ppm)                                                          | 0           | 0           | 0           |
| <b>Particulate Matter (PM10)<sup>d</sup></b>                                    |             |             |             |
| National <sup>b</sup> maximum 24-hour concentration (µg/m <sup>3</sup> )        | 159.6       | 119.0       | 354.0       |
| National <sup>b</sup> second-highest 24-hour concentration (µg/m <sup>3</sup> ) | 101.8       | 60.4        | 56.0        |
| State <sup>c</sup> maximum 24-hour concentration (µg/m <sup>3</sup> )           | 111.0       | 119.0       | 355.0       |
| State <sup>c</sup> second-highest 24-hour concentration (µg/m <sup>3</sup> )    | 71.0        | 65.2        | 58.0        |
| State annual average concentration (µg/m <sup>3</sup> ) <sup>e</sup>            | 28.8        | 28.1        | 33.4        |
| National annual average concentration (µg/m <sup>3</sup> )                      | 37.8        | 27.5        | 47.5        |
| Number of days standard exceeded <sup>a</sup>                                   |             |             |             |
| NAAQS 24-hour (>150 µg/m <sup>3</sup> ) <sup>f</sup>                            | –           | –           | –           |
| CAAQS 24-hour (>50 µg/m <sup>3</sup> ) <sup>f</sup>                             | 53          | 36          | 69          |
| <b>Particulate Matter (PM2.5)</b>                                               |             |             |             |
| National <sup>b</sup> maximum 24-hour concentration (µg/m <sup>3</sup> )        | –           | –           | –           |
| National <sup>b</sup> second-highest 24-hour concentration (µg/m <sup>3</sup> ) | –           | –           | –           |
| State <sup>c</sup> maximum 24-hour concentration (µg/m <sup>3</sup> )           | –           | –           | –           |
| State <sup>c</sup> second-highest 24-hour concentration (µg/m <sup>3</sup> )    | –           | –           | –           |
| National annual designation value (µg/m <sup>3</sup> )                          | –           | –           | –           |
| National annual average concentration (µg/m <sup>3</sup> )                      | –           | –           | –           |
| State annual designation value (µg/m <sup>3</sup> )                             | –           | –           | –           |
| State annual average concentration (µg/m <sup>3</sup> ) <sup>e</sup>            | –           | –           | –           |
| Number of days standard exceeded <sup>a</sup>                                   |             |             |             |
| NAAQS 24-hour (>35 µg/m <sup>3</sup> )                                          | –           | –           | –           |

| Pollutant Standards                                                                                                                                                                                                              | 2006 | 2007 | 2008 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|
| Notes: CAAQS = California ambient air quality standards.<br>NAAQS = national ambient air quality standards.<br>– = insufficient data available to determine the value.                                                           |      |      |      |
| a An exceedance is not necessarily a violation.                                                                                                                                                                                  |      |      |      |
| b National statistics are based on standard conditions data. In addition, national statistics are based on samplers using federal reference or equivalent methods.                                                               |      |      |      |
| c State statistics are based on local conditions data, except in the South Coast Air Basin, for which statistics are based on standard conditions data. In addition, State statistics are based on California-approved samplers. |      |      |      |
| d Measurements usually are collected every 6 days.                                                                                                                                                                               |      |      |      |
| e State criteria for ensuring that data are sufficiently complete for calculating valid annual averages are more stringent than the national criteria.                                                                           |      |      |      |
| f Mathematical estimate of how many days concentrations would have been measured as higher than the level of the standard, had each day been monitored. Values have been rounded.                                                |      |      |      |
| Sources: ARB 2009a, EPA 2009a.                                                                                                                                                                                                   |      |      |      |

**Table 5.5-5. Ambient Air Quality Monitoring Data for the San Joaquin Valley Air Basin**

| Pollutant Standards                                               | 2006  | 2007  | 2008  |
|-------------------------------------------------------------------|-------|-------|-------|
| <b>1-Hour Ozone</b>                                               |       |       |       |
| Maximum 1-hour concentration (ppm)                                | 0.141 | 0.138 | 0.157 |
| 1-hour California designation value                               | 0.14  | 0.14  | 0.15  |
| 1-hour expected peak day concentration                            | –     | –     | –     |
| Number of days standard exceeded <sup>a</sup>                     |       |       |       |
| CAAQS 1-hour (>0.09 ppm)                                          | 90    | 69    | 95    |
| <b>8-Hour Ozone</b>                                               |       |       |       |
| National maximum 8-hour concentration (ppm)                       | 0.121 | 0.110 | 0.132 |
| National second-highest 8-hour concentration (ppm)                | 0.119 | 0.109 | 0.130 |
| State maximum 8-hour concentration (ppm)                          | 0.122 | 0.110 | 0.132 |
| State second-highest 8-hour concentration (ppm)                   | 0.120 | 0.109 | 0.130 |
| 8-hour national designation value                                 | 0.110 | 0.107 | 0.108 |
| 8-hour California designation value                               | 0.117 | 0.120 | 0.124 |
| 8-hour expected peak day concentration                            | –     | –     | –     |
| Number of days standard exceeded <sup>a</sup>                     |       |       |       |
| NAAQS 8-hour (>0.075 ppm)                                         | 120   | 110   | 127   |
| CAAQS 8-hour (>0.070 ppm)                                         | 141   | 138   | 150   |
| <b>Carbon Monoxide (CO)</b>                                       |       |       |       |
| National <sup>b</sup> maximum 8-hour concentration (ppm)          | 3.73  | 3.16  | 2.34  |
| National <sup>b</sup> second-highest 8-hour concentration (ppm)   | 3.65  | 2.95  | 2.14  |
| California <sup>c</sup> maximum 8-hour concentration (ppm)        | 3.73  | 3.16  | 2.34  |
| California <sup>c</sup> second-highest 8-hour concentration (ppm) | 3.65  | 2.95  | 2.14  |
| Maximum 1-hour concentration (ppm)                                | 4.65  | 3.62  | 2.87  |
| Second-highest 1-hour concentration (ppm)                         | 4.12  | 3.4   | 2.52  |
| Number of days standard exceeded <sup>a</sup>                     |       |       |       |
| NAAQS 8-hour (≥9 ppm)                                             | 0     | 0     | 0     |
| CAAQS 8-hour (≥9.0 ppm)                                           | 0     | 0     | 0     |
| NAAQS 1-hour (≥35 ppm)                                            | 0     | 0     | 0     |



| <b>Pollutant Standards</b>                                                              | <b>2006</b> | <b>2007</b> | <b>2008</b> |
|-----------------------------------------------------------------------------------------|-------------|-------------|-------------|
| CAAQS 1-hour ( $\geq 20$ ppm)                                                           | 0           | 0           | 0           |
| <b>Particulate Matter (PM<sub>10</sub>)<sup>d</sup></b>                                 |             |             |             |
| National <sup>b</sup> maximum 24-hour concentration ( $\mu\text{g}/\text{m}^3$ )        | 304.0       | 172.1       | 390.3       |
| National <sup>b</sup> second-highest 24-hour concentration ( $\mu\text{g}/\text{m}^3$ ) | 162.3       | 104.5       | 338.1       |
| State <sup>c</sup> maximum 24-hour concentration ( $\mu\text{g}/\text{m}^3$ )           | 255.0       | 135.0       | 353.5       |
| State <sup>c</sup> second-highest 24-hour concentration ( $\mu\text{g}/\text{m}^3$ )    | 188.0       | 116.2       | 125.6       |
| State annual average concentration ( $\mu\text{g}/\text{m}^3$ ) <sup>e</sup>            | 56.5        | 48.5        | 56.0        |
| National annual average concentration ( $\mu\text{g}/\text{m}^3$ )                      | 55.4        | 54.8        | 59.7        |
| Number of days standard exceeded <sup>a</sup>                                           |             |             |             |
| NAAQS 24-hour ( $>150 \mu\text{g}/\text{m}^3$ ) <sup>f</sup>                            | 4           | 1           | 5           |
| CAAQS 24-hour ( $>50 \mu\text{g}/\text{m}^3$ ) <sup>f</sup>                             | 167         | 145         | 182         |
| <b>Particulate Matter (PM<sub>2.5</sub>)</b>                                            |             |             |             |
| National <sup>b</sup> maximum 24-hour concentration ( $\mu\text{g}/\text{m}^3$ )        | –           | –           | –           |
| National <sup>b</sup> second-highest 24-hour concentration ( $\mu\text{g}/\text{m}^3$ ) | –           | –           | –           |
| State <sup>c</sup> maximum 24-hour concentration ( $\mu\text{g}/\text{m}^3$ )           | –           | –           | –           |
| State <sup>c</sup> second-highest 24-hour concentration ( $\mu\text{g}/\text{m}^3$ )    | –           | –           | –           |
| National annual designation value ( $\mu\text{g}/\text{m}^3$ )                          | –           | –           | –           |
| National annual average concentration ( $\mu\text{g}/\text{m}^3$ )                      | –           | –           | –           |
| State annual designation value ( $\mu\text{g}/\text{m}^3$ )                             | –           | –           | –           |
| State annual average concentration ( $\mu\text{g}/\text{m}^3$ ) <sup>e</sup>            | –           | –           | –           |
| Number of days standard exceeded <sup>a</sup>                                           |             |             |             |
| NAAQS 24-hour ( $>35 \mu\text{g}/\text{m}^3$ )                                          | –           | –           | –           |

Notes: CAAQS = California ambient air quality standards.

NAAQS = national ambient air quality standards.

– = insufficient data available to determine the value.

<sup>a</sup> An exceedance is not necessarily a violation.

<sup>b</sup> National statistics are based on standard conditions data. In addition, national statistics are based on samplers using federal reference or equivalent methods.

<sup>c</sup> State statistics are based on local conditions data, except in the South Coast Air Basin, for which statistics are based on standard conditions data. In addition, State statistics are based on California-approved samplers.

<sup>d</sup> Measurements usually are collected every 6 days.

<sup>e</sup> State criteria for ensuring that data are sufficiently complete for calculating valid annual averages are more stringent than the national criteria.

<sup>f</sup> Mathematical estimate of how many days concentrations would have been measured as higher than the level of the standard, had each day been monitored. Values have been rounded.

Sources: ARB 2009a, EPA 2009a.

As indicated in Table 5.5-3, the MCAB has experienced 204 violations of the national 8-hour ozone standard during the 3-year monitoring period. There were no reported violations of the national 1-hour or 8-hour CO standards. The MCAB has experienced 103 violations of the state 1-hour ozone standard, 275 violations of the state 8-hour ozone standard, and 6 violations of the state PM<sub>10</sub> standard during the 3-year monitoring period. There have been no violations of the state 8-hour CO standard.

As indicated in Table 5.5-4, the SVAB has experienced 158 violations of the national 8-hour ozone standard during the 3-year monitoring period. There were no reported violations of the national 1-hour or 8-hour CO standards. The SVAB has experienced 101 violations of the state 1-hour ozone standard, 228 violations of the state 8-hour ozone standard, and 158 violations of the state PM10 standard during the 3-year monitoring period. There have been no violations of the state 8-hour CO standard.

As indicated in Table 5.5-5, the SJVAB has experienced 357 violations of the national 8-hour ozone standard and 10 violations of the federal PM10 standard over the 3-year monitoring period. There have been no violations of the national 1-hour or 8-hour CO standards.

### Attainment Status

If monitored pollutant concentrations meet state or federal standards over a designated period of time, the area is classified as being in attainment for that pollutant. If concentrations violate the standards, the area is considered a nonattainment area for that pollutant. If data are insufficient to determine whether a pollutant is violating the standard, the area is designated as unclassified. If monitored pollutant concentrations violated the standards in the past but are no longer in violation, the area is considered a maintenance area.

As stated above, the program area includes all or part of 36 counties. Table 5.5-6 summarizes the national and state criteria pollutant attainment status for these counties.

**Table 5.5-6. Criteria Pollutant Attainment Status in the Program Area**

| County  | Pollutant                 | National                          | State                  |
|---------|---------------------------|-----------------------------------|------------------------|
| Alameda | 1-hour Ozone <sup>a</sup> | N/A                               | Serious Nonattainment  |
|         | 8-hour Ozone              | Marginal Nonattainment            | Nonattainment          |
|         | CO                        | Moderate Maintenance (P)          | Attainment             |
|         | PM10                      | Unclassified/Attainment           | Nonattainment          |
|         | PM2.5                     | Nonattainment                     | Nonattainment          |
|         | NO <sub>2</sub>           | Unclassified/Attainment           | Attainment             |
| Alpine  | 1-hour Ozone <sup>a</sup> | N/A                               | Unclassified           |
|         | 8-hour Ozone              | Unclassified/Attainment           | Unclassified           |
|         | CO                        | Unclassified/Attainment           | Unclassified           |
|         | PM10                      | Unclassified/Attainment           | Nonattainment          |
|         | PM2.5                     | Unclassified/Attainment           | Unclassified           |
|         | NO <sub>2</sub>           | Unclassified/Attainment           | Attainment             |
| Amador  | 1-hour Ozone <sup>a</sup> | N/A                               | Nonattainment          |
|         | 8-hour Ozone              | Former Subpart 1 <sup>b</sup>     | Nonattainment          |
|         | CO                        | Unclassified/Attainment           | Unclassified           |
|         | PM10                      | Unclassified/Attainment           | Unclassified           |
|         | PM2.5                     | Unclassified/Attainment           | Unclassified           |
|         | NO <sub>2</sub>           | Unclassified/Attainment           | Attainment             |
| Butte   | 1-hour Ozone <sup>a</sup> | N/A                               | Moderate Nonattainment |
|         | 8-hour Ozone              | Former Subpart 1 (P) <sup>c</sup> | Nonattainment          |
|         | CO                        | Moderate Maintenance (P)          | Attainment             |
|         | PM10                      | Unclassified/Attainment           | Nonattainment          |

| County       | Pollutant                 | National                                    | State                                              |
|--------------|---------------------------|---------------------------------------------|----------------------------------------------------|
|              | PM2.5                     | Nonattainment (P)                           | Nonattainment                                      |
|              | NO <sub>2</sub>           | Unclassified/Attainment                     | Attainment                                         |
| Calaveras    | 1-hour Ozone <sup>a</sup> | N/A                                         | Nonattainment                                      |
|              | 8-hour Ozone              | Former Subpart 1                            | Nonattainment                                      |
|              | CO                        | Unclassified/Attainment                     | Unclassified                                       |
|              | PM10                      | Unclassified/Attainment                     | Nonattainment                                      |
|              | PM2.5                     | Unclassified/Attainment                     | Unclassified                                       |
|              | NO <sub>2</sub>           | Unclassified/Attainment                     | Attainment                                         |
| Colusa       | 1-hour Ozone <sup>a</sup> | N/A                                         | Moderate Nonattainment                             |
|              | 8-hour Ozone              | Unclassified/Attainment                     | Nonattainment-Transitional                         |
|              | CO                        | Unclassified/Attainment                     | Unclassified                                       |
|              | PM10                      | Unclassified/Attainment                     | Nonattainment                                      |
|              | PM2.5                     | Unclassified/Attainment                     | Nonattainment                                      |
|              | NO <sub>2</sub>           | Unclassified/Attainment                     | Attainment                                         |
| Contra Costa | 1-hour Ozone <sup>a</sup> | N/A                                         | Serious Nonattainment                              |
|              | 8-hour Ozone              | Marginal Nonattainment                      | Nonattainment                                      |
|              | CO                        | Moderate Maintenance (P)                    | Attainment                                         |
|              | PM10                      | Unclassified/Attainment                     | Nonattainment                                      |
|              | PM2.5                     | Nonattainment                               | Nonattainment                                      |
|              | NO <sub>2</sub>           | Unclassified/Attainment                     | Attainment                                         |
| El Dorado    | 1-hour Ozone <sup>a</sup> | N/A                                         | Nonattainment/Serious Nonattainment/Attainment (P) |
|              | 8-hour Ozone              | Serious Nonattainment (P)                   | Nonattainment/ Unclassified (P)                    |
|              | CO                        | Moderate Maintenance (P)                    | Unclassified                                       |
|              | PM10                      | Unclassified/Attainment                     | Nonattainment                                      |
|              | PM2.5                     | Nonattainment (P)                           | Unclassified/Attainment (P)                        |
|              | NO <sub>2</sub>           | Unclassified/Attainment                     | Attainment                                         |
| Fresno       | 1-hour Ozone <sup>a</sup> | N/A                                         | Severe Nonattainment                               |
|              | 8-hour Ozone              | Serious Nonattainment                       | Nonattainment                                      |
|              | CO                        | Moderate Maintenance (P)                    | Attainment                                         |
|              | PM10                      | Serious Maintenance (P)                     | Nonattainment                                      |
|              | PM2.5                     | Nonattainment                               | Nonattainment                                      |
|              | NO <sub>2</sub>           | Unclassified/Attainment                     | Attainment                                         |
| Glenn        | 1-hour Ozone <sup>a</sup> | N/A                                         | Moderate Nonattainment                             |
|              | 8-hour Ozone              | Unclassified/Attainment                     | Nonattainment-Transitional                         |
|              | CO                        | Unclassified/Attainment                     | Unclassified                                       |
|              | PM10                      | Unclassified/Attainment                     | Nonattainment                                      |
|              | PM2.5                     | Unclassified/Attainment                     | Unclassified                                       |
|              | NO <sub>2</sub>           | Unclassified/Attainment                     | Attainment                                         |
| Kern         | 1-hour Ozone <sup>a</sup> | N/A                                         | Severe Nonattainment/Moderate Nonattainment (P)    |
|              | 8-hour Ozone              | Former Subpart 1/ Serious Nonattainment (P) | Nonattainment                                      |
|              | CO                        | Unclassified/ Maintenance (P)               | Attainment/Unclassified (P)                        |

| County   | Pollutant                 | National                                          | State                          |
|----------|---------------------------|---------------------------------------------------|--------------------------------|
|          | PM10                      | Serious Nonattainment/<br>Serious Maintenance (P) | Nonattainment                  |
|          | PM2.5                     | Nonattainment (P)                                 | Nonattainment/Unclassified (P) |
|          | NO <sub>2</sub>           | Unclassified/Attainment                           | Attainment                     |
| Kings    | 1-hour Ozone <sup>a</sup> | N/A                                               | Severe Nonattainment           |
|          | 8-hour Ozone              | Serious Nonattainment                             | Nonattainment                  |
|          | CO                        | Unclassified/Attainment                           | Unclassified                   |
|          | PM10                      | Serious Maintenance (P)                           | Nonattainment                  |
|          | PM2.5                     | Nonattainment                                     | Nonattainment                  |
|          | NO <sub>2</sub>           | Unclassified/Attainment                           | Attainment                     |
|          |                           |                                                   |                                |
| Lake     | 1-hour Ozone <sup>a</sup> | N/A                                               | Attainment                     |
|          | 8-hour Ozone              | Unclassified/Attainment                           | Attainment                     |
|          | CO                        | Unclassified/Attainment                           | Attainment                     |
|          | PM10                      | Unclassified/Attainment                           | Attainment                     |
|          | PM2.5                     | Unclassified/Attainment                           | Attainment                     |
|          | NO <sub>2</sub>           | Unclassified/Attainment                           | Attainment                     |
|          |                           |                                                   |                                |
| Lassen   | 1-hour Ozone <sup>a</sup> | N/A                                               | Attainment                     |
|          | 8-hour Ozone              | Unclassified/Attainment                           | Unclassified                   |
|          | CO                        | Unclassified/Attainment                           | Unclassified                   |
|          | PM10                      | Unclassified/Attainment                           | Nonattainment                  |
|          | PM2.5                     | Unclassified/Attainment                           | Unclassified                   |
|          | NO <sub>2</sub>           | Unclassified/Attainment                           | Attainment                     |
|          |                           |                                                   |                                |
| Madera   | 1-hour Ozone <sup>a</sup> | N/A                                               | Severe Nonattainment           |
|          | 8-hour Ozone              | Serious Nonattainment                             | Nonattainment                  |
|          | CO                        | Unclassified/Attainment                           | Unclassified                   |
|          | PM10                      | Serious Maintenance (P)                           | Nonattainment                  |
|          | PM2.5                     | Nonattainment                                     | Nonattainment                  |
|          | NO <sub>2</sub>           | Unclassified/Attainment                           | Attainment                     |
|          |                           |                                                   |                                |
| Mariposa | 1-hour Ozone <sup>a</sup> | N/A                                               | Nonattainment                  |
|          | 8-hour Ozone              | Former Subpart 1                                  | Nonattainment                  |
|          | CO                        | Unclassified/Attainment                           | Unclassified                   |
|          | PM10                      | Unclassified/Attainment                           | Unclassified                   |
|          | PM2.5                     | Unclassified/Attainment                           | Unclassified                   |
|          | NO <sub>2</sub>           | Unclassified/Attainment                           | Attainment                     |
|          |                           |                                                   |                                |
| Merced   | 1-hour Ozone <sup>a</sup> | N/A                                               | Severe Nonattainment           |
|          | 8-hour Ozone              | Serious Nonattainment                             | Nonattainment                  |
|          | CO                        | Unclassified/Attainment                           | Unclassified                   |
|          | PM10                      | Unclassified/Attainment                           | Nonattainment                  |
|          | PM2.5                     | Nonattainment                                     | Nonattainment                  |
|          | NO <sub>2</sub>           | Unclassified/Attainment                           | Attainment                     |
|          |                           |                                                   |                                |
| Modoc    | 1-hour Ozone <sup>a</sup> | N/A                                               | Attainment                     |
|          | 8-hour Ozone              | Unclassified/Attainment                           | Unclassified                   |
|          | CO                        | Unclassified/Attainment                           | Unclassified                   |
|          | PM10                      | Unclassified/Attainment                           | Nonattainment                  |
|          | PM2.5                     | Unclassified/Attainment                           | Unclassified                   |
|          |                           |                                                   |                                |

| County      | Pollutant                 | National                               | State                                      |
|-------------|---------------------------|----------------------------------------|--------------------------------------------|
| Napa        | NO <sub>2</sub>           | Unclassified/Attainment                | Attainment                                 |
|             | 1-hour Ozone <sup>a</sup> | N/A                                    | Serious Nonattainment                      |
|             | 8-hour Ozone              | Marginal Nonattainment                 | Nonattainment                              |
|             | CO                        | Moderate Maintenance (P)               | Attainment                                 |
|             | PM10                      | Unclassified/Attainment                | Nonattainment                              |
|             | PM2.5                     | Nonattainment                          | Nonattainment                              |
| Nevada      | NO <sub>2</sub>           | Unclassified/Attainment                | Attainment                                 |
|             | 1-hour Ozone <sup>a</sup> | N/A                                    | Nonattainment                              |
|             | 8-hour Ozone              | Former Subpart 1(P)                    | Nonattainment                              |
|             | CO                        | Unclassified/Attainment                | Unclassified                               |
|             | PM10                      | Unclassified/Attainment                | Nonattainment                              |
|             | PM2.5                     | Unclassified/Attainment                | Unclassified                               |
| Placer      | NO <sub>2</sub>           | Unclassified/Attainment                | Attainment                                 |
|             | 1-hour Ozone <sup>a</sup> | N/A                                    | Nonattainment/ Attainment (P)              |
|             | 8-hour Ozone              | Serious Nonattainment (P)              | Nonattainment/ Unclassified (P)            |
|             | CO                        | Unclassified/ Moderate Maintenance (P) | Unclassified/Attainment (P)                |
|             | PM10                      | Unclassified/Attainment                | Nonattainment                              |
|             | PM2.5                     | Nonattainment (P)                      | Unclassified/Attainment/ Nonattainment (P) |
| Plumas      | NO <sub>2</sub>           | Unclassified/Attainment                | Attainment                                 |
|             | 1-hour Ozone <sup>a</sup> | N/A                                    | Unclassified                               |
|             | 8-hour Ozone              | Unclassified/Attainment                | Unclassified                               |
|             | CO                        | Unclassified/Attainment                | Attainment                                 |
|             | PM10                      | Unclassified/Attainment                | Nonattainment                              |
|             | PM2.5                     | Unclassified/Attainment                | Unclassified                               |
| Sacramento  | NO <sub>2</sub>           | Unclassified/Attainment                | Attainment                                 |
|             | 1-hour Ozone <sup>a</sup> | N/A                                    | Serious Nonattainment                      |
|             | 8-hour Ozone              | Serious Nonattainment                  | Nonattainment                              |
|             | CO                        | Moderate Maintenance (P)               | Attainment                                 |
|             | PM10                      | Moderate Nonattainment                 | Nonattainment                              |
|             | PM2.5                     | Nonattainment                          | Nonattainment                              |
| San Benito  | NO <sub>2</sub>           | Unclassified/Attainment                | Attainment                                 |
|             | 1-hour Ozone <sup>a</sup> | N/A                                    | Moderate Nonattainment                     |
|             | 8-hour Ozone              | Unclassified/Attainment                | Nonattainment                              |
|             | CO                        | Unclassified/Attainment                | Unclassified                               |
|             | PM10                      | Unclassified/Attainment                | Nonattainment                              |
|             | PM2.5                     | Unclassified/Attainment                | Attainment                                 |
| San Joaquin | NO <sub>2</sub>           | Unclassified/Attainment                | Attainment                                 |
|             | 1-hour Ozone <sup>a</sup> | Extreme Nonattainment                  | Severe Nonattainment                       |
|             | 8-hour Ozone              | Serious Nonattainment                  | Nonattainment                              |
|             | CO                        | Moderate Maintenance (P)               | Attainment                                 |
|             | PM10                      | Serious Maintenance (P)                | Nonattainment                              |
|             | PM2.5                     | Nonattainment                          | Nonattainment                              |
| Shasta      | NO <sub>2</sub>           | Unclassified/Attainment                | Attainment                                 |
|             | 1-hour Ozone <sup>a</sup> | N/A                                    | Moderate Nonattainment                     |



| County     | Pollutant                 | National                                       | State                              |
|------------|---------------------------|------------------------------------------------|------------------------------------|
|            | 8-hour Ozone              | Unclassified/Attainment                        | Nonattainment                      |
|            | CO                        | Unclassified/Attainment                        | Unclassified                       |
|            | PM10                      | Unclassified/Attainment                        | Nonattainment                      |
|            | PM2.5                     | Unclassified/Attainment                        | Unclassified                       |
|            | NO <sub>2</sub>           | Unclassified/Attainment                        | Attainment                         |
| Sierra     | 1-hour Ozone <sup>a</sup> | N/A                                            | Unclassified                       |
|            | 8-hour Ozone              | Unclassified/Attainment                        | Unclassified                       |
|            | CO                        | Unclassified/Attainment                        | Unclassified                       |
|            | PM10                      | Unclassified/Attainment                        | Nonattainment                      |
|            | PM2.5                     | Unclassified/Attainment                        | Unclassified                       |
|            | NO <sub>2</sub>           | Unclassified/Attainment                        | Attainment                         |
| Siskiyou   | 1-hour Ozone <sup>a</sup> | N/A                                            | Attainment                         |
|            | 8-hour Ozone              | Unclassified/Attainment                        | Nonattainment                      |
|            | CO                        | Unclassified/Attainment                        | Unclassified                       |
|            | PM10                      | Unclassified/Attainment                        | Attainment                         |
|            | PM2.5                     | Unclassified/Attainment                        | Unclassified                       |
|            | NO <sub>2</sub>           | Unclassified/Attainment                        | Attainment                         |
| Solano     | 1-hour Ozone <sup>a</sup> | N/A                                            | Serious Nonattainment              |
|            | 8-hour Ozone              | Maringal Nonattainment (P)                     | Nonattainment                      |
|            | CO                        | Moderate Maintenance (P)                       | Attainment                         |
|            | PM10                      | Unclassified/Attainment                        | Nonattainment                      |
|            | PM2.5                     | Nonattainment (P)                              | Nonattainment                      |
|            | NO <sub>2</sub>           | Unclassified/Attainment                        | Attainment                         |
| Stanislaus | 1-hour Ozone <sup>a</sup> | N/A                                            | Severe Nonattainment               |
|            | 8-hour Ozone              | Serious Nonattainment                          | Nonattainment                      |
|            | CO                        | Moderate Maintenance (P)                       | Attainment                         |
|            | PM10                      | Serious Maintenance (P)                        | Nonattainment                      |
|            | PM2.5                     | Nonattainment                                  | Nonattainment                      |
|            | NO <sub>2</sub>           | Unclassified/Attainment                        | Attainment                         |
| Sutter     | 1-hour Ozone <sup>a</sup> | N/A                                            | Serious/Moderate Nonattainment (P) |
|            | 8-hour Ozone              | Serious Nonattainment/<br>Former Subpart 1 (P) | Nonattainment                      |
|            | CO                        | Unclassified/Attainment                        | Attainment                         |
|            | PM10                      | Unclassified/Attainment                        | Nonattainment                      |
|            | PM2.5                     | Nonattainment                                  | Unclassified                       |
|            | NO <sub>2</sub>           | Unclassified/Attainment                        | Attainment                         |
| Tehama     | 1-hour Ozone <sup>a</sup> | N/A                                            | Moderate Nonattainment             |
|            | 8-hour Ozone              | Unclassified/Attainment                        | Nonattainment                      |
|            | CO                        | Unclassified/Attainment                        | Unclassified                       |
|            | PM10                      | Unclassified/Attainment                        | Nonattainment                      |
|            | PM2.5                     | Unclassified/Attainment                        | Unclassified                       |
|            | NO <sub>2</sub>           | Unclassified/Attainment                        | Attainment                         |
| Tulare     | 1-hour Ozone <sup>a</sup> | N/A                                            | Severe Nonattainment               |
|            | 8-hour Ozone              | Serious Nonattainment                          | Nonattainment                      |
|            | CO                        | Unclassified/Attainment                        | Attainment                         |

| County   | Pollutant                 | National                 | State                  |
|----------|---------------------------|--------------------------|------------------------|
| Tuolumne | PM10                      | Serious Maintenance (P)  | Nonattainment          |
|          | PM2.5                     | Nonattainment            | Nonattainment          |
|          | NO <sub>2</sub>           | Unclassified/Attainment  | Attainment             |
|          | 1-hour Ozone <sup>a</sup> | N/A                      | Nonattainment          |
|          | 8-hour Ozone              | Former Subpart 1         | Nonattainment          |
|          | CO                        | Unclassified/Attainment  | Attainment             |
|          | PM10                      | Unclassified/Attainment  | Unclassified           |
| Yolo     | PM2.5                     | Unclassified/Attainment  | Unclassified           |
|          | NO <sub>2</sub>           | Unclassified/Attainment  | Attainment             |
|          | 1-hour Ozone <sup>a</sup> | N/A                      | Serious Nonattainment  |
|          | 8-hour Ozone              | Serious Nonattainment    | Nonattainment          |
|          | CO                        | Moderate Maintenance (P) | Attainment             |
|          | PM10                      | Unclassified/Attainment  | Nonattainment          |
|          | PM2.5                     | Nonattainment (P)        | Unclassified           |
| Yuba     | NO <sub>2</sub>           | Unclassified/Attainment  | Attainment             |
|          | 1-hour Ozone <sup>a</sup> | N/A                      | Moderate Nonattainment |
|          | 8-hour Ozone              | Unclassified/Attainment  | Nonattainment          |
|          | CO                        | Unclassified/Attainment  | Unclassified           |
|          | PM10                      | Unclassified/Attainment  | Nonattainment          |
|          | PM2.5                     | Nonattainment (P)        | Unclassified           |
|          | NO <sub>2</sub>           | Unclassified/Attainment  | Attainment             |

## Notes:

CO – carbon monoxide.

N/A = not available/applicable.

NO<sub>2</sub> = nitrogen dioxide.

PM2.5 = particulate matter 2.5 microns in diameter or less.

PM10 = particulate matter 10 microns in diameter or less.

(P) = Designation applies to a portion of the county.

<sup>a</sup> The U.S. Environmental Protection Agency (EPA) revoked the 1-hour ozone standard on June 15, 2005.<sup>b</sup> On June 8, 2007, the United States Court of Appeals vacated the Subpart 1 portion of the Phase 1 Rule. The Subpart 1 areas in the Greenbook are listed as “Former Subpart 1” until reclassification of the areas is finalized. Proposed reclassifications were published on January 16, 2009 (74 FR 2936).<sup>c</sup> EPA will redesignate the entire county as a nonattainment area on or before March 12, 2010.

Sources: ARB 2009b, EPA 2009b, Williams pers. comm.

## Sensitive Land Uses

*Air quality-sensitive land uses* are generally defined as locations where sensitive receptors reside. Sensitive receptors are more susceptible to health problems associated with air pollutants. Some examples of sensitive receptors are schools, elderly housing, hospitals, and clinics. Land uses in the program area where sensitive receptors may be exposed to increased levels of pollutants during program construction include residences, schools, and parks that may be located near (within 1 mile) farms or other areas where construction activities associated with the program will occur. As farms are typically located in rural areas, the number of sensitive receptors affected by the program alternatives is expected to be minimal.

## 5.5.4 Impacts

Air quality impacts from the program alternatives would result from construction activities and program operation. This section describes the potential impacts related to these sources resulting from the five program alternatives. Mitigation measures to reduce significant impacts are also identified. Table 5.5-7 provides a summary of the potential impacts for each alternative relative to the baseline condition. For the purposes of this analysis, the baseline conditions were assumed to be the current regulatory program as instituted at the time of the writing of the ECR (refer to Chapter 3).

**Table 5.5-7. Summary of Potential Impacts Relative to Baseline Conditions**

| Alternative   | Construction Emission | Operational Emissions | Toxic Air Contaminants                         |
|---------------|-----------------------|-----------------------|------------------------------------------------|
| Alternative 1 | +                     | +                     | + (diesel PM)<br>- (pesticides)                |
| Alternative 2 | ++                    | +/-                   | + (diesel PM)<br>- (fertilizers/pesticides)    |
| Alternative 3 | ++                    | +/-                   | + (diesel PM)<br>- (fertilizers/pesticides)    |
| Alternative 4 | ++                    | +/-                   | + (diesel PM)<br>- - (fertilizers/pesticides)  |
| Alternative 5 | +++                   | +/-                   | ++ (diesel PM)<br>- - (fertilizers/pesticides) |

Notes: PM = particulate matter.  
 + Increasing emissions relative to the baseline.  
 - Decreasing emissions relative to the baseline.  
 +/- Information inconclusive. Potential increase or decrease in emissions relative to baseline.

## Assessment Methods

### Construction Emissions

Construction emissions, including ozone precursors (ROG and NO<sub>x</sub>), CO, PM<sub>10</sub>, and PM<sub>2.5</sub>, are primarily the result of earth-moving activities and heavy-duty diesel-powered equipment. Management practices used to prevent impacts on water quality that require physical changes or heavy-duty equipment would generate construction emissions. Table 5.5-8 summarizes the management practices expected under each alternative and describes their potential construction emissions. In addition to these management practices, installation of monitoring wells would require not only construction of the well itself but also any accessory facilities (e.g., pump houses and access roads).

**Table 5.5-8. Summary of Management Practices and Potential Construction Emissions**

| <b>Management Practice</b>             | <b>Applicable Alternatives</b>                                                                                    | <b>Potential Construction Emissions</b>                                                                                                                                                                                       |
|----------------------------------------|-------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Nutrient management                    | Alternatives 1 through 4 where nutrient or dissolved oxygen problems are identified<br>Alternative 5, all growers | N/A—no construction required under this management practice. <sup>a</sup>                                                                                                                                                     |
| Improved water management              | Alternatives 1 through 5 where COCs are identified                                                                | N/A—no construction required under this management practice. <sup>b</sup>                                                                                                                                                     |
| Tailwater recovery system              | Alternatives 1 through 5 where COCs are identified                                                                | Generation of exhaust emissions from construction equipment (e.g., backhoe, small bulldozer) required to dig and excavate the catchment pond and install pumps. Minor generation of fugitive dust from excavation activities. |
| Pressurized irrigation                 | Alternatives 1 through 5 where COCs are identified                                                                | If construction equipment is required to set up the irrigation system, minor amounts of exhaust emissions would be generated.                                                                                                 |
| Sediment trap, hedgerow, or buffer     | Alternatives 1 through 5 where COCs are identified                                                                | Generation of exhaust emissions from construction equipment required to create the trap or physical barrier.                                                                                                                  |
| Cover cropping or conservation tillage | Alternatives 1 through 5 where COCs are identified                                                                | N/A—no construction required under this management practice. <sup>c</sup>                                                                                                                                                     |
| Wellhead protection                    | Alternatives 2 through 5                                                                                          | Generation of exhaust emissions from construction equipment required to create the berm. Minor generation of fugitive dust from excavation activities.                                                                        |

**Notes:**

COCs = constituents of concern.

N/A = not applicable.

<sup>a</sup> This practice may result in reduced fertilizer and pesticide application, thereby reducing toxic air contaminants.<sup>b</sup> This practice may reduce the amount of water currently being pumped, thereby reducing emissions associated with diesel exhaust.<sup>c</sup> It is likely that this practice will reduce fugitive dust (PM<sub>10</sub> and PM<sub>2.5</sub>) emissions by reducing the amount of soil exposed to the elements.

Pollutant emissions are highly dependent on the total amount of disturbed area, the duration of construction, and the intensity of construction activity. In addition, the number and types of heavy-duty equipment significantly affect the generation of diesel particulate matter (DPM). Construction impacts can thus vary depending on the management practices implemented under the program alternative. In general, however, construction required by the various management practices would be minor. Consequently, construction emissions resulting from program implementation most likely would be miniscule on a per-farm basis.

The selection of management practices is a function of crop type, physical setting, and economics. The origin of regulatory authority (e.g., coalition groups versus individual growers) may affect funding sources, outreach, and enforcement; but selection of management practices is ultimately dependent on economics, agronomic needs, and the environment (ICF Jones & Stokes 2008). It is

therefore difficult to determine how changes in the lead entity as a result of the program alternatives would affect, if at all, management practices used to prevent water quality impacts. Consequently, a quantified analysis of potential construction emissions is not possible, and a qualitative assessment of air quality effects resulting from the proposed program alternatives was performed. The qualitative analysis took into account the following:

- Stipulations for installation of monitoring wells,
- Interrelationship between monitoring and implementation of management practices,
- Generation of fugitive dust from management practices requiring earthwork, and
- Generation of emissions from the use of heavy-duty diesel-powered equipment.

### **Operational Emissions**

Long-term air quality impacts are associated with changes in the permanent, continued daily use of the program area. Operational emissions from the program alternatives would primarily result from vehicle trips for site inspections and monitoring. Implementation of tailwater recovery systems would require the use of pumps, likely diesel powered, that also would be considered a source of operational emissions. Likewise, if individual groundwater wells require diesel-powered pumps; these facilities would contribute to operational impacts. These sources are expected to be transitory and short term (e.g., semi-annual well sampling, back-up pump motors, and annual inspections), but the extent of these activities is unknown at this time.

Possible operational emissions resulting from the proposed program alternatives would include ozone precursors (ROG and NO<sub>x</sub>), PM<sub>10</sub>, PM<sub>2.5</sub>, and pesticides/fertilizers. Emissions are dependent on the frequency of activity and the type of emission source. In addition, implementation of nutrient management plans and conservation tillage may result in air quality benefits by reducing the use of nutrients and fertilizers.

The level of potential operational activities and the number of sources that may result from implementation of program alternatives are currently unknown. Therefore, a quantified analysis of potential emissions is not possible, and a qualitative analysis of operational emissions was performed. The qualitative analysis took into account provisions for groundwater monitoring plans and wells, as well as the frequency and responsible party for site inspections.

### **Toxic Air Contaminants/Hazardous Air Pollutants**

TACs and HAPs associated with the proposed program include pesticides, NOA, and DPM from operation of diesel-fueled construction equipment. Given the uncertainty in potential emission sources and the level of activity associated with the proposed program alternatives, a qualitative analysis of TAC/HAP emissions was performed. The qualitative analysis took into account the factors considered during the evaluation of construction and operational emissions (listed above).

## **Significance Determinations**

For this analysis, an impact pertaining to air quality was considered significant under CEQA if it would result in any of the following environmental effects, which are based on professional practice and State CEQA Guidelines Appendix G (14 CCR 15000 et seq.):

- Conflict with or obstruct implementation of the applicable air quality plan,



- Violate any air quality standard or contribute substantially to an existing or projected air quality violation,
- Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is designated as nonattainment under an applicable federal or state ambient air quality standard (including releasing emissions that exceed quantitative thresholds for ozone precursors),
- Expose sensitive receptors to substantial pollutant concentrations, or
- Create objectionable odors affecting a substantial number of people.

In addition, the State CEQA Guidelines state that the significance criteria established by the applicable air quality management or air pollution control district may be relied on to make the determinations above. Significance criteria for each of the various air districts are summarized in Table 5.5-2. Impacts related to air quality were determined using the local thresholds identified in Table 5.5-2 based on the respective air district in which the program activity is located.

## Alternative 1 – Full Implementation of Current Program (No Project Alternative)

### Impact AQ-1. Generation of Construction Emissions in Excess of Local Air District Thresholds

Alternative 1 involves full implementation of the existing regulatory program. Coalition groups would function as the lead entities, and growers would implement management practices when surface water monitoring data show two or more exceedances of water quality objectives.

Construction impacts would result from implementation of management practices that require physical changes or the use of heavy-duty equipment (See Table 5.5-8). As stated above, it is difficult to determine how management practices selected under this alternative would change relative to existing conditions. It is therefore not possible to determine construction-related effects based on a quantitative analysis. However, it is logical to assume that, as monitoring continues under Alternative 1, it would result in selection and implementation of more management plans and resulting management practices. Consequently, implementation of Alternative 1 may result in increased criteria pollutant emissions from construction activities relative to baseline conditions.

Construction emissions associated with Alternative 1 would result in a significant impact if the incremental difference, or increase, relative to existing conditions exceeds the applicable air district thresholds shown in Table 5.5-2. Management practices with the greatest potential for emissions include those that break ground or move earth matter, thus producing fugitive dust, and those that require the use of heavy equipment (e.g., backhoes or bulldozers), thus producing criteria pollutants from exhaust. The management practices fitting this description are sediment trap, hedgerow, or buffer; pressurized irrigation; and tailwater recovery systems.

While it is anticipated that any emissions resulting from construction activities would be minuscule on a per-farm basis, in the absence of a quantitative analysis, data are insufficient to determine whether emissions would exceed threshold levels. Consequently, this is considered a potentially significant impact. Implementation of **Mitigation Measure AQ-MM-1** by growers would reduce this impact to a less-than-significant level.

**Impact AQ-2. Generation of Operational Emissions in Excess of Local Air District Thresholds**

Alternative 1 does not involve any groundwater monitoring or grower site inspections. Operational emissions therefore would result from vehicle trips made by the coalition groups to perform surface water quality monitoring and from diesel-powered wells installed in tailwater recovery systems.

Surface water quality monitoring is already occurring under existing conditions. Alternative 1 therefore is not expected to result in an appreciable difference in operational emissions related to vehicle trips for monitoring. However, installation of diesel-powered pumps as part of tailwater recovery systems would represent an additional source of emissions. With limited information on the number and hours of operation associated with these pumps, a quantitative analysis of emissions is not possible.

Any new emissions generated under Alternative 1 are not expected to be substantial or to exceed applicable air district thresholds. In addition, they may be moderated by emissions benefits related to management practices that reduce irrigation and cover crops (see Table 5.5-8). However, the difference in emissions relative to existing conditions is not known at this time and therefore cannot be compared to the significance criteria. This is considered a potentially significant impact. Implementation of **Mitigation Measure AQ-MM-2** would reduce this impact to a less-than-significant level.

**Impact AQ-3. Elevated Health Risks from Exposure of Nearby Sensitive Receptors to TACs/HAPs**

TACs and HAPs resulting from Alternative 1 include DPM from diesel construction equipment and new pumps, pesticides/fertilizers, and asbestos. Sensitive receptors near member growers could be affected by these sources.

As discussed in Chapter 3, one of the goals of the nutrient management and conservation tillage management practices is to reduce the application of pesticides/fertilizers. Because Alternative 1 would result in greater likelihood of these management practices being implemented, it is reasonable to assume that pesticides/fertilizers—and thus the potential for exposure to these chemicals—would be reduced under Alternative 1.

It is expected that construction emissions may increase relative to existing conditions, thus resulting in minor increases of DPM. Elevated levels of construction in areas where NOA is common may also increase the likelihood of exposure to asbestos. New diesel-powered pumps also would increase DPM emissions relative to baseline conditions. This is considered a potentially significant impact. Implementation of **Mitigation Measures AQ-MM-1, AQ-MM-2, and AQ-MM-3** would reduce this impact to a less-than-significant level.

**Alternative 2 – Third-Party Lead Entity****Impact AQ-1. Generation of Construction Emissions in Excess of Local Air District Thresholds**

As discussed previously, it is difficult to determine how changes in the lead entity as a result of the program alternatives would affect, if at all, management practices used to prevent water quality impacts. Impacts related to generation of construction emissions under Alternative 2 are expected to be similar to those described for Alternative 1 (see **Impact AQ-1**). However, because wellhead protection, which requires the use of heavy-duty equipment, may be implemented by some farmers

as a management practice for fertilizer use (see Table 5.5-8), construction emissions may be slightly greater than those anticipated for Alternative 1. This is considered a potentially significant impact. Implementation of **Mitigation Measure AQ-MM-1** would reduce this impact to a less-than-significant level.

### **Impact AQ-2. Generation of Operational Emissions in Excess of Local Air District Thresholds**

Under Alternative 2, operational emissions would result from vehicle trips made by the third-party groups to perform surface water and groundwater monitoring, and from new diesel-powered pumps installed as part of tailwater recovery systems. Existing wells that are already in operation would be used to conduct the regional groundwater monitoring. Consequently, it is not anticipated that new stationary sources would be operated as part of the groundwater monitoring plans.

This alternative allows for a reduction in surface water quality monitoring under low-threat circumstances or when watershed or area management objectives plans have been adopted. Consequently, the number of trips, and thus operational emissions, associated with surface water quality monitoring may be reduced relative to existing regulations. However, new vehicle trips for regional groundwater monitoring and operation of new diesel-powered pumps for tailwater recovery systems may outweigh any emissions benefits achieved by this reduction. With limited information on the number and distances of vehicle trips associated with monitoring, and the number and hours of operation of the pumps, a quantitative analysis of emissions is not possible.

Any new emissions generated under Alternative 2 are not expected to be substantial or to exceed applicable air district thresholds. In addition, they may be moderated by emissions benefits related to management practices that reduce irrigation and cover crops (see Table 5.5-8). However, the difference in emissions relative to existing conditions is not known at this time and therefore cannot be compared to the significance criteria. This is considered a potentially significant impact. Implementation of **Mitigation Measure AQ-MM-2** would reduce this impact to a less-than-significant level.

### **Impact AQ-3. Elevated Health Risks from Exposure of Nearby Sensitive Receptors to TACs/HAPs**

Impacts related to elevated health risks from exposure to HAPs and TACs under Alternative 2 are expected to be similar to those described for Alternative 1. Please refer to **Impact AQ-1**. This is considered a potentially significant impact. Implementation of **Mitigation Measures AQ-MM-1, AQ-MM-2, and AQ-MM-3** would reduce this impact to a less-than-significant level.

## **Alternative 3 – Individual Farm Water Quality Management Plans**

### **Impact AQ-1. Generation of Construction Emissions in Excess of Local Air District Thresholds**

As discussed previously, it is difficult to determine how changes in the lead entity as a result of the program alternatives would affect, if at all, management practices used to prevent water quality impacts. Impacts related to generation of construction emissions under Alternative 3 are expected to be similar to those described for Alternative 2. Please refer to **Impact AQ-1**. This is considered a potentially significant impact. Implementation of **Mitigation Measure AQ-MM-1** would reduce this impact to a less-than-significant level.

**Impact AQ-2. Generation of Operational Emissions in Excess of Local Air District Thresholds**

Operational emissions would result from vehicle trips made by the Central Valley Water Board or another implementation agency to conduct annual site inspections on 5 percent of farms and from new diesel-powered pumps installed as part of tailwater recovery systems. This alternative does not require growers or the Central Valley Water Board to perform surface water or groundwater monitoring. Rather, individual growers would conduct visual inspections of their own farms. Consequently, minimal emissions would be associated with vehicle travel. Because surface water quality monitoring, which generates emissions from vehicle trips, is required under existing conditions, implementation of Alternative 3 would reduce emissions from this activity relative to existing regulations.

Operational emissions from vehicle travel for grower site inspections are expected to be minimal. The number and distances of trips that would be completed as part of Alternative 3 are not currently known. Likewise, the number of new well pumps to be installed as part of tailwater recovery systems is unavailable. Consequently, it is not possible to quantify emissions or determine whether new emissions from site inspections and well pumps would offset the reduction benefits achieved by eliminating vehicle trips for water quality monitoring.

Operational emissions would result in a significant effect if the incremental difference, or increase, relative to existing conditions exceeds any of the applicable air district thresholds shown in Table 5.5-2. Any increase in emissions generated by Alternative 3 is expected to be miniscule and may be moderated by emissions benefits related to management practices that reduce irrigation and cover crops (see Table 5.5-8). However, the magnitude of potential emissions is not known at this time. This impact is considered potentially significant. Implementation of **Mitigation Measure AQ-MM-2** would reduce this impact to a less-than-significant level.

**Impact AQ-3. Elevated Health Risks from Exposure of Nearby Sensitive Receptors to TACs/HAPs**

Impacts related to elevated health risks from exposure to HAPs and TACs under Alternative 3 are expected to be similar to those described for Alternative 2. Please refer to **Impact AQ-3**. This is considered a potentially significant impact. Implementation of **Mitigation Measures AQ-MM-1, AQ-MM-2, and AQ-MM-3** would reduce this impact to a less-than-significant level.

**Alternative 4 – Direct Oversight with Regional Monitoring****Impact AQ-1. Generation of Construction Emissions in Excess of Local Air District Thresholds**

As discussed previously, it is difficult to quantify how changes in the lead entity as a result of the program alternatives would affect, if at all, the management practices used to prevent water quality impacts. Impacts associated with generation of construction emissions under Alternative 4 are expected to be similar to those described for Alternatives 2 and 3. Please refer to **Impact AQ-1**. This impact is considered potentially significant. Implementation of **Mitigation Measure AQ-MM-1** would reduce this impact to a less-than-significant level.

**Impact AQ-2. Generation of Operational Emissions in Excess of Local Air District Thresholds**

Under Alternative 4, operational emissions would result from vehicle trips made by lead entities to perform water quality monitoring, vehicle trips made by the Central Valley Water Board to perform

grower site inspections, and new diesel-powered pumps installed as part of tailwater recovery systems. Alternative 4 allows for individual growers to perform their own monitoring, depending on the threat level of their operation to water quality. Vehicle trips associated with this type of monitoring include those required to transport samples to the laboratory for analysis.

Emissions benefits may be achieved through practices that reduce irrigation and cover crops (see Table 5.5-8). However, in the absence of a quantitative analysis, data are insufficient to determine how the net operational emissions under Alternative 4 would change relative to existing regulations. Although any increases in emissions are expected to be minuscule and to not exceed air district thresholds, the magnitude of emissions is presently unknown. This is considered a potentially significant impact. Implementation of **Mitigation Measure AQ-MM-2** would reduce this impact to a less-than-significant level.

### **Impact AQ-3. Elevated Health Risks from Exposure of Nearby Sensitive Receptors to TACs/HAPs**

TACs and HAPs resulting from Alternative 4 include DPM from diesel construction equipment and new pumps, pesticides/fertilizers, and asbestos. Sensitive receptors near member growers could be affected by these sources. Because the extent of construction and operational activities is not known at this time, a determination of effects based on a quantitative analysis is not possible. Construction emissions are expected to increase relative to existing conditions, thus resulting in minor increases of DPM. Likewise, new diesel-powered pumps would increase DPM emissions relative to baseline conditions. Elevated levels of construction in areas where NOA is common also may increase the likelihood of exposure to asbestos.

Alternative 4 may result in greater likelihood of conservation tillage and nutrient management being selected as management practices. While the benefits of nutrient management practices on the quantity of pesticide application are difficult to estimate, it is logical to assume that stipulations for such practices would reduce pesticide use. Consequently, implementation of Alternative 4 is expected to decrease the risk of exposure of nearby sensitive receptors to pesticides relative to existing conditions.

Because implementation of Alternative 4 is expected to increase the risk of exposure to DPM and asbestos, this impact is considered potentially significant. Implementation of **Mitigation Measures AQ-MM-1, AQ-MM-2, and AQ-MM-3** would reduce this impact to a less-than-significant level.

## **Alternative 5 – Direct Oversight with Farm Monitoring**

### **Impact AQ-1. Generation of Construction Emissions in Excess of Local Air District Thresholds**

Under Alternative 5, construction impacts would result from installation of individual farm groundwater monitoring wells and implementation of management practices that require physical changes or the use of heavy-duty equipment. Construction emissions resulting from implementation of management practices are expected to be similar to those described for Alternatives 2, 3, and 4 (please see **Impact AQ-1**). However, the construction of individual farm groundwater monitoring wells and accessory facilities (e.g., pump houses and access roads) would generate new construction emissions. Consequently, implementation of Alternative 5 would result in increased criteria pollutant emissions from construction activities.



Construction emissions associated with Alternative 5 would result in a significant effect if the incremental difference, or increase, relative to existing conditions exceeds any of the applicable air district thresholds shown in Table 5.5-2. Management practices with the potential for the greatest emissions include sediment trap, hedgerow, or buffer; pressurized irrigation; wellhead protection; and tailwater recovery systems. Construction of individual groundwater wells most likely would require small earth-moving equipment, such as drills or bobcats.

While it is anticipated that any emissions resulting from construction activities would be minuscule, in the absence of a quantitative analysis, data are insufficient to determine whether emissions would exceed threshold levels. Consequently, this is considered a potentially significant effect. Implementation of **Mitigation Measure AQ-MM-1** would reduce this impact to a less-than-significant level.

### **Impact AQ-2. Generation of Operational Emissions in Excess of Local Air District Thresholds**

Under Alternative 5, operational emissions would result from vehicle trips made by growers to transport well samples to the laboratory and the Central Valley Water Board to perform grower site inspections, as well as new stationary sources associated with the groundwater wells (e.g., pumps powered by motors). Because watershed monitoring is required under existing regulations, implementation of Alternative 5 would reduce emissions from this activity relative to existing conditions. In addition, emissions benefits may be achieved by management practices that reduce irrigation and cover crops (see Table 5.5-8). However, in the absence of a quantitative analysis, data are insufficient to determine whether this reduction would offset the increase in emissions from vehicle trips for grower site inspections and/or new stationary sources from individual groundwater wells.

Operational emissions would have a significant effect if the incremental difference, or increase, relative to existing conditions exceeds any of the applicable air district thresholds shown in Table 5.5-2. Any operational emissions resulting from implementation of Alternative 5 are not expected to exceed air district thresholds, but the magnitude of these emissions is not known at this time. This impact is considered potentially significant. Implementation of **Mitigation Measure AQ-MM-2** would reduce this impact to a less-than-significant level.

### **Impact AQ-3. Elevated Health Risks from Exposure of Nearby Sensitive Receptors to Construction-Related TACs/HAPs**

TACs and HAPs resulting from Alternative 5 include DPM from diesel construction equipment and asbestos. In addition, new diesel-powered pumps would produce DPM. Sensitive receptors near member growers could be affected by these sources. Because the extent of construction and operational activities is not known at this time, a determination of effects based on a quantitative analysis is not possible. Construction emissions are expected to increase relative to existing conditions, thus resulting in minor increases of DPM. Elevated levels of construction in areas where NOA is common also may increase the likelihood of exposure to asbestos.

Because implementation of Alternative 5 is expected to increase the risk of exposure to DPM and asbestos, this impact is considered potentially significant. Implementation of **Mitigation Measures AQ-MM-1, AQ-MM-2, and AQ-MM-3** would reduce this impact to a less-than-significant level. Note that these measures may not be necessary in many cases where applicable air district thresholds do not exist.

## 5.5.5 Mitigation and Improvement Measures

### **Mitigation Measure AQ-MM-1: Apply Applicable Air District Mitigation Measures to Reduce Construction Emissions below the District Thresholds**

Growers will apply appropriate construction mitigation measures from the applicable air district to reduce construction emissions. These measures will be applied on a project-level basis and may be tailored in consultation with the appropriate air district, depending on the severity of anticipated construction emissions. Although not specifically cited in this document, references to individual air district documents that contain recommended mitigation measures are included in Chapter 8, References.

### **Mitigation Measure AQ-MM-2: Apply Applicable Air District Mitigation Measures to Reduce Operational Emissions below the District Thresholds**

Growers will apply appropriate mitigation measures from the applicable air district to reduce operational emissions. These measures were suggested by the district or are documented in official rules and guidance reports; however, not all districts make recommendations for operational mitigation measures. Where applicable, measures will be applied on a project-level basis and may be tailored in consultation with the appropriate air district, depending on the severity of anticipated operational emissions.

### **Mitigation Measure AQ-MM-3: Apply Applicable Air District Mitigation Measures to Reduce TAC/HAP Emissions**

Growers will apply appropriate TAC and HAP mitigation measures from the applicable air district to reduce public exposure to DPM, pesticides, and asbestos. These measures were suggested by the district or are documented in official rules and guidance reports; however, not all districts make recommendations for mitigation measures for TAC/HAP emissions. These measures will be applied on a project-level basis and may be tailored in consultation with the appropriate air district, depending on the severity of anticipated TAC/HAP emissions.

#### 5.6.1 Introduction

This section discusses potential impacts on climate change associated with program alternatives. Specifically, the section discusses federal, state, and local regulations related to greenhouse gases (GHGs) that would apply to the program. It summarizes relevant information on global climate change and presents an analysis of the statewide, national, and global GHG emissions inventories. Conventional air pollutants (e.g., ozone precursors [ROG and NO<sub>x</sub>], CO, and particulate matter) are addressed in Section 5.5, Air Quality.

#### 5.6.2 Regulatory Framework

Climate change has only recently been widely recognized as an imminent threat to the global climate, economy, and population. Thus, the climate change regulatory setting—nationally, statewide, and locally—is complex and evolving. The following section identifies key legislation, executive orders, and seminal court cases relevant to the environmental assessment of program GHG emissions.

### Federal

#### Federal Climate Change Policies

In 2002, President George W. Bush set a national policy goal of reducing the GHG emission intensity (tons of GHG emissions per million dollars of gross domestic product) of the U.S. economy by 18 percent by 2012. No binding reductions were associated with the goal. Rather, EPA administers a variety of voluntary programs and partnerships with GHG emitters in which EPA collaborates with industries producing and utilizing synthetic gases to reduce emissions of these particularly potent GHGs.

On September 30, 2009, EPA proposed a new rule that would establish significance thresholds for six GHGs. The rule would define when CAA permits under the New Source Review (NSR) and Title V operation permit programs would be required for new and existing facilities. The proposed threshold is 25,000 tons of carbon dioxide equivalents (CO<sub>2</sub>e) per year. Facilities exceeding this threshold would be required to obtain a permit that would demonstrate they are using best management practices (BMPs). EPA estimates that 14,000 large sources would need to obtain permits, the majority of which would be municipal solid waste landfills. EPA is currently evaluating the proposal and will issue final guidance once a ruling has been made (EPA 2009a).

#### ***Massachusetts et al. vs. Environmental Protection Agency et al.***

In *Massachusetts et al. vs. Environmental Protection Agency et al.* (April 2, 2007), the U.S. Supreme Court ruled that EPA was authorized by the CAA to regulate carbon dioxide (CO<sub>2</sub>) emissions from new motor vehicles. The Court did not mandate that EPA enact regulations to reduce GHG emissions,

but found that EPA could avoid taking action only if EPA found that GHGs do not contribute to climate change or EPA offered a “reasonable explanation” for not determining that GHGs contribute to climate change.

## EPA Finding of Endangerment

On December 7, 2009, the EPA Administrator found that current and projected concentrations of CO<sub>2</sub>, methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF<sub>6</sub>) threaten the public health and welfare of current and future generations. Additionally, the Administrator found that combined emissions of CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, and HFCs from motor vehicles contribute to atmospheric concentrations and thus to the threat of climate change. Although the endangerment finding in itself does not place requirements on industry, it is an important step in the process of EPA regulating GHGs.

EPA has prepared various documents in support of the endangerment finding, including a *Summary of the Science Supporting EPA's Finding that Greenhouse Gases Threaten Public Health and Welfare* (EPA 2009b). The summary notes that “[c]limate change is expected to worsen regional ozone pollution, with associated risks in respiratory infection, aggravation of asthma, and premature death. The impact on particulate matter remains less certain.”

## Update on Corporate Average Fuel Economy (CAFE) Standards

On May 19, 2009, President Obama announced the enactment of a 35.5-miles-per-gallon fuel economy standard for automobiles and light-duty trucks that will take effect in 2012. On June 30, 2009, EPA granted California's waiver of CAA preemption to enforce new GHG emission standards for new motor vehicles beginning with the 2009 model year. The new regulations add four new GHG pollutants (CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, and HFCs) to the existing regulations for criteria, criteria-precursor, and TACs (EPA 2009c).

## State

A variety of legislation has been enacted in California that relates to climate change, much of which sets aggressive goals for GHG reductions within the state. However, none of this legislation provides definitive direction regarding the treatment of climate change in environmental review documents pursuant to CEQA.

## Assembly Bill 32 Chapter 488, Statutes of 2006

The California Global Warming Solutions Act of 2006, widely known as AB 32, requires ARB to develop and enforce regulations for reporting and verification of statewide GHG emissions. ARB is directed to set a GHG emissions limit, based on 1990 levels, to be achieved by 2020. The bill sets a timeline for adopting a scoping plan for achieving reductions in a technologically and economically feasible manner.

The heart of the bill is the requirement that statewide GHG emissions must be reduced to 1990 levels by the year 2020. California needs to reduce GHG emissions by approximately 29 percent below “business as usual” (based on compliance with requirements in effect under applicable federal and state law) of year 2020 GHG emissions to achieve this goal. The bill requires ARB to adopt rules and regulations in an open public process to achieve the maximum technologically

feasible and cost-effective GHG reductions. To help guide implementation of AB 32, ARB adopted the AB 32 Scoping Plan in December 2008 (ARB 2009a).

## **California Air Resources Board AB 32 Scoping Plan**

In December 2008, ARB met the AB 32 mandate for approving a Scoping Plan for reducing California GHG emissions to 1990 levels by 2020 (ARB 2008). The Scoping Plan and earlier ARB reports included quantification of California's 1990 GHG emission levels at anticipated 2020 GHG emission levels based on projections of economic and population growth that were estimated on a business-as-usual scenario of compliance with existing federal and state laws and continuation of existing economic trends and other activities. ARB then subtracted the 1990 target GHG emissions from the forecast 2020 emissions and identified a numeric reduction target for GHGs that needed to be achieved for California to comply with AB 32. ARB calculations require a reduction of 28.3 percent (often rounded up to 29 percent) of GHG emissions in relation to the otherwise forecast business-as-usual scenario to meet AB 32 goals.

The Scoping Plan includes a wide variety of measures to reduce GHG emissions from multiple sectors of the economy, including the agricultural industry. According to ARB, California's agricultural sector represented 6 percent of the State's GHG emissions budget in 2004 (ARB 2009a). During development of the Scoping Plan, potential GHG mitigation measures were identified to help reduce these emissions from agricultural operations. Specifically, the Scoping Plan highlights voluntary adoption of manure digester technology as the main strategy for reducing GHG emissions from the agricultural sector. In 2013, the degree of this investment will be analyzed to determine whether implementation of the technology should be made mandatory (ARB 2009a).

## **Executive Order S-03-05 (2005)**

California Executive Order S-03-05 (June 1, 2005) mandates a reduction of GHG emissions to 2000 levels by 2010, to 1990 levels by 2020, and to 80 percent below 1990 levels by 2050. Although the 2020 target is the core of AB 32, and has effectively been incorporated into AB 32, the 2050 target remains the goal of the Executive Order.

## **Executive Order S-01-07 Low Carbon Fuel Standards**

Executive Order S-01-07 (January 18, 2007) requires a 10 percent or greater reduction in the average fuel carbon intensity for transportation fuels in California regulated by ARB. ARB identified the low carbon fuel standards (LCFS) as a Discrete Early Action item under AB 32. On April 23, 2009, ARB adopted regulations implementing the LCFS.

## **Assembly Bill 1493 (Pavley), Chapter 200, Statutes of 2002**

AB 1493 requires ARB to adopt regulations by January 1, 2005, to reduce GHG emissions from noncommercial passenger vehicles and light-duty trucks of model year 2009 and thereafter. For this mandate to take effect, ARB was required to obtain a federal waiver from EPA that would allow California to deviate from the national car and light-duty truck standards set by EPA under the CAA. This waiver, generally referred to as the Pavley Waiver after the principal author of AB 1493, was initially requested in 2004; the federal government declined to regulate GHG under the CAA.

California and other states sued the federal government, in an attempt to compel EPA to regulate GHG under the CAA and take action on the waiver request, which was also being sought by several



other states. In April 2007, the U.S. Supreme Court ruled in *Massachusetts et al. v. Environmental Protection Agency et al.* (discussed above) that EPA has authority to regulate GHG emissions as pollutants. Nevertheless, the Pavley Waiver request was formally denied by EPA in December 2007. In January 2008, the State Attorney General filed a new lawsuit against EPA for denying California's request for the Pavley Waiver to regulate and limit GHG emissions from these automobiles. On June 30, 2009, EPA granted California's waiver of CAA preemption to enforce new GHG emission standards for new motor vehicles beginning with the 2009 model year.

## **2010 CEQA Guidelines, Section 15064.4**

As required by SB 97, the Office of Planning and Research (OPR) has prepared guidelines for the analysis of GHG effects in CEQA documents. The guidelines were incorporated into the 2010 revisions of the CEQA analysis handbook. They confirm the discretion of lead agencies to determine appropriate significance thresholds, but require the preparation of an EIR if "there is substantial evidence that the possible effects of a particular project are still cumulatively considerable not withstanding compliance with adopted regulations or requirements."

## **Senate Bill 375 (Steinberg), Statutes of 2008**

SB 375 (Steinberg) provides for a new planning process that would coordinate land use planning and regional transportation plans and funding priorities in order to help California meet the GHG reduction goals established in AB 32. SB 375 requires regional transportation plans, developed by Metropolitan Planning Organizations (MPOs), to incorporate a "sustainable communities strategy" in their regional transportation plans that will achieve GHG emission reduction targets set by ARB. SB 375 also includes provisions for streamlined CEQA review for some infill projects, such as transit-oriented development. SB 375 will be implemented over the next several decades. The first round of GHG emissions targets for MPOs are expected to take effect in September 2010.

## **Research on GHG Emissions from Fertilizer**

According to ARB, N<sub>2</sub>O represented 2.8 percent of California's total GHG emissions in 2004. Of these emissions, approximately 50 percent originated from agricultural soils, with the majority resulting from the application of organic and synthetic fertilizers (ARB 2009b). To better understand and quantify emissions, ARB is currently conducting research on agricultural emissions of N<sub>2</sub>O. Results may be used to improve fertilizer management practices and develop a California-specific baseline for N<sub>2</sub>O emissions (ARB 2009b).

## **Local**

As discussed in Section 5.5, 24 local air districts manage air quality within the program area (see Figure 5.5-1). Currently, the San Joaquin Valley Air Pollution Control District (SJVAPCD), South Coast Air Quality Management District (SCAQMD), and Bay Area Air Quality Management District (BAAQMD) have developed guidelines for the analysis of GHGs in CEQA documents. The Sacramento Metropolitan Air Quality Management District (SMAQMD) is in the process of updating its CEQA guidelines, but has yet to publish a draft document. The following discussion provides a summary of the GHG guidance provided by the SJVAPCD, SCAQMD, and BAAQMD. Note that only the SJVAPCD has adopted their guidance as regulation. Thresholds proposed by the BAAQMD and SMAQMD are still undergoing revisions and have not been adopted as final regulations.

## **San Joaquin Valley Air Pollution Control District**

In December 2009, the SJVAPCD formally adopted the region's first GHG thresholds for determining significant impacts with regard to climate change in CEQA documents. The SJVAPCD's guidance is intended to streamline CEQA review by pre-quantifying emission reductions that would be achieved through the implementation of best performance standards (BPS). BPS are developed by the SJVAPCD and are based on current technologies, operating principles, and energy efficiency tactics. According to the December 2009 report, development projects failing to implement BPS or demonstrate a 29 percent reduction in GHG emissions relative to business-as-usual (BAU) conditions are considered to result in a significant impact on climate change (SJVAPCD 2009).

## **South Coast Air Quality Management District**

On December 5, 2008, the SCAQMD Governing Board adopted the staff proposal for an interim GHG significance threshold for stationary/industrial projects where the SCAQMD is lead agency. The interim thresholds use a tiered approach, where Tier 3 is expected to be the primary tier by which the SCAQMD will determine significance. The Tier 3 screening level proposes a threshold of 10,000 metric tons of CO<sub>2</sub>e per year for stationary/industrial sources, which represents a 90-percent emissions capture rate. Indirect, direct, and to the extent feasible, life cycle emissions from both construction (amortized over 30 years), and operational activities will be added and compared to the proposed threshold. At this time, the SCAQMD is reviewing a GHG significance threshold for residential/commercial projects (SCAQMD 2008).

## **Bay Area Air Quality Management District**

The BAAQMD released its CEQA Air Quality Guidelines in December 2009 (EDAW 2009). The guidance proposes significance thresholds for operational GHG emissions. The BAAQMD currently does not recommend a construction GHG emission threshold because of insufficient information to determine an appropriate significance level. District staff recommends considering construction emissions on a case-by-case basis and encourages the implementation of BMPs.

The proposed threshold of significance for operational-related GHG emissions from land use projects is 1,100 metric tons of CO<sub>2</sub>e per year. Projects exceeding this threshold would not be considered to result in a significant impact related to GHG emissions if their yearly GHG efficiency is less than 4.6 metric tons of CO<sub>2</sub>e per service population (project jobs + projected residents) for mixed-use projects or if the project complies with an approved Climate Action Plan. The proposed threshold for stationary sources is 10,000 metric tons of CO<sub>2</sub>e per year. If annual GHG emissions from project operations are below the above thresholds, the proposed project would result in a less-than-significant impact on global climate change (EDAW 2009).

## **5.6.3 Environmental Setting**

### **Global Climate Change**

Global climate change is caused in large part by anthropogenic (human-made) emissions of GHGs released into the atmosphere through combustion of fossil fuels and by other activities that affect the global GHG budget, such as deforestation and land use change. According to the California Energy Commission (CEC), GHG emissions in California are attributable to human activities

associated with industrial/manufacturing, utilities, transportation, residential, and agricultural sectors as well as natural processes (CEC 2006).

GHGs play a critical role in the Earth's radiation budget by trapping infrared radiation emitted from the Earth's surface that could have otherwise escaped to space. Prominent GHGs contributing to this process include water vapor, CO<sub>2</sub>, N<sub>2</sub>O, CH<sub>4</sub>, ozone, certain HFCs and PFCs, and SF<sub>6</sub>. This phenomenon, known as the *greenhouse effect*, keeps the Earth's atmosphere near the surface warmer than it would otherwise be and allows for successful habitation by humans and other forms of life. Combustion of fossil fuels releases carbon that has been stored underground into the active carbon cycle, thus increasing concentrations of GHGs in the atmosphere. Emissions of GHGs in excess of natural ambient concentrations are thought to be responsible for enhancement of the greenhouse effect and to contribute to what is termed *global warming*, a trend of unnatural warming of the Earth's natural climate. Higher concentrations of these gases lead to more absorption of radiation and warm the lower atmosphere further, thereby increasing evaporation rates and temperatures near the surface.

Climate change is a global problem, and GHGs are global pollutants, unlike criteria air pollutants (such as ozone precursors) and TACs, which are primarily pollutants of regional and local concern. Because GHG emissions have long atmospheric lifetimes, GHGs are effectively well mixed globally and are expected to persist in the atmosphere for time periods several orders of magnitude longer than criteria pollutants such as ozone. Given their long atmospheric lifetimes, GHG emission reduction strategies can be effectively undertaken on a global scale whereby the mitigation of local GHG emissions can be offset by distant GHG reduction activities.

The Intergovernmental Panel on Climate Change (IPCC) was established by the World Meteorological Organization and United Nations Environment Programme to assess scientific, technical, and socioeconomic information relevant for the understanding of climate change, its potential impacts, and options for adaptation and mitigation. The IPCC predicts substantial increases in global temperatures between 1.1 and 6.4° Celsius (depending on scenario) by 2100 (IPCC 2007a).

Climate change could potentially affect the natural environment in California, and the world at large, in the following ways:

- Rising sea levels along the California coastline, particularly in San Francisco and the Delta due to ocean expansion;
- Changing extreme-heat conditions, such as heat waves and very high temperatures, which could last longer and become more frequent;
- Increasing wildfire frequency and intensity;
- Increasing heat-related human deaths, infectious diseases, and risk of respiratory problems caused by deteriorating air quality;
- Decreasing snow pack and stream flow in the Sierra Nevada, affecting winter recreation and water supplies;
- Increasing severity of winter storms, affecting peak stream flows and flooding;
- Changing growing season conditions that could affect California agriculture, causing variations in crop quality and yield; and

- Changing distribution of plant and wildlife species due to changes in temperature, competition from colonizing species, changes in hydrologic cycles, changes in sea levels, and other climate-related effects.

These changes in California's climate and ecosystems are occurring at a time when California's population is expected to increase from 34 to 59 million by 2040 (CEC 2005). As such, the number of people potentially affected by climate change as well as the amount of anthropogenic GHG emissions expected under a business-as-usual scenario is expected to increase.

As a consequence of worldwide GHG emissions altering the global climate, the program area may be subject to increased vulnerability to the following impacts:

- Reduced water supply to the program area,
- Increased risk of heat-related human deaths,
- Increased spread of infectious diseases, and
- Increased risk of respiratory problems associated with deteriorating air quality in the program area.

## Greenhouse Gases

AB 32 documents six gases: CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, HFCs, PFCs, and SF<sub>6</sub>. Note that water vapor, although the most abundant GHG, is not included in AB 32 because natural concentrations and fluctuations far outweigh anthropogenic influences. This section documents the characteristics and sources of CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O. While extremely potent, HFCs, PFCs, and SF<sub>6</sub> are human-made chemicals emitted mainly from air conditioners and refrigerants, manufacturing processes, and power distribution, respectively. Consequently, these gases are less relevant to the analysis of climate change impacts related to the proposed program.

To simplify reporting and analysis, GHG emissions are compared by their global warming potential (GWP) (IPCC 1996 and 2001). The IPCC defines the GWP of various GHG emissions on a normalized scale that recasts all GHG emissions in terms of CO<sub>2</sub>e, which compares the gas in question to that of the same mass of CO<sub>2</sub> (CO<sub>2</sub> has a GWP of 1 by definition). For example, a high GWP represents high infrared absorption and long atmospheric lifetime when compared to CO<sub>2</sub>. One must also select a time horizon to convert GHG emissions to equivalent CO<sub>2</sub> emissions, in order to account for chemical reactivity and lifetime differences between various GHG species. The standard time horizon for climate change analysis is 100 years. Generally, GHG emissions are quantified in terms of metric tons of CO<sub>2</sub>e emitted per year.

Table 5.6-1 lists the GWP of each GHG, its lifetime, and its abundance in the atmosphere in parts per trillion. Collectively, HFCs, PFCs, and SF<sub>6</sub> are referred to as high global warming potential gases (HGWPG). CO<sub>2</sub> is by far the largest component of worldwide CO<sub>2</sub>e emissions, followed by CH<sub>4</sub>, N<sub>2</sub>O, and HGWPGs in order of decreasing contribution to CO<sub>2</sub>e.

**Table 5.6-1. Lifetimes and Global Warming Potentials of Several Significant Greenhouse Gases**

| <b>Gas</b>                    | <b>Global Warming Potential (100 years)</b> | <b>Lifetime (years)</b> | <b>1998 Atmospheric Abundance (ppt)<sup>a</sup></b> |
|-------------------------------|---------------------------------------------|-------------------------|-----------------------------------------------------|
| CO <sub>2</sub>               | 1                                           | 50–200                  | 365,000,000                                         |
| CH <sub>4</sub>               | 21                                          | 9–15                    | 1,745                                               |
| N <sub>2</sub> O              | 310                                         | 120                     | 314                                                 |
| HFC-23                        | 11,700                                      | 264                     | 14                                                  |
| HFC-134a                      | 1,300                                       | 14.6                    | 7.5                                                 |
| HFC-152a                      | 140                                         | 1.5                     | 0.5                                                 |
| CF <sub>4</sub>               | 6,500                                       | 50,000                  | 80                                                  |
| C <sub>2</sub> F <sub>6</sub> | 9,200                                       | 10,000                  | 3                                                   |
| SF <sub>6</sub>               | 23,900                                      | 3,200                   | 4.2                                                 |

<sup>a</sup> 1 ppt is a mixing ratio unit indicating the concentration of a pollutant in parts per trillion by volume.  
Sources: IPCC 1996, 2001 (pages 388–390).

## Carbon Dioxide

CO<sub>2</sub> is the most important anthropogenic GHG and accounts for more than 75 percent of all anthropogenic GHG emissions. Its long atmospheric lifetime (on the order of decades to centuries) ensures that atmospheric concentrations of CO<sub>2</sub> will remain elevated for decades after mitigation efforts to reduce GHG concentrations are promulgated (IPCC 2007b).

Increasing concentrations of CO<sub>2</sub> in the atmosphere are primarily a result of emissions from the burning of fossil fuels, gas flaring, cement production, and land use changes. Three-quarters of anthropogenic CO<sub>2</sub> emissions are the result of fossil fuel burning (and, to a very small extent, cement production), and approximately one-quarter of CO<sub>2</sub> emissions are the result of land use change (IPCC 2007b).

Atmospheric concentrations of anthropogenic CO<sub>2</sub> emissions have increased, most notably since the industrial revolution. CO<sub>2</sub> concentration has increased from approximately 280 to 379 parts per million (ppm) over the last 250 years (Solomon et al. 2007). The IPCC estimates that the present atmospheric concentration of CO<sub>2</sub> has not been exceeded in the last 650,000 years and is likely to be the highest ambient concentration in the last 20 million years (IPCC 2007b, Solomon et al. 2007).

## Methane

CH<sub>4</sub>, the main component of natural gas, is the second largest contributor to anthropogenic GHG emissions and has a GWP of 21 (AEP 2007; IPCC 1996).

Anthropogenic emissions of CH<sub>4</sub> are the result of growing rice, raising cattle, combusting natural gas, and mining coal (NOAA 2005). Atmospheric CH<sub>4</sub> has increased from a pre-industrial concentration of 715 to 1,775 parts per billion (ppb) in 2005 (IPCC 2007a). Although the cause is unclear, atmospheric concentrations of CH<sub>4</sub> have not risen as quickly as anticipated (NOAA 2005).



## Nitrous Oxide

N<sub>2</sub>O is a powerful GHG, with a GWP of 310 (IPCC 1996). Anthropogenic sources of N<sub>2</sub>O include agricultural processes, nylon production, fuel-fired power plants, nitric acid production, and vehicle emissions. N<sub>2</sub>O is also used in rocket engines and racecars and as an aerosol spray propellant. Agricultural processes that result in anthropogenic N<sub>2</sub>O emissions are fertilizer use and microbial processes in soil and water (AEP 2007).

N<sub>2</sub>O concentrations in the atmosphere have increased from pre-industrial levels of 270 to 319 ppb in 2005 (IPCC 2007a).

## Greenhouse Gas Inventories

A GHG inventory is a quantification of all GHG emissions and sinks within a selected physical and/or economic boundary. GHG inventories can be performed on a large scale (e.g., for global and national entities) or on a small scale (e.g., for a particular building or person).

Many GHG emission and sink specifications are complicated to evaluate because natural processes may dominate the carbon cycle. Although some emission sources and processes are easily characterized and well understood, some components of the GHG budget (e.g., the balance of GHG sources and sinks) are not known with accuracy. Because protocols for quantifying GHG emissions from many sources are currently under development by international, national, state, and local agencies, ad hoc tools must be developed to quantify emissions from certain sources and sinks in the interim.

The following sections outline the global, national, and statewide GHG inventories to provide a context for the magnitude of program-related emissions. GHG emissions from the agricultural sector are highlighted.

## IPCC 2004 Global Greenhouse Gas Inventory

The most recent global GHG inventory analyzed emissions in 2004 and was conducted by the IPCC. According to the IPCC, global anthropogenic GHG emissions were estimated at 49 gigatons of CO<sub>2</sub>e (GtCO<sub>2</sub>e) in 2004, which is 24 percent greater than 1990 emissions levels. CO<sub>2</sub> contributed to 76.7 percent of total emissions, CH<sub>4</sub> accounted for 14.3 percent, N<sub>2</sub>O contributed to 7.9 percent, and fluorinated gases (HFCs, PFCs, and SF<sub>6</sub>) contributed to the remaining 1.1 percent of global emissions (IPCC 2007c). Table 5.6-2 presents global GHG emissions by sector, as defined in the IPCC report. As Table 5.6-2 indicates, the agricultural sector represents 13.5 percent of total GHG emissions.

**Table 5.6-2. Global Greenhouse Gas Emissions from the IPCC 2004 Inventory (GtCO<sub>2</sub>e)**

| <b>Sector</b>                        | <b>2004 CO<sub>2</sub>e Emissions</b> |
|--------------------------------------|---------------------------------------|
| Energy                               | 12.69                                 |
| Industry                             | 9.50                                  |
| Forestry                             | 8.53                                  |
| Agriculture                          | 6.61                                  |
| Transportation                       | 6.41                                  |
| Residential and commercial buildings | 3.87                                  |
| Waste and wastewater                 | 1.37                                  |
| Total emissions                      | 49                                    |

Notes:  
CO<sub>2</sub>e = carbon dioxide equivalents.  
GtCO<sub>2</sub>e = gigatons of CO<sub>2</sub>e.  
Source: Adapted from IPCC 2007c (page 5).

## National 2007 Greenhouse Gas Inventory

EPA estimates that total U.S. GHG emissions in 2007 amounted to 7,150.1 million metric tons of CO<sub>2</sub>e (MMTCO<sub>2</sub>e), which is 17 percent greater than 1990 levels (EPA 2009d). CO<sub>2</sub> contributed to 85.4 percent of total emissions, CH<sub>4</sub> accounted for 8.2 percent, N<sub>2</sub>O contributed to 4.4 percent, and fluorinated gases (HFCs, PFCs, and SF<sub>6</sub>) contributed to the remaining 2.1 percent of national emissions. Table 5.6-3 summarizes the U.S. GHG emissions in 2007, based on CO<sub>2</sub> equivalents. The agricultural sector represents approximately 6 percent of total GHG emissions (EPA 2009d).

**Table 5.6-3. U.S. Greenhouse Gas Emissions from the EPA 2007 Inventory (MMTCO<sub>2</sub>e)**

| <b>Sector</b>                           | <b>2007 CO<sub>2</sub>e Emissions</b> |
|-----------------------------------------|---------------------------------------|
| Energy                                  | 6,170.3                               |
| Industrial processes                    | 353.8                                 |
| Solvent and other product use           | 4.4                                   |
| Agriculture                             | 413.1                                 |
| Land use, land-use change, and forestry | 42.9                                  |
| Waste                                   | 165.6                                 |
| Total emissions                         | 7,150.1                               |

Notes:  
CO<sub>2</sub>e = carbon dioxide equivalents.  
MMTCO<sub>2</sub>e = million metric tons of CO<sub>2</sub>e.  
Source: EPA 2009d (page ES-11).

## State 2006 Greenhouse Gas Inventory

ARB recently completed a GHG inventory of California's 2006 GHG emissions. Their report states that 1990 emissions amounted to 433.3 MMTCO<sub>2</sub>e, while 2006 emissions levels rose to

483.9 MMTCO<sub>2</sub>e (ARB 2009c). CO<sub>2</sub> emissions accounted for 89 percent of the state's 2006 inventory, followed by CH<sub>4</sub> (5 percent), N<sub>2</sub>O (3 percent), and other gases including HGWPGs (3 percent) (ARB 2009c). Table 5.6-4 summarizes statewide GHG emissions by sector, as defined in ARB report, and indicates that GHGs from the agricultural sector represent 6 percent of total emissions.

**Table 5.6-4. State Greenhouse Gas Emissions from the 2006 ARB Inventory (MMTCO<sub>2</sub>e)**

| <b>Sector</b>            | <b>2006 CO<sub>2</sub>e Emissions</b> |
|--------------------------|---------------------------------------|
| Transportation           | 188.721                               |
| Electricity generation   | 106.458                               |
| Industry                 | 101.619                               |
| Agriculture and forestry | 29.034                                |
| Residential              | 29.034                                |
| Commercial               | 14.517                                |
| Other                    | 14.517                                |
| Total emissions          | 483.9                                 |

Notes:

CO<sub>2</sub>e = carbon dioxide equivalents.

MMTCO<sub>2</sub>e = million metric tons of CO<sub>2</sub>e.

Emissions inventory includes estimates for carbon dioxide, methane, nitrous oxides, sulfur hexafluoride, hydrofluorocarbons, and perfluorocarbons.

Source: Adapted from ARB 2009c.

## 5.6.4 Impacts

The primary GHG emissions generated from the program alternatives include CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O. Climate change impacts from the program alternatives would result from these GHGs emitted as vehicle exhaust during construction activities and program operation. In addition, as discussed above, application of fertilizers releases a significant amount of N<sub>2</sub>O, which is a powerful GHG. This section describes the potential impacts resulting from these sources related to the five program alternatives. Mitigation measures to reduce significant impacts also are identified.

For the purposes of this analysis, the baseline conditions were assumed to be the current regulatory program as instituted at the time of the writing of the ECR (refer to Chapter 3).

## Assessment Methods

GHG emissions (CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O) from construction activities are primarily the result of fuel use by construction equipment, as well as worker and vendor trips to the project site. Management practices used to prevent impacts on water quality that require heavy-duty equipment would generate GHG emissions through equipment exhaust (see Table 5.5-8). As described in Section 5.5, construction activity, and thus the number and type of heavy-duty equipment, can vary depending on the management practices implemented under the proposed program. In general, however, construction

required by the various management practices would be minor. Consequently, GHG emissions resulting from heavy-duty vehicle exhaust most likely would be miniscule.

Operational GHG emissions from the program alternatives would primarily result from vehicle trips for site inspections and monitoring. Diesel-powered well pumps for groundwater wells and tailwater recovery systems also may generate a minor amount of GHGs as exhaust. As discussed in Section 5.5, the extent of these activities is unknown at this time. However, GHG emissions from these sources are expected to be transitory and short term (e.g., semi-annual well sampling, back-up pump motors, and annual inspections).

Certain management practices also may result in GHG emissions benefits relative to existing conditions. For example, improved irrigation management may reduce the amount of time that pressurized pump generators are used. This practice also will help create water-efficient irrigation systems and devices, thereby reducing the amount of water required. Enhanced nutrient application may minimize the number of tractors required to plow a field. This practice also may reduce fertilizer use, which is a source of N<sub>2</sub>O emissions. However, as discussed above, the extent and intensity of these activities are unknown.

The amount of GHG emissions from construction equipment and vehicle trips is heavily dependent on the type of management practice and the frequency of monitoring and site inspections, respectively. The number of diesel-powered well pumps also impact the quantity of GHGs emitted during program operation. Likewise, GHG reductions from improvements in irrigation and nutrient management are dependent on the number of farmers implementing these strategies, as well as the condition of their existing facilities. Because information on these sources is currently unavailable, a quantified analysis of potential GHG emissions is not possible (please refer to Section 5.5 for an expanded discussion on the availability of existing data). Consequently, a qualitative analysis of GHG emissions was performed. The qualitative analysis took into account the following:

- Stipulations for the installation of monitoring wells,
- Combustion emissions from heavy-duty equipment required by potential management practices,
- Provisions for groundwater monitoring plans and site inspections, and
- Stipulations for nutrient monitoring plans.

## Significance Determinations

Certain criteria must be examined to determine whether a project will result in a significant effect on the environment. As of the writing of this report, the agencies with jurisdiction over air quality regulation and GHG emissions, such as EPA, ARB, and the various local air districts, have not formally adopted applicable significance thresholds, standards, or analysis protocols for the assessment of GHG emissions (please refer to Section 5.6.2). Thus, a methodology to establish an appropriate baseline or develop a program-level inventory for the proposed program, which would allow for an appropriate analysis of the program's impacts on climate change or the impact of climate change on the proposed program, has not yet been established. Recent policy documents and proposed thresholds developed at federal, state, and local levels recommend that GHGs be addressed quantitatively based on their cumulative contribution to climate change impacts, rather than on a project-specific basis.

## Alternative 1 – Full Implementation of Current Program (No Project Alternative)

### Impact CC-1. Generation of Greenhouse Gas Emissions Resulting in Global Climate Change

Alternative 1 involves full implementation of the existing regulatory program. Coalition groups would function as the lead entities, and growers would implement management practices when surface water monitoring data show two or more exceedances of water quality objectives.

Implementation of Alternative 1 would result in local GHG emissions from construction equipment exhaust, diesel-powered well pumps installed as part of tailwater recovery systems, and vehicle trips for surface water quality monitoring. It is logical to assume that, as monitoring continues under Alternative 1, it would result in selection and implementation of more management plans and resulting management practices. Depending on the type of management practice selected, operational GHG emissions may be reduced relative to existing conditions due to improved irrigation systems and nutrient management. However, in the absence of project-specific information, it is difficult to determine which management practices would be selected or the number, type, and frequency of heavy-duty equipment that would be used.

As previously noted, GHG contaminants tend to accumulate in the atmosphere because of their relatively long lifespan. Consequently, their impact on the atmosphere is mostly independent of the point of emission. In other words, GHG emissions are more appropriately evaluated on a regional, state, or even national scale than on an individual level. Further, given the magnitude of state, federal, and national GHG emissions (see Section 5.6.3), it is unlikely that the minor amounts of GHG emissions resulting from vehicle and equipment exhaust would result in a discernible effect on global climate change. Consequently, this impact is considered less than significant at the local level. No mitigation is required.

## Alternative 2 – Third-Party Lead Entity

### Impact CC-1. Generation of Greenhouse Gas Emissions Resulting in Global Climate Change

Construction-related GHGs emitted under Alternative 2 are expected to be similar to those described for Alternative 1 (see **Impact CC-1**). Because the number of trips associated with surface water quality monitoring under Alternative 2 may be reduced relative to existing regulations, this alternative may reduce operational-related GHG emissions from vehicles. In addition, management practices that reduce well pumping and improve the efficiency of nutrient application may result in emissions benefits. However, new vehicle trips for regional groundwater monitoring, as well as the operation of new diesel-powered pumps for tailwater recovery systems, may outweigh any emissions benefits achieved by these reductions. With limited information on the number and distances of vehicle trips associated with monitoring, the number and hours of operation of the pumps, and the practices to be implemented, a quantitative analysis of emissions is not possible.

However, as discussed above, it is unlikely that the minor amounts of GHG emissions generated under Alternative 2 would result in a discernible effect on global climate change. Consequently, this impact is considered less than significant at the local level. No mitigation is required.



## Alternative 3 – Individual Farm Water Quality Management Plans

### Impact CC-1. Generation of Greenhouse Gas Emissions Resulting in Global Climate Change

Construction-related GHG emissions generated under Alternative 3 are expected to be similar to those described for Alternative 1 (see **Impact CC-1**).

As discussed in Section 5.6.4, Alternative 3 does not require growers or the Central Valley Water Board to perform surface water or groundwater monitoring. Consequently, no GHG emissions would be associated with this activity. However, GHG emissions would be generated by vehicle travel for grower site inspections and any new well pumps installed as part of tailwater recovery systems. Although these emissions are expected to be minimal, without a quantified analysis, it is not possible to determine whether new emissions from site inspections would offset the reduction benefits achieved by management strategies that reduce water consumption and enhance nutrient application. However, it is unlikely that any new GHG emissions resulting from vehicle exhaust would result in a discernible effect on global climate change. Consequently, this impact is considered less than significant at the local level. No mitigation is required.

## Alternative 4 – Direct Oversight with Regional Monitoring

### Impact CC-1. Generation of Greenhouse Gas Emissions Resulting in Global Climate Change

Implementation of Alternative 4 would result in local GHG emissions from construction equipment exhaust and would be similar to those anticipated under Alternative 1 (see **Impact CC-1**).

Operational GHGs from vehicle trips for sampling transport, site inspections, and regional water quality monitoring—as well as from any new well pumps installed as part of tailwater recovery systems—are expected under Alternative 4. However, implementation of nutrient management plans, which optimize the use of fertilizer, may reduce N<sub>2</sub>O emissions. Likewise, other management practices that reduce water consumption and enhance nutrient application may result in emissions benefits. In the absence of a quantitative analysis, determining the net change in GHG emissions under this alternative is beyond the scope of this analysis. However, if GHG emissions were to increase relative to existing conditions, it is unlikely they would result in a discernible effect on global climate change due to the nature of GHGs. Consequently, this impact is considered less than significant at the local level. No mitigation is required.

## Alternative 5 – Direct Oversight with Farm Monitoring

### Impact CC-1. Generation of Greenhouse Gas Emissions Resulting in Global Climate Change

Implementation of Alternative 5 would result in GHG emissions from installation of individual farm groundwater wells and implementation of management practices that require the use of heavy-duty equipment. Construction emissions resulting from implementation of management practices are expected to be similar to Alternative 1 (see **Impact CC-1**). However, the construction of individual farm groundwater wells and accessory facilities (e.g., pump houses and access roads) would generate new GHG emissions. Consequently, construction-related GHG emissions under Alternative 5 may be slightly greater than those anticipated for Alternative 1.

Local GHG emissions also would be generated by vehicle trips for sampling transport and site inspections, as well as minor amounts of GHGs emitted by new compression engines required to power well pumps. Alternative 5 would result in N<sub>2</sub>O reductions, as all farms would be required to develop a nutrient management plan. In the absence of a quantitative analysis, determining the net change in GHG emissions under this alternative is beyond the scope of this analysis. However, if GHG emissions were to increase, it is unlikely they would result in a discernible effect on global climate change due to the nature of GHGs. Consequently, this impact is considered less than significant at the local level. No mitigation is required.

## 5.6.5 Mitigation and Improvement Measures

Because the program alternatives would not result in any significant impacts on climate, no mitigation measures are required. However, given the seriousness of global climate change, any and all actions that reduce GHG emissions should be considered by program applicants. Potential actions include measures to reduce vehicle trips (e.g., optimizing route plans), use of alternative fuels, and using clean diesel and/or filters for construction equipment.

### **Mitigation Measure CC-MM-1: Apply Applicable Air District Mitigation Measures to Reduce Construction and Operational GHG Emissions (recommended)**

Several of the standard mitigation measures provided by the 24 local air districts to reduce criteria pollutant emissions would also help to minimize GHG emissions (please see Section 5.6.5). Measures to reduce vehicle trips and promote use of alternative fuels, as well as clean diesel technology and construction equipment retrofits, should be considered by the program applicants.

### **Mitigation Measure CC-MM-2: Apply Applicable California Attorney General Mitigation Measures to Reduce Construction and Operational GHG Emissions (recommended)**

A recent report by the California Attorney General's office entitled *The California Environmental Quality Act: Addressing Global Warming at the Local Agency Level* identifies various example measures to reduce GHG emissions at the project level (State of California Department of Justice 2008). The following mitigation measures and project design features were compiled from the California Attorney General's Office report. They are not meant to be exhaustive but to provide a sample list of measures that could be incorporated into future project design. Only those measures applicable to the proposed program are included.

#### Solid Waste Measures

- Reuse and recycle construction and demolition waste (including, but not limited to, soil, vegetation, concrete, lumber, metal, and cardboard).
- Provide interior and exterior storage areas for recyclables and green waste and adequate recycling containers.
- Recover by-product methane to generate electricity.

#### Transportation and Motor Vehicles

- Limit idling time for commercial vehicles, including delivery and construction vehicles.
- Use low- or zero-emission vehicles, including construction vehicles.

### 5.7.1 Introduction

This section describes potential impacts on vegetation and wildlife associated with the program alternatives. Specifically, it summarizes relevant laws and policies, discusses the existing environmental setting for vegetation and wildlife in the program area, and identifies potential impacts on vegetation and wildlife that may result from implementation of program alternatives. Mitigation measures to avoid or reduce potentially significant impacts also are presented.

The program area crosses a range of physiographic regions from the surrounding mountain ranges into the valleys. Each of these regions can be further subdivided into many habitats defined by the plant communities present and their associated wildlife species. Natural habitat types include valley riparian, conifer forests, oak woodland, chaparral, annual grassland, wetlands, and riverine; and human-influenced habitats include agricultural land, pastureland, managed wetland, and urban areas.

The varied habitat types within California are conducive to a great diversity of plant, animal, and fish species, many of which are endemic to the state. Because of habitat conversion to agriculture and residential and commercial development, many of these species have become rare, threatened, or endangered. Such species have been state or federally listed, or are candidate or proposed species for listing as protected under the California Endangered Species Act (CESA) and the ESA.

### 5.7.2 Regulatory Framework

The following federal, state, and local policies and laws are relevant to vegetation and wildlife in the program area.

#### Federal

##### Endangered Species Act

The ESA protects fish and wildlife species, and their habitats identified by USFWS and NMFS as threatened or endangered. Refer to Section 5.8, Fisheries, for additional explanation of the ESA.

##### Section 7 – Endangered Species Act Consultation Process

Section 7 ESA consultation provides a means for authorizing take of listed species for actions by federal agencies. Federal agency actions include activities that are:

- On federal land,
- Conducted by a federal agency,
- Funded by a federal agency, or
- Authorized by a federal agency (including issuance of federal permits and licenses).

Under Section 7, the federal agency conducting, funding, or permitting an action (the federal lead agency) must, in consultation with USFWS or NMFS as appropriate, ensure that its proposed action will not jeopardize the continued existence of an endangered or threatened species, or destroy or adversely modify designated critical habitat. If a proposed project “may affect” a listed species or designated critical habitat, the lead agency is required to prepare a biological assessment (BA) evaluating the nature and severity of the expected effect. The BA is prepared for the proposed action and is submitted to USFWS or NMFS to initiate consultation. In response to a BA, USFWS or NMFS issues a biological opinion (BO), with a determination that the proposed action either:

- May jeopardize the continued existence of one or more listed species (jeopardy finding) or result in the destruction or adverse modification of critical habitat (adverse modification finding), or
- Will not jeopardize the continued existence of any listed species (no jeopardy finding) or result in adverse modification of critical habitat (no adverse modification finding).

The BO issued by USFWS or NMFS may stipulate discretionary “reasonable and prudent” conservation measures. If the proposed action would not jeopardize a listed species, USFWS or NMFS may issue an incidental take statement to authorize the proposed activity and may include appropriate measures to offset the impacts of take.

## Section 9 – Endangered Species Act Prohibitions

Section 9 of the ESA prohibits the take of any fish or wildlife species listed under the ESA as endangered. Take of threatened species is also prohibited under Section 9, unless otherwise authorized by federal regulations. *Take*, as defined by the ESA, means “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct” (Section 3 of the ESA; 16 United States Code [USC] Section 1532[19]). *Harm* is defined by regulation as “any act that kills or injures the species, including significant habitat modification” (50 CFR 17.3 222.102). In addition, Section 9 prohibits removing, digging up, cutting, and maliciously damaging or destroying federally listed plants on sites under federal jurisdiction. Section 9 does not prohibit take of federally listed plants on sites not under federal jurisdiction. If the project may result in take prohibited by Section 9, this take would need to be authorized through ESA Sections 7 or 10 (providing for the issuance of “incidental take” permits).

## Sections 4(d) and 10 – Incidental Take

Incidental take of a listed species may be broadly authorized under Section 4(d) of the ESA, which authorizes incidental take consistent with certain conditions. Through a Section 4(d) rule, USFWS or NMFS may apply take prohibitions for threatened species but exempt certain programs or activities if they meet the requirements specified in the rule. NMFS may apply a Section 4(d) rule either at the time of listing or subsequently. A good example is the 4(d) rule that protects anglers if they accidentally catch a protected listed fish species, provided that they release it unharmed.

In cases where a nonfederal entity is undertaking an action that does not require federal authorization, the take of listed species must be permitted by USFWS or NMFS through Section 10 of the ESA. If the proposed action would result in the incidental take of a listed species, the applicant must first obtain a Section 10(a)(1)(B) incidental take permit (ITP). *Incidental take* under Section 10 is defined as take of federally listed fish and wildlife species “that is incidental to, but not the purposes of, otherwise lawful activities.” To receive an ITP, the nonfederal entity is required to

prepare a habitat conservation plan (HCP). The HCP must include conservation measures that avoid, minimize, and mitigate the project's impacts on listed species and their habitat.

### Section 4(f) – Recovery Plans

Section 4(f) of the ESA requires that recovery plans be prepared for listed species. Recovery is the improvement of the status of the listed species to the point at which listing is no longer required. Recovery plans are guidance documents, not regulatory documents (NMFS 2009, <http://www.nwr.noaa.gov/Salmon-Recovery-Planning/ESA-Recovery-Plans/Index.cfm>). Recovery plans are intended to inform the recovery process for each species and for implementing the ESA as a whole (for example by providing a framework for Section 7 consultations, development of an HCP under Section 10, formulation of special rules under Section 4[d], and designation of critical habitat).

## Clean Water Act

The CWA is the primary federal law protecting the quality of the nation's surface waters, including lakes, rivers, and coastal wetlands. The CWA empowers the EPA to set national water quality standards and effluent limitations, and includes programs addressing both point-source and nonpoint-source pollution. *Point-source pollution* originates or enters surface waters at a single, discrete location, such as an outfall structure or an excavation or construction site. *Nonpoint-source pollution* originates over a broader area and includes urban contaminants in storm water runoff and sediment loading from upstream areas. The CWA operates on the principle that all discharges into the nation's waters are unlawful unless they are specifically authorized by a permit; permit review is the CWA's primary regulatory tool.

### Section 404 – Permits for Discharges of Fill in Waters and Wetlands

CWA Section 404 regulates the discharge of dredged and fill materials into waters of the United States. *Waters of the United States* refers to oceans, bays, rivers, streams, lakes, ponds, and wetlands, including any of the features listed below.

- Areas within the ordinary high water mark (OHWM) of a stream, including non-perennial streams with a defined bed and bank and any stream channel that conveys natural runoff, even if it has been realigned.
- Seasonal and perennial wetlands, including coastal wetlands.

On January 9, 2001, the U.S. Supreme Court made a decision in *Solid Waste Agency of Northern Cook County v. United States Army Corps of Engineers* (121 S. Ct. 675 [2001]), generally referred to as *SWANCC*, that affected U.S. Army Corps of Engineers (USACE) jurisdiction in isolated waters. Based on *SWANCC*, USACE no longer has jurisdiction or regulates isolated wetlands (i.e., wetlands with no hydrologic connection to waters of the United States).

Applicants must obtain a permit from USACE for all discharges of dredged or fill material into waters of the United States, including adjacent wetlands, before proceeding with a proposed activity. USACE may issue an individual permit evaluated on a case-by-case basis or a general permit evaluated at a program level for a series of related activities. General permits are preauthorized and are issued to cover multiple instances of similar activities expected to cause only minimal adverse environmental effects. Nationwide permits (NWP) are a type of general permit issued to cover particular fill activities. Each NWP specifies particular conditions that must be met for the NWP to apply to a particular project, including acreage limits on the extent of fill.



Compliance with Section 404 requires compliance with several other environmental laws and regulations. USACE cannot issue an individual permit or verify the use of a general permit until the requirements of the National Environmental Policy Act (NEPA), ESA, and the NHPA have been met. In addition, USACE cannot issue or verify any permit until a water quality certification has been issued pursuant to CWA Section 401.

## **Section 401 – Water Quality Certification**

Under CWA Section 401, applicants for a federal license or permit to conduct activities that may result in the discharge of a pollutant into waters of the United States must obtain certification from the state in which the discharge would originate or, if appropriate, from the interstate water pollution control agency with jurisdiction over affected waters at the point where the discharge would originate. Therefore, all projects with a federal component that may affect state water quality, including projects that require federal agency approval, such as issuance of a Section 404 permit, must also comply with Section 401.

## **Migratory Bird Treaty Act**

The Migratory Bird Treaty Act (MBTA) (16 USC 703) enacts the provisions of treaties between the United States, Great Britain, Mexico, Japan, and the Soviet Union; the act authorizes the U.S. Secretary of the Interior to protect and regulate the taking of migratory birds. It establishes seasons and bag limits for hunted species and protects migratory birds, their occupied nests, and their eggs (16 USC 703; 50 CFR 21, 10). Most actions that result in taking of or permanent or temporary possession of a protected species constitute violations of the MBTA. The MBTA also prohibits destruction of occupied nests. The Migratory Bird Permit Memorandum (MBPM-2) dated April 15, 2003, clarifies that destruction of most unoccupied bird nests is permissible under the MBTA; exceptions include nests of federally threatened or endangered migratory birds, bald eagles, and golden eagles. USFWS is responsible for overseeing compliance with the MBTA. Most bird species and their occupied nests that occur in the program area would be protected under the MBTA.

## **Bald and Golden Eagle Protection Act**

The Bald and Golden Eagle Protection Act makes it illegal to import, export, take (which includes molest or disturb), sell, purchase, or barter any bald eagle (*Haliaeetus leucocephalus*) or golden eagle (*Aquila chrysaetos*), or parts thereof. The USFWS oversees enforcement of this act. The 1978 amendment authorizes the U.S. Secretary of the Interior to permit the taking of golden eagle nests that interfere with resource development or recovery operations.

## **State**

### **California Endangered Species Act**

The CESA (California Fish and Game Code [CFG] Sections 2050–2068) generally parallels the main provisions of the ESA (16 USC 1531–1544) and is administered by the California Department of Fish and Game (DFG). A state lead agency is required to consult with DFG to ensure that any action it undertakes is not likely to jeopardize the continued existence of any endangered or threatened species, or result in the destruction or adverse modification of essential habitat.

The CESA prohibits taking of listed species except as otherwise provided in state law. Unlike the ESA, the CESA applies the take prohibitions to species under petition for listing (state candidates) in addition to listed species.

Section 2081 of the CFGC expressly allows DFG to authorize the incidental take of endangered, threatened, and candidate species if all of the following conditions are met:

- The take is incidental to an otherwise lawful activity,
- The impacts of the authorized take are minimized and fully mitigated,
- Issuance of the permit will not jeopardize the continued existence of the species,
- The permit is consistent with any regulations adopted in accordance with Sections 2112 and 2114 (legislature-funded recovery strategy pilot programs in the affected area), and
- The applicant ensures that adequate funding is provided for implementing mitigation measures and monitoring compliance with these measures and their effectiveness.

The CESA provides that an incidental take permit obtained under the ESA may authorize the taking of the same species if it is listed under the CESA, with no further CESA authorization or approval required (CFGC Section 2080.1).

Regarding rare plant species, CESA defers to the California Native Plant Protection Act (CNPPA), which prohibits importing rare and endangered plants into California, taking rare and endangered plants, and selling rare and endangered plants. State-listed plants are protected mainly in cases where state agencies are involved in projects subject to CEQA. In these cases, plants listed as rare under the CNPPA are not protected under the CESA but can be protected under CEQA.

## California Environmental Quality Act

CEQA is the regulatory framework by which California public agencies identify and mitigate significant environmental impacts. Although threatened and endangered species are protected by specific federal and state laws, the State CEQA Guidelines Section 15380(b) provides that a species not listed under the ESA or the CESA may be considered rare or endangered if it can be shown that the species meets certain specific criteria. The criteria have been modeled after the definitions of the ESA and sections of the CFGC discussing rare and endangered plants and animals.

A project normally is considered to result in a significant environmental effect (in the context of biological resources) if it *substantially* adversely affects a threatened, endangered, or rare species or *substantially* adversely affects the habitat of such species; *substantially* adversely affects wetlands under jurisdiction of Section 404 of the CWA; *substantially* interferes with the movement of native resident or migratory fish or wildlife; conflicts with any local policies or ordinances protecting biological resources, such as a tree preservation policy; or conflicts with the provisions of an adopted HCP, Natural Community Conservation Plan, or other approved local, regional, or state HCP. Substantial evidence includes fact, a reasonable assumption predicated on fact, or expert opinion supported by fact. The State CEQA Guidelines define rare, threatened, or endangered species as those listed under the ESA and the CESA, as well as any other species that meets the criteria of the resource agencies or local agencies—for example, DFG-designated species of special concern and plant species identified by the California Native Plant Society (CNPS) as being of conservation interest. The State CEQA Guidelines specify that the lead agency (in this case, the Central Valley Water Board) preparing a CEQA compliance document must consult with and receive written

findings from USFWS and DFG concerning project impacts on species that are listed as endangered or threatened. The effects of the project on these species and habitats will be important in determining whether the project is considered to cause significant environmental impacts under CEQA. Although DFG does not specifically regulate the discharge or placement of material into wetlands (or waters of the state), impacts on these sensitive habitats also could be considered significant under CEQA—depending on the magnitude of impact.

## California Fish and Game Code

### Section 1602 – Streambed Alteration Agreements

Under CFGC Section 1602, public agencies are required to notify DFG before undertaking any project that would divert, obstruct, or change the natural flow, bed, channel, or bank of any river, stream, or lake. Regulation also generally includes riparian habitat adjacent to these water features. Preliminary notification and project review generally occur during the environmental process. When an existing fish or wildlife resource may be substantially adversely affected, DFG is required to propose reasonable project changes to protect the resources. These modifications are formalized in a streambed alteration agreement (SAA) that becomes part of the plans, specifications, and bid documents for the project.

### Sections 3503 and 3503.5 – Occupied Bird Nests

Section 3503 of the CFGC prohibits killing birds and destruction of occupied bird nests. Sections 3503.5 and 3515 prohibit killing raptor and passerine species and destruction of occupied raptor and passerine nests. Consultation with DFG will be required if nesting birds will be affected by project-related activities.

### Fully Protected Species

The CFGC prohibits take of *fully protected species*. Section 5050 lists fully protected amphibians and reptiles, Section 3511 lists fully protected birds, and Section 4700 lists fully protected mammals. The CFGC defines *take* as “hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill.” Except for take related to scientific research, all take of fully protected species is prohibited. DFG cannot issue take permits for fully protected species.

### Section 3513 – Migratory Birds

Section 3513 of the CFGC prohibits the take or possession of any migratory non-game bird as designated in the MBTA, or any part of such migratory non-game bird, except as provided by rules and regulations adopted by the U.S. Secretary of the Interior under provisions of the MBTA.

## Regulatory Classification of Special-Status Species

*Special-status species* are plants and animals that are legally protected under state and federal Endangered Species Acts or other regulations, and species that are considered sufficiently rare by the scientific community to qualify for such listing. Special-status plants and animals are species in the following categories:

- Species listed or proposed for listing as threatened or endangered under the ESA (50 CFR 17.12 [listed plants], 50 CFR 17.11 [listed animals], and various notices in the Federal Register [FR] [proposed species]);
- Species that are candidates for possible future listing as threatened or endangered under the ESA (73 FR 75176, December 10, 2008; 71 FR 53755, September 12, 2006; 69 FR 24876, May 4, 2004);
- Species listed or proposed for listing by the State of California as threatened or endangered under the CESA (14 CCR 670.5);
- Species that meet the definitions of rare or endangered under CEQA (State CEQA Guidelines, Section 15380);
- Plants listed as rare under the CNPPA (CFCG Sections 1900 et seq.);
- Plants considered by the CNPS to be "rare, threatened, or endangered in California" (Lists 1B and 2 in CNPS 2009);
- Plants listed by the CNPS as plants about which more information is needed to determine their status and plants of limited distribution (Lists 3 and 4 in CNPS 2009), which may be included as special-status species on the basis of local significance or recent biological information;
- Animal species of special concern to DFG (Remsen 1978 [birds], Williams 1986 [mammals], and Jennings and Hayes 1994 [amphibians and reptiles]); and
- Animals fully protected in California (CFCG Sections 3511 [birds], 4700 [mammals], and 5050 [amphibians and reptiles]).

Special-status species included in the analysis of impacts were limited to those listed under the ESA or the CESA and other species that DFG has designated as species of special concern. Inclusion in the impact analysis was based on overlapping of the species ranges with the program area, based on records from the California Natural Diversity Database (CNDDB) (2009). Also see "Regulatory Classification of Special-Status Species" in Section 5.8, Fisheries.

### 5.7.3 Environmental Setting

This section describes the habitat types and resources in the program area. Most of the habitat in irrigated lands in the program area is agricultural or managed wetland, although some natural terrestrial habitats also could be affected, such as annual grasslands. The following sections are subdivided into the two main categories of irrigated lands within the program area, agricultural lands and managed wetlands.

#### Agricultural Lands

Agricultural lands include irrigated lands used for crop production, any man-made structure used for agricultural purposes, and raising livestock. These areas are usually located on flat to gently rolling terrain in all three hydrologic basins of the program area. Habitat types on agricultural lands include cropland, orchard, vineyard, and pasture.

Irrigated croplands typically comprise row crops planted in monocultures. Natural vegetation and weeds are generally eliminated by flood irrigation, tillage, and herbicide application. Orchards and

vineyards usually contain single tree, shrub, or vine species planted in rows. A low-growing herbaceous understory or cover crop may be present but is generally managed to control overgrowth. Irrigated pasture consists of perennial grasses and legumes planted for livestock forage, although the vegetation may include native grasses and forbs and weedy non-natives. Pastures are managed to improve forage quality using irrigation, fertilizer application, and weed control. Natural habitats occur adjacent to many agricultural lands, most commonly annual grassland, seasonal wetland, vernal pool, saltbush scrub, riparian woodland, and oak woodland.

Much of the natural communities in the Central Valley have been largely replaced by agricultural habitats, with varying effects to wildlife. The intensive management of irrigated lands, especially croplands, orchards, and vineyards, including disking, crop rotation, and the use of pesticides and herbicides, further reduces the value of these agricultural lands for wildlife. However, many wildlife species have adapted to agricultural lands and use them for foraging and breeding. Compared to other agricultural crops, rice and grain are considered high-value crops for wildlife because many wildlife species, especially water fowl, forage in waste grain fields, and flooded rice fields provide habitat similar to natural wetlands. Irrigated pastures also provide foraging and breeding habitat. Orchards provide moderate-quality habitat because they are used by many species of birds for nesting habitat, but orchards provide only limited foraging habitat for wildlife. Row crops, cotton fields, and vineyards provide low-quality habitat for wildlife species because they are frequently disturbed, and require applications of herbicides and pesticides. Consequently, these croplands provide limited foraging and breeding opportunities and minimal cover.

## Managed Wetlands

California wetland ecosystems have been heavily modified by flood control, water storage, and water conveyance projects that altered the natural hydrology of the Central Valley, which once supported over 4 million acres of wetlands (Kwasny et al. 2004:3). Much of the remaining wetlands in the Central Valley are managed by artificial flooding to mimic the natural hydrology of wetland systems. The total acreage of these managed wetlands in the Central Valley watershed, from Modoc National Wildlife Refuge (NWR) in the north to Kern NWR in the south, is approximately 144,000 acres. These wetlands are principally located in the lower elevations of the various subbasins in which they occur. These low areas have traditionally served as the receiving lands for return flows from upland water users.

In the program area, managed wetlands occur in state wildlife areas, in NWRs, and on private lands managed for wildlife habitat. Some of the wildlife areas and refuges also include sensitive natural communities, such as riparian habitats and vernal pools (at the San Luis NWR Complex) adjacent to the managed wetlands. Details of the existing managed wetlands in each subbasin of the program area, including types, acreages, and current management practices, are provided in Chapter 5 of the ECR.

The DFG Lands Program has public lands programs to support, restore, and enhance wetlands for wildlife habitat, as well as several private lands incentive programs, including the California Waterfowl Habitat Program (CWHP) for habitat management, the Permanent Wetland Easement Program for state purchase of farming and development rights, and the Landowner Incentives Program for enhancing habitat (DFG no date). The CWHP includes over 29,000 acres of habitat for wintering and breeding waterfowl in the Tulare Basin, the Grassland Bypass Project Area, Suisun Marsh, and Sacramento Valley (DFG no date). The program pays private landowners to implement management plans that require “moist-soil management” practices, such as spring and summer



irrigation, weed abatement to control the spread of invasive plants, and management of uplands and summer wetlands for breeding ducks.

Managed wetlands typically are flooded using delivered canal water, water diverted from rivers or sloughs, or groundwater from deep well pumping (Kwasny et al. 2004:3). Without this flooding, most managed wetland areas would remain as upland vegetation or as seasonally wet areas only in heavy rain years. Infrastructure in managed wetlands includes levees, water control structures, and other features to control the timing, depth, and duration of flooding. The control of flooding allows implementation of habitat management practices to create wildlife habitat, including vegetation for food and cover, adequate water quality, and breeding and resting sites. Maintenance of infrastructure in managed wetlands includes activities such as levee inspection and repair; water control structure inspection, repair, and cleaning; ditch and swale cleaning; and pump tests and repair (Kwasny et al. 2004:21–22). All of these maintenance activities result in routine disturbance of vegetation in managed wetlands.

In the Central Valley, managed wetlands are described by three main flooding regimes distinguished by timing and duration: seasonal, semi-permanent, and permanent (Kwasny et al. 2004:4).

## Seasonal Wetlands

Seasonal wetlands comprise approximately from 85 to 95 percent of all managed wetlands (Kwasny et al. 2004:4). They are initially flooded between August and October, remain flooded throughout winter, and are drawn down in spring—between March and May. Spring drawdown concentrates invertebrates in receding wetlands to provide forage for migratory waterfowl and shorebirds, and exposes mudflats on which wetland plants germinate. Following drawdown, most seasonal wetlands remain dry in summer. Of the managed wetland types, seasonal wetlands typically have the greatest diversity of vegetation and water depths, number of species (both plant and animal), and abundance of migratory birds and other wetland-dependent wildlife on an annual basis.

Irrigated seasonal wetlands receive water one to three times between April and June each year, depending on the food plants desired and geographic location of the area. These wetlands, along with non-irrigated seasonal wetlands, are then flooded in early fall and maintained through winter until February or March, when they are gradually drawn down to achieve desired soil temperatures for germination of desired food plants. Plant species promoted in managed seasonal wetlands include non-native species such as swamp timothy (*Crypsis schoenoides*) and watergrass (*Echinochloa crus-galli*) and native species such as smartweed (*Polygonum lapathifolium*). Irrigation also may be used to control plant species that are undesirable for wildlife, such as cocklebur (*Xanthium strumarum*) (Kwasny et al. 2004:4). Depending on spring weather conditions, the type of wetland vegetation that is being encouraged, or the need to discourage certain species, irrigation can occur any time from May through July and can vary in both frequency and duration. Following irrigation, when soils are dry enough to support heavy equipment, managed wetlands are disced and mowed for weed control and enhancement of seed-producing wetland plants for waterfowl (Kwasny et al. 2004:4, 18–20).

## Semi-Permanent and Permanent Wetlands

Semi-permanent and permanent wetlands are less common than managed seasonal wetlands and comprise only from 5 to 15 percent of the total managed wetlands in the Central Valley (Kwasny et al. 2004:5). Semi-permanent wetlands, also known as “brood ponds,” typically are flooded from

October through mid-July, and permanent wetlands are flooded year-round. These habitat types are often characterized by a combination of open water, emergent vegetation, and submergent aquatic vegetation. Common plant species in semi-permanent and permanent wetlands include native species, such as cattails (*Typha* spp.), tules (*Schoenoplectus* [*Scirpus*] *acutus*), other bulrushes, horned-pondweed (*Zannichellia palustris*), and sago pondweed (*Stuckenia pectinata* [*Potamogeton pectinatus*]). These wetlands provide important habitat for resident wildlife, and provide breeding and molting habitats for waterfowl at a time of year when most seasonal wetlands are dry (Kwasny et al. 2004:5). The semi-permanent wetlands are usually dewatered for 2–3 months around July of each year and may be re-flooded for the fall and winter waterfowl migrations. Permanent wetlands typically are drawn down only every 3–5 years to recycle nutrients, increase productivity, and, in some cases, control undesirable fish populations (e.g., carp). Both types of wetlands are commonly disced, mowed, burned, hayed, or grazed to control vegetation (Kwasny et al. 2004:5. 18–20).

## Special-Status Species

### Plants

Tables 5.7-1a, 5.7-1b, and 5.7-1c are specific for each of the three hydrologic basins and include status, location, and habitat information for state and federally listed plant species documented as occurring in the program area counties (CNDDB 2009). Several hundred more non-listed special-status plant species are documented by the CNDDB as occurring in the program area, but they are too numerous for inclusion in a table.

### Agricultural Lands

Special-status plants would not be expected to occur in irrigated croplands, orchards, or vineyards because they are usually eliminated by cultivation practices. They are also unlikely to occur in irrigated pastures because of the habitat modification and intense grazing. The habitats most similar to irrigated pasture are grasslands, including annual grassland and meadows, which may support vernal pools and other seasonal wetlands.

### Managed Wetlands

Although managed seasonal wetlands provide suitable hydrologic conditions for special-status seasonal wetland and vernal pool species, the routine disturbances experienced in managed wetlands for maintenance activities make these areas unlikely to support special-status plants. Similarly, the managed semi-permanent wetlands could provide suitable hydrological conditions for special-status freshwater marsh species but are unlikely to support these species due to ongoing disturbances of the habitat.

### Wildlife

Tables 5.7-2a, 5.7-2b, and 5.7-2c are specific for each of the three hydrologic basins and include status, location, and habitat requirements of the special-status wildlife species that could occur within them. Documentation of occurrence of these species was based on the CNDDB (2009).

## **Agricultural Lands**

Many special-status wildlife species could occur on irrigated lands in the Central Valley. Grain crops and irrigated pastures provide important foraging habitat for many special-status birds, including greater sandhill crane, Swainson's hawk, burrowing owls, and other raptors. Flooded rice fields provide aquatic habitat for giant garter snakes.

## **Managed Wetlands**

Managed seasonal wetlands provide suitable hydrologic conditions for seasonal wetland and vernal pool species and could support special-status wildlife species that are adapted to these habitat conditions. Similarly, the managed semi-permanent wetlands could provide suitable hydrological conditions for special-status wildlife species that are adapted to these habitat conditions.

**Table 5.7-1a. State-Listed and Federally Listed Plants with Potential to Occur in the Program Area – Sacramento Valley Basin**

| <b>Common and Scientific Name</b>                                     | <b>Legal Status<sup>a</sup><br/>Federal/State/<br/>CNPS</b> | <b>Geographic Distribution/Floristic<br/>Province<sup>b</sup></b>                                               | <b>Habitat Requirements</b>                                                                                                               | <b>Blooming<br/>Period</b>          |
|-----------------------------------------------------------------------|-------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| McDonald's rock-cress<br><i>Arabis macdonaldiana</i>                  | E/E/1B.1                                                    | North Coast Ranges and Klamath Ranges: Mendocino, Siskiyou, Trinity, Del Norte County; Josephine County, Oregon | Serpentine soils in lower montane coniferous forest, North Coast coniferous forest, and upper montane coniferous forest; 135–1,800 meters | May–July                            |
| Clara Hunt's milk-vetch<br><i>Astragalus claranus</i>                 | E/T/1B.1                                                    | Southern portion of the North Coast Ranges: endemic to Napa and Sonoma Counties                                 | Serpentine, volcanic, rocky, or clay soils in chaparral openings, cismontane woodland, valley and foothill grassland; 75–275 meters       | March–May                           |
| Indian Valley brodiaea<br><i>Brodiaea coronaria</i> ssp. <i>rosea</i> | –/E/1B.1                                                    | Inner north Coast Ranges: Colusa, Glenn, Lake, and Tehama Counties                                              | Serpentine soils in closed-cone coniferous forest, chaparral, cismontane woodland, valley and foothill grassland; 335–1,450 meters        | May–June                            |
| Siskiyou mariposa-lily<br><i>Calochortus persistens</i>               | C/R/1B.2                                                    | Northeastern Klamath Ranges in Siskiyou County; also adjacent Oregon                                            | Rocky areas in lower montane coniferous forest, North Coast coniferous forest; 1,000–1,860 meters                                         | June–July                           |
| Stebbins' morning-glory<br><i>Calystegia stebbinsii</i>               | E/E/1B.1                                                    | Northern Sierra Nevada Foothills with reported occurrences in El Dorado and Nevada Counties                     | Serpentine or gabbroic soils in chaparral openings, cismontane woodland; 185–730 meters                                                   | (March) April–July                  |
| Tiburon paintbrush<br><i>Castilleja affinis</i> ssp. <i>neglecta</i>  | E/T/1B.2                                                    | San Francisco Bay Area: Marin, Napa, and Santa Clara Counties                                                   | Serpentine grasslands; 60–400 meters                                                                                                      | April–June                          |
| Pine Hill ceanothus<br><i>Ceanothus roderickii</i>                    | E/R/1B.2                                                    | Endemic to El Dorado County                                                                                     | Serpentine or gabbro soils in chaparral or cismontane woodland; 260–630 meters                                                            | April–June                          |
| Hoover's spurge<br><i>Chamaesyce hooveri</i>                          | T/–/1B.2                                                    | Central Valley from Butte to Tehama Counties                                                                    | Below high water marks of large northern hardpan and volcanic vernal pools; 25–250 meters                                                 | July–September (uncommonly October) |
| Ashland thistle<br><i>Cirsium ciliolatum</i>                          | –/E/2.1                                                     | Klamath Ranges, Siskiyou County; Oregon                                                                         | Cismontane woodland, valley and foothill grassland; 800–1,400 meters                                                                      | June–August                         |
| Suisun thistle<br><i>Cirsium hydrophilum</i> var. <i>hydrophilum</i>  | E/–/1B.1                                                    | Suisun Marsh, Solano County                                                                                     | Salt marshes and swamps; at sea level                                                                                                     | July–September                      |

| Common and Scientific Name                                              | Legal Status <sup>a</sup><br>Federal/State/<br>CNPS | Geographic Distribution/Floristic<br>Province <sup>b</sup>                                                       | Habitat Requirements                                                                                                                | Blooming<br>Period |
|-------------------------------------------------------------------------|-----------------------------------------------------|------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| Soft bird's-beak<br><i>Cordylanthus mollis</i> ssp.<br><i>mollis</i>    | E/R/1B.2                                            | Northern Central Coast with occurrences in Contra Costa, Marin*, Napa, Sacramento*, Solano, and Sonoma* Counties | Coastal salt marshes and swamps; below 3 meters                                                                                     | July–November      |
| Palmate-bracted bird's-beak<br><i>Cordylanthus palmatus</i>             | E/E/1B.1                                            | Livermore Valley and scattered locations in the Central Valley from Colusa to Fresno Counties                    | Alkaline grassland, alkali meadow, chenopod scrub; 5–155 meters                                                                     | May–October        |
| Tracy's eriastrum<br><i>Eriastrum tracyi</i>                            | –/R/1B.2                                            | Colusa, Glenn, Santa Clara, Tehama, and Trinity Counties                                                         | Chaparral, cismontane woodland, on gravelly shale or clay soils, often in open areas; 315–975 meters                                | June–July          |
| Trinity buckwheat<br><i>Eriogonum alpinum</i>                           | –/E/1B.2                                            | Siskiyou and Trinity Counties                                                                                    | On serpentinite in rocky areas in alpine boulder and rock field, subalpine and upper montane coniferous forests; 2,185–2,900 meters | June–September     |
| Ione buckwheat<br><i>Eriogonum apricum</i> var.<br><i>apricum</i>       | E/E/1B.1                                            | Amador and Sacramento Counties                                                                                   | Openings in chaparral on Ione soil; 60–145 meters                                                                                   | July–October       |
| Loch Lomond button-celery<br><i>Eryngium constancei</i>                 | E/E/1B.1                                            | Lake, Napa, and Sonoma Counties: Loch Lomond and Diamond Mountain                                                | Volcanic ash flow vernal pools; 460–855 meters                                                                                      | April–June         |
| Pine Hill flannelbush<br><i>Fremontodendron decumbens</i>               | E/R/1B.2                                            | Pine Hill area in El Dorado County, Grass Valley vicinity in Nevada County, Yuba County                          | Rocky gabbro or serpentinite soils in chaparral, cismontane woodland; 425–760 meters                                                | April–July         |
| Gentner's fritillary<br><i>Fritillaria gentneri</i>                     | E/–/1B.1                                            | High Cascade Range in Siskiyou County                                                                            | Chaparral and cismontane woodland, sometimes on serpentine soils; 1,005–1,120 meters                                                | April–May          |
| El Dorado bedstraw<br><i>Galium claifornicum</i> ssp.<br><i>sierrae</i> | E/R/1B.2                                            | Endemic to El Dorado County                                                                                      | On gabbroic soils in chaparral, cismontane woodland, lower montane coniferous forest; 100–585 meters                                | May–June           |
| Boggs Lake hedge hyssop<br><i>Gratiola heterosepala</i>                 | –/E/1B.2                                            | Inner North Coast Ranges, central Sierra Nevada foothills, Sacramento Valley, Modoc Plateau                      | Clay soils in marshes and swamps along lake margins and vernal pools; 10–2,375 meters                                               | April–August       |



| Common and Scientific Name                                                       | Legal Status <sup>a</sup><br>Federal/State/<br>CNPS | Geographic Distribution/Floristic<br>Province <sup>b</sup>                                                                            | Habitat Requirements                                                                                                    | Blooming<br>Period |
|----------------------------------------------------------------------------------|-----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|--------------------|
| Lake County western flax<br><i>Hesperolinon didymocarpum</i>                     | -/E/1B.2                                            | Southern Inner North Coast Ranges, northeast San Francisco Bay region, especially Mt. Diablo: Contra Costa, Napa, and Solano Counties | Chaparral, cismontane woodland, valley and foothill grassland usually on soils derived from serpentinite; 30–900 meters | May–July           |
| Burke's goldfields<br><i>Lasthenia burkei</i>                                    | E/E/1B.1                                            | Lake, Mendocino, and Sonoma Counties                                                                                                  | Wet meadows and seeps, vernal pools; 15–600 meters                                                                      | April–June         |
| Contra Costa goldfields<br><i>Lasthenia conjugens</i>                            | E/-/1B.1                                            | North Coast, southern Sacramento Valley, San Francisco Bay, South Coast                                                               | Mesic areas in cismontane woodland, alkaline playas, valley and foothill grassland, vernal pools; below 470 meters      | March–June         |
| Mason's lilaeopsis<br><i>Lilaeopsis masonii</i>                                  | -/R/1B.1                                            | Southern Sacramento Valley, northeastern San Francisco Bay                                                                            | Riparian scrub, brackish or freshwater marshes and swamps; below 10 meters                                              | April–November     |
| Butte County meadowfoam<br><i>Limnanthes floccosa</i> ssp. <i>californica</i>    | E/E/1B.1                                            | Endemic to Butte County                                                                                                               | Mesic areas in valley and foothill grassland, vernal pools and swales; 46–930 meters                                    | March–May          |
| Sebastopol meadowfoam<br><i>Limnanthes vinculans</i>                             | E/E/1B.1                                            | Napa? and Sonoma Counties                                                                                                             | Vernal pools, vernal mesic grasslands and wet meadows; 15–305 meters                                                    | April–May          |
| Milo Baker's lupine<br><i>Lupinus milo-bakeri</i>                                | -/T/1B.1                                            | North Coast Ranges in Colusa and Mendocino Counties                                                                                   | Valley and foothill grasslands, along streams, ditches, and often along roads in foothill woodlands; 395–430 meters     | June–September     |
| Few-flowered navarretia<br><i>Navarretia leucocephala</i> ssp. <i>pauciflora</i> | E/T/1B.1                                            | Lake and Napa Counties                                                                                                                | Volcanic ash/mud flow vernal pools; 400–855 meters                                                                      | May–June           |
| Many-flowered navarretia<br><i>Navarretia leucocephala</i> ssp. <i>plieantha</i> | E/E/1B.1                                            | Lake and Sonoma Counties                                                                                                              | Volcanic ash/mud flow vernal pools; 30–950 meters                                                                       | May–June           |
| Colusa grass<br><i>Neostapfia colusana</i>                                       | T/E/1B.1                                            | Central Valley with scattered occurrences from Colusa to Merced Counties                                                              | Adobe soils of vernal pools; 5–200 meters                                                                               | May–August         |
| San Joaquin Valley Orcutt grass<br><i>Orcuttia inaequalis</i>                    | T/E/1B.1                                            | Scattered locations along east edge of the San Joaquin Valley and adjacent foothills, from Stanislaus County to Tulare County         | Vernal pools; 10–755 meters                                                                                             | April–September    |
| Hairy Orcutt grass<br><i>Orcuttia pilosa</i>                                     | E/E/1B.1                                            | Scattered locations along east edge of Central Valley and adjacent foothills from Tehama to Merced Counties                           | Vernal pools; 46–200 meters                                                                                             | May–September      |

| Common and Scientific Name                                                    | Legal Status <sup>a</sup><br>Federal/State/<br>CNPS | Geographic Distribution/Floristic<br>Province <sup>b</sup>                               | Habitat Requirements                                                                                                                          | Blooming<br>Period                       |
|-------------------------------------------------------------------------------|-----------------------------------------------------|------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| Slender Orcutt grass<br><i>Orcuttia tenuis</i>                                | T/E/1B.1                                            | Inner North Coast Ranges, Cascade Range<br>foothills, Sacramento County                  | Vernal pools; 35–1,760 meters                                                                                                                 | May–September<br>(uncommonly<br>October) |
| Sacramento Orcutt grass<br><i>Orcuttia viscida</i>                            | E/E/1B.2                                            | Known only from Sacramento County                                                        | Vernal pools; 30–100 meters                                                                                                                   | April–July                               |
| Layne's ragwort<br><i>Packera layneae</i>                                     | T/R/1B.2                                            | Northern Sierra Nevada Foothills, Butte,<br>El Dorado, Tuolumne, and Yuba Counties       | Rocky serpentinite or gabbro soils in<br>chaparral and foothill woodland; 200–<br>1,000 meters                                                | April–August                             |
| Yreka phlox<br><i>Phlox hirsuta</i>                                           | E/E/1B.2                                            | Siskiyou County                                                                          | Lower and upper montane coniferous forest,<br>on serpentinite talus slopes; 820–<br>1,500 meters                                              | April–June                               |
| Calistoga popcorn-flower<br><i>Plagiobothrys strictus</i>                     | E/T/1B.1                                            | Napa County, near Calistoga                                                              | Alkaline areas near thermal springs; 90–<br>160 meters                                                                                        | March–June                               |
| Napa blue grass<br><i>Poa napensis</i>                                        | E/E/1B.1                                            | Napa County, near Calistoga                                                              | Alkaline areas near thermal springs; 100–<br>200 meters                                                                                       | May–August                               |
| Hartweg's golden sunburst<br><i>Pseudobahia bahiifolia</i>                    | E/E/1B.1                                            | Central Sierra Nevada foothills, eastern<br>San Joaquin Valley                           | Clay soils in cismontane woodland, valley<br>and foothill grassland; 15–150 meters                                                            | March–April                              |
| Tahoe yellow cress<br><i>Rorippa subumbellata</i>                             | C/E/1B.1                                            | Lake Tahoe Basin: El Dorado, Nevada*,<br>and Placer Counties; also adjacent<br>Nevada    | Lower montane coniferous forest, meadows<br>and seeps, on decomposed granitic beaches;<br>1,895–1,900 meters                                  | May–September                            |
| Lake County stonecrop<br><i>Sedella leiocarpa</i>                             | E/E/1B.1                                            | Known from fewer than five occurrences<br>in Lake County                                 | Vernally mesic depressions on volcanic<br>outcrops in cismontane woodland, valley<br>and foothill grassland, vernal pools; 365–<br>790 meters | April–May                                |
| Keck's checkerbloom<br><i>Sidalcea keckii</i>                                 | E/–/1B.1                                            | Fresno and Tulare Counties                                                               | Serpentine clay soils in cismontane<br>woodland, valley and foothill grassland;<br>120–425 meters                                             | April–May                                |
| Scadden Flat<br>checkerbloom<br><i>Sidalcea stipularis</i>                    | –/E/1B.1                                            | Two occurrences near Scadden Flat,<br>Nevada County                                      | Freshwater seep, wet meadow, montane<br>freshwater marshes and swamps; 700–<br>730 meters                                                     | July–August                              |
| Red Mountain catchfly<br><i>Silene campanulata</i> ssp.<br><i>campanulata</i> | –/E/4.2                                             | North Coast Ranges: Colusa, Glenn,<br>Mendocino, Shasta, Tehama, and Trinity<br>Counties | On soils derived from serpentine substrates<br>on rocky slopes in Jeffrey pine forest and<br>mixed chaparral; 425–2,085 meters                | April–July                               |

| Common and Scientific Name                         | Legal Status <sup>a</sup><br>Federal/State/<br>CNPS | Geographic Distribution/Floristic<br>Province <sup>b</sup>                                                               | Habitat Requirements                                                                              | Blooming<br>Period                 |
|----------------------------------------------------|-----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|------------------------------------|
| Showy rancheria clover<br><i>Trifolium amoenum</i> | E/-/1B.1                                            | Coast Ranges foothills in the San Francisco Bay region, currently known from only two recent occurrences in Marin County | Valley and foothill grassland, coastal bluff scrub, sometimes on serpentinite soils; 5–415 meters | April–June                         |
| Greene's tuctoria<br><i>Tuctoria greenei</i>       | E/R/1B.1                                            | Scattered distribution along eastern Central Valley and foothills from Shasta to Tulare Counties                         | Dry vernal pools; 30–1,070 meters                                                                 | May–July<br>(uncommonly September) |
| Crampton's tuctoria<br><i>Tuctoria mucronata</i>   | E/E/1B.1                                            | Southwestern Sacramento Valley, Solano and Yolo Counties                                                                 | Mesic areas in valley and foothill grassland, vernal pools; 5–10 meters                           | April–August                       |

<sup>a</sup> Status explanations:

**Federal**

- C = candidate for listing under the federal Endangered Species Act.
- E = listed as endangered under the federal Endangered Species Act.
- T = listed as threatened under the federal Endangered Species Act.
- = no listing.

**State**

- E = listed as endangered under the California Endangered Species Act.
- T = listed as threatened under the California Endangered Species Act.
- R = listed as rare under the California Native Plant Protection Act (this category is no longer used for newly listed plants, but some plants previously listed as rare retain this designation).
- = no listing.

**California Native Plant Society (CNPS)**

- 1B = List 1B species: rare, threatened, or endangered in California and elsewhere.
- 4 = List 4 species: limited distribution and on a watch list.
- 0.1 = seriously endangered in California.
- 0.2 = fairly endangered in California.
- \* = presumed extirpated from that county.
- ? = occurrence within county needs to be confirmed.

<sup>b</sup> Floristic provinces as defined in Hickman 1993.

**Table 5.7-1b. State-Listed and Federally Listed Plants with Potential to Occur in the Program Area – San Joaquin Valley Basin**

| <b>Common and Scientific Name</b>                           | <b>Legal Status<sup>a</sup><br/>Federal/State/<br/>CNPS</b> | <b>Geographic Distribution/Floristic<br/>Province<sup>b</sup></b>                                                                               | <b>Habitat Requirements</b>                                                                                                                                      | <b>Blooming<br/>Period</b> |
|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
| Yosemite onion<br><i>Allium yosemitense</i>                 | -/R/1B.3                                                    | Central Sierra Nevada: Mariposa and Tuolumne Counties                                                                                           | Rocky, metamorphic or granite soils in broadleaved upland forest, chaparral, cismontane woodland, lower montane coniferous forest; 535–2,200 meters              | April–July                 |
| Large-flowered fiddleneck<br><i>Amsinckia grandiflora</i>   | E/E/1B.1                                                    | Historically known from Mt. Diablo foothills in Alameda, Contra Costa, and San Joaquin Counties; currently known from three natural occurrences | Cismontane woodland, valley and foothill grassland; 275–550 meters                                                                                               | April–May                  |
| Ione manzanita<br><i>Arctostaphylos myrtifolia</i>          | T/-/1B.2                                                    | Central Sierra Nevada Foothills, Amador and Calaveras Counties                                                                                  | Acidic, lone soil, clay or sandy soils in chaparral and cismontane woodland; 60–580 meters                                                                       | November–February          |
| Pallid manzanita<br><i>Arctostaphylos pallida</i>           | T/E/1B.1                                                    | Eastern San Francisco Bay area, Sobrante and Huckleberry Ridges, Berkeley-Oakland Hills in Alameda and Contra Costa Counties                    | On siliceous sandy or gravelly shales in broadleaved upland forest, closed-cone coniferous forest, chaparral, cismontane woodland, coastal scrub; 185–465 meters | December–March             |
| Chinese Camp brodiaea<br><i>Brodiaea pallida</i>            | T/E/1B.1                                                    | Central Sierra Nevada Foothills, near Chinese Camp, Calaveras and Tuolumne Counties                                                             | Serpentine soils in valley and foothill grassland, vernal swales and streambeds; 385 meters                                                                      | May–June                   |
| Mariposa pussypaws<br><i>Calyptridium pulchellum</i>        | T/-/1B.1                                                    | Central Sierra Nevada; Fresno, Madera, and Mariposa Counties                                                                                    | Sandy or gravelly areas on granitic soils in chaparral, cismontane woodland; 400–1,220 meters                                                                    | April–August               |
| San Benito evening-primrose<br><i>Camissonia benitensis</i> | T/-/1B.1                                                    | Inner South Coast Ranges with occurrences in Fresno and San Benito Counties                                                                     | Serpentine alluvium, clay or gravelly soils in chaparral, cismontane woodland, valley and foothill grassland; 600–1,280 meters                                   | April–June                 |
| Tompkins' sedge<br><i>Carex tompkinsii</i>                  | -/R/4.3                                                     | Central Sierra Nevada Foothills, southern high Sierra Nevada in Fresno, Mariposa, and Tuolumne Counties                                         | Sometimes granitic soils in chaparral, cismontane woodland, lower and upper montane coniferous forest; 420–1,830 meters                                          | May–July                   |
| Tree-anemone<br><i>Carpenteria californica</i>              | -/T/1B.2                                                    | Central and southern Sierra Nevada Foothills, Kings and San Joaquin Rivers, Fresno and Madera Counties, Contra Costa and Tehama Counties        | Usually granitic soils in chaparral and cismontane woodland; 340–1,340 meters                                                                                    | May–July                   |

| Common and Scientific Name                                                       | Legal Status <sup>a</sup><br>Federal/State/<br>CNPS | Geographic Distribution/Floristic<br>Province <sup>b</sup>                                                                                                                      | Habitat Requirements                                                                                           | Blooming<br>Period                  |
|----------------------------------------------------------------------------------|-----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|-------------------------------------|
| Succulent owl's-clover<br><i>Castilleja campestris</i> ssp.<br><i>succulenta</i> | T/E/1B.2                                            | Eastern edge of San Joaquin Valley and adjacent foothills, from Stanislaus to Fresno Counties                                                                                   | Vernal pools, often on acidic soils; 50–750 meters                                                             | April–May                           |
| California jewel-flower<br><i>Caulanthus californicus</i>                        | E/E/1B.2                                            | Historically common in western San Joaquin Valley and interior foothills; currently known from scattered locations in Fresno, Kern, Santa Barbara, and San Luis Obispo Counties | Sandy soils in valley and foothill grassland, chenopod scrub, and pinyon-juniper woodland; 70–1,000 meters     | February–May                        |
| Hoover's spurge<br><i>Chamaesyce hooveri</i>                                     | T/–/1B.2                                            | Central Valley from Butte to Tehama Counties                                                                                                                                    | Below high water marks of large northern hardpan and volcanic vernal pools; 25–250 meters                      | July–September (uncommonly October) |
| Robust spineflower<br><i>Chorizanthe robusta</i> var.<br><i>robusta</i>          | E/–/1B.1                                            | Coastal central California, from Marin to Monterey Counties                                                                                                                     | Sandy or gravelly areas in coastal scrub, coastal dunes, and openings in cismontane woodland; below 300 meters | April–September                     |
| Presidio clarkia<br><i>Clarkia franciscana</i>                                   | E/E/1B.1                                            | San Francisco Bay, Presidio, Oakland Hills: Alameda and San Francisco Counties                                                                                                  | Serpentine grassland, coastal scrub; 25–335 meters                                                             | May–July                            |
| Merced clarkia<br><i>Clarkia lingulata</i>                                       | –/E/1B.1                                            | Central Sierra Nevada Foothills, Merced River Canyon, Mariposa County                                                                                                           | Closed-cone coniferous forest, chaparral, cismontane woodland; 400–455 meters                                  | May–June                            |
| Soft bird's-beak<br><i>Cordylanthus mollis</i> ssp.<br><i>mollis</i>             | E/R/1B.2                                            | Northern Central Coast with occurrences in Contra Costa, Marin*, Napa, Sacramento*, Solano, and Sonoma* Counties                                                                | Coastal salt marshes and swamps; below 3 meters                                                                | July–November                       |
| Mt. Diablo bird's-beak<br><i>Cordylanthus nidularius</i>                         | –/R/1B.1                                            | Known from one occurrence on Mount Diablo                                                                                                                                       | Chaparral, in grassy or rocky areas within serpentine chaparral; 600–800 meters                                | July–August                         |
| Palmate-bracted bird's-beak<br><i>Cordylanthus palmatus</i>                      | E/E/1B.1                                            | Livermore Valley and scattered locations in the Central Valley from Colusa to Fresno Counties                                                                                   | Alkaline grassland, alkali meadow, chenopod scrub; 5–155 meters                                                | May–October                         |
| Tracy's eriastrum<br><i>Eriastrum tracyi</i>                                     | –/R/1B.2                                            | Colusa, Glenn, Santa Clara, Tehama, and Trinity Counties                                                                                                                        | Chaparral, cismontane woodland, on gravelly shale or clay soils, often in open areas; 315–975 meters           | June–July                           |
| Ione buckwheat<br><i>Eriogonum apricum</i> var.<br><i>apricum</i>                | E/E/1B.1                                            | Amador and Sacramento Counties                                                                                                                                                  | Openings in chaparral on Ione soil; 60–145 meters                                                              | July–October                        |



| Common and Scientific Name                                                 | Legal Status <sup>a</sup><br>Federal/State/<br>CNPS | Geographic Distribution/Floristic<br>Province <sup>b</sup>                                                                                         | Habitat Requirements                                                                                                                              | Blooming<br>Period |
|----------------------------------------------------------------------------|-----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| Irish Hill buckwheat<br><i>Eriogonum apricum</i> var.<br><i>prostratum</i> | E/E/1B.1                                            | Amador County                                                                                                                                      | Openings in chaparral on lone soil; 90–120 meters                                                                                                 | June–July          |
| Congdon's woolly sunflower<br><i>Eriophyllum congdonii</i>                 | –/R/1B.2                                            | Known only from the Merced River drainage in Mariposa County                                                                                       | On rocky metamorphic soils in valley and foothill grassland, chaparral, cismontane woodland, lower montane coniferous forest; 500–1,900 meters    | April–June         |
| Delta button-celery<br><i>Eryngium racemosum</i>                           | –/E/1B.1                                            | San Joaquin River delta, floodplains, and adjacent Sierra Nevada Foothills: Calaveras, Contra Costa, Merced, San Joaquin*, and Stanislaus Counties | Riparian scrub in seasonally inundated depressions on clay soils; 3–30 meters                                                                     | June–September     |
| Boggs Lake hedge hyssop<br><i>Gratiola heterosepala</i>                    | –/E/1B.2                                            | Inner North Coast Ranges, central Sierra Nevada foothills, Sacramento Valley, Modoc Plateau                                                        | Clay soils in marshes and swamps along lake margins and vernal pools; 10–2,375 meters                                                             | April–August       |
| Santa Cruz tarplant<br><i>Holocarpha macradenia</i>                        | T/E/1B.2                                            | Coastal slope of the Santa Cruz Mountains, Monterey and Santa Cruz Counties                                                                        | Coastal terrace grasslands, coastal scrub, often on light sandy to sandy clay soils; 10–220 meters                                                | June–October       |
| Contra Costa goldfields<br><i>Lasthenia conjugens</i>                      | E/–/1B.1                                            | North Coast, southern Sacramento Valley, San Francisco Bay, South Coast                                                                            | Mesic areas in cismontane woodland, alkaline playas, valley and foothill grassland, vernal pools; below 470 meters                                | March–June         |
| Congdon's lewisia<br><i>Lewisia congdonii</i>                              | –/R/1B.3                                            | Fresno and Mariposa Counties                                                                                                                       | On rocky granitic or metamorphic, mesic substrates in chaparral, cismontane woodland, lower and upper montane coniferous forest; 500–2,800 meters | April–June         |
| Mason's lilaeopsis<br><i>Lilaeopsis masonii</i>                            | –/R/1B.1                                            | Southern Sacramento Valley, northeastern San Francisco Bay                                                                                         | Riparian scrub, brackish or freshwater marshes and swamps; below 10 meters                                                                        | April–November     |
| Mariposa lupine<br><i>Lupinus citrinus</i> var.<br><i>deflexus</i>         | –/T/1B.2                                            | Mariposa County                                                                                                                                    | On sandy granitic soils in chaparral, cismontane woodland; 400–610 meters                                                                         | April–May          |
| San Joaquin woollythreads<br><i>Monolopia congdonii</i>                    | E/–/1B.2                                            | Carrizo Plain and western San Joaquin Valley from San Benito to Kern Counties                                                                      | Saltbush scrub, sandy soils in valley and foothill grassland, on flats in alkaline or loamy soils; 60–800 meters                                  | February–May       |
| Colusa grass<br><i>Neostapfia colusana</i>                                 | T/E/1B.1                                            | Central Valley with scattered occurrences from Colusa to Merced Counties                                                                           | Adobe soils of vernal pools; 5–200 meters                                                                                                         | May–August         |

| Common and Scientific Name                                    | Legal Status <sup>a</sup><br>Federal/State/<br>CNPS | Geographic Distribution/Floristic<br>Province <sup>b</sup>                                                                                | Habitat Requirements                                                                                                                          | Blooming<br>Period                    |
|---------------------------------------------------------------|-----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
| San Joaquin Valley Orcutt grass<br><i>Orcuttia inaequalis</i> | T/E/1B.1                                            | Scattered locations along east edge of the San Joaquin Valley and adjacent foothills, from Stanislaus to Tulare Counties                  | Vernal pools; 10–755 meters                                                                                                                   | April–September                       |
| Hairy Orcutt grass<br><i>Orcuttia pilosa</i>                  | E/E/1B.1                                            | Scattered locations along east edge of Central Valley and adjacent foothills from Tehama to Merced Counties                               | Vernal pools; 46–200 meters                                                                                                                   | May–September                         |
| Slender Orcutt grass<br><i>Orcuttia tenuis</i>                | T/E/1B.1                                            | Inner North Coast Ranges, Cascade Range foothills, Sacramento County                                                                      | Vernal pools; 35–1,760 meters                                                                                                                 | May–September<br>(uncommonly October) |
| Sacramento Orcutt grass<br><i>Orcuttia viscida</i>            | E/E/1B.2                                            | Known only from Sacramento County                                                                                                         | Vernal pools; 30–100 meters                                                                                                                   | April–July                            |
| Layne's ragwort<br><i>Packera layneae</i>                     | T/R/1B.2                                            | Northern Sierra Nevada Foothills, Butte, El Dorado, Tuolumne, and Yuba Counties                                                           | Rocky serpentinite or gabbro soils in chaparral and foothill woodland; 200–1,000 meters                                                       | April–August                          |
| San Francisco popcorn-flower<br><i>Plagiobothrys diffusus</i> | –/E/1B.1                                            |                                                                                                                                           |                                                                                                                                               |                                       |
| Hartweg's golden sunburst<br><i>Pseudobahia bahiifolia</i>    | E/E/1B.1                                            | Central Sierra Nevada foothills, eastern San Joaquin Valley                                                                               | Clay soils in cismontane woodland, valley and foothill grassland; 15–150 meters                                                               | March–April                           |
| San Joaquin adobe sunburst<br><i>Pseudobahia peirsonii</i>    | T/E/1B.1                                            | Fresno, Kern, and Tulare Counties                                                                                                         | Cismontane woodland, valley and foothill grassland, on adobe clay soils; 90–800 meters                                                        | March–April                           |
| Adobe sanicle<br><i>Sanicula maritima</i>                     | –/R/1B.1                                            | Coastal Monterey and San Luis Obispo Counties; historically known from the San Francisco Bay area in Alameda* and San Francisco* Counties | Moist clay, serpentinite or ultramafic soils, in meadows and seeps, chaparral, coastal prairie, valley and foothill grassland; 30–240 meters  | February–May                          |
| Rock sanicle<br><i>Sanicula saxatilis</i>                     | –/R/1B.2                                            | Contra Costa and Santa Clara Counties                                                                                                     | Bedrock outcrops and talus slopes in broad-leaved upland forest, chaparral, valley and foothill grassland, and oak woodland; 620–1,175 meters | April–May                             |
| Keck's checkerbloom<br><i>Sidalcea keckii</i>                 | E/–/1B.1                                            | Fresno and Tulare Counties                                                                                                                | Serpentine clay soils in cismontane woodland, valley and foothill grassland; 120–425 meters                                                   | April–May                             |

| Common and Scientific Name                       | Legal Status <sup>a</sup><br>Federal/State/<br>CNPS | Geographic Distribution/Floristic<br>Province <sup>b</sup>                                                              | Habitat Requirements                                                                                      | Blooming<br>Period                    |
|--------------------------------------------------|-----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|---------------------------------------|
| California seablite<br><i>Suaeda californica</i> | E/-/1B.1                                            | Morro Bay; San Luis Obispo, San Francisco, and Contra Costa Counties; historically found in the south San Francisco Bay | Margins of tidal salt marsh; below 15 meters                                                              | July–October                          |
| Greene's tuctoria<br><i>Tuctoria greenei</i>     | E/R/1B.1                                            | Scattered distribution along eastern Central Valley and foothills from Shasta to Tulare Counties                        | Dry vernal pools; 30–1,070 meters                                                                         | May–July<br>(uncommonly<br>September) |
| Red Hills vervain<br><i>Verbena californica</i>  | T/T/1B.1                                            | Tuolumne County                                                                                                         | Moist areas in cismontane woodland and grassland, usually in serpentinite seeps or creeks; 260–400 meters | May–September                         |

<sup>a</sup> Status explanations:

**Federal**

- C = candidate for listing under the federal Endangered Species Act.
- E = listed as endangered under the federal Endangered Species Act.
- T = listed as threatened under the federal Endangered Species Act.
- = no listing.

**State**

- E = listed as endangered under the California Endangered Species Act.
- T = listed as threatened under the California Endangered Species Act.
- R = listed as rare under the California Native Plant Protection Act (this category is no longer used for newly listed plants, but some plants previously listed as rare retain this designation).
- = no listing.

**California Native Plant Society (CNPS)**

- 1B = List 1B species: rare, threatened, or endangered in California and elsewhere.
- 4 = List 4 species: limited distribution and on a watch list.
- 0.1 = seriously endangered in California.
- 0.2 = fairly endangered in California.
- \* = presumed extirpated from that county.
- ? = occurrence within county needs to be confirmed.

<sup>b</sup> Floristic provinces as defined in Hickman 1993.

**Table 5.7-1c. State-Listed and Federally Listed Plants with Potential to Occur in the Program Area – Tulare Lake Basin**

| <b>Common and Scientific Name</b>                                                | <b>Legal Status<sup>a</sup><br/>Federal/State/<br/>CNPS</b> | <b>Geographic Distribution/Floristic<br/>Province<sup>b</sup></b>                                                                                                                                       | <b>Habitat Requirements</b>                                                                                                    | <b>Blooming<br/>Period</b>          |
|----------------------------------------------------------------------------------|-------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| Bakersfield smallscale<br><i>Atriplex tularensis</i>                             | –/E/1B.1                                                    | Southern San Joaquin Valley, Kern Lake bed, Kern County; possible extinct – only remaining occurrence at Kern Lake Preserve now thought to be a form of <i>A. serenana</i> and not <i>A. tularensis</i> | Valley sink scrub; 90–200 meters                                                                                               | June–October                        |
| Kaweah brodiaea<br><i>Brodiaea insignis</i>                                      | –/E/1B.2                                                    | Southern Sierra Nevada foothills, Kaweah and Tule River drainages, Tulare County                                                                                                                        | Granitic or clay soils in cismontane woodland, valley and foothill grassland; 150–1,400 meters                                 | April–June                          |
| Mariposa pussypaws<br><i>Calyptridium pulchellum</i>                             | T/–/1B.1                                                    | Central Sierra Nevada; Fresno, Madera, and Mariposa Counties                                                                                                                                            | Sandy or gravelly areas on granitic soils in chaparral, cismontane woodland; 400–1,220 meters                                  | April–August                        |
| San Benito evening-primrose<br><i>Camissonia benitensis</i>                      | T/–/1B.1                                                    | Inner South Coast Ranges with occurrences in Fresno and San Benito Counties                                                                                                                             | Serpentine alluvium, clay or gravelly soils in chaparral, cismontane woodland, valley and foothill grassland; 600–1,280 meters | April–June                          |
| Tompkins' sedge<br><i>Carex tompkinsii</i>                                       | –/R/4.3                                                     | Central Sierra Nevada foothills, southern high Sierra Nevada in Fresno, Mariposa, and Tuolumne Counties                                                                                                 | Sometimes granitic soils in chaparral, cismontane woodland, lower and upper montane coniferous forest; 420–1,830 meters        | May–July                            |
| Tree-anemone<br><i>Carpenteria californica</i>                                   | –/T/1B.2                                                    | Central and southern Sierra Nevada foothills, Kings and San Joaquin Rivers, Fresno and Madera Counties, Contra Costa and Tehama Counties                                                                | Usually granitic soils in chaparral and cismontane woodland; 340–1,340 meters                                                  | May–July                            |
| Succulent owl's-clover<br><i>Castilleja campestris</i><br><i>ssp. succulenta</i> | T/E/1B.2                                                    | Eastern edge of San Joaquin Valley and adjacent foothills, from Stanislaus to Fresno Counties                                                                                                           | Vernal pools, often on acidic soils; 50–750 meters                                                                             | April–May                           |
| California jewel-flower<br><i>Caulanthus californicus</i>                        | E/E/1B.2                                                    | Historically common in western San Joaquin Valley and interior foothills; currently known from scattered locations in Fresno, Kern, Santa Barbara, and San Luis Obispo Counties                         | Sandy soils in valley and foothill grassland, chenopod scrub, and pinyon-juniper woodland; 70–1,000 meters                     | February–May                        |
| Hoover's spurge<br><i>Chamaesyce hooveri</i>                                     | T/–/1B.2                                                    | Central Valley from Butte to Tehama Counties                                                                                                                                                            | Below high water marks of large northern hardpan and volcanic vernal pools; 25–250 meters                                      | July–September (uncommonly October) |

| Common and Scientific Name                                  | Legal Status <sup>a</sup><br>Federal/State/<br>CNPS | Geographic Distribution/Floristic<br>Province <sup>b</sup>                                                                                | Habitat Requirements                                                                                                                              | Blooming<br>Period        |
|-------------------------------------------------------------|-----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| Springville clarkia<br><i>Clarkia springvillensis</i>       | T/E/1B.2                                            | Southern Sierra Nevada foothills, Springville, Tulare County                                                                              | Chaparral, cismontane woodland, valley and foothill grassland, on granitic soils; 245–1,220 meters                                                | May–July                  |
| Palmate-bracted bird's-beak<br><i>Cordylanthus palmatus</i> | E/E/1B.1                                            | Livermore Valley and scattered locations in the Central Valley from Colusa to Fresno Counties                                             | Alkaline grassland, alkali meadow, chenopod scrub; 5–155 meters                                                                                   | May–October               |
| Mojave tarplant<br><i>Deinandra mohavensis</i>              | –/E/1B.3                                            | Kern, Riverside, San Bernardino*, and San Diego Counties                                                                                  | Moist sites in chaparral, coastal scrub, riparian scrub; 640–1,600 meters                                                                         | July–October<br>(January) |
| Kern mallow<br><i>Eremalche kernensis</i>                   | E/–/1B.1                                            | Vicinity of Lokern in Kern and Tulare Counties                                                                                            | Valley sink scrub, saltbush scrub, chenopod scrub, valley and foothill grasslands, on sandy clay-loam soils; 70–1,000 meters                      | March–May                 |
| Tracy's eriastrum<br><i>Eriastrum tracyi</i>                | –/R/1B.2                                            | Colusa, Glenn, Santa Clara, Tehama, and Trinity Counties                                                                                  | Chaparral, cismontane woodland, on gravelly shale or clay soils, often in open areas; 315–975 meters                                              | June–July                 |
| Striped adobe-lily<br><i>Fritillaria striata</i>            | –/T/1B.1                                            | Southeastern San Joaquin Valley, western Sierra Nevada foothills, northern foothills of the Tehachapi Mountains: Kern and Tulare Counties | Blue oak woodland, valley and foothill grassland, usually heavy clay soils; 135–1,455 meters                                                      | February–April            |
| Boggs Lake hedge hyssop<br><i>Gratiola heterosepala</i>     | –/E/1B.2                                            | Inner North Coast Ranges, central Sierra Nevada foothills, Sacramento Valley, Modoc Plateau                                               | Clay soils in marshes and swamps along lake margins and vernal pools; 10–2,375 meters                                                             | April–August              |
| Congdon's lewisia<br><i>Lewisia congdonii</i>               | –/R/1B.3                                            | Fresno and Mariposa Counties                                                                                                              | On rocky granitic or metamorphic, mesic substrates in chaparral, cismontane woodland, lower and upper montane coniferous forest; 500–2,800 meters | April–June                |
| Father Crowley's lupine<br><i>Lupinus padre-crowleyi</i>    | –/R/1B.2                                            | Inyo, Mono, and Tulare Counties                                                                                                           | On decomposed granitic substrate in Great Basin scrub, riparian forest, riparian scrub, upper montane coniferous forest; 2,200–4,000 meters       | July–August               |
| San Joaquin woollythreads<br><i>Monolopia congdonii</i>     | E/–/1B.2                                            | Carrizo Plain and western San Joaquin Valley from San Benito to Kern Counties                                                             | Saltbush scrub, sandy soils in valley and foothill grassland, on flats in alkaline or loamy soils; 60–800 meters                                  | February–May              |



| Common and Scientific Name                                              | Legal Status <sup>a</sup><br>Federal/State/<br>CNPS | Geographic Distribution/Floristic<br>Province <sup>b</sup>                                                               | Habitat Requirements                                                                                                                                | Blooming<br>Period              |
|-------------------------------------------------------------------------|-----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| Bakersfield cactus<br><i>Opuntia basilaris</i> var.<br><i>treleasei</i> | E/E/1B.1                                            | Southern San Joaquin Valley in Kern County                                                                               | Chenopod scrub, cismontane woodland, valley and foothill grassland; granitic sandy or gravelly soil on bluffs, low hills, and flats; 120–550 meters | April–May                       |
| San Joaquin Valley Orcutt grass<br><i>Orcuttia inaequalis</i>           | T/E/1B.1                                            | Scattered locations along east edge of the San Joaquin Valley and adjacent foothills, from Stanislaus to Tulare Counties | Vernal pools; 10–755 meters                                                                                                                         | April–September                 |
| Hartweg's golden sunburst<br><i>Pseudobahia bahiifolia</i>              | E/E/1B.1                                            | Central Sierra Nevada foothills, eastern San Joaquin Valley                                                              | Clay soils in cismontane woodland, valley and foothill grassland; 15–150 meters                                                                     | March–April                     |
| San Joaquin adobe sunburst<br><i>Pseudobahia peirsonii</i>              | T/E/1B.1                                            | Fresno, Kern, and Tulare Counties                                                                                        | Cismontane woodland, valley and foothill grassland, on adobe clay soils; 90–800 meters                                                              | March–April                     |
| Keck's checkerbloom<br><i>Sidalcea keckii</i>                           | E/-/1B.1                                            | Fresno and Tulare Counties                                                                                               | Serpentine clay soils in cismontane woodland, valley and foothill grassland; 120–425 meters                                                         | April–May                       |
| Greene's tuctoria<br><i>Tuctoria greenei</i>                            | E/R/1B.1                                            | Scattered distribution along eastern Central Valley and foothills from Shasta to Tulare Counties                         | Dry vernal pools; 30–1,070 meters                                                                                                                   | May–July (uncommonly September) |

<sup>a</sup> Status explanations:

**Federal**

- C = candidate for listing under the federal Endangered Species Act.  
 E = listed as endangered under the federal Endangered Species Act.  
 T = listed as threatened under the federal Endangered Species Act.  
 – = no listing.

**State**

- E = listed as endangered under the California Endangered Species Act.  
 T = listed as threatened under the California Endangered Species Act.  
 R = listed as rare under the California Native Plant Protection Act (this category is no longer used for newly listed plants, but some plants previously listed as rare retain this designation).  
 – = no listing.

**California Native Plant Society (CNPS)**

- 1B = List 1B species: rare, threatened, or endangered in California and elsewhere.  
 4 = List 4 species: limited distribution and on a watch list.  
 0.1 = seriously endangered in California.

- 0.2 = fairly endangered in California.  
 0.3 = not very threatened in California (low degree/immediacy of threats or no current threats known).  
 \* = presumed extirpated from that county.  
 ? = occurrence within county needs to be confirmed.

<sup>b</sup> Floristic provinces as defined in Hickman 1993.

**Table 5.7-2a. Special-Status Wildlife Species with Potential to Occur in the Program Area – Sacramento Valley Basin**

| Common and Scientific Names                                                   | Status <sup>a</sup><br>Federal/State/<br>Other | Geographic Distribution                                                                                                                                              | Habitat Requirements                                                                                                                                                       |
|-------------------------------------------------------------------------------|------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Invertebrates</b>                                                          |                                                |                                                                                                                                                                      |                                                                                                                                                                            |
| Conservancy fairy shrimp<br><i>Branchinecta conservatio</i>                   | E/-/-                                          | Disjunct occurrences in Solano, Merced, Tehama, Ventura, Butte, and Glenn Counties                                                                                   | Large, deep vernal pools in annual grasslands                                                                                                                              |
| Vernal pool fairy shrimp<br><i>Branchinecta lynchi</i>                        | T/-/-                                          | Central Valley, central and south Coast Ranges from Tehama to Santa Barbara Counties; isolated populations also in Riverside County.                                 | Common in vernal pools; also found in sandstone rock outcrop pools                                                                                                         |
| Valley elderberry longhorn beetle<br><i>Desmocerus californicus dimorphus</i> | T/-/-                                          | Streamside habitats below 3,000 feet throughout the Central Valley                                                                                                   | Riparian and oak savanna habitats with elderberry shrubs; elderberries are the host plant                                                                                  |
| Delta green ground beetle<br><i>Elaphrus viridus</i>                          | T/-/-                                          | Restricted to Olcott Lake and other vernal pools at Jepson Prairie Preserve, Solano County                                                                           | Sparsely vegetated edges of vernal lakes and pools; occur up to 250 feet from pools                                                                                        |
| Vernal pool tadpole shrimp<br><i>Lepidurus packardii</i>                      | E/-/-                                          | Shasta County south to Merced County                                                                                                                                 | Vernal pools and ephemeral stock ponds                                                                                                                                     |
| Shasta crayfish<br><i>Pacifastacus fortis</i>                                 | E/E/-                                          | Only in Shasta County in the Pit River drainage and two tributary systems: Fall River and Hat Creek                                                                  | Clear, cool, spring-fed lakes, rivers, and streams; usually at or near the spring inflow site                                                                              |
| <b>Amphibians</b>                                                             |                                                |                                                                                                                                                                      |                                                                                                                                                                            |
| California tiger salamander<br><i>Ambystoma californiense</i>                 | T/SSC/-                                        | Central Valley, including Sierra Nevada foothills, up to approximately 1,000 feet, and coastal region from Butte County south to northeastern San Luis Obispo County | Small ponds, lakes, or vernal pools in grasslands and oak woodlands for larvae; rodent burrows, rock crevices, or fallen logs for cover for adults and for summer dormancy |
| Western tailed-frog<br><i>Ascaphus truei</i>                                  | -/SSC/-                                        | In California, from coastal Mendocino County north to the Oregon border and east to Shasta County                                                                    | Permanent streams with low temperatures in forests dominated by Douglas fir, redwood, Sitka spruce, Ponderosa pine, and western hemlock                                    |

| Common and Scientific Names                         | Status <sup>a</sup><br>Federal/State/<br>Other | Geographic Distribution                                                                                                                                                                                                                                                      | Habitat Requirements                                                                                                                                                                                                                                                                          |
|-----------------------------------------------------|------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Foothill yellow-legged frog<br><i>Rana boylei</i>   | –/SSC/–                                        | In the Klamath, Cascade, north Coast, south Coast, Transverse, and Sierra Nevada Ranges up to approximately 6,000 feet                                                                                                                                                       | Creeks or rivers in woodland, forest, mixed chaparral, and wet meadow habitats with rock and gravel substrate and low overhanging vegetation along the edge; usually found near riffles with rocks and sunny banks nearby                                                                     |
| California red-legged frog<br><i>Rana draytonii</i> | T/SSC/–                                        | Along the coast and coastal mountain ranges of California from Marin to San Diego Counties and in the Sierra Nevada from Tehama to Fresno Counties                                                                                                                           | Permanent and semi-permanent aquatic habitats, such as creeks and coldwater ponds, with emergent and submergent vegetation; may estivate in rodent burrows or cracks during dry periods                                                                                                       |
| Western spadefoot<br><i>Spea hammondi</i>           | –/SSC/–                                        | Sierra Nevada foothills, Central Valley, Coast Ranges, coastal counties in southern California                                                                                                                                                                               | Shallow streams with riffles and seasonal wetlands, such as vernal pools in annual grasslands and oak woodlands                                                                                                                                                                               |
| <b>Reptiles</b>                                     |                                                |                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                               |
| Western pond turtle<br><i>Emys marmorata</i>        | –/SSC/–                                        | From the Oregon border of Del Norte and Siskiyou Counties south along the coast to San Francisco Bay, inland through the Sacramento Valley, and on the western slope of the Sierra Nevada                                                                                    | Ponds, marshes, rivers, streams, and irrigation canals with muddy or rocky bottoms and with watercress, cattails, water lilies, or other aquatic vegetation in woodlands, grasslands, and open forests                                                                                        |
| Giant garter snake<br><i>Thamnophis gigas</i>       | T/T/–                                          | Central Valley from the vicinity of Burrell in Fresno County north to near Chico in Butte County; has been extirpated from areas south of Fresno                                                                                                                             | Sloughs, canals, low-gradient streams and freshwater marsh habitats with a prey base of small fish and amphibians; also found in irrigation ditches and rice fields; requires grassy banks and emergent vegetation for basking and areas of high ground protected from flooding during winter |
| <b>Birds</b>                                        |                                                |                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                               |
| Tricolored blackbird<br><i>Agelaius tricolor</i>    | –/SSC/–                                        | Permanent resident in the Central Valley from Butte to Kern Counties; breeds at scattered coastal locations from Marin County south to San Diego County and at scattered locations in Lake, Sonoma, and Solano Counties; rare nester in Siskiyou, Modoc, and Lassen Counties | Nests in dense colonies in emergent marsh vegetation, such as tules and cattails, or upland sites with blackberries, nettles, thistles, and grain fields; habitat must be large enough to support 50 pairs; probably requires water at or near the nesting colony                             |

| Common and Scientific Names                        | Status <sup>a</sup><br>Federal/State/<br>Other | Geographic Distribution                                                                                                                                                                                                                                                                              | Habitat Requirements                                                                                                                                                                                                        |
|----------------------------------------------------|------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Short-eared owl<br><i>Asio flammeus</i>            | –/SSC/–                                        | Permanent resident along the coast from Del Norte to Monterey Counties although very rare in summer north of San Francisco Bay, in the Sierra Nevada north of Nevada County, in the plains east of the Cascades, and in Mono County; small, isolated populations                                     | Freshwater and salt marshes, lowland meadows, and irrigated alfalfa fields; needs dense tules or tall grass for nesting and daytime roosts                                                                                  |
| Long-eared owl<br><i>Asio otus</i>                 | –/SSC/–                                        | Permanent resident east of the Cascade Range from Placer County north to the Oregon border, east of the Sierra Nevada from Alpine to Inyo Counties; scattered breeding populations along the coast and in southeastern California; winters throughout the Central Valley and southeastern California | Nests in abandoned crow, hawk, or magpie nests usually in dense riparian stands of willows, cottonwoods, live oaks, or conifers                                                                                             |
| Western burrowing owl<br><i>Athene cunicularia</i> | –/SSC/–                                        | Lowlands throughout California, including the Central Valley, northeastern plateau, southeastern deserts, and coastal areas; rare along the south coast                                                                                                                                              | Level, open, dry, heavily grazed or low stature grassland or desert vegetation with available burrows                                                                                                                       |
| Redhead<br><i>Aythya Americana</i>                 | –/SSC/–                                        | Permanent resident and winter migrant in the Central Valley and central California foothills                                                                                                                                                                                                         | Usually nests in freshwater wetlands with tall emergent vegetation interspersed with areas of deep, open water; in winter and migration, forages and rests on large, deep bodies of water and may form rafts far from shore |
| Swainson's hawk<br><i>Buteo swainsoni</i>          | –/T/–                                          | Lower Sacramento and San Joaquin Valleys, the Klamath Basin, and Butte Valley; highest nesting densities occur near Davis and Woodland, Yolo County                                                                                                                                                  | Nests in oaks or cottonwoods in or near riparian habitats; forages in grasslands, irrigated pastures, and grain fields                                                                                                      |
| Mountain plover<br><i>Charadrius montanus</i>      | –/SSC/–                                        | Does not breed in California; in winter, found in the Central Valley south of Yuba County; along the coast in parts of San Luis Obispo, Santa Barbara, Ventura, and San Diego Counties; and in parts of Imperial, Riverside, Kern, and Los Angeles Counties                                          | Occupies open plains or rolling hills with short grasses or very sparse vegetation; nearby bodies of water are not needed; may use newly plowed or sprouting grain fields                                                   |
| Black tern<br><i>Chlidonias niger</i>              | –/SSC/–                                        | Migrant and breeder in the northeastern plateau and portions of the Central Valley                                                                                                                                                                                                                   | Nests in dense wetland vegetation; uses fresh emergent wetlands, lakes, ponds, moist grasslands, and agricultural fields                                                                                                    |

| Common and Scientific Names                                | Status <sup>a</sup><br>Federal/State/<br>Other | Geographic Distribution                                                                                                                                                                                                                                                                                                                           | Habitat Requirements                                                                                                                                                                                                     |
|------------------------------------------------------------|------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Northern harrier<br><i>Circus cyaneus</i>                  | -/SSC/-                                        | Occurs throughout lowland California; has been recorded in fall at high elevations                                                                                                                                                                                                                                                                | Nests and forages in grasslands, meadows, marshes, and seasonal and agricultural wetlands                                                                                                                                |
| Western yellow-billed cuckoo<br><i>Coccyzus americanus</i> | C/E/-                                          | Nests along the upper Sacramento, lower Feather, south fork of the Kern, Amargosa, Santa Ana, and Colorado Rivers                                                                                                                                                                                                                                 | Wide, dense riparian forests with a thick understory of willows for nesting; sites with a dominant cottonwood overstory are preferred for foraging; may avoid valley-oak riparian habitats where scrub jays are abundant |
| Yellow warbler<br><i>Dendroica petechia brewsteri</i>      | -/SSC/-                                        | Nests over all of California except the Central Valley, the Mojave Desert region, and high altitudes along the eastern side of the Sierra Nevada; winters along the Colorado River and in parts of Imperial and Riverside Counties; two small permanent populations in San Diego and Santa Barbara Counties                                       | Nests in riparian areas dominated by willows, cottonwoods, sycamores, or alders or in mature chaparral; may also use oaks, conifers, and urban areas near stream courses                                                 |
| White-tailed kite<br><i>Elanus leucurus</i>                | -/FP/-                                         | Lowland areas west of the Sierra Nevada from the head of the Sacramento Valley south, including coastal valleys and foothills to western San Diego County at the Mexico border                                                                                                                                                                    | Low foothills or valley areas with valley or live oaks, riparian areas, and marshes near open grasslands for foraging                                                                                                    |
| Greater sandhill crane<br><i>Grus canadensis tabida</i>    | -/T/-                                          | Breeds in Siskiyou, Modoc, Lassen, Plumas, and Sierra Counties; winters in the Central Valley, southern Imperial County, Lake Havasu National Wildlife Refuge, and the Colorado River Indian Reserve                                                                                                                                              | Summers in open terrain near shallow lakes or freshwater marshes; winters in plains and valleys near bodies of fresh water                                                                                               |
| Bald eagle<br><i>Haliaeetus leucocephalus</i>              | -/E, FP/-                                      | Nests in Siskiyou, Modoc, Trinity, Shasta, Lassen, Plumas, Butte, Tehama, Lake, and Mendocino Counties and in the Lake Tahoe Basin; re-introduced into central coast; winter range includes the rest of California, except the southeastern deserts, very high altitudes in the Sierra Nevada, and east of the Sierra Nevada south of Mono County | In western North America, nests and roosts in coniferous forests within 1 mile of a lake, reservoir, stream, or the ocean                                                                                                |
| Yellow-breasted chat<br><i>Icteria virens</i>              | -/SSC/-                                        | Nests locally in coastal mountains and Sierra Nevada foothills, east of the Cascades in northern California, along the Colorado River, and very locally inland in southern California                                                                                                                                                             | Nests in dense riparian habitats dominated by willows, alders, Oregon ash, tall weeds, blackberry vines, and grapevines                                                                                                  |



| Common and Scientific Names                                         | Status <sup>a</sup><br>Federal/State/<br>Other | Geographic Distribution                                                                                                                                                                                                                                                                                                                                                          | Habitat Requirements                                                                                                                                                                                                                                                                                                                                                                                                                        |
|---------------------------------------------------------------------|------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| California black rail<br><i>Laterallus jamaicensis coturniculus</i> | -/T, FP/-                                      | Permanent resident in the San Francisco Bay and eastward through the Delta into Sacramento and San Joaquin Counties; small populations in Marin, Santa Cruz, San Luis Obispo, Orange, Riverside, and Imperial Counties                                                                                                                                                           | Tidal salt marshes associated with heavy growth of pickleweed; also occurs in brackish marshes or freshwater marshes at low elevations                                                                                                                                                                                                                                                                                                      |
| American white pelican<br><i>Pelecanus erythrorhynchos</i>          | -/SSC/-                                        | In large water bodies throughout the state                                                                                                                                                                                                                                                                                                                                       | Year-round in California range, winters along coast, and breeds only inland; breeds in multi-species assemblages of colonial nesters along lakes; nests on ground on earthen, sandy, and rocky islands or (rarely) peninsulas and (locally) on floating tule-mat islands; forages in shallow inland waters, such as open areas in marshes and along lake or river edges; wintering and non-breeding feed in shallow coastal marine habitats |
| Bank swallow<br><i>Riparia riparia</i>                              | -/T/-                                          | Along the Sacramento River from Tehama to Sacramento Counties, along the Feather and lower American Rivers, in the Owens Valley; and in the plains east of the Cascade Range in Modoc, Lassen, and northern Siskiyou Counties; small populations near the coast from San Francisco County to Monterey County                                                                     | Nests in bluffs or banks, usually adjacent to water, where the soil consists of sand or sandy loam                                                                                                                                                                                                                                                                                                                                          |
| Yellow-headed blackbird<br><i>Xanthocephalus xanthocephalus</i>     | -/SSC/-                                        | Locally numerous in the Klamath Basin, Modoc Plateau, Great Basin desert, and large mountain valleys in northeastern California and in the San Joaquin Valley; common breeders in the Colorado River valley, the Salton Sink, and the western Mojave Desert; scarce in the Sacramento Valley and along the southern coast in Los Angeles, Riverside, and San Bernardino Counties | Nests in marshes with tall emergent vegetation, such as tules or cattails, generally in open areas and edges over relatively deep water; breeding marshes often on edges of deep water bodies, such as lakes, reservoirs, and larger ponds                                                                                                                                                                                                  |

| Common and Scientific Names                                           | Status <sup>a</sup><br>Federal/State/<br>Other | Geographic Distribution                                                                                                                      | Habitat Requirements                                                                                                                                                                                                                                                          |
|-----------------------------------------------------------------------|------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Mammals</b>                                                        |                                                |                                                                                                                                              |                                                                                                                                                                                                                                                                               |
| Pallid bat<br><i>Antrozous pallidus</i>                               | -/SSC/WBWG:<br>High priority                   | Throughout California except in the high Sierra, from Shasta to Kern Counties and the northwest coast, primarily at lower and mid elevations | A variety of habitats from desert to coniferous forest but most closely associated with oak, yellow pine, redwood, and giant sequoia habitats in northern California and oak woodland, grassland, and desert scrub in southern California; relies heavily on trees for roosts |
| Townsend's big-eared bat<br><i>Corynorhinus townsendii pallescens</i> | -/SSC/-                                        | Klamath Mountains, Cascades, Sierra Nevada, Central Valley, Transverse and Peninsular Ranges, Great Basin, and the Mojave and Sonora Deserts | Requires caves, tunnels, buildings, or other human-made structures for roosting; gleans insects from brush or trees and feeds along habitat edges                                                                                                                             |
| Hoary bat<br><i>Lasurius cinerius</i>                                 | -/SSC/-                                        | Throughout California from sea level to 13,200 feet                                                                                          | Primarily found in forested habitats but also found in riparian areas and in park and garden settings in urban areas; day roosts within foliage of trees                                                                                                                      |
| Western red bat<br><i>Lasiurus blossevillei</i>                       | -/SSC/WBWG:<br>High priority                   | Scattered throughout much of California at lower elevations                                                                                  | Found primarily in riparian and wooded habitats but occurs at least seasonally in urban areas; day roosts in trees within the foliage; found in fruit orchards and sycamore riparian habitats in the Central Valley                                                           |

<sup>a</sup> Status explanations:

**Federal**

- E = listed as endangered under the federal Endangered Species Act.
- T = listed as threatened under the federal Endangered Species Act.
- C = candidate species for which the U.S. Fish and Wildlife Service has on file sufficient information on biological vulnerability and threat(s) to support issuance of a proposed rule to list, but issuance of the proposed rule is precluded.
- = no listing.

**State**

- E = listed as endangered under the California Endangered Species Act.
- T = listed as threatened under the California Endangered Species Act.
- FP = fully protected under the California Fish and Game Code.
- SSC = species of special concern in California.
- = no listing.

**Western Bat Working Group (WBWG)**Available: <[http://www.wbwg.org/spp\\_matrix.html](http://www.wbwg.org/spp_matrix.html)>.

High priority = species are imperiled or at high risk of imperilment.

**Table 5.7-2b. Special-Status Wildlife Species with Potential to Occur in the Program Area – San Joaquin Valley Basin**

| Common and Scientific Names                                                   | Status <sup>a</sup>     | Geographic Distribution                                                                                                                                                  | Habitat Requirements                                                                                                                                                       |
|-------------------------------------------------------------------------------|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                               | Federal/State/<br>Other |                                                                                                                                                                          |                                                                                                                                                                            |
| Invertebrates                                                                 |                         |                                                                                                                                                                          |                                                                                                                                                                            |
| Conservancy fairy shrimp<br><i>Branchinecta conservatio</i>                   | E/-/-                   | Disjunct occurrences in Solano, Merced, Tehama, Ventura, Butte, and Glenn Counties                                                                                       | Large, deep vernal pools in annual grasslands                                                                                                                              |
| Longhorn fairy shrimp<br><i>Branchinecta longiantenna</i>                     | E/-/-                   | Eastern margin of central Coast Ranges from Contra Costa to San Luis Obispo Counties                                                                                     | Small, clear pools in sandstone rock outcrops; clear to moderately turbid clay- or grass-bottomed pools in a variety of habitats                                           |
| Vernal pool fairy shrimp<br><i>Branchinecta lynchi</i>                        | T/-/-                   | Central Valley, central and south Coast Ranges from Tehama to Santa Barbara Counties; isolated populations also in Riverside County                                      | Common in vernal pools; also found in sandstone rock outcrop pools                                                                                                         |
| Valley elderberry longhorn beetle<br><i>Desmocerus californicus dimorphus</i> | T/-/-                   | Streamside habitats below 3,000 feet throughout the Central Valley                                                                                                       | Riparian and oak savanna habitats with elderberry shrubs; elderberries are the host plant                                                                                  |
| Vernal pool tadpole shrimp<br><i>Lepidurus packardii</i>                      | E/-/-                   | Shasta County south to Merced County                                                                                                                                     | Vernal pools and ephemeral stock ponds                                                                                                                                     |
| Amphibians                                                                    |                         |                                                                                                                                                                          |                                                                                                                                                                            |
| California tiger salamander<br><i>Ambystoma californiense</i>                 | T/SSC/-                 | Central Valley, including the Sierra Nevada foothills, up to approximately 1,000 feet, and coastal region from Butte County south to northeastern San Luis Obispo County | Small ponds, lakes, or vernal pools in grasslands and oak woodlands for larvae; rodent burrows, rock crevices, or fallen logs for cover for adults and for summer dormancy |
| Relictual slender salamander<br><i>Bratrachoseps relictus</i>                 | -/SSC/-                 | Endemic to southern Sierra Nevada from 540 to 7,350 meters                                                                                                               | Habitat requirements are poorly understood                                                                                                                                 |

| Common and Scientific Names                                    | Status <sup>a</sup><br>Federal/State/<br>Other | Geographic Distribution                                                                                                                                                                   | Habitat Requirements                                                                                                                                                                                                                                                                          |
|----------------------------------------------------------------|------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Kern Canyon slender salamander<br><i>Bratrachoseps simatus</i> | -/T/-                                          | Restricted in range to the Kern River drainage in the southern Sierra Nevada, at elevations ranging between 980 and 6,300 feet                                                            | Isolated colonies along streams, ridges, and canyons on moist, shaded, north-facing rocky slopes and shaded tributary canyons in oak and mixed pine-oak woodland; found beneath rocks and rotting logs                                                                                        |
| Foothill yellow-legged frog<br><i>Rana boylei</i>              | -/SSC/-                                        | Occurs in the Klamath, Cascade, North Coast, south Coast, Transverse, and Sierra Nevada Ranges up to approximately 6,000 feet                                                             | Creeks or rivers in woodland, forest, mixed chaparral, and wet meadow habitats with rock and gravel substrate and low overhanging vegetation along the edge; usually found near riffles with rocks and sunny banks nearby                                                                     |
| California red-legged frog<br><i>Rana draytonii</i>            | T/SSC/-                                        | Found along the coast and coastal mountain ranges of California from Marin to San Diego Counties and in the Sierra Nevada from Tehama to Fresno Counties                                  | Permanent and semi-permanent aquatic habitats, such as creeks and coldwater ponds, with emergent and submergent vegetation; may estivate in rodent burrows or cracks during dry periods                                                                                                       |
| Western spadefoot<br><i>Spea hammondi</i>                      | -/SSC/-                                        | Sierra Nevada foothills, Central Valley, Coast Ranges, and coastal counties in southern California                                                                                        | Shallow streams with riffles and seasonal wetlands, such as vernal pools in annual grasslands and oak woodlands                                                                                                                                                                               |
| <b>Reptiles</b>                                                |                                                |                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                               |
| Silvery legless lizard<br><i>Anniella pulchra pulchra</i>      | -/SSC/-                                        | Along the Coast, Transverse, and Peninsular Ranges from Contra Costa to San Diego Counties, with spotty occurrences in the San Joaquin Valley                                             | Habitats with loose soil for burrowing or thick duff or leaf litter; often forages in leaf litter at plant bases; may be found on beaches, sandy washes, and in woodland, chaparral, and riparian areas                                                                                       |
| Western pond turtle<br><i>Emys marmorata</i>                   | -/SSC/-                                        | From the Oregon border of Del Norte and Siskiyou Counties south along the coast to San Francisco Bay, inland through the Sacramento Valley, and on the western slope of the Sierra Nevada | Occupies ponds, marshes, rivers, streams, and irrigation canals with muddy or rocky bottoms and with watercress, cattails, water lilies, or other aquatic vegetation in woodlands, grasslands, and open forests                                                                               |
| Giant garter snake<br><i>Thamnophis gigas</i>                  | T/T/-                                          | Central Valley from the vicinity of Burrell in Fresno County north to near Chico in Butte County; has been extirpated from areas south of Fresno                                          | Sloughs, canals, low-gradient streams and freshwater marsh habitats with a prey base of small fish and amphibians; also found in irrigation ditches and rice fields; requires grassy banks and emergent vegetation for basking and areas of high ground protected from flooding during winter |

| Common and Scientific Names                                                                      | Status <sup>a</sup><br>Federal/State/<br>Other | Geographic Distribution                                                                                                                                                                                                                                                                              | Habitat Requirements                                                                                                                                                                                                                                              |
|--------------------------------------------------------------------------------------------------|------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Birds</b>                                                                                     |                                                |                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                   |
| Tricolored blackbird<br><i>Agelaius tricolor</i>                                                 | -/SSC/-                                        | Permanent resident in the Central Valley from Butte to Kern Counties; breeds at scattered coastal locations from Marin County south to San Diego County and at scattered locations in Lake, Sonoma, and Solano Counties; rare nester in Siskiyou, Modoc, and Lassen Counties                         | Nests in dense colonies in emergent marsh vegetation, such as tules and cattails, or upland sites with blackberries, nettles, thistles, and grain fields; habitat must be large enough to support 50 pairs; probably requires water at or near the nesting colony |
| Short-eared owl<br><i>Asio flammeus</i>                                                          | -/SSC/-                                        | Permanent resident along the coast from Del Norte to Monterey Counties although very rare in summer north of San Francisco Bay, in the Sierra Nevada north of Nevada County, in the plains east of the Cascades, and in Mono County; small, isolated populations                                     | Freshwater and salt marshes, lowland meadows, and irrigated alfalfa fields; needs dense tules or tall grass for nesting and daytime roosts                                                                                                                        |
| Long-eared owl<br><i>Asio otus</i>                                                               | -/SSC/-                                        | Permanent resident east of the Cascade Range from Placer County north to the Oregon border, east of the Sierra Nevada from Alpine to Inyo Counties; scattered breeding populations along the coast and in southeastern California; winters throughout the Central Valley and southeastern California | Nests in abandoned crow, hawk, or magpie nests, usually in dense riparian stands of willows, cottonwoods, live oaks, or conifers                                                                                                                                  |
| Western burrowing owl<br><i>Athene cunicularia hypugea</i>                                       | -/SSC/-                                        | Lowlands throughout California, including the Central Valley, northeastern plateau, southeastern deserts, and coastal areas; rare along south coast                                                                                                                                                  | Level, open, dry, heavily grazed or low stature grassland or desert vegetation with available burrows                                                                                                                                                             |
| Redhead<br><i>Aythya Americana</i>                                                               | -/SSC/-                                        | Permanent resident and winter migrant in the Central Valley and central California foothills                                                                                                                                                                                                         | Usually nests in freshwater wetlands with tall emergent vegetation interspersed with areas of deep, open water; in winter and migration, forage and rest on large, deep bodies of water and may form rafts far from shore                                         |
| Swainson's hawk<br><i>Buteo swainsoni</i>                                                        | -/T/-                                          | Lower Sacramento and San Joaquin Valleys, the Klamath Basin, and Butte Valley; highest nesting densities occur near Davis and Woodland, Yolo County                                                                                                                                                  | Nests in oaks or cottonwoods in or near riparian habitats; forages in grasslands, irrigated pastures, and grain fields                                                                                                                                            |
| Western snowy plover<br>(inland populations)<br><i>Charadrius alexandrinus nivosus</i> (nesting) | T/SSC/-                                        | Nests at inland lakes throughout northeastern, central, and southern California, including Mono Lake and Salton Sea                                                                                                                                                                                  | Barren to sparsely vegetated ground at alkaline or saline lakes, reservoirs, ponds and riverine sand bars; also along sewage, salt-evaporation, and agricultural wastewater ponds                                                                                 |

| Common and Scientific Names                                | Status <sup>a</sup><br>Federal/State/<br>Other | Geographic Distribution                                                                                                                                                                                                                                                                                     | Habitat Requirements                                                                                                                                                                                                                               |
|------------------------------------------------------------|------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Mountain plover<br><i>Charadrius montanus</i>              | -/SSC/-                                        | Does not breed in California; in winter, found in the Central Valley south of Yuba County; along the coast in parts of San Luis Obispo, Santa Barbara, Ventura, and San Diego Counties; and in parts of Imperial, Riverside, Kern, and Los Angeles Counties                                                 | Occupies open plains or rolling hills with short grasses or very sparse vegetation; nearby bodies of water are not needed; may use newly plowed or sprouting grain fields                                                                          |
| Black tern<br><i>Chlidonias niger</i>                      | -/SSC/-                                        | Migrant and breeder in the northeastern plateau and portions of the Central Valley                                                                                                                                                                                                                          | Nests in dense wetland vegetation; uses fresh emergent wetlands, lakes, ponds, moist grasslands, and agricultural fields                                                                                                                           |
| Northern harrier<br><i>Circus cyaneus</i>                  | -/SSC                                          | Throughout lowland California; has been recorded in fall at high elevations                                                                                                                                                                                                                                 | Nests and forages in grasslands, meadows, marshes, and seasonal and agricultural wetlands                                                                                                                                                          |
| Western yellow-billed cuckoo<br><i>Coccyzus americanus</i> | C/E/-                                          | Nests along the upper Sacramento, lower Feather, south fork of the Kern, Amargosa, Santa Ana, and Colorado Rivers                                                                                                                                                                                           | Wide, dense riparian forests with a thick understory of willows for nesting; sites with a dominant cottonwood overstory are preferred for foraging; may avoid valley-oak riparian habitats where scrub jays are abundant                           |
| Yellow rail<br><i>Coturnicops noveboracensis</i>           | -/SSC/-                                        | Large distribution from Alaska and Canada and south through Mexico                                                                                                                                                                                                                                          | Yellow rail prefer wet sedge meadows, along with riparian type habitats.                                                                                                                                                                           |
| Black swift<br><i>Cypseloides niger</i>                    | -/SSC/-                                        | Summer resident and migrant in California range                                                                                                                                                                                                                                                             | Restricted to limited potential nesting locations: behind or beside permanent or semi-permanent waterfalls, on perpendicular cliffs near water, and in sea caves; forages for flying ants far from nesting locales over a variety of habitat types |
| Fulvous whistling duck<br><i>Dendrocygna bicolor</i>       | -/SSC/-                                        | Mainly a summer resident and migrant in California range                                                                                                                                                                                                                                                    | Found in freshwater and coastal marshes, rice fields, and flooded tall-grass areas with adjacent uplands; feeds nocturnally on seeds of emergent vegetation; ground nester; nests built on dense floating or flooded emergent vegetation           |
| Yellow warbler<br><i>Dendroica petechia brewsteri</i>      | -/SSC/-                                        | Nests over all of California except the Central Valley, the Mojave Desert region, and high altitudes along the eastern side of the Sierra Nevada; winters along the Colorado River and in parts of Imperial and Riverside Counties; two small permanent populations in San Diego and Santa Barbara Counties | Nests in riparian areas dominated by willows, cottonwoods, sycamores, or alders or in mature chaparral; may also use oaks, conifers, and urban areas near stream courses                                                                           |



| Common and Scientific Names                                         | Status <sup>a</sup><br>Federal/State/<br>Other | Geographic Distribution                                                                                                                                                                                                                                                                                                                          | Habitat Requirements                                                                                                                                                                                                                                                                                                                                                                                                                        |
|---------------------------------------------------------------------|------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| White-tailed kite<br><i>Elanus leucurus</i>                         | -/FP/-                                         | Lowland areas west of the Sierra Nevada from the head of the Sacramento Valley south, including coastal valleys and foothills to western San Diego County at the Mexico border                                                                                                                                                                   | Low foothills or valley areas with valley or live oaks, riparian areas, and marshes near open grasslands for foraging                                                                                                                                                                                                                                                                                                                       |
| Greater sandhill crane<br><i>Grus canadensis tabida</i>             | -/T/-                                          | Breeds in Siskiyou, Modoc, Lassen, Plumas, and Sierra Counties; winters in the Central Valley, southern Imperial County, Lake Havasu National Wildlife Refuge, and the Colorado River Indian Reserve                                                                                                                                             | Summers in open terrain near shallow lakes or freshwater marshes; winters in plains and valleys near bodies of fresh water                                                                                                                                                                                                                                                                                                                  |
| Bald eagle<br><i>Haliaeetus leucocephalus</i>                       | -/E, FP/-                                      | Nests in Siskiyou, Modoc, Trinity, Shasta, Lassen, Plumas, Butte, Tehama, Lake, and Mendocino Counties and in the Lake Tahoe Basin; reintroduced into central coast; winter range includes the rest of California, except the southeastern deserts, very high altitudes in the Sierra Nevada, and east of the Sierra Nevada south of Mono County | In western North America, nests and roosts in coniferous forests within 1 mile of a lake, reservoir, stream, or the ocean                                                                                                                                                                                                                                                                                                                   |
| Yellow-breasted chat<br><i>Icteria virens</i>                       | -/SSC/-                                        | Nests locally in coastal mountains and Sierra Nevada foothills, east of the Cascades in northern California; along the Colorado River; and very locally inland in southern California                                                                                                                                                            | Nests in dense riparian habitats dominated by willows, alders, Oregon ash, tall weeds, blackberry vines, and grapevines                                                                                                                                                                                                                                                                                                                     |
| California black rail<br><i>Laterallus jamaicensis coturniculus</i> | -/T, FP/-                                      | Permanent resident in the San Francisco Bay and eastward through the Delta into Sacramento and San Joaquin Counties; small populations in Marin, Santa Cruz, San Luis Obispo, Orange, Riverside, and Imperial Counties                                                                                                                           | Tidal salt marshes associated with heavy growth of pickleweed; also occurs in brackish marshes or freshwater marshes at low elevations                                                                                                                                                                                                                                                                                                      |
| American white pelican<br><i>Pelecanus erythrorhynchos</i>          | -/SSC/-                                        | Occurs in large water bodies throughout the state                                                                                                                                                                                                                                                                                                | Year-round in California range, winters along coast and breeds only inland; breeds in multi-species assemblages of colonial nesters along lakes; nests on ground on earthen, sandy, and rocky islands or (rarely) peninsulas and (locally) on floating tule-mat islands; forages in shallow inland waters, such as open areas in marshes and along lake or river edges; wintering and non-breeding feed in shallow coastal marine habitats. |

| Common and Scientific Names                                           | Status <sup>a</sup><br>Federal/State/<br>Other | Geographic Distribution                                                                                                                                                                                                                                                                                                                                                          | Habitat Requirements                                                                                                                                                                                                                                                                                                     |
|-----------------------------------------------------------------------|------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Least Bell's vireo<br><i>Vireo bellii pusillus</i>                    | E/E/-                                          | Summers mainly in southern California; recently recorded nesting in the San Joaquin River National Wildlife Refuge in Stanislaus County                                                                                                                                                                                                                                          | Typically inhabits structurally diverse dense riparian woodlands or shrubs along water courses or near open water; nests in shrubs or low trees, usually 3 feet above ground, in a horizontal or down-sloping twig fork, typically near the edge of the thicket; an obligate riparian species during the breeding season |
| Yellow-headed blackbird<br><i>Xanthocephalus xanthocephalus</i>       | -/SSC/-                                        | Locally numerous in the Klamath Basin, Modoc Plateau, Great Basin desert, and large mountain valleys in northeastern California and in the San Joaquin Valley; common breeders in the Colorado River valley, the Salton Sink, and the western Mojave Desert; scarce in the Sacramento Valley and along the southern coast in Los Angeles, Riverside, and San Bernardino Counties | Nests in marshes with tall emergent vegetation, such as tules or cattails, generally in open areas and edges over relatively deep water; breeding marshes often on edges of deep water bodies such as lakes, reservoirs, and or larger ponds                                                                             |
| <b>Mammals</b>                                                        |                                                |                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                          |
| Pallid bat<br><i>Antrozous pallidus</i>                               | -/SSC/WBWG:<br>High priority                   | Throughout California except in the high Sierra, from Shasta to Kern Counties and the northwest coast, primarily at lower and mid elevations                                                                                                                                                                                                                                     | A variety of habitats from desert to coniferous forest but most closely associated with oak, yellow pine, redwood, and giant sequoia habitats in northern California and oak woodland, grassland, and desert scrub in southern California; relies heavily on trees for roosts                                            |
| Townsend's big-eared bat<br><i>Corynorhinus townsendii pallescens</i> | -/SSC/-                                        | Klamath Mountains, Cascades, Sierra Nevada, Central Valley, Transverse, and Peninsular Ranges, Great Basin, and the Mojave and Sonora Deserts                                                                                                                                                                                                                                    | Requires caves, tunnels, buildings or other human-made structures for roosting; gleans insects from brush or trees and feeds along habitat edges                                                                                                                                                                         |
| Hoary bat<br><i>Lasurius cinerius</i>                                 | -/SSC/-                                        | Throughout California from sea level to 13,200 feet                                                                                                                                                                                                                                                                                                                              | Primarily found in forested habitats but also found in riparian areas and in park and garden settings in urban areas; day roosts within foliage of trees                                                                                                                                                                 |
| Western red bat<br><i>Lasiurus blossevillei</i>                       | -/SSC/WBWG:<br>High priority                   | Scattered throughout much of California at lower elevations                                                                                                                                                                                                                                                                                                                      | Found primarily in riparian and wooded habitats but occurs at least seasonally in urban areas; day roosts in trees within the foliage; found in fruit orchards and sycamore riparian habitats in the Central Valley                                                                                                      |

| Common and Scientific Names                                  | Status <sup>a</sup>     | Geographic Distribution                                                                                                                                                                                                                                                | Habitat Requirements                                                                                                 |
|--------------------------------------------------------------|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|
|                                                              | Federal/State/<br>Other |                                                                                                                                                                                                                                                                        |                                                                                                                      |
| Riparian woodrat<br><i>Neotoma fuscipes riparia</i>          | E/SSC/-                 | Historical distribution along the San Joaquin, Stanislaus, and Tuolumne Rivers and at Caswell State Park in San Joaquin, Stanislaus, and Merced Counties; presently limited to San Joaquin County at Caswell State Park and a possible second population near Vernalis | Riparian habitats with dense shrub cover, willow thickets, and oak overstory                                         |
| Riparian brush rabbit<br><i>Sylvilagus bachmani riparius</i> | E/E/-                   | Limited to San Joaquin County at Caswell State Park, near the confluence of the Stanislaus and San Joaquin Rivers, and the Paradise Cut area on Union Pacific right-of-way lands                                                                                       | Native valley riparian habitats with large clumps of dense shrubs, low-growing vines, and some tall shrubs and trees |
| San Joaquin kit fox<br><i>Vulpes macrotis mutica</i>         | E/T/-                   | Principally occurs in the San Joaquin Valley and adjacent open foothills to the west; recent records from 17 counties extending from Kern County north to Contra Costa County                                                                                          | Saltbush scrub and grassland habitats, and occasionally agricultural fields                                          |

<sup>a</sup> Status explanations:

**Federal**

E = listed as endangered under the federal Endangered Species Act.

T = listed as threatened under the federal Endangered Species Act.

C = candidate species for which U.S. Fish and Wildlife Service has on file sufficient information on biological vulnerability and threat(s) to support issuance of a proposed rule to list, but issuance of the proposed rule is precluded.

- = no listing.

**State**

E = listed as endangered under the California Endangered Species Act.

T = listed as threatened under the California Endangered Species Act.

FP = fully protected under the California Fish and Game Code.

SSC = species of special concern in California.

- = no listing.

**Western Bat Working Group (WBWG)**

Available: <[http://www.wbwg.org/spp\\_matrix.html](http://www.wbwg.org/spp_matrix.html)>.

High priority = species are imperiled or at high risk of imperilment.

**Table 5.7-2c. Special-Status Wildlife Species with Potential to Occur in the Program Area – Tulare Lake Basin**

| Common and Scientific Names                                                   | Status <sup>a</sup>     | Geographic Distribution                                                                                                                                                                   | Habitat Requirements                                                                                                                                                                                                      |
|-------------------------------------------------------------------------------|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                               | Federal/State/<br>Other |                                                                                                                                                                                           |                                                                                                                                                                                                                           |
| Invertebrates                                                                 |                         |                                                                                                                                                                                           |                                                                                                                                                                                                                           |
| Valley elderberry longhorn beetle<br><i>Desmocerus californicus dimorphus</i> | T/-/-                   | Streamside habitats below 3,000 feet throughout the Central Valley                                                                                                                        | Riparian and oak savanna habitats with elderberry shrubs; elderberries are the host plant                                                                                                                                 |
| Amphibians                                                                    |                         |                                                                                                                                                                                           |                                                                                                                                                                                                                           |
| California tiger salamander<br><i>Ambystoma californiense</i>                 | T/SSC/-                 | Central Valley, including the Sierra Nevada foothills, up to approximately 1,000 feet; and coastal region from Butte County south to northeastern San Luis Obispo County                  | Small ponds, lakes, or vernal pools in grasslands and oak woodlands for larvae; rodent burrows, rock crevices, or fallen logs for cover for adults and for summer dormancy                                                |
| Kern Canyon slender salamander<br><i>Bratrachoseps simatus</i>                | -/T/-                   | Restricted in range to the Kern River drainage in the southern Sierra at elevations ranging between 980 and 6,300 feet                                                                    | Isolated colonies along streams, ridges, and canyons on moist, shaded, north-facing rocky slopes and shaded tributary canyons in oak and mixed pine-oak woodland; found beneath rocks and rotting logs                    |
| Foothill yellow-legged frog<br><i>Rana boylei</i>                             | -/SSC/-                 | In the Klamath, Cascade, North Coast, South Coast, Transverse, and Sierra Nevada Ranges up to approximately 6,000 feet                                                                    | Creeks or rivers in woodland, forest, mixed chaparral, and wet meadow habitats with rock and gravel substrate and low overhanging vegetation along the edge; usually found near riffles with rocks and sunny banks nearby |
| Western spadefoot<br><i>Spea hammondi</i>                                     | -/SSC/-                 | Sierra Nevada foothills, Central Valley, Coast Ranges, coastal counties in southern California                                                                                            | Shallow streams with riffles and seasonal wetlands, such as vernal pools in annual grasslands and oak woodlands                                                                                                           |
| Reptiles                                                                      |                         |                                                                                                                                                                                           |                                                                                                                                                                                                                           |
| Silvery legless lizard<br><i>Anniella pulchra pulchra</i>                     | -/SSC/-                 | Along the Coast, Transverse, and Peninsular Ranges from Contra Costa to San Diego Counties, with spotty occurrences in the San Joaquin Valley                                             | Habitats with loose soil for burrowing or thick duff or leaf litter; often forages in leaf litter at plant bases; may be found on beaches, sandy washes, and in woodland, chaparral, and riparian areas                   |
| Western pond turtle<br><i>Emys marmorata</i>                                  | -/SSC/-                 | From the Oregon border of Del Norte and Siskiyou Counties south along the coast to San Francisco Bay, inland through the Sacramento Valley, and on the western slope of the Sierra Nevada | Ponds, marshes, rivers, streams, and irrigation canals with muddy or rocky bottoms and with watercress, cattails, water lilies, or other aquatic vegetation in woodlands, grasslands, and open forests                    |

| Common and Scientific Names                                                                      | Status <sup>a</sup><br>Federal/State/<br>Other | Geographic Distribution                                                                                                                                                                                                                                                                              | Habitat Requirements                                                                                                                                                                                                                                              |
|--------------------------------------------------------------------------------------------------|------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Birds</b>                                                                                     |                                                |                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                   |
| Tricolored blackbird<br><i>Agelaius tricolor</i>                                                 | -/SSC/-                                        | Permanent resident in the Central Valley from Butte to Kern Counties; breeds at scattered coastal locations from Marin County south to San Diego County and at scattered locations in Lake, Sonoma, and Solano Counties; rare nester in Siskiyou, Modoc, and Lassen Counties                         | Nests in dense colonies in emergent marsh vegetation, such as tules and cattails, or upland sites with blackberries, nettles, thistles, and grain fields; habitat must be large enough to support 50 pairs; probably requires water at or near the nesting colony |
| Short-eared owl<br><i>Asio flammeus</i>                                                          | -/SSC/-                                        | Permanent resident along the coast from Del Norte to Monterey Counties although very rare in summer north of San Francisco Bay, in the Sierra Nevada north of Nevada County, in the plains east of the Cascades, and in Mono County; small, isolated populations                                     | Freshwater and salt marshes, lowland meadows, and irrigated alfalfa fields; needs dense tules or tall grass for nesting and daytime roosts                                                                                                                        |
| Long-eared owl<br><i>Asio otus</i>                                                               | -/SSC/-                                        | Permanent resident east of the Cascade Range from Placer County north to the Oregon border, east of the Sierra Nevada from Alpine to Inyo Counties; scattered breeding populations along the coast and in southeastern California; winters throughout the Central Valley and southeastern California | Nests in abandoned crow, hawk, or magpie nests, usually in dense riparian stands of willows, cottonwoods, live oaks, or conifers                                                                                                                                  |
| Western burrowing owl<br><i>Athene cunicularia hypugea</i>                                       | -/SSC/-                                        | Lowlands throughout California, including the Central Valley, northeastern plateau, southeastern deserts, and coastal areas; rare along south coast                                                                                                                                                  | Level, open, dry, heavily grazed or low stature grassland or desert vegetation with available burrows                                                                                                                                                             |
| Redhead<br><i>Aythya Americana</i>                                                               | -/SSC/-                                        | Permanent resident and winter migrant in the Central Valley and central California foothills                                                                                                                                                                                                         | Usually nests in freshwater wetlands with tall emergent vegetation interspersed with areas of deep, open water; in winter and migration, forage and rest on large, deep bodies of water and may form rafts far from shore                                         |
| Swainson's hawk<br><i>Buteo swainsoni</i>                                                        | -/T/-                                          | Lower Sacramento and San Joaquin Valleys, the Klamath Basin, and Butte Valley; highest nesting densities occur near Davis and Woodland, Yolo County                                                                                                                                                  | Nests in oaks or cottonwoods in or near riparian habitats; forages in grasslands, irrigated pastures, and grain fields                                                                                                                                            |
| Western snowy plover<br>(inland populations)<br><i>Charadrius alexandrinus nivosus</i> (nesting) | T/SSC/-                                        | Nests at inland lakes throughout northeastern, central, and southern California, including Mono Lake and the Salton Sea                                                                                                                                                                              | Barren to sparsely vegetated ground at alkaline or saline lakes, reservoirs, ponds, and riverine sand bars; also along sewage, salt-evaporation, and agricultural wastewater ponds                                                                                |

| Common and Scientific Names                             | Status <sup>a</sup><br>Federal/State/<br>Other | Geographic Distribution                                                                                                                                                                                                                                                                                                                              | Habitat Requirements                                                                                                                                                                                                            |
|---------------------------------------------------------|------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Mountain plover<br><i>Charadrius montanus</i>           | -/SSC/-                                        | Does not breed in California; in winter, found in the Central Valley south of Yuba County; along the coast in parts of San Luis Obispo, Santa Barbara, Ventura, and San Diego Counties; and in parts of Imperial, Riverside, Kern, and Los Angeles Counties                                                                                          | Open plains or rolling hills with short grasses or very sparse vegetation; nearby bodies of water are not needed; may use newly plowed or sprouting grain fields                                                                |
| Black tern<br><i>Chlidonias niger</i>                   | -/SSC/-                                        | Migrant and breeder in the northeastern plateau and portions of the Central Valley                                                                                                                                                                                                                                                                   | Nests in dense wetland vegetation; uses fresh emergent wetlands, lakes, ponds, moist grasslands, and agricultural fields                                                                                                        |
| Northern harrier<br><i>Circus cyaneus</i>               | -/SSC                                          | Throughout lowland California; has been recorded in fall at high elevations                                                                                                                                                                                                                                                                          | Nests and forages in grasslands, meadows, marshes, and seasonal and agricultural wetlands                                                                                                                                       |
| Fulvous whistling duck<br><i>Dendrocygna bicolor</i>    | -/SSC/-                                        | Mainly a summer resident and migrant in California range                                                                                                                                                                                                                                                                                             | Freshwater and coastal marshes, rice fields, and flooded tall-grass areas with adjacent uplands; feeds nocturnally on seeds of emergent vegetation; ground nester; nests built on dense floating or flooded emergent vegetation |
| White-tailed kite<br><i>Elanus leucurus</i>             | -/FP/-                                         | Lowland areas west of the Sierra Nevada from the head of the Sacramento Valley south, including coastal valleys and foothills to western San Diego County at the Mexico border                                                                                                                                                                       | Low foothills or valley areas with valley or live oaks, riparian areas, and marshes near open grasslands for foraging                                                                                                           |
| Greater sandhill crane<br><i>Grus canadensis tabida</i> | -/T/-                                          | Breeds in Siskiyou, Modoc, Lassen, Plumas, and Sierra Counties; winters in the Central Valley, southern Imperial County, Lake Havasu National Wildlife Refuge, and the Colorado River Indian Reserve                                                                                                                                                 | Summers in open terrain near shallow lakes or freshwater marshes; winters in plains and valleys near bodies of fresh water                                                                                                      |
| Bald eagle<br><i>Haliaeetus leucocephalus</i>           | -/E, FP/-                                      | Nests in Siskiyou, Modoc, Trinity, Shasta, Lassen, Plumas, Butte, Tehama, Lake, and Mendocino Counties and in the Lake Tahoe Basin; reintroduced into the central coast; winter range includes the rest of California, except the southeastern deserts, very high altitudes in the Sierra Nevada, and east of the Sierra Nevada south of Mono County | In western North America, nests and roosts in coniferous forests within 1 mile of a lake, reservoir, stream, or the ocean                                                                                                       |



| Common and Scientific Names                                           | Status <sup>a</sup><br>Federal/State/<br>Other | Geographic Distribution                                                                                                                                                                                                                                                                                                                                                          | Habitat Requirements                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-----------------------------------------------------------------------|------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| American white pelican<br><i>Pelecanus erythrorhynchos</i>            | -/SSC/-                                        | In large water bodies throughout the state                                                                                                                                                                                                                                                                                                                                       | Year-round in California range; winters along coast and breeds only inland; breed in multi-species assemblages of colonial nesters along lakes; nests on ground on earthen, sandy, and rocky islands or (rarely) peninsulas and (locally) on floating tule-mat islands; forages in shallow inland waters, such as open areas in marshes and along lake or river edges; wintering and non-breeding feed in shallow coastal marine habitats |
| Yellow-headed blackbird<br><i>Xanthocephalus xanthocephalus</i>       | -/SSC/-                                        | Locally numerous in the Klamath Basin, Modoc Plateau, Great Basin desert, and large mountain valleys in northeastern California and in the San Joaquin Valley; common breeders in the Colorado River Valley, the Salton Sink, and the western Mojave desert; scarce in the Sacramento Valley and along the southern coast in Los Angeles, Riverside, and San Bernardino Counties | Nests in marshes with tall emergent vegetation, such as tules or cattails, generally in open areas and edges over relatively deep water; breeding marshes often on edges of deep water bodies such as lakes, reservoirs, and or larger ponds                                                                                                                                                                                              |
| <b>Mammals</b>                                                        |                                                |                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Pallid bat<br><i>Antrozous pallidus</i>                               | -/SSC/WBWG:<br>High priority                   | Throughout California except in the high Sierra, from Shasta to Kern Counties and the northwest coast, primarily at lower and mid elevations                                                                                                                                                                                                                                     | A variety of habitats from desert to coniferous forest but most closely associated with oak, yellow pine, redwood, and giant sequoia habitats in northern California and oak woodland, grassland, and desert scrub in southern California; relies heavily on trees for roosts                                                                                                                                                             |
| Townsend's big-eared bat<br><i>Corynorhinus townsendii pallescens</i> | -/SSC/-                                        | Klamath Mountains, Cascades, Sierra Nevada, Central Valley, Transverse and Peninsular Ranges, Great Basin, and the Mojave and Sonora Deserts                                                                                                                                                                                                                                     | Requires caves, tunnels, buildings or other human-made structures for roosting; gleans insects from brush or trees and feeds along habitat edges                                                                                                                                                                                                                                                                                          |
| Hoary bat<br><i>Lasurius cinerius</i>                                 | -/SSC/-                                        | Throughout California from sea level to 13,200 feet                                                                                                                                                                                                                                                                                                                              | Primarily found in forested habitats but also found in riparian areas and in park and garden settings in urban areas; day roosts within foliage of trees                                                                                                                                                                                                                                                                                  |
| Western red bat<br><i>Lasiurus blossevillei</i>                       | -/SSC/WBWG:<br>High priority                   | Scattered throughout much of California at lower elevations                                                                                                                                                                                                                                                                                                                      | Primarily in riparian and wooded habitats but occurs at least seasonally in urban areas; day roosts in trees within the foliage; found in fruit orchards and sycamore riparian habitats in the Central Valley                                                                                                                                                                                                                             |

| Common and Scientific Names                             | Status <sup>a</sup>     | Geographic Distribution                                                                                                                                                 | Habitat Requirements                                                                             |
|---------------------------------------------------------|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
|                                                         | Federal/State/<br>Other |                                                                                                                                                                         |                                                                                                  |
| Buena Vista Lake shrew<br><i>Sorex ornatus relictus</i> | E/SSC/-                 | In the basin of the historical Buena Vista Lake                                                                                                                         | In marshlands and riparian areas; prefers moist soil and uses stumps, logs, and litter for cover |
| San Joaquin kit fox<br><i>Vulpes macrotis mutica</i>    | E/T/-                   | Principally in the San Joaquin Valley and adjacent open foothills to the west; recent records from 17 counties, extending from Kern County north to Contra Costa County | Saltbush scrub and grassland habitats and occasionally agricultural fields                       |

<sup>a</sup> Status explanations:

**Federal**

- E = listed as endangered under the federal Endangered Species Act.
- T = listed as threatened under the federal Endangered Species Act.
- C = candidate species for which U.S. Fish and Wildlife Service has on file sufficient information on biological vulnerability and threat(s) to support issuance of a proposed rule to list, but issuance of the proposed rule is precluded.
- = no listing.

**State**

- E = listed as endangered under the California Endangered Species Act.
- T = listed as threatened under the California Endangered Species Act.
- FP = fully protected under the California Fish and Game Code.
- SSC = species of special concern in California.
- = no listing.

Western Bat Working Group (WBWG)

Available: <[http://www.wbwg.org/spp\\_matrix.html](http://www.wbwg.org/spp_matrix.html)>.

High priority = species are imperiled or at high risk of imperilment.

## 5.7.4 Effects of Existing Impaired Water Quality on Biological Resources

The majority of agricultural effects on surface water quality occur below the major storage reservoirs in the Central Valley. Details of agricultural impacts are discussed in Section 5.10. The general effects of agriculture include water column toxicity, sediment toxicity, detectable pesticides, nutrients, and salinity. Because groundwater is recharged by downward seepage of surface water and may also be discharged to surface water, contamination can occur between these water sources. Irrigation seepage can contaminate groundwater that underlies porous soils that are heavily fertilized or that receive pesticide applications. Constituents of concern in Central Valley groundwater that are related to agriculture include nutrients, insecticides and herbicides, salt, trace elements, organic carbon and disinfection byproduct precursors, and microorganisms. Sources of these constituents are discussed in Chapter 4.

Possible effects of the existing water quality on natural communities and special-status plant and wildlife species primarily would occur in areas with high salinity and/or pesticide levels. Some special-status plants are adapted to alkaline or saline soils.

## 5.7.5 Impacts

This analysis focuses on the effects of the regulatory program on vegetation and wildlife at a programmatic level, rather than on the specific effects of management practices used by various growers.

### Assessment Methods

To identify existing environmental conditions and special-status plant and wildlife species that could be affected by the program alternatives, ICF biologists reviewed the existing information listed below:

- CNDDDB records search of the counties that are under the jurisdiction of the Central Valley Water Board (the program area),
- *Inventory of Rare and Endangered Plants of California* (CNPS 2009), and
- Printed and online information.

The evaluation of impacts is supported by the information provided in the environmental setting and by the following assumptions:

- Under all program alternatives, when a constituent of concern is identified through monitoring, management practices would be used to reduce the level of that constituent in surface water or groundwater.
- If monitoring shows that a constituent is not of concern, management practices currently used to address that constituent may be reduced or discontinued.

- Under Alternatives 2 through 5, the use of groundwater management practices would increase and the use of any surface water management practice that harms groundwater would decrease (e.g., retention ponds in coarse soils that encourage waste percolation to groundwater basins).

The origin of regulatory authority (e.g., coalition groups versus individual growers) may affect funding sources, outreach, and enforcement, but management practice selection is ultimately dependent on crop type, physical setting, and economics (as described in the ECR). It is infeasible to determine and quantify the effect, if any, of changes in the lead entity as a result of the program alternatives on management practices used to prevent water quality impacts. Consequently, a qualitative assessment of potential effects of program alternatives on vegetation and wildlife was performed. The management practices proven to benefit water quality, as described in the ECR, were reviewed and analyzed to identify the potential impacts of management practices on vegetation and wildlife.

## Significance Determinations

For this analysis, an impact pertaining to vegetation and wildlife was considered significant under CEQA if it would result in any of the following environmental effects, which are based on professional practice and State CEQA Guidelines Appendix G (14 CCR 15000 et seq.).

- A substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by DFG or the USFWS;
- A substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, or regulations, or by DFG or the USFWS;
- Substantial interference with the movement of any native resident or migratory fish or wildlife species, or with established native resident or migratory wildlife corridors; or impedance of the use of native wildlife nursery sites;
- Conflict with any local policies or ordinances protecting biological resources;
- Conflict with the provisions of an adopted HCP; natural community conservation plan; or other approved local, regional, or state HCP;
- Substantial reduction in the habitat of a fish or wildlife species;
- Causation of a fish or wildlife population to drop below self-sustaining levels;
- The threat of elimination of a plant or animal community;
- Substantial reduction in the number of, or restriction of the range of, a rare or endangered plant or animal; or
- Effects that are incrementally small but cumulatively considerable, meaning that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.

## **Alternative 1 – Full Implementation of Current Program (No Project Alternative)**

Alternative 1 involves continuation and full implementation of the existing program. Use of coalition groups as the lead monitoring entities would continue, and third-party entities and growers would implement management practices in response to identified water quality issues. Under this alternative, management practices would be implemented to reduce the levels of identified constituents of concern below the baseline conditions for surface water. It is assumed that continuation of the program would result in implementation of a greater number of surface water management practices than are present under baseline conditions, due to continued use of the program's monitoring feedback loops.

The changes in management practices are not dictated by the alternative and would vary widely, depending on choices made by individual growers for their crops, locations, and local and regional water quality concerns. Management practices expected to be implemented include nutrient management; improved water management; tailwater recovery systems; pressurized irrigation; sediment trap, hedgerow, or buffer zones; and cover cropping.

Use of nutrient management would positively affect both wildlife and vegetation, as it would limit the amount of nutrients going into waterways and would result in a net positive water quality impact over time. In addition, improved water management would benefit both wildlife and vegetation, as it would decrease the amount of sedimentation to surface water, which clogs the waterway and inhibits filter-feeding organisms along with chlorophyll organisms.

Tailwater recovery systems would result in beneficial impacts similar to those of improved water management, but there would be a lag time in release of the water because these systems perform like a detention pond, where sediment can settle and then the water is released back into the system or reused for irrigation. These management practices would result in a slight loss of water from evaporation and percolation, which could result in a very minimal amount of downstream riparian loss. This loss would be only during sediment settling time, and then the water would enter back into the system. Losses due to evaporation and percolation could be offset to an unknown degree if the recovered tailwater is reused for irrigation rather than discharged after settling. If the irrigation water comes from surface water diversions, reduced diversions would result in increased instream flows in the stream of origin. Thus, implementation of this management practice is not expected to result in significant effects. Sediment traps, hedgerows, or buffer zones would result in beneficial impacts similar to those of tailwater recovery systems in terms of the delay time for the water to capture sediment and the water eventually entering the system. Use of these management practices would result in a less-than-significant impact on wildlife and vegetation.

Use of runoff-reducing management practices would reduce surface water flows from fields, limiting the amount of water that returns to the waterway and resulting in a loss of habitat in areas adjacent to downstream waterways.

### **Impact BIO-1. Loss of Downstream Habitat from Reduced Field Runoff**

Management practices that reduce field runoff would result in beneficial impacts on water quality but may adversely affect downstream wildlife and vegetation that depend on agricultural surface runoff. These practices cause water to be recirculated or used at an agronomic rate, resulting in a

minimal amount of agricultural runoff. This would result in a net loss of water entering waterways and potential habitat loss along runoff ditches and downstream waterbodies.

Such habitat would be seasonally present, available only during times of irrigation, and unlikely to support sensitive communities or special-status plants. While reduced runoff leads to, or is the result of, reduced surface water diversions to fields, some regions rely largely on groundwater to irrigate. While it is anticipated that the loss of sensitive communities or special-status plants resulting from reduced runoff would be small, if any, data are insufficient to determine how much loss would occur. Consequently, this is considered a potentially significant impact. Implementation of **Mitigation Measure BIO-MM-2** would reduce this impact to a less-than-significant level.

### **Impact BIO-2. Improved Water Quality in Natural Communities Adjacent to Agricultural Lands and Managed Wetlands**

In general, the anticipated improvements in water quality as a result of program implementation under Alternative 1 would result in a beneficial effect on natural communities that receive runoff from agricultural lands or managed wetlands. Decreases in salinity and pesticide levels could benefit habitat quality for plant species, including special-status species, and sensitive natural communities located adjacent to managed wetlands. This would be a beneficial impact, and no mitigation is required.

### **Impact BIO-3. Potential Loss of Sensitive Natural Communities and Special-Status Plants from Construction Activities**

Construction impacts would result from implementation of management practices that require physical changes, such as construction of water and sediment control basins, temporary water checks, tailwater return systems, vegetated drain systems, windbreaks, and filter strips. As stated above, it is difficult to determine to what extent management practices selected under Alternative 1 would change relative to existing conditions; thus, it is not possible to quantify any construction-related effects. However, it is logical to assume that continued implementation of Alternative 1 would result in selection of more management practices where testing reveals that water quality objectives are not being met. Consequently, implementation of Alternative 1 may result in effects on vegetation from construction activities.

In general, management practices would be implemented on existing agricultural lands and managed wetlands, which are unlikely to support native vegetation or special-status plants. However, construction that directly or indirectly affects natural vegetation communities adjacent to existing irrigated lands, particularly annual grasslands with inclusions of seasonal wetlands or vernal pools and riparian communities, could result in loss of sensitive wetland communities or special-status plants growing in the uncultivated or unmanaged areas. While it is anticipated that the loss of sensitive communities or special-status plants resulting from construction activities would be small, if any, data are insufficient to determine how much loss would occur. Consequently, this is considered a potentially significant impact. Implementation of **Mitigation Measure BIO-MM-1** would reduce this impact to a less-than-significant level.

## **Alternative 2 – Third-Party Lead Entity**

Monitoring, tracking, and management plan requirements of Alternative 2 are expected to result in changes similar to those in Alternative 1 in the use of management practices by growers, along with



the addition of groundwater-specific practices. Under this alternative, management practices would be implemented to reduce the levels of identified constituents of concern below the baseline conditions for both surface water and groundwater. The reduction of identified constituents of concern below baseline levels is assumed to benefit sensitive natural communities as well as special-status plant and wildlife species. The changes in management practices are not dictated by the alternative and would vary widely, depending on choices made by individual growers for their crops, locations, and local and regional water quality concerns. Management practices expected to be implemented include nutrient management; improved water management; tailwater recovery systems; pressurized irrigation; sediment traps, hedgerows, or buffer zones; cover cropping; and wellhead protection.

#### **Impact BIO-1. Loss of Downstream Habitat from Reduced Field Runoff**

**Impact BIO-1** is described under Alternative 1. This impact is considered less than significant with mitigation.

#### **Impact BIO-2. Improved Water Quality in Natural Communities Adjacent to Agricultural Lands and Managed Wetlands**

**Impact BIO-2** is described under Alternative 1. This impact is considered beneficial.

#### **Impact BIO-3. Potential Loss of Sensitive Natural Communities and Special-Status Plants from Construction Activities**

Construction impacts would result from implementation of management practices that require physical changes, as described for Alternative 1. Under Alternative 2, it is assumed that management practices would be somewhat greater, with inclusion of groundwater-specific management practices such as wellhead protection. Consequently, implementation of Alternative 2 may result in effects on vegetation from construction activities.

While it is anticipated that the loss of sensitive communities or special-status plants resulting from construction activities would be small, if any, data are insufficient to determine how much loss would occur. Consequently, this is considered a potentially significant impact. Implementation of **Mitigation Measure BIO-MM-1** would reduce this impact to a less-than-significant level.

#### **Impact BIO-4. Potential Loss of Wetland Communities due to Loss of Existing Sedimentation Ponds**

Under Alternative 2, the assumed decrease in the use of surface water management practices that are harmful to groundwater could result in abandonment or fill of tailwater sedimentation ponds in areas that currently percolate water to groundwater basins. Although they are artificially created features, sedimentation ponds can develop vegetation communities that support wetland species, depending on the specific hydrologic regime of individual ponds. Ponds that hold water intermittently or seasonally may support plant species adapted to seasonal wetland conditions, and ponds that are continually flooded may support emergent vegetation adapted to permanent wetland conditions. Thus, the loss of these ponds could result in drying of artificially created wetlands and an indirect loss of wetland habitat. The loss of wetland communities resulting from abandonment or fill of retention ponds would be small but cannot be quantified. It is also important to note that implementation of one of the potential management practices under this alternative, installation of tailwater return systems, would result in creation of tailwater ponds that could develop the same

wetland characteristics as the abandoned or filled sedimentation ponds. Creation of new tailwater ponds could result in no net loss or potentially an increase in these wetland communities. However, the final extent of the tailwater ponds that could be created under this alternative cannot be quantified. Consequently, the loss of existing sedimentation ponds is considered a potentially significant impact. Implementation of **Mitigation Measure BIO-MM-2** would reduce this impact to a less-than-significant level.

#### **Impact BIO-5. Impacts to Special-Status Wildlife Species due to Loss of Existing Sedimentation Ponds**

Under Alternative 2, the assumed decrease in the use of surface water management practices that are harmful to groundwater could result in abandonment or fill of tailwater sedimentation ponds in areas that currently percolate water to groundwater basins. Although they are artificially created features, sedimentation ponds can provide habitat for special-status wildlife species. The banks of these ponds could support habitat for special-status burrowing wildlife species, including San Joaquin kit fox and burrowing owl. Ponds that hold water intermittently or seasonally may support special-status wildlife species adapted to seasonal wetland conditions, such as vernal pool fairy shrimp and vernal pool tadpole shrimp, California red-legged frog, and California tiger salamander, depending on the proximity of these ponds to natural habitats. The ponds also provide foraging habitat for many bird species. Ponds that hold water intermittently provide foraging habitat for wading birds, and ponds that are continually flooded may support foraging and nesting habitat for waterfowl. The abandonment or fill of retention ponds would be small and cannot be quantified but could affect wildlife species that are dependent on them. As discussed under **Impact BIO-4**, however, the creation of new tailwater ponds could mitigate part or all of this impact. Because the extent of new tailwater ponds cannot be quantified, the loss of existing sedimentation ponds is considered a potentially significant impact. Implementation of **Mitigation Measure BIO-MM-1** would reduce this impact to a less-than-significant level.

### **Alternative 3 – Individual Farm Water Quality Management Plans**

Potential impacts related to vegetation and wildlife under Alternative 3 are expected to be as described for Alternative 2. Like Alternative 2, Alternative 3 would implement water quality management plans that would result in a beneficial impact on surface water quality and groundwater quality, which would ultimately benefit both vegetation and wildlife communities.

### **Alternative 4 – Direct Oversight with Regional Monitoring**

Potential impacts related to vegetation and wildlife under Alternative 4 are expected to be as described for Alternative 2 and Alternative 3. Alternative 4 would additionally implement nutrient management plans that would result in a beneficial impact on surface water quality and groundwater quality, which would ultimately benefit both vegetation and wildlife communities.

### **Alternative 5 – Direct Oversight with Farm Monitoring**

The potential changes in management practices under Alternative 5 would be similar to those described for Alternative 2. Alternative 5 would additionally implement nutrient management plans, which would ultimately benefit both vegetation and wildlife communities. Under Alternative 5,

however, individual supply wells would be installed and monitored, which could result in direct impacts on land surface in agricultural lands and managed wetlands.

#### **Impact BIO-6. Loss of Sensitive Natural Communities and Special-Status Plants from Construction Activities and Installation of Groundwater Monitoring Wells**

Construction impacts would result from implementation of management practices that require physical changes and from installation of groundwater monitoring wells. As described for Alternative 2, it was assumed that Alternative 5 would result in the selection of more management practices than under existing conditions. The placement of monitoring wells cannot be predetermined; therefore, the potential impacts on sensitive natural communities and special-status plants cannot be quantified.

In general, management practices would be implemented on existing agricultural lands and managed wetlands, resulting in a less-than-significant impact. It was assumed that groundwater monitoring well placement also could be primarily limited to agricultural land and non-sensitive habitat. However, if construction related to implementation of management practices required changes to managed wetlands or to natural vegetation communities that are adjacent to existing irrigated lands, there would be a potential for loss of vegetation in sensitive wetland communities or loss of special-status plants growing in the uncultivated or unmanaged areas. While it is anticipated that the loss of sensitive communities or special-status plants resulting from construction activities would be small, if any, data are insufficient to determine how much loss would occur. Consequently, this is considered a potentially significant impact. Implementation of **Mitigation Measure BIO-MM-1** would reduce this impact to a less-than-significant level.

#### **Impact BIO-7. Loss of Special-Status Wildlife from Construction Activities and Installation of Groundwater Monitoring Wells**

Construction impacts would result from implementation of management practices that require physical changes and from installation of groundwater monitoring wells. As described for Alternative 2, it was assumed that Alternative 5 would result in the selection of more management practices than under existing conditions. The placement of monitoring wells cannot be predetermined; therefore, the potential impacts on special-status wildlife species and their habitat cannot be quantified.

In general, management practices would be implemented on existing agricultural lands and managed wetlands, resulting in a less-than-significant impact. It was assumed that placement of groundwater monitoring wells also could be limited primarily to agricultural land and non-sensitive habitat. However, construction for management practices that require changes to managed wetlands or to natural vegetation communities adjacent to existing irrigated lands could result in a loss of special-status wildlife species occurring in the uncultivated or unmanaged areas. While it is anticipated that the loss of special-status wildlife species resulting from construction activities would be small, if any, data are insufficient to determine how much loss would occur. Consequently, this is considered a potentially significant impact. Implementation of **Mitigation Measure BIO-MM-1** would reduce this impact to a less-than-significant level.

## 5.7.6 Mitigation and Improvement Measures

### **Mitigation Measure BIO-MM-1: Avoid and Minimize Impacts on Sensitive Biological Resources**

Implementation of the following avoidance and minimization measures would ensure that the construction activities related to implementation of management practices and installation of monitoring wells on irrigated lands would minimize effects on sensitive vegetation communities (such as riparian habitat and wetlands adjacent to the construction area) and special-status plants and wildlife species as defined and listed in Section 5.7.3. In each instance where particular management practices could result in impacts on the biological resources listed above, growers should use the least impactful effective management practice to avoid such impacts. Where the ILRP water quality improvement goals cannot be achieved without incurring potential impacts, individual farmers, coalitions, or third-party representatives should implement the following measures to reduce potential impacts to less-than-significant levels.

- Where detention basins are to be abandoned, retain the basin in its existing condition or ensure that sensitive biological resources are not present before modification.
- Where construction in areas that may contain sensitive biological resources cannot be avoided through the use of alternative management practices, conduct an assessment of habitat conditions and the potential for presence of sensitive vegetation communities or special-status plant and animal species prior to construction. This may include the hiring of a qualified biologist to identify riparian and other sensitive vegetation communities and/or habitat for special status plant and animal species;
- Avoid and minimize disturbance of riparian and other sensitive vegetation communities.
- Avoid and minimize disturbance to areas containing special-status plant or animal species.
- Where adverse effects on sensitive biological resources cannot be avoided, undertake additional CEQA review and develop a restoration or compensation plan to mitigate the loss of the resources.

### **Mitigation Measure BIO-MM-2: Determine Extent of Wetland Loss and Compensate for Permanent Loss of Wetlands**

Prior to implementing any management practice that will result in the permanent loss of wetlands, conduct a delineation of affected wetland areas to determine the acreage of loss in accordance with current USACE methods. For compliance with the CWA Section 404 permit and WDRs, compensate for the permanent loss (fill) of wetlands and ensure no net loss of habitat functions and values. Compensation ratios will be determined through coordination with the Central Valley Water Board and USACE as part of the permitting process. Compensation may be a combination of mitigation bank credits and restoration/creation of habitat, as described below:

- Purchase credits for the affected wetland type (e.g., perennial marsh, seasonal wetland) at a locally approved mitigation bank and provide written evidence to the resource agencies that compensation has been established through the purchase of mitigation credits.
- Develop and ensure implementation of a wetland restoration plan that involves creating or enhancing the affected wetland type.

### 5.8.1 Introduction

This section discusses the regulatory framework for protection of fish resources, the environmental setting for fish within the program area, and the existing effects of impaired surface and groundwater on fish in the program area. The potential impacts on fish that may result from implementation of program alternatives are identified, and mitigation measures to avoid or reduce potentially significant impacts are presented.

### 5.8.2 Regulatory Framework

The following federal, state, and local policies and laws are relevant to fish in the program area. Some of these regulations are described in Section 5.7, Vegetation and Wildlife, as noted.

#### Federal

##### Endangered Species Act

The ESA protects fish species and their habitats identified by the USFWS and NMFS as threatened or endangered. *Endangered* refers to species, subspecies, evolutionarily significant units (ESUs), or distinct population segments (DPSs) that are in danger of extinction through all or a significant portion of their range<sup>1</sup>; *threatened* refers to species, subspecies, ESUs, or DPSs that are likely to become endangered in the near future. *Species of concern* refers to species, subspecies, ESUs, or DPSs that NMFS or USFWS are concerned about because of status and threats and for which there is insufficient information to warrant listing under the ESA. The ESA is administered by USFWS and NMFS. In general, NMFS is responsible for protection of ESA-listed marine species and anadromous fishes, whereas other listed species are under USFWS jurisdiction.

##### Section 7 – Endangered Species Act Consultation Process

Section 7 consultation is explained in Section 5.7, Vegetation and Wildlife.

##### Section 9 – Endangered Species Act Prohibitions

Section 9 of the ESA is explained in Section 5.7, Vegetation and Wildlife.

---

<sup>1</sup> An evolutionarily significant unit (ESU) is a population or group of populations that is substantially reproductively isolated from other population units of the same species and represents an important component in the evolutionary legacy of the species. *ESU* refers only to Pacific salmon species. A distinct population segment (DPS) is the smallest division of a taxonomic vertebrate species that is permitted to be protected under the Endangered Species Act. Individuals within a DPS may interbreed when mature but do not interbreed with individuals from other DPSs.

## **Sections 4(d) and 10 – Incidental Take**

Incidental take is explained in Section 5.7, Vegetation and Wildlife.

## **Section 4(f) – Recovery Plans**

As described in Section 5.7, Vegetation and Wildlife, Section 4(f) of the ESA requires that recovery plans be prepared for listed species. NMFS is currently developing a Recovery Plan for Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead.

## **Magnuson-Stevens Fishery Conservation and Management Act**

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established a requirement to describe and identify essential fish habitat (EFH) in each fishery management plan. *EFH* is defined as “waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity” (50 CFR 600.110). Important components of EFH are substrate; water quality; water quantity, depth, and velocity; channel gradient and stability; food; cover and habitat complexity; space; access and passage; and habitat connectivity. The act requires all federal agencies to consult with NMFS on all actions or proposed actions that are permitted, funded, or undertaken by the agency that may adversely affect EFH. Only species managed under a federal fishery management plan are covered under EFH regulations. All four Central Valley Chinook salmon runs (winter-, spring-, fall-, and late fall-run Chinook salmon) are subject to the Magnuson-Stevens Act and are regulated by the Pacific Coast Salmon Fishery Management Plan (FMP). The FMP includes designation of EFH, which occurs within waters affected by the IRLP.

## **Sustainable Fisheries Act**

The Sustainable Fisheries Act (Public Law 104-297) of 1996 reauthorized and amended the Magnuson Fishery Conservation and Management Act (now the Magnuson-Stevens Act), the latter of which was initially enacted in 1976 to define fisheries jurisdiction within federal waters and create the National Oceanic and Atmospheric Administration structure for federal fisheries management. The revisions provided in the 1996 law brought major changes to requirements for preventing overfishing and revitalizing depleted fisheries, mostly through the scientific management and reporting conducted via fisheries management reports.

## **Clean Water Act**

Sections 401 and 404 of the CWA are described in Section 5.7, Vegetation and Wildlife. The responsibility of the State Water Board under Section 303(d) is described in Section 5.9, Hydrology and Water Quality.

## **Federal Insecticide, Fungicide, and Rodenticide Act**

The Federal Insecticide, Fungicide, and Rodenticide Act, as amended (FIFRA), requires EPA to regulate the sale and use of pesticides in the United States through registration and labeling of the pesticide products currently in use (EPA 2004). FIFRA directs EPA to restrict the use of pesticides as necessary to prevent unreasonable adverse effects on people and the environment, taking into account the costs and benefits of various pesticide uses. FIFRA prohibits sale of any pesticide in the



United States unless it is registered and labeled indicating approved uses and restrictions. Use of a pesticide in a manner that is inconsistent with the label instructions violates the law. In addition, FIFRA requires EPA to re-register older pesticides based on new data that meet current regulatory and scientific standards. EPA must ensure that the use of pesticides it registers under FIFRA will not result in harm to species listed as endangered or threatened under the ESA. USFWS and NMFS provide technical assistance and consult with EPA during the registration and re-registration of pesticides to prevent and minimize the impacts of pesticides on fish, wildlife, and plants. In addition, the EPA's Endangered Species Protection Program (ESPP) was initiated in 1988. This program relies on cooperation between USFWS, EPA regions, states, and pesticide users. As part of this program, EPA has created bulletins for individual counties within the United States that can be accessed from the ESPP website (<http://www.epa.gov/espp/>). The bulletins provide information on pesticide use limitations intended to minimize impacts on threatened and endangered species.

## Recent Court Orders

### Pesticide Buffer Zones around Salmonid Streams

A citizen suit was filed under the ESA against the EPA by a group of environmental organizations (*Washington Toxics Coalition et al. v. EPA*) who alleged that EPA violated Section 7(a)(2) of the ESA by failing to consult on the effects to 26 ESUs of listed Pacific salmonids from EPA's continuing approval of 54 pesticide active ingredients. On July 2, 2002, the Court ruled that EPA had violated ESA Section 7(a)(2) and ordered EPA to initiate interagency consultation with NMFS and make determinations about effects to the salmonids from all 54 active ingredients by December 2004. The court also issued an order on January 22, 2004, that establishes pesticide buffer zones. *Buffer zones* are areas adjacent to certain streams, rivers, lakes estuaries, and other water bodies, in which pesticides are not to be used. Generally, the buffers established by the Court are 20 yards for ground application and 100 yards for aerial application, adjacent to certain salmon-supporting waters in Washington, Oregon, and California. *Salmon-supporting waters* are defined as certain water bodies below the normal high water mark; buffers are measured from that normal high water mark. Waters included in the action are those supporting listed anadromous salmonids or their critical habitat. Failure to comply with the court order is not a violation of FIFRA. The court order remains in effect until one of the following occurs:

- EPA determines that these pesticides have no effect on listed Pacific salmon and steelhead,
- EPA determines that these pesticides are not likely to adversely affect these species, or
- EPA completes consultation with NMFS about the potential effects of the pesticides on Pacific salmon and steelhead.

NMFS will provide biological opinions on 37 active ingredients in pesticides by February 29, 2012, as a result of the court order against EPA registration (NMFS 2008a). The reasonable and prudent alternative included in the first of these biological opinions (NMFS 2008b, which deals with pesticides containing chlorpyrifos, diazinon, and malathion) includes specifications for enlarged buffer zones, restrictions on application in windy conditions or when soil is moist, provision of non-crop vegetation strips adjacent to cropland, reporting of fish kills following application, and monitoring of areas prone to pesticide runoff. The specific buffers to be applied under element 1 of the reasonable and prudent alternative are:

- Where ground applications are permitted: Do not apply pesticide products within 500 feet (152.4 meters) of salmonid habitats<sup>2</sup>.
- Where aerial applications are permitted: Do not apply pesticide products within 1,000 feet (304.8 meters) of salmonid habitats.

It is estimated that the 500-foot and 1,000-foot buffers would translate into 820,000 and 1.34 million acres, respectively, of cultivated land within the range of listed salmonids in California's Central Valley, equivalent to 36 percent and 59 percent, respectively, of the total acreage (Poletika et al. 2009). EPA set a deadline of May 13, 2010, for pesticide registrants to confirm that they will comply with the limitations imposed by the NMFS (2008b) biological opinion or be subject to administrative procedures under FIFRA (Keigwin 2010).<sup>3</sup> A May 7 reply letter from the pesticide registrants stated that they would not be willing to make any of the registration revisions described by EPA in its previous letters to the registrants (EPA 2010).

### **San Francisco Bay Area Endangered Species Litigation**

On May 30, 2007, the Center for Biological Diversity filed a lawsuit in the Federal District Court for the Northern District of California alleging that EPA failed to comply with Section 7(a)(2) of the ESA in regard to 74 pesticides that may affect 11 species that are listed as endangered or threatened under the ESA (*Center for Biological Diversity v. EPA*, Case No. 07-2794-JCS [N.D. Cal.]). The species identified in the lawsuit are found in the greater San Francisco Bay area: Alameda whipsnake, bay checkerspot butterfly, California clapper rail, California freshwater shrimp, California tiger salamander, delta smelt, salt marsh harvest mouse, San Francisco garter snake, San Joaquin kit fox, tidewater goby, and valley elderberry longhorn beetle. Comments are currently being solicited by EPA on a stipulated injunction and proposed order; the injunction would require EPA to make effects determinations and initiate consultation with USFWS under Section 7(a)(2) of the ESA for all 74 pesticides by the end of 2011. During the effects determination phase, the injunction would limit pesticide use (for example, by requiring application buffers), dependent on pesticide and species.

## **State**

### **California Endangered Species Act**

The CESA is described in Section 5.7, Vegetation and Wildlife.

### **California Environmental Quality Act**

CEQA is described in Section 5.7, Vegetation and Wildlife.

---

<sup>2</sup> *Salmonid habitats* is defined as freshwaters, estuarine habitats, and nearshore marine habitats including bays within the ESU/DPS range, including migratory corridors. The freshwater habitats include intermittent streams and other temporally connected habitats to salmonid-bearing waters. Freshwater habitats also include all known types of off-channel habitats as well as drainages, ditches, and other manmade conveyances to salmonid habitats that lack salmonid exclusion devices.

<sup>3</sup> In fact, the EPA (2009:5) letter to pesticide registrants notes "If the registrants are prepared to adopt some of these limitations, the Agency [EPA] will work with you to develop the terms and conditions of the amendment request and the process that will be followed to proceed with requesting these changes to product labeling."

## California Fish and Game Code

### Section 3515 – Fully Protected Species

As described in Section 5.7, Vegetation and Wildlife, the CFCG prohibits take of fully protected species (also see “Regulatory Classification of Special-Status Species” below). Section 3515 of the CFCG lists fully protected fish.

## Local

### County Endangered Species Pesticide Application Bulletins

DPR issues county bulletins that describe the distribution and occurrence of ESA-listed species and contain worksheets to assist users in applying pesticides in a manner that will reduce potential impacts to ESA-listed species. The bulletin scheme is voluntary rather than mandatory, and the guidelines are currently superseded by the Court-ordered buffers around salmonid streams (see above).

## Regulatory Classification of Special-Status Species

*Special-status species* are here defined to include all species native to California that have been specifically identified by USFWS, NMFS or DFG as currently warranting some level of protection from human impacts. Some species may be identified as requiring monitoring to assess the potential need for protection in the future. The following terms are used by state and federal agencies to designate special-status species. The terms are ranked approximately from the most to the least protective designation.

- **Fully Protected (FP):** Species designated as fully protected under CFCG Section 3515. FP species may not be taken or possessed at any time, and no licenses or permits may be issued for their take except for collecting these species for necessary scientific research and relocating bird species for the protection of livestock.
- **Federal Endangered (FE):** Species designated as endangered under the ESA (described above). An FE species is one that is in danger of extinction throughout all or a significant portion of its range. Harm of any individual of an FE species is prohibited except with prior authorization from USFWS or NMFS (most ESA-listed species are within USFWS jurisdiction; but some partly marine species, including all Pacific salmon and steelhead, are regulated by NMFS).
- **State Endangered (SE):** Species designated as endangered under the CESA (described above). These include native species or subspecies of a bird, mammal, fish, amphibian, reptile, or plant that is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes—including loss of habitat, change in habitat, overexploitation, predation, competition, or disease (CESA Section 2062). Harm of any individual of an SE species is prohibited except under special circumstances that require prior authorization from DFG.
- **Federal Threatened (FT):** Species designated as threatened under the ESA (described above). An FT species is one that is likely to become endangered in the foreseeable future throughout all or a significant portion of its range. At the discretion of USFWS or NMFS, harm of any individual of an FT species may be prohibited or restricted.

- **State Threatened (ST):** Species designated as endangered under the CESA (described above). These include native species or subspecies of a bird, mammal, fish, amphibian, reptile, or plant that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of special protection and management efforts (CESA Section 2067). Harm of any individual of an ST species is prohibited except under special circumstances that require prior authorization from DFG.
- **State Candidate (SC):** Species designated as candidates for listing under the CESA (described above). These are native species or subspecies of a bird, mammal, fish, amphibian, reptile, or plant that the Fish and Game Commission has formally noticed as being under review by DFG for addition to either the list of endangered species or the list of threatened species, or a species for which the Commission has published a notice of proposed regulation to add the species to either list (CESA Section 2068). Harm of any individual of an SC species is prohibited except under special circumstances that require prior authorization from DFG.
- **Species of Special Concern (SSC):** A species, subspecies, or distinct population of a vertebrate animal native to California that has been determined by DFG to warrant protection and management intended to reduce the need to give the species formal protection as an SE, ST or SC species. *Species of Special Concern* is an administrative designation and carries no formal legal status. However, Section 15380 of the State CEQA Guidelines clearly indicates that species of special concern should be included in an analysis of project impacts if they can be shown to meet the criteria of sensitivity outlined therein (Comrack et al. 2008).
- **Federal Proposed (FP):** Species that have been proposed by USFWS or NMFS for listing as endangered or threatened under the ESA. FP species must be evaluated in the Section 7 consultation for any federal action (described under “Section 7 –Endangered Species Act Consultation Process”) and are normally evaluated in the NEPA review of any action that may affect the species.
- **Federal Candidate (FC):** Species that are candidates for listing as endangered or threatened under the ESA. Such species have not yet been proposed for listing. Consideration of FC species can assist environmental planning efforts by providing advance notice of potential listings, allowing resource managers to alleviate threats and thereby possibly remove the need to list species as endangered or threatened. Thus, FC species are normally evaluated in the NEPA review of any action that may affect the species.
- **Federal Species of Concern (FSoC):** *Species of Concern* are not defined or mentioned in the ESA, but some offices of both NMFS and USFWS use this term to describe special-status species that have not been designated under any of the formal federal status terms described above. Usually these are species for which the agency (NMFS or USFWS) has some concerns about status or threats, but for which data are insufficient to indicate that the species warrants treatment as a candidate for listing.
- **Designated Critical Habitat and Recovery Plans:** Many FE and FT species have designated critical habitat and/or approved recovery plans. Federal regulations prohibit actions that would destroy or adversely modify designated critical habitat. One reason for designation of critical habitat is that, although such habitat may not be currently occupied, it is essential in order to achieve recovery of these species. Accordingly, for these species, the species distribution is assumed to include the known range of the species plus any additional areas of designated critical habitat. Species recovery plans identify actions that are required in order to secure recovery of a species.

Special-status species within the program area included in the analysis of impacts were limited to those listed under the ESA or CESA and other species that DFG has designated as SSC. The impact analysis was based on overlapping of the species ranges with the program area, using records from the CNDDDB and other relevant sources (Moyle 2002).

## 5.8.3 Environmental Setting

### Waters in the ILRP Program Area

A general physiographic description of the program area is provided in Chapter 4. Additionally, Section 5.7, Vegetation and Wildlife, describes the habitats of agricultural lands and managed wetlands; the latter category includes seasonal wetlands and semi-permanent and permanent wetlands. In addition to some of these wetland habitats, waters receiving inputs from irrigated lands within the program area are of major importance to fish. The description below is largely based on the account of existing habitat by Williams (2006) and sources therein.

The Sacramento and San Joaquin Rivers run south and north, respectively, along the Central Valley and meet at the Delta, the upper portion of the San Francisco estuary where approximately 5 percent of historical tidal wetlands remain. South of the San Joaquin River is the Tulare Lake Basin, the rivers of which are not tributary to the other two main rivers in the Central Valley or the sea; therefore, native anadromous fishes are not present, but endemic inland fishes are. Rivers reaching into the Sierra Nevada are fed by both snow melt and rainfall (e.g., the Mokelumne) whereas lower rivers not extending into the mountains receive only rainfall (e.g., the Cosumnes). Most of the major rivers in the program area have been dammed for flood control, water storage, and hydroelectricity purposes, restricting habitat for migratory fish such as anadromous salmonids. Dams are generally found among the foothills of mountain ranges. Natural flow cycles are dammed, and water from reservoirs is released mostly during summer to allow irrigation and to prevent impaired water quality for farmlands receiving water from the Delta. Because floods occur primarily because of winter storms, water is gradually released before winter, with temporary increases following storms until early spring, when the reservoir levels are allowed to increase. The reservoirs then capture and store snow melt runoff for release later in the year.

Considerable quantities of water are exported from the Delta to supply water storage facilities and agriculture in the San Joaquin Valley and further south. Export flows alter flow patterns in the Delta and entrain fish at the export facilities. The Sacramento River and its tributaries rarely pose problems for fish migration because of reduced flows. This is not the case in the San Joaquin River, where sections of the river have been without water for more than half a century. The San Joaquin River Restoration Program began flow releases from Millerton Reservoir in late 2009 that are the first step in an attempt to restore Chinook salmon to that river. Major sections of Central Valley rivers have been separated from historical floodplains by levees constructed for flood control. Bypasses created by these actions may function as important habitat for species such as Chinook salmon when flooded (Sommer et al. 2001). Mitigation for lost salmonid habitat behind impassable dams is provided by five hatcheries (Coleman National Fish Hatchery on Battle Creek, Feather River Hatchery, Nimbus Hatchery, Mokelumne River Fish Hatchery, and Merced River Fish Facility) that together release 30 million juvenile salmon and approximately 1 million juvenile steelhead into rivers or the San Francisco Bay.

## Special-Status Species

Thirty-one special-status fish species are in areas encompassed by the ILRP (Table 5.8-1). Life-stage occurrence and timing are presented in Table 5.8-2 for anadromous fish formally listed under the ESA or CESA that occur in the ILRP program area. An account for the fall-run/late fall-run Chinook salmon ESU is also presented because this ESU is subject to a federal FMP (making it subject to EFH requirements under the Magnuson-Stevens Act; see above) and includes the majority of Chinook salmon in the ILRP program area.

**Table 5.8-1. Special-Status Fish Species Potentially Affected by the Irrigated Lands Regulatory Program**

| Common Name                                              | Scientific Name                       | Federal Status | State Status |
|----------------------------------------------------------|---------------------------------------|----------------|--------------|
| <b>Lampreys</b>                                          |                                       |                |              |
| Lamprey, river                                           | <i>Lampetra ayresii</i>               | –              | SSC          |
| Lamprey, Kern Brook                                      | <i>Lampetra hubbsi</i>                | –              | SSC          |
| Lamprey, Goose Lake                                      | <i>Lampetra tridentata</i> ssp. 1     | –              | SSC          |
| <b>Anadromous Non-Salmonid Fish</b>                      |                                       |                |              |
| Sturgeon, green (Southern DPS)                           | <i>Acipenser medirostris</i>          | FT             | SSC          |
| Smelt, delta                                             | <i>Hypomesus transpacificus</i>       | FT             | ST           |
| Smelt, longfin                                           | <i>Spirinchus thaleichthys</i>        | –              | ST, SSC      |
| <b>Salmonid Fish</b>                                     |                                       |                |              |
| Trout, Lahontan cutthroat (Western Lahontan Basin)       | <i>Oncorhynchus clarkii henshawi</i>  | FT             | –            |
| Trout, Paiute cutthroat                                  | <i>Oncorhynchus clarkii seleniris</i> | FT             | –            |
| Trout, California golden                                 | <i>Oncorhynchus mykiss aguabonita</i> | –              | SSC          |
| Trout, Kern River rainbow                                | <i>Oncorhynchus mykiss gilberti</i>   | –              | SSC          |
| Steelhead (California Central Valley DPS)                | <i>Oncorhynchus mykiss irideus</i>    | FT             | –            |
| Trout, Goose Lake redband                                | <i>Oncorhynchus mykiss</i> ssp. 1     | –              | SSC          |
| Trout, McCloud River redband                             | <i>Oncorhynchus mykiss</i> ssp. 2     | –              | SSC          |
| Trout, Little Kern golden                                | <i>Oncorhynchus mykiss whitei</i>     | FT             | –            |
| Salmon, chinook (Central Valley fall-/late fall-run ESU) | <i>Oncorhynchus tshawytscha</i>       | FSOC           | SSC          |
| Salmon, chinook (Central Valley spring-run ESU)          | <i>Oncorhynchus tshawytscha</i>       | FT             | ST           |
| Salmon, chinook (Sacramento River winter-run ESU)        | <i>Oncorhynchus tshawytscha</i>       | FE             | SE           |
| <b>Freshwater and Estuarine Fish</b>                     |                                       |                |              |
| Chub, Goose Lake tui                                     | <i>Gila bicolor thalassina</i>        | –              | SSC          |
| Chub, Lahontan Lake tui                                  | <i>Gila bicolor pectinifer</i>        | –              | SSC          |
| Hitch, Clear Lake                                        | <i>Lavinia exilicauda chi</i>         | –              | SSC          |
| Roach, pit                                               | <i>Lavinia symmetricus mitrulus</i>   | –              | SSC          |
| Roach, San Joaquin                                       | <i>Lavinia symmetricus</i> ssp. 1     | –              | SSC          |
| Roach, Red Hills                                         | <i>Lavinia symmetricus</i> ssp. 3     | –              | SSC          |
| Hardhead                                                 | <i>Mylopharodon conocephalus</i>      | –              | SSC          |



| Common Name             | Scientific Name                               | Federal Status | State Status |
|-------------------------|-----------------------------------------------|----------------|--------------|
| Splittail, Sacramento   | <i>Pogonichthys macrolepidotus</i>            | –              | SSC          |
| Sucker, Modoc           | <i>Catostomus microps</i>                     | FE             | SE, FP       |
| Sucker, Goose Lake      | <i>Catostomus occidentalis lacusanserinus</i> | –              | SSC          |
| Sucker, mountain        | <i>Catostomus platyrhynchus</i>               | –              | SSC          |
| Perch, Sacramento       | <i>Archoplites interruptus</i>                | –              | SSC          |
| Sculpin, rough          | <i>Cottus asperimus</i>                       | –              | ST           |
| Sculpin, bigeye marbled | <i>Cottus klamathensis macrops</i>            | –              | SSC          |

## Notes:

FE = Federal endangered.

SE = State endangered.

FP = DFG fully protected species.

SSC = DFG species of special concern.

FSoC = Federal species of concern.

ST = State threatened.

FT = Federal threatened.

– = no listing.

Sources: Source for species names, table order, and listing status information is California Department of Fish and Game (2009a), except for some species names from Moyle (2002) and Moyle et al. (2008).

**Table 5.8-2. Assumed Life Stage, Timing, and Distribution of Anadromous Listed Species Potentially Affected by the Irrigated Lands Regulatory Program**

| Species                                                                                                                  |                                                                                        | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|--------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| <b>Fall-Run Chinook Salmon (Central Valley Fall-/Late Fall-Run Chinook Salmon Evolutionarily Significant Unit)</b>       |                                                                                        |     |     |     |     |     |     |     |     |     |     |     |     |
| Adult migration                                                                                                          | SF Bay to Upper Sacramento River and tributaries, Mokelumne River, and SJR tributaries |     |     |     |     |     |     |     |     |     |     |     |     |
| Spawning                                                                                                                 | Upper Sacramento River and tributaries, Mokelumne River, and SJR tributaries           |     |     |     |     |     |     |     |     |     |     |     |     |
| Egg incubation <sup>a</sup>                                                                                              | Upper Sacramento River and tributaries, Mokelumne River, and SJR tributaries           |     |     |     |     |     |     |     |     |     |     |     |     |
| Juvenile rearing (natal stream)                                                                                          | Upper Sacramento River and tributaries, Mokelumne River, and SJR tributaries           |     |     |     |     |     |     |     |     |     |     |     |     |
| Juvenile movement and rearing                                                                                            | Upper Sacramento River and tributaries, Mokelumne River, and SJR tributaries to SF Bay |     |     |     |     |     |     |     |     |     |     |     |     |
| <b>Late Fall-Run Chinook Salmon (Central Valley Fall-/Late Fall-Run Chinook Salmon Evolutionarily Significant Unit )</b> |                                                                                        |     |     |     |     |     |     |     |     |     |     |     |     |
| Adult Migration and Holding                                                                                              | SF Bay to Upper Sacramento River and tributaries                                       |     |     |     |     |     |     |     |     |     |     |     |     |
| Spawning <sup>a</sup>                                                                                                    | Upper Sacramento River and tributaries                                                 |     |     |     |     |     |     |     |     |     |     |     |     |
| Egg incubation                                                                                                           | Upper Sacramento River and tributaries                                                 |     |     |     |     |     |     |     |     |     |     |     |     |
| Juvenile rearing (natal stream)                                                                                          | Upper Sacramento River and tributaries                                                 |     |     |     |     |     |     |     |     |     |     |     |     |
| Juvenile movement                                                                                                        | Upper Sacramento River and tributaries to SF Bay                                       |     |     |     |     |     |     |     |     |     |     |     |     |
| <b>Central Valley Spring-Run Chinook Salmon Evolutionarily Significant Unit</b>                                          |                                                                                        |     |     |     |     |     |     |     |     |     |     |     |     |
| Adult migration and holding                                                                                              | SF Bay to Upper Sacramento River and tributaries                                       |     |     |     |     |     |     |     |     |     |     |     |     |

| <b>Species</b>                     |                                                  | <b>Jan</b> | <b>Feb</b> | <b>Mar</b> | <b>Apr</b> | <b>May</b> | <b>Jun</b> | <b>Jul</b> | <b>Aug</b> | <b>Sep</b> | <b>Oct</b> | <b>Nov</b> | <b>Dec</b> |
|------------------------------------|--------------------------------------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| Spawning                           | Upper Sacramento River and tributaries           |            |            |            |            |            |            |            |            |            |            |            |            |
| Egg incubation                     | Upper Sacramento River and tributaries           |            |            |            |            |            |            |            |            |            |            |            |            |
| Juvenile rearing<br>(natal stream) | Upper Sacramento River and tributaries           |            |            |            |            |            |            |            |            |            |            |            |            |
| Juvenile movement                  | Upper Sacramento River and tributaries to SF Bay |            |            |            |            |            |            |            |            |            |            |            |            |

**Sacramento River Winter-Run Chinook Salmon Evolutionarily Significant Unit**

|                                    |                                  |  |  |  |  |  |  |  |  |  |  |  |  |
|------------------------------------|----------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|
| Adult migration and holding        | SF Bay to Upper Sacramento River |  |  |  |  |  |  |  |  |  |  |  |  |
| Spawning                           | Upper Sacramento River           |  |  |  |  |  |  |  |  |  |  |  |  |
| Egg incubation                     | Upper Sacramento River           |  |  |  |  |  |  |  |  |  |  |  |  |
| Juvenile rearing<br>(natal stream) | Upper Sacramento River to SF Bay |  |  |  |  |  |  |  |  |  |  |  |  |
| Juvenile movement and rearing      | Upper Sacramento River to SF Bay |  |  |  |  |  |  |  |  |  |  |  |  |

**California Central Valley Steelhead Distinct Population Segment**

|                   |                                                  |  |  |  |  |  |  |  |  |  |  |  |  |
|-------------------|--------------------------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|
| Adult migration   | SF Bay to Upper Sacramento River and tributaries |  |  |  |  |  |  |  |  |  |  |  |  |
| Spawning          | Upper Sacramento River and tributaries           |  |  |  |  |  |  |  |  |  |  |  |  |
| Egg incubation    | Upper Sacramento River and tributaries           |  |  |  |  |  |  |  |  |  |  |  |  |
| Juvenile rearing  | Upper Sacramento River and tributaries to SF Bay |  |  |  |  |  |  |  |  |  |  |  |  |
| Juvenile movement | Upper Sacramento River and tributaries to SF Bay |  |  |  |  |  |  |  |  |  |  |  |  |

| Species                                        |                                                                                                                 | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| <b>Delta Smelt</b>                             |                                                                                                                 |     |     |     |     |     |     |     |     |     |     |     |     |
| Adult migration                                | Delta                                                                                                           |     |     |     |     |     |     |     |     |     |     |     |     |
| Spawning                                       | Delta, Suisun Marsh                                                                                             |     |     |     |     |     |     |     |     |     |     |     |     |
| Larval and early juvenile rearing              | Delta, Suisun Marsh                                                                                             |     |     |     |     |     |     |     |     |     |     |     |     |
| Estuarine rearing: juveniles and adults        | Lower Delta, Suisun Bay                                                                                         |     |     |     |     |     |     |     |     |     |     |     |     |
| <b>Longfin Smelt</b>                           |                                                                                                                 |     |     |     |     |     |     |     |     |     |     |     |     |
| Adult migration                                | SF Bay and San Pablo Bay to Suisun Bay, Suisun Marsh, Delta, Lower Sacramento River and Lower San Joaquin River |     |     |     |     |     |     |     |     |     |     |     |     |
| Spawning                                       | Suisun Marsh, Lower Sacramento and San Joaquin Rivers                                                           |     |     |     |     |     |     |     |     |     |     |     |     |
| Larval and early juvenile rearing and movement | Suisun Bay, San Pablo Bay, Lower Delta                                                                          |     |     |     |     |     |     |     |     |     |     |     |     |
| Adult and juvenile rearing                     | SF Bay, Suisun Bay, San Pablo Bay                                                                               |     |     |     |     |     |     |     |     |     |     |     |     |
| <b>Green Sturgeon</b>                          |                                                                                                                 |     |     |     |     |     |     |     |     |     |     |     |     |
| Adult migration and holding                    | SF Bay to upper Sacramento River                                                                                |     |     |     |     |     |     |     |     |     |     |     |     |
| Spawning                                       | Upper Sacramento River                                                                                          |     |     |     |     |     |     |     |     |     |     |     |     |
| Larval rearing                                 | Upper Sacramento River                                                                                          |     |     |     |     |     |     |     |     |     |     |     |     |
| Juvenile rearing and migration                 | Sacramento River, Delta, Suisun Bay                                                                             |     |     |     |     |     |     |     |     |     |     |     |     |

Delta = Sacramento–San Joaquin River Delta; SF Bay = San Francisco Bay; SJR = San Joaquin River.

Note: Shading intensity indicates relative occurrence of life stages by month.

<sup>a</sup> Spawning and incubation occurs from October to February in the Feather, American, and Mokelumne Rivers.

Sources: Brown and Moyle 1993; Wang and Brown 1993; USFWS 1996; McEwan 2001; Moyle 2002; Hallock 1989; NMFS 2009; Williams 2006.

### **Green Sturgeon (Southern DPS)**

Two DPSs exist for the green sturgeon: the southern DPS and the northern-Pacific DPS (68 FR 4433). The southern DPS includes the spawning populations of green sturgeon south of the Eel River (exclusive), principally including the Sacramento River green sturgeon spawning population. The northern-Pacific DPS includes spawning populations in the Eel, Mad, Trinity, and Klamath Rivers plus several coastal streams in Oregon.

Green sturgeon use both freshwater and saltwater habitat. As adults, green sturgeon live most of their lives in nearshore oceanic waters, bays, and estuaries. Mature adult green sturgeon move into large, turbulent freshwater rivers to spawn (Moyle et al. 1992a in Moyle 2002). Spawning occurs once the fish are more than 15 years old and is then believed to occur every 2 to 5 years (Moyle 2002). Green sturgeon migrate to fresh water in late February and spawn from March to July, with peak spawning occurring from April to June (Moyle et al. 1995). Each female produces from 60,000 to 140,000 eggs (Moyle 2002). Specific spawning habitat preferences are unclear, but eggs likely are broadcast over bedrock or sand to cobble substrates (Moyle et al. 1995). Juvenile green sturgeon live in fresh and estuarine waters for 1 to 3 years before out-migrating to salt water (Nakamoto et al. 1995 in NMFS 2009; Moyle 2002).

Juveniles and adults are benthic feeders, generally living close to the bottom of the water column, and juveniles have been reported to eat mysid shrimp and amphipods in the Delta (Radtke 1966 in Moyle 2002). Adults may eat small fish and macroinvertebrates (Moyle 2002).

Data for assessment of population abundance trends of the green sturgeon southern DPS are limited, and the generally low abundances and high interannual variability hinder trend detection. Nevertheless, the trend in number of juveniles appears to be downward based on collection of fish in rotary screw traps at Red Bluff Diversion Dam (RBDD) and the Glenn-Colusa Irrigation District (GCID) diversion dam, as well as from the density of fish salvaged (green sturgeon per volume of water exported) at the SWP and CVP fish facilities (NMFS 2009: 121–123). The main factor believed responsible for decline of the southern DPS green sturgeon is the reduction in spawning habitat to a limited section of the Sacramento River. There are numerous other threats, including insufficient freshwater flow rates at spawning areas, contaminants, entrainment, impassable barriers, influence of exotic species, small population size, elevated water temperatures, and by-catch of green sturgeon in fisheries, that could potentially affect the status of the southern DPS green sturgeon (Biological Review Team 2005; 71 FR 17757).

### **Delta Smelt**

The delta smelt is listed under both the ESA and CESA as a threatened species (58 FR 12854, March 5, 1993). Rearing habitat for juvenile and adult delta smelt typically is found in the estuarine waters of the lower Delta and Suisun Bay, where salinity is between 2 and 7 parts per thousand (ppt). Delta smelt tolerate from 0 to 19 ppt salinity. Delta smelt occupy open shallow waters but also occur in the main channel in the region where fresh water and brackish water mix. They occur in the water column at depths of 0–4 meters (Kimmerer 2008:12). The mixing zone of fresh and brackish water may be hydraulically conducive to their ability to maintain position and metabolic efficiency (Moyle 2002).

Adult delta smelt begin a spawning migration, which may encompass several months, and move into the upper Delta during December or January. Spawning occurs between January and July, with peak

spawning during April through mid-May (Moyle 2002). Spawning occurs in shallow edgewaters in the upper Delta channels, including the Sacramento River above Rio Vista, Cache Slough, Lindsey Slough, and Barker Slough. Spawning also was observed in the Sacramento River up to Garcia Bend during drought conditions, possibly attributable to adults moving farther inland in response to saltwater intrusion (Wang and Brown 1993). Most delta smelt spawn once and then die, although some individuals may spawn again (Bennett 2005:16). A small proportion of adults may survive a second year and spawn a year later. This may be important to the overall population because, although 2-year-olds are rare, female fecundity is much greater in older, larger individuals. A 70-millimeter (mm) female produces about 2,000 eggs whereas a 105-mm female produces about 7,000 eggs (Bennett 2005:16). Eggs are broadcast over the bottom, where they attach to firm sediment, woody material, and vegetation. Hatching takes approximately 9 to 13 days, and larvae begin feeding 4 to 5 days later. Newly hatched larvae contain a large oil globule that makes them semi-buoyant and allows them to stay off the bottom. Larval smelt feed on rotifers and other zooplankton. As their fins and swim bladder develop, they move higher into the water column. Larvae and juveniles gradually move downstream toward rearing habitat in the estuarine mixing zone (Wang 1986). Adult copepods are important as food for juvenile delta smelt. The copepod *Eurytemora affinis* and the mysid *Neomysis mercedis* were historically important prey for delta smelt (Moyle et al. 1992b:70) but have been largely replaced by the introduced copepod *Pseudodiaptomus forbesi* during summer months in the Delta (USFWS 2008a:228). Recent studies have suggested that a proportion of the delta smelt population exhibits a contingent life-history pattern. Instead of undergoing the migrations typical of the species, there is evidence that delta smelt may reside year-round in areas such as the Cache Slough Complex off the southern Sacramento River (Sommer et al. 2009:11–12).

From 1969 to 1981, the mean delta smelt Towntown Survey (TNS) and Fall Midwater Trawl (FMWT) indices were 22.5 and 894, respectively. Both indices suggest that the delta smelt population declined abruptly in the early 1980s (Moyle et al. 1992b). From 1982 to 1992, the mean delta smelt TNS and FMWT indices dropped to 3.2 and 272 respectively. The population rebounded somewhat in the mid-1990s (Sweetnam 1999); the mean TNS and FMWT indices were 7.1 and 529, respectively, during the 1993–2002 period. However, delta smelt numbers have trended precipitously downward since about 2000 (USFWS 2008a).

Currently, the delta smelt population indices are two orders of magnitude smaller than historical highs, and recent population abundance estimates are up to three orders of magnitude below historical highs (Newman 2008). The median TNS index from 2000 through 2008 fell similarly to 1.6; and it has dropped to its lowest levels during the last 4 years, with indices of 0.3, 0.4, 0.4, and 0.6 during 2005 through 2008, respectively. It is highly unlikely that the indices from 2004 to 2007 can be considered statistically different from one another (Sommer et al. 2007), but they are very likely lower than at any time prior in the period of record. The total number of delta smelt collected in the 20-mm survey decreased substantially during the years from 2002 to 2008 (from 4,917 to 587 fish) compared with the period from 1995 through 2001 (from 98 to 1,084 fish) (USFWS 2008).

Severe alterations in the composition and abundance of the primary producer and primary/secondary consumer assemblages<sup>4</sup> in the Delta have been implicated in the recent decline of delta smelt and other native fish species (USFWS 1996; Kimmerer 2002). The decrease in abundance of

---

<sup>4</sup> Primary consumers may be zooplankton, fish, or other aquatic organisms that feed on primary producers (phytoplankton); secondary consumers (including fish and other organisms) feed on primary consumers.



various pelagic (open-water) fish species has been termed the Pelagic Organism Decline (POD) and is currently under investigation (Sommer et al. 2007). Factors that may have contributed to the POD phenomenon include reductions in food quantity (e.g., non-native invertebrate consumption of phytoplankton leading to reduced zooplankton prey for small pelagic fishes), reductions in population size (through losses at water diversions or to non-native predators), and detrimental changes to habitat (e.g., increases in contaminants and other chemical constituents, as well as alterations of salinity, temperature, and turbidity regimes) (Sommer et al. 2007). The delta smelt exhibits an unusual life-history compared to most fishes, which may make it susceptible to environmental alterations. It has a very limited range (portions of the San Francisco estuary), generally lives for only 1 year, and has relatively low fecundity.

### **Longfin Smelt**

The longfin smelt is found from Alaska to California. In California, varying sizes of populations of longfin smelt are found in the lower portions of the major watersheds (Klamath River, Eel River, and Russian River) (DFG 2009b:5–6). The largest population is likely to be that inhabiting the San Francisco estuary, including the Delta. Wang (1986:6–10) found a single longfin smelt at Moss Landing in Monterey Bay. In the San Francisco estuary, the longfin smelt is rarely found upstream of Rio Vista or Medford Island in the Delta (Moyle 2002:236), although in low-flow years, longfin smelt may occur almost as far upstream as the City of Sacramento on the Sacramento River and to Rough-and-Ready Island on the San Joaquin River (DFG 2009b:7). Adults concentrate in Suisun, San Pablo, and North San Francisco Bays (Moyle 2002). Off-channel, upstream areas such as the Cache Slough Complex and the Yolo Bypass also may be occupied (DFG 2009b:7).

Longfin smelt are anadromous and pelagic; adults occupy the upper portion of the water column and juveniles, the middle to bottom (Wang 1986:6–10, Moyle 2002:236). Adults and juveniles are found in estuaries and can tolerate salinities from 0 ppt to full-strength sea water. Most larval and early-juvenile longfin smelt are found in salinities ranging from 1.1 to 18.5 ppt (Unger 1994:7). After the early juvenile stage, salinities in the 15-to 30-ppt range are generally occupied (Moyle 2002:236). Longfin smelt in the San Francisco estuary spawn in fresh or slightly brackish water (Moyle 2002:236). Prior to spawning, these fish aggregate in deepwater habitats available in the northern Delta, including primarily the channel habitats of Suisun Bay and the Sacramento River (Rosenfield and Baxter 2007). Catches of gravid (carrying eggs internally) adults and larval longfin smelt indicate that the primary spawning locations for these fish are in or near the Suisun Bay channel, the Sacramento River channel near Rio Vista, and (at least historically) Suisun Marsh (Wang 1991; Moyle 2002; Rosenfield and Baxter 2007). Moyle (2002) indicated that longfin smelt may spawn in the San Joaquin River as far upstream as Medford Island. In the Delta, longfin smelt spend most of their life cycle in deep, cold, brackish-to-marine waters of the Delta and nearshore environments (Moyle 2002; Rosenfield and Baxter 2007). They are capable of living their entire life cycle in fresh water, as demonstrated by landlocked populations.

Prespawning adults are generally restricted to brackish (2–35 ppt) or marine habitats. In fall and winter, longfin smelt move upstream into fresh water to spawn. Most spawners are 2 years old, with lesser numbers of 1- and 3-year-olds (DFG 2009b:10). Spawning may occur as early as November, and larval surveys indicate that spawning may extend into June (Moyle 2002). The exact nature and extent of spawning habitat are still unknown for this species (Moyle 2002), although major aggregations of gravid adults occur in the northwestern Delta and eastern Suisun Bay (Rosenfield and Baxter 2007). Fecundity ranges from approximately 1,900 eggs in a 73-mm female to approximately 18,000 eggs in a 120-mm female (DFG 2009b:11).

Embryos hatch in 40 days at 7 degrees Celsius (°C) and are buoyant (Dryfoos 1965, as cited by Moyle 2002:236). They move into the upper part of the water column and are carried into the estuary. High outflows transport the larvae into Suisun and San Pablo Bays. In low outflow years, larvae move into the western Delta and Suisun Bay. Higher outflows are reflected positively in juvenile survival and adult abundance. Rearing habitat is highly suitable in Suisun and San Pablo Bays, in part because juveniles require brackish water in the 2- to 18-ppt range. Longfin smelt are pelagic foragers that feed extensively on copepods, amphipods, and shrimp (USFWS 1996; Moyle 2002).

Year-class abundance of longfin smelt appears to depend, in part, on the environmental conditions experienced by the eggs and young fish. One such factor is Delta inflow and outflow during larval and early juvenile life stages. Outflow affects the downstream distribution of smelt and their vulnerability to entrainment in diversions. Both inflows and outflows move larvae and juveniles into the low-salinity zone, where feeding conditions are optimal (Kimmerer 2002). Freshwater flows during the late winter and early spring clearly are related to increased production of young-of-the year (YOY) longfin smelt (Stevens and Miller 1983; Jassby et al. 1995; Meng and Matern 2001; Kimmerer 2002; Rosenfeld and Baxter 2007). Moyle (2002) attributed the relationship between smelt abundance and outflow to reduced availability of brackish water habitat for larvae and juveniles. Baxter (2000, in Moyle 2002) found that smelt numbers are a function of the number of spawners and of outflow during spawning and larval periods in the previous year. Herbold (1998 pers. comm. to Moyle 2002:237) developed a regression indicating that mean spring (March–May) outflows much less than 3,400 cubic feet per second (cfs) would cause reproductive failure. Outflow in the years 1986–1994 (including the 1987–1992 drought) was close to this level. Although not highlighted by these authors, relationships with Delta outflow also would hold true for Delta inflow because of the correlation between inflow and outflow.

Kimmerer (2002) found a negative relationship between abundance and X2<sup>5</sup>, indicating higher abundance at higher flows. This was the strongest fish-X2 relationship found, although it declined by a factor of 4 after 1987 (Kimmerer 2002:46) and establishment of the Asian Corbula clam. Dege and Brown (2004) found a strong relationship between X2 and the distribution of longfin smelt: although the geographic distribution of YOY longfin varied over the years 1995–2001, annual distributions always were centered on the location of X2. As mentioned for delta smelt, Dege and Brown's (2004) findings are consistent with the hypothesis that abundance is controlled in part by an X2 location affording maximum rearing habitat. However, a recent examination by Kimmerer et al. (2009) indicated that "the mechanism chiefly responsible for the X2 relationship for longfin smelt remains unknown." This was because changes in habitat availability (defined by salinity) were insufficient to support observed changes in abundance. Kimmerer et al. (2009) suggested that the mechanism may be related to juvenile longfin smelt increasing the probability of their retention within preferred waters by occupying deeper waters under higher salinity conditions.

---

<sup>5</sup> X2 is the location in the San Francisco Bay-Delta estuary relative to the Golden Gate Bridge (measured in kilometers) of the 2-parts per thousand (ppt) isohaline 1 meter off the bottom (San Francisco Estuary Project 1993). An *isohaline* is a line connecting all points of equal salinity. X2 represents the upstream end of the entrainment zone (where riverine current meets upstream-flowing estuarine currents and variations in flow interact with particle settling to trap particles, resulting in a region of the estuary characterized by higher levels of particulates, higher abundance of several types of organisms, and a turbidity maximum—and the transition from fresh water to the estuarine salt gradient). X2 is a function of Delta outflow volume; as outflow increases, X2 is reduced (the 2-ppt isohaline moves downstream).

Moyle (2002) speculated that the continuing decline of longfin smelt abundance is attributable to multiple factors acting synergistically. Besides outflow/X2, Moyle identified entrainment (SWP, CVP, and in-Delta agricultural) and take during salvage, the impact of introduced species on longfin food supply, extreme flooding during spawning, impacts of introduced predators, and toxic substances as possible contributors. In its petition for the listing of longfin smelt under the ESA, the Bay Institute (2007) also cited outflow, entrainment, food-related impacts of invasive species, and toxic pollutants as probable contributors to the decline of longfin abundance. They did not list predation by invasive species or flooding but did include increase in water temperature and physical disruption of spawning habitat and critical prey species habitat by dredging.

The abundance of longfin smelt in the San Francisco estuary has fluctuated over time. However, abundance has been in decline since the early 1980s and was very low during the drought years of the 1990s and in recent wet years (Rosenfield and Baxter 2007; Sommer et al. 2007). The decline has been seen in the reduction of longfin smelt captured in the percent of trawls throughout San Francisco Bay (Rosenfield and Baxter 2007). The 2007 FMWT had the lowest index (13) recorded since the survey began in 1967. The highest index between 1988 and 2008 was 8,205 (in 1995). The index in 2008 was 139 (DFG 2009c).

Severe alterations in the composition and abundance of the primary producer and primary/secondary consumer assemblages in the Delta have been implicated in the recent decline of longfin smelt and other native fish species (USFWS 1996; Kimmerer 2002). In combination with other factors, these alterations have resulted in longfin smelt being listed as threatened under the CESA in early 2009. The California Fish and Game Commission (2009:1) stated:

In making the recommendation to list the longfin smelt pursuant to the California Endangered Species Act, the Department relied most heavily on the following: (1) longfin smelt is short-lived, (2) introductions of exotic organisms have altered its habitat, distribution, food supply, and possibly abundance, (3) water projects have adversely modified its habitat, distribution, food supply, and probably abundance, and (4) contaminants identified in ambient water samples have periodically adversely affected test organisms and may be affecting longfin smelt abundance. Threats to the longfin smelt population are likely to continue or increase, and several measures of longfin smelt abundance were examined and the Department found that they all indicate that the population has declined substantially.

### **Lahontan Cutthroat Trout (Western Lahontan Basin DPS)**

The Lahontan cutthroat trout is native to the greater Lahontan Basin in eastern California, southern Oregon, and northern Nevada (Trotter 2008, cited by Moyle et al. 2008:247). In the Carson, Walker, and Truckee Basins, only a few scattered streams contain the western Lahontan Basin DPS of Lahontan cutthroat trout (Trotter 2008, cited by Moyle et al. 2008:247). The Lahontan cutthroat trout also has been planted and established in a few creeks outside its historical range, including west-slope drainages near the Truckee Basin (Moyle et al. 2008:247).

The Lahontan cutthroat trout occurs in a wide variety of coldwater river and lake habitats, including alkaline (e.g., Pyramid and Walker Lakes) and alpine oligotrophic lakes (e.g., Lake Tahoe and Independence Lake) (USFWS 1995:19). The Lahontan cutthroat trout primarily occupies streams with well-vegetated and stable stream banks and pools with cover nearby, as well as riffle-run complexes for spawning and cover (USFWS 1995:19). Lake residents are adapted to a wide variety of lake habitats with optimal average mid-summer epilimnion (the top-most layer in a thermally stratified lake) temperatures of less than 22°C and a mid-epilimnion pH of 6.5 to 8.5 (Moyle et al. 2008:246). The Lahontan cutthroat trout can tolerate alkalinity and total dissolved solid (TDS)

levels as high as 3,000 milligrams per liter (mg/l) and 10,000 mg/l, respectively (Koch et al. 1979, cited by USFWS 1995:20).

Irrespective of occupation of rivers or lakes, the Lahontan cutthroat trout spawns in river habitats from April to July, depending on stream flow, water temperature, and elevation (USFWS 1995:20–21). Spawning migrations are observed at water temperatures between 5 and 16°C (Lea 1968, USFWS 1977, Sigler et al. 1983, Cowan 1983, all cited by USFWS 1995:21). Preferred water depths for redds (nests the females dig in the gravel for egg deposition) average 13 centimeters (cm), and velocities average 56 centimeters/ second (cm/s) (Schmetterling 2000, cited by Moyle et al. 2008:246), while gravel substrate ranges from 6 to 50 mm (Coffin 1981, cited by Moyle et al. 2008:246). Water must be saturated with oxygen and have minimal siltation to prevent eggs from suffocating. Eggs hatch after 4–6 weeks, depending on water temperature, and fry emerge from the gravel after 13–23 days (Calhoun 1942, Lea 1968, and Rankel 1976, all cited by USFWS 1995:21). Fry can spend up to 2 years in their natal stream before migrating to lake environments, but most migrate at the end of their first summer (Trotter 2008, cited by Moyle et al. 2008:246). Females reach reproductive maturity at 3–4 years, while males mature at 2–3 years. Consecutive-year spawning is unusual, and only 50 percent of surviving females and 25 percent of spawning males spawn again (Cowan 1982, cited by USFWS 1995:20). The Lahontan cutthroat trout generally lives for 4–9 years; stream-dwelling fish have shorter life spans than lake dwellers (Moyle et al. 2008:245). Stream-dwelling Lahontan cutthroat trout are opportunistic and feed mostly on drifting terrestrial and aquatic insects (Moyle 2002:290). Large Lahontan cutthroat trout also feed on juvenile fish of other species (Moyle et al. 2008:245).

Factors affecting Lahontan cutthroat trout abundance and habitat are the introduction of non-native trout, overexploitation, logging, dams and diversions, grazing, mining, loss of genetic diversity, and disease (Moyle et al. 2008:249–251). Moyle et al. (2008:249) estimated that probably only a few hundred wild self-sustaining fish age 1 year and older exist today. A recovery plan was adopted by USFWS in 1995 with the goal of improving the species' status sufficiently to warrant delisting. A number of actions included in this plan fall under the general headings of (1) permanent and temporary fish barriers, followed by non-native trout eradication and then repatriation of the Lahontan cutthroat trout; (2) construction of permanent barriers to protect Lahontan cutthroat trout-occupied upstream habitat; (3) eradication/control of non-native salmonids through electrofishing; and (4) barrier removal projects to reconnect habitat (USFWS 2009:44). Although there has been progress in some of these actions, the problems of interactions with non-native trout and habitat degradation remain to the extent that a change in listing is not warranted and some reconsideration of recovery plan actions should be considered (USFWS 2009:75–76).

### **Paiute Cutthroat Trout**

The Paiute cutthroat trout is very similar to the Lahontan cutthroat trout but almost completely lacks spots and has different coloration (Moyle 2002:288; Moyle et al. 2008:254). It is native to only around 15 kilometers (km) of the Silver King Creek drainage in Alpine County but has been introduced to five other locations within the same drainage and seven other locations in Mono, Inyo, Tuolumne, Fresno, and Madera Counties (Moyle et al. 2008:256). The species has been extirpated from its historical range by introductions of trout from other sources and persists in around 33 km of stream habitat into which it was introduced (USFWS 2008b:4).

The Paiute cutthroat trout matures at 2 years of age and lives to only 3 or 4 years old (Wong 1975; USFWS 2004:11). Peak spawning is in June and July (Wong 1975). Eggs hatch after 6–8 weeks, and

the fry emerge from the gravel 2–3 weeks later (USFWS 2004:11). Small juveniles (less than 50 mm long) occupy backwaters or mainstem shoal habitats (USFWS 2004:11). Moyle et al. (2008:255) note that the habitat requirements of the Paiute cutthroat trout appear to be similar to those of other alpine stream trout: cold (below 18–20°C), well oxygenated water; cover in the form of emergent vegetation and undercut banks; clean spawning gravel; and adequate food (invertebrates).

The Paiute cutthroat trout faces threats common to native trout within California. Other species of trout have been introduced to its native drainage, resulting in extirpation of the Paiute cutthroat trout by competition, predation, and hybridization (Moyle et al. 2008:257). Habitat loss due to grazing and recreational use caused declines in abundance (USFWS 2004:41–42). The species is made up of several small, isolated populations and is therefore vulnerable to large disturbances such as fires (USFWS 2004:45).

A recovery plan for the Paiute cutthroat trout was written by USFWS (2004). Its main element is the reintroduction of the species to its full native range after removing non-native trout. Abundance seems to be stable at around 1,000 fish (Moyle et al. 2008:256–257). Other conservation actions have included reductions in grazing and fishing within the Paiute cutthroat trout's range (USFWS 2004:9, 12).

### **California Central Valley Steelhead DPS**

The California Central Valley steelhead DPS includes all naturally spawned anadromous steelhead below natural and man-made impassable barriers in the Sacramento and San Joaquin Rivers and their tributaries, excluding steelhead from San Francisco and San Pablo Bays and their tributaries but including two artificial propagation programs: the Coleman National Fish Hatchery, and the Feather River Hatchery.

The habitat requirements of Central Valley steelhead are similar to those of central California coast steelhead. Water quality is a critical factor during the freshwater residence time with cool, clear, and well-oxygenated water needed for maximum survival (Moyle 2002). Juvenile steelhead (ages 1+ and 2+) occupy deeper water than fry and show a stronger preference for pool habitats with ample cover, as well as for rapids and cascade habitats (Dambacher 1991). Juveniles generally occupy habitat with large structures such as boulders, undercut banks, and large woody debris that provide feeding opportunities, segregation of territories, refuge from high water velocities, and cover from fish and bird predators (Moyle et al. 2008).

Central Valley steelhead exhibit flexible reproductive strategies that allow for persistence in spite of variable flow conditions (McEwan 2001). Peak adult migration historically occurred from late September to late October, with some creeks—such as Mill Creek—showing a small mid-February run (Hallock 1989). Optimal spawning temperatures are from 4 to 11°C (McEwan and Jackson 1996). Emergent fry migrate into shallow water (<36 cm) areas such as the stream edge or low gradient riffles, often in open areas with coarse substrates (Everest and Chapman 1972, Everest et al. 1986, and Fontaine 1988, all cited by Moyle et al. 2008). In the late summer and fall, juveniles move into higher velocity, deeper, mid-channel areas (Everest and Chapman 1972, Fontaine 1988, and Hartman 1965, all in Moyle et al. 2008). Age data from a sample of 100 fish taken in 1954 indicated that steelhead spent 1 (29 percent), 2 (70 percent), or 3 (1 percent) years in fresh water before migrating out of the basin to the ocean (Hallock et al. 1961). Juvenile Central Valley steelhead generally migrate from late December through the beginning of May, with a peak in mid-March (Moyle et al. 2008).



Central Valley steelhead are opportunistic predators of aquatic and terrestrial insects, small fish, frogs, and mice; but their primary diet consists of benthic aquatic insect larvae, particularly caddisflies (*Trichoptera*), midges (*Chironomidae*), and mayflies (*Ephemeroptera*) (Merz 2002). Depending on season and steelhead size, they also may eat salmon eggs, juvenile salmon, sculpins, and suckers (Merz 2002).

Historically, Central Valley steelhead adult abundance was probably on the order of 1–2 million fish (McEwan 2001:19) and had declined to 40,000 fish by the early 1960s (DFG 1965, cited by McEwan 2001:18). The counts of adult steelhead at RBDD have declined from an annual average count of over 11,000 fish in the 10-year period beginning in 1967, to around 2,200 in the 1990s (McEwan and Jackson 1996, cited by McEwan 2001:19). The most recent estimate of the number of female spawners was based on back-calculation from the number of juveniles collected in research trawls and was approximately 3,600 fish (Lindley 2005a:291). The primary limiting factor for Central Valley steelhead is the inaccessibility of the great majority (82–95 percent) of historical spawning and rearing habitat due to major dams (McEwan 2001:21). Other limiting factors include small passage barriers, water development and land use activities, levees and bank protection, dredging and sediment disposal, mining, contaminants, fisheries management practices, hatcheries, inadequately screened water diversions, and predation by non-native species (McEwan 2001; Moyle et al. 2008; NMFS 2009).

### **Little Kern Golden Trout**

The Little Kern golden trout is endemic to the Little Kern River (Fresno County) and its tributaries (Moyle et al. 2008:217). It is a rainbow trout subspecies that resulted from isolation of the Little Kern River from the remainder of the Kern River by natural barriers. The subspecies currently is found in several small, isolated tributaries of the Little Kern River's headwaters.

The life-history of the Little Kern golden trout has not been well studied; it is assumed to be similar to that of the California golden trout (Moyle et al. 2008:217). The California golden trout is physiologically adapted to thrive in relatively cold, alpine streams (10–19°C) that are characterized by short growing seasons and low productivity (Myrick and Cech 2003, Knapp and Dudley 1990, both in Moyle et al. 2008). It is a small species relative to other salmonids, with the result that it uses relatively small-diameter substrates for spawning (4–12 mm), occupies shallow water during spawning (5–20 cm), and buries eggs to relatively shallow depths (40–60 mm) (Knapp and Vredenburg 1996:519–529). Water flow at egg deposition sites is between 30 and 70 cm/s<sup>-1</sup> (with 45–55 cm/s<sup>-1</sup> selected most often) (Knapp and Vredenburg 1996:527). Reproduction occurs at age 3 or 4 and begins in May, or when maximum daily temperatures are consistently greater than 15°C (Knapp and Vredenburg 1996:528). The temperature range during spawning (15–21°C) is relatively warm for salmonids (Knapp and Vredenburg 1996:528). Eggs incubate for 20 days at a temperature of 14 °C, and fry emerge from the gravel 2–3 weeks after hatching at a size of 25 mm total length (Moyle et al. 2008:210). Habitat requirements of the Little Kern golden trout are the same as those of California golden trout (Moyle et al. 2008:217) and include a preference for pool habitat, emergent vegetation, and undercut banks (Matthews 1996). Prey consists of terrestrial and aquatic invertebrates, particularly adult and larval insects, with feeding occurring all day and night but more so during the day (Moyle et al. 2008:210). Lifespan of the California golden trout is up to 9 years (Knapp and Dudley 1990).



Threats to the Little Kern golden trout are primarily due to planting of rainbow trout, which may cause unwanted hybridization and loss of genetic diversity, and competition with illegally planted brown trout (Moyle et al. 2008:218).

Critical habitat for the Little Kern golden trout has been designated to include all of the Little Kern River and its tributaries above the barrier falls 1 mile below the mouth of Trout Meadows Creek (50 FR 15428). In listing the species and designating critical habitat, USFWS noted that increased temperature and siltation could occur due to “uncontrolled use of ORV’s [off-road vehicles], improper road construction, careless logging activities, pollution from mining operations or overgrazing in a large portion of the drainage basin” (50 FR 15428).

Conservation efforts for native trout, including the Little Kern golden trout, have included construction of barriers to prevent hybridization with non-native trout that have moved upstream, destruction and removal of non-native trout and hybrids with poison and netting, and rearing and release of hatchery-raised fish (Moyle et al. 2008:211–212, 217). The species has increased from a low distribution of only 16 km of stream in 1973 to over 51 km and three headwater lakes in 1998 (Moyle et al. 2008:217). It is estimated that the current abundance of pure, unhybridized Little Kern golden trout of greater than 1 year old is approximately 5,000–6,000 fish (Moyle et al. 2008:218). A DFG management plan for the species was completed in 1978 and was revised in 1984 and 1995. Moyle et al. (2008:219) recommend that the plan requires further revision because of the issue of past hybridization that has not fully been resolved by management actions to date.

#### **Central Valley Fall-/Late Fall–Run Chinook Salmon ESU**

The Central Valley fall-/late fall–run Chinook salmon ESU includes all natural populations in the Sacramento and San Joaquin River Basins and their tributaries. Fall-run Chinook salmon are the most abundant run in the Central Valley and are the principal run raised in hatcheries (Moyle 2002; Williams 2006). Both wild and hatchery-origin fish exist in the Central Valley, and the proportion of hatchery fish in mixed-stock ocean fisheries may be as high as 90 percent (Barnett-Johnson et al. 2007:1688). Fall-/late fall–run Chinook salmon are produced at five hatcheries in the Central Valley (Coleman National Fish Hatchery on Battle Creek, Feather River Hatchery, Nimbus Fish Hatchery on the American River, the Mokelumne River Fish Hatchery, and the Merced River Fish Facility); the annual number of juveniles released has been over 20 million fish (Joint Hatchery Review Committee 2001:Appendix V).

Fall-run Chinook salmon migrate to spawning grounds as sexually mature adults and usually spawn from 1 to 2 months after entry. Peak spawning is from October to November, but spawning can continue through January. Substrates used for spawning tend to be a mixture of small cobble and large gravel that will allow aeration of eggs buried in redds (Moyle et al. 2008), and spawning usually occurs at the tails of holding pools at depths of 30–100 cm and water velocity of 40–60 cm/s (Moyle et al. 2008:127). Cover (such as undercut banks, submerged wood, or deeper pools) is important for various life stages, including holding adults and rearing juveniles (Bjornn and Reiser 1991:97, 133–136). Fry typically emerge from December through March and rear in natal streams for 1–7 months, usually moving downstream into the main rivers within a few weeks after emergence. Both fry and smolts can be found in the San Francisco estuary. Estuarine habitats are important rearing environments, and survival to adulthood decreases as the rate of anthropogenic alteration increases (Magnusson and Hilborn 2003). Fish spend from 2 to 5 years at sea before returning to spawn (Moyle et al. 2008). Fall-run/late fall–run Chinook salmon habitat requirements are generally similar to those of other Chinook salmon, but an important difference from races such

as spring-run and winter-run (see below) is that spawning occurs soon after fresh water entry and takes place in relatively low reaches of rivers (Moyle et al. 2008). This made fall-/late fall-run Chinook salmon less susceptible to the effects of impassable dams than other runs of Chinook and steelhead in the Central Valley. Temperature is a key environmental variable and is optimal for adult migration at 10–20°C, for adult holding at 10–16°C, for spawning at 13–16°C, for egg incubation at 9–13°C, for juvenile rearing at 13–20°C, and for smoltification at 10–19°C (Moyle et al. 2008:127–128). Juveniles make extensive use of off-channel habitats such as inundated floodplains where they grow faster because of warmer water temperatures and abundant food (Moyle et al. 2008; Sommer et al. 2001). Relatively abundant food may offset the higher metabolic costs of high-temperature environments such as inundated floodplains (Moyle et al. 2008).

The natural-origin fall-/late fall-run Chinook population has fluctuated since the 1960s and has declined during the last several years from an average escapement of almost 330,000 in 1992–2006 (with a low of around 88,000 fish in 1992) to around 88,500 fish in 2007 and less than 60,000 fish in 2008 (AFRP 2009). Low abundance in 2008 and forecasted low abundance in 2009 led to the closure of almost all fisheries in California. The current low abundance is thought to be due to warmer ocean conditions delaying coastal upwelling and limiting productivity of nearshore waters for juvenile Chinook (Lindley et al. 2009:32, 35). Other factors affecting the fall-run/late fall-run Chinook salmon include negative effects of water diversions (both through loss of individuals and through false triggers to migration by altered hydrodynamics), hatchery-reared fish (e.g., hybridization and competition), harvest (often due to increased fishing effort triggered by the presence of hatchery-reared fish), loss of habitat (particularly behind dams but also due to armoring of river banks for flood protection), pollution (e.g., municipal discharges and agricultural runoff), and alien species (particularly predators such as striped bass [*Morone saxatilis*]) (Moyle et al. 2008:141–143).

### Central Valley Spring-Run Chinook Salmon ESU

The Central Valley spring-run Chinook salmon ESU includes all naturally spawned populations in the Sacramento River and its tributaries in California, including the Feather River, and one artificial propagation program: the DFG Feather River Hatchery spring-run Chinook salmon program. There are only three remaining independent populations (Mill, Deer, and Butte Creeks); their geographic proximity to each other makes these populations susceptible to a regional disaster such as a large forest fire or volcanic eruption (Lindley et al. 2007:11).

Returning Central Valley spring-run Chinook migrate upstream as sexually immature fish in spring, hold through summer in deep pools, spawn in early fall, and migrate downstream as juveniles after either a few months or a year in fresh water (Moyle et al. 2008). Spawning migration extends from February to early July, with peaks in mid-April in Butte Creek and in mid-May in Deer and Mill Creeks (Williams 2006). Central Valley spring-run Chinook attain maturity at ages of 2–4 years. They generally migrate higher into watersheds than other runs in order to find deep pools where cooler temperatures allow over-summering (Moyle et al. 2008). Spawning often occurs in the tailwaters of their final holding pool (Moyle 2002). Preferred spawning habitat seems to be at depths of 25–100 cm and at water velocities of 30–80 cm/s (Williams 2006). Incubation lasts from 40 to 60 days and is extremely sensitive to temperature, with high egg mortality at temperatures above 14–16 °C. Fry emerge in another 4–6 weeks (Williams 2006). Migration can begin within hours of emergence, after a few months of natal rearing, or after over-summering in the natal stream (Hill and Webber 1999; Moyle et al. 2008). Central Valley spring-run Chinook salmon are probably largely ocean-type fish (i.e., migrating downstream as relatively young fish in April and May, as

occurs in Central Valley fall-run/late fall-run Chinook), but some individuals remain to rear until fall or winter and migrate at 12–15 months old (Moyle et al. 2008:167; NMFS 2009:94). As Central Valley spring-run Chinook travel downstream, they may rear in the lower reaches of non-natal tributaries and along mainstem margin habitats—particularly smaller fish that need to grow larger before ocean entry (Moyle et al. 2008). Juveniles feed mainly on zooplankton, benthic invertebrates, terrestrial drift, and larvae of other fishes—especially suckers (Moyle 2002; Moyle et al. 2008).

The abundance of Central Valley spring Chinook salmon has declined from run sizes of perhaps 600,000 adults between the late 1880s and 1940s (DFG 1998, cited by NMFS 2009:94) to tens of thousands of individuals in recent years; total abundance of natural-origin fish was less than 5,000 spawners in 2008 (AFRP 2009). According to Lindley (2005b:153), there are three primary limiting factors to Central Valley spring-run Chinook:

- Loss of most historical spawning habitat due to impassable dams,
- Degradation of remaining habitat, and
- Genetic threats from the Feather River Hatchery spring-run Chinook salmon program.

Other limiting factors include water diversions, unscreened or inadequately screened water diversions, excessively high water temperatures, predation by non-native species, urbanization and rural development, logging, grazing, agriculture, mining, estuarine alteration, fisheries management, and “natural” factors such as ocean upwelling (Moyle et al. 2008; NMFS 2009). Efforts to recover the populations within the ESU, such as gravel placement, have achieved some success. Although they lacked spring-run for many years prior, Battle Creek and Clear Creek each averaged 100–200 spring-run Chinook spawners over the past 3 years (DFG 2009c).

### **Sacramento River Winter-Run Chinook Salmon ESU**

The Sacramento River winter-run Chinook salmon ESU includes all naturally spawned populations in the Sacramento River and its tributaries, as well as two artificial propagation programs: winter-run Chinook from the Livingston Stone National Fish Hatchery and winter-run Chinook in a captive brood stock program maintained at Livingston Stone National Fish Hatchery and the University of California, Davis, Bodega Marine Laboratory.

Winter-run Chinook occur in areas with a continuous supply of cold water, such as the spring-fed streams of the basalt and porous lava region of northeastern California (Moyle et al. 2008). They occur only in the Sacramento River Basin because they require water temperatures sufficiently cold in summer to enable successful incubation and sufficiently warm in winter to support juvenile rearing (Moyle et al. 2008; Stillwater Sciences 2006 in Moyle et al. 2008). Winter-run Chinook historically migrated high into the watersheds of the McCloud, Pit, and upper Sacramento Rivers to spawn. This habitat was lost with construction of Shasta Dam in the 1940s (Moyle et al. 2008).

Winter-run Chinook life-history timing differs considerably from the other three Central Valley Chinook salmon races. Winter-run spawning migration extends from January to May, with a peak in mid-March. They enter fresh water as sexually immature adults and migrate upriver to the reaches below Keswick Dam, where they hold for several months until spawning in April through early August (Moyle et al. 2008; Williams 2006). Optimal temperatures for holding range from 10 to 16°C, and optimal water velocities range from 47 to 125 cm/s (USFWS 2003). Incubation, which is the most temperature-sensitive life-history stage, occurs in the hottest part of the year and is facilitated by cold water releases from Shasta Reservoir (Moyle et al. 2008). To ensure moderate redd

temperatures, winter-run Chinook spawn at depths of 1–7 m (Moyle 2002). Fry emerge from the gravel from July through mid-October (Moyle et al. 2008; Williams 2006; Yoshiyama et al. 1998). After emergence, juveniles are restricted in their rearing habitat to those reaches that maintain cool summer temperatures. Flows above 15,000 cfs in the Sacramento River at Wilkins Slough trigger downstream migration toward the Delta, beginning in October for fry-sized fish (less than 70 mm fork length) (R. del Rosario and Y. Redler, NMFS, unpublished data). Rearing in the Delta lasts from 2.5 to 3 months on average; earlier entry to the Delta results in longer residence there. Exit from the Delta occurs later when the Yolo Bypass is inundated, indicating that this habitat is used for rearing. The majority of the population leaves the Delta in March, with the first emigrants leaving after pulse flows greater than 20,000 cfs measured at the Sacramento River at Freeport (R. del Rosario and Y. Redler, NMFS, unpublished data).

The number of spawning winter-run Chinook salmon was as high as nearly 120,000 fish in 1969, before a precipitous decline to less than 200 individuals in some years of the early 1990s (AFRP 2009). The biggest single cause of winter Chinook salmon decline was the loss of access to spawning areas caused by construction of Shasta and Keswick Dams in the 1940s. Other ongoing factors include the existence of only one population, with a low population size; climate variability (e.g., drought); unscreened or inadequately screened water diversions; predation; pollution (e.g., from the Iron Mountain Mine); adverse flow and water quality conditions leading to high water temperatures; fisheries management; passage barriers (e.g., RBDD); and degraded spawning habitat (Moyle et al. 2008). Lindley and Mohr (2003) calculated that an increase in striped bass abundance to historical levels (i.e., 3 million adults) would considerably increase the extinction risk of winter-run Chinook salmon. Implementation of the conservation hatchery program for winter-run Chinook salmon in the early 1990s has successfully begun to restore the population; the number of spawners topped 15,000 in 2005 and 2006. Lower numbers of fish (less than 3,000) in 2007 and 2008 are probably attributable to the reduced ocean productivity that has affected all runs of Chinook salmon from the Central Valley (Lindley et al. 2009).

### **Modoc Sucker**

In California, the Modoc sucker occurs only in portions of the Turner and Ash Creek Watersheds, two drainage systems of the Pit River in Modoc County (Moyle 2002:189–190). The species also occurs in tributaries of Goose Lake in Oregon. These tributaries include Washington, Hulbert, and Johnson Creeks and two smaller unnamed feeder streams.

Optimal habitat for Modoc suckers includes low- to moderate-flow streams with large shallow pools, ample cover (e.g., riparian vegetation or undercut banks), soft sediments, and moderately clear water (Moyle 2002:190). As stream habitat in lower reaches may dry up in summer, Modoc suckers need adequate water flow and optimal temperatures during April and May to migrate upstream in order to spawn and find refuge. After spawning, eggs adhere to the bottom substrate. Sexual maturity usually occurs at age 3, although males may mature sooner, and they live for only 4–5 years. Modoc suckers primarily feed on detritus and filamentous algae, as well as aquatic insect larvae and crustaceans (Moyle 2002: 190).

Several interacting factors are primarily responsible for decline of the Modoc sucker (Moyle 2002:190–191). Channelization of streams has eliminated much of the pool habitat that the species requires. Grazing by cattle, exacerbated by road building and logging, has reduced the amount of streamside vegetation cover and has increased sedimentation into pools. Flows reduced by water diversions and dams limit fish movement. Predation by brown trout, the most piscivorous (fish-

eating) of California's non-native trouts, is likely to have reduced the abundance of the Modoc sucker. Hybridization with the more common Sacramento sucker (*Catostomus occidentalis*) may have caused the species to decline and was a result of the removal of natural barriers to Sacramento sucker upstream migration (e.g., waterfalls; 50 FR 24523). However, hybridization "is apparently rare and insufficient to create problems for the Modoc sucker" (Moyle 2002:189).

Critical habitat designated for the Modoc sucker by USFWS in 1985 (50 FR 24526) consists of 26 stream miles and a 50-foot riparian zone within the watersheds of Turner, Washington, Hurlbert, Johnson, and Rush Creeks. Activities that may adversely modify critical habitat include (50 FR 24528) overgrazing by livestock in areas adjacent to streams; channelization, impoundment, and water diversions; introduction of additional exotic species that may compete with or prey on Modoc suckers; application of herbicides or insecticides that are toxic to Modoc suckers or their food sources; pollution of streams by silt or other pollutants; and removal of streamside trees or bushes that would reduce shade and cover, thereby reducing suitability of the habitat.

Moyle (2002:191) notes that much progress has been made in restoring the Modoc sucker populations by improving habitat through actions such as fencing of streams to exclude cattle and installation of barriers to prevent upstream migration of Sacramento sucker. He states (Moyle 2002:190): "...today their situation is secure enough that upgrading the species to threatened status can seriously be considered."

## 5.8.4 Existing Effects of Impaired Water Quality on Fish

Impaired water quality in the water column or sediment contamination may kill fish from direct, acute exposure or cause energy reallocation, increase susceptibility to disease and predation, reduce reproductive success, and increase behavioral abnormalities, which all may contribute to decreased evolutionary fitness (Werner et al. 2008:1). Migratory ability also may be affected (e.g., in salmonids) (NMFS 2008b). The majority of agricultural effects on surface water quality occur below the major storage reservoirs in the Central Valley; however, effects also are associated with irrigation of pasture at higher elevations. The general effects of agriculture on water quality include changes in water column toxicity, sediment toxicity, detectable pesticides, and salinity, among others. As noted in Section 5.7, Vegetation and Wildlife, irrigation seepage can contaminate groundwater underlying porous soils that are heavily fertilized or that receive pesticide applications. Constituents of concern in Central Valley groundwater that are related to agriculture include nutrients, pesticides, salt, trace elements, organic carbon and disinfection byproduct precursors, and microorganisms. Sources of these constituents are discussed in Section 5.9, Hydrology and Water Quality. Groundwater does not affect fish directly but becomes important when it enters water bodies as surface water (e.g., as base flow during low-runoff months). Therefore, the impacts analysis related to surface water quality is relevant to groundwater quality impacts on fish.

## Sources of Information

Assessment methods for determining the existing water quality impairment effects on fish focused largely on recent studies relevant to nonpoint source runoff within the program area—especially with respect to pesticides, which are perhaps of greatest concern among the constituents from



irrigated lands and other lands included in the ILRP. Much of the information in the analysis of existing effects addresses the potential effects on salmonids because these species have received the most study. Where possible, existing information related to other species is provided. In examining existing uses of pesticides and potential impacts on aquatic resources in the San Francisco estuary watershed, Kuivila and Hladik (2008) noted that analyses to date are subject to several limitations:

- Monitoring studies analyze fewer than half of the pesticides applied in the watershed.
  - Testing procedures may not be well developed or tests may be different from the majority of pesticides that are being analyzed.
- Pesticide use changes over time.
  - For example, molinate (a rice pesticide) was no longer sold or distributed after June 30, 2008.
- Most knowledge relates to dissolved pesticides in the upper watershed.
  - Monitoring usually occurs in small creeks as opposed to larger systems such as the Delta.
- There is no comprehensive long-term monitoring of current-use pesticides.

The programmatic analysis of effects on fish associated with the existing ILRP therefore is primarily qualitative. The main sources of information used in the analysis of existing effects include:

- The results of water quality monitoring over 2004–2006 for the ILRP by coalition groups and others that tested for toxicity to fathead minnow (see ICF Jones and Stokes 2008),
- EPA assessments of the potential effects of a number of pesticides on listed salmonid ESUs in the Central Valley,
- NMFS biological opinions on EPA's proposed registration of certain pesticides, and
- Various published and unpublished studies.

The first three items are described in more detail below.

### **Central Valley Water Board 2007 Review of Monitoring Data for ILRP**

As noted in Section 5.9, Hydrology and Water Quality, water quality monitoring by grower coalitions and others has been conducted for the ILRP since 2003 (Central Valley Water Board 2007). The toxicity testing of the surface water column using fathead minnows (*Pimephales promelas*) is of particular relevance in determining potential impacts on fish. The fathead minnow generally is considered a good indicator of the potential toxic effects of ammonia and the effects of pesticides at higher concentrations than may affect other, non-fish test organisms (Central Valley Water Board 2007:I-8). Testing is limited to acute toxicity and does not include potential chronic and long-term effects, such as reproductive impairment. Tests evaluate whether mortality of test organisms (percent dying) is statistically significantly different from laboratory control organisms when exposed to ambient water for 96 hours. As noted by the Central Valley Water Board (2007:I-4):

Some areas of the Central Valley have been monitored at a consistent frequency over the three-year period comprising six to eight sampling events per year. Other areas within the Central Valley have a much lower frequency of monitoring from which to infer findings from the water quality data. These data limitations need to be considered.



Analysis of potential effects of the ILRP was made with reference to the results of the fathead minnow toxicity testing and other testing detailed by the Central Valley Water Board (2007).

The raw data used by the Central Valley Water Board (2007) were used to assess existing conditions for water quality constituents not described in the *2007 Review of Monitoring Data for ILRP*. It should be noted that these data often were collected in small tributaries and agricultural drains that may not be representative of conditions in the ranges of special-status species.

## EPA Assessment of Pesticide Effects and NMFS Biological Opinions

As noted under “Regulatory Framework” above, EPA is conducting court-ordered assessments of the potential effects from continued EPA approval of a number of pesticide active ingredients on ESA-listed Pacific anadromous salmonids and San Francisco estuary terrestrial and aquatic species. These assessments include four fish species within the ILRP program area: the Central Valley spring-run Chinook salmon ESU, the Sacramento River winter-run Chinook salmon ESU, the California Central Valley steelhead DPS, and delta smelt. The EPA Office of Pesticide Programs (OPP) has conducted a risk assessment for each of the pesticide active ingredients and several others using the following framework (Turner 2002a):

- Aquatic toxicity: Acute (survival) and chronic (primarily reproductive) effects were reviewed based on existing studies of a number of freshwater and estuarine fishes, invertebrates, and plants.
- Environmental fate and transport: Degradation and mobility within soils were judged from existing information.
- Incidents: Two OPP databases of registered incidents (e.g., spills) involving the active ingredients were queried.
- Estimated and actual concentrations in water: Existing models were used to provide estimated environmental concentrations (EECs), which were used in conjunction with actual local monitoring data.
- Recent changes in pesticide active ingredient registrations: Changes to the registration (e.g., to mitigate risk to aquatic species) are reviewed.
- Existing protections: National, state, and local protective measures were reviewed.

In 2008, NMFS issued a BO on the effects of EPA’s registration of chlorpyrifos, diazinon, and malathion on listed salmonids using the analyses conducted by EPA and other information. The BO used a risk assessment (Figure 5.8-1) process to examine several risk hypotheses:

1. Exposure to chlorpyrifos, diazinon, and malathion is sufficient to:
  - a. Kill salmonids from direct, acute exposure;
  - b. Reduce salmonid survival through impacts to growth;
  - c. Reduce salmonid growth through impacts on the availability and quantity of salmonid prey;
  - d. Impair swimming which leads to reduced growth (via reductions in feeding), delayed and interrupted migration patterns, survival (via reduced predator avoidance), and reproduction (reduced spawning success); and

- e. Reduce olfactory-mediated behaviors resulting in consequences to survival, migration, and reproduction.
- 2. Exposure to mixtures of chlorpyrifos, diazinon, and malathion can act in combination to increase adverse effects to salmonids and salmonid habitat.
- 3. Exposure to other stressors of the action, including oxon degradates, adjuvants, tank mixtures, and other active and other ingredients in pesticide products containing chlorpyrifos, diazinon, and malathion, causes adverse effects to salmonids and their habitat.
- 4. Exposure to other pesticides present in the action area can act in combination with chlorpyrifos, diazinon, and malathion to increase effects to salmonids and their habitat.
- 5. Exposure to elevated temperatures can enhance the toxicity of the stressors of the action.

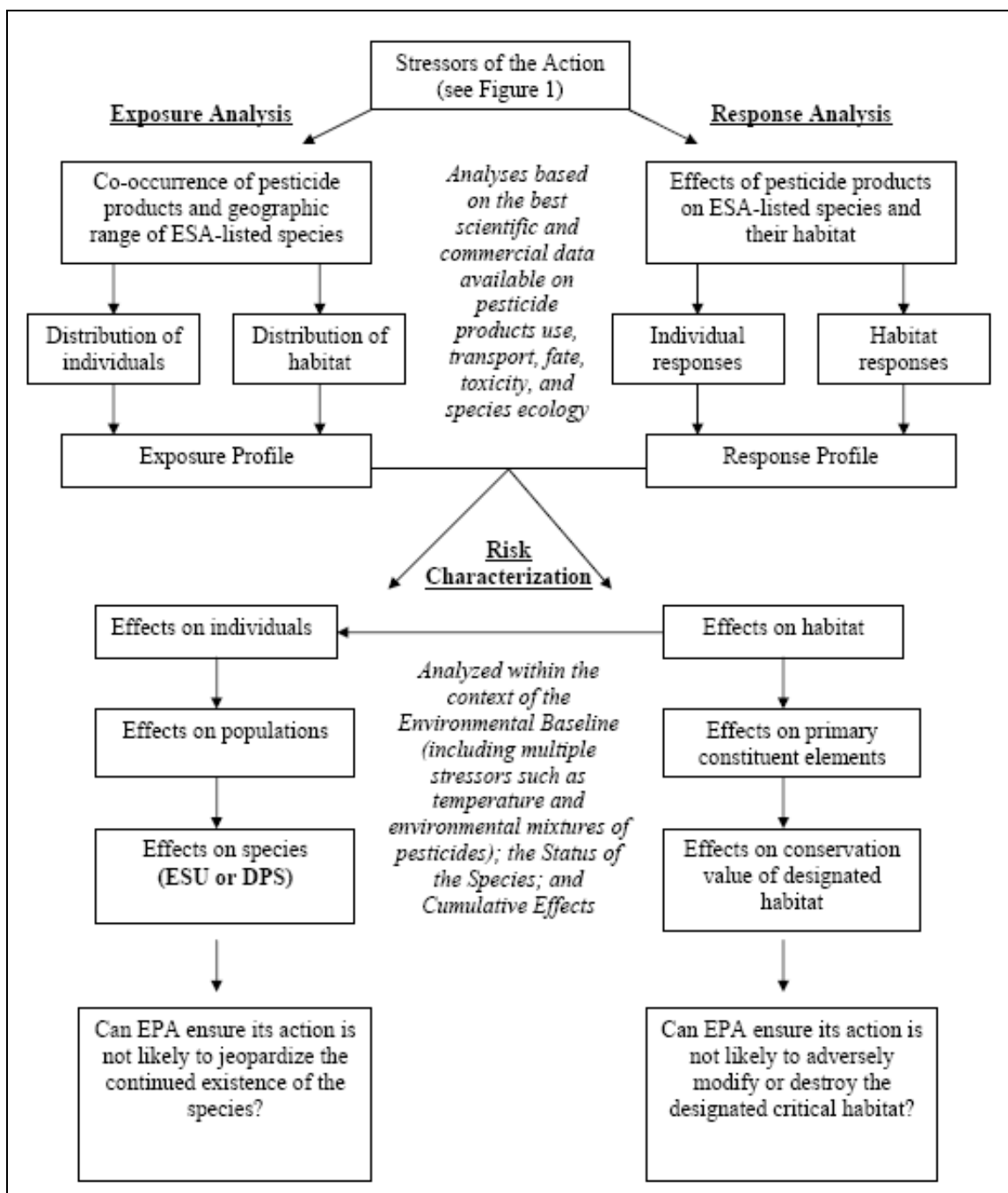


**Figure 5.8-1. Conceptual Framework Adopted by NMFS to Assess Effects of EPA Registration of Pesticide Active Ingredients**

Source: NMFS 2008:39.

## Existing Effects by Key Parameters

The existing effects of impaired water quality are discussed by key parameters, including general toxicity, sediment, pesticides, nutrients and organics, trace elements and salts, pathogens, and temperature.

### General Toxicity

#### Toxicity Testing of Fathead Minnows

The Central Valley Water Board (2007) summarized results of fathead minnow toxicity testing data by ILRP zone boundaries. As noted above, fathead minnows are a useful indicator of ammonia pollution as well as higher concentrations of pesticides, although it is not necessarily clear which pollutants contribute most to the toxicity results for fathead minnows. For Zones 1 and 4, tests were grouped into categories indicating reductions in survival in relation to laboratory control organisms: greater than 0- to 20-percent reductions (>0–20%), greater than 20- to 50-percent reductions (>20–50%), and greater than 50- to 100-percent reductions (>50–100%).

In Zone 1, which is comprised of the Sacramento River watershed that drains the northern part of the Central Valley into the Sacramento River, eight tests indicated statistically significant toxicity to fathead minnow (Table 5.8-3). Six of these events were found in the area of the Butte/ Yuba/ Sutter Subwatershed and two in the Colusa Basin Subwatershed (Figure 5.8-2). Overall, 1.6 percent of the total fathead minnow tests (501 total) showed statistically significant toxicity (Table 5.8-3). Six percent of the individual monitoring locations indicated toxicity to fathead minnow at least once. Four of the eight significant tests showed reductions in survival of >0–20 percent, whereas only one indicated a reduction in survival of >50–100 percent.

**Table 5.8-3. Results of Toxicity Testing of Fathead Minnows in the Program Area**

| Zone | Number of Tests | Number of Statistically Significant Tests | Reduction in Survival Compared to Laboratory Control |         |          |
|------|-----------------|-------------------------------------------|------------------------------------------------------|---------|----------|
|      |                 |                                           | >0–20%                                               | >20–50% | >50–100% |
| 1    | 501             | 8                                         | 4                                                    | 3       | 1        |
| 2    | 342             | 11                                        | –                                                    | –       | –        |
| 3    | 588             | 13                                        | –                                                    | –       | –        |
| 4    | 235             | 22                                        | 7                                                    | 11      | 4        |

Source: Central Valley Water Board 2007.

In Zone 2, which includes parts of San Joaquin, Contra Costa, Alameda, and Calaveras Counties and the Delta, 11 of 342 (3.2 percent) tests for fathead minnow toxicity were statistically significant (Table 5.8-3). Approximately 17 percent of the individual monitoring sites in Zone 2 exhibited fathead minnow toxicity during the monitoring period. Observed minnow toxicity was mostly limited to the drains in the Delta, except for the Lone Tree Creek, Marsh Creek, and Sand Creek Subwatershed monitoring points (Figure 5.8-3).

Zone 3, which is essentially the San Joaquin River drainage, resulted in 13 of 588 (2.2 percent) tests for fathead minnow toxicity that were statistically significant (Table 5.8-3). Approximately 19 percent of the individual monitoring sites in Zone 3 exhibited fathead minnow toxicity during the monitoring period (Figure 5.8-4). Toxicity to fathead minnow in Zone 3 monitoring was typically

mid-range in magnitude (generally from 10 to 65 percent mortality). Two of the 13 significant tests showed mortality greater than 50 percent.

Zone 4 encompasses the entire Tulare Lake Basin, including portions of Fresno, Kings, Tulare, and Kern Counties. Twenty-two of 235 (9.4 percent) tests for fathead minnow toxicity were statistically significant (Table 5.8-3). Approximately 31 percent of the individual monitoring sites in Zone 4 exhibited fathead minnow toxicity during the monitoring period (Figure 5.8-5). One-half of statistically significant toxicity tests to fathead minnow in Zone 4 monitoring was in the >20–50 percent reduction in survival range, whereas just under one-quarter (4 of 22) of tests indicated a reduction in survival of >50–100 percent.

### Recent Toxicity Testing in the Delta

Werner et al. (2008) conducted toxicity testing from 2005 to 2007 on juvenile striped bass and delta smelt using water collected from various locations in the Delta. The main findings included:

- No reduction in survival or growth of juvenile striped bass compared to control fish (however, only two tests were carried out);
- Reduction in survival of larval and juvenile delta smelt that was related to differences in turbidity and conductivity between sites, although there was some indication that ammonia also may have reduced survival;
- No inhibition of acetyl-cholinesterase—which would indicate sublethal effects of organophosphate or carbamate insecticides—from brain and muscle tissue of striped bass and Delta smelt; and
- Significant expression of stress-responsive genes in juvenile striped bass.

In general, these results provided some evidence for negative effects of general toxicity in the Delta, but the effects were subtle and not readily apparent at the whole-organism level.

### Role of Contaminants in the Pelagic Organism Decline

As noted in the species profiles of delta and longfin smelt, the recent declines in these and other pelagic species in the San Francisco Bay-Delta have been termed the POD. Abundance indices of delta and longfin smelt, striped bass, and threadfin shad exhibited substantial decreases in 2000–2002 (Johnson et al. 2010). Factors implicated in the POD include water diversions, non-native species, and contaminants. Historical water chemistry, toxicity, and histopathological data for the legal Delta and a surrounding 30-mile buffer were reviewed to assess the feasibility of integrating population ecology with ecotoxicology to investigate the role of contaminants in the POD (Johnson et al. 2010). Several major conclusions were reached from this review:

- Few chemicals have sufficient data available to draw conclusions about the role of contaminants in the POD.
- Toxicity in water samples collected in the Delta in the pre-POD years was equal to or greater than samples in the POD years.
- Data from the pre-POD period are insufficient to determine whether lesions in fish were more or less common or severe compared to the POD years.
- Overall, while contaminants are unlikely to be a major cause of the POD, they cannot be eliminated as a possible contributor to the decline.



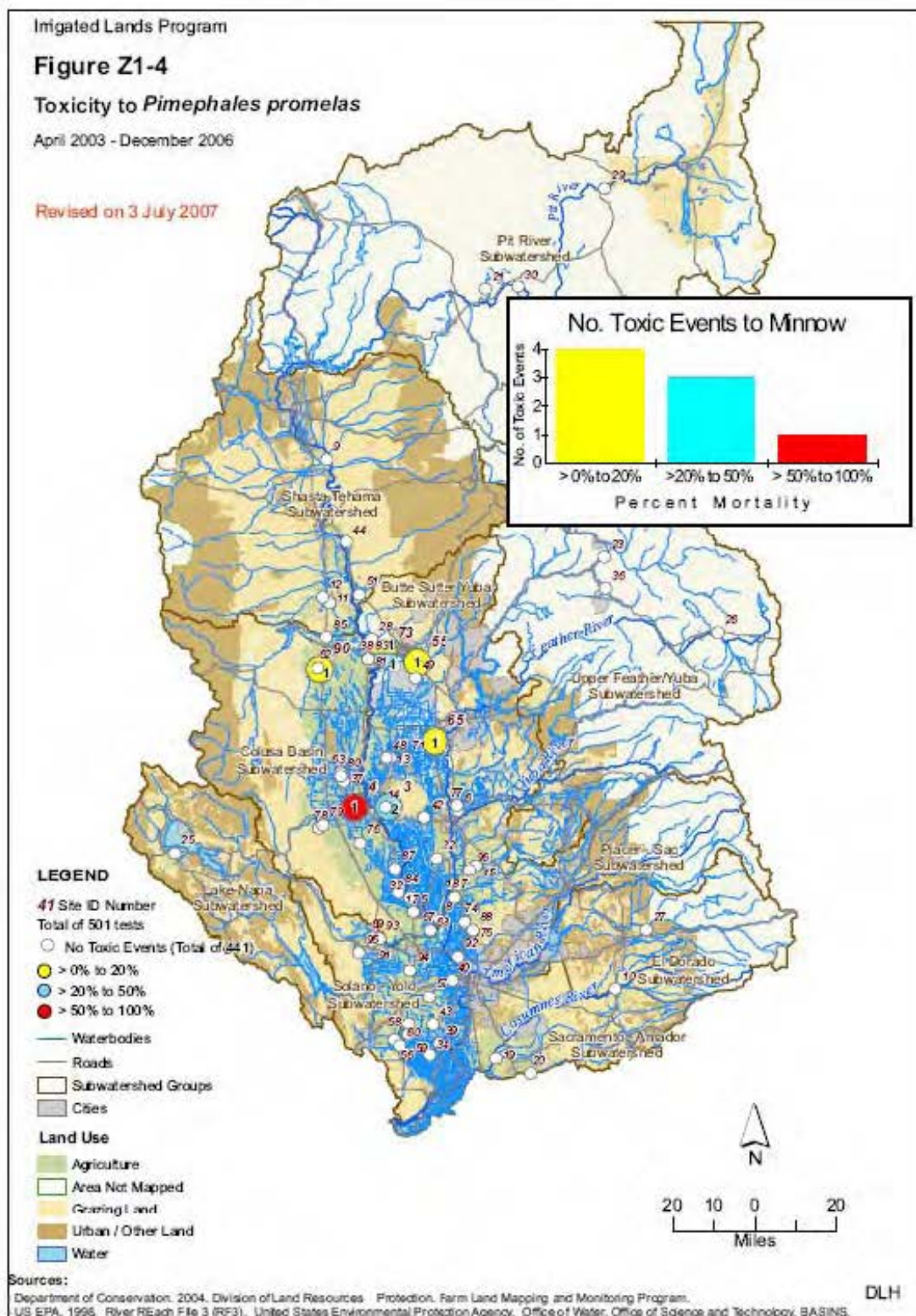


**Figure 5.8-2. Toxicity to Fathead Minnow (*Pimephales promelas*) in Zone 1 of the ILRP**

Source: Central Valley Water Board 2007.



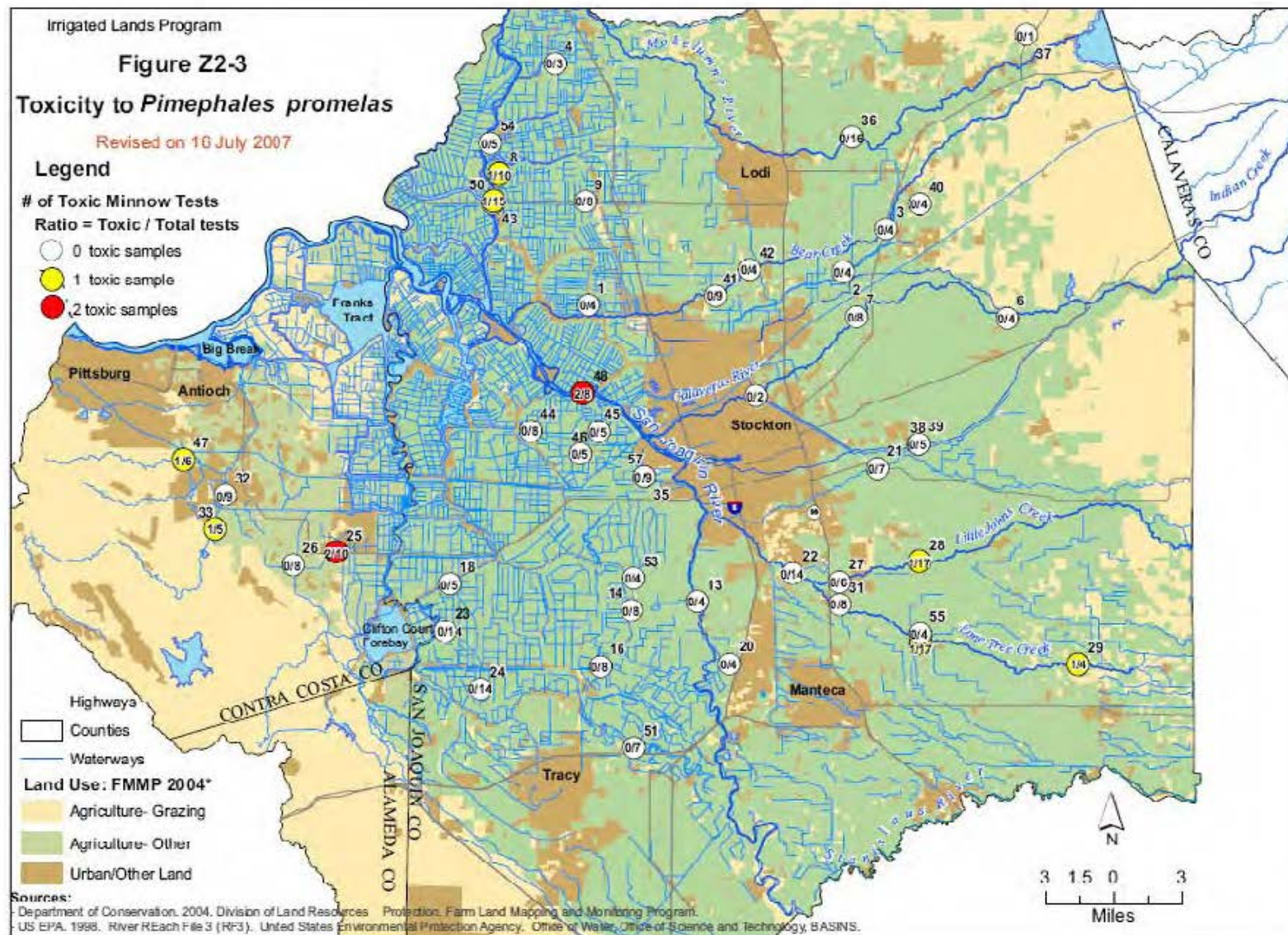


**Figure 5.8-3. Toxicity to Fathead Minnow (*Pimephales promelas*) in Zone 2 of the ILRP**

Source: Central Valley Water Board 2007.



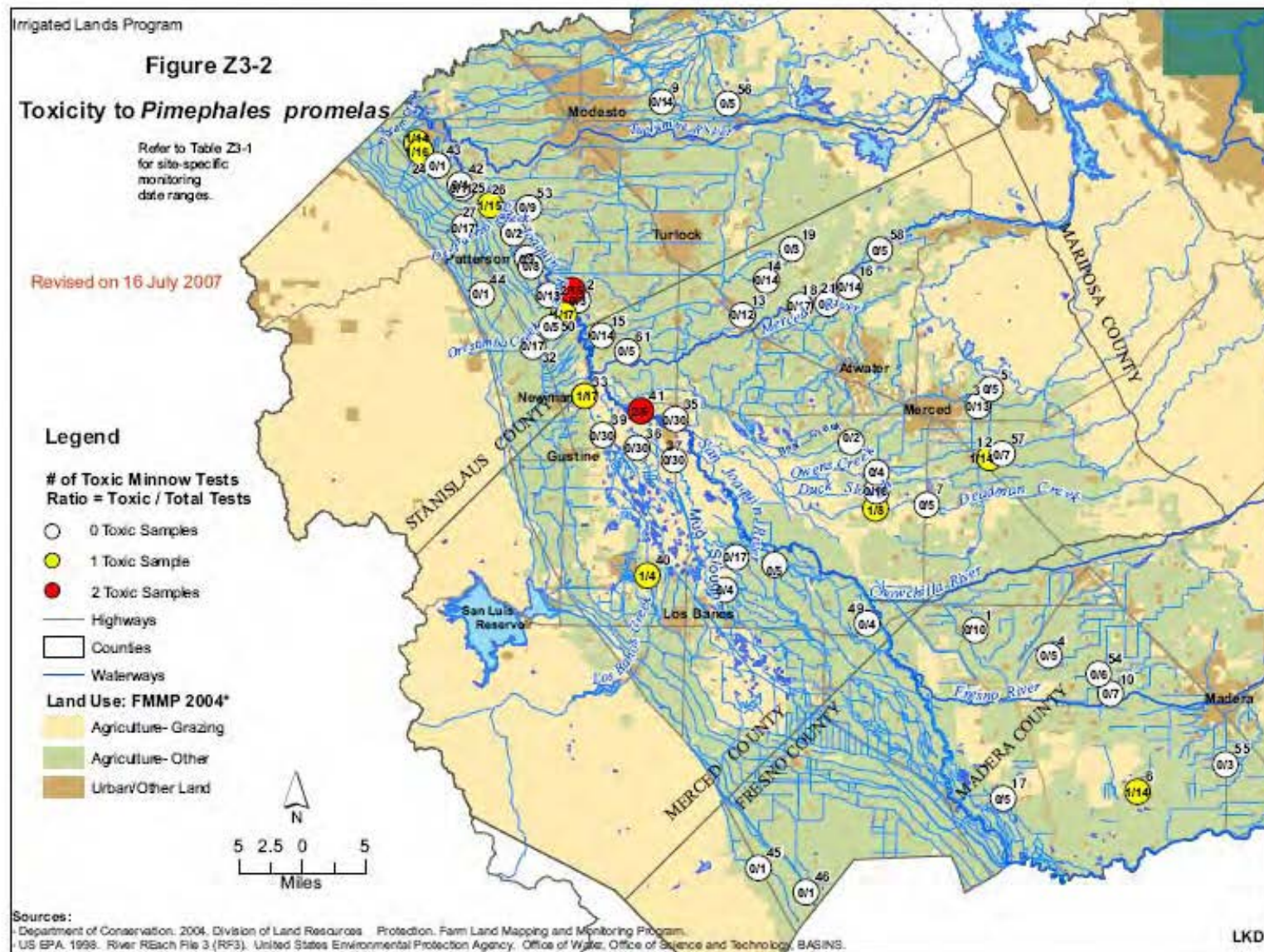


**Figure 5.8-4. Toxicity to Fathead Minnow (*Pimephales promelas*) in Zone 3 of the ILRP**

Source: Central Valley Water Board 2007.

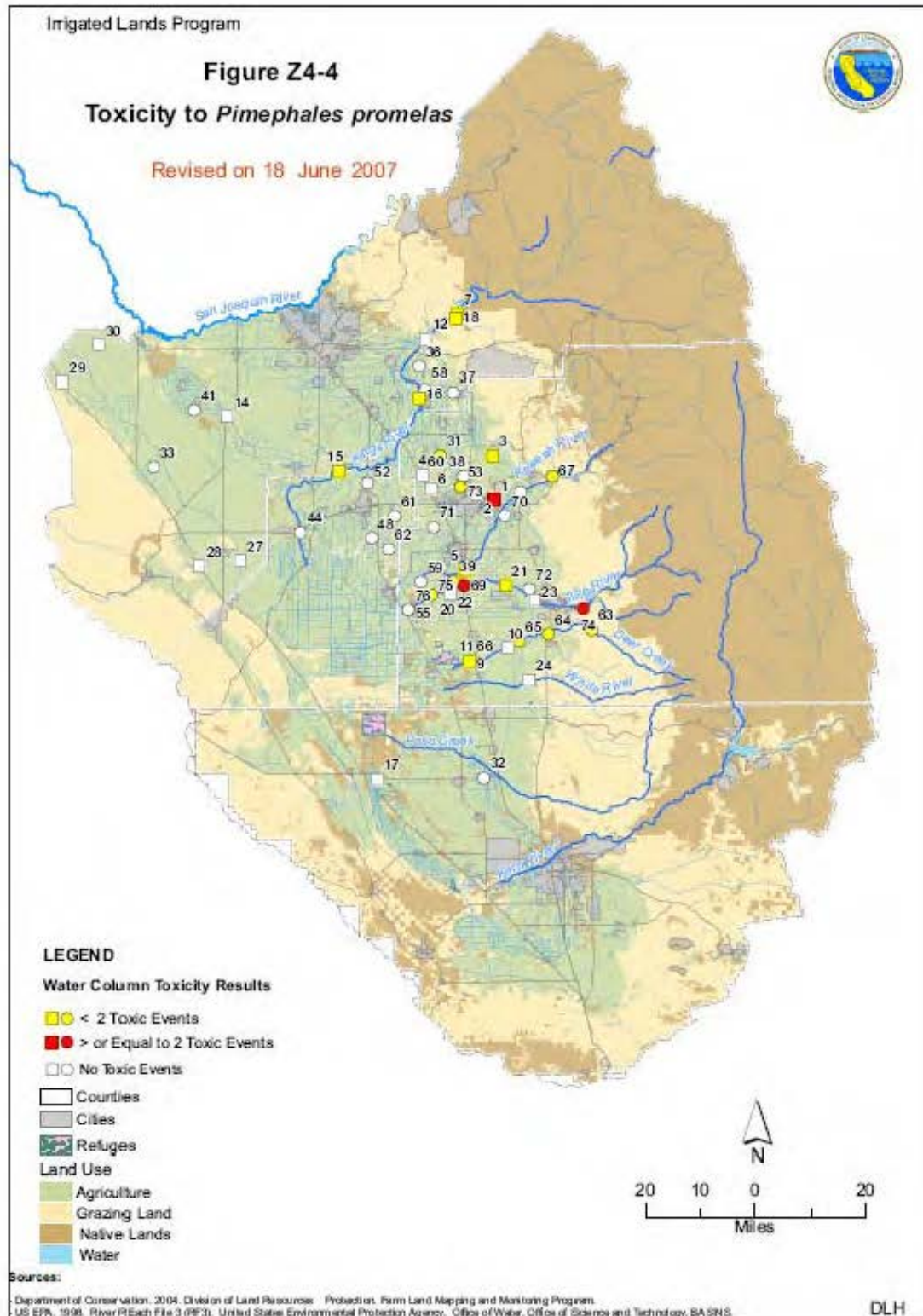


**Figure 5.8-5. Toxicity to Fathead Minnow (*Pimephales promelas*) in Zone 4 of the ILRP**

Source: Central Valley Water Board 2007.

Summary results of the review are presented in Table 5.8-4.

**Table 5.8-4. Summary of Data Review and Analyses of the Role of Contaminants in the Pelagic Organism Decline**

| Analysis                                                                | Data Sources Reviewed and Main Findings                                                                                                      |                                                                                                                                          |                                                                                                                                  |
|-------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
|                                                                         | Chemistry                                                                                                                                    | Toxicity                                                                                                                                 | Histopathology                                                                                                                   |
| Pre-POD vs. POD years                                                   | Greater concentrations of chemicals in pre-POD years                                                                                         | As much or more toxicity in pre-POD years                                                                                                | Insufficient data from the pre-POD period                                                                                        |
| 2000–02 vs. 2003–08 (i.e., period of greatest decline vs. post-decline) | Lack of data for comparison                                                                                                                  | No difference in the percentage of toxic water samples for <i>C. dubia</i> and <i>P. promelas</i>                                        | Insufficient data                                                                                                                |
| January–June (period of susceptibility of young fish and high runoff)   | Chlorpyrifos: more than 5% of samples contained toxic concentration.<br>Diazinon: approximately 5% of samples contained toxic concentration. | Delta waters: percentage of toxic samples less than in tributaries but indicates potential for toxicity to preys utilized by POD species | No applicable data. Some lesions were described as developing in the fall.                                                       |
| POD species vs. non-POD species                                         | POD species are not always more sensitive to chemicals (striped bass are more sensitive to chlorpyrifos than non-POD species)                | No applicable data                                                                                                                       | Little evidence of major histopathologies for both POD and non-POD species (2004–2007)                                           |
| Impacts on prey items                                                   | Toxicity to prey items possible (limited data available)                                                                                     | Potential for toxicity to prey items based on toxicity test results                                                                      | Full stomachs of captured individuals indicates that prey items of POD species have not been reduced by exposure to contaminants |

POD = Pelagic Organism Decline.

Source: Johnson et al. 2010.

## Sediment

Excessive sedimentation and turbidity is considered the main threat to fish habitat in the United States (Henley et al. 2000). Excessive sedimentation and turbidity may lead to:

- Decreased light penetration, leading to reduced phytoplankton production and reduced food availability for higher trophic levels, including fish and their prey;
- Reduction of the amount of interstitial space within streambed gravel, resulting in less habitat available for some fish prey (aquatic invertebrates) and reduced permeability for fish that spawn in gravel (e.g., salmonids);
- Migration of fish away from turbid waters;
- Reduced DO;
- Thickening of gill epithelia (tissue) and reduced respiratory function; and
- Depressed feeding rates of fish that rely on vision (Henley et al. 2000).



Turbidity goals vary for different basins within the program area and are dependent on ambient conditions. Some species, such as delta smelt, apparently require or seek a certain amount of turbidity. Juvenile and subadult delta smelt are rarely found in waters with Secchi depth greater than 75–100 cm (Feyrer et al. 2007; Nobriga et al. 2008); laboratory survival of larval delta smelt was zero at 0 NTU (nephelometric turbidity units) and increased to approximately 45% at 5 NTU and 60% at 20 NTU (Lindberg and Baskerville-Bridges 2006).

Newcombe and Jensen (1996) modeled the effects of suspended sediment on salmonids and other fish by calculating a severity-of-ill-effect score (a 15-point scale ranging from no effect to more than 80 percent mortality) as a function of total suspended sediment concentration (mg/l) and duration of exposure. Total suspended solids data collected by the ILRP may be used to assess the effects of total suspended sediment. The data are not continuous estimates but are still informative with respect to analyzing potential effects. For each monitoring site in Zones 1 and 3 (data were not available for Zones 2 and 4), it was assumed that the minimum total suspended solids value obtained was present over the long term (365 days, or 8,760 hours) and that the maximum value obtained was short term (24 hours). The severity of response was calculated from the following equation, which was developed by Newcombe and Jensen (1996) for salmonids in freshwater:

$$\text{Severity-of-ill-effect score} = 1.0642 + 0.6068 (\ln(\text{duration})) + 0.7384 (\ln(\text{total suspended solids}))$$

The severity at each site was calculated as the average of the short-term and long-term values. The analysis indicated that most (72 percent) sites in Zone 1 had severity-of-ill-effect scores of 6–7, indicating moderate physiological stress and impaired homing (Table 5.8-5). Nearly all (93 percent) sites in Zone 3 had severity scores of 7–9, with the majority having a score of 8 (major physiological stress).

**Table 5.8-5. Suspended Sediment Severity-of-Ill-Effect Scores by Site**

| Severity Score | Description                                                                                                                            | Number of Sites |        |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------|
|                |                                                                                                                                        | Zone 1          | Zone 3 |
| 0              | No behavioral effects                                                                                                                  | 0               | 0      |
| 1              | Alarm reaction                                                                                                                         | 0               | 0      |
| 2              | Abandonment of cover                                                                                                                   | 0               | 0      |
| 3              | Avoidance response                                                                                                                     | 0               | 0      |
| 4              | Short-term reduction in feeding rates; short-term reduction in feeding success                                                         | 0               | 0      |
| 5              | Minor physiological stress; increase in rate of coughing                                                                               | 1               | 0      |
| 6              | Moderate physiological stress                                                                                                          | 13              | 2      |
| 7              | Impaired homing                                                                                                                        | 11              | 5      |
| 8              | Indications of major physiological stress; long-term reduction in feeding rate; long-term reduction in feeding success; poor condition | 7               | 17     |
| 9              | Reduced growth rate; reduced fish density                                                                                              | 1               | 6      |
| 10             | 0–20 percent mortality; increased predation                                                                                            | 0               | 0      |
| 11             | >20–40 percent mortality                                                                                                               | 0               | 0      |
| 12             | >40–60 percent mortality                                                                                                               | 0               | 0      |
| 13             | >60–80 percent mortality                                                                                                               | 0               | 0      |
| 14             | >80–100 percent mortality                                                                                                              | 0               | 0      |

Note. It was assumed that tests for total suspended solids mostly represent total suspended sediment.

Source: ICF analysis of ILRP data (Kulesza pers. comm.).

## Pesticides

As with other toxic substances, pesticides may cause acute or chronic effects on fish. Pesticides may be dissolved or adsorbed to sediment particles (Kuivila and Hladik 2008). In the Central Valley, a study by Bailey et al. (1994) suggested that pesticide runoff from irrigated rice fields in the Sacramento River Basin reduced abundance of juvenile striped bass. However, Kimmerer et al. (2001) re-examined this finding with additional years of data and did not find the same link. Kuivila and Moon (2004) suggested that, even though their water quality sampling indicated that delta smelt larvae and juveniles were not exposed to lethal concentrations of pesticides in the Delta (from April to June of 1998–2000), the duration of exposure to sublethal levels of pesticides nevertheless may have resulted in chronic effects. As noted above, Werner et al. (2008) found no acetylcholinesterase inhibition from Delta water tested on brain and muscle tissue of striped bass and delta smelt, indicating that organophosphate and carbamate insecticides were not at sufficient levels to cause such an effect. The Central Valley Water Board (2007) review of monitoring data for the ILRP showed that pesticides are detected throughout the program area in surface water and are also of some concern in groundwater (ICF Jones and Stokes 2008), as described in Section 5.9, Hydrology and Water Quality. A substantial number of pesticide management plans have been implemented in the program area, particularly in the San Joaquin Valley (Figures 5.8-6 to 5.8-9), that are aimed at reducing pesticide levels in water bodies.

Impairment of olfaction (and, by implication, associated behaviors) was shown to occur in the laboratory at pesticide mixture concentrations similar to those observed in a large river (Tierney et al. 2008). Baldwin et al. (2009) recently modeled sublethal pesticide exposure (organophosphate and carbamate) and resulting reductions in feeding behavior, food ration, growth, and size at migration. They showed that presence of pesticides in concentrations typical for seasonal application may constrain the recovery of ESA-listed stocks even when exposure is only for a period of a few days. Over 20 years, seasonal exposures to a 4-day organophosphate pulse were projected to reduce spawner abundance by 73 percent relative to an unexposed control population.

### Timing of Pesticide Runoff

Kuivila and Hladik (2008) summarized the main periods of pesticide runoff for the San Francisco estuary watershed (Table 5.8-6). For agricultural pesticides (i.e., non-urban uses), the main detection period ranges from January to August. This period coincides with the following life history stages of sensitive anadromous species in the IRLP area (see Table 5.8-6):

- Fall-run Chinook salmon: egg incubation, juvenile rearing (natal stream), and juvenile movement and rearing;
- Late fall–run Chinook salmon: adult migration and holding, spawning, egg incubation, juvenile rearing (natal stream), and juvenile movement;
- Spring-run Chinook salmon: adult migration and holding, juvenile rearing (natal stream), and juvenile movement;
- Winter-run Chinook salmon: all life history stages;
- Steelhead: all life-history stages;
- Delta smelt: all life-history stages;
- Longfin smelt: all life-history stages; and



- Green sturgeon: all life-history stages.

### **Effects of Continued EPA Pesticide Approval on Listed Central Valley Fishes**

Of the 60 pesticide active ingredients for which EPA made effects determinations related to listed Central Valley anadromous salmonids, a determination of “may affect” was made for 11 pesticides (18 percent) for winter-run Chinook salmon, 13 pesticides (22 percent) for spring-run Chinook salmon, and 16 pesticides (27 percent) for steelhead (Table 5.8-7). A similar proportion of pesticides received a determination of “may affect, but unlikely to adversely affect,” ranging from 17 pesticides (28 percent) in steelhead to 19 pesticides (32 percent) in winter-run Chinook salmon. A “no effect” determination was made for 30 pesticides (50 percent) for winter-run Chinook salmon, 29 pesticides (48 percent) for spring-run Chinook salmon, and 27 pesticides (45 percent) for steelhead (Table 5.8-7).

NMFS (2008) concluded that EPA registration of chlorpyrifos, diazinon, and malathion would jeopardize the continued existence of, and destroy or adversely modify critical habitat for, the Central Valley spring-run Chinook salmon ESU, the Sacramento River winter-run Chinook salmon ESU, and the California Central Valley steelhead DPS. A reasonable and prudent alternative to the registration was provided in the BO.

EPA recently completed several analyses of the potential adverse effects of continued registration of pesticide active ingredients on delta smelt and its critical habitat. It was determined that the continued registration of alachlor, atrazine, chlorpyrifos, thiobencarb, and trifluralin “may affect, and is likely to adversely affect” delta smelt and would modify delta smelt critical habitat. For alachlor and atrazine, direct effects (acute and chronic effects on delta smelt) were not likely to occur, whereas indirect effects (reductions in invertebrate and plant food, or reduction in riparian habitat) were likely to occur (Panger et al. 2009; Corbin et al. 2009a). For the remaining pesticides, both direct and indirect effects were assessed to be likely to occur (Corbin et al. 2009b; White et al. 2009; Hartless et al. 2009). EPA is in the process of conducting analyses of the potential effects on delta smelt of several more pesticides and has initiated formal consultation with USFWS for the continued registration of alachlor, atrazine, chlorpyrifos, thiobencarb, and trifluralin.

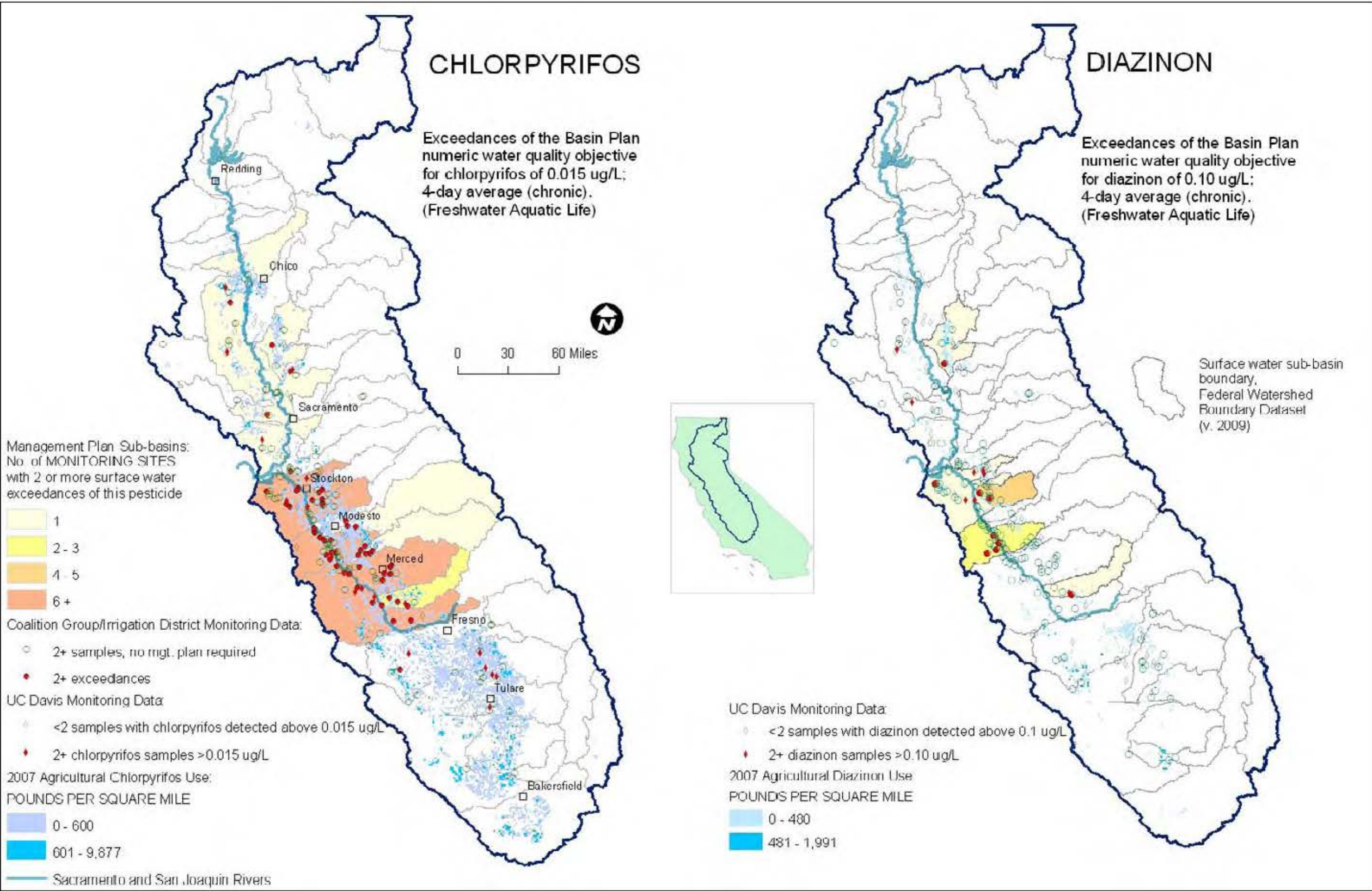


Figure 5.8-6. Chlorpyrifos and Diazinon Use, Monitoring Data, and Management Plans



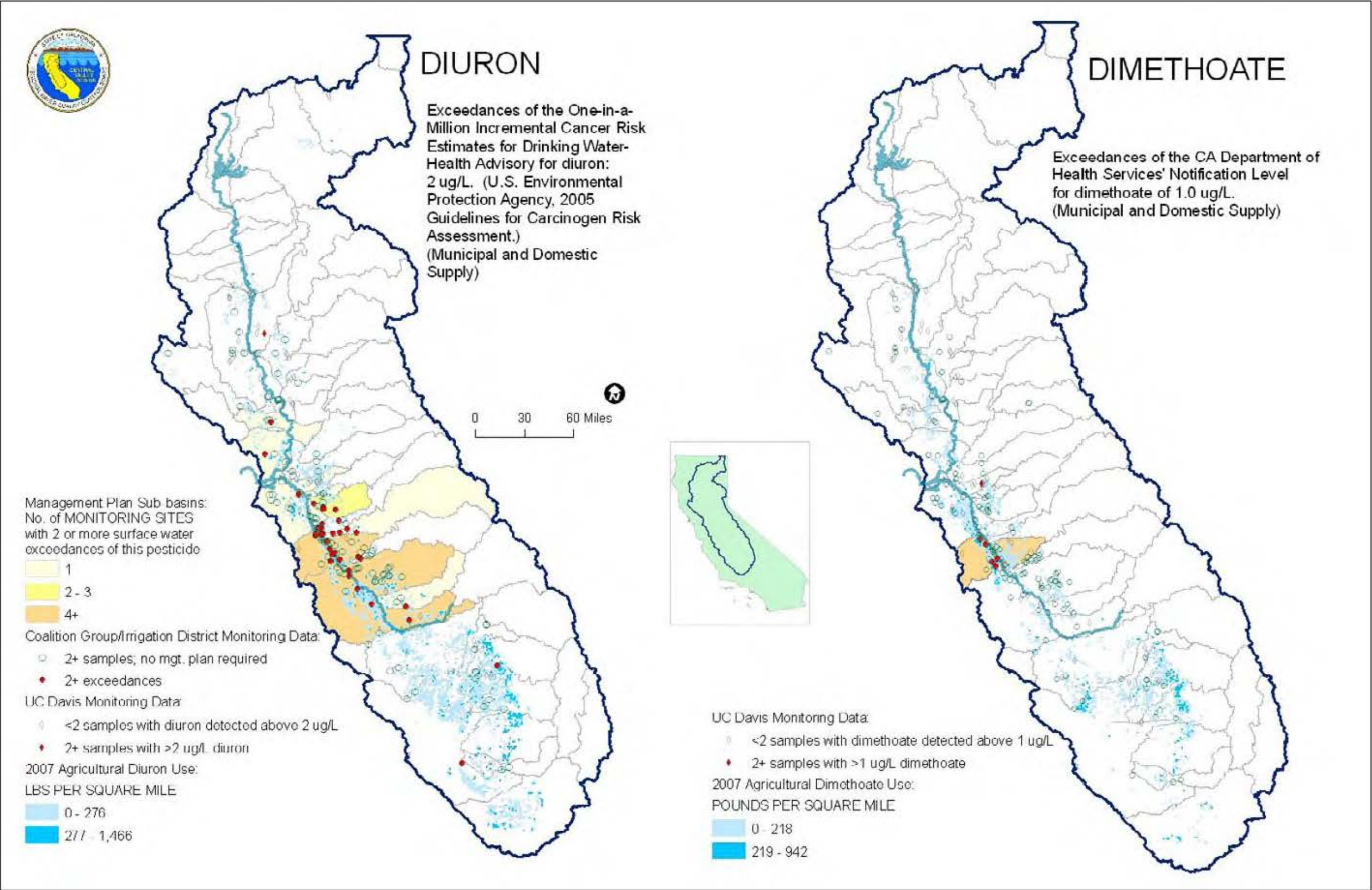


Figure 5.8-7. Diuron and Dimethoate Use, Monitoring Data, and Management Plans



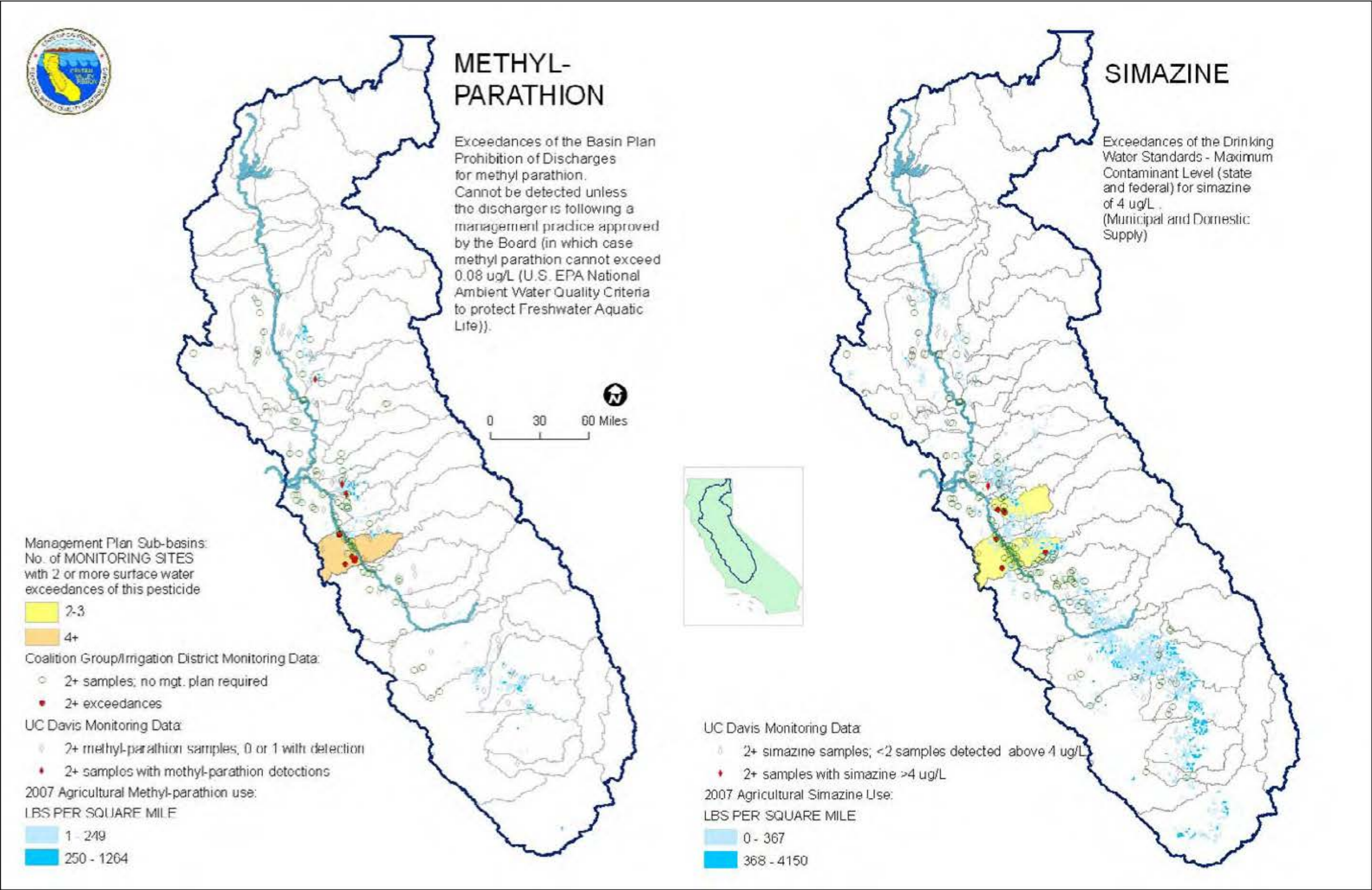


Figure 5.8-8. Methyl-Parathion and Simazine Use, Monitoring Data, and Management Plans



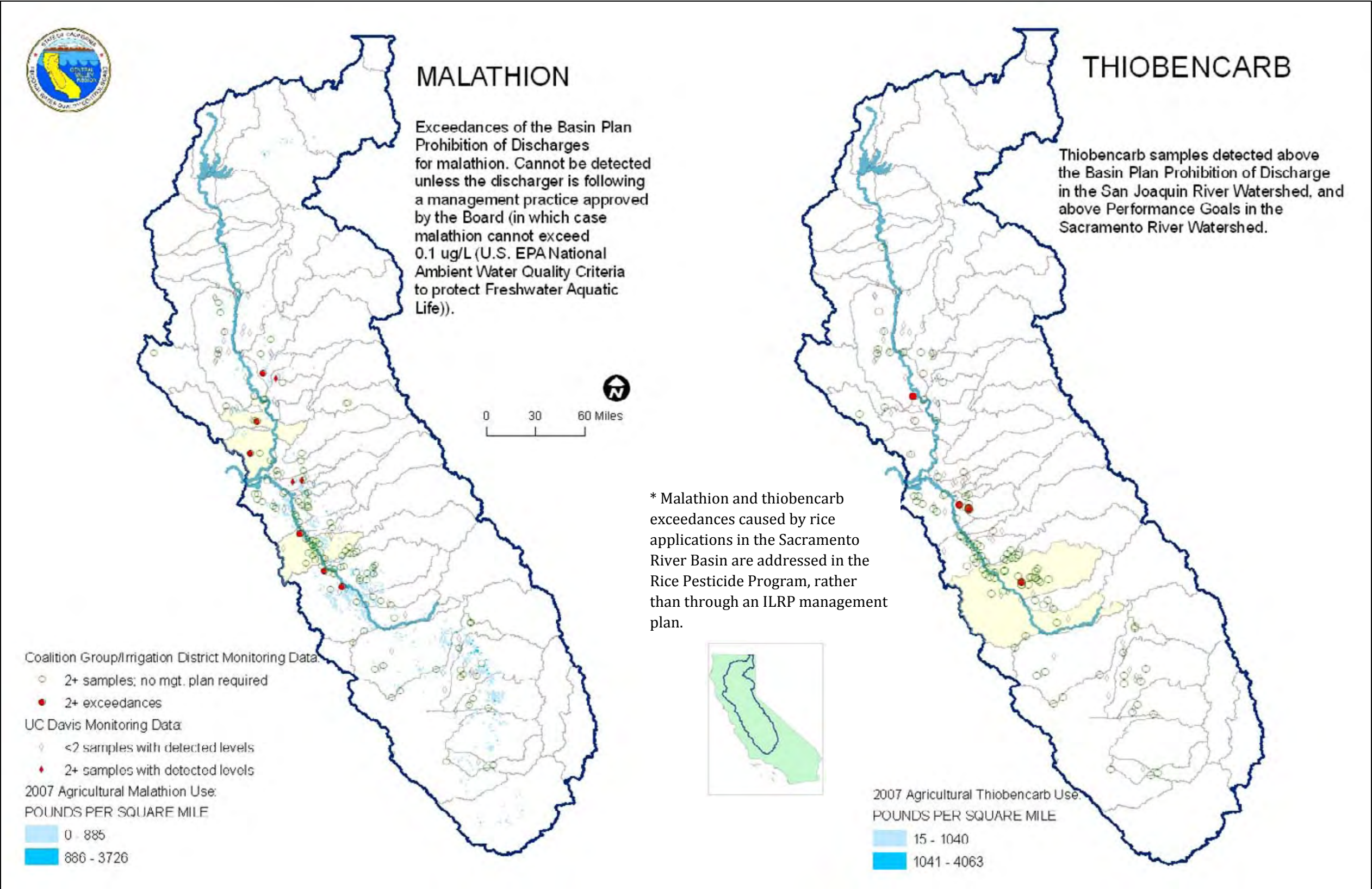


Figure 5.8-9. Malathion and Thiobencarb Use, Monitoring Data, and Management Plans

**Table 5.8-6. Overview of Seasonal Inputs of Current-Use Pesticides with Details of Detection, Transport, Fate, and Application**

| <b>Description</b>                             | <b>Detection Season</b> | <b>Transport Processes</b>              | <b>Major Pesticides of Concern</b>   | <b>Persistence in Water</b> | <b>Major Uses</b>                          | <b>Timing of Application</b> |
|------------------------------------------------|-------------------------|-----------------------------------------|--------------------------------------|-----------------------------|--------------------------------------------|------------------------------|
| First flush of dormant-spray insecticides      | January–March           | Rainfall runoff; atmospheric            | Diazonon, methidathion, chlorpyrifos | Moderate                    | Orchards                                   | December–February            |
| First flush of herbicides                      | January–March           | Rainfall runoff                         | Simazine                             | Stable                      | Orchards, grapes, rights-of-way, landscape | November–February            |
|                                                |                         |                                         | Hexazinone                           | Stable                      | Alfalfa                                    | December–January             |
|                                                |                         |                                         | Diuron                               | Stable                      | Alfalfa, rights-of-way                     | December–February            |
|                                                |                         |                                         | DCPA (dacthal)                       | Stable                      | Onions, cole crops                         | January–February             |
| Spring detection of insecticides               | March–April             | Rainfall runoff; irrigation return flow | Carbofuran                           | Variable                    | Alfalfa                                    | March                        |
|                                                |                         |                                         | Chlorpyrifos                         | Moderate                    |                                            |                              |
|                                                |                         |                                         | Malathion                            | Degrades                    |                                            |                              |
| Spring and summer detection of rice pesticides | May–July                | Release of rice field water (seepage)   | Thiobencarb                          | Variable                    | Rice                                       | May–June                     |
| Summer detection of other pesticides           | June–August             | Irrigation return flow                  | Eptam                                | Stable                      | Alfalfa, corn, safflower                   | May–July                     |
|                                                |                         |                                         | Metolachlor                          | Stable                      | Tomatoes                                   | April–June                   |
|                                                |                         |                                         | Chlorpyrifos, diazinon               | Moderate                    | Almonds, walnuts                           | May–August                   |
|                                                |                         |                                         | Malathion                            | Degrades                    |                                            |                              |
| Urban creeks                                   | Year-round              | Rainfall runoff; irrigation return flow | Diazinon, chlorpyrifos               | Moderate                    | Urban use                                  | Year-round                   |
|                                                |                         |                                         | Carbaryl, malathion                  | Degrades                    |                                            |                              |

Source: Kuivila and Hladik 2008.



**Table 5.8-7. Effects Determinations for Pesticide Active Ingredients on Listed Central Valley Anadromous Salmonids**

| <b>Pesticide Active Ingredient</b> | <b>Sacramento River Winter-Run Chinook Salmon ESU</b>                                    | <b>Central Valley Spring-Run Chinook Salmon ESU</b>                                      | <b>California Central Valley Steelhead DPS</b>                                           | <b>Source</b>             |
|------------------------------------|------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|---------------------------|
| 1,3-Dichloropropene                | May affect, but is not likely to adversely affect                                        | No effect                                                                                | No effect                                                                                | Daughtry 2004a            |
| 2,4-Dichlorophenoxyacetic Acid     | May affect (aquatic weed control); may affect, but not likely to adversely affect (rice) | May affect (aquatic weed control); may affect, but not likely to adversely affect (rice) | May affect (aquatic weed control); may affect, but not likely to adversely affect (rice) | Borges et al. 2004        |
| Acephate                           | No effect                                                                                | No effect                                                                                | No effect                                                                                | Patterson 2004a           |
| Acrolein                           | May affect, but not likely to adversely affect                                           | May affect, but not likely to adversely affect                                           | May affect, but not likely to adversely affect                                           | Turner and Erickson 2003  |
| Alachlor                           | No effect                                                                                | No effect                                                                                | No effect                                                                                | Turner 2002b              |
| Atrazine                           | No effect                                                                                | No effect                                                                                | No effect                                                                                | Brassard et al. 2003      |
| Azinphos Methyl                    | May affect                                                                               | May affect                                                                               | May affect                                                                               | Erickson and Turner 2003a |
| Bensulide                          | May affect, but not likely to adversely affect                                           | May affect                                                                               | May affect                                                                               | Turner 2002a              |
| Bentazon                           | No effect                                                                                | No effect                                                                                | No effect                                                                                | Turner 2002c              |
| Bromacil and Lithium Bromacil      | May affect, but not likely to adversely affect (rights-of-way); no effect (citrus)       | May affect, but not likely to adversely affect (rights-of-way); no effect (citrus)       | May affect, but not likely to adversely affect (rights-of-way); no effect (citrus)       | Turner 2003a              |
| Bromoxynil                         | May affect, but not likely to adversely affect                                           | May affect, but not likely to adversely affect                                           | May affect, but not likely to adversely affect                                           | Patterson 2004b           |
| Captan                             | No effect                                                                                | No effect                                                                                | No effect                                                                                | Patterson 2003c           |
| Carbaryl**                         | May affect                                                                               | May affect                                                                               | May affect                                                                               | Erickson and Turner 2003b |
| Carbofuran*                        | May affect, but not likely to adversely affect                                           | May affect, but not likely to adversely affect                                           | May affect, but not likely to adversely affect                                           | Tarkowski 2004a           |
| Chlorothalonil                     | May affect, but not likely to adversely affect                                           | May affect, but not likely to adversely affect                                           | May affect, but not likely to adversely affect                                           | Turner 2003b              |
| Chlorpyrifos**                     | May affect                                                                               | May affect                                                                               | May affect                                                                               | Turner 2003c              |
| Coumaphos                          | No effect                                                                                | No effect                                                                                | No effect                                                                                | Leyhe 2004a               |
| Diazinon*                          | May affect                                                                               | May affect                                                                               | May affect                                                                               | Turner 2002d              |
| Dicamba                            | No effect                                                                                | No effect                                                                                | No effect                                                                                | Turner 2003d              |
| Dichlobenil                        | No effect                                                                                | No effect                                                                                | No effect                                                                                | Stavola and Turner 2003a  |

| <b>Pesticide Active Ingredient</b> | <b>Sacramento River Winter-Run Chinook Salmon ESU</b>                                                                 | <b>Central Valley Spring-Run Chinook Salmon ESU</b>                                                                   | <b>California Central Valley Steelhead DPS</b>                                                                        | <b>Source</b>             |
|------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|---------------------------|
| Diflubenzuron                      | No effect                                                                                                             | No effect                                                                                                             | No effect                                                                                                             | Patterson 2004c           |
| Dimethoate                         | May affect, but not likely to adversely affect                                                                        | May affect, but not likely to adversely affect                                                                        | May affect, but not likely to adversely affect                                                                        | Patterson 2004d           |
| Disulfoton                         | May affect, but not likely to adversely affect                                                                        | May affect, but not likely to adversely affect                                                                        | May affect, but not likely to adversely affect                                                                        | Patterson 2003f           |
| Diuron                             | May affect (crop finding, if applied above 3.2 pounds of active ingredient per acre); may affect (non-crop finding)   | May affect (crop finding, if applied above 3.2 pounds of active ingredient per acre); may affect (non-crop finding)   | May affect (crop finding, if applied above 3.2 pounds of active ingredient per acre); may affect (non-crop finding)   | Turner 2003e              |
| Ethoprop                           | No effect                                                                                                             | May affect, but not likely to adversely affect                                                                        | May affect, but not likely to adversely affect                                                                        | Patterson 2003g           |
| Fenamiphos                         | May affect, but not likely to adversely affect                                                                        | May affect, but not likely to adversely affect                                                                        | May affect                                                                                                            | Stavola and Turner 2003b  |
| Fenbutatin Oxide                   | May affect                                                                                                            | May affect                                                                                                            | May affect                                                                                                            | Turner 2002e              |
| Glyphosphate                       | May affect, but not likely to adversely affect                                                                        | May affect, but not likely to adversely affect                                                                        | May affect, but not likely to adversely affect                                                                        | Patterson 2004e           |
| Hexazinone                         | No effect                                                                                                             | No effect                                                                                                             | No effect                                                                                                             | Leyhe 2004b               |
| Iprodione                          | No effect                                                                                                             | No effect                                                                                                             | No effect                                                                                                             | Turner 2003f              |
| Lindane                            | May affect, but not likely to adversely affect                                                                        | May affect, but not likely to adversely affect                                                                        | May affect, but not likely to adversely affect                                                                        | Patterson 2004f           |
| Linuron                            | No effect                                                                                                             | No effect                                                                                                             | No effect                                                                                                             | Patterson 2004g           |
| Malathion*                         | May affect (agricultural use); may affect (residential use, including public health and structural pest control uses) | May affect (agricultural use); may affect (residential use, including public health and structural pest control uses) | May affect (agricultural use); may affect (residential use, including public health and structural pest control uses) | Martinez and Leyhe 2004   |
| Methamidophos                      | No effect                                                                                                             | No effect                                                                                                             | No effect                                                                                                             | Patterson 2004h           |
| Methidathion                       | May affect, but not likely to adversely affect                                                                        | May affect, but not likely to adversely affect                                                                        | May affect                                                                                                            | Daughtry 2004b            |
| Methomyl*                          | May affect                                                                                                            | May affect                                                                                                            | May affect                                                                                                            | Erickson and Turner 2003c |
| Methyl Parathion                   | May affect, but not likely to adversely affect                                                                        | May affect, but not likely to adversely affect                                                                        | May affect, but not likely to adversely affect                                                                        | Daughtry and Turner 2004  |
| Metolachlor                        | No effect                                                                                                             | May affect, but not likely to adversely affect                                                                        | May affect, but not likely to adversely affect                                                                        | Erickson and Turner 2002c |

| <b>Pesticide Active Ingredient</b> | <b>Sacramento River Winter-Run Chinook Salmon ESU</b> | <b>Central Valley Spring-Run Chinook Salmon ESU</b> | <b>California Central Valley Steelhead DPS</b> | <b>Source</b>               |
|------------------------------------|-------------------------------------------------------|-----------------------------------------------------|------------------------------------------------|-----------------------------|
| Metribuzin                         | No effect                                             | No effect                                           | No effect                                      | Patterson 2004i             |
| Molinate                           | No effect                                             | No effect                                           | No effect                                      | Turner 2002f                |
| Naled                              | No effect                                             | No effect                                           | May affect, but not likely to adversely affect | Stavola 2004a               |
| Norflurazon                        | No effect                                             | No effect                                           | No effect                                      | Turner 2003g                |
| Oryzalin                           | May affect, but not likely to adversely affect        | May affect, but not likely to adversely affect      | May affect, but not likely to adversely affect | Erickson and Turner 2003d   |
| Oxyfluorfen                        | No effect                                             | No effect                                           | No effect                                      | Daughtry 2004c              |
| Paraquat Dichloride                | No effect                                             | No effect                                           | No effect                                      | Turner 2002g                |
| Pebulate                           | No effect                                             | No effect                                           | No effect                                      | Turner 2002h                |
| Pendimethalin                      | May affect                                            | May affect                                          | May affect                                     | Pluntke 2004                |
| Phorate                            | May affect                                            | May affect                                          | May affect                                     | Odenkirchen and Turner 2003 |
| Phosmet                            | No effect                                             | No effect                                           | No effect                                      | Turner and Mahoney 2003     |
| Prometryn                          | No effect                                             | No effect                                           | May affect                                     | Erickson and Turner 2002b   |
| Propargite                         | Not likely to adversely affect                        | Not likely to adversely affect                      | Not likely to adversely affect                 | Turner 2002i                |
| Simazine                           | No effect                                             | No effect                                           | No effect                                      | Turner 2003h                |
| Tebuthiuron                        | No effect                                             | No effect                                           | No effect                                      | Stavola 2004b               |
| Terbacil                           | No effect                                             | No effect                                           | No effect                                      | Turner 2003i                |
| Thiobencarb                        | No effect                                             | No effect                                           | No effect                                      | Turner 2002f                |
| Thiodicarb                         | No effect                                             | No effect                                           | No effect                                      | Turner 2003j                |
| Triclopyr BEE                      | May affect, but not likely to adversely affect        | May affect, but not likely to adversely affect      | May affect, but not likely to adversely affect | Tarkowski 2004b             |
| Triclopyr TEA                      | No effect                                             | No effect                                           | No effect                                      | Turner 2002j                |
| Trifluralin                        | May affect, but not likely to adversely affect        | May affect                                          | May affect                                     | Stavola 2004c               |

\* Draft Biological Opinion has been issued.

\*\* Final Biological Opinion has been issued.

## Nutrients and Organics

*Nutrients* include compounds containing nitrogen or phosphorus. Substances such as ammonia may be directly toxic to fish whereas excess nutrient runoff may trigger blooms of phytoplankton that cause DO depletion following die-off and bacterial decomposition. *Organics* are carbon-containing compounds (dissolved or particulate) such as dead vegetation and manure that also may cause depletion of DO during biological breakdown. Monitoring of DO levels in the program area showed that a considerable number of locations in Zones 2 and 3 (the only zones for which data were summarized) had concentrations below trigger limits: nearly 50 percent (228 of 463) of tests in Zone 2 and 20 percent (225 of 1,145) in Zone 3 (Central Valley Water Board 2007). Trigger limits varied between 5 and 8 mg/l of DO depending on the water body. Examination of DO data for Zone 1 revealed that 71 percent (543 of 761) of tests were below 9.0 mg/l, 39 percent (295 of 761) of tests were below 7.0 mg/l, and 12 percent (88 of 761) of tests were below 5 mg/l. In Zone 4, 46 percent (152 of 329) of tests were below 9.0 mg/l, 14 percent (46 of 329) of tests were below 7.0 mg/l, and 4 percent (14 of 329) of tests were below 5 mg/l. The Pit River (Pit River Subwatershed) is listed as impaired under CWA Section 303(d) for organic enrichment/low DO, which may be a result of agriculture and grazing. High oxygen demand from a variety of sources (possibly including agriculture) has been responsible for low DO in the Stockton Deepwater Ship Channel (Lehman et al. 2004; Central Valley Water Board 2005); DO below 6 mg/l appeared to inhibit upstream migration of Chinook salmon (Hallock et al. 1970). A recent court ruling upheld an amendment to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins that requires studies from entities responsible for oxygen demand in the Stockton Deepwater Ship Channel. The studies will be used to set load and wasteload allocations for DO in the channel (TMDLs) in order to achieve the water quality objectives of 6.0 mg/l in the San Joaquin River (between Turner Cut and Stockton, from September 1 through November 30) and 5.0 mg/l the remainder of the year (Central Valley Water Board 2005).

## Trace Elements and Salts

The presence of trace elements in water originating from irrigated lands has the potential to affect fish through chronic or acute mechanisms. For example, tile water (subsurface drain water) may contain elevated concentrations of major ions (such as sodium and sulfate) and of trace elements (such as selenium and boron). Saiki et al. (1992) found that atypical ratios of major cations and ions were probably the cause of toxicity of tile water to juvenile Chinook salmon and striped bass, as opposed to simply elevated concentrations. The role of elevated concentrations of trace elements may have contributed to toxicity in that study, but this was not clear. Toxicity of selenium to juvenile Chinook salmon was shown by Hamilton and Wiedmeyer (1990).

Monitoring of trace elements varied within the program area. In relation to results from Zone 1, the Central Valley Water Board (2007:Z1-18) stated:

There were several monitoring results for metals, which were not accompanied by hardness data. Hardness provides critical information to be able to evaluate aquatic life protection for some metals. Staff did conduct some review and evaluated the likely hardness value that would be necessary to cause an exceedance in the measured value of metals. In all cases, it would have been unlikely that the water would be sufficiently soft to cause metal toxicity.

Trigger limits for selenium were exceeded in 7 percent (23 of 327) of tests in Zone 1. In Zone 2, trigger limits were not exceeded in any tests (0 of 141) for selenium. Two percent (4 of 182) of tests

exceeded selenium trigger limits in Zone 3. Only 23 tests for selenium were conducted in Zone 4, and none exceeded 5 micrograms per liter ( $\mu\text{g/l}$ ), the trigger limit in other zones.

Increased salt content of water leads to increased conductivity. Conductivity may increase in waters receiving runoff from irrigated lands (Tate et al. 2005). Differences in conductivity have the potential to influence fish assemblage structure (Taylor et al. 1993). EPA (2005) stated in regard to conductivity:

Studies of inland fresh waters indicate that streams supporting good mixed fisheries have a range between 150 and 500  $\mu\text{mhos/cm}$ . Conductivity outside this range could indicate that the water is not suitable for certain species of fish or macroinvertebrates.

Summaries of conductivity monitoring in the program area were provided only for Zones 2–4 by the Central Valley Water Board (2007), as described by ICF Jones and Stokes (2008). Trigger limits were exceeded in 27 percent (89 of 323) of tests in Zone 2 and in 26 percent (299 of 1145) of tests in Zone 3. Very few measurements were above trigger limits in Zone 4, which the Central Valley Water Board (2007) suggested may have been due to the relatively few monitoring events in Zone 4 compared to other zones. Much monitoring occurred on mainstem rivers with relatively low conductivity, and salinity levels in Zone 3 are relatively low compared to other zones. Note that triggers for conductivity are typically in reference to agricultural use (ICF Jones and Stokes 2008), but they may serve as useful guidelines for freshwater aquatic life, as they are generally 700  $\mu\text{mhos/cm}$  (micromhos per centimeter) or less (Central Valley Water Board 2007). Conductivity data for Zone 1 indicated that 16 percent (109 of 687) of tests were above 700  $\mu\text{S/cm}$  (microsiemens per centimeter), and 29 percent (196 of 687) of tests were above 500  $\mu\text{S/cm}$ . Increases in conductivity are perhaps most relevant to freshwater species with low salinity tolerance. Estuarine species such as delta smelt are more tolerant of a variety of salinities and are found in waters with higher conductivity. For example, the peak occurrence of juvenile delta smelt in summer is at conductivity of 1,000–5,000  $\mu\text{S/cm}$  (Nobriga et al. 2008).

## Pathogens

Pathogens are monitored for potential exceedance of trigger limits in relation to human health. Pathogens of concern to fish may affect fish populations in the program area, but data are insufficient to draw any conclusions about existing effects.

## Temperature

Streams and other water bodies are often cooler than irrigation return water that they receive (Tate et al. 2005). The temperature differential has the potential to affect fish populations, especially coldwater species such as salmonids. Prioritization of exceedance tracking of other pollutants has not allowed detailed consideration of temperature data in the program area by the Central Valley Water Board, although temperature monitoring is carried out by the grower coalitions. It is anticipated that temperature criteria and subsequent assessment of exceedances will be undertaken as management plans are developed under all ILRP alternatives.

### 5.8.5 Impacts

This analysis focuses on the effects of the regulatory program on fish at a programmatic level, rather than on the specific effects of management practices used by various growers.



## Assessment Methods

The assessment of potential impacts on fish was qualitative by necessity, given the lack of substantial information regarding the extent of environmental changes that may arise from adoption of program alternatives. The basic means of assessment was to consider existing conditions as the baseline and examine proposed changes related to each alternative.

## Significance Determinations

The significance determinations for fish are the same as those described in Section 5.7, Vegetation and Wildlife.

## Alternative 1 – Full Implementation of Current Program (No Project Alternative)

Alternative 1 involves continuing and fully implementing the existing regulatory program. Use of coalition groups as the lead monitoring entities would continue, and third-party entities and growers would implement management practices in response. Under this alternative, management practices would be implemented to reduce the levels of identified constituents of concern below the baseline conditions. Monitoring and management plan requirements of Alternative 1 are expected to result in further implementation of management practices by growers. Although the use of specific management practices is speculative, general effects can be predicted based on the categories of management practices available, including improved water management (erosion and sediment control); nutrient management; tailwater recovery systems; pressurized irrigation; sediment traps, hedgerows, or buffers; and cover cropping or conservation tillage. Implementation of management plans (e.g., for chlorpyrifos, diazinon, and malathion) are expected to result in beneficial impacts. Alternative 1 does not involve any groundwater monitoring or grower site inspections. Management practices currently used to address a constituent could be reduced or discontinued if monitoring shows that a constituent is not of concern.

### **Impact FISH-1. Improvement to Surface Water Quality in Water Bodies Receiving Inputs from Agricultural Lands and Managed Wetlands**

Improvements to surface water quality from implementation of management practices in impaired water bodies receiving inputs from lands in the program area are likely to benefit fish (e.g., by reducing contaminant loads and decreasing sedimentation and total suspended solids). This improvement is a beneficial impact and requires no mitigation.

### **Impact FISH-2. Temporary Loss or Alteration of Fish Habitat during Construction of Facilities for Management Practices**

Construction impacts would result from implementation of management practices that require physical changes to lands in the program area. These physical changes primarily include erosion and sediment controls with features such as construction of water and sediment control basins, temporary water checks, tailwater return systems, vegetated drain systems, windbreaks, and filter strips. Physical changes may be associated with implementation of other management practices, such as construction of filter ditches for pesticide management. Installation of facilities for management practices such as pressurized irrigation and sediment traps is unlikely to significantly

exceed the baseline disturbance that occurs during routine field preparation. Construction of features associated with management practices may temporarily reduce the amount or quality of existing fish habitat in certain limited circumstances (e.g., by encroachment onto adjacent water bodies, removal of riparian vegetation, or reduction in water quality—such as increases in sediment runoff during construction). It is difficult to determine whether the management practices selected under Alternative 1 would change relative to existing conditions, and it is not possible to quantify any construction-related effects. Implementation of Alternative 1 may result in effects on fish habitat from construction activities related to management practices. The main management practices and their potential impacts during construction include:

- Nutrient management: no impact (no construction).
- Improved water management: no impact (no construction).
- Tailwater recovery system: potentially significant impact (significant construction).
- Pressurized irrigation: less-than-significant impact (construction effects not likely to significantly exceed impacts associated with baseline field preparation activities).
- Sediment trap, hedgerow, or buffer: less-than-significant impact (construction effects not likely to significantly exceed impacts associated with baseline field preparation activities).

While it is anticipated that the loss of fish habitat resulting from construction activities would be small, if any, data are insufficient to determine how much loss would occur. Consequently, this is considered a potentially significant impact. Implementation of **Mitigation Measure FISH-MM-1** would reduce this impact to a less-than-significant level.

### **Impact FISH-3. Permanent Loss or Alteration of Fish Habitat during Construction of Facilities for Management Practices**

In some cases, permanent loss of fish habitat may occur as a result of construction required for implementation of management practices. Some of the impact may be due to loss of structural habitat (e.g., vegetation) whereas loss of dynamic habitat (e.g., wetted habitat) could be an issue where tailwater augments natural flows or makes seasonal streams into perennial systems. This may be of concern in areas where tailwater return flows are composed mostly of pumped groundwater. Because the extent of the loss is not known, the impact is considered potentially significant. Implementation of **Mitigation Measure FISH-MM-2** would reduce this impact to a less-than-significant level.

### **Impact FISH-4. Toxicity to Fish or Fish Prey from Particle-Coagulant Water Additives**

Polyacrylamides (PAMs) are applied to reduce erosion and sediment runoff and thereby improve water quality (Sojka et al. 2000). Anionic PAMs are safe to aquatic life when used at prescribed rates (Sojka et al. 2000). Because neutral and cationic PAMs may be toxic to fish and their prey (Sojka et al. 2000; Mason et al. 2005), application of anionic PAMs is recommended in areas with sensitive fish species (Mason et al. 2005). This impact is considered potentially significant. Implementation of **Mitigation Measure FISH-MM-2** would reduce this impact to a less-than-significant level.

## **Alternative 2 – Third-Party Lead Entity**

As with Alternative 1, monitoring, tracking, and management plan requirements of Alternative 2 are expected to result in changes in the use of management practices by growers. Under this alternative,

management practices would be implemented to reduce the levels of identified constituents of concern below the baseline conditions. As with all alternatives, management practices currently used to address a constituent could be reduced or discontinued if monitoring shows that a constituent is not of concern. These changes in management practices will vary, depending on choices made by individual growers for their crops, locations, and water quality concerns. Although the use of specific management practices is speculative, general effects can be predicted based on the categories of management practices available, including erosion and sediment control, nutrient management, pesticide management, and irrigation water management.

Potential impacts to fish resulting from Alternative 2 would be expected to be similar to those described for Alternative 1; **Impacts FISH-1, FISH-2, FISH-3, and FISH-4** all apply. In addition, wellhead protection activities may occur with associated construction activities.

#### **Impact FISH-5. Temporary Loss or Alteration of Fish Habitat during Wellhead Protection Construction Required by Groundwater Quality Management Plans**

As noted above, Alternative 2 would result in similar construction impacts to Alternative 1. However, Alternative 2 would also require management practices to fulfill the requirements of GQMPs. The primary management practice related to groundwater is wellhead protection. The impact associated with this activity is not likely to significantly exceed impacts associated with baseline field preparation activities. Therefore, this impact is considered less than significant, and no mitigation is required.

### **Alternative 3 – Individual Farm Water Quality Management Plans**

Potential impacts on fish under Alternative 3 are generally expected to be as described for Alternative 2. Although uncertain, periodic visual verification of groundwater management practices under Alternative 3 instead of groundwater monitoring required under Alternative 2 may not result in **Impact FISH-1** (improved water quality) achieving the same level of improvement. This is dependent on the extent to which groundwater contributes to surface water quality. Lack of monitoring would not allow the same rigorous assessment of the effectiveness of management practices as should be available under Alternative 2; the opportunity to adaptively manage potential issues presumably would be more difficult without monitoring data. As with all alternatives, management practices currently used to address a constituent could be reduced or discontinued if monitoring shows that a constituent is not of concern.

### **Alternative 4 – Direct Oversight with Regional Monitoring**

Potential impacts on fish under Alternative 4 are expected to be as described for Alternatives 2 and 3. However, given the probability of increased monitoring of individual farms, and especially those at higher risk of generating significant impacts—in addition to wellhead protection, nutrient management plans, tracking of nutrient and pesticide application, and monitoring of individual wells—the positive benefit of **Impact FISH-1** (improved water quality) would probably be greater under Alternative 4 than under Alternative 2 or Alternative 3. As with all alternatives, management practices currently used to address a constituent could be reduced or discontinued if monitoring shows that a constituent is not of concern.

## Alternative 5 – Direct Oversight with Farm Monitoring

The potential impacts attributable to management practices under Alternative 5 would be similar to those described for Alternatives 2, 3, and 4. Given the emphasis on monitoring of individual farms, wellhead protection, nutrient management plans, tracking of nutrient and pesticide application, monitoring of individual wells, and potential installation of monitoring wells, the positive benefit of **Impact FISH-1** (improved water quality) probably would be greater under Alternative 5 than under any other alternative. However, installation of the monitoring wells could result in direct impacts on fish habitat adjacent to agricultural lands and managed wetlands. As with all alternatives, management practices currently used to address a constituent could be reduced or discontinued if monitoring shows that a constituent is not of concern.

### **Impact FISH-6. Temporary Loss or Alteration of Fish Habitat during Construction of Facilities for Management Practices and Groundwater Monitoring Wells**

This impact is essentially the same as **Impact FISH-2** except that, in addition to the temporary loss or alteration of habitat due to construction of management practices, further loss or alteration of fish habitat may occur from construction of monitoring wells. Accordingly, the impact is considered potentially significant. Implementation of **Mitigation Measure FISH-MM-1** would reduce this impact to a less-than-significant level.

### **Impact FISH-7. Permanent Loss or Alteration of Fish Habitat during Construction of Facilities for Management Practices and Groundwater Monitoring Wells**

This impact is essentially the same as **Impact FISH-3** except that, in addition to the temporary loss or alteration of habitat due to construction of features associated with management practices, permanent loss or alteration of fish habitat may occur from construction of monitoring wells. Accordingly, the impact is considered potentially significant. Implementation of **Mitigation Measure FISH-MM-2** would reduce this impact to a less-than-significant level.

## 5.8.6 Mitigation and Improvement Measures

### **Mitigation Measure FISH-MM-1: Avoid and Minimize Impacts to Fish and Fish Habitat**

This mitigation measure incorporates all measures identified in **Mitigation Measure BIO-MM-1**, described in Section 5.7, Vegetation and Wildlife. In each instance where particular management practices could result in impacts to special-status fish species (see “Regulatory Classification of Special-Status Species” in Section 5.8.2), growers should use the least impactful effective management practice to avoid such impacts. Where the ILRP water quality improvement goals cannot be achieved without incurring potential impacts, individual farmers, coalitions, or third-party representatives should implement the following measures to reduce potential impacts to less-than-significant levels. Note that these measures may not be necessary in many cases and are dependent on the location of construction in relation to water bodies containing special-status fish.

- Where construction in areas that may contain special-status fish species cannot be avoided through the use of alternative management practices, conduct an assessment of habitat conditions and the potential for presence of special-status fish species prior to construction;

this may include the hiring of a qualified fisheries biologist to determine the presence of special status fish species;

- Based on the species present in adjacent water bodies and the likely extent of construction work that may affect fish, limit construction to periods that avoid or minimize impacts to special-status fish species.
- Where construction periods cannot be altered to minimize or avoid effects on special-status fish, undertake additional CEQA review and develop a restoration or compensation plan to mitigate the loss of the resources.

**Mitigation Measure FISH-MM-2: Educate Growers on the Use of Polyacrylamides for Sediment Control**

The Central Valley Water Board will provide information on the potential risks to aquatic life, including special-status fish, that may result from the use of cationic or neutral PAMs during water management activities. Information in the form of leaflets and website information will be provided to grower coalitions, encouraging the use of anionic PAMs. Application of anionic PAMs at prescribed rates will be emphasized in the information provided to growers. Adoption of the USDA National Conservation Practice Standard 450 also will be recommended in the information.



### 5.9.1 Introduction

This section describes potential impacts on surface water and groundwater resources associated with the program alternatives. Specifically, it summarizes relevant laws and policies, discusses the existing environmental setting for surface water and groundwater in the program area, and identifies potential impacts on surface water and groundwater that may result from implementation of program alternatives. Mitigation measures to avoid or reduce potentially significant impacts also are presented.

The Central Valley watershed is divided into three major hydrologic regions (Figure 5.9-1) or surface water basins:

- The Sacramento River Basin contains the entire drainage area of the Sacramento River and its tributaries. It begins upstream of Shasta Lake near the Oregon border and extends south to the Delta, stretching roughly from the northeast corner of California to Sacramento County.
- The San Joaquin River Basin contains the entire drainage area of the San Joaquin River and its tributaries. It extends from the Delta and the Cosumnes River in the north to the southern reaches of the San Joaquin River watershed, encompassing the area from Sacramento County (including the southeast corner of the county itself) to Madera County (and portions of Fresno County).
- The Tulare Lake Basin includes the Southern San Joaquin Valley. It ranges from the southern limit of the San Joaquin River watershed to the crest of the Tehachapi Mountains.

Each of the three major surface water basins is divided into subwatersheds delineated by DWR CalWater boundaries. The ECR discusses the three basins and their 30 associated subwatersheds, and provides all methods used to assess the surface water conditions of the basins. The reader is referred to this document for additional detail.

The groundwater basins and subbasins that exist in the Central Valley watershed have been delineated using the boundaries in Bulletin 118 (DWR 2003). Figures 5.9-2 through 5.9-4 map the boundaries of these basins. Although the groundwater basin boundaries do not coincide exactly with surface water basin boundaries, DWR reports groundwater information separately for the Sacramento River, San Joaquin River, and Tulare Lake Basins. The Sacramento River Basin consists of 90 groundwater basins and subbasins, the San Joaquin River Basin includes 9 groundwater subbasins, and the Tulare Lake Basin includes 19 groundwater basins and subbasins. The ECR discusses the 118 basins and subbasins in detail, and focuses on the occurrence of groundwater contamination due to irrigated agriculture. The reader is referred to this document for additional detail.

## 5.9.2 Regulatory Framework

The following federal and state regulations are relevant to surface water and groundwater resources in the program area.

### Federal

#### Clean Water Act

The State Water Board is the state agency with primary responsibility for implementing the CWA which establishes regulations relating to water resource issues. Typically, all regulatory requirements are implemented by the State Water Board through nine Regional Water Boards established throughout the state. The Central Valley Water Board is responsible for regulating waste discharges to Central Valley waters protected under the CWA.

The CWA is the primary federal law that protects the quality of the nation's surface waters, including lakes, rivers, and coastal wetlands. It operates on the principle that all discharges into the nation's waters, unless exempted, are unlawful unless specifically authorized by a permit. Permit review is the CWA's primary regulatory tool. Section 402(l)(1) of the CWA exempts the discharge of return flows from irrigated agriculture from this permit requirement. The following sections provide additional details on specific sections of the CWA.

#### Permits for Stormwater Discharge

CWA Section 402 regulates construction-related stormwater discharges to surface waters through the National Pollution Discharge Elimination System (NPDES) program, administered by EPA. In California, the State Water Board is authorized by EPA to oversee the NPDES program through the Regional Water Boards (see "Porter-Cologne Water Quality Control Act" below). The NPDES program provides for both general permits (which cover a number of similar or related activities) and individual permits.

#### General Construction Permit

Most construction projects that disturb 1 acre of land or more are required to obtain coverage under the NPDES General Permit for Construction Activities (General Construction Permit), which requires the applicant to file a public notice of intent to discharge stormwater and to prepare and implement a stormwater pollution prevention plan (SWPPP). The SWPPP includes a site map, description of proposed construction activities, demonstration of compliance with relevant local ordinances and regulations, and overview of the BMPs that will be implemented to prevent soil erosion and discharge of other construction-related pollutants that could contaminate nearby water resources. Permittees are required to conduct annual monitoring and reporting to ensure that BMPs are correctly implemented and are effective in controlling the discharge of stormwater-related pollutants.

#### National Toxics Rule (40 CFR Part 131.36)

The National Toxics Rule is EPA's rule promulgating the numeric water quality criteria necessary to bring all states into compliance with the CWA. The National Toxics Rule applies to the 14 states and territories that were without EPA-approved criteria when the final rule was published (Alaska,

Arkansas, California, Florida, Idaho, Kansas, Michigan, Nevada, New Jersey, Rhode Island, Vermont, Washington, District of Columbia, and Puerto Rico). For these states and territories, the criteria in the National Toxics Rule are the legally enforceable standards for all purposes and programs under the CWA.

## California Toxics Rule (40 CFR Part 131.38)

EPA's California Toxics Rule promulgates numeric water quality criteria for more than 126 priority pollutants. The numeric criteria in the California Toxics Rule must be achieved in the surface waters of the state with relevant beneficial uses (e.g., municipal supply, aquatic life). If these objectives are not met within a water of the state with a designated beneficial use, the water body would be listed as impaired.

## Federal Antidegradation Policy

Federal water quality regulation contains an antidegradation policy and a requirement that states develop a similar policy (40 CFR Section 131.12). This regulation establishes a three-part test to determine whether increases in pollutant loading or adverse changes in the quality of federal surface water may be permitted. The three tests are described in the policy transcribed below:

### Section 131.12 Antidegradation Policy

- (a) The State shall develop and adopt a statewide antidegradation policy and identify the methods for implementing such policy pursuant to this subpart. The antidegradation policy and implementation methods shall, at a minimum, be consistent with the following:
  - (1) Existing instream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected.
  - (2) Where the quality of the waters exceed levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water, that quality shall be maintained and protected unless the State finds, after full satisfaction of the intergovernmental coordination and public participation provisions of the State's continuing planning process, that allowing lower water quality is necessary to accommodate important economic or social development in the area in which the waters are located. In allowing such degradation or lower water quality, the State shall assure water quality adequate to protect existing uses fully. Further, the State shall assure that there shall be achieved the highest statutory and regulatory requirements for all new and existing point sources and all cost-effective and reasonable best management practices for nonpoint source control.
  - (3) Where high quality waters constitute an outstanding National resource, such as waters of National and State parks and wildlife refuges and waters of exceptional recreational or ecological significance, that water quality shall be maintained and protected.
  - (4) In those cases where potential water quality impairment associated with a thermal discharge is involved, the antidegradation policy and implementing method shall be consistent with section 316 of the Act.

The state antidegradation policy described below complies with this requirement and incorporates the federal policy by reference.

## State

### Porter-Cologne Water Quality Control Act

The Porter-Cologne Act established the State Water Board and divided the state into nine regions, each overseen by a Regional Water Board. The State Water Board is the primary state agency responsible for protecting the quality of the state's surface water and groundwater supplies, although much of its daily implementation authority is delegated to the Regional Water Boards, which are responsible for implementing CWA Sections 402 and 303(d). In general, the State Water Board manages both water rights and statewide regulation of water quality, while the Regional Water Boards focus exclusively on water quality within their regions.

### California Regional Water Quality Control Board, Central Valley Region

The Central Valley Water Board is responsible for implementing Basin Plans for the Sacramento and San Joaquin River Basins and the Tulare Lake Basin. A Basin Plan identifies beneficial uses of surface water and groundwater as well as water quality objectives to protect those uses. Numerical and narrative criteria are contained in Basin Plans for several key water quality constituents, including DO, water temperature, trace metals, turbidity, suspended material, pesticides, salinity, radioactivity, and other related constituents.

The methods the Central Valley Water Board uses to implement Basin Plan criteria include issuing WDRs. WDRs may be issued to any entity that discharges waste that may affect the quality of any Central Valley surface water or groundwater. For discharges to waters protected under the CWA, WDRs also could serve as a federally required NPDES permit (under the CWA) and incorporate the requirements of other applicable regulations.

The Water Code authorizes State and Regional Water Boards to conditionally waive WDRs if this is in the public interest. Over the years, the Regional Water Boards have issued waivers for over 40 categories of discharges. Although waivers are always conditional, the historical waivers had few conditions. In general, they required that discharges not cause violations of water quality objectives but did not require water quality monitoring. SB 390, signed into law on October 6, 1999, required the Regional Water Boards to review their existing waivers and to renew them or replace them with WDRs. Under SB 390, waivers not reissued automatically expired on January 1, 2003. To comply with SB 390, the Regional Water Boards adopted revised waivers. The most controversial waivers were those for discharges from irrigated agriculture. Discharges from agricultural lands include irrigation return flow, flows from tile drains, and storm water runoff. As a control mechanism, development of a "conditional prohibition," as allowed by a Basin Plan, is an innovative and proven successful approach for controlling discharges.

### Basin Plans and Water Quality Objectives

The Porter-Cologne Act provides for development and periodic review of Basin Plans that designate beneficial uses of California's major rivers and groundwater basins, and establish narrative and numerical water quality objectives for those waters. Beneficial uses represent the services and qualities of a water body (i.e., the reasons the water body is considered valuable), while water quality objectives represent the standards necessary to protect and support those beneficial uses. Basin Plans are primarily implemented through development of WDRs, waivers of WDRs, and NPDES permits to regulate waste discharges so that water quality objectives are met. NPDES

permits do not apply to agricultural return flows. Basin Plans are required to be reviewed every 3 years and provide the regulatory basis for determining WDRs and waivers of WDRs.

### **Water Quality Objectives by Region**

The Regional Water Boards have set water quality objectives for all groundwater and surface waters in their respective regions for the following substances and parameters: ammonia, bacteria, biostimulatory substances, chemical constituents, color, DO, floating material, oil and grease, pH, pesticides, radioactivity, salinity, sediment, settleable material, suspended material, tastes and odors, temperature, toxicity, and turbidity. Basin Plans also include the following narrative water quality objectives: "bacteria, chemical constituents, taste/odor and toxicity". Where there is a waste discharge of a substance that does not currently have specified numeric objectives in a Basin Plan, the Central Valley Water Board may use the narrative objective to determine appropriate objectives for such wastes (examples include pesticides).

### **State Antidegradation Policy**

A key policy of California's water quality program is the Antidegradation Policy. This policy, formally known as the *Statement of Policy with Respect to Maintaining High Quality Waters in California* (State Water Board Resolution No. 68-16), restricts degradation of surface water and groundwater. In particular, this policy protects water bodies where existing quality is higher than necessary for the protection of beneficial uses. Under the Antidegradation Policy, any actions that can adversely affect water quality in surface water and groundwater must (1) be consistent with maximum benefit to the people of the State; (2) not unreasonably affect present and anticipated beneficial use of the water; and (3) not result in water quality less than that prescribed in water quality plans and policies. The policy also requires that waste discharges to high-quality waters meet WDRs that result in best practicable treatment or control of the discharge and ensure that avoidance of pollution or nuisance and highest water quality consistent with maximum benefit to the people of the State be maintained (State Water Board 1968).

## **5.9.3 Environmental Setting**

The ILRP program area extends from the northeast corner of California to the southern part of the Central Valley. The environmental setting summarizes the information found in the ECR for the three major hydrologic basins.

### **Sacramento River Basin**

#### **Regional Hydrology**

The Sacramento River Basin contains the entire drainage area of the Sacramento River and its tributaries, from the northeast corner of California to Sacramento County (Figure 5.9-5). The basin drains approximately one-third of total runoff in the state into the middle and lower reaches of the Sacramento River.

Land uses in the Sacramento River Basin are principally forest and range lands in the upper reaches, with urban development focused around the City of Sacramento. Agriculture is the dominant land use on the valley floor, followed by urban development.



The Sacramento River Basin encompasses approximately 12.2 million acres. Of this amount, 2.4 million acres are classified as agricultural lands. The majority of the irrigated agricultural acres occur on the Valley floor, in the Solano-Yolo, Colusa Basin, and Butte-Sutter-Yuba Subwatersheds. Rice is the primary crop in the Sacramento River Basin, particularly in the Colusa and Butte-Sutter-Yuba Subwatersheds where poorly drained soils provide ideal conditions for this crop. Other predominant crop types include field crops, orchards, pasture, and grains.

Agricultural land uses account for less than 10 percent of total acreage in the Pit River, Shasta-Tehama, Upper Feather River–Upper Yuba River, American River, and Lake-Napa Subwatersheds.

The eight subwatersheds and the 90 groundwater basins and subbasins in the Sacramento River Basin are described in detail in the ECR.

## Surface Water Quality

In general, agricultural operations have a greater impact on surface water in the Central Valley area around the Sacramento River than in the higher surrounding elevations of the Coast and Cascade Ranges and Sierra Nevada. This is primarily due to the valley topography allowing for much larger agricultural operations. Figure 5.9-6 is a conceptual surface water model that depicts various agricultural operations and use of surface water. Source water from rivers is used in agricultural operations, and agricultural return flows often are conveyed back to the river carrying agricultural-related contaminants.

The ECR identifies the known agricultural contaminants and conditions that affect surface water quality in the Sacramento River Basin. These include pesticides such as diazinon, chlorpyrifos, Azimphos-methyl, carbofuran, Group A pesticides, methyl parathion, and molinate/ordram. Toxicity, and bacteria are also known water quality problems in the Sacramento River Basin.

Water quality concerns in the Sacramento River Basin are concentrated in the Sacramento Valley, in subwatersheds that are heavily dominated by agriculture. These include the Butte-Sutter-Yuba, Colusa Basin, and Solano-Yolo Subwatersheds (see Figures 5.9-7 through 5.9-9) where agricultural land uses constitute 36, 37, and 60 percent of total acreage, respectively. Areas of water quality impairment, as indicated by two or more water quality exceedances, are mapped in Figures 5.9-7 through 5.9-9. Section 303(d) listings related to irrigated agriculture occur in all of these subwatersheds, as well as in the American River Subwatershed.

## Groundwater Quality

Detailed information in the ECR focuses on the occurrence of groundwater contamination due to irrigated agriculture in the Sacramento River Basin. Twenty-five percent of the basins or subbasins have insufficient data or available data indicate no groundwater quality problems. In a large number of the basins or subbasins (30 percent), irrigated agriculture occupies 5 percent or less of the area. The ECR also provides the results of monitoring performed as part of the DPR Ground Water Protection Program. The DPR Ground Water Protection Program monitors pesticides in groundwater. Monitoring from 1985 to 2003 revealed that Butte, Colusa, Glenn, Placer, Sacramento, Shasta, Solano, Sutter, Tehama, Yolo, and Yuba Counties contained one or more pesticide detections in groundwater. However, most of these counties showed only minimal detection of pesticides. Glenn, Colusa, Solano, and Butte Counties had the greatest detection of pesticides (see the ECR). Results of the DPR monitoring program for the Sacramento River Basin are summarized in Table 5.9-1.

**Table 5.9-1. Pesticide Detections in Groundwater Wells for Counties in the Sacramento River Basin (1985–2003)**

| County       | ACET      | Atrazine  | Bentazon  | Bromocitl | DACT     | DEA       | Diuron   | Norflurazon | Promoton | Simazine  |
|--------------|-----------|-----------|-----------|-----------|----------|-----------|----------|-------------|----------|-----------|
| Butte        |           | 6         | 8         | 1         |          | 1         | 1        | 2           | 1        | 1         |
| Colusa       | 2         |           | 7         |           |          | 1         |          |             | 1        | 4         |
| Glenn        |           | 23        | 21        |           |          | 4         | 2        |             | 5        | 11        |
| Placer       |           |           | 1         | 1         |          |           |          |             |          |           |
| Sacramento   |           | 1         | 1         |           |          |           |          |             |          |           |
| Shasta       | 1         |           |           |           | 1        |           |          |             |          |           |
| Solano       | 6         | 13        |           |           | 3        | 9         | 4        | 1           | 1        | 1         |
| Sutter       |           |           | 5         |           |          |           |          |             |          | 2         |
| Tehama       | 1         | 3         |           |           |          | 2         | 1        |             |          | 2         |
| Yolo         |           | 5         | 3         |           |          |           |          |             |          | 3         |
| Yuba         |           |           | 8         |           |          |           |          |             |          |           |
| <b>Total</b> | <b>10</b> | <b>51</b> | <b>54</b> | <b>2</b>  | <b>4</b> | <b>17</b> | <b>8</b> | <b>3</b>    | <b>8</b> | <b>24</b> |

Notes:

ACET = 2-amino-4-chloro-6-ethylamino-s-triazine.

DACT = 2,4-diamino-6-chloro-s-triazine.

DEA = deethyl-atrazine.

Source: DPR 2003.

Figure 5.9-17 shows areas throughout California with elevated levels of nitrate in groundwater, including areas within the Sacramento River Basin.

## San Joaquin River Basin

### Regional Hydrology

The San Joaquin River Basin drains a region that extends across the Central Valley to the Coast Ranges, between the Cosumnes River to the north and the San Joaquin River to the south (Figure 5.9-10).

The San Joaquin River Basin encompasses approximately 9.8 million acres. In general, above the valley floor, the basin is dominated by native vegetation. The primary tributaries in the basin are the Stanislaus River, Tuolumne River, and Merced River, which meet with the San Joaquin River in the Valley floor. The basin is dominated by agriculture at the confluence of the San Joaquin and these various rivers. The San Joaquin River Basin includes most of the Delta as well as the Delta-Mendota Canal, a highly manipulated component of the Central Valley Project. Multiple canals in the Delta-Mendota Canal Subwatershed deliver water to agricultural operations and then back to the natural drainages. Many tributaries in the subwatershed that would otherwise be dry during the summer irrigation season flow year-round due to agricultural return flows.

Approximately 2 million acres within the basin are classified as agricultural. Agricultural land uses in the basin are concentrated in the Valley floor—specifically in the Delta-Mendota Canal, San Joaquin Valley Floor, Delta-Carbona, and North Valley Floor Subwatersheds. There is very little agriculture in the remaining subwatersheds, less than 1 percent in most cases. The primary crops

that are produced in the San Joaquin River Basin include field crops, pasture, deciduous fruits and nut orchards, vineyards, grain and hay.

The 12 subwatersheds and nine groundwater subbasins in the San Joaquin River Basin are described in detail in the ECR.

## Surface Water Quality

In general, agricultural operations have a greater impact on surface water in the Central Valley area around the San Joaquin River than in the higher surrounding elevations of the Coast Ranges and Sierra Nevada. This is primarily due to the valley topography allowing for much larger agricultural operations.

The water quality of the San Joaquin River is of critical interest because it flows to the South Delta area, which is a primary source of drinking water, and supplies irrigation water to farms in the western San Joaquin Valley. Water quality concerns in the San Joaquin River Basin relate to the (1) transport of pesticides by agricultural return flows to water bodies; and (2) transport of pesticides that are applied to orchards during the dormant growing season (November to January) and are transported to water bodies during rainfall events. In addition to pesticides, other nutrient-related water quality concerns are associated with irrigated agriculture.

Water quality concerns in the San Joaquin River Basin are concentrated in the subwatersheds that are heavily agricultural—specifically, the Delta-Mendota Canal, San Joaquin Valley Floor, Delta-Carbona, and North Valley Floor Subwatersheds (see Figures 5.9-11 through 5.9-14). Agricultural land constitutes one-third to one-half of the total land use in each of these subwatersheds. Correspondingly, all of these subwatersheds include water bodies impaired by Section 303(d)-listed pollutants that are associated with irrigated agriculture.

Water quality impairments in San Joaquin River Basin surface water are mapped in Figures 5.9-11 through 5.9-14. Many of the rivers, creeks, and agricultural drainages that are dominated by agricultural return flows contain low DO (generally associated with agricultural return flows), fluctuating pH, and elevated levels of EC (indicative of high salinity). Within each watershed, data indicate that chlorpyrifos, diazinon, permethrin, dieldrin, and DDT (and its breakdown products DDD and DDE) are frequently present in concentrations that exceed water quality objectives. Other pesticides are detected in these subwatersheds but not consistently in each subwatershed. These constituents include azinphos-methyl, carbofuran, cyhalothrin, cypermethrin, demeton, dieldrin, dimethoate, disulfoton, diuron, endrin, esfenvalerate/fenvalerate, linuron, malathion, methyl, methyl parathion, methomyl, simazine, thiobencarb, parathion, permethrin-1, permethrin-2, and total permethrin. In addition, elevated levels of naturally occurring metals that are mobilized and suspended in agricultural return flows are common in these subwatersheds—such as copper, arsenic, cadmium, boron, nickel, lead, and selenium.

## Groundwater Quality

Most of the groundwater quality summary information for the San Joaquin River Basin presented in the ECR is reported as part of a discussion of the entire San Joaquin Valley Groundwater Basin, which also includes the Tulare Lake Basin. The more detailed information is presented as discussions of each subbasin within the San Joaquin River Basin. The reader is referred to the ECR for this more detailed information.

Groundwater subbasins underlay approximately 3.73 million acres of the 9.8-million-acre San Joaquin River Basin. Most of these subbasins underlay the San Joaquin Valley floor. Groundwater is extensively used by agricultural and urban entities in this area. Approximately 30 percent of agricultural and urban water use comes from pumping groundwater. (DWR 2003.)

The National Water Quality Assessment (NAWQA) for the San Joaquin Valley Groundwater Basin concluded that groundwater within the eastern portion of the San Joaquin Valley that supplies drinking water to the majority of the population has been degraded by fertilizers and pesticides (Dubrovsky et al. 1998). This report concluded that nitrate concentrations frequently exceeded drinking water standards while pesticides, with the exception of DBCP, rarely exceeded drinking water standards. The specific conclusions are identified in the ECR.

The ECR also provides the results of monitoring that was performed as part of the DPR Ground Water Protection Program and the USGS GAMA Program. The ECR identified pesticide detections by counties and presented the data in table format. Within the San Joaquin River Basin, San Joaquin, Stanislaus, Merced and Madera Counties were the large contributors to pesticide detection in groundwater (ECR 2008). Results from monitoring that was performed as part of the DPR Ground Water Protection Program are summarized in Table 5.9-2.

**Table 5.9-2. Pesticide Detections in Groundwater Wells for Counties in the San Joaquin River Basin (1985–2003)**

| County       | ACET      | Atrazine  | Bentazon | Bromocitl | DACT      | DEA       | Diuron    | Norflurazon | Prometon | Simazine  |
|--------------|-----------|-----------|----------|-----------|-----------|-----------|-----------|-------------|----------|-----------|
| Amador       |           |           |          |           |           |           |           |             |          |           |
| Calaveras    |           |           |          |           |           |           |           |             |          |           |
| Contra Costa |           | 1         |          | 1         |           |           | 1         |             | 2        | 1         |
| Mariposa     |           |           |          |           |           |           |           |             |          |           |
| Madera       | 4         | 2         |          | 2         | 3         | 2         | 6         |             |          | 4         |
| Merced       | 8         | 4         | 1        | 3         | 8         | 2         | 7         | 1           | 1        | 6         |
| San Joaquin  | 19        | 7         |          | 5         | 15        | 10        | 7         | 1           |          | 7         |
| Stanislaus   | 5         | 4         | 3        | 1         | 2         | 1         | 7         |             | 1        | 11        |
| Tuolumne     |           |           |          |           |           |           |           |             |          |           |
| <b>Total</b> | <b>36</b> | <b>18</b> | <b>4</b> | <b>12</b> | <b>28</b> | <b>15</b> | <b>28</b> | <b>2</b>    | <b>4</b> | <b>30</b> |

Notes:

ACET = 2-amino-4-chloro-6-ethylamino-s-triazine.

DACT = 2,4-diamino-6-chloro-s-triazine.

DEA = deethyl-atrazine.

Source: DPR 2003.

As indicated in Figure 5.9-17, high nitrate concentrations are found in groundwater throughout the valley, with high concentrations reported in the San Joaquin River Basin in Merced, Stanislaus, and San Joaquin Counties.

# Tulare Lake Basin

## Regional Hydrology

The Tulare Lake Basin encompasses a drainage area from Fresno to the southern end of the Central Valley near the Grapevine and is essentially a closed basin (Figure 5.9-15).

The Tulare Lake Basin encompasses approximately 10.7 million acres. Of this amount, 3.6 million acres are classified as agricultural. The vast majority of this agricultural land is located in the South Valley Floor Subwatershed (3.5 million acres). In comparison with other subwatersheds in the Tulare Lake Basin, the South Valley Floor Subwatershed is relatively flat. Consequently, the bulk of water quality concerns related to the Tulare Lake Basin involve agricultural operations and agricultural return flows in the South Valley Floor Subwatershed.

Due to the amount of land in the Tulare Lake Basin that is in the Sierra Nevada and the Coast Ranges, most of the basin is dominated by native vegetation and includes little urban development. In the upper watershed areas, irrigated agriculture accounts for less than 2 percent of land uses (Kings River, Kaweah River, Kern River, Grapevine, Coast Range, Sunflower Valley, and Southern Sierra Subwatersheds) with just slightly more in the Temblor Subwatershed (3.3 percent). There is no agriculture in the Fellows Subwatershed. The primary crop types within the Tulare Lake Basin are grain and hay crops, pasture, and deciduous fruits and nuts. The primary crop types within the South Valley Floor Subwatershed are field crops, followed by deciduous fruits and nuts, vineyards, pasture, and grain and hay.

The 10 subwatersheds and the 19 groundwater basins and subbasins in the Tulare Lake Basin are described in detail in the ECR.

## Surface Water Quality

In general, agricultural operations have a greater impact on surface water in the Central Valley between the Fresno area and the Tehachapi Mountains than other parts of the Valley. This is primarily due to the valley topography allowing for much larger agricultural operations.

Section 303(d) water quality concerns within the Tulare Lake Basin are limited to the South Valley Floor Subwatershed. None of the other subwatersheds include water bodies with Section 303(d)-listed pollutants; physical parameters such as EC, pH, temperature, and turbidity are generally within Basin Plan standards. Constituents such as selenium and sedimentation are believed to be naturally occurring (with the exception of the South Valley Floor Subwatershed).

The South Valley Floor Subwatershed is the largest subwatershed within the Tulare Lake Basin, at approximately 5.3 million acres (approximately 8,280 square miles). The subwatershed is located in the southern Central Valley and is bounded to the north by the San Joaquin River, to the south by the Tehachapi Mountains, on the west by the Coast Ranges, and on the east by the Sierra Nevada. As noted, the South Valley Floor Subwatershed is relatively flat compared to the surrounding subwatersheds. Agriculture is the primary land use type in the subwatershed, encompassing approximately 66 percent (3.5 million acres) of the total land area.

Surface water runoff in the South Valley Floor Subwatershed is not sufficient to support existing land uses in the subwatershed, resulting in a large proportion of water being imported from other locations. The Friant-Kern Canal, the San Luis Canal/California Aqueduct System, and the Cross-



Valley Canal are major water delivery facilities that have dramatically altered the way water is managed in the South Valley Floor Subwatershed; water is moved from one end of the valley to the other as needed. Because of the intensive water development that has occurred in the subwatershed, very few channels are not specifically maintained as water delivery features and there is very little monitoring or characterization of the subwatershed's water quality.

During the irrigation season, water bodies in the South Valley Floor Subwatershed are dominated by agricultural return flows, which may transport pesticides to the various east side and west side drainages. In addition, pesticides that are applied during the dormant spray season, which typically occurs between November and January, can be transported from fields during rainfall events. Data indicate that chlorpyrifos, azinphos-methyl, dimethoate, malathion, thiobencarb, esfenvalerate, cypermethrin, toxaphene, DDE, DDT, and DDD are present in concentrations that exceed water quality objectives (Figure 5.9-16 shows areas that experience two or more exceedances for each respective water quality constituent). Copper also has been detected at multiple locations in the South Valley Floor Subwatershed. Copper is a naturally occurring metal that also is used as a pesticide. Other metals such as arsenic, cadmium, boron, lead, molybdenum, manganese, zinc, iron, and selenium have been detected at elevated levels and are likely mobilized by agricultural return flows.

Many of the creeks and drainages located in the South Valley Floor Subwatershed contain low DO. Factors contributing to low DO are currently under investigation but are possibly associated with nutrient loads from irrigated agriculture. In addition, many of the creeks in the subwatershed experience fluctuating levels of pH and elevated levels of EC. Toxicity tests indicate that non-polar organics are causing toxicity problems in the South Valley Floor Subwatershed. Non-polar organics, including chlorpyrifos, diazinon, dimethoate, disulfoton, diuron, cyfluthrin, dioxathion, simazine, and atrazine, were found in some of the samples tested and were identified as likely or potential causes of observed toxicity.

## Groundwater Quality

The Tulare Lake Basin consists of seven groundwater subbasins in the valley floor and 12 smaller basins in the surrounding mountain areas (Figure 5.9-4). As with the San Joaquin River Basin, most of the groundwater quality summary information for the Tulare Lake Basin presented in the ECR is reported as part of a discussion of the entire San Joaquin Valley Groundwater Basin. The more detailed information is presented as discussions of each basin and subbasin. The reader is referred to the ECR for this more detailed information.

The NAWQA for the San Joaquin Valley Groundwater Basin concluded that groundwater within the eastern portion of the San Joaquin Valley (including the eastern side of the Tulare Lake Basin) that supplies drinking water to the majority of the population has been degraded by fertilizers and pesticides (Dubrovsky et al. 1998). This report concluded that nitrate concentrations frequently exceeded drinking water standards while pesticides, with the exception of DBCP, rarely exceeded drinking water standards. The specific conclusions are identified in the ECR.

The ECR also provides the results of monitoring that was performed as part of the DPR Ground Water Protection Program and the USGS GAMA Program. Results from DPR monitoring in the Tulare Lake Basin are summarized in Table 5.9-3. The most numerous detections were reported from Fresno and Tulare Counties.

**Table 5.9-3. Pesticide Detections in Groundwater Wells for Counties in the Tulare Lake Basin (1985–2003)**

| County       | ACET       | Atrazine  | Bentazon | Bromocitl  | DACT       | DEA       | Diuron     | Norflurazon | Promoton  | Simizine   |
|--------------|------------|-----------|----------|------------|------------|-----------|------------|-------------|-----------|------------|
| Fresno       | 121        | 10        |          | 54         | 70         | 7         | 107        | 21          | 4         | 180        |
| Kings        |            | 1         |          |            |            |           | 3          |             | 1         |            |
| Kern         | 4          | 3         |          | 4          | 1          | 2         | 12         |             |           | 2          |
| Tulare       | 70         | 24        |          | 145        | 30         | 10        | 250        | 14          | 8         | 282        |
| <b>Total</b> | <b>195</b> | <b>38</b> |          | <b>203</b> | <b>101</b> | <b>19</b> | <b>372</b> | <b>35</b>   | <b>13</b> | <b>464</b> |

Notes:

ACET = 2-amino-4-chloro-6-ethylamino-s-triazine.

DACT = 2,4-diamino-6-chloro-s-triazine.

DEA = deethyl-atrazine.

Source: DPR 2003.

High nitrate concentrations are found in groundwater throughout the valley portion of the Tulare Lake Basin (see Figure 5.9-17), with the highest concentrations reported in western Tulare and Kern Counties.

## 5.9.4 Impacts

This analysis focuses on the effects of the regulatory program on hydrology and water quality at a programmatic level, rather than on the specific effects of management practices used by various growers.

## Assessment Methods and Data Collection

Collection of resources and data for surface water quality and groundwater quality was accomplished using various state and federal agency websites, and water quality reports from various water quality coalitions. USGS and the Central Valley Water Board conducted many critical water quality studies over the years that play an important role in the data collected for this report. The following key references were used to compile this section:

- California Department of Water Resources. 2003. *California's Groundwater: Bulletin 118 – Update 2003*. Sacramento, CA.
- Central Valley Regional Water Quality Control Board. 2007a. Revised Draft of the 2007 Review of Monitoring Data for the Irrigated Lands Conditional Waiver Program. July.
- Kratzer, Charles, Celia Zamora, and Donna Knifong. 2002. Diazinon and Chlorpyrifos Loads in the San Joaquin River Basin, California, January and February 2000. (USGS Water Resources Investigations Report 02-4103.)
- Kratzer, Charles, Peter Dileanis, Celia Zamora, Steven Silva, Carol Kendall, Brian Bergamazchi, and Randy Dalhgren. 2004. Sources and Transport of Nutrients, Organic Carbon, and Chlorophyll-a in the San Joaquin River Upstream of Vernalis, California, during Summer and Fall 2000 and 2001. Available: <<http://pubs.usgs.gov/wri/wri034127/wri034127rev.pdf>>. Accessed: June 12, 2008.

- Schuette, J., D. Weaver, J. Troiano, M. Pepple, and J. Dias. 2003. Sampling for Pesticide Residues in California Water Wells: 2003 Well Inventory Database, Cumulative Report 1986–2003. (California Department of Pesticide Regulation Document EH03-08.) December.
- U.S. Geological Survey. 2005b. National Water-Quality Assessment Program. San Joaquin–Tulare Basins NAWQA. Available: <<http://ca.water.usgs.gov/sanj/sanj.html>> Accessed: October 13, 2005.
- U.S. Geological Survey. 2005c. Water Quality Database. Available: <<http://nwis.waterdata.usgs.gov/usa/nwis/qwdata>>.
- Weston D. P., J. You, E. L. Amweg, and M. J. Lydy. (In Press.) Sediment Toxicity in Agricultural Areas of California and the Role of Hydrophobic Pesticides. In J. Gan, F. Spurlock, P. Hendley, and D. Weston (eds.), Synthetic Pyrethroids: Occurrence and Behavior in Aquatic Environments. American Chemical Society, Washington, DC.
- Zamora, Celia, Charles Kratzer, Michael Majewski, and Donna Knifong. 2003. Diazinon and Chlorpyrifos Loads in Precipitation and Urban and Agricultural Storm Runoff during January and February 2001 in the San Joaquin River Basin, California. (U.S. Geological Survey Water Resources Investigations Report 03-4091.)

The significance of an impact associated with the program alternatives was determined using professional judgment and collected data, as applied to the significance determinations described below. The key effects were identified and evaluated based on the physical characteristics of the program area and the magnitude, intensity, and duration of the farm management activities expected to be implemented as a result of the regulatory program. Program alternatives are evaluated below in the impact analysis. The baseline description is included in Chapter 4 and earlier in this chapter.

The changes in farm management practices that are anticipated to occur following implementation of the regulatory program alternatives are identified in Table 5.1-1 at the beginning of this chapter and are described in more detail in the ECR. Some or all of these practices are expected to be undertaken in parts of the program area with surface water quality impairments or groundwater quality exceedances associated with agriculture, as described in the ECR and in Chapter 4. Other management practices also may be undertaken, but those listed below were used to form the impact analyses. Specific actions and their potential effects are included in the alternative-specific impact discussions. These actions include the following:

- Nutrient management;
- Improved water management;
- Tailwater recovery systems;
- Pressurized irrigation;
- Sediment trap, hedgerow, or buffer;
- Cover cropping or conservation tillage; and
- Wellhead protection.

## Significance Determinations

For this analysis, an impact pertaining to hydrology and water quality was considered significant under CEQA if it would result in either of the following environmental effects, which are based primarily on professional practice and State CEQA Guidelines Appendix G (14 CCR 15000 et seq.):

- Contribute to degradation of state waters as a result of agricultural discharge, or
- Substantially alter hydrologic patterns of runoff or infiltration.

Other related similar CEQA thresholds of significance that are included in Appendix G of the State CEQA Guidelines, such as thresholds related to flooding, do not apply to this program and thus are not discussed further.

## Alternative 1 –Full Implementation of Current Program (No Project Alternative)

### **Impact HYD-1. Change in Quality of State Waters from Agricultural Discharge or Alteration of Hydrologic Patterns of Runoff or Infiltration**

Alternative 1 involves full implementation of the existing regulatory program. As such, it is similar to baseline conditions, except for additional management practices that would be implemented as a result of monitoring feedback and continuing implementation of management plans. Use of coalition groups as the lead monitoring entities would continue, and third-party entities and growers would implement management practices in response. It is expected that existing water quality conditions, such as the surface water quality impairments detailed in the environmental setting section above and in the ECR, would improve over time as the program would continue to implement surface water management practices and management plans. However, Alternative 1 does not involve implementing any GQMPs to protect groundwater quality from agricultural practices. As a result, the wellhead protection management practice would not apply to this alternative.

Under Alternative 1, growers would implement surface water management practices in response to water quality monitoring results. The practices are listed above (see “Assessment Methods and Data Collection”) and are described in detail in Table 5.1-1. Not all watersheds would implement all of these management practices, as the management practices depend on the needs of the individual watershed. In the case of watersheds that are impaired by irrigated agriculture, all of these management practices may be used on a case-by-case basis to improve water quality.

Nutrient management would improve both surface water quality and groundwater quality by improving the use of chemicals and using improved application techniques, and by limiting the use of nutrients as fertilizer that could potentially seep to groundwater and add nitrate to the groundwater table. Overall, nutrient management would reduce both soluble and insoluble constituents moving to water bodies. Improved water management also would benefit water quality by improving the application of water, and the possibility of using water additives to coagulate particles would reduce the potential sediment loads to water bodies. Pressurized irrigation is somewhat homogenous with the water management practice and would improve groundwater quality and surface water quality. Water would be applied at a rate that would allow for maximum plant consumption and would minimize the amount of groundwater infiltration, which would improve groundwater quality over time.

Tailwater recovery would allow for collection of surface runoff (that may contain levels of pesticides that are above water quality thresholds) to be directed to a tailwater pond instead of a natural water body. This management practice also would greatly improve surface water quality over time. However, use of tailwater ponds could potentially impact groundwater quality over time due to increased infiltration. Sediment traps and buffer zones also would greatly improve surface water quality, as sediment can potentially carry hydrophobic contaminants to surface water bodies and excessive sediment can disrupt river ecosystems. Cover crops also improve both surface water quality and groundwater quality by preventing surface water runoff from entering surface water bodies and by reducing the amount of infiltration to groundwater.

Existing conditions, as outlined in the environmental setting above and in the ECR, cite that nine of the 30 watersheds in the program area have water quality impairments due to agricultural return flows that carry contaminants to surface water. Table 5.9-4 summarizes the number of known water quality impairments in each subwatershed.

**Table 5.9-4. Known Surface Water Quality Impairments in Subwatersheds in the Program Area**

| <b>Subwatershed</b>                                                                                                                                                                                                               | <b>Pesticide applied to agricultural crops</b> | <b>Toxicity/unknown</b> | <b>Agriculture, grazing, or other sources</b> | <b>Physical constituents such as pH, DO or EC</b> | <b>Industrial point sources, agriculture, urban runoff, storm sewers, commercial</b> | <b>Legacy pesticide potentially mobilized by irrigated agricultural operations</b> | <b>Naturally occurring metal that is partly mobilized and concentrated by irrigated agriculture, causing toxic levels in receiving waters</b> | <b>Total number of known water quality impairments</b> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|-------------------------|-----------------------------------------------|---------------------------------------------------|--------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|
| Solano – Yolo                                                                                                                                                                                                                     | X                                              | X                       | X                                             |                                                   |                                                                                      |                                                                                    |                                                                                                                                               | 3                                                      |
| Colusa                                                                                                                                                                                                                            | X                                              | X                       | X                                             |                                                   |                                                                                      |                                                                                    |                                                                                                                                               | 13                                                     |
| Butte – Sutter                                                                                                                                                                                                                    | X                                              | X                       | X                                             |                                                   |                                                                                      |                                                                                    |                                                                                                                                               | 5                                                      |
| American River                                                                                                                                                                                                                    | X                                              | X                       | X                                             |                                                   | X                                                                                    |                                                                                    |                                                                                                                                               | 4                                                      |
| Delta - Mendota Canal                                                                                                                                                                                                             | X                                              | X                       | X                                             | X                                                 |                                                                                      | X                                                                                  | X                                                                                                                                             | 25                                                     |
| San Joaquin Valley Floor                                                                                                                                                                                                          | X                                              | X                       | X                                             | X                                                 |                                                                                      | X                                                                                  | X                                                                                                                                             | 16                                                     |
| Delta Carbona                                                                                                                                                                                                                     | X                                              | X                       | X                                             | X                                                 | X                                                                                    | X                                                                                  | X                                                                                                                                             | 27                                                     |
| North Valley Floor                                                                                                                                                                                                                | X                                              | X                       | X                                             | X                                                 |                                                                                      | X                                                                                  | X                                                                                                                                             | 24                                                     |
| South Valley Floor                                                                                                                                                                                                                | X                                              | X                       | X                                             | X                                                 |                                                                                      | X                                                                                  | X                                                                                                                                             | 26                                                     |
| Sources: Central Valley Water Board 2007a, 2006 Section 303(d) List; Weston et al. in press; Kratzer et al. 2002; Kratzer et al. 2005; USGS 2005b, 2005c; Zamora et al. 2003; 2009 Staff Report on CWA Section 305(b) and 303(d). |                                                |                         |                                               |                                                   |                                                                                      |                                                                                    |                                                                                                                                               |                                                        |

Tailwater recovery systems may reduce the amount of flow in some of the rivers, slightly altering hydrologic patterns, but the amount of alteration is not considered a significant hydrologic impact. Implementation of the management practices associated with Alternative 1 would not increase erosion or siltation. Use of coalitions to monitor surface water quality would not affect the course of a stream or river in the program area. In addition, implementation of management practices such as water management would affect only irrigated agriculture fields and would not alter any natural water body. Therefore, drainage patterns would not be affected from implementation of Alternative 1.



Overall, implementation of Alternative 1 would improve surface water quality over time in the subwatersheds with water quality impairments due to irrigated agriculture. Some of the management practices would slightly alter drainage patterns and runoff infiltration, but the amount of alteration is not considered a significant hydrologic impact compared to existing conditions. Some of the management practices could impact groundwater quality through infiltration during settling of particles. Because addressing groundwater quality is not part of Alternative 1, groundwater quality would continue to be impaired from agriculture practices. Implementation of **Mitigation Measure HYD-MM-1** would reduce this impact to a less-than-significant level.

## Alternative 2 – Third-Party Lead Entity

### **Impact HYD-1. Change in Quality of State Waters from Agricultural Discharge or Alteration of Hydrologic Patterns of Runoff or Infiltration**

Under Alternative 2, third-party groups would act as lead entities to monitor water quality, develop water quality management plans, organize growers, and report on program progress. In comparison with the current program (baseline), this alternative would allow for a reduction in surface water monitoring under lower threat circumstances and when management plans have been developed. This alternative also would require development of GQMPs to minimize discharge of wastes to groundwater.

Under Alternative 2, existing water quality impairments are expected to improve over time as third parties develop and implement surface water and groundwater quality management plans. Under these plans, growers would implement management practices to minimize the amount of wastes discharged to surface water and groundwater.

It is expected that this program alternative would improve existing surface water quality over time and decrease the amount of known water quality impairments, resulting in a net benefit to water quality in the program area.

Under Alternative 2, drainage patterns in the Central Valley would not be substantially affected by the management practices. Tailwater recovery systems may reduce the amount of flow in some of the rivers, slightly altering hydrologic patterns, but the amount of alteration is not considered a significant hydrologic impact. Implementation of the management practices associated with this alternative would not increase erosion or siltation. Use of third parties to monitor surface water quality would not affect the course of a stream or river in the program area. In addition, implementation of management practices such as water management would affect only irrigated agriculture fields and would not alter any natural water body. Therefore, drainage patterns would not be affected from implementation of Alternative 2.

The lack of groundwater monitoring would result in a reduced ability to determine the beneficial water quality impacts from implementation of GQMPs. Nevertheless, groundwater quality is expected to improve under Alternative 2 from implementation of the practices included in GQMPs. Implementation of Alternative 2 is considered beneficial to surface water and groundwater quality. Measuring the performance of implementation of GQMPs would not occur at the local level, but at the regional level through existing groundwater monitoring activities. No mitigation is required.

## Alternative 3 – Individual Farm Water Quality Management Plans

### **Impact HYD-1. Change in Quality of State Waters from Agricultural Discharge or Alteration of Hydrologic Patterns of Runoff or Infiltration**

Potential impacts to water quality and hydrology under Alternative 3 would be similar to those described for Alternative 2 because the types of management practices most likely to be implemented under Alternatives 2 and 3 are not expected to differ greatly. However, Alternatives 3, 4, and 5 involve a more geographically widespread range of implementation of practices.

Under Alternative 3, individual growers would work with the Central Valley Water Board or a designated implementing agency to develop an individual FWQMP that would be submitted to the Central Valley Water Board for approval. The Central Valley Water Board would be the lead entity under this alternative.

Implementation of Alternative 3 could result in greater benefits to water quality because of the Central Valley Water Board's involvement in approval of FWQMPs for unique situations that require unique management. The individual FWQMP would require:

- Growers to evaluate the effectiveness of management practices and report to the Central Valley Water Board on an annual basis,
- Growers to implement management practices to protect surface and groundwater, and
- The Central Valley Water Board or the MOU entity to conduct annual site inspections on a selected number of operations and review available water quality monitoring data to determine the effectiveness of the FWQMPs.

FWQMPs would include such practices as monitoring installed tailwater return systems, reviewing erosion prevention practices, conducting visual monitoring, and reviewing nutrient applications.

Under Alternative 3, existing surface water quality and groundwater quality impairments are expected to improve over time as the FWQMPs are developed and implemented. However, unless specifically required due to surface water quality and groundwater quality problems, Alternative 3 would not mandate surface water and groundwater quality monitoring. Implementation of FWQMPs would require a small amount of physical monitoring, including:

- Visual monitoring of tailwater systems to ensure no off-site discharge,
- Review of erosion prevention practices after storm events,
- Visual monitoring of turbidity in discharges, and
- Review of nutrient applications and estimated crop uptake.

As with Alternatives 1 and 2, implementation of management practices under Alternative 3 is not expected to significantly alter drainage patterns in adjacent streams or rivers.

If regional monitoring efforts determine that water quality is being impacted by irrigated agriculture, additional management practices would be required in the FWQMPs, along with surface water and groundwater quality monitoring. As a result, implementation of Alternative 3 is expected to improve both surface water quality and groundwater quality over time. No mitigation is required.

## Alternative 4 – Direct Oversight with Regional Monitoring

### **Impact HYD-1. Change in Quality of State Waters from Agricultural Discharge or Alteration of Hydrologic Patterns of Runoff or Infiltration**

Potential impacts to water quality and hydrology under Alternative 4 would be similar to those described for Alternative 2. However, since Alternatives 3, 4 and 5 involve a more geographically widespread range of management practices, program area impacts might be greater.

Under Alternative 4, individual growers or legal entities assuming responsibility for waste discharge would work directly with the Central Valley Water Board. This alternative provides the option for group monitoring and reporting conducted by a third-party. Under Alternative 4, regulatory requirements would be scaled using tiered, threat-based criteria. Higher threat operations would be required to implement additional management practices and more extensive monitoring than lower threat operations. All growers would be required to develop an individual FWQMP. The Central Valley Water Board or legal entities would be the lead.

Implementation of Alternative 4 would be similar to implementation of Alternative 3, except for legal entities being the lead for conducting monitoring. Under Alternative 4, existing surface water quality impairments are expected to improve over time as the FWQMPs are developed and implemented. Because this alternative requires FWQMPs to specify groundwater management practices, groundwater quality also is expected to improve over time. As with the other alternatives, implementation of management practices is not expected to significantly alter drainage patterns in adjacent streams or rivers. No mitigation is required.

## Alternative 5 – Direct Oversight with Farm Monitoring

### **Impact HYD-1. Change in Quality of State Waters from Agricultural Discharge or Alteration of Hydrologic Patterns of Runoff or Infiltration**

Potential impacts to water quality and hydrology under Alternative 5 would be similar to those described for Alternative 2.

Under Alternative 5, individual growers would work directly with the Central Valley Water Board. Growers would be required to develop and implement an FWQMP and a nutrient management plan. The Central Valley Water Board would be the lead entity.

Implementation of Alternative 5 would be similar to implementation of Alternative 3 where growers would take the lead for conducting monitoring and developing FWQMPs. Development of a nutrient management plan would increase protection for surface water and groundwater quality. The requirement of a GQMP under Alternative 5 also is expected to benefit groundwater quality.

Monitoring wells would be installed in certain areas to collect groundwater quality data. The contractor would adhere to all state and local permits required for well construction, and water supply would not be affected from these wells since they would be purged only for water quality samples. Both surface water quality and groundwater quality are expected to improve over time with implementation of this alternative. As with the other alternatives, implementation of management practices under Alternative 5 is not expected to significantly alter drainage patterns in adjacent streams or rivers. No mitigation is required.

## 5.9.5 Mitigation and Improvement Measures

### **Mitigation Measure HYD-MM-1: Develop and Implement a Groundwater Quality Management Plan**

Growers will design GQMPs to minimize waste discharge to groundwater from irrigated agricultural lands. Development of GQMPs involves collection and evaluation of available groundwater data, identification of GMAs of concern, identification of constituents of concern within the GMAs, prioritization of the GMAs and constituents of concern, identification of agricultural practices that may be causing or contributing to the problem, and identification of agricultural management practices that should be implemented by local growers to address the constituents of concern. The GQMPs will be reviewed by Central Valley Water Board staff, and approved only after staff judge that the implementation measures are adequate to meet the groundwater quality objectives of the Basin Plan and the State Antidegradation Policy.

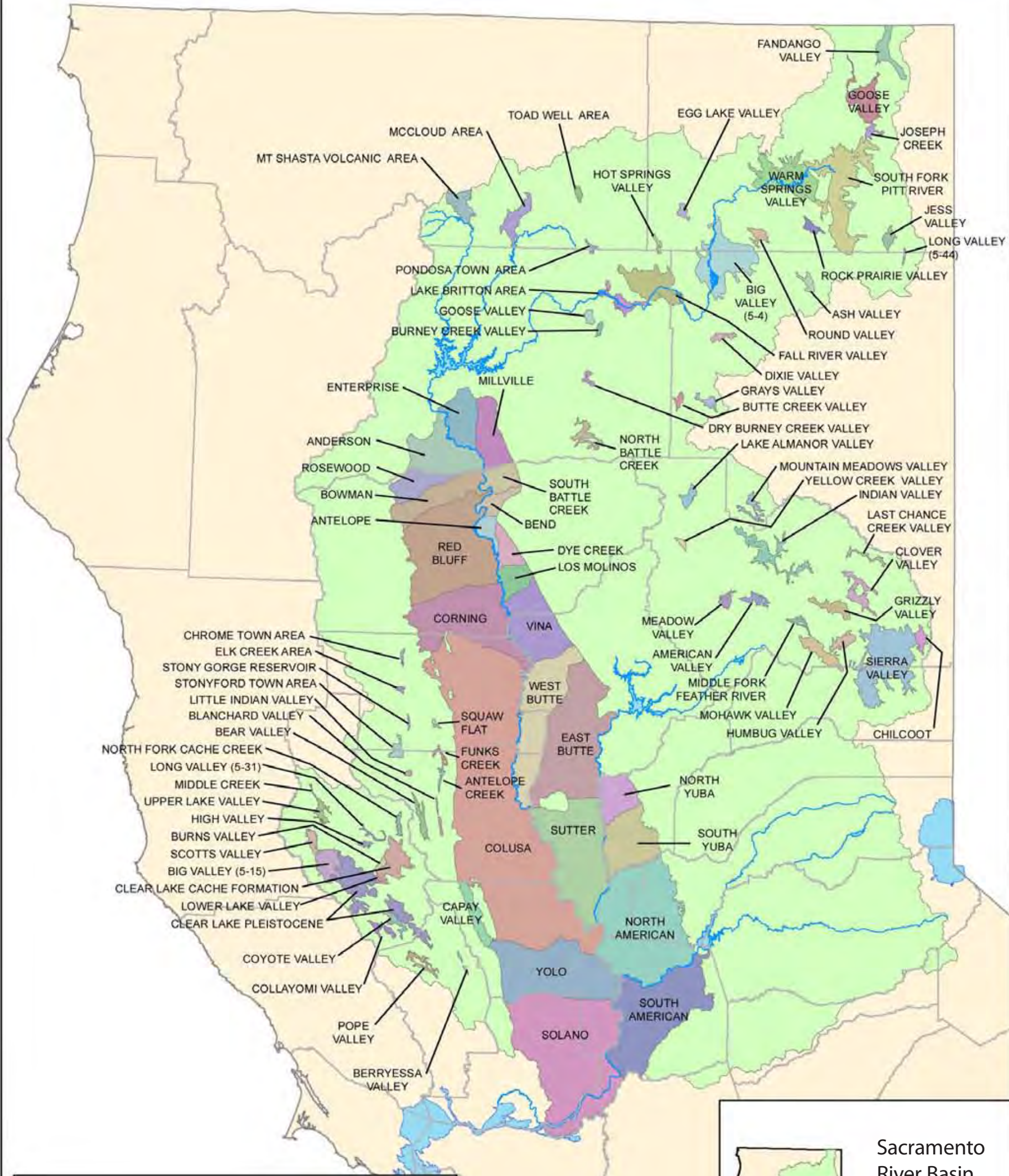




Graphics ...05508.05 PEIR (06/10)JD

**Figure 5.9-1**  
**Program Boundaries and Subdivisions**





**LEGEND**

 Sacramento River Basin

 Groundwater Basins and Subbasins (represented by other various colors)

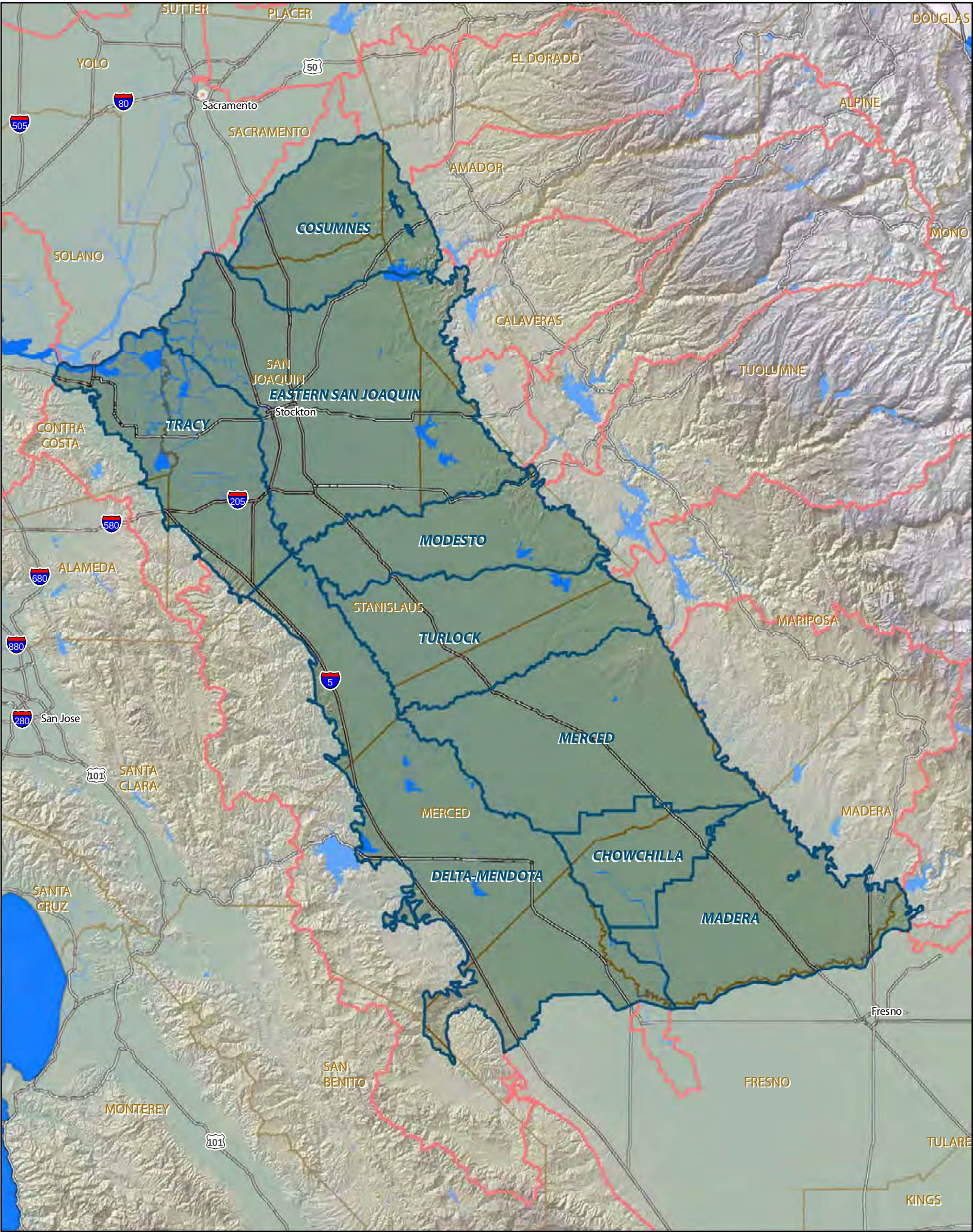


0 50 100  
Miles



Sacramento River Basin





Legend

- Cities
- US Highway
- Interstate
- Groundwater Subbasins Boundaries
- Subwatershed Boundaries
- County Lines

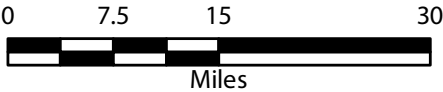


Figure 5.9-3  
San Joaquin River Basin  
Groundwater Subbasins





**Legend**

- Cities
- US Highway
- Interstate
- Subwatershed Boundaries
- Groundwater Basin and Subbasin Boundaries
- County Lines

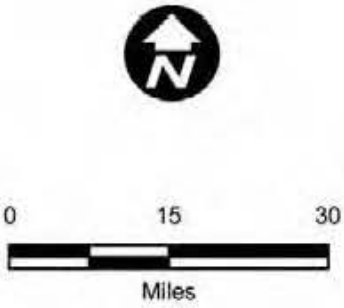


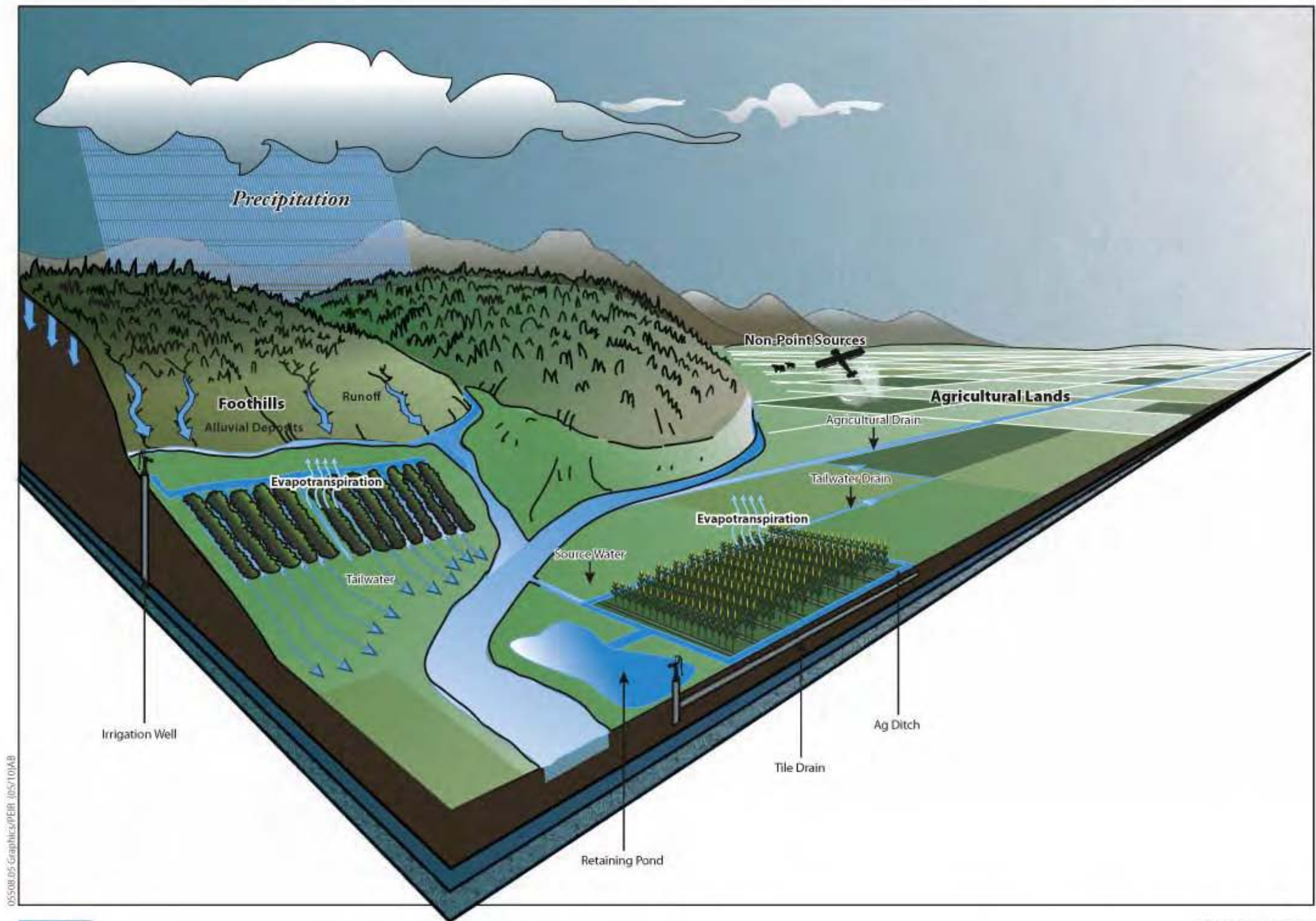
**Figure 5.9-4  
Tulare Lake Basin Groundwater  
Basins and Subbasins**





Figure 5.9-5  
Sacramento River Basin Subwatersheds





00508.05 Graphics/PER 10/5/10/AB

**Figure 5.9-6**  
**Conceptual Surface Water Model**



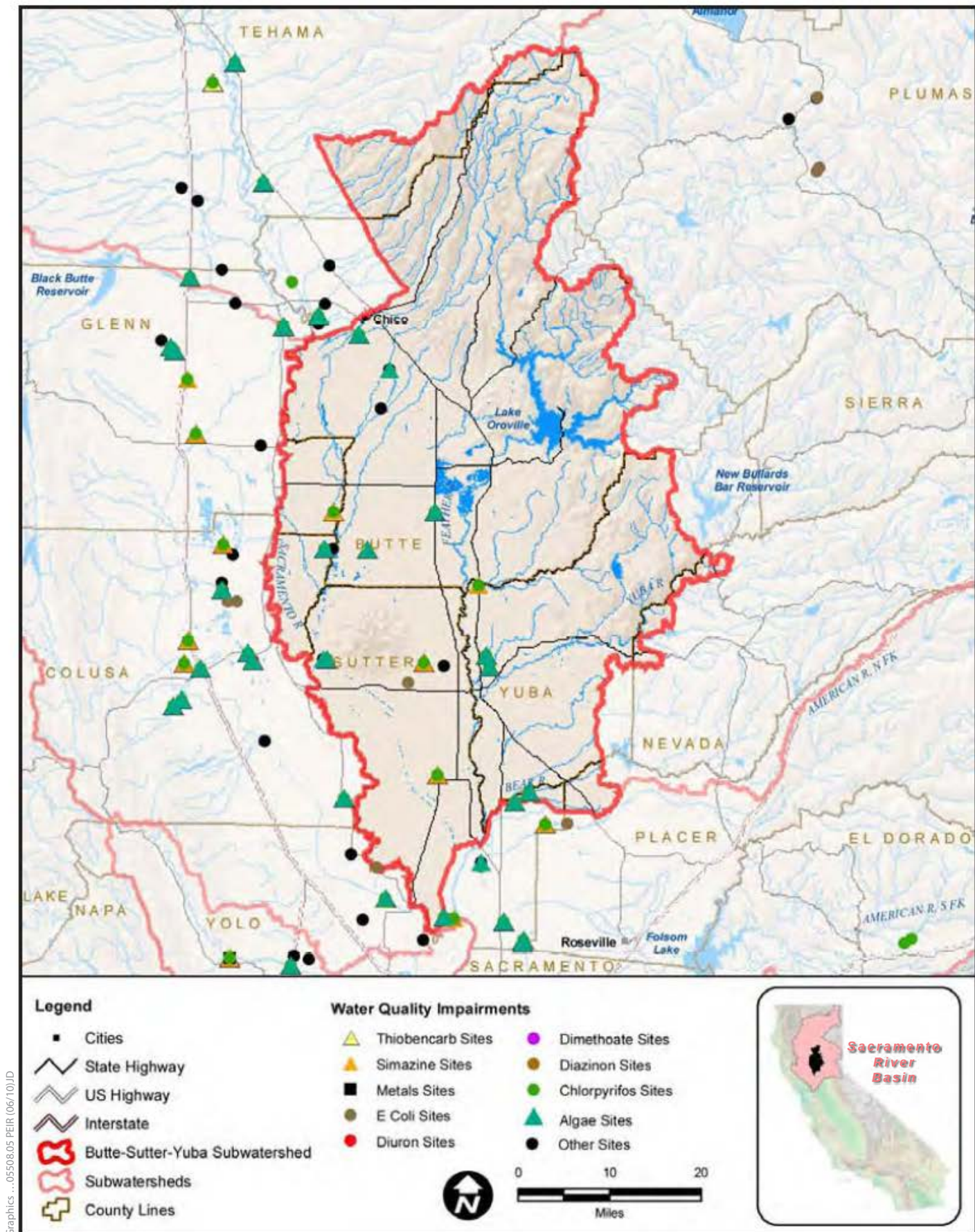


**Figure 5.9-7**  
**Butte-Sutter-Yuba Subwatershed**



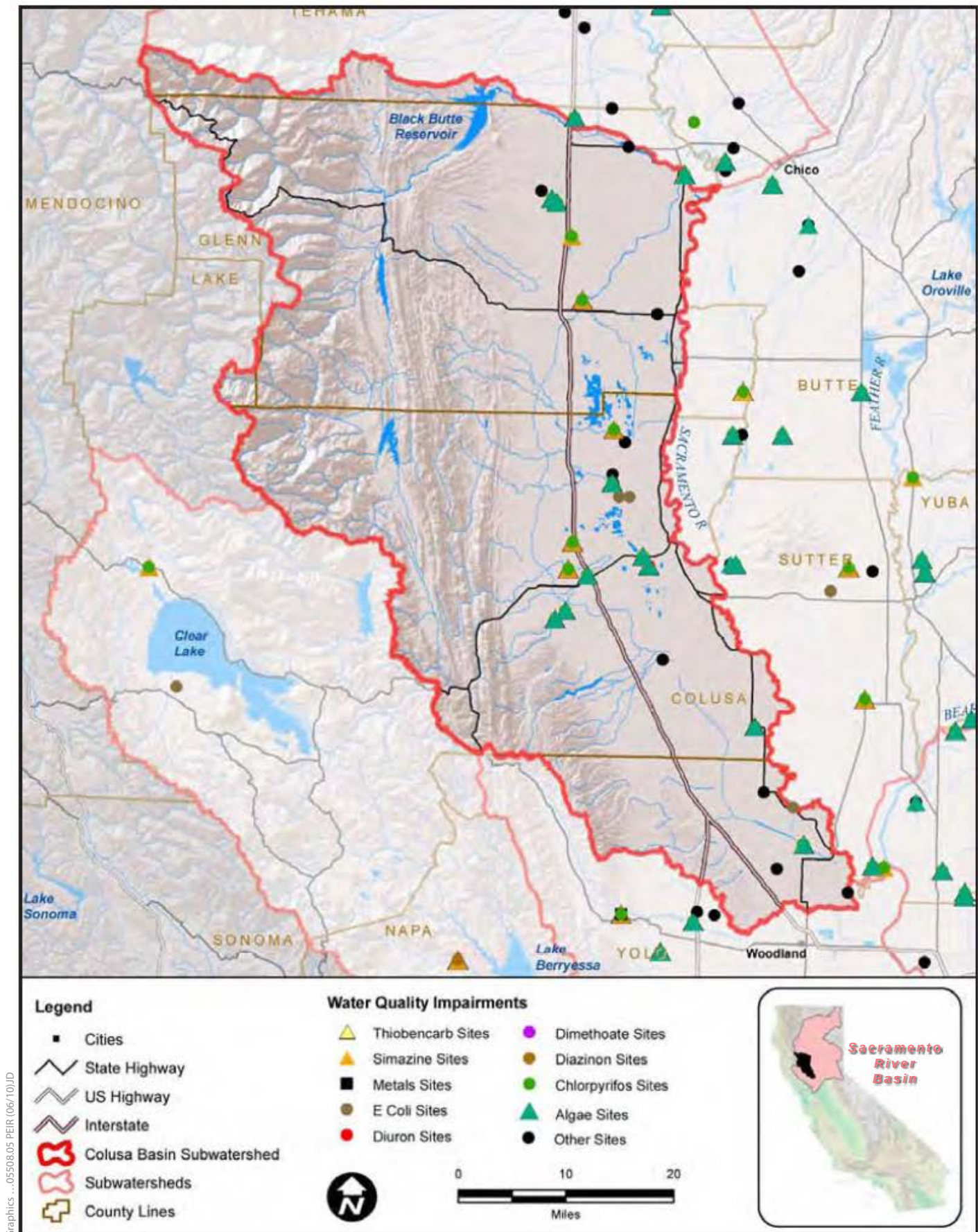


**Figure 5.9-8**  
**Colusa Basin Subwatershed**



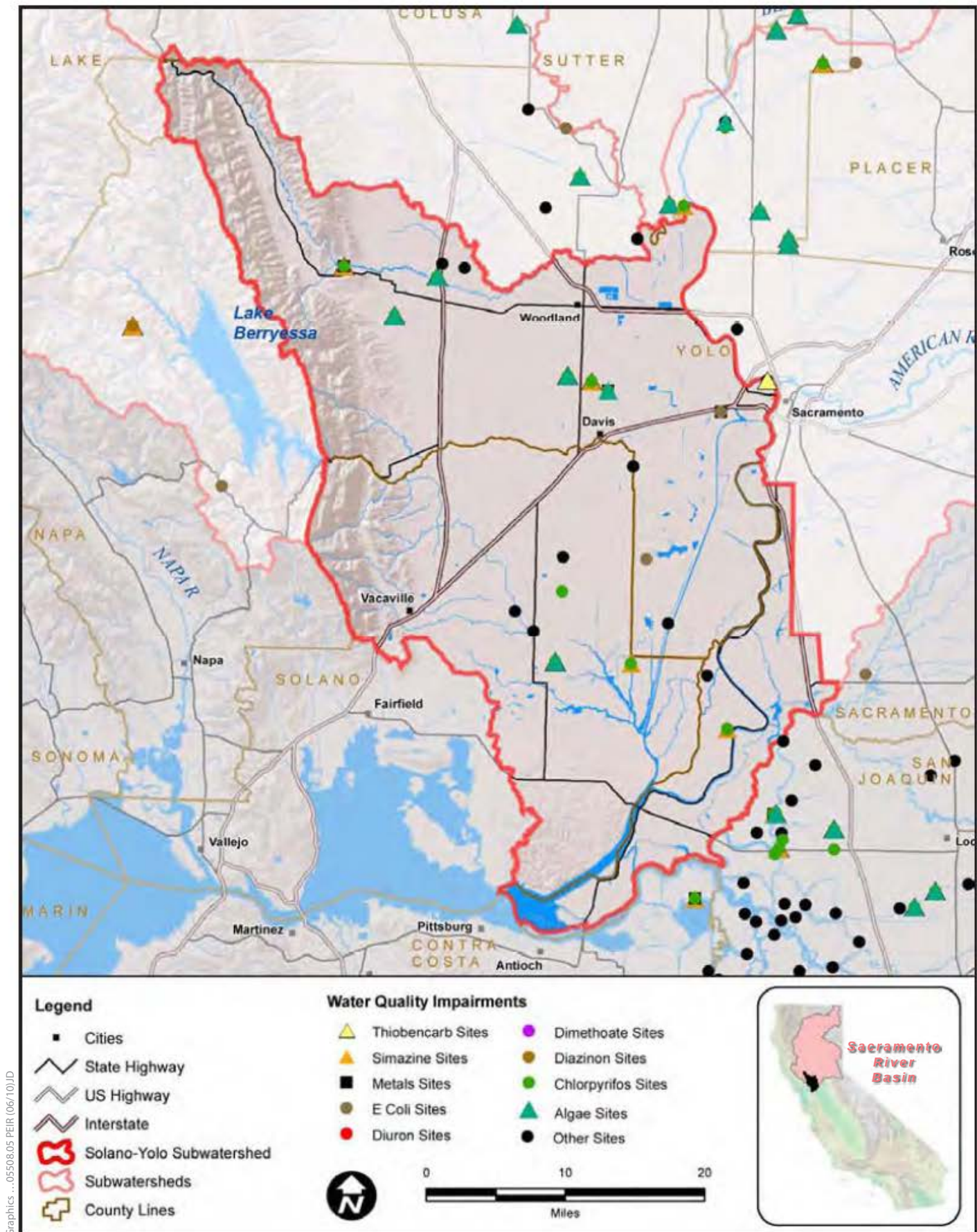


**Figure 5.9-9**  
**Solano-Yolo Subwatershed**





**Figure 5.9-10  
San Joaquin River Basin Subwatersheds**



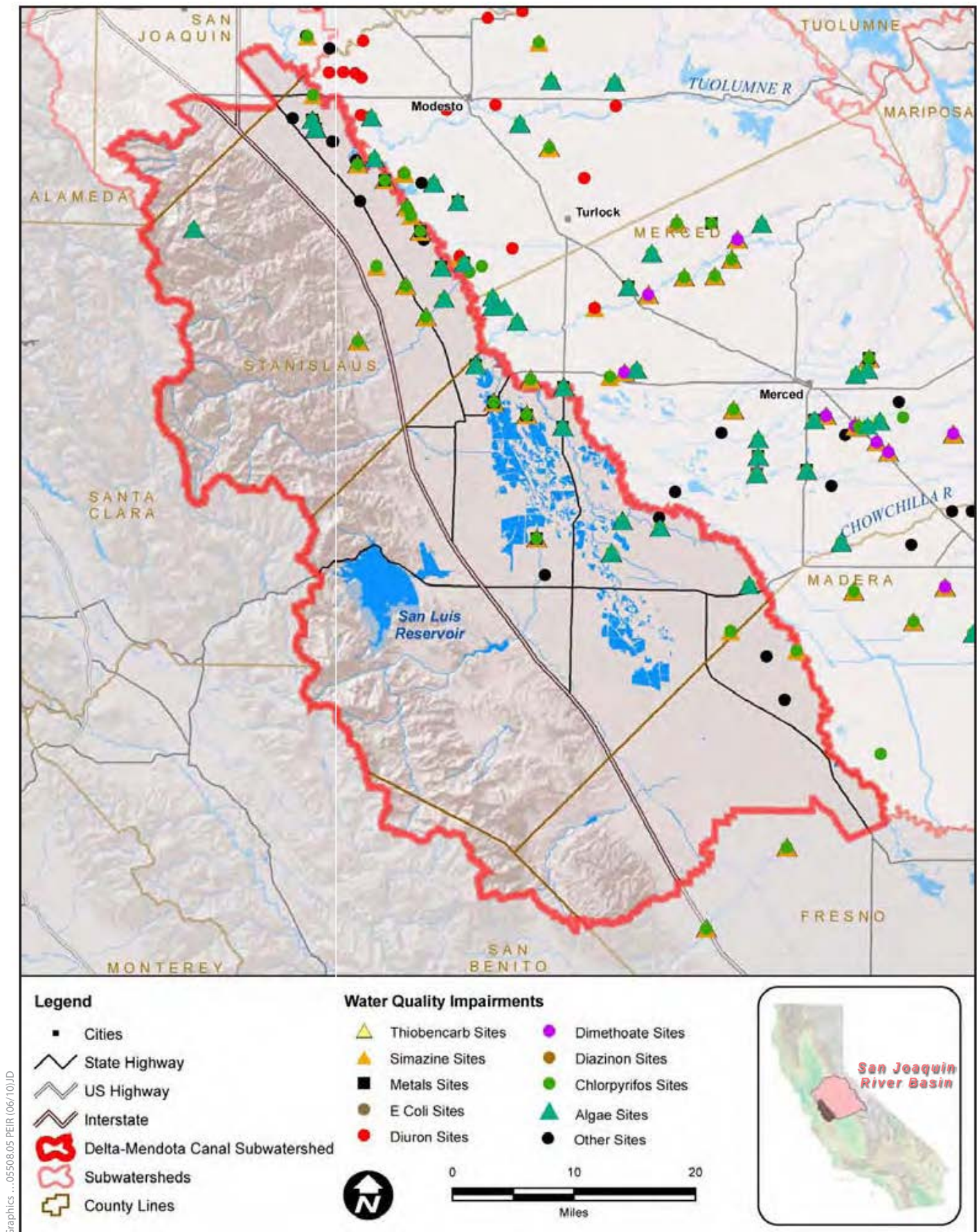


**Figure 5.9-11**  
**Delta-Mendota Canal Subwatershed**



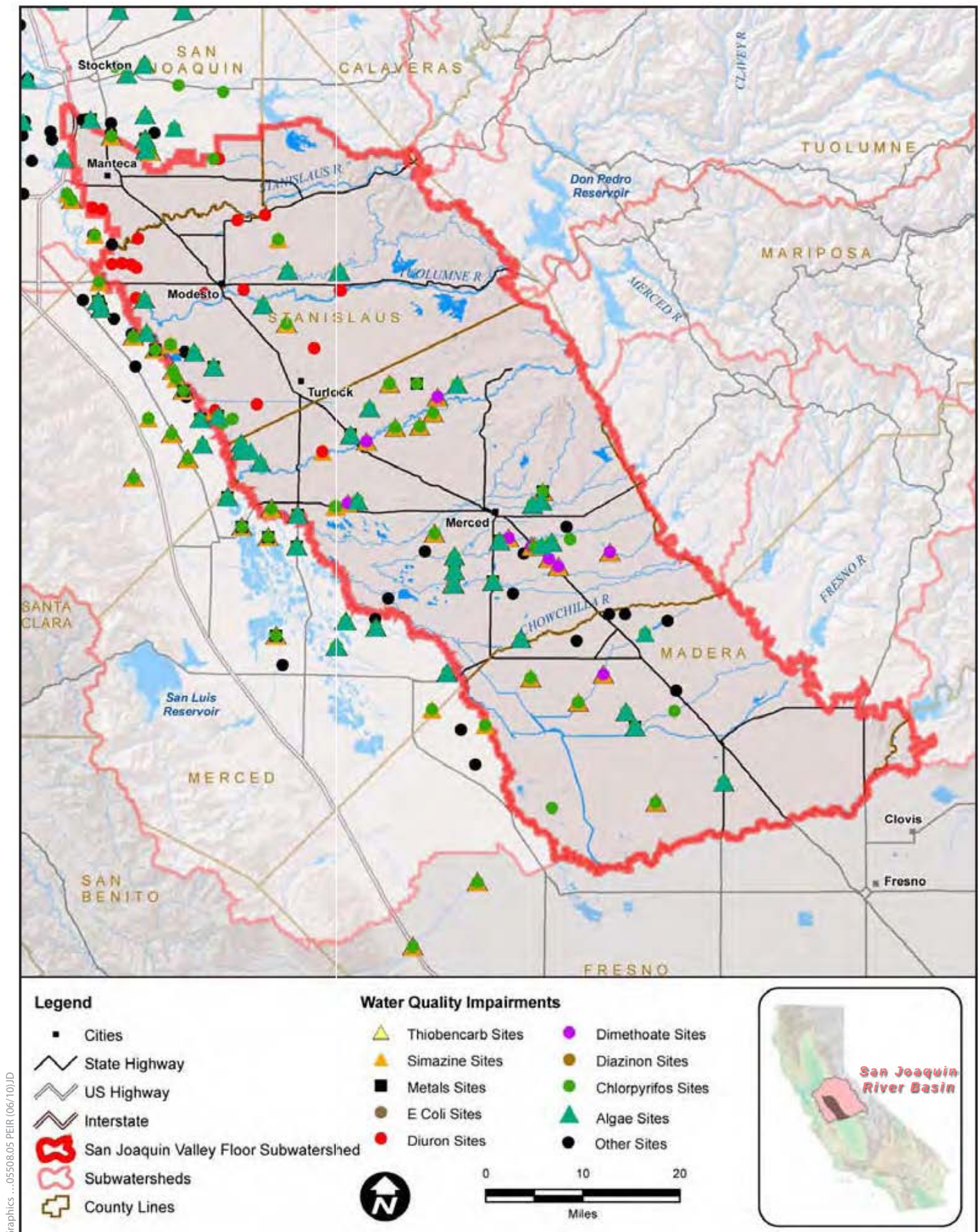


**Figure 5.9-12**  
**San Joaquin Valley Floor Subwatershed**



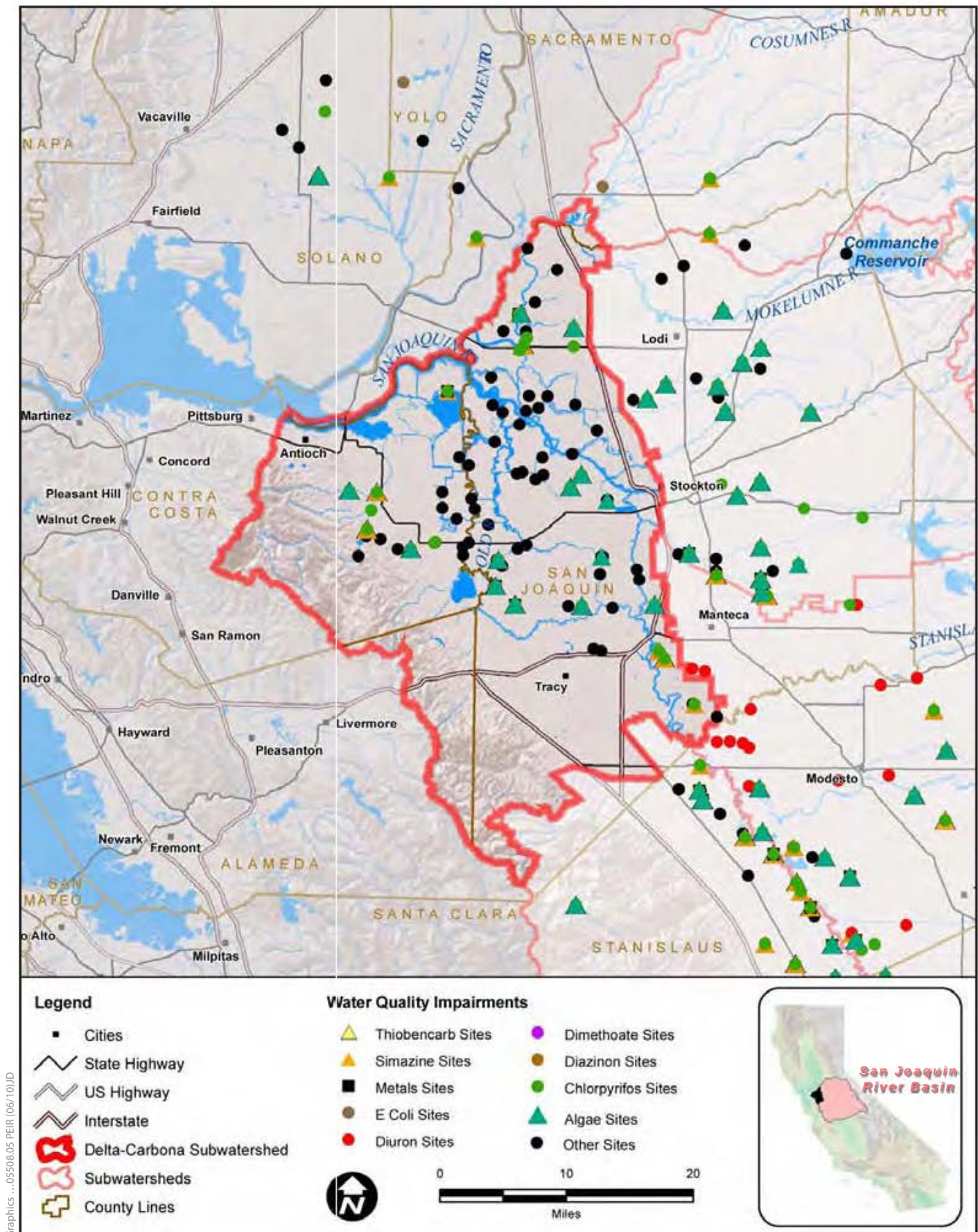


**Figure 5.9-13**  
**Delta-Carbena Subwatershed**



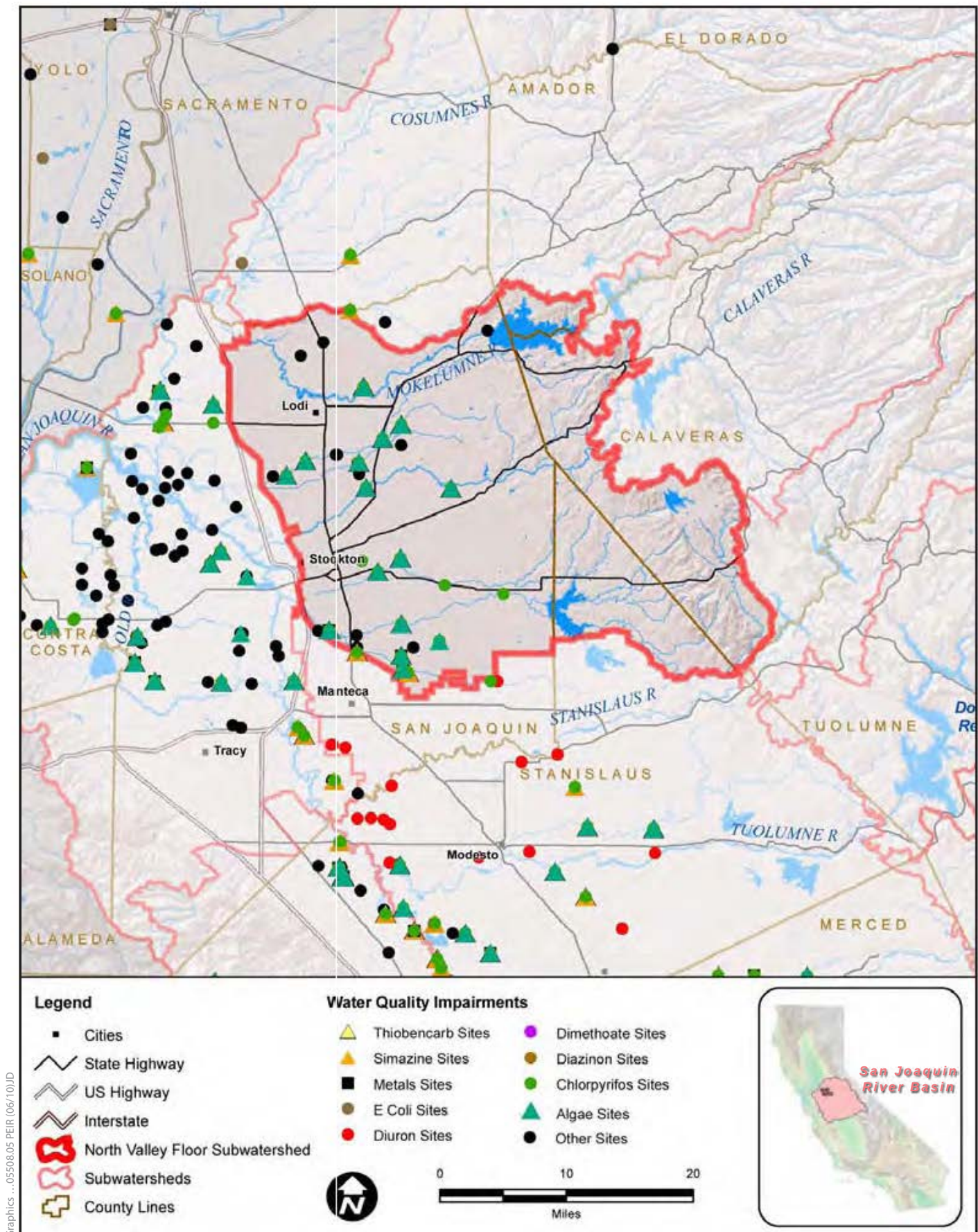
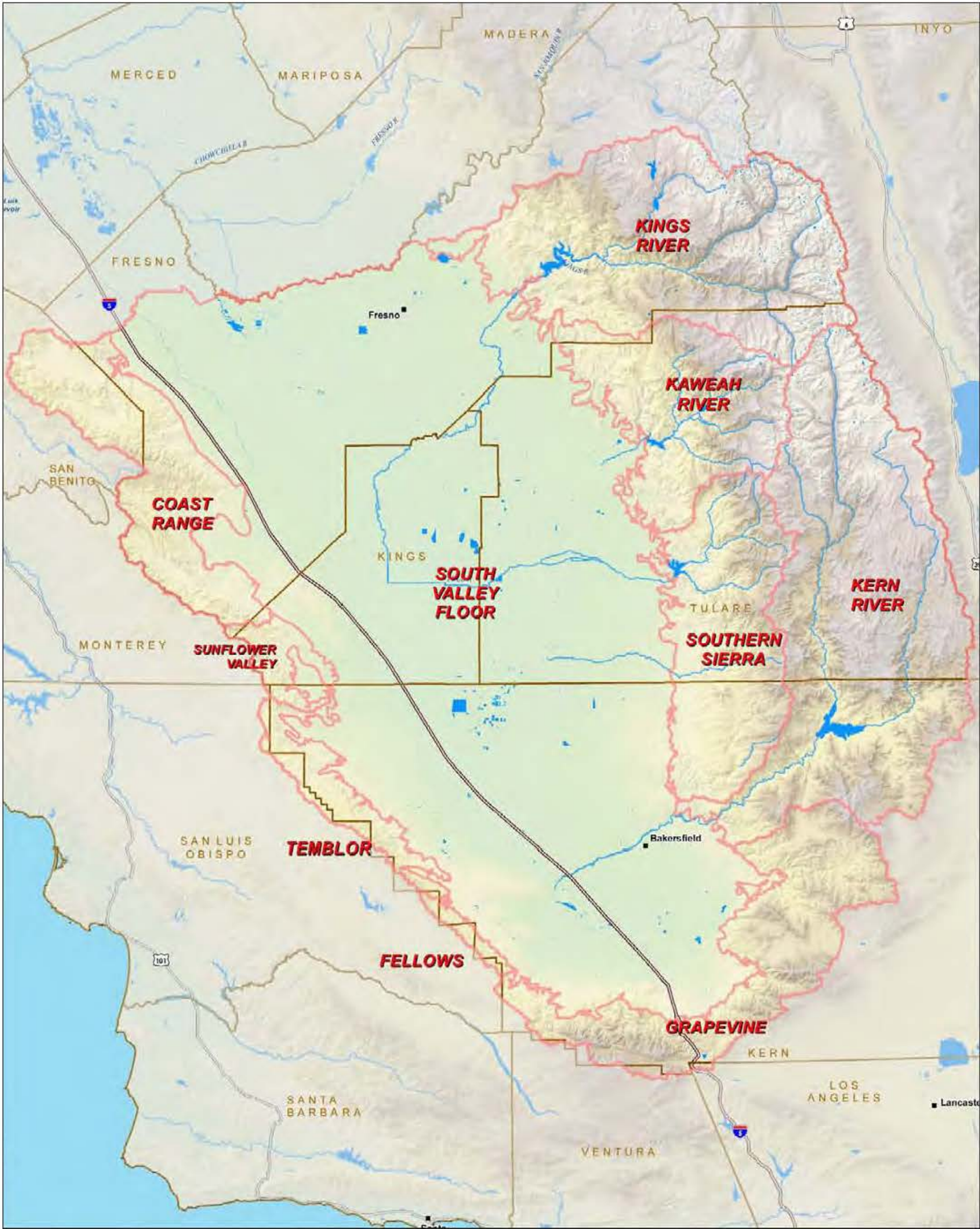


**Figure 5.9-14**  
**North Valley Floor Subwatershed**





Legend

- Cities
- US Highway
- Interstate
- Subwatershed Boundaries
- County Lines

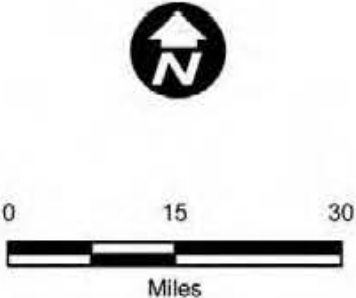


Figure 5.9-15  
Tulare Lake Basin Subwatersheds







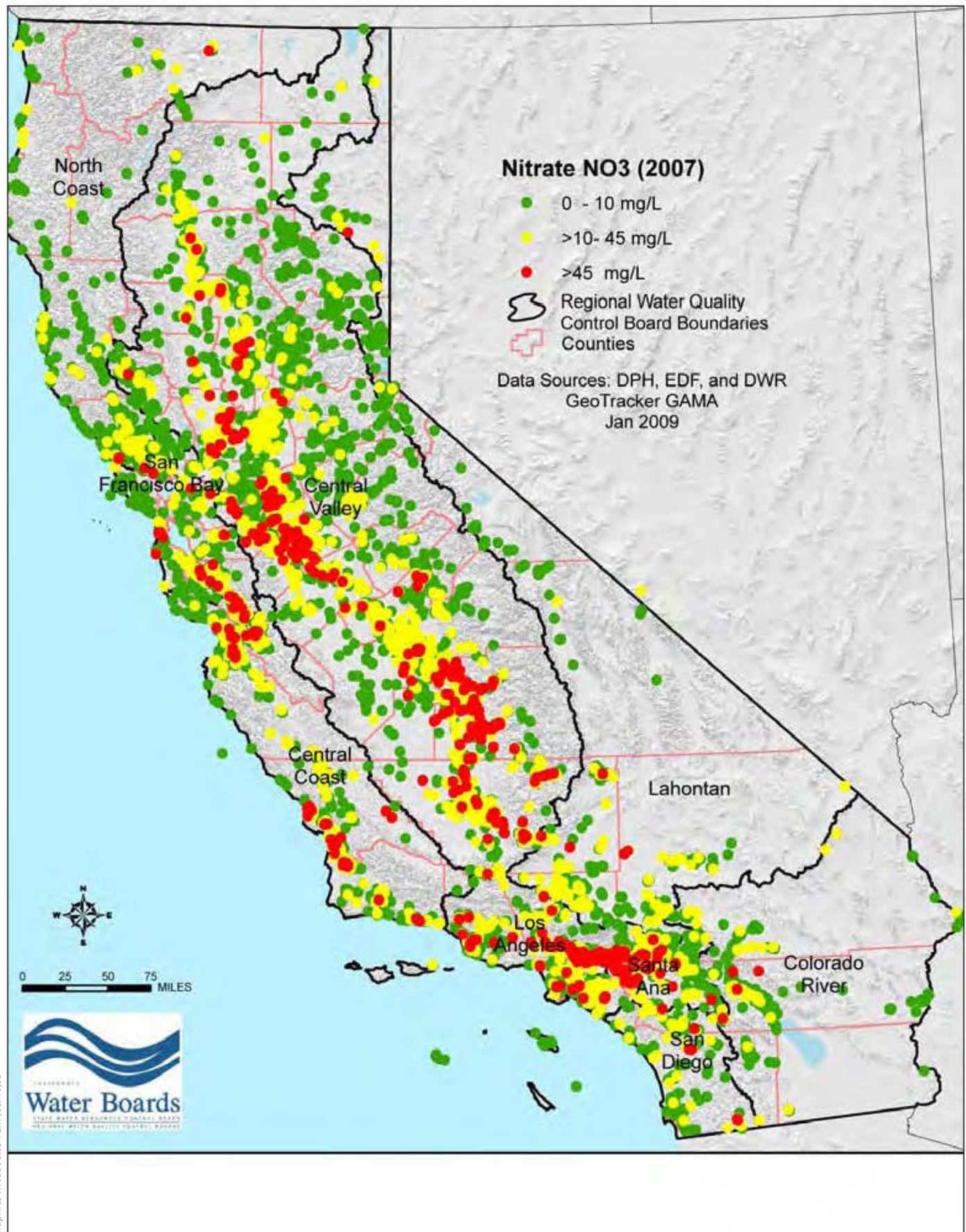


**Figure 5.9-17**  
**Nitrate in California's Groundwater**

### 5.10.1 Introduction

This section describes agricultural land uses in the program area and identifies the potential for impacts on agriculture resources that could be caused by implementation of the various ILRP alternatives. This programmatic evaluation focuses on the potential for the conversion of agricultural lands to nonagricultural uses as a result of increased costs associated with compliance with the ILRP alternatives. The catalyst for these impacts is the cost of achieving and maintaining compliance with the alternatives as discussed in *Technical Memorandum Concerning the Economic Analysis of the Irrigated Lands Regulatory Program* (ICF International 2010) (Draft ILRP Economics Report), incorporated herein by reference.

Of approximately 100 million acres of land in California, approximately 43 million acres are used for agricultural purposes (Thompson 2009). The program area covers approximately 39 million acres, of which approximately 7.8 million acres are irrigated for the purpose of growing crops (ICF International 2010). California is a major global supplier of food, producing more than 400 different agricultural commodities, and is the nation's principal producer of many specialty crops such as almonds, figs, raisins, artichokes, and olives. Agricultural exports reached \$10.9 billion in 2007, with total cash receipts for agricultural products (excluding livestock and poultry) of \$25.8 billion (CDFA 2009). Of the top 10 most agriculturally productive counties in the nation, nine are located in California, with all or parts of eight of those counties located within the boundaries of the Central Valley Water Board (CDFA 2009).

Impacts on agriculture resources can be characterized generally as those that cause the conversion of agricultural lands to a nonagricultural use. In many instances, this occurs as conversion to urban or built-up land, particularly lands close to already urbanized areas (CDFA 2009). Examples of this conversion can be seen near relatively large metropolitan areas that are surrounded by agricultural lands, such as Sacramento, Stockton, and Fresno. As the cities grow, nearby agricultural lands are converted to make room for new housing developments, shopping malls, and other uses associated with urban environments. Besides urbanization, other factors that can affect agricultural land conversions are low-density development, water availability issues, intentional land idling, and economics.

As the name implies, the ILRP deals specifically with irrigated agricultural lands, which represent only a fraction of those lands classified as agricultural. In some cases, irrigated agricultural lands are converted, not to a nonagricultural use, but to a nonirrigated agricultural use such as dryland farming or grazing land. For purposes of the following analysis, such conversions would not constitute a significant impact. With respect to CEQA, significant impacts on agriculture resources typically are those that cause high-quality farmlands to be converted to nonagricultural uses. The specific thresholds that define such impacts are discussed further in Section 5.10.4.

## 5.10.2 Regulatory Framework

This section discusses federal, state, and local regulations related to agriculture that may apply to the program alternatives.

### Federal

There are no federal regulations related to agriculture that would apply to the program alternatives.

### State

#### Farmland Mapping and Monitoring Program

The California Department of Conservation, Division of Land Resource Protection, administers the Farmland Mapping and Monitoring Program (FMMP), which maps important farmland throughout California. Information regarding locations of farmland by category is readily available, and the potential conversion of FMMP lands is addressed in this document. The farmland categories listed under the FMMP are the basis of the State CEQA Guidelines significance thresholds, as discussed in "Significance Thresholds," below. The categories are defined pursuant to USDA land inventory and monitoring criteria, as modified for California.

- *Prime Farmland* is land with the best combination of physical and chemical characteristics for the production of crops. It has the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops when treated and managed in accordance with accepted farming methods. In addition, the land must have been used for irrigated agricultural production in the last 4 years to qualify as Prime Farmland.
- *Farmland of Statewide Importance* is land other than Prime Farmland that has a good combination of physical and chemical characteristics for the production of crops.
- *Unique Farmland* is land that does not meet the criteria for Prime Farmland or Farmland of Statewide Importance, and that has been used for the production of specific high-economic-value crops at some time during the two update cycles prior to the mapping date. This land is usually irrigated but may include nonirrigated orchards or vineyards as found in some climatic zones in California. Land must have been cropped at some time during the 4 years prior to the mapping date.
- *Farmland of Local Importance* is currently producing crops, has the capability of production, or is used for production of confined livestock.
- *Grazing Land* is land on which the existing vegetation, whether grown naturally or through management, is suitable for grazing or browsing of livestock.
- *Urban and Built-Up Land* is used for residential, industrial, commercial, construction, institutional, and public administrative purposes; railroad yards; cemeteries; airports; golf courses; sanitary landfills; sewage treatment plants; water control structures; and other developed purposes.
- *Other Land* is land that is not included in any other mapping categories.



- *Land Committed to Nonagricultural Use* is land that is permanently committed by local elected officials to nonagricultural development by virtue of decisions that cannot be reversed by a majority vote of a city council or county board of supervisors.

## Williamson Act and Farmland Security Zone Contracts

The California Land Conservation Act (Government Code Section 51200 et seq.) of 1965, commonly known as the Williamson Act, provides a tax incentive for the voluntary enrollment of agricultural and open space lands in contracts between local government and landowners. The contract enforceably restricts the land to agricultural and open space uses and compatible uses defined in state law and local ordinances. An agricultural preserve, which is established by local government, defines the boundary of an area within which a city or county will enter into contracts with landowners. The State of California has the following policies regarding public acquisition of and locating public improvements on lands in agricultural preserves and on lands under Williamson Act contracts (Government Code Sections 51290–51295).

- (a) It is the policy of the state to avoid, whenever practicable, the location of any federal, state, or local public improvements and any improvements of public utilities, and the acquisition of land therefor, in agricultural preserves.
- (b) It is further the policy of the state that whenever it is necessary to locate such an improvement within an agricultural preserve, the improvement shall, whenever practicable, be located upon land other than land under a contract pursuant to this chapter.
- (c) It is further the policy of the state that any agency or entity proposing to locate such an improvement shall, in considering the relative costs of parcels of land and the development of improvements, give consideration to the value to the public, as indicated in Article 2 (commencing with Section 51220), of land, and particularly prime agricultural land, within an agricultural preserve.

Since 1998, another option in the Williamson Act Program has been established with the creation of Farmland Security Zone contracts. A *Farmland Security Zone* is an area created within an agricultural preserve by a board of supervisors upon the request of a landowner or group of landowners. Farmland Security Zone contracts offer landowners greater property tax reduction and have a minimum initial term of 20 years. Like Williamson Act contracts, Farmland Security Zone contracts renew annually unless a notice of nonrenewal is filed.

## California Conservation Easements

*Conservation easements* are voluntarily established restrictions that are permanently attached to property deeds, with the general purpose of retaining land in its natural, open space, agricultural, or other condition while preventing uses that are deemed inconsistent with the specific conservation purposes expressed in the easements. Agricultural conservation easements define conservation purposes that are tied to keeping land available for continued use as farmland. Such farmlands remain in private ownership, and the landowner retains all farmland use authority, but the farmland is restricted in its ability to be subdivided or used for nonagricultural purposes, such as urban uses.

The California Farmland Conservancy Program (PRC Section 10200 et seq.) supports the voluntary granting of agricultural conservation easements from landowners to qualified nonprofit organizations, such as land trusts, as well as local governments. Potential impacts on conservation easements would be addressed in subsequent project-level documents.



## Local

### County Land Use Regulations and Ordinances

Most local jurisdictions (cities and counties) have policies and regulations that protect agriculture resources or regulate land use and farmland. These may include establishment of agricultural preserves or agricultural districts, policies protecting identified farmland, and agricultural zoning. The land use and agriculture regulations in county ordinances vary widely. Specific local policies are not addressed in this program-level analysis.

## 5.10.3 Environmental Setting

The area to be covered under the ILRP includes all or part of 38 of the state's 58 counties. Three major watersheds have been delineated within this region, namely the Sacramento River Basin, the San Joaquin River Basin, and the Tulare Lake Basin (Figure 2-1). The three basins cover approximately 40 percent of the total area of the state and approximately 75 percent of the irrigated acreage (Central Valley Water Board 2002a).

### Sacramento River Basin

The Sacramento River Basin contains the entire drainage area of the Sacramento River and its tributaries (approximately 27,210 square miles) from the northeast corner of California to Sacramento County (Figure 2-2). The basin drains approximately one-third of total runoff in the state into the middle and lower reaches of the Sacramento River.

Land uses in the Sacramento River Basin are principally forest and range lands in the upper reaches, with urban development focused around the city of Sacramento. Agriculture is the dominant land use on the valley floor, followed by urban development.

The Sacramento River Basin encompasses approximately 12.2 million acres. Of this amount, 2.4 million acres are classified as agricultural lands. The majority of these irrigated acres occur on the valley floor. Rice is the primary crop in the Sacramento River Basin, particularly in the Colusa and Butte-Sutter-Yuba Subwatersheds, where poorly drained soils provide ideal conditions. Other principal crop types are field crops, orchards, pasture, and grains.

Agricultural land uses account for less than 10 percent of total acreage in the Pit River, Shasta-Tehama, Upper Feather River–Upper Yuba River, American River, and Lake Napa Subwatersheds.

### San Joaquin River Basin

The San Joaquin River Basin drains a region of approximately 15,880 square miles that extends across the Central Valley to the Coast Ranges, between the Cosumnes River to the north and the San Joaquin River to the south (Figure 2-3). The San Joaquin River Basin encompasses approximately 9.8 million acres. In general, the basin is dominated by native vegetation. The primary tributaries in the basin are the Stanislaus River, Tuolumne River, and Merced River, which meet with the San Joaquin River in the valley floor. The basin is dominated by agriculture at the confluence of the San Joaquin and these various rivers. The San Joaquin River Basin includes most of the Delta as well as the Delta-Mendota Canal, a highly manipulated component of the CVP. Multiple canals in the Delta-

Mendota Canal Subwatershed deliver water to agricultural operations and then back to the natural drainages. Many tributaries in the watershed that otherwise would be dry during the summer irrigation season flow year-round because of agricultural return flows.

Approximately 2 million acres in the basin are classified as agricultural. Agricultural land uses in the basin are concentrated in the valley floor—specifically in the Delta-Mendota Canal, San Joaquin Valley Floor, Delta-Carbona, and North Valley Floor Subwatersheds. There is very little agriculture in the remaining subwatersheds, less than 1 percent in most cases. The primary crops that are produced in the San Joaquin River Basin are field crops, pasture, deciduous fruits and nut orchards, vineyards, and grain and hay.

## Tulare Lake Basin

The Tulare Lake Basin encompasses an approximately 17,650-square mile drainage area from Fresno to the southern end of the Central Valley near the Grapevine (Figure 2-4).

Much of the topography in the Tulare Lake Basin is dominated by steep river canyons and large mountains, typical of the Sierra Nevada and Coast Ranges. The basin encompasses approximately 10.7 million acres. Of this amount, 3.6 million acres are classified as agricultural. The vast majority of this agricultural land is located in the South Valley Floor Subwatershed (3.5 million acres), largely because of topography. In comparison with other subwatersheds in the Tulare Lake Basin, the South Valley Floor Subwatershed is relatively flat. Consequently, the bulk of water quality concerns related to the Tulare Lake Basin involve agricultural operations and agricultural return flows in the South Valley Floor Subwatershed.

Because of the amount of land in the Tulare Lake Basin that is in the Sierra Nevada and the Coast Ranges, most of the basin is dominated by native vegetation and includes little urban development. In the upper watershed areas, irrigated agriculture accounts for less than 2 percent of land uses in the Kings River, Kaweah River, Kern River, Grapevine, Coast Range, Sunflower Valley, and Southern Sierra Subwatersheds—with just slightly more in the Temblor Subwatershed (3.3 percent). There is no agriculture in the Fellows Subwatershed. The primary crop types in the Tulare Lake Basin as a whole are grain and hay crops, pasture, and deciduous fruits and nuts. The primary crop types in the South Valley Floor Subwatershed are field crops, followed by deciduous fruits and nuts, vineyards, pasture, and grain and hay.

### 5.10.4 Impacts

Impacts on agriculture resources from the program alternatives would result from the costs to growers of program implementation. This section describes the potential impacts related to agriculture resources resulting from the five program alternatives. For the purposes of this analysis, the baseline conditions were assumed to be the current regulatory program as instituted at the time of the writing of the ECR (refer to Chapter 3).

The assessment of impacts on agriculture resources was accomplished using information gathered from various state and federal agencies. Technical documents related to the economics of agriculture in California also were referenced. The following key references were used to compile this section:

- U.S. Department of Agriculture. 2009. *2007 Census of Agriculture*. United States Summary and State Data. Volume 1.
- ICF International. 2010. *Technical Memorandum Concerning the Economic Analysis of the Irrigated Lands Regulatory Program*.
- California Department of Conservation. 2004. *California Farmland Conversion Report 2000–2002*.
- California Department of Conservation. 2006. *California Farmland Conversion Report 2002–2004*.
- California Department of Conservation. 2008. *California Farmland Conversion Report 2004–2006*.
- Central Valley Production Model.
- DWR land use data.

These references were consulted and considered in light of the results of the Draft ILRP Economics Report in determining the significance of an impact to agriculture resources in the program area.

## Significance Determinations

### Thresholds of Significance

In accordance with the State CEQA Guidelines, the Central Valley Water Board found that implementation of an ILRP alternative would result in a significant impact on agriculture resources if it would:

- Convert prime farmland, unique farmland, or farmland of statewide importance to nonagricultural use; or
- Involve other changes in the existing environment that, because of their location or nature, could result in the conversion of farmland to nonagricultural use.

### Assessment Methods

The Central Valley Production Model (CVPM) is a regional model of irrigated agricultural production and economics that simulates the decisions of agricultural producers (farmers) in the Central Valley of California. The model assumes that farmers maximize profit subject to resource, technical, and market constraints. CVPM has been used to assess the impacts on irrigated agriculture of implementing a number of water-related policy changes. The model can be linked to hydrologic impact analysis in order to show how water supply changes affect agricultural production. It also can be used to assess how crop production, irrigated acreage, and revenue are affected by changes in production costs.

As detailed in the Draft ILRP Economics Report, outputs of the CVPM indicate that varying amounts of farmland dedicated to the production of particular crop types may be removed from production under each ILRP alternative. The predicted lost production acreage would result from net increased operational costs to growers as a result of implementing the alternatives. As the Draft ILRP Economics Report discusses, narrower profit margins would make specific low-margin crop types most vulnerable to lost production. It is important to note that the terminology “lost from production” or “removed from production,” as used in this draft PEIR and the Draft ILRP Economics Report, does not necessarily mean that the land no longer would be used to produce crops, only that it would not be used to produce the particular crop type in question. It is reasonable and logical to

assume that, while some portion of the affected farmland would be converted to nonagricultural use, a majority of the lost acreage would not be converted to a nonagricultural use but instead would be used to produce a crop that would require lower compliance costs and generate sufficient revenue to stay in agricultural production.

The size of the region and the programmatic nature of the analysis prevent drawing conclusions concerning which specific parcels of land would be most vulnerable. Thus, the possible impacts on protected agriculture resources were quantified by overlaying the CVMP vulnerability results with the FMMP farmland types to determine what ratio of vulnerable crop types are contained within FMMP-identified lands of significance, making those lands at risk for conversion or removal from production.

To conduct the analysis, the quantity of prime farmland, unique farmland, or farmland of statewide or local importance that could be converted was estimated. The locations of crop types shown to be vulnerable in the Draft ILRP Economics Report were determined using DWR land use data. Table 5.10-1 shows the aggregated crop types used for the analyses. The crop type data were overlaid onto FMMP farmland data to calculate what percentage of vulnerable crop types are located within prime farmland, unique farmland, or farmland of statewide importance. These ratios of crop type to farmland classification were applied to the outputs of the CVPM economic assessment to determine maximum acreages of lost protected farmland by crop type. The resulting calculations quantify the approximate loss of production, in acres, by farmland classification.

For example; in the Sacramento River Basin, there are approximately 435,000 acres of ORVIN, defined as orchard or vineyard. Of those acres, approximately 315,000 (72 percent) acres occur on prime farmland. The CVPM output indicates that Alternative 1 would result in removal from production of 1,600 acres of ORVIN in the Sacramento River Basin. Under the assumption that farmland loss for a particular crop type would occur proportionally across the various farmland classifications, the analysis indicates that approximately 72 percent of the 1,600 acres lost would be from prime farmland, resulting in a loss of 1,150 acres of ORVIN on prime farmland. These calculations were carried out for all three crop type groupings across all three watersheds, resulting in an approximation of total acreage removed from production per farmland classification.

**Table 5.10-1. Crop Category Definition**

| <b>Abbreviated Crop Category</b>                                                                               | <b>Aggregated Crop Category</b> | <b>Existing Conditions Crop Category*</b>           |
|----------------------------------------------------------------------------------------------------------------|---------------------------------|-----------------------------------------------------|
| FFGO                                                                                                           | Field, Forage, Grain, Other     | Field Crops, Grain and Hay, Irrigated Pasture, Rice |
| ORVIN                                                                                                          | Orchard, Vineyard               | Citrus and Subtropical, Deciduous Orchard, Vineyard |
| VEGT                                                                                                           | Vegetable, Truck                | Vegetable and Truck                                 |
| * Idle (IDLE) and semi-agricultural and incidental (SEMI) were not included in the aggregated crop categories. |                                 |                                                     |

A table is provided for each alternative in the impact analysis that shows the total acreages, grouped by important farmland classification that potentially would be converted to another crop type or land use<sup>1</sup>.

<sup>1</sup> For purposes of the impact analysis, *important farmland* is defined as farmland identified as prime, unique, or of statewide importance by the FMMP.



This analysis assumes that all types of irrigated lands would be removed from production proportionally to their prevalence within a vulnerable crop category. Losses of important farmland shown for Alternatives 2 through 5 are incremental, representing losses in addition to those of Alternative 1 (the existing program).

The economic analysis revealed that, under all alternatives, the greatest loss of productive land would result when growers of low-value crops select relatively costly management practices. Therefore, this analysis adopts that finding and determines the impacts to agriculture resources of those increased costs and resulting loss of production. It is highly likely that growers would avoid these impacts where possible by identifying and enacting practices that would minimize their compliance costs. However, due to the probability that use of costly management practices will be unavoidable in some circumstances, it is concluded that conversion of prime farmland, unique farmland, or farmland of statewide importance to nonagricultural use will result from implementation of all ILRP alternatives.

## **Alternative 1 – Full Implementation of Current Program (No Project Alternative)**

### **Impact AG-1. Conversion of Prime Farmland, Unique Farmland, and Farmland of Statewide Importance to Nonagricultural Use**

Alternative 1 involves full implementation of the existing regulatory program. Coalition groups would function as the lead entities, and growers would implement management practices when surface water monitoring data show two or more exceedances of water quality objectives. Table 5.10-2 shows that, under Alternative 1, a total of 328,653 acres of important farmland potentially would be removed from production because of the increased costs associated with complying with the ILRP. As previously stated, it is unlikely that all of this acreage would be converted to a nonagricultural use, but it is reasonable to assume that some unknown quantity would be. This analysis indicates that, of the five alternatives, Alternative 1 likely would result in the smallest impact with regard to the total amount of important farmland removed from production.

Because implementation of Alternative 1 potentially would result in conversion of prime farmland, unique farmland, and farmland of statewide importance to nonagricultural use, this impact is considered significant. Implementation of **Mitigation Measure AG-MM-1** would reduce the magnitude of the impact, but not to a less-than-significant level.

**Table 5.10-2 Acres of Important Farmland Potentially Removed from Production under Alternative 1**

| Watershed/<br>Crop Type | Farmland Classification |        |                         |               |
|-------------------------|-------------------------|--------|-------------------------|---------------|
|                         | Prime                   | Unique | Statewide<br>Importance | Total Acreage |
| Sacramento River        |                         |        |                         |               |
| VEGT                    | 2,944                   | 156    | 153                     | 3,254         |
| ORVIN                   | 1,098                   | 187    | 219                     | 1,504         |
| FFGO                    | 102,218                 | 26,565 | 25,795                  | 154,578       |
| Total                   | 106,260                 | 26,909 | 26,167                  | 159,335       |
| San Joaquin River       |                         |        |                         |               |
| VEGT                    | 1,880                   | 146    | 491                     | 2,517         |
| ORVIN                   | 973                     | 477    | 393                     | 1,843         |
| FFGO                    | 76,768                  | 24,994 | 35,868                  | 137,630       |
| Total                   | 79,621                  | 25,617 | 36,753                  | 141,990       |
| Tulare Lake             |                         |        |                         |               |
| VEGT                    | 269                     | 13     | 106                     | 388           |
| ORVIN                   | 254                     | 28     | 110                     | 391           |
| FFGO                    | 11,495                  | 1,735  | 13,318                  | 26,548        |
| Total                   | 12,018                  | 1,776  | 13,534                  | 27,327        |
| Grand Total             | 197,898                 | 54,301 | 76,454                  | 328,653       |

VEGT = vegetable, truck; ORVIN =orchard, vineyard; FFGO = field, forage, grain, other.

Note: Totals may not exactly match those found in *Technical Memorandum Concerning the Economic Analysis of the Irrigated Lands Regulatory Program* (ICF International 2010) as a result of rounding.

## Alternative 2 – Third-Party Lead Entity

Potential impacts on agriculture resources resulting from Alternative 2 would be in addition to those described for Alternative 1; **Impact AG-1** would apply.

### **Impact AG-1. Conversion of Prime Farmland, Unique Farmland, and Farmland of Statewide Importance to Nonagricultural Use**

Under Alternative 2, third-party groups (e.g., water quality coalitions) would function as lead entities representing growers. Regulation of discharges to surface water under Alternative 2 would be similar to Alternative 1 (the current ILRP). Table 5.10-3 shows that, under Alternative 2, 9,596 additional acres of important farmland potentially would be removed from production because of the increased costs associated with complying with the ILRP. It is unlikely that all of this acreage would be converted to a nonagricultural use, but it is reasonable to assume that some unknown quantity would be.

Because implementation of Alternative 2 potentially would result in conversion of prime farmland, unique farmland, and farmland of statewide importance to nonagricultural use, this impact is

considered significant. Implementation of **Mitigation Measure AG-MM-1** would reduce the magnitude of the impact, but not to a less-than-significant level.

**Table 5.10-3. Additional Acres of Important Farmland Potentially Removed from Production under Alternative 2**

| Watershed/<br>Crop Type | Farmland Classification |        |                         | Total Acreage |
|-------------------------|-------------------------|--------|-------------------------|---------------|
|                         | Prime                   | Unique | Statewide<br>Importance |               |
| Sacramento River        |                         |        |                         |               |
| VEGT                    | 17                      | 1      | 1                       | 19            |
| ORVIN                   | 14                      | 2      | 3                       | 19            |
| FFGO                    | 1,009                   | 262    | 255                     | 1,526         |
| Total                   | 1,040                   | 265    | 258                     | 1,564         |
| San Joaquin River       |                         |        |                         |               |
| VEGT                    | 72                      | 6      | 19                      | 97            |
| ORVIN                   | 307                     | 151    | 124                     | 582           |
| FFGO                    | 3,879                   | 1,263  | 1,812                   | 6,954         |
| Total                   | 4,258                   | 1,419  | 1,955                   | 7,632         |
| Tulare Lake             |                         |        |                         |               |
| VEGT                    | 7                       | 0      | 3                       | 10            |
| ORVIN                   | 19                      | 2      | 8                       | 29            |
| FFGO                    | 156                     | 24     | 181                     | 361           |
| Total                   | 182                     | 26     | 192                     | 400           |
| Grand Total             | 5,480                   | 1,710  | 2,406                   | 9,596         |

VEGT = vegetable, truck; ORVIN = orchard, vineyard; FFGO = field, forage, grain, other.

Note: Totals may not exactly match those found in *Technical Memorandum Concerning the Economic Analysis of the Irrigated Lands Regulatory Program* (ICF International 2010) as a result of rounding.

## Alternative 3 – Individual Farm Water Quality Management Plans

Potential impacts on agriculture resources resulting from Alternative 3 would be in addition to those described for Alternative 1; **Impact AG-1** would apply.

### **Impact AG-1. Conversion of Prime Farmland, Unique Farmland, and Farmland of Statewide Importance to Nonagricultural Use**

Under Alternative 3, growers would have the option to work directly with the Central Valley Water Board or another implementing entity (e.g., CACs) in development of an FWQMP. Growers individually would apply for a conditional waiver or WDRs that would require obtaining Central Valley Water Board approval of their FWQMP. Table 5.10-4 shows that, under Alternative 3, 43,680 additional acres of important farmland potentially would be removed from production because of the increased costs associated with complying with the ILRP. It is unlikely that all of this acreage would be converted to a nonagricultural use, but it is reasonable to assume that some unknown quantity would be.

Because implementation of Alternative 3 potentially would result in conversion of prime farmland, unique farmland, and farmland of statewide importance to nonagricultural use, this impact is considered significant. Implementation of **Mitigation Measure AG-MM-1** would reduce the magnitude of the impact, but not to a less-than-significant level.

**Table 5.10-4. Additional Acres of Important Farmland Potentially Removed from Production under Alternative 3**

| Watershed/<br>Crop Type                                                                                                                                                                                                                                                                              | Farmland Classification |        |                         |               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|--------|-------------------------|---------------|
|                                                                                                                                                                                                                                                                                                      | Prime                   | Unique | Statewide<br>Importance | Total Acreage |
| Sacramento River                                                                                                                                                                                                                                                                                     |                         |        |                         |               |
| VEGT                                                                                                                                                                                                                                                                                                 | 260                     | 14     | 14                      | 287           |
| ORVIN                                                                                                                                                                                                                                                                                                | 206                     | 35     | 41                      | 282           |
| FFGO                                                                                                                                                                                                                                                                                                 | 12,319                  | 3,202  | 3,109                   | 18,630        |
| Total                                                                                                                                                                                                                                                                                                | 12,785                  | 3,251  | 3,163                   | 19,199        |
| San Joaquin River                                                                                                                                                                                                                                                                                    |                         |        |                         |               |
| VEGT                                                                                                                                                                                                                                                                                                 | 217                     | 17     | 57                      | 290           |
| ORVIN                                                                                                                                                                                                                                                                                                | 410                     | 201    | 166                     | 776           |
| FFGO                                                                                                                                                                                                                                                                                                 | 11,541                  | 3,758  | 5,392                   | 20,691        |
| Total                                                                                                                                                                                                                                                                                                | 12,168                  | 3,975  | 5,615                   | 21,758        |
| Tulare Lake                                                                                                                                                                                                                                                                                          |                         |        |                         |               |
| VEGT                                                                                                                                                                                                                                                                                                 | 67                      | 3      | 27                      | 97            |
| ORVIN                                                                                                                                                                                                                                                                                                | 63                      | 7      | 27                      | 98            |
| FFGO                                                                                                                                                                                                                                                                                                 | 1,095                   | 165    | 1,268                   | 2,528         |
| Total                                                                                                                                                                                                                                                                                                | 1,225                   | 176    | 1,322                   | 2,723         |
| Grand Total                                                                                                                                                                                                                                                                                          | 26,178                  | 7,401  | 10,100                  | 43,680        |
| VEGT = vegetable, truck; ORVIN =orchard, vineyard; FFGO = field, forage, grain, other.<br>Note: Totals may not exactly match those found in <i>Technical Memorandum Concerning the Economic Analysis of the Irrigated Lands Regulatory Program</i> (ICF International 2010) as a result of rounding. |                         |        |                         |               |

## Alternative 4 – Direct Oversight with Regional Monitoring

Potential impacts on agriculture resources resulting from Alternative 4 would be in addition to those described for Alternative 1; **Impact AG-1** would apply.

### **Impact AG-1. Conversion of Prime Farmland, Unique Farmland, and Farmland of Statewide Importance to Nonagricultural Use**

Under Alternative 4, the Central Valley Water Board would develop WDRs and/or a conditional waiver of WDRs for waste discharge from irrigated agricultural lands to groundwater and surface water. Growers, or legal entities responsible for a group of growers' waste discharges, would apply directly with the Central Valley Water Board to obtain coverage ("direct oversight"). Table 5.10-5 shows that, under Alternative 4, 11,799 additional acres of important farmland potentially would be removed from production because of the increased costs associated with complying with the ILRP. It



is unlikely that all of this acreage would be converted to a nonagricultural use, but it is reasonable to assume that some unknown quantity would be.

Because implementation of Alternative 4 potentially would result in conversion of prime farmland, unique farmland, and farmland of statewide importance to nonagricultural use, this impact is considered significant. Implementation of **Mitigation Measure AG-MM-1** would reduce the magnitude of the impact, but not to a less-than-significant level.

**Table 5.10-5. Additional Acres of Important Farmland Potentially Removed from Production under Alternative 4**

| Watershed/<br>Crop Type | Farmland Classification |        |                         | Total Acreage |
|-------------------------|-------------------------|--------|-------------------------|---------------|
|                         | Prime                   | Unique | Statewide<br>Importance |               |
| Sacramento River        |                         |        |                         |               |
| VEGT                    | 87                      | 5      | 5                       | 96            |
| ORVIN                   | 69                      | 12     | 14                      | 94            |
| FFGO                    | 53                      | 14     | 13                      | 80            |
| Total                   | 208                     | 30     | 32                      | 270           |
| San Joaquin River       |                         |        |                         |               |
| VEGT                    | 72                      | 6      | 19                      | 97            |
| ORVIN                   | 358                     | 176    | 145                     | 679           |
| FFGO                    | 5,440                   | 1,771  | 2,542                   | 9,752         |
| Total                   | 41,319                  | 13,432 | 19,074                  | 73,825        |
| Tulare Lake             |                         |        |                         |               |
| VEGT                    | 0                       | 0      | 0                       | 0             |
| ORVIN                   | 63                      | 7      | 27                      | 98            |
| FFGO                    | 391                     | 59     | 453                     | 903           |
| Total                   | 454                     | 66     | 480                     | 1001          |
| Grand Total             | 6,553                   | 2,048  | 3,217                   | 11,799        |

VEGT = vegetable, truck; ORVIN =orchard, vineyard; FFGO = field, forage, grain, other.

Note: Totals may not exactly match those found in *Technical Memorandum Concerning the Economic Analysis of the Irrigated Lands Regulatory Program* (ICF International 2010) as a result of rounding.

## Alternative 5 – Direct Oversight with Farm Monitoring

Potential impacts on agriculture resources resulting from Alternative 5 would be in addition to those described for Alternative 1; **Impact AG-1** would apply.

### Impact AG-1. Conversion of Prime Farmland, Unique Farmland, and Farmland of Statewide Importance to Nonagricultural Use

Alternative 5 would consist of general WDRs designed to protect surface water and groundwater from discharges associated with irrigated agriculture. All growers would be required to apply for and obtain coverage under the general WDRs. Table 5.10-6 shows that, under Alternative 5, 249,490 additional acres of important farmland potentially would be removed from production

because of the increased costs associated with complying with the ILRP. This analysis indicates that, of the five alternatives, Alternative 5 likely would have the greatest impact with regard to the total amount of important farmland removed from production. It is unlikely that all of this acreage would be converted to a nonagricultural use, but it is reasonable to assume that some unknown quantity would be.

Because implementation of Alternative 5 potentially would result in the conversion of prime farmland, unique farmland, and farmland of statewide importance to nonagricultural use, this impact is considered significant. Implementation of **Mitigation Measure AG-MM-1** would reduce the magnitude of the impact, but not to a less-than-significant level.

**Table 5.10-6. Additional Acres of Important Farmland Potentially Removed from Production under Alternative 5**

| Watershed/<br>Crop Type  | Farmland Classification |        |                         |                  |
|--------------------------|-------------------------|--------|-------------------------|------------------|
|                          | Prime                   | Unique | Statewide<br>Importance | Total<br>Acreage |
| <b>Sacramento River</b>  |                         |        |                         |                  |
| VEGT                     | 1,905                   | 101    | 99                      | 2,105            |
| ORVIN                    | 1,646                   | 281    | 329                     | 2,256            |
| FFGO                     | 72,269                  | 18,782 | 18,237                  | 109,288          |
| Total                    | 75,821                  | 19,164 | 18,665                  | 113,650          |
| <b>San Joaquin River</b> |                         |        |                         |                  |
| VEGT                     | 1,301                   | 101    | 340                     | 1,742            |
| ORVIN                    | 1,741                   | 853    | 704                     | 3,298            |
| FFGO                     | 57,044                  | 18,572 | 26,653                  | 102,269          |
| Total                    | 60,086                  | 19,527 | 27,697                  | 107,309          |
| <b>Tulare Lake</b>       |                         |        |                         |                  |
| VEGT                     | 806                     | 40     | 318                     | 1,164            |
| ORVIN                    | 2,346                   | 259    | 1,014                   | 3,619            |
| FFGO                     | 10,283                  | 1,552  | 11,914                  | 23,749           |
| Total                    | 13,436                  | 1,850  | 13,246                  | 28,532           |
| Grand Total              | 149,342                 | 40,541 | 59,608                  | 249,490          |

VEGT = vegetable, truck; ORVIN = orchard, vineyard; FFGO = field, forage, grain, other.

Note: Totals may not exactly match those found in *Technical Memorandum Concerning the Economic Analysis of the Irrigated Lands Regulatory Program* (ICF International 2010) as a result of rounding.

## 5.10.5 Mitigation and Improvement Measures

### **Mitigation Measure AG-MM-1: Assist the Agricultural Community in Identifying Sources of Financial Assistance That Would Allow Growers to Keep Important Farmland in Production**

The Central Valley Water Board will assist the agricultural community in identifying sources of financial assistance from existing federal, state, or local programs that promote water conservation and water quality through increased management practices. Funding received from grants, cost-sharing, or low-interest loans would offset some of the local growers' expenditures for compliance and implementation of FWQMPs, and likely would reduce the estimated losses in irrigated acreage. Potential funding sources for this mitigation measure are discussed below. The programs described below are illustrative and are not intended to constitute a comprehensive list of funding sources.

#### *Federal Farm Bill*

Title II of the 2008 Farm Bill (the Food, Conservation, and Energy Act of 2008, in effect through 2012) authorizes funding for conservation programs such as the Environmental Quality Incentives Program (EQIP) and the Conservation Stewardship Program. Both of these programs provide financial and technical assistance for activities that improve water quality on agricultural lands.

#### *State Water Resources Control Board*

The Division of Financial Assistance administers water quality improvement programs for the State Water Board. The programs provide grant and loan funding to reduce non-point-source pollution discharge to surface waters.

The Division of Financial Assistance currently administers two programs that improve water quality—the Agricultural Drainage Management Loan Program and the Agricultural Drainage Loan Program. Both of these programs were implemented to address the management of agricultural drainage into surface water. The Agricultural Water Quality Grant Program provides funding to reduce or eliminate the discharge of non-point-source pollution from agricultural lands into surface water and groundwater. It currently is funded through bonds authorized by Proposition 84.

The State Water Board's Clean Water State Revolving Fund also has funding authorized through Proposition 84. It provides loan funds to a wide variety of point-source and non-point-source water quality control activities.

#### *Potential Funding Provided by the Safe, Clean, and Reliable Drinking Water Supply Act of 2010*

This act was passed by the Legislature as SBX 7-2 and, if approved by voters in November 2010, would provide grant and loan funding for a wide range of water-related activities, including agricultural water quality improvement, watershed protection, and groundwater quality protection. The actual amount and timing of funding availability will depend on its passage, on the issuance of bonds and the release of funds, and on the kinds of programs and projects proposed and approved for funding.

*Other Funding Programs*

Other state and federal funding programs have been available in recent years to address agricultural water quality improvements. Integrated Regional Water Management grants were authorized and funded by Proposition 50 and now by Proposition 84. These are administered jointly by the State Water Board and DWR. Proposals can include agricultural water quality improvement projects. Reclamation also can provide assistance and cost-sharing for water conservation projects that help reduce discharges.

## Section 5.11

# Minimally Impacted Resources

---

### 5.11.1 Introduction

Pursuant to CEQA Guideline Section 15126.2, an EIR shall identify and focus on the significant environmental effects of the proposed program. Due to the programmatic nature of the analysis, the Lead Agency has determined that no significant direct or indirect environmental impacts would affect the resources listed below.

### 5.11.2 Discussion of Minimally Impacted Resources

#### Aesthetics

While the program alternatives foresee possible construction activity in relation to management practice enactment, any such activity is reasonably expected to occur within presently active agricultural acreage and thus is unlikely to interfere with, degrade, or damage scenic resources.

#### Geology and Soils

The program alternatives would result in a beneficial effect, if any, on geology and soils; management practices enacted to minimize sediment discharges would slow or prevent soil erosion or the loss of topsoil. The program alternatives would result in no foreseeable seismic impacts, nor otherwise undermine soil stability.

#### Hazards and Hazardous Materials

The program alternatives would result in a slight beneficial effect, if any, relating to hazardous materials by decreasing nutrient and pesticide usage and thereby lessening the incidence of transportation, and accidental or intentional discharge of such materials. The program alternatives would result in no foreseeable significant impacts that would create or result in other hazardous conditions.

#### Land Use and Planning

While the program alternatives foresee possible conversion of agricultural lands as a result of increased management practice-related costs, no specific use for converted land can be identified, due to the unknown location of such lands. Determining whether such unknown converted uses would conflict with any applicable land use plan, policy or regulation is unreasonably speculative. Thus, the program alternatives would result in no foreseeable land use and planning-related significant impacts.



## Mineral Resources and Energy

The program alternatives would not result in the foreseeable loss of any known mineral resource.

## Population and Housing

While the program alternatives foresee possible conversion of agricultural lands as a result of increased management practice-related costs, no specific use for converted land can be identified, due to the unknown location of such lands. It is too speculative to determine whether such unknown converted uses would induce substantial population growth. Refer to see Section 6.3, Growth-Inducing Impacts, for a discussion of the extent of foreseeable impacts of land conversion.

The program alternatives would not result in foreseeable displacement of housing or populations.

## Public Services

The program alternatives would not result in foreseeable significant impacts to public service, or lead to the necessity for additional public service facilities. Refer to see Section 6.3, Growth-Inducing Impacts, for a discussion of the extent of foreseeable impacts of land conversion.

## Recreation

It is not anticipated that the program alternatives would substantially increase or decrease the use of recreational facilities, create the need for such facilities, or result in any other foreseeable significant impact on recreational opportunities in the program area.

## Transportation and Circulation

It is not anticipated that the program alternatives would substantially increase or decrease the existing traffic load in the program area. While additional onsite monitoring would be necessary under some alternatives, the alternatives also may decrease traffic flow through reduced needs for nutrients and pesticide deliveries. Regardless, any determination of increased or decreased traffic in relation to baseline conditions would be speculative at this programmatic level.

## Utilities and Service Systems

The program alternatives would result in a beneficial effect, if any, related to utilities and service systems by improving water quality and thereby lessening the burden on existing water treatment facilities and reducing the need for new such facilities. The program alternatives would result in no foreseeable significant impacts that would cause a burden on existing utilities or service systems.

## Chapter 6

# Cumulative and Growth-Inducing Impacts

---

## 6.1 Introduction

This chapter evaluates the cumulative and growth-inducing impacts associated with implementing the ILRP and the potential contribution of the program to those impacts. The impact assessment discusses each resource topic evaluated in this EIR.

## 6.2 Cumulative Impacts

State CEQA Guidelines require that the cumulative impacts of a proposed project be addressed in an EIR when the cumulative impacts are expected to be significant and when the project's incremental effect is cumulatively considerable (State CEQA Guidelines Section 15130[a]). If an environmental effect is not "cumulatively considerable," a Lead Agency need not consider that effect significant but shall briefly describe its basis for concluding that the incremental effect is not cumulatively considerable. (Id.) Cumulative impacts are impacts on the environment that result from the incremental impacts of a proposed action when added to other past, present, and reasonably foreseeable future actions (State CEQA Guidelines Section 15355[b]). Such impacts can result from individually minor but collectively significant actions taking place over time.

The cumulative impact analysis determines the combined effect of the proposed project and other closely related, reasonably foreseeable, projects. This section describes the methods used to evaluate cumulative effects, lists related projects and describes their relationship to the proposed program, identifies cumulative impacts by resource area, and recommends mitigation for significant cumulative effects. Section 15130 of the State CEQA Guidelines states that the discussion of cumulative impacts need not provide as much detail as the discussion of effects attributable to the program alone. The level of detail should be guided by what is practical and reasonable.

According to the State CEQA Guidelines (Section 15130), an adequate discussion of significant cumulative impacts should contain the following elements:

- An analysis of related future projects or planned development that would affect resources in the project area similar to those affected by the proposed project,
- A summary of the expected environmental effects to be produced by those projects with specific reference to additional information stating where that information is available, and
- A reasonable analysis of the cumulative impacts of the relevant projects. An EIR must examine reasonable, feasible options for mitigating or avoiding the project's contribution to any significant cumulative effects.

To identify the related projects, the State CEQA Guidelines (Section 15130[b]) recommend either the "list" or "projection" approach, the use of which must be guided by the standards of practicality and reasonableness. Because of the unidentified location of potential impacts, the Lead Agency has not identified any projects or programs adequately similar in nature, location, and type to result in a meaningful comparative analysis. To the extent feasible, the possible impacts of each resource area

are considered cumulatively in light of similar possible impacts, without reference to specific contributing projects.

## 6.2.1 Significance Determinations and Mitigation

Implementation of program alternatives has been determined to result in potential cumulatively considerable impacts for several resources. While suggested mitigation is provided for each potential cumulatively considerable impact, much of the mitigation cannot be enforced by the Lead Agency, as enforcement requires actions by third parties over which the Central Valley Water Board has no decision-making authority. Where impacts cannot be feasibly mitigated, a Statement of Overriding Consideration will be necessary.

## 6.2.2 Cumulative Impacts by Resource

### 6.2.2.1 Cultural Resources

Use of ground-disturbing management practices under the program alternatives could result in cumulatively considerable effects to cultural resources in concert with other, non-program-related agricultural enterprises and non-agricultural development in the program area. Agricultural operations in the Central Valley, in fact, have been a catalyst for archaeological resource destruction for more than 100 years (Riddell 2002:56). Implementation of **Mitigation Measure CUL-MM-1** would reduce the program's contribution to this impact to a level that is not cumulatively considerable, by ensuring identification of cultural resources and minimization of impacts to identified resources.

### 6.2.2.2 Noise

Noise associated with construction activities would be highly localized. Because noise-sensitive land uses are sparsely located throughout the program area, it is unlikely that noise from construction activities would result in a substantial cumulative effect in association with other noise sources at any given area. Accordingly, no cumulatively considerable noise impacts are predicted to occur as a result of construction activities.

Noise from vehicle trips would not be localized and would occur on roads throughout the program area where the cumulative noise from traffic may exceed local noise standards. Noise from vehicle trips therefore may contribute to traffic noise in these situations. However, because program-related vehicle trips would be limited to occasional trips for site inspections and monitoring, noise from operation of the program alternatives would not be cumulatively considerable.

### 6.2.2.3 Air Quality

Construction emissions associated with the program alternatives would be short term. Because cumulative impacts, by definition, are long-term, construction emissions are not anticipated to result in a cumulatively considerable impact on air quality. As explained in Section 5.5, Air Quality, because operational emissions associated with program alternatives would be minimal, they are not expected to result in cumulatively considerable emissions. In addition, implementation of **Mitigation Measures AQ-MM-1, AQ-MM-2, and AQ-MM-3**, described in Section 5.5, Air Quality, would further reduce any criteria air pollutants generated as a result of program implementation.

#### 6.2.2.4 Climate Change

Unlike criteria pollutant impacts (see Section 5.5), which are local and regional, climate change impacts occur at a global level. The relatively long lifespan and persistence of GHGs (as shown in Table 5.6-1) require that climate change be considered a cumulative and global impact. As stated above, it is unlikely that any increase in global temperature or sea level could be attributed to the emissions resulting from a single project. Rather, it is more appropriate to conclude that the proposed program GHG emissions would combine with emissions across California, the United States, and the globe to cumulatively contribute to global climate change.

Given the magnitude of state, national, and international GHG emissions (see Tables 5.6-2 through 5.6-4), climate change impacts from implementation of program alternatives likely would be negligible. However, scientific consensus concludes that, given the seriousness of climate change, small contributions of GHGs may be cumulatively considerable. Because it is unknown to what extent, if any, climate change would be affected by the incremental GHG emissions produced by the program alternatives, the impact to climate change is considered cumulatively considerable.

Implementation of **Mitigation Measures CC-MM-1** and **CC-MM-2**, described in Section 5.6, Climate Change, would result in lower GHG emissions levels than had they not been incorporated, but they would not completely eliminate program GHG emissions.

#### 6.2.2.5 Vegetation and Wildlife

The Central Valley of California has been subjected to extensive human impacts from land conversion, water development, population growth, and recreation. These impacts have altered the physical and biological integrity of the Central Valley, causing loss of native riparian vegetation along the river system, loss of wetlands, and loss of native habitat for plant and wildlife species. While **Mitigation Measures BIO-MM-1** and **BIO-MM-2** presented in Section 5.7 are sufficient to mitigate any program-related impacts to rare or endangered plant or wildlife species, and to habitat for these species, the cumulative impact of the reduction in quality habitat and the take of individual listed plants or wildlife species is potentially cumulatively considerable.

#### 6.2.2.6 Fish

The ongoing impacts of impaired water quality from irrigated lands are likely to cumulatively affect fish, in combination with contaminants that remain in the program area from past activities. Such activities include mining (e.g., heavy metals from Iron Mountain continue to affect Sacramento River winter-run Chinook salmon [Moyle et al. 2008:142]) and past use of pesticides such as DDT that remain within sediments. Because many of the existing effects discussed in the section “Existing Effects of Impaired Water Quality on Fish” are cumulative, it is difficult to determine the relative contribution of irrigated lands and other sources. For example, low DO in the Stockton Deepwater Ship Channel is a result of contamination from upstream nonpoint sources (possibly including agricultural runoff) and discharges from the Stockton sewage treatment plant (Lehman et al. 2004; Central Valley Water Board 2005). Application of pesticides to non-agricultural lands such as urban parks and the resultant contaminant runoff also cumulatively contribute to impacts of inputs from irrigated lands.

Given the ongoing ESA consultation process for pesticides as a result of recent court orders, it is reasonably foreseeable that further reasonable and prudent measures would be required by NMFS and USFWS that would improve water quality within the program area. Revision of water quality

control plans and TMDLs also can be expected to improve water quality. These and other measures, in combination with the likely beneficial effects of the various program alternatives, suggest that the cumulative effects of the program alternatives are not cumulatively considerable with implementation of **Mitigation Measures FISH-MM-1, FISH-MM-2, and FISH MM-3**, described in Section 5.8, Fisheries.

### 6.2.2.7 Hydrology and Water Quality

Program alternatives 2 through 5 would not result in adverse cumulative impacts on surface water quality, groundwater quality, or hydrology in the program area. Combining one of the program alternatives with other local state programs, such as the CV-SALTS program and the existing dairy program, could result in a cumulative beneficial water quality improvement over time. Similarly, Alternative 1 would not result in adverse cumulative impacts on surface water quality or hydrology in the program area and could result in a cumulative beneficial water quality improvement for surface waters. However, Alternative 1 does not address issues pertaining to groundwater quality and therefore could contribute to cumulatively considerable impacts to groundwater quality as a result of discharges from irrigated lands.

### 6.2.2.8 Agriculture Resources

Since 1984, the average biennial net conversion of prime and unique farmland, and farmlands of statewide importance in California has been 28,344 acres (CDC 2008). However, conversion has increased substantially since 2000, with an average biennial net conversion of 114,003 acres (CDC 2008). During the 2002–2004 period, prime farmland, unique farmland, and farmland of statewide importance was reduced by 133,024 acres (CDC 2006). The trend continued during the 2004–2006 period, with a net reduction of 125,495 acres (CDC 2008). Figure 6-1 provides a summary of important farmland conversion in California from 2000 to 2006.

While conversion of important farmland may not continue at the accelerated rate of the past 10 years due to decreased demand for new housing, it is reasonably foreseeable that it will continue at a rate comparable to that seen since 1984. Given the magnitude of important farmland conversion expected from implementation of the ILRP, the program could result in considerably cumulative impacts to agriculture resources. However, implementation of AG-MM-1, described in Section 5.10, Agriculture Resources, could reduce these impacts to a level that is not cumulatively considerable.

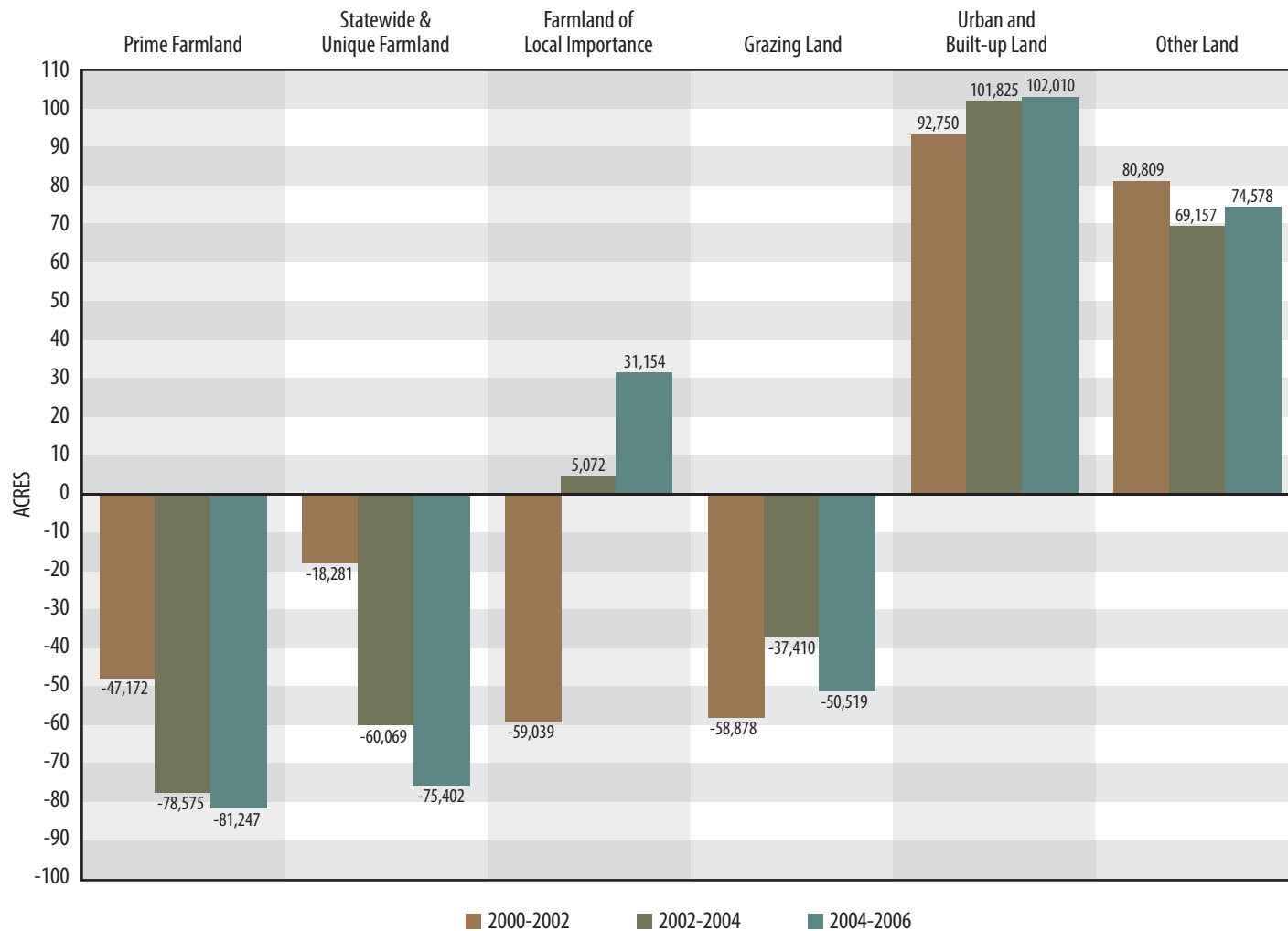
### 6.2.2.9 Other Resources

No cumulatively considerable impacts have been determined to be associated with any other resource areas.

## 6.3 Growth-Inducing Impacts

Section 21100(b)(5) of CEQA requires an EIR to discuss how a proposed program, if implemented, may induce growth and the impacts of that induced growth (see also State CEQA Guidelines Section 15126). CEQA requires the EIR to discuss specifically “the ways in which the proposed project could foster economic or population growth, or the construction of additional housing, either directly or indirectly, in the surrounding environment” (State CEQA Guidelines Section 15126.2[d]).





Source: California Farmland Conversion Report 2000-2002, 2002-2004, 2004-2006

**Figure 6-1**  
**California Farmland Conversion Summary 2000-2006**

As the Agriculture Resources section discusses at length, it is anticipated that the increased costs associated with program alternatives will result in conversion of some acres of irrigated agricultural lands from present use to other purposes. While urbanization is an important component of agricultural land conversion, economic and resource availability factors also lead to more intensive farming or removal from irrigated uses. Irrigated agricultural land leaving its present use could be converted in a variety of ways, including to different agricultural uses—such as conversion from grasslands to orchards; urbanization through development for residential, commercial, or industrial purposes; or temporary or permanent land idling or dry cropping (CDC 2008).

Clearly, conversion of irrigated lands to urban uses would result in a growth-inducing program impact. As the Draft ILRP Economics Report shows, any acres of irrigated lands converted under the ILRP likely would leave present use as a direct or indirect result of an increasing cost burden; reduced profit margins could cause continued production under the present use to become infeasible. Growth-inducing impacts could occur if the converted acreage enters into more productive use, fostering economic growth and resulting in a potential population growth.

Due to the programmatic nature of this analysis, it is not possible to determine the location or quantity of irrigated lands that ultimately may be converted as a result of the ILRP. It is also not possible to determine what the resulting land use may be. Thus, the location or nature of any possible growth-inducing impacts is too speculative to quantify. It is reasonable to assume, however, that an increase in conversion of irrigated lands could remove a barrier to growth in some areas by providing lands for development previously unavailable for that purpose.

## Chapter 7

# List of Preparers

The following persons contributed to preparation of this PEIR. This list is consistent with the requirements set forth in CEQA (Section 15129 of the State CEQA Guidelines).

## 7.1 ICF International

| <b>Name</b>      | <b>Qualifications</b>                                                                 | <b>Participation</b>                         |
|------------------|---------------------------------------------------------------------------------------|----------------------------------------------|
| Mike Rushton     | M.A., Geography<br>B.A., Geography                                                    | Project Director                             |
| Russell Grimes   | M.S., Environmental Management<br>B.S., Environmental Studies                         | Project Director                             |
| Megan Smith      | J.D., Law<br>B.A., English (Non-Fiction Writing)                                      | Project Manager                              |
| Gregg Roy        | B.S., Political Economy of Natural Resources                                          | Economics Technical Lead                     |
| Mike Wingfield   | B.S., Environmental Science                                                           | Project Coordinator<br>Agriculture Resources |
| Gabriel Roark    | M.A., Anthropology<br>B.A., Anthropology                                              | Cultural Resources                           |
| Kathryn Haley    | M.A., Public History<br>B.A., History                                                 | Cultural Resources                           |
| Laura Smith      | B.A., Environmental Studies                                                           | Noise, Air Quality, and Climate Change       |
| Lisa Webber      | M.S., Botany<br>B.A., Biology                                                         | Vegetation                                   |
| Will Kohn        | B.S., Zoology                                                                         | Wildlife                                     |
| Marin Greenwood  | Ph.D., Applied Fish Ecology<br>M.S., Applied Fish Biology<br>B.S., Aquatic Bioscience | Fish                                         |
| Nathaniel Martin | Masters in Public Administration (MPA)<br>B.S., Environmental Studies                 | Hydrology and Water Quality                  |
| Carol-Anne Hicks | B.S., Environmental and Resource Sciences                                             | Publications Specialist                      |
| Alan Barnard     | Advanced Training, Adobe Illustrator,<br>Photoshop                                    | Graphic Artist                               |
| Matt Ewalt       | B.S., Environmental Science                                                           | GIS                                          |

## 7.2 Subconsultants

| <b>Name</b>                   | <b>Qualifications</b>                                                                | <b>Participation</b> |
|-------------------------------|--------------------------------------------------------------------------------------|----------------------|
| Mark Roberson, PhD            | Ph.D, Soil and Water Science<br>M.S., Agriculture (Irrigation Engineering Specialty) | Soil Scientist       |
| Lucas Blair<br>CH2MHill       | M.S., Agricultural and Resource Economics                                            | Economist            |
| Stephen Hatchett<br>CH2MHill  | Ph.D., Agricultural and Resource Economics                                           | Senior Economist     |
| Thomas Wegge<br>TCW Economics | M.S., Environmental Economics<br>B.A., Urban Studies                                 | Principal Economist  |
| Joan Lynn<br>egret, inc.      | 25 years experience in technical editing of<br>environmental documents               | Technical Editor     |

## 7.3 Central Valley Regional Water Quality Control Board

| <b>Name</b>          | <b>Qualifications</b>                                                | <b>Participation</b>    |
|----------------------|----------------------------------------------------------------------|-------------------------|
| Joe Karkoski         | B.S., Chemical Engineering<br>M.A., Public Policy and Administration | Program Manager         |
| Adam Laputz          | M.S., Chemical Engineering                                           | Project Manager         |
| Dana Kulesza         | B.S., Biological Sciences                                            | Environmental Scientist |
| Alan Cregan          | B.S., Geology                                                        | Engineering Geologist   |
| A. Marc Commandatore | B.A., Physical Sciences                                              | Environmental Scientist |
| Polly Lowry          | B.A., Geology                                                        | Engineering Geologist   |

## 8.1 Chapter 1, Summary

### 8.1.1 Printed References

- California Department of Water Resources. 2003. *California's Groundwater: Bulletin 118*. Update 2003. Sacramento, CA. October.
- Central Valley Regional Water Quality Control Board and ICF Jones & Stokes. 2009. *Proposed Long-Term Irrigated Lands Regulatory Program Alternatives*. December. (ICF J&S 05508.05.) Sacramento, CA. Prepared for Long-Term Irrigated Lands Regulatory Program Stakeholder Advisory Workgroup, Sacramento, CA.
- Central Valley Regional Water Quality Control Board. 2002a. *Agricultural Practices and Technologies Draft Report*. Cal EPA – Central Valley Regional Water Quality Control Board. May.
- Central Valley Water Board. See Central Valley Regional Water Quality Control Board.
- DWR. See California Department of Water Resources.
- ICF Jones & Stokes. 2008. Irrigated Lands Regulatory Program Existing Conditions Report. December. (ICF J&S 05508.05.) Sacramento, CA. Prepared for the State Water Resources Control Board and Central Valley Regional Water Quality Control Board, Rancho Cordova, CA.
- Regents of the University of California. Division of Agriculture and Natural Resources. 2003a. *Basic Concepts of Groundwater Hydrology*. (Publication 8083). (Farm Water Quality Planning Reference Sheet 11.1). Available: <<http://anrcatalog.ucdavis.edu/pdf/8083.pdf>>. Accessed: February 2008.
- Regents of the University of California. Division of Agriculture and Natural Resources. 2003b. *Groundwater Quality and Groundwater Pollution*. (Publication 8084). (Farm Water Quality Planning Reference Sheet 11.2.) Available: <<http://anrcatalog.ucdavis.edu/pdf/8084.pdf>>. Accessed: February 2008.
- U.S. Geological Survey. 2004. *Studies by the U.S. Geological Survey on Sources, Transport, and Fate of Agricultural Chemicals*. (Fact Sheet 2004-3098). September. Available: <<http://pubs.usgs.gov/fs/2004/3098/pdfs/fs2004-3098.pdf>>. Accessed: February 2008.
- UC Regents. See Regents of the University of California.
- USGS. See U.S. Geological Survey.



## 8.2 Chapter 2, Introduction

### 8.2.1 Printed References

CalEPA. See California Environmental Protection Agency.

California Environmental Protection Agency, Regional Water Quality Control Board, Central Valley Region. 2010. *Irrigated Lands Regulatory Program Long-Term Program Development Staff Report*. Sacramento, CA. May.

Central Valley Regional Water Quality Control Board and ICF Jones & Stokes. 2009. *Proposed Long-Term Irrigated Lands Regulatory Program Alternatives*. December. (ICF J&S 05508.05.) Sacramento, CA. Prepared for Long-Term Irrigated Lands Regulatory Program Stakeholder Advisory Workgroup, Sacramento, CA.

Central Valley Regional Water Quality Control Board. 2002a. *Agricultural Practices and Technologies Draft Report*. Cal EPA – Central Valley Regional Water Quality Control Board. May.

Central Valley Regional Water Quality Control Board. 2009. *The Water Quality Control Plan (Basin Plan) for the California Regional Water Quality Control Board Central Valley Region*. Fourth Edition. Revised September 2009 (with Approved Amendments). The Sacramento River Basin and the San Joaquin River Basin. California Regional Water Quality Control Board Central Valley Region. Sacramento, CA. Available:  
<[http://www.swrcb.ca.gov/rwqcb5/water\\_issues/basin\\_plans/](http://www.swrcb.ca.gov/rwqcb5/water_issues/basin_plans/)>. Accessed: July 2010.

Central Valley Water Board. See Central Valley Regional Water Quality Control Board.

ICF International. 2010. *Technical Memorandum Concerning the Economic Analysis of the Irrigated Lands Regulatory Program*. Draft. July. (ICF 05508.05.) Sacramento, CA. Prepared for Central Valley Regional Water Quality Control Board, Sacramento, CA.

ICF Jones & Stokes. 2008. *Irrigated Lands Regulatory Program Existing Conditions Report*. December. (ICF J&S 05508.05.) Sacramento, CA. Prepared for the State Water Resources Control Board and Central Valley Regional Water Quality Control Board, Rancho Cordova, CA.

State Water Board. See State Water Resources Control Board.

State Water Resources Control Board. 1968. Resolution No. 68-16, *Statement of Policy with Respect to Maintaining High Quality of Waters in California* (State Antidegradation Policy). October 28, 1968. Sacramento, CA. Available:  
<[http://www.waterboards.ca.gov/board\\_decisions/adopted\\_orders/resolutions/1968/rs68\\_016.pdf](http://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/1968/rs68_016.pdf)>. Accessed: July 2010.

State Water Resources Control Board. 1988. *Nonpoint Source Management Plan*. Sacramento, CA.

State Water Resources Control Board. 1999. *Plan for California's Nonpoint Source Pollution Control Program*. Sacramento, CA. December.

State Water Resources Control Board. 2004. Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program. May 20, 2004.

## 8.3 Chapter 3, Program Description

### 8.3.1 Printed References

California Plant Health Association. 2002. *Western Fertilizer Handbook*. 9<sup>th</sup> edition. Interstate Publisher, Inc. Danville, IL. 351 pp.

## 8.4 Chapter 4, Environmental Setting

### 8.4.1 Printed References

Central Valley Regional Water Quality Control Board. 2002a. *Agricultural Practices and Technologies Draft Report*. Cal EPA – Central Valley Regional Water Quality Control Board. May.

California Department of Water Resources. 2003. *California's Groundwater: Bulletin 118*. Update 2003. Sacramento, CA. October.

ICF Jones & Stokes. 2008. *Irrigated Lands Regulatory Program Existing Conditions Report*. December. (ICF J&S 05508.05.) Sacramento, CA. Prepared for the State Water Resources Control Board and Central Valley Regional Water Quality Control Board, Rancho Cordova, CA.

## 8.5 Chapter 5, Environmental Consequences

### 8.5.1 Printed References

CalEPA. See California Environmental Protection Agency.

California Environmental Protection Agency, Regional Water Quality Control Board, Central Valley Region. 2010. *Irrigated Lands Regulatory Program Long-Term Program Development Staff Report*. Sacramento, CA. May.

ICF International. 2010. *Technical Memorandum Concerning the Economic Analysis of the Irrigated Lands Regulatory Program*. Draft. July. (ICF 05508.05.) Sacramento, CA. Prepared for Central Valley Regional Water Quality Control Board, Sacramento, CA.

ICF Jones & Stokes. 2008. *Irrigated Lands Regulatory Program Existing Conditions Report*. December. (ICF J&S 05508.05.) Sacramento, CA. Prepared for the State Water Resources Control Board and Central Valley Regional Water Quality Control Board, Rancho Cordova, CA.

## 8.6 Section 5.3, Cultural Resources

### 8.6.1 Printed References

- Basin Research Associates. 2003. Historic Properties Survey Report/Finding of Effect for the Wild Goose Storage Inc. Gas Storage Facilities Expansion Project, Butte and Colusa Counties, California. April. Prepared by Basin Research Associates, San Leandro, CA. Prepared for Matrix Environmental Planning, Healdsburg, CA. On file at Northwest Information Center, California Historical Resources Information System, Rohnert Park, CA. (Study S-028031.)
- Beck, W. A. and Y. D. Haase. 1974. *Historical Atlas of California*. Norman, OK: University of Oklahoma Press.
- California Department of Transportation and JRP Historical Consulting Services. 2000. *Water Conveyance Systems in California: Historic Context Development and Evaluation Procedures*. Sacramento, CA: California Department of Transportation. Available: <http://www.dot.ca.gov/ser/downloads/cultural/CanalsDitches.pdf>. Accessed: November 30, 2009.
- California Department of Transportation. 2007. *A Historical Context and Archaeological Research Design for Agricultural properties in California*. Sacramento, CA: California Department of Transportation.
- California Department of Water Resources. 1958. Land Use Survey Maps, Visalia Quadrangle. On file at San Joaquin District of DWR, Fresno, CA.
- California Department of Water Resources. 1974. Tulare County Land and Water Resources: San Joaquin District Report. On file at the California State Library, Sacramento, CA.
- California Department of Water Resources. 1978. Land Use Survey Maps, Visalia Quadrangle. On file at the San Joaquin District of DWR, Fresno, CA.
- California Department of Water Resources. 1985. Land Use Survey Maps, Visalia Quadrangle. On file at the San Joaquin District of DWR, Fresno, CA.
- California Department of Water Resources. 1993. Land Use Survey Maps, Visalia Quadrangle. On file at the San Joaquin District of DWR, Fresno, CA.
- Caltrans. See California Department of Transportation.
- CHRIS Information Centers and California Office of Historic Preservation. 2008. *California Historical Resources Information System Information Center Rules of Operation Manual*. September 26. Sacramento, CA: California Office of Historic Preservation. Available: <http://www.ohp.parks.ca.gov/pages/1069/files/ic%20operations%20manual%209-26-08%20amendment%203.pdf>. Accessed June 24, 2010.
- Cook, S. F. 1978. Historical Demography. Pages 91–98 in R. F. Heizer (ed.), *California Handbook of North American Indians*, Vol. 8, W. C. Sturtevant, general ed. Washington, D.C.: Smithsonian Institution.

- Dillon, B. D. 2002. California PaleoIndians: Lack of Evidence, or Evidence of a Lack? Pages 110–128 in W. J. Wallace and F. A. Riddell (eds.), *Essays in California Archaeology: A Memorial to Franklin Fenenga*. Contributions No. 60. Berkeley, CA: Archaeological Research Facility, University of California.
- DWR. See California Department of Water Resources.
- Elliot, W. 1883. *History of Tulare County*. San Francisco, CA: Wallace W. Elliot.
- Feder, K. L. 1997. Site Survey. Pages 41–68 in T. R. Hester, H. J. Shafer, and K. L. Feder (eds.), *Field Methods in Archaeology*. 7<sup>th</sup> ed. Mountain View, CA: Mayfield Publishing Company.
- Heizer, R. F. 1978. *California*, edited by R. F. Heizer. Handbook of North American Indians, Vol. 8, W. C. Sturtevant, general editor. Washington, D.C.: Smithsonian Institution.
- ICF Jones & Stokes. 2008. Cultural Resources Inventory and Evaluation Report for the Proposed Palermo–East Nicolaus 115-kV Transmission Line Reconductoring Project, Butte, Sutter, and Yuba Counties, California. November. (ICF J&S 06411.06.) Sacramento, CA. Prepared for Pacific Gas and Electric Company, Sacramento, CA.
- Kroeber, A. L. 1976. *Handbook of the Indians of California*. Reprinted. Dover Publications, New York. Originally published 1925, Bulletin No. 78, Bureau of American Ethnology, Smithsonian Institution, Washington, D.C.
- Kyle, D. E., M. B. Hoover, H. E. Rensch, E. G. Rensch, and W. N. Abeloe. 1990. *Historic Spots in California*. 4<sup>th</sup> ed. Stanford University Press: Stanford, California.
- Kyle, D. E., M. B. Hoover, H. E. Rensch, E. G. Rensch, and W. N. Abeloe. 2002. *Historic Spots in California*. 5<sup>th</sup> ed. Stanford, CA: Stanford University Press.
- Lardner, W. B. and M. J. Brock. 1924. *History of Placer and Nevada Counties California*. Historic Record Company, Los Angeles, CA.
- Miliken, R. 1994. The Costanoan-Yokuts Language Boundary in the Contact Period. In *The Ohlone Past and Present*, edited by L. John Bean, pp. 165-181. Ballena Press Anthropological Papers, Vol. 42. Ballena Press, Menlo Park, CA.
- Miliken, R. 1995. A Time of Little Choice. The Disintegration of the Tribal Culture in the San Francisco Bay Area 1769-1810. Ballena Press Anthropological Papers, Vol. 43. Ballena Press, Menlo Park, CA.
- Mitchell, A. 1974. *A Modern History of Tulare County*. Limited Editions of Visalia, Visalia, CA.
- Moratto, M. J. 1984. *California Archaeology*. Academic Press, Orlando.
- Phillips, E. and J. H. Miller. 1915. Sacramento Valley and Foothill Counties of California: An Illustrated Description of all the Counties Embraced in this Richly Productive Geographical Subdivision of the Golden State. The Sacramento Valley Expositions Commission, Sacramento, CA.
- Riddell, F. A. 2002. The Status of San Joaquin Valley Archaeology. Page 55–61 in W. J. Wallace and F. A. Riddell (eds.), *Essays in California Archaeology: A Memorial to Franklin Fenenga*. Contributions No. 60. Berkeley, CA: Archaeological Research Facility, University of California.

- Robinson, W. W. 1948 *Land in California*. University of California Press, Berkeley.
- Shipley, W. F. 1978. Native Languages of California. In *California*, edited by R. F. Heizer, pp. 80–90. *Handbook of North American Indians*, Vol. 8, W. C. Sturtevant, general editor. Smithsonian Institution Press, Washington, D.C.
- Small, K. E. 1926. *History of Tulare County California* (Volume 1 and 2). S. J. Clarke Publishing Company. Chicago.
- Spier, Robert F. G. (1978). "Foothill Yokuts." In *Handbook of North American Indians*. Vol. 8, California, edited by Robert F. Heizer, 471-484. Washington, D.C: Smithsonian Institution.
- Thompson and West. 1880. *History of Sacramento County, California*. Thompson and West, Oakland, CA.
- Thompson, J. 1958. *The Settlement and Geography of the Sacramento-San Joaquin Delta, California*. University Microfilms International, Dissertation Information Service. Ann Arbor, MI.
- Tulare County Board of Trade. 1915. *Tulare County: The Key to Success*. Tulare County Board of Trade. Visalia, CA.
- U.S. Bureau of Reclamation. 1996. *Central Valley Project Improvement Act Environmental Impact Statement*. Preliminary draft. Prepared by Mid-Pacific Region, Bureau of Reclamation, Sacramento, CA.
- USBR. See U.S. Bureau of Reclamation.
- Wallace, W. J. 1978. Northern Valley Yokuts. In *California*, edited by R. F. Heizer, pp. 462–470. *Handbook of North American Indians*, Vol. 8, W. C. Sturtevant, general editor, Smithsonian Institution, Washington, D.C.
- Wells, H. L., W. L. Chambers, and F. Gilbert. 1973. *Chambers' History of Butte County, California, 1882, and Biographical Sketches of its Prominent Men and Pioneers*. Howell-North Books. Berkeley, CA.

## 8.7 Section 5.4, Noise, and Associated Ordinances and General Plans

### 8.7.1 Printed References

- Alameda County. 2009. Municipal Code: County of Alameda, California (Ord. No. 2009-36, enacted July 21, 2009). Chapter 6.60.  
Available: <<http://library.municode.com/index.aspx?clientId=16425&stateId=5&stateName=California>>. Accessed: December 15, 2009.
- Alpine County 2009a. Alpine County Code (Ordinance 690, passed October 20, 2009). Chapter 18.68.90. Available: <<http://www.codepublishing.com/CA/alpinecounty/>>. Accessed: December 15, 2009.



- Alpine County 2009b. Alpine County General Plan. Section E. Available:  
<<http://www.alpinecountyca.gov/documents>>. Accessed: December 15, 2009.
- Amador County. 1974 [1988]. Amador County General Plan: Noise Element.
- Brown-Buntin Associates. 1989. Noise Element Lassen County General Plan. Prepared for Lassen County Planning Department. December 12.
- Butte County. 2009a. Municipal Code: Butte County, California (Ordinance No. 4006, adopted July 21, 2009). Chapter 24. Available:  
<[http://library2.municode.com/11433/home.htm?infobase=16065&doc\\_action=whatsnew](http://library2.municode.com/11433/home.htm?infobase=16065&doc_action=whatsnew)>. Accessed: December 15, 2009.
- Butte County. 2009b. 2030 General Plan and Zoning Ordinance. Chapter 11. Available:  
<<http://www.buttegeneralplan.net/>>. Accessed: December 15, 2009.
- Calaveras County. 1996. Calaveras County General Plan. Chapter 11. Available:  
<[http://www.co.calaveras.ca.us/departments/planning/gen\\_plan.asp#gpdocs](http://www.co.calaveras.ca.us/departments/planning/gen_plan.asp#gpdocs)>. Accessed: December 15, 2009.
- California Department of Transportation. 1998. Traffic Noise Analysis Protocol for New Highway Construction and Reconstruction Projects. Sacramento, CA.
- Caltrans. See California Department of Transportation.
- Colusa County. n.d. Colusa County Code of Ordinances.. Available:  
<[http://www.colusacountyclerk.com/documents/County\\_Code.pdf](http://www.colusacountyclerk.com/documents/County_Code.pdf)>. Accessed: December 15, 2009.
- Contra Costa County. 2005. Contra Costa General Plan 2005-2020. Chapter 11. January 2005.
- Cowan, James P. 1984. *Handbook of Environmental Acoustics*. Van Nostrand Reinhold. New York, NY.
- El Dorado County. 2004. General Plan Public Health, Safety, and Noise Element. July.
- Federal Highway Administration. 2006. *Road Construction Noise Model User's Guide*. (FHWA-HEP-05-054). Prepared for the U.S. Department of Transportation Federal Highway Administration. January.
- FHWA. See Federal Highway Administration.
- Fresno County. 2000. Fresno County General Plan: Health and Safety Element. October.
- Fresno County. 2009. Municipal Code: Fresno County, California (Ordinance 09-020, passed Oct. 20, 2009). Chapter 8.40. Available: <[http://library2.municode.com/defaulttest/home.htm?infobase=16361&doc\\_action=whatsnew](http://library2.municode.com/defaulttest/home.htm?infobase=16361&doc_action=whatsnew)>. Accessed: December 15, 2009.
- Glenn County. 1993. Glenn County General Plan. Volumes 1-3. Available:  
<[http://gcplanupdate.net/general\\_plan/default.asp](http://gcplanupdate.net/general_plan/default.asp)>. Accessed: December 15, 2009.
- Glenn County. 2008. County Code Directory: Title 15, Chapter 560, Section 100. Available:  
<[http://www.countyofglenn.net/govt/county\\_code/](http://www.countyofglenn.net/govt/county_code/)>. Accessed: December 15, 2009.
- Hoover, R. M. and R. H. Keith. 1996. *Noise Control for Buildings, Manufacturing Plants, Equipment, and Products*. Lecture notes, first published 1981. Houston, TX: Hoover & Keith, Inc.

- Hoover, R. M. and R. H. Keith. 2008. *Noise Impact Assessment for New and Converted Storage Wells*. Prepared for Steckman Ridge, LP. January.
- ICF Jones & Stokes. 2008. *Irrigated Lands Regulatory Program Existing Conditions Report*. December. (ICF J&S 05508.05.) Sacramento, CA. Prepared for the State Water Resources Control Board and Central Valley Regional Water Quality Control Board, Rancho Cordova, CA.
- Kern County. 2007. Kern County General Plan. Chapter 3. Available: <<http://www.co.kern.ca.us/planning/pdfs/kcgp/KCGP.pdf>>. Accessed: December 15, 2009.
- Kern County. 2009. Municipal Code: Kern County, California (Ordinance G-7871, passed May 19, 2009.) Chapter 8.3.6. Available: <[http://library2.municode.com/defaulttest/home.htm?infobase=16251&doc\\_action=whatsnew](http://library2.municode.com/defaulttest/home.htm?infobase=16251&doc_action=whatsnew)>. Accessed: December 15, 2009.
- Kings County. 1993 [2004]. Kings County General Plan. Chapter N-1. Available: <<http://www.countyofkings.com/planning/Plan/Generalplan.htm>>. Accessed: December 15, 2009.
- Kings County. 2008. Municipal Code: Kings, California (Ord. No. 644, adopted June 24, 2008.). Chapter 15. Available: <[http://library2.municode.com/defaulttest/home.htm?infobase=12257&doc\\_action=whatsnew](http://library2.municode.com/defaulttest/home.htm?infobase=12257&doc_action=whatsnew)>. Accessed: December 15, 2009.
- Lake County. 2006. Lake County General Plan. Chapter 8.
- Lake County. 2008. Municipal Code: Kings, California (Ordinance No. 2877, passed Oct. 21, 2008). Available: <[http://library2.municode.com/defaulttest/home.htm?infobase=16438&doc\\_action=whatsnew](http://library2.municode.com/defaulttest/home.htm?infobase=16438&doc_action=whatsnew)>. Accessed: December 15, 2009.
- Los Angeles County. 2008. Draft General Plan 2008. Chapter 7. Available: <[http://planning.lacounty.gov/assets/upl/project/gp\\_web-ch07.pdf](http://planning.lacounty.gov/assets/upl/project/gp_web-ch07.pdf)>. Accessed: December 15, 2009.
- Los Angeles County. 2009. Los Angeles, California County Code (updated through 12/1/09). Chapter 8. Available: <<http://search.municode.com/html/16274/index.htm>>. Accessed: December 15, 2009.
- Madera County. 1995. General Plan. Section 7. Available: <[http://www.maderacounty.com/rma/archives/uploads/1128960251\\_Document\\_gppolicy.pdf](http://www.maderacounty.com/rma/archives/uploads/1128960251_Document_gppolicy.pdf)>. Accessed: December 15, 2009.
- Madera County. 2009. Municipal Code: Madera County, California (Ordinance No. 640, passed August 11, 2009). Chapter 9.58. Available: <<http://library.municode.com/index.aspx?clientId=16466&stateId=5&stateName=California>>. Accessed: December 15, 2009.
- Mariposa County. 2006. County of Mariposa General Plan. Chapter 15. Available: <<http://www.mariposacounty.org/index.aspx?NID=458>> Accessed: December 15, 2009.
- Merced County. 1990. Merced County Year 2000 General Plan. Chapter VI. Available: <<http://www.co.merced.ca.us/index.aspx?NID=436>>. Accessed: December 15, 2009.

- Merced County. 2009. Municipal Code: Merced County, California (Ordinance 2342, adopted Oct. 5, 2009.). Chapter 10.60. Available:  
<<http://library.municode.com/index.aspx?clientId=16466&stateId=5&stateName=California>>. Accessed: December 15, 2009.
- Modoc County. 1988. Noise Element to the General Plan. Pages 73–74.
- Napa County. 2009. Municipal Code: Napa County, California (Ordinance No. 1329, passed September 29, 2009). Chapter 8.16. Available:  
<<http://library.municode.com/index.aspx?clientId=16513&stateId=5&stateName=California>>. Accessed: December 15, 2009.
- Nevada County. 1995. Nevada County General Plan. Available:  
<<http://new.mynevadacounty.com/planning/index.cfm?ccs=783>>. Accessed: December 15, 2009.
- Nevada County. 2004. Nevada County Zoning Regulations. Section L-II. April 15.
- Placer County. 1994. Placer County General Plan. Chapter 9. Available:  
<<http://www.placer.ca.gov/Departments/CommunityDevelopment/Planning/CommPlans/PC.P.aspx>>. Accessed: December 15, 2009.
- Placer County. 2009. Placer County Code, Placer County California (updated through 10/2009). Chapter 9.36. Available: <<http://qcode.us/codes/placercounty/>>. Accessed: December 15, 2009.
- Plumas County. 1982 [2004]. Plumas County General Plan. Pages 18-27.
- Plumas County. 2008. Municipal Code: Plumas County, California (Ord. No. 08-1068, enacted Oct. 14, 2008). Chapter 9. Available: < [http://library2.municode.com/defaulttest/home.htm?infobase=13824&doc\\_action=whatsnew](http://library2.municode.com/defaulttest/home.htm?infobase=13824&doc_action=whatsnew)>. Accessed: December 15, 2009.
- Sacramento County. 2009a. Municipal Code of Sacramento County, California. Chapter 6.68. Available: <<http://coco.co.sacramento.ca.us/defaultie.htm>>.
- Sacramento County. 2009b. Draft General Plan, Noise Element. April 13.
- San Benito County. 1980 [1984]. San Benito County Amended Noise Element: General Plan Revision. Available: <<http://sanbenitogpu.com/pdf/1980GP/SBC-ExistingGP-Noise.pdf>>. Accessed: December 15, 2009.
- San Benito County. 2009. San Benito County, California Code of Ordinances. Chapter 25.37.035. Available:  
<[http://www.amlegal.com/nxt/gateway.dll/California/sanbenitocounty\\_ca/sanbenitocountycaliorniacodeofordinance?f=templates\\$fn=default.htm\\$3.0\\$vid=amlegal:sanbenitocountyca](http://www.amlegal.com/nxt/gateway.dll/California/sanbenitocounty_ca/sanbenitocountycaliorniacodeofordinance?f=templates$fn=default.htm$3.0$vid=amlegal:sanbenitocountyca)>. Accessed: December 15, 2009.
- San Joaquin County. 1992. General Plan 2010. Volume 1. Policies and Implementation. July.
- San Joaquin County. 2008. Municipal Code: San Joaquin County, California (Ordinance 4365, passed December 9, 2008). Chapter 9-1025.9. Available: < [http://library2.municode.com/defaultnow/home.htm?infobase=16510&doc\\_action=whatsnew](http://library2.municode.com/defaultnow/home.htm?infobase=16510&doc_action=whatsnew)>. Accessed: December 15, 2009.
- San Luis Obispo County. 1992. Noise Element Part 1: Policy Documentation. May.

- San Luis Obispo County. 2009. Municipal Code: San Luis Obispo County, California (Ordinance 3174, passed Feb. 3, 2009). Chapter 9. Available: <[http://library2.municode.com/default/test/home.htm?infobase=16608&doc\\_action=whatsnew](http://library2.municode.com/default/test/home.htm?infobase=16608&doc_action=whatsnew)>. Accessed: December 15, 2009.
- Shasta County. 2004. Shasta County General Plan. Chapter 5.5. Available: <[http://www.co.shasta.ca.us/Departments/Resourcegmt/drm/general\\_plan.htm](http://www.co.shasta.ca.us/Departments/Resourcegmt/drm/general_plan.htm)>. Accessed: December 15, 2009.
- Sierra County. 1998. Noise Element: 2012 General Plan. October.
- Siskiyou County. 1978. Siskiyou County General Plan Noise Element. December.
- Solano County. 2008. 2008 General Plan. Chapter 5. Available: <<http://solanocountygeneralplan.net/>>. Accessed: December 15, 2009.
- Stanislaus County. 2006. Stanislaus County General Plan. Chapter 4. Available: <<http://www.co.stanislaus.ca.us/PLANNING/pl/general-plan.shtm>>. Accessed: December 15, 2009.
- Stanislaus County. 2009. County Code of Ordinance. Available: <[http://qcode.us/codes/stanislauscounty/view.php?topic=10-10\\_46&frames=on](http://qcode.us/codes/stanislauscounty/view.php?topic=10-10_46&frames=on)>. Accessed: December 15, 2009.
- Sutter County. 1998 [2006]. Sutter County General Plan: Policy Document. Chapter 8.
- Tehama County. 2008. Tehama County General Plan. Chapter 9. Available: <<http://www.tehamagp.com/html/documents.html>>. Accessed: December 15, 2009.
- Tulare County. 1988. Noise Element: Policy Document. February.
- Tuolumne County. 1996. Tuolumne County General Plan Policy Document. Chapter 5. Available: <[http://portal.co.tuolumne.ca.us/psp/ps/TUP\\_COMMUNITY\\_DEV/ENTP/c/TU\\_DEPT\\_MENU.T\\_DOC\\_LIST.GBL?action=U&CONTENT\\_PNM=EMPLOYEE&CATGID=1538#TUP\\_CDD\\_PLANNING\\_FLDR&FolderPath=PORTAL\\_ROOT\\_OBJECT.TUP\\_CDD\\_PLANNING\\_FLDR.ADMN\\_TUODM\\_LIST\\_138&IsFolder=false&IgnoreParamTempl=FolderPath%2cIsFolder](http://portal.co.tuolumne.ca.us/psp/ps/TUP_COMMUNITY_DEV/ENTP/c/TU_DEPT_MENU.T_DOC_LIST.GBL?action=U&CONTENT_PNM=EMPLOYEE&CATGID=1538#TUP_CDD_PLANNING_FLDR&FolderPath=PORTAL_ROOT_OBJECT.TUP_CDD_PLANNING_FLDR.ADMN_TUODM_LIST_138&IsFolder=false&IgnoreParamTempl=FolderPath%2cIsFolder)>. Accessed: December 15, 2009.
- Ventura County. 2008. Ventura County General Plan Goals, Policies, and Programs. Chapter 2.16. Available: <[http://www.ventura.org/rma/planning/pdf/plans/Goals\\_Policies\\_and\\_Programs\\_12-1608.pdf](http://www.ventura.org/rma/planning/pdf/plans/Goals_Policies_and_Programs_12-1608.pdf)>. Accessed: December 15, 2009.
- Ventura County. 2009. Municipal Code: Ventura County, California (Ordinance 4396, passed March 5, 2002 and Ordinance 4395, passed January 13, 2009). Chapter 8107-5.613. Available: <[http://library2.municode.com/default/test/home.htm?infobase=16749&doc\\_action=whatsnew](http://library2.municode.com/default/test/home.htm?infobase=16749&doc_action=whatsnew)>. Accessed: December 15, 2009.
- Yolo County. 2009. Draft 2030 Countywide General Plan. Chapter 8D. Available: <<http://www.yolocounty.org/Index.aspx?page=1689>>. Accessed: December 15, 2009.

Yuba County. 2008. Noise: General Plan Background Report. January. Available: <<http://www.co.yuba.ca.us/departments/community%20development/planning/documents/General%20Plan%20Update%20200708/GPUAC%20Reports/Noise%20Background%20Report.pdf>>. Accessed: December 15, 2009.

Yuba County. 2009. Yuba County Code of Ordinances. Chapter 8.20. Available: <<http://www.co.yuba.ca.us/departments/bos/documents/ordinance/>>. Accessed: December 15, 2009.

### 9.1.1.1 Personal Communications

Grey, Darryl. Assistant Planning Director. Alameda County Planning Department. November 20, 2002 (verified by Laura Smith December 15, 2009)—Telephone conversation with Shannon Hatcher, ICF Jones & Stokes, Air Quality, Climate Change, and Noise Project Manager.

Kelley, Matt. Assistant Planner. Shasta County Department of Resource Management: Planning Division, Redding, CA. July 11, 2007—Telephone conversation with Shannon Hatcher, ICF Jones & Stokes, Air Quality, Climate Change, and Noise Project Manager.

## 8.8 Section 5.5, Air Quality, and Associated Ordinances and General Plans

### 8.8.1 Printed References

Amador County Air Pollution Control District. 2000. *Rule 218—Fugitive Dust Emissions*. Page 2. May. Available <<http://www.arb.ca.gov/DRDB/AMA/CURHTML/R218.HTM>>. Accessed October 18, 2006.

ARB. See California Air Resources Board.

Bay Area Air Quality Management District. 1999. *BAAQMD CEQA Guidelines: Assessing the Air Quality Impacts of Projects and Plans*. Pages 7-9; 14-16; Appendix D. Adopted: April 1996. Revised: December 1999. San Francisco, CA.

Bay Area Air Quality Management District. 2009. *BAAQMD Draft CEQA Guidelines*. Prepared by EDAW. September 2009. Sacramento, CA.

Butte County Air Quality Management District. 2008. *CEQA Air Quality Handbook Guidelines for Assessing Air Quality Impacts for Project Subject to SEQA Review*. Page 2-2; 2-4. January. Chico, CA.

Calaveras Air Pollution Control District. 2008. *Fugitive Dust Prevention and Control and Asbestos Hazard Dust Mitigation Plan*.

California Air Resources Board. 2000. *Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles*. Stationary Source Division, Mobile Source Control Division. Sacramento, CA. October



- California Air Resources Board. 2008a. Ambient Air Quality Standards. Last Revised: November 17, 2008. Available: <<http://www.arb.ca.gov/research/aaqs/aaqs2.pdf>>. Accessed: August 20, 2009.
- California Air Resources Board. 2008b. In-Use Mobile Agricultural Equipment Regulation. Last Revised: May 15, 2008. Available: <<http://www.arb.ca.gov/ag/agtractor/agtractor.htm>>. Accessed: August 20, 2009.
- California Air Resources Board. 2009a. ARB Databases: Aerometric Data Analysis and Management System (ADAM). *Top 4 Summary*. Available: <<http://www.arb.ca.gov/adam/cgi-bin/db2www/adamtop4b.d2w/start>>. Accessed: August 20, 2009.
- California Air Resources Board. 2009b. *Area Designation Maps/State and National*. Last revised: February 9, 2009. Available: <<http://www.arb.ca.gov/desig/adm/adm.htm>>. Accessed: August 12, 2009.
- County of Tuolumne. 2000. *Thresholds of Significance Under the California Environmental Quality Act (CEQA)*. Page 3. Community Development Department. April 12. Sonoma, CA.
- California Department of Pesticide Regulation. 2009. About DPR. Available: <<http://www.cdpr.ca.gov/dprabout.htm>>. Accessed: March 1, 2010.
- DPR, see California Department of Pesticide Regulation
- El Dorado County Air Pollution Control District. 2002. *Guide to Air Quality Assessment: Determining Significance of Air Quality Impacts Under the California Environmental Quality Act*. First Edition. El Dorado County. Pages 3-5 and 2-6. February 2002. Placerville, CA.
- El Dorado County Air Quality Management District. 2005a. *Rule 223-1*. Available: <[http://www.edcgov.us/emd/apcd/PDF/Rule\\_223\\_Fugitive\\_Dust\\_General\\_Requirements.pdf](http://www.edcgov.us/emd/apcd/PDF/Rule_223_Fugitive_Dust_General_Requirements.pdf)>. Accessed: August 25, 2009.
- El Dorado County Air Quality Management District. 2005b. *Rule 223-2*. Available: <[http://www.edcgov.us/emd/apcd/PDF/Rule\\_223-2\\_Fugitive\\_Dust\\_Asbestos\\_Hazard\\_1018\\_Final.pdf](http://www.edcgov.us/emd/apcd/PDF/Rule_223-2_Fugitive_Dust_Asbestos_Hazard_1018_Final.pdf)>. Accessed: August 24, 2009.
- EPA. See U.S. Environmental Protection Agency.
- Feather River Air Quality Management District. 2009. Air Quality CEQA Review. Last Revised: July 27, 2009. Available: <<http://www.frawmd.org/PlanningTools.htm>>. Accessed: August 10, 2009.
- Feather River Air Quality Management District. n.d. *CEQA Significance Thresholds*. Available: <[http://www.fraqmd.org/CEQA\\_Thresholds.htm](http://www.fraqmd.org/CEQA_Thresholds.htm)>. Accessed: August 12, 2009.
- Great Basin Air Pollution Control District. 2006. Rule 401 Fugitive Dust. Last Revised: December 4, 2006. Last Revised: December 4, 2006 Available: <<http://www.gbuapcd.org/rulesandregulations/PDF/Rule401.pdf>> Accessed: August 24, 2009.
- ICF Jones & Stokes. 2008. *Irrigated Lands Regulatory Program Existing Conditions Report*. December. (ICF J&S 05508.05.) Sacramento, CA. Prepared for the State Water Resources Control Board and Central Valley Regional Water Quality Control Board, Rancho Cordova, CA.
- Kern County Planning Department. 2004. Guidelines for Preparing an Air Quality Assessment for Use in Environmental Impact Reports. Pg. 5. Planning Department. Bakersfield, CA.

- Lake County Air Quality Management District. 2006. *Rules and Regulations*. Page 148. Last Revised: August 9, 2006. Available: <<http://www.arb.ca.gov/DRDB/LAK/CURHTML/LCAQMDRULEBOOK2006.PDF>>. Accessed: August 12, 2009.
- Modoc County Air Pollution Control District. n.d. Rule 8.7—Asbestos Containing Serpentine Rock Toxic Control Measure. Available <<http://www.arb.ca.gov/DRDB/MOD/CURHTML/R8-7.HTM>>. Accessed: August 28, 2009.
- Monterey Bay Air Pollution Control District. 2004. *CEQA Guidelines*. Pages 5-2, 5-5, 8-2, 8-3, 8-8, and 8-15. Monterey Bay Unified Air Pollution Control District. June. Monterey, CA.
- Northern Sierra Air Quality Management District. 2000. *Guidelines for Assessing Air Quality Impacts of Land Use Projects*. Page 9. Grass Valley, CA.
- Sacramento Metropolitan Air Quality Management District. 2004. *Guide to Assessing Air Quality in Sacramento County*. Pages 2-10 and 2-11. July 10. Sacramento, CA
- San Joaquin Valley Unified Air Pollution Control District. 2002. *Guide for Assessing and Mitigating Air Quality Impacts*. Pages 22-26. Mobile Source/CEQA Section of the Planning Division of the San Joaquin Valley Unified Air Pollution Control District. January 10. Fresno, CA.
- Shasta County Air Quality Management District. n.d. *Standard Mitigation Measures Applicable to All Projects*. Submitted to the Shasta County Planning Agency for Inclusion by Reference in the Shasta County General Plan.
- Shasta County. 2004. *Shasta County General Plan*. Page 6.05.012. Available <<http://www.co.shasta.ca.us/Departments/Resourcegmt/drm/pdf/65airq.pdf>>. Accessed: August 13, 2009.
- U.S. Environmental Protection Agency. 2009a. Air Data. Available: <<http://www.epa.gov/air/data/geosel.html>>. Accessed: August 20, 2009.
- U.S. Environmental Protection Agency. 2009b. *Green Book*. Available: <<http://www.epa.gov/oar/oaqps/greenbk/>>. Accessed: August 10, 2009.
- Yolo-Solano Air Quality Management District. 2007 *Handbook for Assessing and Mitigation Air Quality Impact*. Page 6. Yolo-Solano Air Quality Management District. July 11. Davis, CA.

### 9.1.1.2 Personal Communications

- Barber, Daniel. Air Quality Specialist. San Joaquin Valley Air Pollution Control District, Fresno, CA. March 14, 2007—Telephone Conversation with Shannon Hatcher, Air Quality, Climate Change, and Noise Program Manager, ICF Jones & Stokes.
- Beck, Eldon. Assistant Air Pollution Control Officer. Siskiyou County Air Pollution Control District, Yreka, CA. August 12, 2009 and September 2, 2009—Telephone Conversations with Laura Smith, Air Quality and Climate Change Specialist, ICF Jones & Stokes.
- Bertotti, Joe. Air Pollution Control Officer. Lassen County Air Pollution Control District, Susanville, CA. August 25, 2009— Telephone Conversations with Laura Smith, Air Quality and Climate Change Specialist, ICF Jones & Stokes

- Backus, Brent. Associate Planner. Placer County Air Pollution Control District, Auburn, CA. June 26, 2006—Email Message to Shannon Hill, Air Quality and Climate Change Specialist, ICF Jones & Stokes.
- Cadrett, John. CEQA Coordinator. San Joaquin Valley Air Pollution Control District, Fresno, CA. June 15, 2005—Telephone Conversation with Shannon Hatcher, Air Quality, Climate Change, and Noise Program Manager, ICF Jones & Stokes.
- Chang, Yu-Shuo. Air Quality Planner. Placer County Air Pollution Control District, Auburn, CA. August 10, 2009—Email Message with Shannon Hill, Air Quality and Climate Change Specialist, ICF Jones & Stokes.
- Conway, David. Air Pollution Specialist. Mariposa County Air Quality Management District, Mariposa, CA. August, 12, 2009 and August 24, 2009— Telephone Conversations with Laura Smith, Air Quality and Climate Change Specialist, ICF Jones & Stokes.
- Damo, Julie. Air Quality Engineer. Kern County Air Pollution Control District, Bakersfield, CA. August 25, 2009 and December 1, 2009—Email messages to Laura Smith, Air Quality and Climate Change Specialist, ICF Jones & Stokes
- Gearhart, Douglass. Air Pollution Control Officer. Lake County Air Quality Management District, Lakeport, CA. August 12, 2009— Telephone Conversations with Laura Smith, Air Quality and Climate Change Specialist, ICF Jones & Stokes
- Gomez, T.J. Air Pollution Standards Officer. Colusa County Air Quality Management District, Colusa, CA. August 19, 2009—Email message with Shannon Hill, Air Quality and Climate Change Specialist, ICF Jones & Stokes.
- Grewal, Lakhmire. Air Pollution Control Officer. Calaveras County Air Pollution Control District, San Andreas, CA. August 24, 2009— Telephone Conversations with Laura Smith, Air Quality and Climate Change Specialist, ICF Jones & Stokes
- Haas, Katie. Air Pollution Inspector II. Modoc County Air Pollution Control District, Alturas, CA. August 12, 2009— Telephone Conversations with Laura Smith, Air Quality and Climate Change Specialist, ICF Jones & Stokes
- Harris, Jim. Air Pollution Control Officer. Amador County Air Pollution Control District, Jackson, CA. August 12, 2008 and August 24, 2008—Telephone Conversation and Email with Laura Smith, Air Quality and Climate Change Specialist, ICF Jones & Stokes.
- Kulesza, Dana. Environmental Scientist. Irrigated Lands Regulatory Program, Rancho Cordova, CA. November 24, 2009. Email message to Megan Smith, Program Manager, ICF Jones & Stokes.
- Ledbetter, Ian. Glenn County Air Pollution Control District, Willows, CA. August 10, 2009—email message with Shannon Hill, Air Quality and Climate Change Specialist, ICF Jones & Stokes.
- Longmire, Sam. Air Pollution Control Specialist III. Northern Sierra Air Pollution Control District, Grass Valley, CA. August 25, 2009—Email message to Laura Smith, Air Quality and Climate Change Specialist, ICF Jones & Stokes.
- Otani, Dennis. Senior Air Quality Specialist. El Dorado County Air Pollution Control District, Placerville, CA. 2004 and 2006—Telephone Conversation with Shannon Hatcher, Air Quality, Climate Change, and Noise Program Manager, ICF Jones & Stokes.

- Sandman, Bill. Deputy Air Pollution Control Officer. Tuolumne County Air Pollution Control District, Columbia, CA. . August 31, 2009—Email Message to Laura Smith, Air Quality and Climate Change Specialist, ICF Jones & Stokes.
- Schade, Ted. Great Basin Unified Air Pollution Control District, Bishop, CA. August 18, 2009—Telephone conversation with Laura Smith, Air Quality and Climate Change Specialist, ICF Jones & Stokes.
- Siong, Patia. Senior Air Quality Specialist. San Joaquin Valley Air Pollution Control District, Stockton CA. September 3, 2009—Email Message to Laura Smith, Air Quality and Climate Change Specialist, ICF Jones & Stokes.
- Sunday, Joe. Air Pollution Specialist. Tehama County Air Pollution Control District, Red Bluff, CA. August 10, 2009—Email Message with Shannon Hill, Air Quality and Climate Change Specialist, ICF Jones & Stokes.
- Waldrop, John. Shasta County Air Pollution Control District, Redding, CA. August 12, 2009—Email Message with Laura Smith, Air Quality and Climate Change Specialist, ICF Jones & Stokes.
- Williams, Gail. Air Quality Planner. Butte County Air Quality Management District, Chico, CA. September 2, 2009—Telephone Conversation with Laura Smith, Air Quality and Climate Change Specialist, ICF Jones & Stokes.

## 8.9 Section 5.6, Climate Change

### 8.9.1 Printed References

- AEP. See Association of Environmental Professionals.
- ARB. See California Air Resources Board.
- Association of Environmental Professionals. 2007. *Alternative Approaches to Analyzing Greenhouse*
- California Air Resources Board. 2008. *Climate Change Proposed Scoping Plan: A Framework for Change*. October. Available: <<http://www.arb.ca.gov/cc/scopingplan/document/psp.pdf>>. Accessed: August 12, 2009.
- California Air Resources Board. 2009a. Agricultural Sector. Last revised: April 6, 2009. Available: <<http://www.arb.ca.gov/cc/scopingplan/agriculture-sp/agriculture-sp.htm>>. Accessed: August 20, 2009.
- California Air Resources Board. 2009b. Research on GHG Emissions from Fertilizer. Last revised: July 30, 2009. Available: <<http://www.arb.ca.gov/ag/fertilizer/fertilizer.htm>>. Accessed: August 20, 2009.
- California Air Resources Board. 2009c. Greenhouse Gas Inventory Data- Graphs. Last revised: May 22, 2009. Available: <<http://www.arb.ca.gov/cc/inventory/data/graph/graph.htm>>. Accessed: September 22, 2009.
- California Energy Commission. 2005. *Global Climate Change and California*. Pages 2–3. CEC-6002005 007-SF. Prepared by Susan Brown.

California Energy Commission. 2006. *Inventory of California Greenhouse Gas Emissions and Sinks 1990 to 2004*. (CEC-600-2006-013-SF.) December. Available: <<http://www.energy.ca.gov/2006publications/CEC-600-2006-013/CEC-600-2006-013-SF.PDF>>. Accessed: September 21, 2009.

CEC. See California Energy Commission.

EDAW. 2009. California Environmental Quality Act: Air Quality Guidelines. Prepared for: Bay Area Air Quality Management District. December.

EPA. See U.S. Environmental Protection Agency.

*Gas Emissions and Global Climate Change in CEQA Documents*. Available: <[http://www.counties.org/images/public/Advocacy/ag\\_natres/AEP\\_Global\\_Climate\\_Change\\_June\\_29\\_Final.pdf](http://www.counties.org/images/public/Advocacy/ag_natres/AEP_Global_Climate_Change_June_29_Final.pdf)> Accessed: September 22, 2009.

Governor's Office of Planning and Research. 2009. *CEQA Guidelines Sections Proposed to be Added or Amended*. Available: <[http://www.opr.ca.gov/ceqa/pdfs/PA\\_CEQA\\_Guidelines.pdf](http://www.opr.ca.gov/ceqa/pdfs/PA_CEQA_Guidelines.pdf)>. Accessed: August 12, 2009.

ICF Jones & Stokes. 2008. *Irrigated Lands Regulatory Program Existing Conditions Report*. December. (ICF J&S 05508.05.) Sacramento, CA. Prepared for the State Water Resources Control Board and Central Valley Regional Water Quality Control Board, Rancho Cordova, CA.

Intergovernmental Panel on Climate Change. 1996. 1995: Science of Climate Change. (Second Assessment Report). Cambridge University Press. Cambridge, U.K

Intergovernmental Panel on Climate Change. 2001. Atmospheric Chemistry and Greenhouse Gases. In: *Climate Change 2001: Working Group I: The Scientific Basis*. Available: <http://www.ipcc.ch/ipccreports/tar/wg1/pdf/TAR-04.PDF>. Accessed: September 22, 2009.

Intergovernmental Panel on Climate Change. 2007a. Summary for Policy Makers. In: *Climate Change 2007: The Physical Science Basis*. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Available: <<http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf>>. Accessed: July 28, 2009.

International Panel on Climate Change. 2007b. *Climate Change 2007: The Physical Science Basis*. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning (eds.)]. Available: <<http://www.ipcc.ch/ipccreports/ar4-wg1.htm>>. Accessed: September 22, 2009.

International Panel on Climate Change. 2007c. *Climate Change 2007: Synthesis Report*. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Available: <[http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4\\_syr\\_spm.pdf](http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf)>. Accessed: September 22, 2009.

IPCC. See International Panel on Climate Change.

National Oceanic and Atmospheric Administration. 2005. Greenhouse Gases: Frequently Asked Questions. Available: <<http://lwf.ncdc.noaa.gov/oa/climate/gases.html>>. Accessed: September 22, 2009.



- NOAA. See National Oceanic and Atmospheric Administration.
- OPR. See Governor's Office of Planning and Research.
- San Joaquin Valley Air Pollution Control District. 2009. Final Draft Staff Report: Addressing Greenhouse Gas Emissions under the California Environmental Quality Act. September.
- SCAQMD. See South Coast Air Quality Management District.
- SJVAPCD. See San Joaquin Valley Air Pollution Control District.
- Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K. B. Averyt, M. Tignor, and H. L. Miller (eds.). 2007. *Technical Summary*. (Working Group III Fourth Assessment Report). Available: <<http://www.ipcc.ch/ipccreports/ar4-wg3.htm>>. Accessed: September 1, 2009.
- South Coast Air Quality Management District. 2008. Board Meeting Date: December 5, 2008 Agenda No. 31. Last revised November 26, 2008. Available: <<http://www.aqmd.gov/hb/2008/December/081231a.htm>>. Accessed: October 1, 2009.
- State of California, Department of Justice. 2008. The California Environmental Quality Act: Addressing Global Warming Impacts at the Local Agency Level. Last revised: December 9, 2008. Available: <[http://www.ag.ca.gov/globalwarming/pdf/GW\\_mitigation\\_measures.pdf](http://www.ag.ca.gov/globalwarming/pdf/GW_mitigation_measures.pdf)>. Accessed: September 25, 2009.
- State of California, Department of Justice. 2009. November 4, 2009—Email and letter to Dave Warner, San Joaquin Valley Air Pollution Control District, regarding the final draft staff report on greenhouse gas emissions under CEQA. Available: <[http://ag.ca.gov/globalwarming/pdf/comments\\_SJVAPCD\\_threshold\\_proposal.pdf](http://ag.ca.gov/globalwarming/pdf/comments_SJVAPCD_threshold_proposal.pdf)>. Accessed November 24, 2009.
- U.S. Environmental Protection Agency. 2009a. Fact Sheet: Proposed Rule: Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule. Last revised: September 30, 2009. Available: <<http://www.epa.gov/NSR/fs20090930action.html>>. Accessed: November 23, 2009.
- U.S. Environmental Protection Agency. 2009b. *Summary of the Science Supporting EPA's Finding That Greenhouse Gases Threaten Public Health and Welfare*. Page 1. April 17. Available: <<http://www.epa.gov/climatechange/endangerment/downloads/ScienceFactSheet.pdf>>. Accessed: August 12, 2009.
- U.S. Environmental Protection Agency. 2009c. California State Motor Vehicle Pollution Control Standards; Notice of Decision Granting a Waiver of Clean Air Act Preemption for California's 2009 and Subsequent Model Year Greenhouse Gas Emission Standards for New Motor Vehicles. Pages 1 & 11. Last revised: June 30, 2009. Available: <<http://www.epa.gov/otaq/climate/ghgwaiver.pdf>>. Accessed: June 30, 2009.
- U.S. Environmental Protection Agency. 2009d. *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2007*. EPA 430-R-004. April. Available: <<http://epa.gov/climatechange/emissions/usinventoryreport.html>>. Accessed: September 22, 2009.

## 8.10 Section 5.7, Vegetation and Wildlife

### 8.10.1 Printed References

- California Department of Fish and Game. No Date. *Private Lands Incentive Programs*. Available: <<http://www.dfg.ca.gov/lands/wetland/private.html>>. Accessed: December 4, 2009.
- California Native Plant Society. 2009. Inventory of Rare and Endangered Plants (Online Edition, Version v7-09d 10-07-09). Available: <<http://cnps.web.aplus.net/cgi-bin/inv/inventory.cgi>>. Accessed: October 16, 2009.
- California Natural Diversity Database. 2009. RareFind, Version 3.1.0. (August 1, 2009, update). California Department of Fish and Game, Biogeographic Data Branch.
- CNDDDB. See California Natural Diversity Database.
- CNPS. See California Native Plant Society.
- DFG. See California Department of Fish and Game.
- Hickman, J. C. (ed.). 1993. *The Jepson Manual: Higher Plants of California*. Berkeley: University of California Press.
- Jennings, M. R., and M. P. Hayes. 1994. Amphibian and reptile species of special concern in California. California Department of Fish and Game. Sacramento, CA.
- Kwasny, D. C., M. Wolder, and C. R. Isola. 2004. *Central Valley Joint Venture Technical Guide to Best Management Practices for Mosquito Control in Managed Wetlands*. Date Posted: 2006. Available: <[http://www.centralvalleyjointventure.org/materials/CVJV\\_Mosquito\\_WQMP\\_rev.pdf](http://www.centralvalleyjointventure.org/materials/CVJV_Mosquito_WQMP_rev.pdf)>. Accessed: December 3, 2009.
- National Marine Fisheries Service. 2009. ESA Salmon Recovery Plans. National Oceanic and Atmospheric Administration, Northwest Regional Office. Seattle, WA. Last Revised: January 13, 2010. Available: <<http://www.nwr.noaa.gov/Salmon-Recovery-Planning/ESA-Recovery-Plans/Index.cfm>>. Accessed: April 2010.
- Remsen, J. V., Jr. 1978. Bird Species of Special Concern in California. Sacramento, CA: California Department of Fish and Game, Wildlife Management Branch.
- Western Bat Working Group. 2007. The Western Bat Species: Regional Priority Matrix. Available: <[http://wbwg.org/speciesinfo/species\\_matrix/species\\_matrix.html](http://wbwg.org/speciesinfo/species_matrix/species_matrix.html)>.
- Williams, D. F. 1986. Mammalian Species of Special Concern in California. (Wildlife Management Division Administrative Report 86-1.) Sacramento, CA: California Department of Fish and Game, Wildlife Management Division.

## 8.11 Section 5.8, Fisheries

### 8.11.1 Printed References

- Anadromous Fish Restoration Program. 2009. Chinookprod. Last updated: April 30, 2009. Available: <<http://delta.dfg.ca.gov/afrp/documents/Chinookprod%20043009version2.xls>>. Accessed: May 31, 2009.
- Bailey, H.C., C. Alexander, C. DiGiorgio, M. Miller, S.I. Doroshov, and D.E. Hinton. 1994. The effect of agricultural discharge on striped bass (*Morone saxatilis*) in California's Sacramento-San Joaquin drainage. *Ecotoxicology* 3: 123-142.
- Baldwin, D.H., J. A. Spromberg, T. K. Collier, and N. L. Scholz. 2009. A fish of many scales: extrapolating sublethal pesticide exposures to the productivity of wild salmon populations. *Ecological Applications* 19(8): 2004–2015.
- Barnett-Johnson, R., C. B. Grimes, C. F. Royer, and C. J. Donohoe. 2007. Identifying the contribution of wild and hatchery Chinook salmon (*Oncorhynchus tshawytscha*) to the ocean fishery using otolith microstructure as natural tags. *Canadian Journal of Fish and Aquatic Sciences* 64:1683–1692.
- Baxter, R. D. 2000. Splittail and Longfin Smelt. IEP Newsletter 13(2):19–21. California Department of Water Resources, Division of Environmental Services. Sacramento, CA. Available: <[www.iep.water.ca.gov/report/newsletter](http://www.iep.water.ca.gov/report/newsletter)>.
- Bay Institute. 2007. Petition to the State of California Fish and Game Commission for the Listing of Longfin Smelt (*Spirinchus thaleichthys*) as an Endangered Species under the California Endangered Species Act. Submitted by the Bay Institute, the Center for Biological Diversity, and the Natural Resources Defense Council. August 8. Available: <<http://www.bay.org/LongfinSmeltState.pdf>>.
- Bennett, W.A. 2005. Critical Assessment of the Delta Smelt population in the San Francisco Estuary, California. San Francisco Estuary and Watershed Science, Vol. 3, Issue 2 [September 2005], Art. 1
- Biological Review Team. 2005. *Green sturgeon (Acipenser medirostris) Status Review Update*. Prepared for the National Marine Fisheries Service. 36 pp.
- Bjornn, T. C., and D. W. Reiser. 1991. Habitat Requirements of Salmonids in Streams. *American Fisheries Society Special Publication* 19:83–138.
- Borges, S., C. Dzubow, G. Orrick, and A. Stavola. 2004. 2,4-Dichlorophenoxyacetic Acid Analysis of Risks to Endangered and Threatened Salmon and Steelhead. U.S. Environmental Protection Agency Environmental Field Branch Office of Pesticide Programs. December 1.
- Brassard, C., L. Gill, A. Stavola, J. Lin, and L. Turner. 2003. Atrazine Analysis of Risks to Endangered and Threatened Salmon and Steelhead. U.S. Environmental Protection Agency Policy and Regulatory Services Branch and Environmental Field Branch Office of Pesticide Programs. July 27.
- Brown, L. R., and P. B. Moyle. 1993. Distribution, ecology, and status of the fishes of the San Joaquin River drainage, California. *California Fish and Game* 79:96–114.

- Calhoun, A.J. 1942. The biology of the black-spotted trout (*Salmo clarkihenshawi*) (Gill and Jordan) in two Sierra Nevada lakes. Ph.D. dissertation. Stanford University, Palo Alto, California. 218 pp.
- California Department of Fish and Game. 1965. California Fish and Wildlife Plan.
- California Department of Fish and Game. 1998. A status review of the spring run Chinook salmon in the Sacramento River drainage. Report to the Fish and Game Commission. Candidate species status report 98-1. Sacramento, California. June. 394 pages.
- California Department of Fish and Game. 2009a. Special Animals List. October. State of California, The Resources Agency, Department of Fish and Game, Biogeographic Data Branch. July. Available: <<http://www.dfg.ca.gov/biogeodata/cnddb/pdfs/SPAnimals.pdf>>.
- California Department of Fish and Game. 2009b. A status review of the longfin smelt (*Spirinchus thaleichthys*) in California. Report to the Fish and Game Commission. January 23.
- California Department of Fish and Game. 2009c. GrandTab. Fisheries Branch Anadromous Resources Assessment. California Central Valley Sacramento and San Joaquin River Systems. February 18.
- California Department of Fish and Game. 2009c. Longfin Smelt Indices from 1967-2008. Available: <<http://www.delta.dfg.ca.gov/data/mwt/Indices/sld003.asp>>. Accessed: June 19, 2009.
- California Fish and Game Commission. 2009. Title 14: Fish and Game Commission Notice of Proposed Changes in Regulations. April 23. Available: <[http://www.fgc.ca.gov/regulations/new/2009/670\\_5lfsntc.pdf](http://www.fgc.ca.gov/regulations/new/2009/670_5lfsntc.pdf)>.
- Central Valley Regional Water Quality Control Board. 2005. Amendments to the water quality control plan for the Sacramento River and San Joaquin River basins for the control program for factors contributing to the dissolved oxygen impairment in the stockton deep Water ship channel. Final staff report. February 23.
- Central Valley Regional Water Quality Control Board. 2007. Revised Draft of the 2007 Review of Monitoring Data for the Irrigated Lands Conditional Waiver Program. July.
- Coffin, P. (1981) Distribution and life history of the Lahontan/Humboldt cutthroat trout- Humboldt River drainage Basin.
- Comrack, L., B. Bolster, J. Gustafson, D. Steele, and E. Burkett. April 10, 2008. Species of Special Concern: A Brief Description of an Important California Department of Fish and Game Designation. California Department of Fish and Game, Wildlife Branch, Nongame Wildlife Program Report 2008-03, Sacramento, CA. 4pp.
- Corbin, M., B. Anderson, P. Doelling, and J. Hetrick. 2009a. Potential Risks of Atrazine Use to Federally Threatened California Red-legged Frog (*Rana aurora draytonii*) and Delta Smelt (*Hypomesus transpacificus*). Pesticide Effects Determinations. U.S. Environmental Protection Agency, Environmental Fate and Effects Division, Office of Pesticide Programs. February 19.

- Corbin, M., R. Daiss, D.R. Judkins, J.K.Wolf, and P. Hurley. 2009b. Risks of Chlorpyrifos Use to Federally Threatened & Endangered California red-legged frog (*Rana aurora draytonii*), California tiger salamander (*Ambystoma californiense*), San Francisco garter snake (*Thamnophis sirtalis tetrataenia*), California clapper rail, (*Rallus longirostris obsoletus*), Salt marsh harvest mouse (*Reithrodontomys raviventris*), Bay checkerspot butterfly (*Euphydryas editha bayensis*), Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), San Joaquin kit fox (*Vulpes macrotis mutica*), California freshwater shrimp (*Syncaris pacifica*), and Delta smelt (*Hypomesus transpacificus*). Pesticide Effects Determinations. U.S. Environmental Protection Agency, Environmental Fate and Effects Division, Office of Pesticide Programs. October 16.
- Cowan, W. 1983. Annual fisheries management report FY-83', Summit Lake Indian Reservation, Humboldt County, Nevada. Unpublished report. Summit Lake Paiute Tribe, Winnemucca, Nevada. 37 pp.
- Dambacher J. 1991. Distribution, abundance, and emigration of juvenile steelhead (*Oncorhynchus mykiss*) and analysis of stream habitat in the Steamboat Creek basin, Oregon. MS thesis, Oregon State University, Corvallis, Oregon. 129 p.
- Daughtry, N. 2004a. 1,3-Dichloropropene Analysis of Risks to Endangered and Threatened Salmon and Steelhead. U.S. Environmental Protection Agency Environmental Field Branch Office of Pesticide Programs. April 19.
- Daughtry, N. 2004b. Methidathion: Analysis of Risks to Endangered and Threatened Salmon and Steelhead. Environmental Protection Agency, Environmental Field Branch Office of Pesticide Programs, April 1.
- Daughtry, N. 2004c. Oxyfluorfen: Analysis of Risks to Endangered and Threatened Salmon and Steelhead. Environmental Protection Agency, Environmental Field Branch Office of Pesticide Programs, April 28.
- Daughtry, N. and L. Turner, 2004. Methyl Parathion: Analysis of Risks to Endangered and Threatened Salmon and Steelhead. Environmental Protection Agency, Environmental Field Branch Office of Pesticide Programs, April 1.
- Dege, M, and L. R. Brown. 2004. Effect of outflow on spring and summertime distribution and abundance of larval and juvenile fishes in the upper San Francisco estuary. *American Fisheries Society Symposium* 39:49–65.
- Del Rosario, R., and Y. Redler. Unpublished data. Residence of Juvenile Winter-Run Chinook Salmon in the Sacramento-San Joaquin Delta: Emigration Coincides with Pulse Flows and Floodplain Drainage. Poster presentation at 9th Biennial State of the San Francisco Estuary Conference. September.
- Dryfoos, R. L. 1965. The Life History and Ecology of the Longfin Smelt in Lake Washington. Ph.D. dissertation, University of Washington.
- Erickson, W. and L. Turner, 2002b. Protemetryn: Analysis of Risks to Endangered and Threatened Salmon and Steelhead. Environmental Protection Agency, Environmental Field Branch Office of Pesticide Programs, November 29.



- Erickson, W., and L. Turner, 2002c. Metolachlor: Analysis of Risks to Endangered and Threatened Salmon and Steelhead. Environmental Protection Agency, Environmental Field Branch Office of Pesticide Programs, November 29.
- Erickson, W., and L. Turner. 2003a. Azinphos Methyl Analysis of Risks to Endangered and Threatened Salmon and Steelhead. U.S. Environmental Protection Agency Environmental Field Branch Office of Pesticide Programs. May 15.
- Erickson, W., and L. Turner, 2003c. Mythomyl: Analysis of Risks to Endangered and Threatened Salmon and Steelhead. Environmental Protection Agency, Environmental Field Branch Office of Pesticide Programs, March 31.
- Erickson, W., and L. Turner, 2003d. Oryzalin: Analysis of Risks to Endangered and Threatened Salmon and Steelhead. Environmental Protection Agency, Environmental Field Branch Office of Pesticide Programs, March 31.
- Erickson, W., and L. Turner. 2003b. Carbaryl Analysis of Risks to Endangered and Threatened Salmon and Steelhead. U.S. Environmental Protection Agency Environmental Field Branch Office of Pesticide Programs. March 31.
- Everest, F. H., and D. W. Chapman. 1972. Habitat selection and spatial interactions by juvenile Chinook salmon and steelhead trout in two Idaho streams. *Journal of the Fisheries Research Board of Canada* 29:91–100.
- Everest, F. H., G.H. Reeves, J.R. Sedell, J. Wolfe, D. Hohler, and D.A. Heller, D. A. 1986 Abundance, behavior, and habitat utilization by coho salmon and steelhead trout in Fish Creek, Oregon, as influenced by habitat enhancement. Annual Report 1985 Project No. 84-11. Prepared by U.S. Forest Service for Bonneville Power Administration, Portland, Oregon.
- Feyrer, F., M. L. Nobriga, and T. R. Sommer. 2007. Multidecadal trends for three declining fish species: habitat patterns and mechanisms in the San Francisco Estuary, California, USA. *Canadian Journal of Fisheries and Aquatic Sciences* 64 (4): 723–734.
- Fontaine, B. 1988. An evaluation of the effectiveness of instream structures for steelhead trout rearing habitat in the Steamboat Creek basin. M.S. Thesis. Oregon State University, Corvallis, OR.
- Hallock, R. J. 1989. Upper Sacramento River steelhead, *Oncorhynchus mykiss*, 1952–1988. Report to the Fish and Wildlife Service. 85 pp.
- Hallock, R. J., R.T. Elwell, and D.H. Fry. 1970. Migrations of adult king salmon (*Oncorhynchus tshawytscha*) in the San Joaquin Delta, as demonstrated by the use of sonic tags. Calif. Depart. Fish Game Fish. Bull. 15
- Hallock, R. J., W. F. Van Woert, and L. Shapovalov. 1961. An evaluation of stocking hatchery reared steelhead rainbow trout (*Salmo gairdneri gairdneri*) in the Sacramento River system. California Department of Fish and Game. *Fish Bulletin* 114. 74 pp.
- Hamilton, S.J., and R.H. Wiedmeyer. 1990. Concentrations of boron, molybdenum, and selenium in Chinook salmon. *Transactions of the American Fisheries Society* 119: 500-510.

- Hartless, C., M. Janson, R. Miller, F. Khan, and B. Anderson. 2009. Risks of Trifluralin Use to the Federally Listed California Red-legged Frog (*Rana aurora draytonii*), Delta Smelt (*Hypomesus transpacificus*), San Francisco Garter Snake (*Thamnophis sirtalis tetrataenia*), and San Joaquin Kit Fox (*Vulpes macrotis mutica*). Pesticide Effects Determinations. U.S. Environmental Protection Agency, Environmental Fate and Effects Division, Office of Pesticide Programs. October 16.
- Hartman, G. F. 1965. The role of behavior in the ecology and interaction of underyearling coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*Salmo gairdneri*). *Journal of the Fisheries Research Board of Canada* 20:1,035–1,081.
- Henley, W.F., M.A. Patterson, R.J. Neves, and A.D. Lemly. 2000. Effects of sedimentation and turbidity on lotic food webs: a concise review for natural resource managers. *Reviews in Fisheries Science* 8(2): 125-139.
- Hill, K. A., and J. D. Webber. 1999. *Butte Creek spring-run Chinook salmon, Oncorhynchus tshawytscha, juvenile outmigration and life history 1995–1998*. Inland Fisheries Administrative Report No. 99-5. California Department of Fish and Game, Sacramento Valley and Central Sierra Region. Rancho Cordova, CA.
- ICF Jones & Stokes. 2008. *Irrigated Lands Regulatory Program Existing Conditions Report*. December. (ICF J&S 05508.05.) Sacramento, CA. Prepared for the State Water Resources Control Board and Central Valley Regional Water Quality Control Board, Rancho Cordova, CA.
- Jassby, A. D., W. J. Kimmerer, S. G. Monismith, C. Armor, J. E. Cloern, T. M. Powell, J. R. Schubel, and T. J. Vendlinski. 1995. Isohaline position as a habitat indicator for estuarine populations. *Ecological Applications* 5:272–289.
- Johnson, M.L., I. Werner, S. Teh, and F. Loge. 2010. Evaluation of chemical, toxicological, and histopathologic data to determine their role in the pelagic organism decline. Report to the State Water Resources Control Board. April 20.
- Joint Hatchery Review Committee. 2001. *Final Report on Anadromous Salmonid Fish Hatcheries in California*. California Department of Fish and Game and National Marine Fisheries Service, Southwest Region.
- Keigwin, R.P. 2010. Letter from Richard P. Keigwin, Jr., Director of EPA Pesticide Re-evaluation Division, to Counsels for Dow AgroSciences LLC., Makhteshim Agan of North America, Inc., and Cheminova, Inc. USA. Available: <<http://www.epa.gov/espp/litstatus/wtc/Biop1-Letter-to-Registrants-April-2010.pdf>> Accessed: May 7, 2010.
- Kimmerer, W. J. 2002. Effects of freshwater flow on abundance of estuarine organisms: physical effects or trophic linkages? *Marine Ecology Progress Series* 243:39–55.
- Kimmerer, W. J. 2008. Losses of Sacramento River Chinook Salmon and Delta Smelt to Entrainment in Water Diversions in the Sacramento–San Joaquin Delta. *San Francisco Estuary and Watershed Science* 6(2).
- Kimmerer, W. J., E. S. Gross, and M. L. MacWilliams. 2009. Is the Response of Estuarine Nekton to Freshwater Flow in the San Francisco Estuary Explained by Variation in Habitat Volume? *Estuaries and Coasts* 32(2):375–389.

- Kimmerer, W.J., J.H. Cowan, L.W. Miller, and K.A. Rose. 2001. Analysis of an estuarine striped bass population: effects of environmental conditions during early life. *Estuaries* 24 (4): 557-575.
- Knapp, R. A. and T.L. Dudley. 1990. Growth and longevity of golden trout, *Oncorhynchus aguabonita*, in their native streams. California Department of Fish and Game.
- Knapp, R. A., and V.T. Vrendenburg. 1996. Spawning by California golden trout: characteristics of spawning fish, season and daily timing, redd characteristics, and microhabitat preferences. *Trans. Am. Fish. Soc.*, 125, 519-531.
- Koch, D.L., J.J. Cooper, E.L. Lider, R.L. Jacobson, and R.J. Spencer. 1979. Investigations of Walker Lake, Nevada: Dynamic ecological relationships. Desert Research Center, University of Nevada, Reno. 91 pp.
- Kuivila, K., and M. Hladik. 2008. Understanding the occurrence and transport of current-use pesticides in the San Francisco Estuary watershed. *San Francisco Estuary and Watershed Science* 6(3).
- Kuivila, K.M., and G.E. Moon. 2004. Potential exposure of larval and juvenile delta smelt to dissolved pesticides in the Sacramento-San Joaquin Delta, California. In: Feyrer, F., Brown, L.R., Orsi, J.J., editors. Early life history of fishes in the San Francisco estuary and watershed. American Fisheries Society Symposium 39:229-241.
- Lea, T. N. 1968. Ecology of the Lahontan cutthroat trout, *Salmo clarki henshawi*, in Independence Lake, California. Master's thesis. University of California, Berkeley. 95 pp.
- Lehman, P.W., J. Sevier, J. Giulianotti, and M. Johnson. 2004. Sources of Oxygen Demand in the Lower San Joaquin River, California. *Estuaries* 27( 3): 405-418.
- Leyhe, J. 2004a. Coumaphos Analysis of Risks to Endangered and Threatened Salmon and Steelhead. U.S. Environmental Protection Agency Environmental Field Branch Office of Pesticide Programs. August 1.
- Leyhe, J. 2004b. Hexazione: Analysis of Risks to Endangered and Threatened Salmon and Steelhead. Environmental Protection Agency, Environmental Field Branch Office of Pesticide Programs, October 9.
- Lindberg, J., and B. Baskerville-Bridges. 2006. Factors influencing growth and development of delta smelt, and other topics. Presentation to EET. Available: <<http://bestscience.org/docs/seminar/Lindberg%20-%20EET%20Dec%202006.ppt>>
- Lindley, S. T., and M. S. Mohr. 2003. Modeling the effect of striped bass (*Morone saxatilis*) on the population viability of Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*). *Fishery Bulletin* 101 (2):321-331.
- Lindley, S. T., C. B. Grimes, M. S. Mohr, W. Peterson, J. Stein, J. T. Anderson, L.W. Botsford, D. L. Bottom, C. A. Busack, T. K. Collier, J. Ferguson, J. C. Garza, A. M. Grover, D. G. Hankin, R. G. Kope, P. W. Lawson, A. Low, R. B. MacFarlane, K. Moore, M. Palmer-Zwahlen, F. B. Schwing, J. Smith, C. Tracy, R. Webb, B. K. Wells, T. H. Williams. 2009. *What caused the Sacramento River fall Chinook stock collapse?* March 18. Pre-publication report to the Pacific Fishery Management Council.

- Lindley, S. T., R. S. Schick, E. Mora, P. B. Adams, J. J. Anderson, S. Greene, C. Hanson, B. P. May, D. R. McEwan, R. B. MacFarlane, C. Swanson, J. G. Williams. 2007. Framework for Assessing Viability of Threatened and Endangered Chinook Salmon and Steelhead in the Sacramento-San Joaquin Basin. San Francisco Estuary and Watershed Science Vol. 5, Issue 1 (February 2007). Article 4. Available: <<http://repositories.cdlib.org/jmie/sfews/vol5/iss1/art4>>.
- Lindley. 2005a. California Central Valley Steelhead ESU. Pages 288-299 in T. P. Good, R. S. Waples, and P. Adams (eds.), Updated Status of Federally Listed ESUs of West Coast Salmon and Steelhead. NOAA Technical Memorandum NMFS-NWFSC-66. Seattle, WA: US Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northwest Fisheries Science Center.
- Lindley. 2005b. Central Valley Spring-Run Chinook Salmon ESU. Pages 153-162 in T. P. Good, R. S. Waples, and P. Adams (eds.), Updated Status of Federally Listed ESUs of West Coast Salmon and Steelhead. NOAA Technical Memorandum NMFS-NWFSC-66. Seattle, WA: US Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northwest Fisheries Science Center.
- Magnusson, A. and R. Hilborn. 2003. Estuarine influence on survival rates of coho (*Oncorhynchus kisutch*) and Chinook salmon (*Oncorhynchus tshawytscha*) released from hatcheries on the U.S. Pacific coast. *Estuaries* 26: 1094-1103.
- Martinez, J., and J. Leyhe. 2004. Malathion: Analysis of Risks to Endangered and Threatened Salmon and Steelhead. Environmental Protection Agency, Environmental Field Branch Office of Pesticide Programs, December 1.
- Mason, L.B., C. Amrhein, C. C. Goodson, M. R. Matsumoto, and M. A. Anderson. 2005. Reducing Sediment and Phosphorus in Tributary Waters with Alum and Polyacrylamide. *Journal of Environmental Quality* 34: 1998-2004.
- Matthews, K. R. 1996. Diel movement and habitat use of California golden trout in the Golden Trout Wilderness. *Transactions of the American Fisheries Society* 125, 78-86.
- McEwan, D. R. 2001. Central Valley Steelhead. Pages 1-44 in R. L. Brown (ed.), California Department of Fish and Game Fish Bulletin 179, Vol. 1. Contributions to the Biology of Central Valley Salmonids. Sacramento, CA: California Department of Fish and Game.
- McEwan, D., and T. A. Jackson. 1996. Steelhead Restoration and Management Plan. California Department of Fish and Game, Sacramento, CA. Available: <<http://www.waterrights.ca.gov/hearings/CachumaPhase2Exhibits-DFG2.pdf>>.
- Meng, L., and S. A. Matern. 2001. Native and introduced larval fishes of Suisun Marsh, California: the effect of freshwater flow. *Transactions of the American Fisheries Society* 130:750-765.
- Merz, J. E. 2002. Seasonal feeding habits, growth, and movement of steelhead trout in the lower Mokelumne River, California. *California Fish and Game* 88:95-111.
- Moyle, P. B., B. Herbold, D. E. Stevens, and L. W. Miller. 1992b. Life history and status of Delta smelt in the Sacramento-San Joaquin Estuary, California. *Transactions of the American Fisheries Society* 121:67-77.

- Moyle, P. B., J. A. Israel, and S. E. Purdy. 2008. *Salmon, Steelhead and Trout in California: Status of an Emblematic Fauna*. Prepared for California Trout by University of California, Davis, Center for Watershed Science. 316 pp.
- Moyle, P.B. 2002. *Inland Fishes of California*. Second edition. University of California Press, Berkeley, CA. 502 pp.
- Moyle, P.B., P.J. Foley, and R. M. Yoshiyama. 1992a. Status of green sturgeon in California. Unpubl. Rpt., NOAA-NMFS, Terminal Island, Calif. 11 pp.
- Moyle, P.B., R.M. Yoshiyama, J.E. Williams, and E.D. Wikramanayake. 1995. Fish species of special concern in California. 2<sup>nd</sup> edition. Sacramento: California Department of Fish and Game.
- Myrick, C. A., and J.J. Cech. 2003. The physiological performance of golden trout at water temperatures of 10–19 °C. *Calif. Fish Game*, 89 20-29.
- Nakamoto, R. J., T. T. Kisanuki, and G. H. Goldsmith. 1995. Age and growth of Klamath River green sturgeon (*Acipenser medirostris*). U.S. Fish and Wildlife Service. Project # 93-FP-13. 20 pages.
- National Marine Fisheries Service. 2008a. NOAA Biological Opinion on Pesticides Recommends Buffers to Protect Salmon. Press release. November 18. Available: [http://www.nmfs.noaa.gov/mediacenter/docs/pesticides\\_bio\\_op.pdf](http://www.nmfs.noaa.gov/mediacenter/docs/pesticides_bio_op.pdf) > Accessed: November 9, 2009.
- National Marine Fisheries Service. 2008b. Environmental Protection Agency Registration of Pesticides Containing Chlorpyrifos, Diazinon, and Malathion. Endangered Species Act Section 7 Consultation Biological Opinion. Silver Spring, Maryland: U.S. Department of Commerce, National Marine Fisheries Service.
- National Marine Fisheries Service. 2009. Final Biological Opinion and Conference Opinion on of Long-Term Central Valley Project and State Water Project Operations Criteria and Plan. June 4. Endangered Species Act Section 7 Consultation.
- Newcombe, C.P., and J.O. Jensen. 1996. Channel suspended sediment and fisheries: a synthesis for quantitative assessment of risk and impact. *North American Journal of Fisheries Management* 16: 693-727.
- Newman K.B. 2008. Sample design-based methodology for estimating delta smelt abundance. *San Francisco Estuary and Watershed Science* 6(3): article 3. Available: <http://repositories.cdlib.org/jmie/sfews/vol6/iss3/art3>.
- Nobriga, M. L., T. R. Sommer, F. Feyrer, and K. Fleming. 2008. Long-Term Trends in Summertime Habitat Suitability for Delta Smelt (*Hypomesus transpacificus*). *San Francisco Estuary and Watershed Science* 6.
- Odenkirchen, E., and L. Turner, 2003. Phorate: Analysis of Risks to Endangered and Threatened Salmon and Steelhead. Environmental Protection Agency, Environmental Field Branch Office of Pesticide Programs, July 29.
- Panger, M., R. Paris, T. Steeger, and R.D. Jones. 2009. Potential Risks of Alachlor Use to Federally Threatened California Red-legged Frog (*Rana aurora draytonii*) and Delta Smelt (*Hypomesus transpacificus*). Pesticide Effects Determinations. U.S. Environmental Protection Agency, Environmental Fate and Effects Division, Office of Pesticide Programs. June 15.



- Patterson, M. 2003c. Captan Analysis of Risks to Endangered and Threatened Salmon and Steelhead. U.S. Environmental Protection Agency Policy and Regulatory Services Branch and Environmental Field Branch Office of Pesticide Programs. December 1.
- Patterson, M. 2003f. Disulfoton Analysis of Risks to Endangered and Threatened Salmon and Steelhead. U.S. Environmental Protection Agency Policy and Regulatory Services Branch and Environmental Field Branch Office of Pesticide Programs. December 1.
- Patterson, M. 2003g. Ethoprop Analysis of Risks to Endangered and Threatened Salmon and Steelhead. U.S. Environmental Protection Agency Policy and Regulatory Services Branch and Environmental Field Branch Office of Pesticide Programs. December 1.
- Patterson, M. 2004a. Acephate Analysis of Risks to Endangered and Threatened Salmon and Steelhead. U.S. Environmental Protection Agency Environmental Field Branch Office of Pesticide Programs. February 9.
- Patterson, M. 2004b. Bromoxynil Analysis of Risks to Endangered and Threatened Salmon and Steelhead. U.S. Environmental Protection Agency Policy and Regulatory Services Branch and Environmental Field Branch Office of Pesticide Programs. November 26.
- Patterson, M. 2004c. Diflufenzuron Analysis of Risks to Endangered and Threatened Salmon and Steelhead. U.S. Environmental Protection Agency Policy and Regulatory Services Branch and Environmental Field Branch Office of Pesticide Programs. July 15.
- Patterson, M. 2004d. Dimethoate Analysis of Risks to Endangered and Threatened Salmon and Steelhead. U.S. Environmental Protection Agency Policy and Regulatory Services Branch and Environmental Field Branch Office of Pesticide Programs. July 15.
- Patterson, M. 2004e. Glyphosphate: Analysis of Risks to Endangered and Threatened Salmon and Steelhead. Environmental Protection Agency, Environmental Field Branch Office of Pesticide Programs, October 8.
- Patterson, M. 2004f. Lindane: Analysis of Risks to Endangered and Threatened Salmon and Steelhead. Environmental Protection Agency, Environmental Field Branch Office of Pesticide Programs, November 29.
- Patterson, M. 2004g. Linuron: Analysis of Risks to Endangered and Threatened Salmon and Steelhead. Environmental Protection Agency, Environmental Field Branch Office of Pesticide Programs, March 18.
- Patterson, M. 2004h. Methamidophos: Analysis of Risks to Endangered and Threatened Salmon and Steelhead. Environmental Protection Agency, Environmental Field Branch Office of Pesticide Programs, February 23.
- Patterson, M. 2004i. Metribuzin: Analysis of Risks to Endangered and Threatened Salmon and Steelhead. Environmental Protection Agency, Environmental Field Branch Office of Pesticide Programs, July 15.
- Pluntke, K. 2004. Pendimethalin: Analysis of Risks to Endangered and Threatened Salmon and Steelhead. Environmental Protection Agency, Environmental Field Branch Office of Pesticide Programs, December 20.

- Poletika, N.N., R. Reiss, S. A. Cryer, and S. P. Cramer. 2009. Spray Drift Exposure Refinements for Salmonid Off-Channel Habitat. Laboratory Study ID: 091117. Indianapolis, IN: Regulatory Sciences and Government Affairs—Indianapolis Lab Dow AgroSciences LLC; Alexandria, VA: Exponent, Inc.; Gresham, OR: Cramer Fish Sciences, Inc. Available: <[www.chlorpyrifos.com/pdf/Spray\\_Drift\\_091117.pdf](http://www.chlorpyrifos.com/pdf/Spray_Drift_091117.pdf)> Accessed: May 6, 2010.
- Radtke, L. D. 1966. Distribution of smelt, juvenile sturgeon, and starry flounder in the Sacramento-San Joaquin Delta with observations on food of sturgeon. In J. L. Turner and D. W. Kelly (ed.), *Ecological studies of the Sacramento-San Joaquin Estuary. Part II*; California Department of Fish and Game, Fish Bulletin 136:115–119.
- Rankel, G.L. 1976. Fishery management program, Summit Lake Indian reservation, Humboldt County, Nevada. Special Report of the U.S. Fish and Wildlife Service, Division of Fishery Services, Reno, Nevada. 35 pp.
- Rosenfield, J. A., and R. D. Baxter. 2007. Population dynamics and distribution patterns of longfin smelt in the San Francisco Estuary. *Transactions of the American Fisheries Society* 136:1577–1592.
- Saiki, M.K., M.R. Jennings, and R.H. Wiedmeyer. 1992. Toxicity of agricultural subsurface drainwater from the San Joaquin Valley, California, to juvenile Chinook salmon and striped bass. *Transactions of the American Fisheries Society* 121: 78-93.
- Schmetterling, D. A. 2000. Redd Characteristics of fluvial westslope cutthroat trout in four tributaries to the Blackfoot River, Montana. *North American Journal of Fisheries Management* 20, 776–783.
- Sigler, W.F., W.T. Helm, P.A. Kucera, S. Vigg, and G.W. Workman. 1983. Life history of the Lahontan cutthroat trout, *Salmo clarki henshawi*, in Pyramid Lake, Nevada. *Great Basin Naturalist* 43:1- 29.
- Sojka, R.E., R.D. Lentz, I. Shainberg, T.J. Trout, C.W. Ross, C.W. Robbins, J.A. Entry, J.K. Aase, D.L. Bjorneberg, W.J. Orts, D.T. Westermann, D.W. Morishita, M.E. Watwood, T.L. Spofford, and F.W. Barvenik. 2000. Irrigating with polyacrylamide (PAM): Nine years and a million acres of experience. P. 161-169 in R.G. Evans, B.L. Benham, and T.P. Trooien (eds.). *Proceedings of the National Irrigation Symposium, 4<sup>th</sup> Decennial Symposium*, Phoenix, Arizona, 14-16 November 2000. Publication 701P0004. St Joseph, MI: American Society of Agricultural Engineers.
- Sommer, T. R., M. L. Nobriga, W. C. Harrell, W. Batham, and W. J. Kimmerer. 2001. Floodplain rearing of juvenile Chinook salmon: Evidence of enhanced growth and survival. *Canadian Journal of Fisheries and Aquatic Sciences* 58:325–333.
- Sommer, T., C. Armor, R. Baxter, R. Breuer, L. Brown, M. Chotkowski, S. Culberson, F. Feyrer, M. Gingras, B. Herbold, W. Kimmerer, A. Mueller-Solger, M. Nobriga, and K. Souza. 2007. The Collapse of Pelagic Fishes in the Upper San Francisco Estuary. *Fisheries* 32 (6): 270-277.
- Sommer, T., K. Reece, and F. Mejia. 2009. Delta smelt life-history contingents: a possible upstream rearing strategy. *IEP Newsletter* 22(1): 11-13.
- Stavola, A. 2004a. Naled: Analysis of Risks to Endangered and Threatened Salmon and Steelhead. Environmental Protection Agency, Environmental Field Branch Office of Pesticide Programs, April 1.

- Stavola, A. 2004b. No Effect Determination for Tebuthiuron for Pacific Anadromous Salmonids. Memorandum to Arthur-Jean Williams, Chief, Environmental Field Branch and External Affairs Division, U.S. Environmental Protection Agency. July 29.
- Stavola, A. 2004c. Trifluralin: Analysis of Risks to Endangered and Threatened Salmon and Steelhead. Environmental Protection Agency, Environmental Field Branch Office of Pesticide Programs, April 1.
- Stavola, A., and L. Turner. 2003a. Dichlobenil Analysis of Risks to Endangered and Threatened Salmon and Steelhead. U.S. Environmental Protection Agency Environmental Field Branch Office of Pesticide Programs. July 31.
- Stavola, A., and L. Turner. 2003b. Fenamiphos Analysis of Risks to Endangered and Threatened Salmon and Steelhead. U.S. Environmental Protection Agency Environmental Field Branch Office of Pesticide Programs. December 1.
- Stevens, D.E. and L.W. Miller. 1983. Effects of River Flow on Abundance of Young Chinook Salmon, American Shad, Longfin Smelt, and Delta Smelt in the Sacramento–San Joaquin River System. *North American Journal of Fisheries Management*. 3 425–437.
- Stillwater Sciences. 2006. Sacramento River ecological flows study. State of the System Report for The Nature Conservancy prepared by Stillwater Sciences.
- Sweetnam, D.A. 1999. Status of Delta Smelt in the Sacramento-San Joaquin Estuary. *California Fish and Game* 85: 22-27.
- Tarkowski, G. M. 2004b. Triclopyr Butoxyethyl Ester: Analysis of Risks to Endangered and Threatened Salmon and Steelhead. December 1.
- Tarkowski, G.M. 2004a. Carbofuran Analysis of Risks to Endangered and Threatened Salmon and Steelhead. U.S. Environmental Protection Agency Environmental Field Branch Office of Pesticide Programs. December 1.
- Tarkowski, G.M. 2004a. Carbofuran Analysis of Risks to Endangered and Threatened Salmon and Steelhead. U.S. Environmental Protection Agency Environmental Field Branch Office of Pesticide Programs. December 1.
- Tate, K.W., D. L. Lancaster, J.A. Morrison, D.F. Lile, Y. Sado, and B. Huang. 2005. Monitoring helps reduce water-quality impacts in flood-irrigated pasture. *California Agriculture* 59(3): 168-175.
- Taylor, C. M., M.R. Winston, and W.J. Matthews. 1993. Fish species-environment and abundance relationships in a Great Plains river system. *Ecography* 16: 16-23.
- Tierney, K., J. Sampson, P.S. Ross, M. Sekela, and C.J. Kennedy. 2008. Salmon olfaction is impaired by an environmentally realistic pesticide mixture. *Environmental Science and Technology* 42: 4996–5001.
- Trotter, P. 2008. Cutthroat: Native Trout of the West. University of California Press. 560 pp.
- Turner, L.T. 2002a. Bensulide Analysis of Risks to Endangered and Threatened Salmon and Steelhead. U.S. Environmental Protection Agency Environmental Field Branch Office of Pesticide Programs. November 29.

- Turner, L.T. 2002b. Effects Determination for Alachlor for Pacific Anadromous Salmonids. Memorandum to Arthur-Jean Williams, Chief, Environmental Field Branch Field and External Affairs Division, U.S. Environmental Protection Agency. May 30.
- Turner, L.T. 2002c. Effects Determination for Bentazon for Pacific Anadromous Salmonids. Memorandum to Arthur-Jean Williams, Chief, Environmental Field Branch Field and External Affairs Division, U.S. Environmental Protection Agency. May 28.
- Turner, L. 2002c. Diazinon Analysis of Risks to Endangered and Threatened Salmon and Steelhead. U.S. Environmental Protection Agency Environmental Field Branch Office of Pesticide Programs. November 29.
- Turner, L., 2002d. Fenbutatin Oxide: Analysis of Risks to Endangered and Threatened Salmon and Steelhead. Environmental Protection Agency, Environmental Field Branch Office of Pesticide Programs, November 29.
- Turner, L., 2002e. Effects Determination for Molinate and Thiobencarb for Pacific Anadromous Salmonids. Memorandum to Arthur-Jean Williams, Chief, Environmental Field Branch and External Affairs Division, U.S. Environmental Protection Agency.
- Turner, L., 2002f. No Effect Determination for Paraquat Dichloride for Pacific Anadromous Salmonids. Memorandum to Arthur-Jean Williams, Chief, Environmental Field Branch and External Affairs Division, U.S. Environmental Protection Agency. May 30.
- Turner, L.T. 2002g. No Effect Determination for Paraquat Dichloride for Pacific Anadromous Salmonids. Memorandum to Arthur-Jean Williams, Chief, Environmental Field Branch Field and External Affairs Division, U.S. Environmental Protection Agency. December 23.
- Turner, L., 2002g. Effects Determination for Pebulate for Pacific Anadromous Salmonids. Memorandum to Arthur-Jean Williams, Chief, Environmental Field Branch and External Affairs Division, U.S. Environmental Protection Agency. December 23.
- Turner, L., 2002h. Propargite: Analysis of Risks to Endangered and Threatened Salmon and Steelhead. Environmental Protection Agency, Environmental Field Branch Office of Pesticide Programs, July 23.
- Turner, L., 2002j. No Effect Determination for Triclopyr TEA for Pacific Anadromous Salmonids. Memorandum to Arthur-Jean Williams, Chief, Environmental Field Branch and External Affairs Division, U.S. Environmental Protection Agency. November 30.
- Turner, L. 2003b. Bromacil and Lithium Bromacil: Analysis of Risks from Herbicide Use to Ten Evolutionarily Significant Units of Pacific Salmon and Steelhead. U.S. Environmental Protection Agency Environmental Field Branch Office of Pesticide Programs. November 8.
- Turner, L. 2003c. Chlorothalonil Analysis of Risks to Endangered and Threatened Salmon and Steelhead. U.S. Environmental Protection Agency Environmental Field Branch Office of Pesticide Programs. December 1.
- Turner, L. 2003d. Chlorpyrifos Analysis of Risks to Endangered and Threatened Salmon and Steelhead. U.S. Environmental Protection Agency Environmental Field Branch Office of Pesticide Programs. March 31.

- Turner, L. 2003f. Diuron Analysis of Risks to Endangered and Threatened Salmon and Steelhead. U.S. Environmental Protection Agency Environmental Field Branch Office of Pesticide Programs. July 30.
- Turner, L., 2003g. No Effect Determination for Iprodione for Pacific Anadromous Salmonids. Memorandum to Arthur-Jean Williams, Chief, Environmental Field Branch and External Affairs Division, U.S. Environmental Protection Agency. December 1.
- Turner, L., 2003h. No Effect Determination for Norflurazon for Pacific Anadromous Salmonids. Memorandum to Arthur-Jean Williams, Chief, Environmental Field Branch and External Affairs Division, U.S. Environmental Protection Agency. March 23.
- Turner, L., and M. K. Mahoney. 2003i. Phosmet: Analysis of Risks to Endangered and Threatened Salmon and Steelhead. Environmental Protection Agency, Environmental Field Branch Office of Pesticide Programs, November 26.
- Turner, L., 2003j. Simazine: Analysis of Risks to Endangered and Threatened Salmon and Steelhead. Environmental Protection Agency, Environmental Field Branch Office of Pesticide Programs, July 25.
- Turner, L., 2003k. No Effect Determination for Terbacil for Pacific Anadromous Salmonids. Memorandum to Arthur-Jean Williams, Chief, Environmental Field Branch and External Affairs Division, U.S. Environmental Protection Agency. July 29.
- Turner, L., 2003l. No Effects Determination for Thiodicarb for Pacific Anadromous Salmonids. Memorandum to Arthur-Jean Williams, Chief, Environmental Field Branch and External Affairs Division, U.S. Environmental Protection Agency. March 31.
- Turner, L., and W. Erickson. 2003. Acrolein Analysis of Risks from the Aquatic Herbicide Use in Irrigation Supply Canals to Eleven Evolutionarily Significant Units of Pacific Salmon and Steelhead. U.S. Environmental Protection Agency Environmental Field Branch Office of Pesticide Programs. May 15.
- Turner, L.T. 2003e. No Effect Determination for Dicamba for Pacific Anadromous Salmonids. Memorandum to Arthur-Jean Williams, Chief, Environmental Field Branch Field and External Affairs Division, U.S. Environmental Protection Agency. March 27.
- U.S. Environmental Protection Agency. 2004. Summaries of Environmental Laws Administered by the EPA—Federal Insecticide, Fungicide, and Rodenticide Act. December 2. Prepared by L. Schierow, Environmental and Natural Resources Policy Division. Available: <<http://ncseonline.org/nle/crsreports/briefingbooks/laws/l.cfm?>>. Accessed: October 2005.
- U.S. Environmental Protection Agency. 2005. Monitoring and assessing water quality. 5.9 Conductivity. Available: < <http://www.epa.gov/volunteer/stream/vms59.html>> Accessed: December 4, 2009.
- U.S. Environmental Protection Agency. 2010. Registrants' May 7, 2010 Response to EPA's April 29, 2010 Letter: Implementation of Chlorpyrifos, Diazinon and Malathion Salmonid BiOp. Available: < <http://www.epa.gov/espp/litstatus/wtc/davids-letter.pdf>> Accessed: May 13, 2010.
- U.S. Fish and Wildlife Service. 1977. Fisheries Management Plan - Summit Lake Indian Reservation. U.S. Fish and Wildlife Service, Reno, Nevada. 38 pp.



- U.S. Fish and Wildlife Service. 1995. Lahontan Cutthroat Trout (*Oncorhynchus clarki henshawi*) Recovery Plan. U.S. Fish and Wildlife Service, Portland, OR. 107 pp. and appendices.
- U.S. Fish and Wildlife Service. 1996. Sacramento–San Joaquin Delta Native Fishes Recovery Plan. U.S. Fish and Wildlife Service, Portland, Oregon.
- U.S. Fish and Wildlife Service. 2003. Flow-habitat relationships for steelhead and fall, late-fall and winter-run Chinook salmon spawning in the Sacramento River between Keswick Dam and Battle Creek. Final report. Sacramento: U.S. Fish and Wildlife Service.
- U.S. Fish and Wildlife Service. 2004. Revised recovery plan for the Paiute cutthroat trout (*Oncorhynchus clarki selenensis*). Portland, OR: U.S. Fish and Wildlife Service.
- U.S. Fish and Wildlife Service. 2008a. Formal Endangered Species Act Consultation on the Proposed Coordinated Operations of the Central Valley Project (CVP) and State Water Project (SWP). Biological opinion. December. Sacramento, CA.
- U.S. Fish and Wildlife Service. 2008b. Paiute cutthroat trout (*Oncorhynchus clarkii selenensis*) 5-Year Review: Summary and Evaluation. June. Reno, NV: U.S. Fish and Wildlife Service.
- U.S. Fish and Wildlife Service. 2009. Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*) 5-Year Review: Summary and Evaluation. June. Reno, NV: U.S. Fish and Wildlife Service.
- Unger, P. A. 1994. Quantifying salinity habitat of estuarine species. *IEP Newsletter* Autumn 1994:7–10. Available: <<http://www.iep.water.ca.gov/report/newsletter>>.
- Wang, J. C. S. 1986. Fishes of the Sacramento–San Joaquin Estuary and Adjacent Waters, California: A Guide to the Early Life Histories. (Interagency Ecological Program Technical Report 9.) Sacramento, CA: California Department of Water Resources.
- Wang, J. C. S. 1991. Early Life Stages and Early Life History of the Delta Smelt, *Hypomesus transpacificus*, in the Sacramento–San Joaquin Estuary, with Comparison of Early Life Stages of the Longfin Smelt, *Spirinchus thaleichthys*. (FS/BIO-IATR/91-28. Technical Report 28.) Sacramento, CA: California Department of Water Resources. Prepared for Interagency Ecological Studies Program for the Sacramento–San Joaquin Estuary, Stockton, CA.
- Wang, J. C. S., and R. L. Brown. 1993. Observations of early life stages of delta smelt, *Hypomesus transpacificus*, in the Sacramento–San Joaquin estuary in 1991, with a review of its ecological status in 1988 to 1990. Technical Report 35. November.
- Werner, I., L. Deanovic, D. Markiewicz, M. Stillway, N. Offer, R. Connon, and S. Brander 2008. Pelagic Organism Decline (POD): Acute and Chronic Invertebrate and Fish Toxicity Testing in the Sacramento-San Joaquin Delta 2006-2007. Final Report. 30 April.
- White, K., W.P. Eckel, W. Shaughnessy, B. Carr, and J. Holmes. 2009. Potential Risks of Thiobencarb Use to Federally Threatened California Red-legged Frog (*Rana aurora draytonii*) and Delta Smelt (*Hypomesus transpacificus*). Pesticide Effects Determinations. U.S. Environmental Protection Agency, Environmental Fate and Effects Division, Office of Pesticide Programs. October 19.
- Williams, J. G. 2006. Central Valley Salmon: a perspective on Chinook and steelhead in the Central Valley of California. *San Francisco Estuary and Watershed Science*, Volume 4, Issue 3, Article 2. December.

Wong, D.M. 1975. Aspects of the life history of the Paiute cutthroat trout, *Salmo clarki seleniris* Snyder, in North Fork Cottonwood Creek, Mono County, California, with notes on behavior in a stream aquarium. M.A. thesis, Calif. State Univ., Long Beach. 178 pp.

Yoshiyama, R. M., F. W. Fisher, and P. B. Moyle. 1998. Historical abundance and decline of Chinook salmon in the Central Valley Region of California. *North American Journal of Fisheries Management* 18:487–521.

## 8.11.2 Personal Communications

Herbold, Bruce. 1998. Personal comment cited in Moyle, P. B. 2002. *Inland Fishes of California*. Revised and expanded. Berkeley, CA: University of California Press.

Kulesza, Dana, Environmental Scientist, Central Valley Regional Water Quality Control Board. Date—type of pers comm to Who, Title, ICF International, Sacramento, CA.

## 8.12 Section 5.9, Hydrology and Water Quality

### 8.12.1 Printed References

California Department of Pesticide Regulation. 2003. 2003 Well Inventory Database, Cumulative Report 1986–2003. DPR Ground Water Protection Program.

California Department of Water Resources. 2003. *California's Groundwater: Bulletin 118—Update 2003*. Sacramento, CA.

Central Valley Regional Water Quality Control Board. 2007a. Revised Draft of the 2007 Review of Monitoring Data for the Irrigated Lands Conditional Waiver Program. July.

DPR, see California Department of Pesticide Regulation.

Dubrovsky, N.M., C.R. Kratzer, L.R. Brown, J.A.M. Gronberg, K.R. Burow. 1998. Water Quality in the San Joaquin–Tulare Basins, California, 1992–1995. Last updated: April 20, 1998. Available: <<http://water.usgs.gov/pubs/circ1159>>. Accessed: July 2010.

ICF Jones & Stokes. 2008. *Irrigated Lands Regulatory Program Existing Conditions Report*. December. (ICF J&S 05508.05.) Sacramento, CA. Prepared for the State Water Resources Control Board and Central Valley Regional Water Quality Control Board, Rancho Cordova, CA.

Kratzer, Charles, Celia Zamora, and Donna Knifong. 2002. Diazinon and Chlorpyrifos Loads in the San Joaquin River Basin, California, January and February 2000. (U.S. Geological Survey Water Resources Investigations Report 02-4103.)

Kratzer, Charles, Peter Dileanis, Celia Zamora, Steven Silva, Carol Kendall, Brian Bergamazchi, and Randy Dalhgren. 2004. Sources and Transport of Nutrients, Organic Carbon, and Chlorophyll-a in the San Joaquin River Upstream of Vernalis, California, during Summer and Fall 2000 and 2001. Available: <<http://pubs.usgs.gov/wri/wri034127/wri034127rev.pdf>>. Accessed: June 12, 2008.

- Schuette, J., D. Weaver, J. Troiano, M. Pepple, and J. Dias. 2003. Sampling for Pesticide Residues in California Water Wells: 2003 Well Inventory Database, Cumulative Report 1986–2003. (California Department of Pesticide Regulation Document EH03-08.) December.
- State Water Resources Control Board. 1968. Resolution No. 68-16, *Statement of Policy with Respect to Maintaining High Quality of Waters in California* (State Antidegradation Policy). October 28, 1968. Sacramento, CA. Available: <[http://www.waterboards.ca.gov/board\\_decisions/adopted\\_orders/resolutions/1968/rs68\\_016.pdf](http://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/1968/rs68_016.pdf)>. Accessed: July 2010.
- U.S. Geological Survey. 2005b. National Water-Quality Assessment Program. San Joaquin–Tulare Basins NAWQA. Available: <<http://ca.water.usgs.gov/sanj/sanj.html>> Accessed: October 13, 2005.
- U.S. Geological Survey. 2005c. Water Quality Database. Available: <<http://nwis.waterdata.usgs.gov/usa/nwis/qwdata>>.
- Weston D. P., J. You, E. L. Amweg, and M. J. Lydy. (In Press.) Sediment Toxicity in Agricultural Areas of California and the Role of Hydrophobic Pesticides. In J. Gan, F. Spurlock, P. Hendley, and D. Weston (eds.), *Synthetic Pyrethroids: Occurrence and Behavior in Aquatic Environments*. American Chemical Society, Washington, DC.
- Zamora, Celia, Charles Kratzer, Michael Majewski, and Donna Knifong. 2003. Diazinon and Chlorpyrifos Loads in Precipitation and Urban and Agricultural Storm Runoff during January and February 2001 in the San Joaquin River Basin, California. (U.S. Geological Survey Water Resources Investigations Report 03-4091.)

## 8.13 Section 5.10, Agricultural Resources

### 8.13.1 Printed References

- California Department of Conservation, Division of Land Resource Protection. 2002. 2000–2002. Farmland Conversion Report. Farmland Mapping and Monitoring Program.
- California Department of Conservation, Division of Land Resource Protection. 2008. 2004 – 2006 Farmland Conversion Report. Farmland Mapping and Monitoring Program.
- California Department of Conservation, Division of Land Resource Protection. 2006. 2002–2004 Farmland Conversion Report. Farmland Mapping and Monitoring Program.
- California Department of Conservation, Division of Land Resource Protection. 2008. 2004 – 2006 Farmland Conversion Report. Farmland Mapping and Monitoring Program.
- California Department of Food and Agriculture. 2009. *California Agricultural Highlights, 2008–2009*. Brochure. Sacramento, CA. Available: <<http://www.cdffa.ca.gov/Publications.html>>. Accessed: July 2010.
- CDFA, see California Department of Food and Agriculture
- Central Valley Regional Water Quality Control Board. 2002a. *Agricultural Practices and Technologies Draft Report*. Cal EPA – Central Valley Regional Water Quality Control Board. May.

- ICF International. 2010. *Technical Memorandum Concerning the Economic Analysis of the Irrigated Lands Regulatory Program*. Draft. July. (ICF 05508.05.) Sacramento, CA. Prepared for Central Valley Regional Water Quality Control Board, Sacramento, CA.
- Thompson. 2009. California Agricultural Land Loss & Conservation: The Basic Facts. American Farmland Trust.
- U.S. Department of Agriculture. 2009. 2007 Census of Agriculture. United States Summary and State Data. Volume 1.
- USDA, see U.S. Department of Agriculture

## 8.14 Chapter 6, Cumulative and Growth-Inducing Impacts

### 8.14.1 Printed References

- California Department of Conservation, Division of Land Resource Protection. 2006. 2002–2004 Farmland Conversion Report. Farmland Mapping and Monitoring Program.
- California Department of Conservation, Division of Land Resource Protection. 2008. 2004 – 2006 Farmland Conversion Report. Farmland Mapping and Monitoring Program.
- Central Valley Regional Water Quality Control Board. 2005. *Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control Program for Factors Contributing to the Dissolved Oxygen Impairment in the Stockton Deep Water Ship Channel*. Final staff report. February 23.
- ICF International and CH2MHill. 2010. Technical Memorandum Concerning the Economic Analysis of the Irrigated Lands Regulatory Program. Administrative Draft. May. (ICF 05508.05.) Sacramento, CA. Prepared for Central Valley Regional Water Quality Control Board, Sacramento, CA.
- Lehman, P.W., J. Sevier, J. Giulianotti, and M. Johnson. 2004. Sources of Oxygen Demand in the Lower San Joaquin River, California. *Estuaries* 27( 3): 405–418.
- Moyle, P. B., J. A. Israel, and S. E. Purdy. 2008. *Salmon, Steelhead and Trout in California: Status of an Emblematic Fauna*. Prepared for California Trout by University of California, Davis, Center for Watershed Science. 316 pp.
- Riddell, F. A. 2002. The Status of San Joaquin Valley Archaeology. Page 55–61 in W. J. Wallace and F. A. Riddell (eds.), *Essays in California Archaeology: A Memorial to Franklin Fenenga*. Contributions No. 60. Berkeley, CA: Archaeological Research Facility, University of California.



CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY  
REGIONAL WATER QUALITY CONTROL BOARD  
CENTRAL VALLEY REGION

Irrigated Lands Regulatory Program  
Long-Term Program Development

Staff Report

*Draft Report  
for Public Review*

July 2010







**STATE OF CALIFORNIA**  
*Arnold Schwarzenegger, Governor*

**CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY**  
*Linda S. Adams, Secretary*

**REGIONAL WATER QUALITY CONTROL BOARD  
CENTRAL VALLEY REGION**

*Katherine Hart, Chair*  
*Cheryl K. Maki, Vice Chair*  
*Julian C. Isham, Member*  
*Karl E. Longley, Member*  
*Sandra O. Meraz, Member*  
*Dan Odenweller, Member*  
*Robert G. Walters, Member*

---

*Pamela Creedon, Executive Officer*

---

*11020 Sun Center Drive #200  
Rancho Cordova, California 95670-6114*

---

Phone: (916) 464-3291  
eMail: [info5@waterboards.ca.gov](mailto:info5@waterboards.ca.gov)  
Web site: <http://www.waterboards.ca.gov/centralvalley/>.

**DISCLAIMER**

*This publication is a report by staff of the California Regional Water Quality Control Board, Central Valley Region. This report contains the evaluation of alternatives and technical support for the development of a long-term Irrigated Lands Regulatory Program. Mention of specific products does not represent endorsement of those products by the Central Valley Water Board.*

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY  
REGIONAL WATER QUALITY CONTROL BOARD  
CENTRAL VALLEY REGION

Irrigated Lands Regulatory Program  
Long-Term Program Development

Staff Report

*Draft Report  
for Public Review*

**July 2010**

**REPORT PREPARED BY:**

Adam Laputz  
Dana Kulesza  
Alan Cregan  
A. Marc Commandatore  
Polly Lowry  
Joe Karkoski



## **ACKNOWLEDGMENTS**

The authors gratefully acknowledge the valuable contributions from the Central Valley Water Board Irrigated Lands Regulatory Program staff, ILRP Stakeholder Advisory Workgroup, State Water Board, Department of Pesticide Regulation, ICF International, TCW Economics, CH2M HILL, Mark Roberson PhD, and Joan Lynn – egret, inc.

# CONTENTS

|                                                                                                               |           |
|---------------------------------------------------------------------------------------------------------------|-----------|
| <b>EXECUTIVE SUMMARY.....</b>                                                                                 | <b>1</b>  |
| GENERAL CONTEXT FOR THE PREFERRED ALTERNATIVE.....                                                            | 1         |
| <b>I.    INTRODUCTION .....</b>                                                                               | <b>5</b>  |
| <b>II.   CURRENT IRRIGATED LANDS REGULATORY PROGRAM DESCRIPTION .....</b>                                     | <b>6</b>  |
| A.    BACKGROUND .....                                                                                        | 6         |
| B.    REGULATORY SETTING: CONDITIONAL WAIVERS .....                                                           | 6         |
| C.    COALITION GROUPS .....                                                                                  | 7         |
| D.    MONITORING AND REPORTING .....                                                                          | 9         |
| E.    ENFORCEMENT.....                                                                                        | 9         |
| <b>III.  CENTRAL VALLEY IRRIGATED LANDS ENVIRONMENTAL AND INDUSTRY<br/>      SETTING .....</b>                | <b>10</b> |
| A.    INDUSTRY SUMMARY .....                                                                                  | 10        |
| B.    POTENTIAL WASTE DISCHARGE FROM IRRIGATED AGRICULTURAL LANDS.....                                        | 18        |
| C.    WATER QUALITY DATA SUMMARY FOR GROUND AND SURFACE WATERS ACCEPTING IRRIGATED<br>AGRICULTURAL WASTE..... | 19        |
| D.    SMALL COMMUNITIES AND DRINKING WATER.....                                                               | 48        |
| <b>IV.   LEGAL AND REGULATORY REQUIREMENTS .....</b>                                                          | <b>52</b> |
| A.    CALIFORNIA WATER CODE .....                                                                             | 52        |
| B.    CALIFORNIA ENVIRONMENTAL QUALITY ACT .....                                                              | 53        |
| C.    NONPOINT-SOURCE PROGRAM .....                                                                           | 54        |
| D.    CENTRAL VALLEY REGIONAL WATER QUALITY CONTROL PLANS.....                                                | 56        |
| E.    STATE ANTIDEGRADATION POLICY .....                                                                      | 57        |
| F.    ENFORCEMENT POLICY .....                                                                                | 69        |
| <b>V.    OTHER REGULATORY PROGRAMS .....</b>                                                                  | <b>70</b> |
| A.    U.S. ENVIRONMENTAL PROTECTION AGENCY FEDERAL INSECTICIDE, FUNGICIDE, AND<br>RODENTICIDE ACT .....       | 70        |
| B.    CALIFORNIA DEPARTMENT OF PESTICIDE REGULATION PROGRAMS .....                                            | 70        |
| C.    GRASSLAND BYPASS PROJECT .....                                                                          | 80        |
| D.    CENTRAL VALLEY REGIONAL WATER BOARD DAIRY ORDER .....                                                   | 81        |
| E.    STATE WATER BOARD STORMWATER PROGRAM .....                                                              | 85        |
| F.    LOCAL GROUNDWATER MANAGEMENT PLANS .....                                                                | 88        |
| G.    PROGRAMS DEVELOPED BY OTHER REGIONAL WATER BOARDS.....                                                  | 89        |
| <b>VI.   LONG-TERM PROGRAM DEVELOPMENT PROCESS.....</b>                                                       | <b>92</b> |
| <b>VII.  GOALS AND OBJECTIVES OF THE LONG-TERM IRRIGATED LANDS<br/>      REGULATORY PROGRAM .....</b>         | <b>92</b> |
| A.    IRRIGATED LANDS DEFINITION.....                                                                         | 92        |
| B.    PROGRAM GOALS AND OBJECTIVES.....                                                                       | 92        |
| <b>VIII. ALTERNATIVES FOR THE LONG-TERM IRRIGATED LANDS PROGRAM .....</b>                                     | <b>93</b> |
| <b>IX.   EVALUATION OF LONG-TERM PROGRAM ALTERNATIVES .....</b>                                               | <b>96</b> |
| A.    CONSISTENCY WITH PROGRAM GOALS AND OBJECTIVES AND POLICIES .....                                        | 97        |
| B.    PREDICTED EFFECTIVENESS OF ADMINISTRATION BASED ON EXISTING PROGRAMS .....                              | 116       |
| C.    ECONOMIC IMPACTS.....                                                                                   | 120       |
| D.    ENVIRONMENTAL IMPACTS .....                                                                             | 130       |



|             |                                                                                                                              |            |
|-------------|------------------------------------------------------------------------------------------------------------------------------|------------|
| <b>X.</b>   | <b>RECOMMENDED PROGRAM ALTERNATIVE .....</b>                                                                                 | <b>136</b> |
| A.          | BEST-PERFORMING PROGRAM ELEMENTS .....                                                                                       | 136        |
| B.          | RECOMMENDED LONG-TERM IRRIGATED LANDS REGULATORY PROGRAM.....                                                                | 142        |
| <b>XI.</b>  | <b>EVALUATION OF RECOMMENDED LONG-TERM IRRIGATED LANDS<br/>REGULATORY PROGRAM .....</b>                                      | <b>162</b> |
| A.          | CONSISTENCY WITH PROGRAM GOALS AND OBJECTIVES AND POLICIES .....                                                             | 162        |
| B.          | RECOMMENDED IRRIGATED LANDS REGULATORY PROGRAM PREDICTED EFFECTIVENESS OF<br>ADMINISTRATION BASED ON EXISTING PROGRAMS ..... | 168        |
| C.          | RECOMMENDED IRRIGATED LANDS REGULATORY PROGRAM ECONOMIC IMPACTS .....                                                        | 169        |
| D.          | RECOMMENDED IRRIGATED LANDS REGULATORY PROGRAM ENVIRONMENTAL IMPACTS.....                                                    | 171        |
| <b>XII.</b> | <b>NEXT STEPS .....</b>                                                                                                      | <b>173</b> |
|             | <b>REFERENCES .....</b>                                                                                                      | <b>174</b> |

#### LIST OF APPENDICES

|                             |                                                                                                                |
|-----------------------------|----------------------------------------------------------------------------------------------------------------|
| <a href="#">APPENDIX A:</a> | DECEMBER 2009 PROPOSED LONG-TERM IRRIGATED LANDS REGULATORY PROGRAM<br>ALTERNATIVES                            |
| <a href="#">APPENDIX B:</a> | CENTRAL VALLEY WATER BOARD DRAFT GROUNDWATER NITRATE SUMMARY REPORT                                            |
| <a href="#">APPENDIX C:</a> | SMALL COMMUNITY WATER SYSTEM NITRATE EXCEEDANCES                                                               |
| <a href="#">APPENDIX D:</a> | RECOMMENDED IRRIGATED LANDS REGULATORY PROGRAM SURFACE AND<br>GROUNDWATER QUALITY MANAGEMENT PLAN REQUIREMENTS |

#### LIST OF TABLES

|    |                                                                                                                                                                                         |     |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| 1  | SUMMARY OF CENTRAL VALLEY AGRICULTURAL OPERATIONS IN 2007 .....                                                                                                                         | 13  |
| 2  | TOP 20 CROPS BY ACREAGE IN THE CENTRAL VALLEY, 2007 .....                                                                                                                               | 15  |
| 3  | NUMBER OF MANAGEMENT PLANS BY CONSTITUENT AND SURFACE WATER BASIN.....                                                                                                                  | 26  |
| 4  | MANAGEMENT PLAN PESTICIDES: COALITION AND WATER DISTRICT MONITORING DATA<br>SUMMARY FOR SITES WITH TWO OR MORE SAMPLES COLLECTED (PER ANALYTE)<br>BETWEEN JULY 2004 AND JUNE 2009 ..... | 29  |
| 5  | NUMBER OF MANAGEMENT PLANS REQUIRED FOR METALS IN NUMBER OF SUBBASINS .....                                                                                                             | 34  |
| 6  | SMALL COMMUNITY SYSTEMS WITH HIGH NITRATE LEVELS WITH AGRICULTURAL<br>POSSIBLE CONTAMINATING ACTIVITIES.....                                                                            | 50  |
| 7  | WELL REPLACEMENT COST ESTIMATE .....                                                                                                                                                    | 51  |
| 8  | WELL OPERATION AND MAINTENANCE COST ESTIMATE.....                                                                                                                                       | 51  |
| 9  | CALIFORNIA WATER CODE REQUIREMENTS FOR IMPLEMENTATION MECHANISMS .....                                                                                                                  | 53  |
| 10 | SUMMARY OF PROPOSED ILRP ALTERNATIVES .....                                                                                                                                             | 96  |
| 11 | OVERALL SUMMARY OF EVALUATION RESULTS .....                                                                                                                                             | 97  |
| 12 | SUMMARY OF PROGRAM GOALS AND OBJECTIVES EVALUATION .....                                                                                                                                | 98  |
| 13 | SUMMARY OF CALIFORNIA WATER CODE EVALUATION .....                                                                                                                                       | 104 |
| 14 | SUMMARY OF NONPOINT SOURCE POLICY EVALUATION .....                                                                                                                                      | 107 |
| 15 | SUMMARY OF ANTIDEGRADATION EVALUATION .....                                                                                                                                             | 114 |
| 16 | SCOPE OF CENTRAL COAST AND CENTRAL VALLEY WATER BOARD ILRPs .....                                                                                                                       | 119 |
| 17 | SUMMARY OF AVERAGE ESTIMATED ANNUALIZED COSTS (\$000,000) BY ALTERNATIVE .....                                                                                                          | 122 |
| 18 | CROP CATEGORY DEFINITION.....                                                                                                                                                           | 124 |
| 19 | SUMMARY OF CHANGES IN TOTAL IRRIGATED ACREAGE (000) BY BASIN FROM<br>ALTERNATIVE 1 .....                                                                                                | 128 |
| 20 | SUMMARY OF CHANGES IN TOTAL VALUE OF PRODUCTION (\$000,000) BY BASIN FROM<br>ALTERNATIVE 1 .....                                                                                        | 129 |
| 21 | SUMMARY OF CHANGES IN AGRICULTURE SECTOR JOBS BY BASIN FROM ALTERNATIVE 1.....                                                                                                          | 129 |
| 22 | LONG-TERM ILRP TIMEFRAME FOR IMPLEMENTATION.....                                                                                                                                        | 144 |

## LIST OF FIGURES

|    |                                                                                                                                           |     |
|----|-------------------------------------------------------------------------------------------------------------------------------------------|-----|
| 1  | CURRENT ILRP COALITION GROUPS.....                                                                                                        | 8   |
| 2  | CROP AND LIVESTOCK SHARES OF TOTAL AGRICULTURAL PRODUCTION IN CALIFORNIA,<br>1950–2000 .....                                              | 11  |
| 3  | CALIFORNIA MARKET VALUE OF AGRICULTURAL PRODUCTS SOLD.....                                                                                | 12  |
| 4  | DISTRIBUTION OF CENTRAL VALLEY FARM SIZE IN 2007.....                                                                                     | 14  |
| 5  | CALIFORNIA FARMS BY TYPE OF ORGANIZATION—PERCENT OF TOTAL .....                                                                           | 15  |
| 6  | STATEWIDE ANNUAL REPORTED TONS OF NITROGEN PURCHASED FOR FARM USE AND<br>IRRIGATED ACREAGE, 1961–2008 .....                               | 17  |
| 7  | CENTRAL VALLEY ESTIMATED NITROGEN INPUT FROM FERTILIZERS, MANURE, AND<br>ATMOSPHERIC DEPOSITION IN MILLIONS OF KILOGRAMS, 1987–2001 ..... | 18  |
| 8  | COMPARISON OF THE 2006 ECR WATERSHEDS AND THE 2009 INTERAGENCY<br>WATERSHED BOUNDARY DATASET .....                                        | 22  |
| 9  | ILRP MONITORING SITE LOCATIONS .....                                                                                                      | 24  |
| 10 | CENTRAL VALLEY HYDROLOGIC SUBBASINS WITH ILRP MANAGEMENT PLANS.....                                                                       | 27  |
| 11 | CHLORPYRIFOS AND DIAZINON USE, MONITORING DATA, AND MANAGEMENT PLANS .....                                                                | 35  |
| 12 | DIURON AND DIMETHOATE USE, MONITORING DATA, AND MANAGEMENT PLANS .....                                                                    | 36  |
| 13 | METHYL-PARATHION AND SIMAZINE USE, MONITORING DATA, AND MANAGEMENT PLANS.....                                                             | 37  |
| 14 | MALATHION AND THIOBENCARB USE, MONITORING DATA, AND MANAGEMENT PLANS .....                                                                | 38  |
| 15 | WATER COLUMN AND SEDIMENT TOXICITY MONITORING DATA AND MANAGEMENT PLANS .....                                                             | 39  |
| 16 | E. COLI AND NITRATE MONITORING DATA AND MANAGEMENT PLANS.....                                                                             | 40  |
| 17 | ARSENIC AND BORON MONITORING DATA AND MANAGEMENT PLANS .....                                                                              | 41  |
| 18 | COPPER AND CADMIUM MONITORING DATA AND MANAGEMENT PLANS .....                                                                             | 42  |
| 19 | LEAD AND NICKEL MONITORING DATA AND MANAGEMENT PLANS .....                                                                                | 43  |
| 20 | SELENIUM, ELECTRICAL CONDUCTIVITY, AND TOTAL DISSOLVED SOLIDS MONITORING<br>DATA AND MANAGEMENT PLANS .....                               | 44  |
| 21 | FLOW DIAGRAM FOR LONG-TERM ILRP ANTIDEGRADATION APPROACH.....                                                                             | 68  |
| 22 | FLOWCHART SUMMARIZING PROPOSED PRIORITIZATION PROCESS .....                                                                               | 153 |
| 23 | LONG-TERM ILRP PRIORITIZATION SCHEME EXAMPLE.....                                                                                         | 161 |

## LIST OF ACRONYMS/ABBREVIATIONS

|                            |                                                                                                              |
|----------------------------|--------------------------------------------------------------------------------------------------------------|
| ACL                        | Administrative Civil Liability                                                                               |
| BAT                        | best available technology economically achievable                                                            |
| BCT                        | best practicable control technology currently achievable                                                     |
| BMP                        | best management practice                                                                                     |
| BPTC                       | best practicable treatment or control                                                                        |
| CAC                        | County Agricultural Commissioner                                                                             |
| CCR                        | California Code of Regulations                                                                               |
| CDFA                       | California Department of Food and Agriculture                                                                |
| Central Valley Water Board | Central Valley Regional Water Quality Control Board                                                          |
| CEQA                       | California Environmental Quality Act                                                                         |
| CFR                        | Code of Federal Regulations                                                                                  |
| COD                        | chemical oxygen demand                                                                                       |
| CV-SALTS                   | Central Valley Salinity Alternatives for Long-Term Sustainability                                            |
| CWC                        | California Water Code                                                                                        |
| DPR                        | California Department of Pesticide Regulation                                                                |
| ECR                        | Existing Conditions Report                                                                                   |
| EIR                        | Environmental Impact Report                                                                                  |
| FIFRA                      | Federal Insecticide, Fungicide, and Rodenticide Act                                                          |
| FWQMP                      | farm water quality management plan                                                                           |
| GQMP                       | groundwater quality management plan                                                                          |
| GWMP                       | (local existing) groundwater management plan                                                                 |
| GWPA                       | groundwater protection areas (DPR)                                                                           |
| GWPL                       | groundwater protection list (DPR)                                                                            |
| ILRP                       | Irrigated Lands Regulatory Program                                                                           |
| JPA                        | joint powers authority                                                                                       |
| MAA                        | Management Agency Agreement                                                                                  |
| MCL                        | maximum contaminant level                                                                                    |
| MDL                        | method detection limit                                                                                       |
| MEP                        | maximum extent practicable                                                                                   |
| MP                         | management practice                                                                                          |
| MRP Plan                   | monitoring and reporting program plan                                                                        |
| MS4                        | municipal separate storm sewer system                                                                        |
| NASS                       | National Agricultural Statistics Service, USDA                                                               |
| NMP                        | nutrient management plan                                                                                     |
| NPDES                      | National Pollutant Discharge Elimination System                                                              |
| NPS Policy                 | State Water Board Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program |
| NPS                        | nonpoint source                                                                                              |
| PCPA                       | Pesticide Contamination Prevention Act                                                                       |
| PEIR                       | Program Environmental Impact Report                                                                          |

|                   |                                                    |
|-------------------|----------------------------------------------------|
| PREC              | Pesticide Regulation & Evaluation Committee (DPR)  |
| PY                | Personnel-year                                     |
| RL                | reporting limit                                    |
| ROWD              | report of waste discharge                          |
| SNV               | specific numerical values (DPR)                    |
| State Water Board | State Water Resources Control Board                |
| SVOC              | semi-volatile organic compounds                    |
| SWAMP             | Surface Water Ambient Monitoring Program           |
| SWPPP             | Storm Water Pollution Prevention Plan              |
| TIC               | Technical Issues Committee                         |
| TMDL              | Water Board Total Maximum Daily Load Program       |
| TSS               | total suspended solids                             |
| USDA              | United States Department of Agriculture            |
| USEPA             | United States Environmental Protection Agency      |
| USGS              | United States Geological Survey                    |
| Waiver            | conditional waiver of waste discharge requirements |
| WDRs              | waste discharge requirements                       |
| WIDB              | DPR's well inventory database                      |
| µg/l              | micrograms per liter                               |

## EXECUTIVE SUMMARY

In 2003 the California Regional Water Quality Control Board, Central Valley Region (Central Valley Water Board) adopted a conditional waiver of waste discharge requirements (WDRs) for discharges from irrigated agricultural lands (irrigated lands regulatory program or “ILRP”). The ILRP’s requirements were designed to reduce wastes discharged from irrigated agricultural sites to Central Valley surface waters (e.g., tailwater, runoff from fields, subsurface drains). The 2003 waiver program was set to expire in 2006, at which time the Central Valley Water Board adopted a new conditional waiver for discharges from irrigated agricultural lands that continues the 2003 interim program until 2011.

As part of the 2003 and 2006 waiver programs, the Central Valley Water Board directed staff to prepare an environmental impact report (EIR) for a long-term ILRP that would protect State waters from irrigated agricultural waste discharges. Although the requirements of the current ILRP are aimed to protect surface water bodies, the directive to develop a long-term program and EIR is not as explicit, as “State” waters include ground and surface waters within the State ([California Water Code](#), Section 13050[e]).

### General Context for the Preferred Alternative

Virtually all Water Board regulatory programs rely on the same fundamental activities: (1) monitoring, (2) assessment, (3) planning, and (4) implementation. These activities are related and often iterative. Broadly speaking, monitoring involves the collection of data that allows stakeholders and the Board to assess whether the objectives of the regulatory program are being achieved. Based on the assessment of the data, plans are developed or adjusted to address any identified water quality issues. Alternatively, the information from the assessment may lead to a conclusion that no changes are needed. Finally, any plan that is developed must be implemented with adequate monitoring or feedback mechanisms to ensure the planned activities are being carried out.

The monitoring, assessment, planning, and implementation activities are considered in the context of the water quality issues that must be addressed. For certain areas and crops, available information may indicate:

1. no or limited effects of agricultural discharge on water quality;
2. clear relationships between discharge and water quality problems; or
3. uncertainty as to whether irrigated agriculture is contributing to an identified problem (e.g., agricultural waste discharges are often commingled, either in a shared drainage conveyance or shared groundwater aquifer. This commingling of discharge makes it more difficult to determine whether specific irrigated agricultural operations are contributing to a water quality



problem or whether there is a general practice used by all operations that must be changed to improve water quality).

Each of these circumstances suggests a different regulatory approach—limited requirements in the first instance; a focus on implementing appropriate practices to correct the water quality problem in the second instance; and a focus on additional investigation in the third instance.

In developing the preferred alternative (or ~~recommended~~ alternative”), Water Board staff are mindful that there is a balancing of costs associated with a new regulatory program. A more stringent regulatory program may increase the likelihood of improving and protecting water quality, but the cost of compliance for regulated entities and the State to oversee the program can be overly burdensome. The California Water Code (CWC) requires that costs be considered when developing programs for agriculture. Given that agricultural operators are price takers in the market and cannot directly pass on their costs to consumers, these costs become especially important. Conversely, a regulatory program that is lax or allows too much time for compliance can lead to an exacerbation of water quality problems and prolonged impacts on beneficial uses.

To assist the Central Valley Water Board in trying to strike the appropriate balance, a Stakeholder Advisory Workgroup was formed. The Workgroup included representatives from local, State, and federal agencies; agricultural interests; water suppliers; environmental/environmental justice groups; and other interested parties. Over the course of 9 months (December 2008–August 2009), the Advisory Workgroup came to consensus on the goals and objectives of the program and the five alternatives that should be considered and analyzed.

At the request of the Advisory Workgroup, Water Board staff developed a “straw proposal” based on an initial review of the five alternatives and staff’s review of existing Water Board regulatory programs that address irrigated agriculture or are structured to deal with a large group of waste dischargers. In April and May 2010, staff reviewed the straw proposal with stakeholders. Stakeholders were generally supportive of the straw proposal, although there were a number of concerns. The elements that received stakeholder support; the concerns expressed; and the environmental impact, economic analysis, and policy analysis described below all were considered in developing the preferred alternative.

The five programmatic alternatives have been evaluated against the long-term ILRP goals and objectives and State policy and law and considered in a Draft PEIR<sup>1</sup> and Draft ILRP Economics Report (economics report).<sup>2</sup> The results of the evaluation have been used to identify the elements of each alternative that best

---

<sup>1</sup> *Draft Irrigated Lands Regulatory Program Program Environmental Impact Report* (ICF International 2010) (Draft PEIR)

<sup>2</sup> ICF International 2010, *Draft Technical Memorandum Concerning the Economic Analysis of the Irrigated Lands Regulatory Program* (Draft ILRP Economics Report).

achieve the evaluation measures (e.g., goals and objectives, policy, environmental impacts, cost). These elements have been combined to create a recommended long-term ILRP. This report (1) summarizes the information that the Central Valley Water Board has considered in the development of a recommended long-term ILRP, (2) describes and evaluates the range of proposed program alternatives, and (3) provides a recommended alternative based on the policy, economic, and environmental review.

Elements of the long-term ILRP alternatives found to best achieve evaluation measures are summarized below.

- Scope: consideration of surface –and” groundwater waste discharges to achieve the goals and objectives proposed by the Stakeholder Advisory Workgroup (current ILRP does not include waste discharge to groundwater)
- Third-party lead or coalition groups, as opposed to Central Valley Water Board lead, to take advantage of local knowledge and administrative/cost efficiencies in dealing with a few groups versus thousands of individual operations
- Regional surface and groundwater quality management plans, as opposed to individual water quality management plans, to minimize paperwork/administrative burdens while clearly defining the expectations and approach for addressing water quality problems
- Regional surface and groundwater quality monitoring, as opposed to individual or no water quality monitoring, to take advantage of cost efficiencies in coordinating with other monitoring efforts while providing sufficient information to characterize water quality
- The above elements are included in a Central Valley Water Board staff-recommended long-term ILRP provided in this report.

This report is intended to provide interested stakeholders with the information necessary to understand the process that the Central Valley Water Board has conducted in the development of a recommended long-term ILRP and the rationale for the recommended ILRP components. This report considers and summarizes the results of the Draft PEIR and economics report.

During the July 28–September 27, 2010, long-term ILRP Draft PEIR comment period, interested stakeholders are encouraged to provide comments on this report, the Draft PEIR, and the economics report. To facilitate a timely and accurate response to comments received, the Central Valley Water Board requests that written comments include (1) a heading indicating the page/section of report (s) (PEIR/economics/staff report) the comment is addressing, (2) a summary of comment/recommended change, and (3) any discussion supporting the comment/recommended change. The Central Valley Water Board prefers

that comments be submitted electronically to the following email address:  
[ILRPcomments@icfi.com](mailto:ILRPcomments@icfi.com). If email is unavailable, written comments should be provided to:

ILRP Comments  
Ms. Megan Smith  
ICF International  
630 K Street, Suite 400  
Sacramento, CA 95814  
Fax: (916) 456-6724

Stakeholder comments will be considered during the development of a final recommended long-term ILRP and Final PEIR. Any questions regarding the long-term ILRP or this notification should be directed to Adam Laputz at (916) 464-4848 or [awlaputz@waterboards.ca.gov](mailto:awlaputz@waterboards.ca.gov).

## I. INTRODUCTION

There are numerous and varying irrigated agricultural operations within the boundaries of the Central Valley Water Board. Common to all types of these operations is the use of water to sustain crops. Depending on irrigation method, water use, geography, geology, and the “waste” constituents (e.g., nutrients, pesticides, pathogens) present or used at a site, there is the possibility that water discharged from the site will carry these constituents off site and into ground or surface waters.

The Central Valley Regional Water Quality Control Board Irrigated Lands Regulatory Program (ILRP) was initiated in 2003 with the adoption of a conditional waiver of WDRs for discharges from irrigated lands. The 2003 waiver program was renewed in 2006 (current ILRP). The current ILRP’s requirements are designed to reduce wastes discharged from irrigated agricultural sites (e.g., tailwater, runoff from fields, subsurface drains) to Central Valley surface waters ([Central Valley Water Board 2006](#)).

In addition to providing conditions, or requirements, for discharge of waste from irrigated agricultural lands to surface waters, the Central Valley Water Board’s current ILRP establishes that Board staff will develop a program environmental impact report (PEIR) for a long-term ILRP (long-term program) that will protect waters of the State from said discharges. Although the requirements of the current ILRP are aimed to protect surface water bodies, the directive to develop a long-term program and PEIR is not as limited, as waters of the State include ground and surface waters within the State of California ([CWC](#), Section 13050[e]).

The Central Valley Water Board completed an [Existing Conditions Report](#) (ECR) for Central Valley irrigated agricultural operations in December 2008. The ECR was developed to establish baseline conditions for estimating potential environmental and economic effects of long-term ILRP alternatives in a PEIR and other associated analyses. The ECR has been used in the development of this report and is incorporated by reference.

In fall 2008, the Central Valley Water Board convened the Long-Term ILRP Stakeholder Advisory Workgroup (Workgroup). The Workgroup included a range of stakeholder interests representing local government, industry, agricultural, and environmental/environmental justice coalitions throughout the Central Valley. The main goal of the Workgroup was to provide Central Valley Water Board staff with input on the development of the long-term ILRP. Central Valley Water Board staff and the Workgroup developed long-term program goals and objectives and a range of proposed alternatives for consideration in a PEIR and economic analysis. In August 2009 the Workgroup approved these goals, objectives, and range of proposed alternatives for the long-term ILRP. The Workgroup process, long-term ILRP goals and objectives, and range of alternatives are included in the December 2009 ~~Proposed~~ Long-Term Irrigated Lands Regulatory Program

Alternatives” document ([Alternatives Document](#)—Appendix A). The Central Valley Water Board has committed to evaluate the Workgroup-approved range of alternatives in economics, PEIR, and policy analyses.

As part of the development of the long-term ILRP, the Central Valley Water Board’s contractor, ICF International, has developed a Draft PEIR<sup>3</sup> and economics report.<sup>4</sup> The results of the Draft PEIR and economic analysis have been considered in evaluating proposed alternatives and developing the staff-recommended alternative in this report.

This report (1) summarizes the information Central Valley Water Board staff (staff) have considered in the development of a recommended long-term ILRP, (2) describes and evaluates the range of proposed program alternatives, and (3) provides a recommended staff alternative based on the policy, economic, and environmental review.

## **II. CURRENT IRRIGATED LANDS REGULATORY PROGRAM DESCRIPTION**

### **A. Background**

In 2003 the Central Valley Water Board adopted a revised conditional waiver of WDRs for discharges from irrigated agricultural lands (the original was adopted in 1982 and revised in 2002). The current ILRP essentially began with the adoption of the 2003 conditional waiver.

### **B. Regulatory Setting: Conditional Waivers**

Owners and operators of irrigated agricultural operations, nursery stock production, managed wetlands, and greenhouse operations with permeable floors that have the potential to discharge waste to surface waters of the State and do not currently discharge under a waiver, WDRs, or National Pollutant Discharge Elimination System (NPDES) permits must obtain regulatory coverage under the current ILRP. The current ILRP implements the CWC. Under the current ILRP, irrigated agricultural operations<sup>5</sup> have three regulatory options: individual WDRs, an individual conditional waiver of WDRs, or a coalition group conditional waiver of WDRs. The vast majority of operators have chosen the coalition group conditional waiver, a few have chosen the individual waiver, and none are currently regulated under WDRs. Approximately 25,000 growers are

---

<sup>3</sup> Draft Irrigated Lands Regulatory Program Environmental Impact Report (ICF International 2010) (Draft PEIR)

<sup>4</sup> ICF International 2010, Draft Technical Memorandum Concerning the Economic Analysis of the Irrigated Lands Regulatory Program) (Draft ILRP Economics Report).

<sup>5</sup> For ease of reading purposes, this report will use the terms “irrigated agricultural operations,” “irrigated lands,” “operators,” or “growers” to refer to all types of discharges regulated through the ILRP, which also includes discharges from nursery stock production, managed wetlands, and greenhouse operations with permeable floors.



currently enrolled in the program, equating to 5 million of the approximately 7 million acres<sup>6</sup> of commercial irrigated agricultural lands in the Central Valley Region.

Conditions that must be met by coalitions and growers include ensuring the Central Valley Water Board knows who is participating in the program (names and parcels are identified); conducting monitoring to determine whether discharges from irrigated lands are affecting surface waters; and developing and implementing measures to address identified water quality problems.

### **C. Coalition Groups**

Most irrigated agricultural operations choose to participate in a coalition group (generally referred to as third-party group). Coalition groups conduct water quality monitoring, submit reports to the Central Valley Water Board, and develop management plans to address water quality problems. All program enrollees must comply with the conditions in the Coalition Group Conditional Waiver, including the requirement to implement management practices that protect water quality. There are currently eight coalition groups:

- California Rice Commission
- East San Joaquin Water Quality Coalition
- Goose Lake Water Quality Coalition
- Sacramento Valley Water Quality Coalition
- San Joaquin County and Delta Water Quality Coalition
- Southern San Joaquin Valley Water Quality Coalition
- Westlands Water District Stormwater Coalition
- Westside San Joaquin River Watershed Coalition

Most coalitions are geographically based, although one is commodity-based (rice). Two coalitions are further subdivided into subwatershed groups (Sacramento Valley Water Quality Coalition and Southern San Joaquin Valley Water Quality Coalition). Figure 1 shows the current Central Valley Water Board approved coalitions and their boundaries. Coalitions charge member growers annual fees based on acreage of land enrolled.

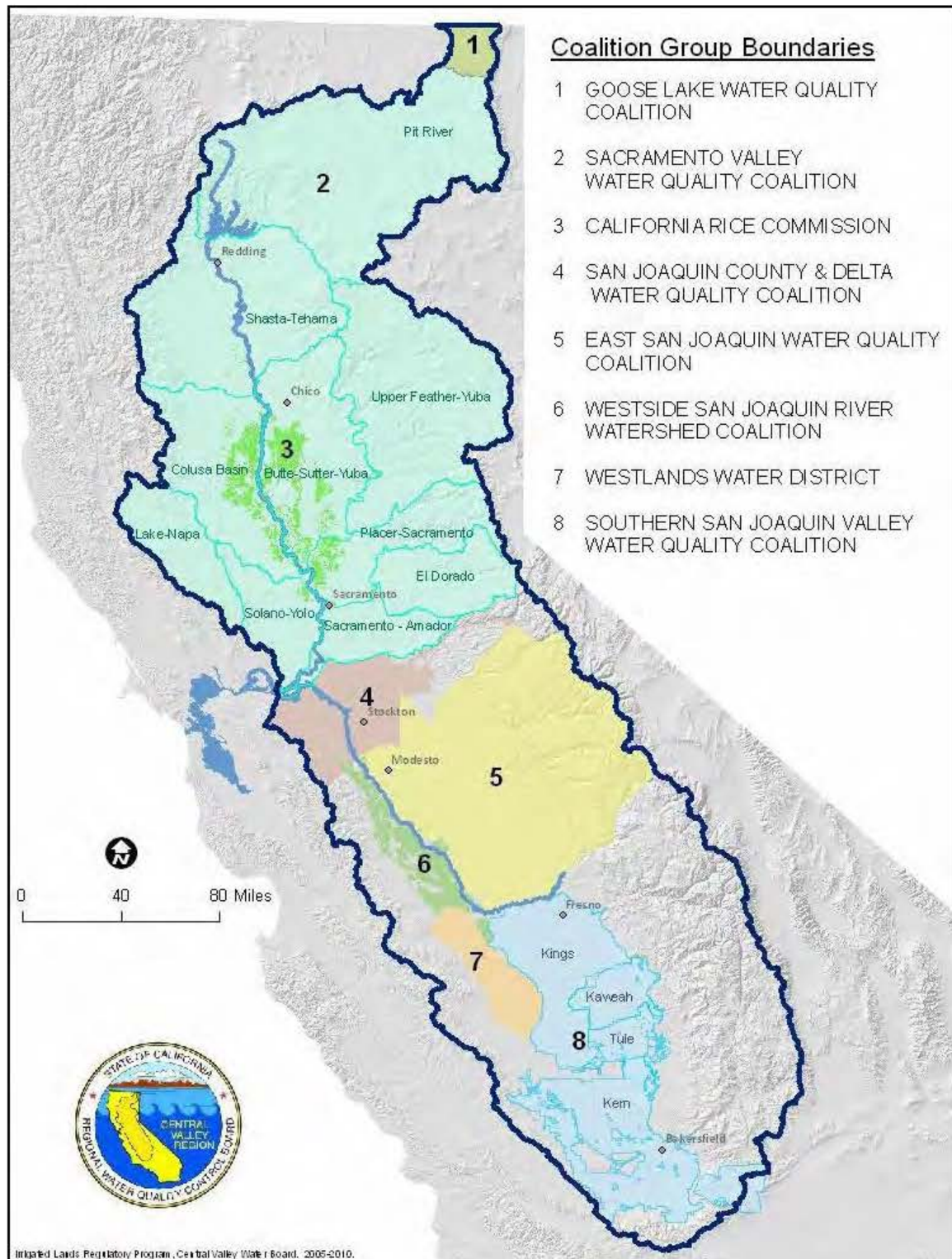
Coalitions provide a local presence and an efficient means to address water quality problems. Water Board staff are working with only a few coalition

---

<sup>6</sup> Total irrigated agricultural acreage calculations range from 6.5 million (2007 USDA Agricultural Census) to over 8 million (2006–2008 CA Department of Conservation's Farmland Monitoring and Mapping Program, ECR). Seven million acres is cited here as a measure of the most current information. The ECR, which is the baseline for environmental and economic review (Draft PEIR/Economics Report), estimates approximately 8 million acres of irrigated agricultural lands within the Central Valley.

representatives for routine program work, rather than tens of thousands of individuals.

**Figure 1. Current ILRP Coalition Groups**



## **D. Monitoring and Reporting**

All coalition groups prepare and implement a [monitoring and reporting program plan \(MRP Plan\)](#) to assess potential irrigated agricultural water quality impacts of its members. Coalition groups currently are required to monitor roughly 70 constituents at every site, monthly during the irrigation season and twice during the storm season. These constituents include pesticides, metals, nutrients, toxicity, pathogens, general chemistry, and physical parameters.

Where monitoring results show more than one exceedance of a particular waste constituent at the same monitoring site within a 3-year period, coalition groups are required to prepare and submit a management plan to address the exceedances with their members. Under the current program, the Central Valley Water Board has required that the coalitions develop management plans to address 686 waste constituent–water body combinations. The first step in implementing a management plan often is conducting source identification studies. Once sources are known, growers must implement management practices to address the water quality problem.

## **E. Enforcement**

### **1. Individual Agricultural Operation Enforcement**

ILRP requirements are enforced using two types of compliance actions: administrative actions and water quality actions. For example, an irrigated agricultural operator who does not respond to a Central Valley Water Board, CWC Section 13267, *Request for Technical Report*, would be placed under enforcement based on failure to respond to the technical report. On the other hand, a grower unlawfully discharging waste to surface waters could be placed under enforcement based on water quality actions.

Staff periodically conduct inspections to determine whether an operation has the potential to discharge, and therefore should be participating in the ILRP. Staff also conducts inspections in response to complaints. Routine inspections by Water Board staff are not conducted for each irrigated agricultural operation under the current ILRP.

### **2. Coalition Group Enforcement**

Coalition groups are third-party entities representing irrigated lands operations. Because coalition groups are not discharging waste, the Central Valley Water Board has limited authority to directly enforce program requirements. Program enforcement options are limited to direct actions upon irrigated agricultural operators, or revoking Water Board coalition approval. Most coalition groups do not have regulatory authority over members to require implementation of water quality management practice(s). In these cases, coalitions provide members

information on management practices through mailers and group meetings, and rely on the Central Valley Water Board to enforce program requirements.

### **III. CENTRAL VALLEY IRRIGATED LANDS ENVIRONMENTAL AND INDUSTRY SETTING**

#### **A. Industry Summary**

##### **1. History**

California's Central Valley has been one of the most productive agricultural regions in the world for more than 60 years. Contrary to the high agricultural productivity in the area, most regions in the Central Valley are arid to semiarid and are naturally water-deficient. Early irrigation in the valley, starting at the end of the nineteenth century, was limited to gravity diversions from the San Joaquin River and developed into intense groundwater pumping starting in the 1920s, leading to an increase in irrigated acreage westwards and upslope.

Transformation from extensive to intensive agriculture<sup>7</sup> occurred around the turn of the twentieth century, from 1890 to 1930 (Johnston and McCalla 2004). During this 40-year rapid expansion period, irrigated agricultural acres increased from about 1 million to almost 5 million acres. In 1948, California permanently took over as the largest agricultural State in the union in terms of value of production (Johnston and McCalla 2004).

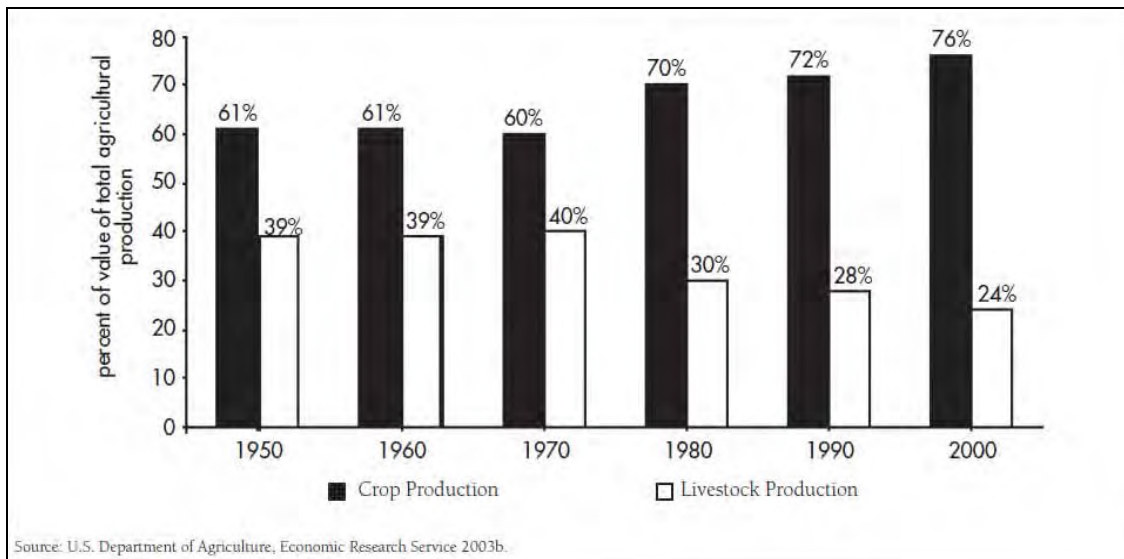
After completion of the Central Valley Project and the State Water Project in 1953 and 1967, respectively, much of the San Joaquin Valley was irrigated with high-quality imported water from the Sacramento Valley conveyed by the Delta-Mendota Canal and the California Aqueduct (Schoups et al. 2005). This allowed irrigated agriculture to expand by more than 3 million acres. Agriculture shifted from majority animal to majority plant production (see Figure 2), and the share of intensive agricultural crops (fruits, nuts, berries, and vegetables) rose from 63 percent in 1950 to 77 percent of total crop products by 2000. Growth was most pronounced in nursery products (rising from 4 percent to 15 percent).

---

<sup>7</sup> Intensive agriculture describes a system characterized by high inputs of capital, labor, and/or heavy usage of technologies such as pesticides and fertilizers relative to land area.



**Figure 2. Crop and Livestock Shares of Total Agricultural Production in California, 1950–2000**



Source: From Johnston and McCalla 2004.

## 2. Central Valley Agriculture Today

Central Valley agriculture continues to be sustained by the extensive system of reservoirs and canals and also by the availability of groundwater (Faunt et al. 2009).

### Agricultural Output Economics

California's agricultural sector produces \$39 billion<sup>8</sup> in goods and services each year (USDA 2008, see Figure 3). The market value of agricultural products grown on Central Valley irrigated land was about \$13 billion in 2007. Using about 1 percent of U.S. farmland, the Central Valley supplies 12 percent of U.S. agricultural output by value (Great Valley Center 2009). California surpasses Texas, the second highest agriculturally productive State, by almost 92 percent. Eight of the nation's top 10 producing counties are in California; Fresno is the leading agricultural county in the nation. Six of the seven top producing counties in California are in the Central Valley (listed in decreasing order: Fresno, Tulare, Kern, Merced, Stanislaus, San Joaquin, and Kings Counties).

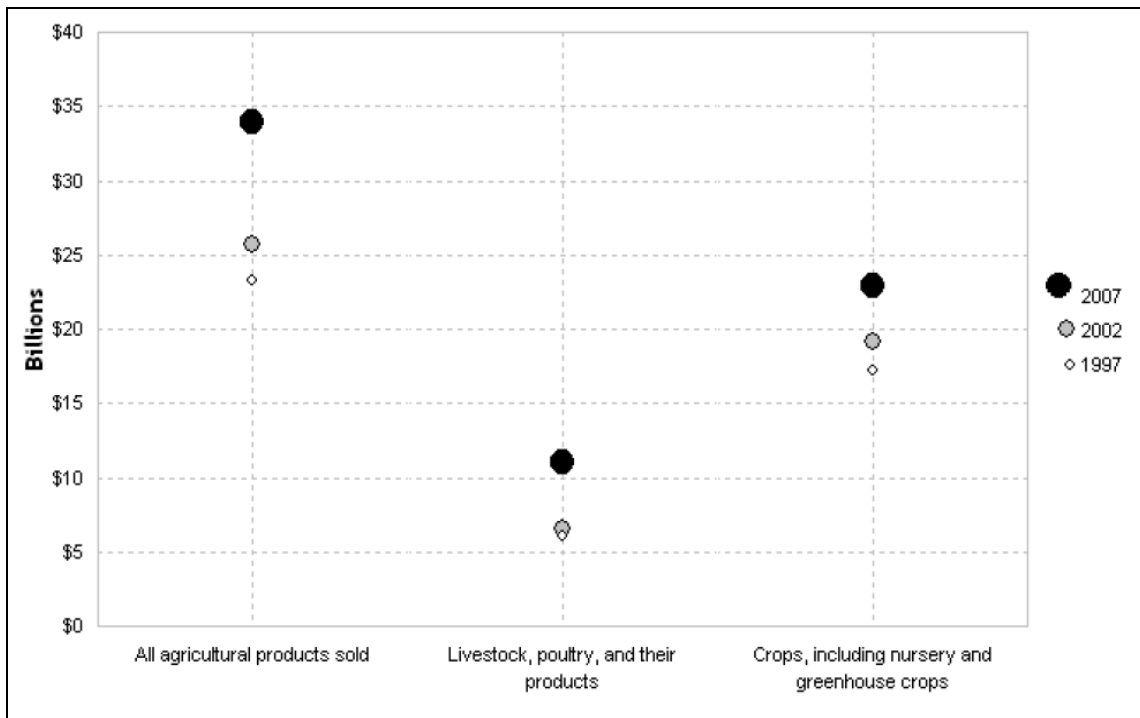
The estimated average market value of products sold per farm in the Central Valley was between \$350,000 and \$480,000, and the estimated net cash per farm average in 2007 was \$72,000. The net cash per farm average varied widely among Central Valley counties; -\$10,233 in Nevada County and \$410,658 in Kern County. All nine counties with an average net profit loss in 2007 are in the

<sup>8</sup> Value is for total agricultural products and services throughout California.



foothill and upper watershed regions, as are all five counties with an average net profit of less than \$20,000. See Table 1 for more information.

**Figure 3. California Market Value of Agricultural Products Sold**



Source: From the 2007 Census of Agriculture, California Report.

**Table 1. Summary of Central Valley Agricultural Operations in 2007**

|                                                                 | Central Valley<br>Totals |
|-----------------------------------------------------------------|--------------------------|
| <b>Number of Farms</b>                                          |                          |
| Irrigated Land                                                  | <b>34,124</b>            |
| All Cropland                                                    | <b>36,541</b>            |
| Fruits, tree nuts, berries                                      | 22,349                   |
| Other crops and hay                                             | 4,141                    |
| Grains, oilseeds, dry beans, dry peas                           | 3,894                    |
| Pasture                                                         | 2,195                    |
| Vegetables, melons, potatoes                                    | 2,125                    |
| Nursery, greenhouse, floriculture, sod                          | 829                      |
| Cotton and cottonseed                                           | 818                      |
| Cut Christmas trees, short-rotation woody crops                 | 191                      |
| <b>Acres</b>                                                    |                          |
| Irrigated Land                                                  | 6,521,541                |
| All Cropland                                                    | 7,345,984                |
| Average Size of Farm                                            | 414                      |
| Median Size of Farm                                             | 36                       |
| <b>Market Value of Products Sold</b>                            |                          |
| Fruits, tree nuts, berries                                      | \$7,707,251,000          |
| Vegetables, melons, potatoes                                    | \$2,179,456,000          |
| Grains, oilseeds, dry beans, dry peas                           | \$991,518,000            |
| Nursery, greenhouse, floriculture, sod                          | \$748,005,000            |
| Other crops and hay                                             | \$604,130,000            |
| Cotton and cottonseed                                           | \$554,628,000            |
| Cut Christmas trees, short-rotation woody crops                 | \$1,502,000              |
| Source: From the 2007 Census of Agriculture, California Report. |                          |

### Acres and Farm Size

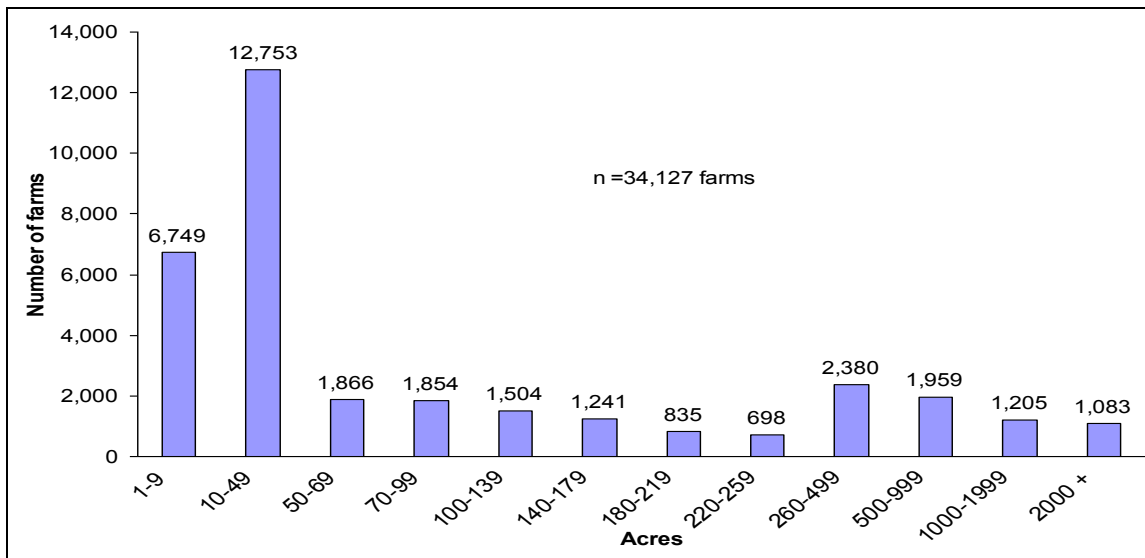
According to the U.S. Department of Agriculture (USDA) National Agricultural Statistics Service's (NASS) 2007 Census of Agriculture, there were about 34,000 irrigated farms on 6.5 million acres in the Central Valley in 2007. According to the California Department of Conservation's Farmland Mapping and Monitoring Program, there were approximately 7.5 million acres of irrigated agriculture in the Central Valley in 2007.<sup>9</sup>

<sup>9</sup> All numbers should be considered estimates of Central Valley Water Board totals because (a) the 2007 Census of Agriculture definition of a farm (operation with annual sales of at least \$1,000) differs from the ILRP definition; (b) some counties are partially outside Central Valley Water Board boundaries; and (c) the 2007 Census of Agriculture does not provide information if there is a risk of disclosing an individual respondent(s) data. California Department of Conservation's Farmland Mapping and Monitoring Program estimate of 7.5 million acres is probably closer to the actual acreage, as this number includes land in farms making less than \$1,000 per year and land for individual farms that USDA did not disclose. Neither of these totals

Between 2000 and 2006, 35,488 acres of the Central Valley's prime agricultural land was converted to urban uses (Central Valley Center 2009).<sup>10</sup>

More than half of the farms in the Central Valley are less than 50 acres in size. While the average farm size is 414 acres, the median size is 36 acres. Approximately 80 percent of California farms are family- or individually operated (see Figures 4 and 5).

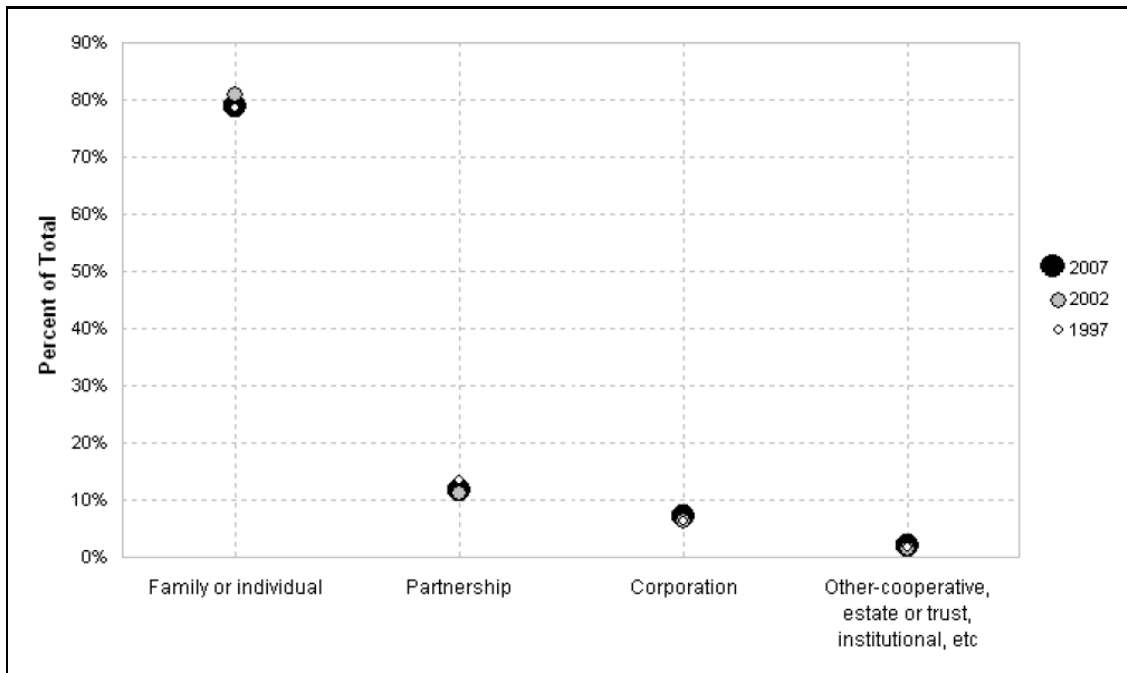
**Figure 4. Distribution of Central Valley Farm Size in 2007**



includes acres of managed wetlands, which are approximately an additional 80,765 acres. The ECR, which is the baseline for environmental and economic review (Draft PEIR/Economics Report), estimates approximately 8 million acres of irrigated agricultural lands in the Central Valley.

<sup>10</sup> Prime farmland is defined in section 5.10.2 of the Draft PEIR.

**Figure 5. California Farms by Type of Organization—Percent of Total**



Source: From the 2007 USDA Census of Agriculture, California Report.

### Crop Diversity

Sixty-one percent of Central Valley farms grow a fruit, nut, or berry crop. The next largest category is “other crops and hay,” which comprises 11 percent of Central Valley farms. More than 250 different crops are grown in the Central Valley, but in 2007 the top 20 crops made up approximately 78 percent of the total cropland acres. See Table 2 for more information.

**Table 2. Top 20 crops by acreage in the Central Valley, 2007**

| Crop         | 2007 Acres | Crop                           | 2007 Acres |
|--------------|------------|--------------------------------|------------|
| Almonds      | 1,103,000  | Tomatoes                       | 109,000    |
| Alfalfa      | 1,007,000  | Prunes                         | 82,000     |
| Rice         | 606,000    | Safflower                      | 74,000     |
| Grapes       | 568,000    | Oranges                        | 57,000     |
| Winter wheat | 511,000    | Olives                         | 53,000     |
| Cotton       | 486,000    | Clover                         | 51,000     |
| Corn         | 412,000    | Double crop: winter wheat/corn | 39,000     |
| Walnuts      | 345,000    | Barley                         | 26,000     |
| Pistachios   | 168,000    | Asparagus                      | 17,000     |
| Oats         | 155,000    | Sunflowers                     | 16,000     |

Source: From the 2007 USDA Cropland Data Layer. Rounded to the nearest 1,000 acres.

Organic farming has been one of the fastest growing segments of U.S. and California agriculture for more than a decade (USDA 2010). California is the leading State in certified organic cropland. In 2007 there were 369,000 certified organic acres in California.

California's agricultural industry receives various support services from organizations such as the USDA's Natural Resources Conservation Service, University of California Cooperative Extension, the California Farm Bureau Federation, the California Department of Food and Agriculture (CDFA), and many commodity-, region-, and growing style-specific boards and associations.

### **Irrigation Practices**

Irrigation practices throughout the Central Valley include methods such as gravity-driven irrigation (flood and furrow), sprinklers, and drip. According to Orang et al. (2005), acreage of gravity-driven irrigation systems has declined from 80 percent of all irrigated acreage in 1970 to 50 percent in 2000. During the same time period, percent acreage of drip irrigation systems has increased from zero to 30 percent. In general, more runoff occurs from flood and furrow irrigation than sprinkler irrigation, and there is usually little to no runoff from drip irrigation if used properly.

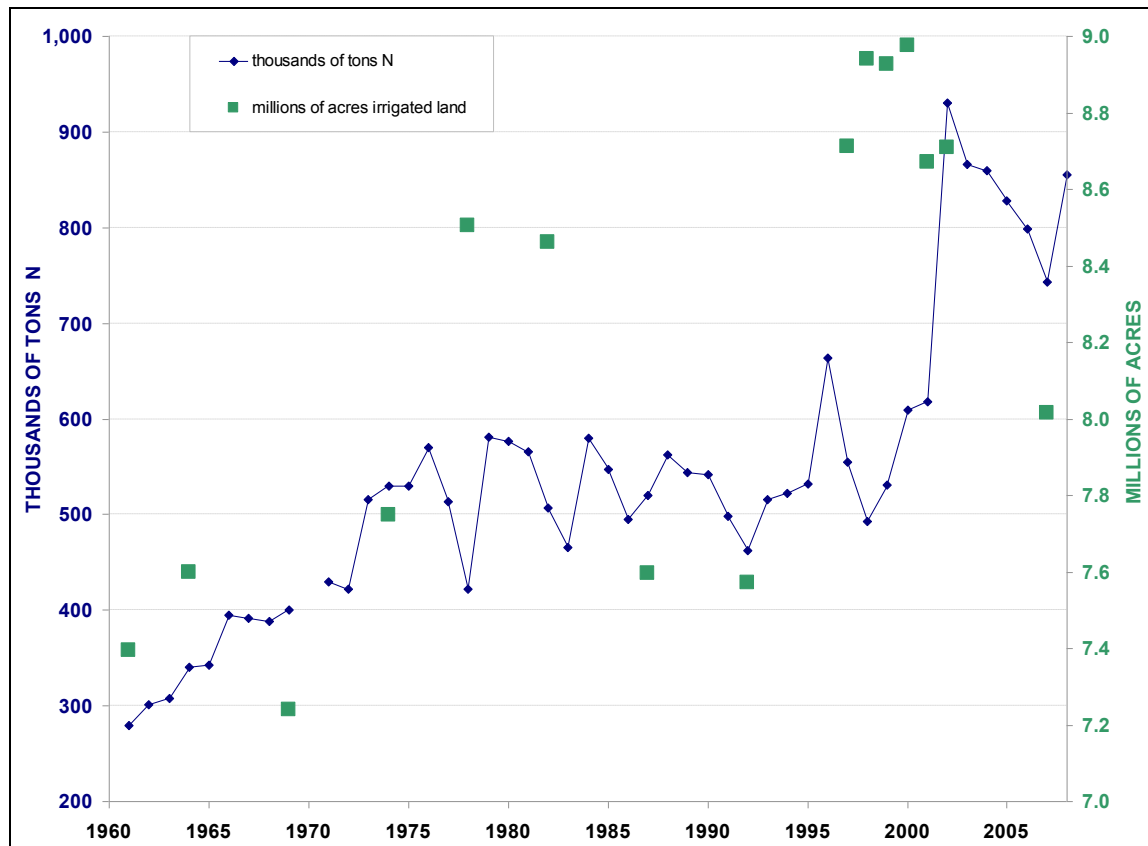
### **Fertilizer Use**

The use of synthetic nitrogen fertilizers has increased steadily in the last 50 years, rising almost twentyfold to the current worldwide rate of 1 billion tons per year (Glass 2003). The current California rate of synthetic nitrogen fertilizer use is estimated at 856,000 tons of nitrogen per year from county-level fertilizer purchasing information (CDFA 2010). The reported tons of nitrogen in fertilizers purchased by farm users annually in California increased threefold between 1961 and 2008 (279,000 to 856,000 tons), according to reports submitted to the CDFA. During the same time period, irrigated acres in California increased by approximately 8 percent. Figure 6 shows the tons of purchased nitrogen fertilizer and estimated irrigated acreage in California from 1961–2008.

The majority of inorganic fertilizer is applied to cropland versus pastureland. Approximately 61 percent of cropland in the Central Valley was fertilized with commercial fertilizer, lime, and soil conditioners in 2007, versus 1 percent of pastureland; however, these numbers vary widely by county and crop. Percent of cropland fertilized per county in 2007 ranged from 84 percent in Fresno County to 4 percent in Mariposa County. Percent of pastureland fertilized in 2007 ranged from 6 percent in San Joaquin County to less than 1 percent in Sierra and Kern Counties. These percentages do not account for the type, tonnage, or frequency of fertilizers used, only whether use occurred at least once per year.



**Figure 6. Statewide Annual Reported Tons of Nitrogen Purchased for Farm Use and Irrigated Acreage, 1961–2008<sup>11</sup>**



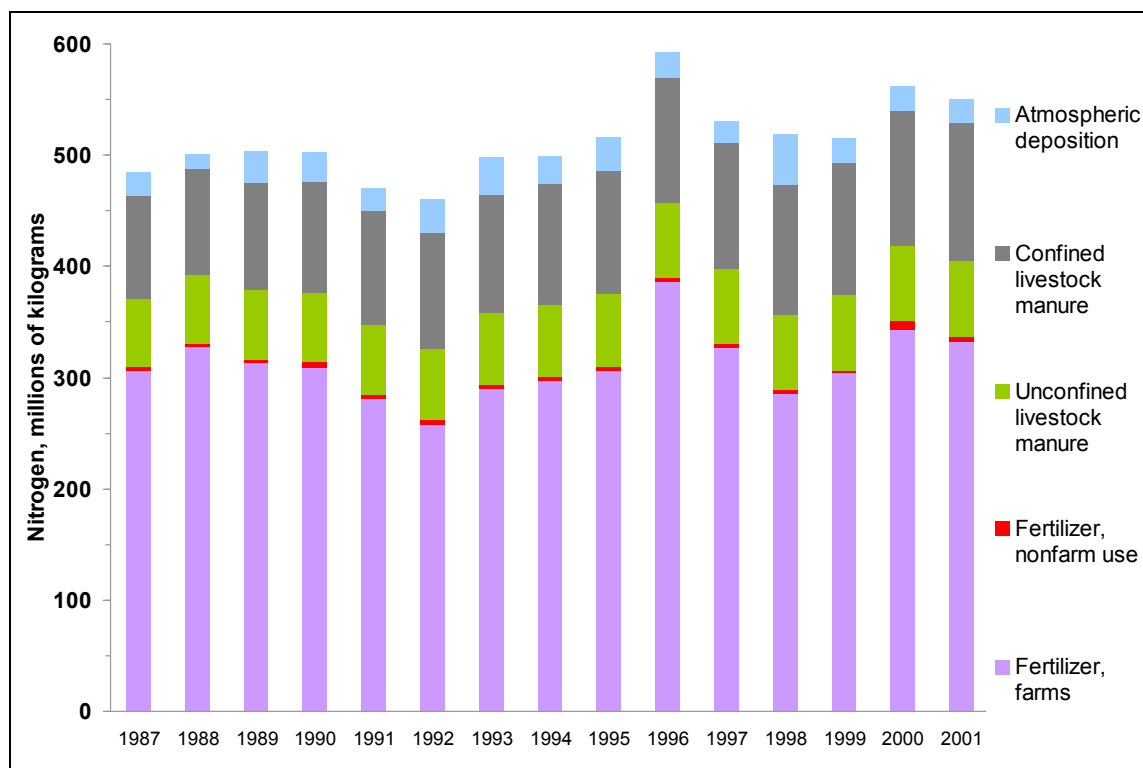
In the U.S. Geological Survey (USGS) Scientific Investigations Report 2006-5012: County Level Estimates of Nutrient Inputs to the Land Surface of the Conterminous United States, 1982–2001 (2006 USGS Nutrient Input Report), Ruddy, Lorenz, and Mueller (2006) used existing data to estimate and allocate nutrient input data for fertilizer use, livestock manure, and atmospheric deposition to counties in the conterminous United States for the years 1982 through 2001. The purpose of the study was to consolidate nutrient input data from fertilizer use, livestock manure, and atmospheric deposition and make them available in a consistent format. They found that of the sources included in the study, farm fertilizer was the largest source of nitrogen, and these inputs were highest in the upper Midwest, along eastern coastal areas, and in irrigated areas of the West. The study did not consider potential nitrogen inputs from human waste and did not take into account nitrogen plant uptake, legume nitrogen fixation, or any other nitrogen sinks (i.e., the data do not represent net inputs to the environment after gross inputs and outputs are balanced).

<sup>11</sup> Annual nitrogen data as reported to the CDFA by the last licensee selling/distributing fertilizers to unlicensed purchasers for farm use. Acres of irrigated land as reported in the USDA Ag Census, except for 1998–2001 data, which is from the California Department of Water Resources.

Data sources for the 2006 USGS Nutrient Input Report include state and county fertilizer sales from the Association of American Plant Food Control Officials; State and county fertilizer expenditures as well as livestock populations from the USDA NASS Census of Agriculture; human population per county from the U.S. Census Bureau; and nutrient wet deposition chemistry for point locations from the National Atmospheric Deposition Program.

Between 1987 and 2001, an average of 862 million kilograms/950 thousand tons nitrogen was created or used annually in California from the study sources, with the total remaining fairly constant over this time period. On average, 513 million kilograms/565 thousand tons of the California total were in the Central Valley (60 percent; see Figure 7). Within the Central Valley, the average percent contribution of the total nitrogen (for the sources considered in this study) are: farm fertilizer use, 60.5 percent; confined livestock manure, 21.1 percent; unconfined livestock manure, 12.7 percent; atmospheric deposition, 5 percent; non-farm fertilizer use, 0.8 percent.

**Figure 7. Central Valley Estimated Nitrogen Input from Fertilizers, Manure, and Atmospheric Deposition in Millions of Kilograms, 1987–2001**



Source: After Ruddy, Lorenz, Mueller (USGS) 2006.

## B. Potential Waste Discharge from Irrigated Agricultural Lands

Agricultural production practices can result in a number of wastes entering surface and groundwater, including sediment, nutrients, pathogens, pesticides,

metals, and salts. Discharge of these wastes may degrade water quality, affect beneficial uses, and impose costs on water users (e.g., treatment for drinking water use).

Waste may be discharged to surface waters in tailwater, tile drain discharge, stormwater runoff, drift of sprayed materials into surface waters, and direct disposal via spills and leaks. Wastes may be leached to groundwater during irrigation; discharged to groundwater in stormwater, irrigation water, or other surface runoff that reaches dry wells or other conduits; disposed directly (spills and leaks) into wells or other conduits; and leached during irrigation events designed to force salts below the root zone.

While irrigated agricultural practices can contribute to water quality degradation, agriculture is not generally the sole source of these pollutants in Central Valley ground and surface water. Urban, industrial, mining, timber, and natural sources also may contribute to waste constituent loads.

More detailed information on agricultural constituents of concern, their effects on water quality, and pathways of discharge to surface and groundwater is given in Chapters 3 (surface water) and 4 (groundwater) of the ECR.

### **C. Water Quality Data Summary for Ground and Surface Waters Accepting Irrigated Agricultural Waste**

The ECR, prepared by ICF Jones and Stokes, was initiated in 2005 and released in final version in December 2008. The ECR was conducted to support the development of the long-term ILRP and PEIR, as well as to serve as a baseline of information on surface and groundwater quality, land uses, existing regulatory programs, and management practices within a unique combination of California Department of Water Resources' (DWR's) Calwater watershed boundaries and ECR-defined watersheds<sup>12</sup> in the Central Valley region. Figure 8 graphically depicts the ECR watersheds (white boundaries and text) and the subbasins discussed.

The ECR summarizes surface water quality data based on two main data sources: the 2002 303(d) list, and ILRP monitoring data collected from May 2004 through October 2006. The ECR's main surface water quality findings are summarized below by basin:

#### **Sacramento River Basin**

Of the eight ECR watersheds in the Sacramento River Basin, only one watershed does not contain a water body that is 303(d) listed as impaired from irrigated agriculture. However, management plans are being required for water bodies in all eight watersheds under the current ILRP.

---

<sup>12</sup> The locations and characteristics of these watersheds are described in the ECR.

## **San Joaquin River Basin**

The San Joaquin River Basin is delineated into 12 ECR watersheds. Management plans (current ILRP) are required for water bodies in five of these watersheds; four of these five watersheds contain 303(d) listed water bodies impaired for waste constituents from irrigated agriculture.

## **Tulare Lake Basin**

Of the ten ECR watersheds in the Tulare Lake Basin, only one watershed contains a water body that is 303(d) listed as impaired from irrigated agriculture; a water quality management plan is required for this same watershed under the current ILRP.

Groundwater quality data from DWR's *Bulletin 118*, California Department of Pesticide Regulation (DPR) data, USGS, and the Groundwater Ambient Monitoring and Assessment (GAMA) program were considered and summarized by groundwater subbasin in the ECR. The ECR's main groundwater quality findings follow.

*The results of the investigations reported here are consistent with conclusions drawn in the GAMA Program of relatively localized evidence of groundwater pollution in the Sacramento Basin. This also holds true for detections of pollution in the San Joaquin and Tulare Lake Basins as well.*

*Pesticide detections in groundwater in the Sacramento River, San Joaquin River, and Tulare Lake Basins are generally limited to a small number of compounds (DPR 2003). These detections are related to physical and chemical properties of soils and the specific compounds, water management, and spatial and temporal variability of pesticide application and soil-water processes and properties. Data on transport of pesticides in groundwater highlights additional issues attributable to legacy pesticides that will need to be addressed during development of the long-term irrigated lands regulatory program. There are also difficulties in assessing the effects of groundwater pollution based on the relatively long period of time before pesticides used on irrigated agriculture begin to be detected in groundwater.*

In general, data from 2006 and earlier were collected and analyzed in the ECR. Since 2006, the Central Valley Water Board has continued to collect vast amounts of surface water quality data through the current ILRP. Also, during this period of time, the GAMA program has continued to release groundwater studies for the Central Valley, concern over nitrates in groundwater has been a major concern before the State and Central Valley Water Boards,<sup>13</sup> and the focus of the long-term ILRP moved from primarily a surface water effort to consideration of groundwater protection requirements. In addition, the Central Valley Water Board

---

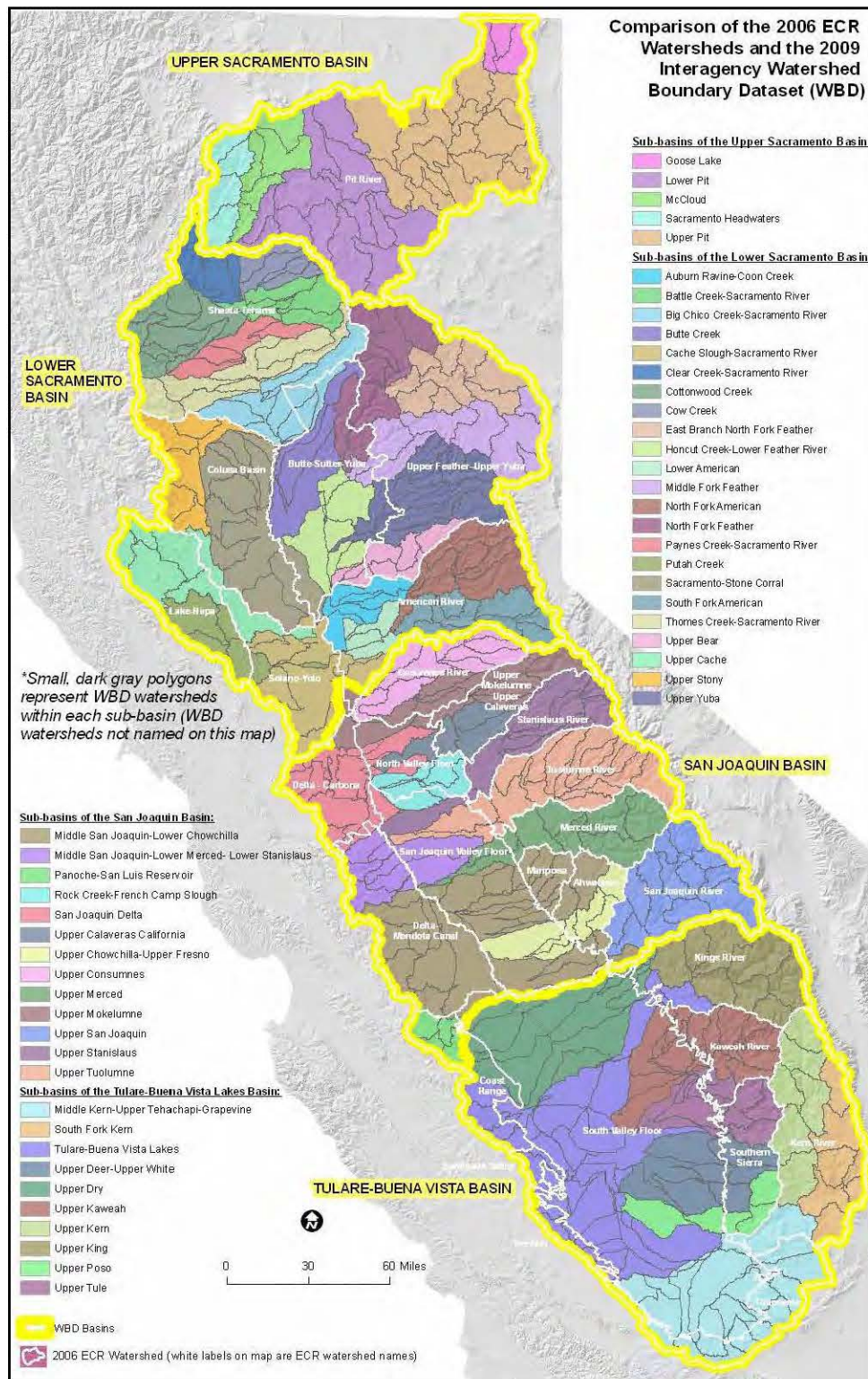
<sup>13</sup> Joint State and Central Valley Water Board meeting, Clovis, September 2007.

has, since the initiation of the ECR, significantly expanded capabilities in using geographic information systems (GIS) to evaluate and summarize large datasets.

This staff report builds on the ECR by using GIS to evaluate and summarize surface water quality data collected in the current ILRP and contracted University of California at Davis (UC Davis) water quality monitoring, and current information regarding nitrates in Central Valley groundwater.



**Figure 8. Comparison of the 2006 ECR Watersheds and the 2009 Interagency Watershed Boundary Dataset**



ECR findings on surface and groundwater quality are generally consistent with the findings in this report; however, additional exceedances of water quality objectives are identified in this report because it covers a longer monitoring period and additional datasets. Also, this report uses smaller, hydrologically accurate watershed areas ([2009 Interagency Watershed Boundary Dataset](#) subbasins) than the ECR to summarize information. The smaller subbasins provide a better tool to describe Central Valley areas that may or may not have water quality problems associated with irrigated agriculture. Figure 8 compares the Interagency Watershed Boundary Dataset subbasins and the ECR watersheds.

## **1. Surface Water Summary**

### **Coalition Group and Irrigation District Monitoring**

Since 2004, coalition groups and irrigation districts have collected extensive monitoring data for the ILRP at more than 240 sites. These data have been used to determine areas where management plans are needed to reduce waste runoff from irrigated agriculture, as well as areas where agricultural runoff does not appear to be negatively affecting surface water quality. See Figure 9 for monitoring site locations.

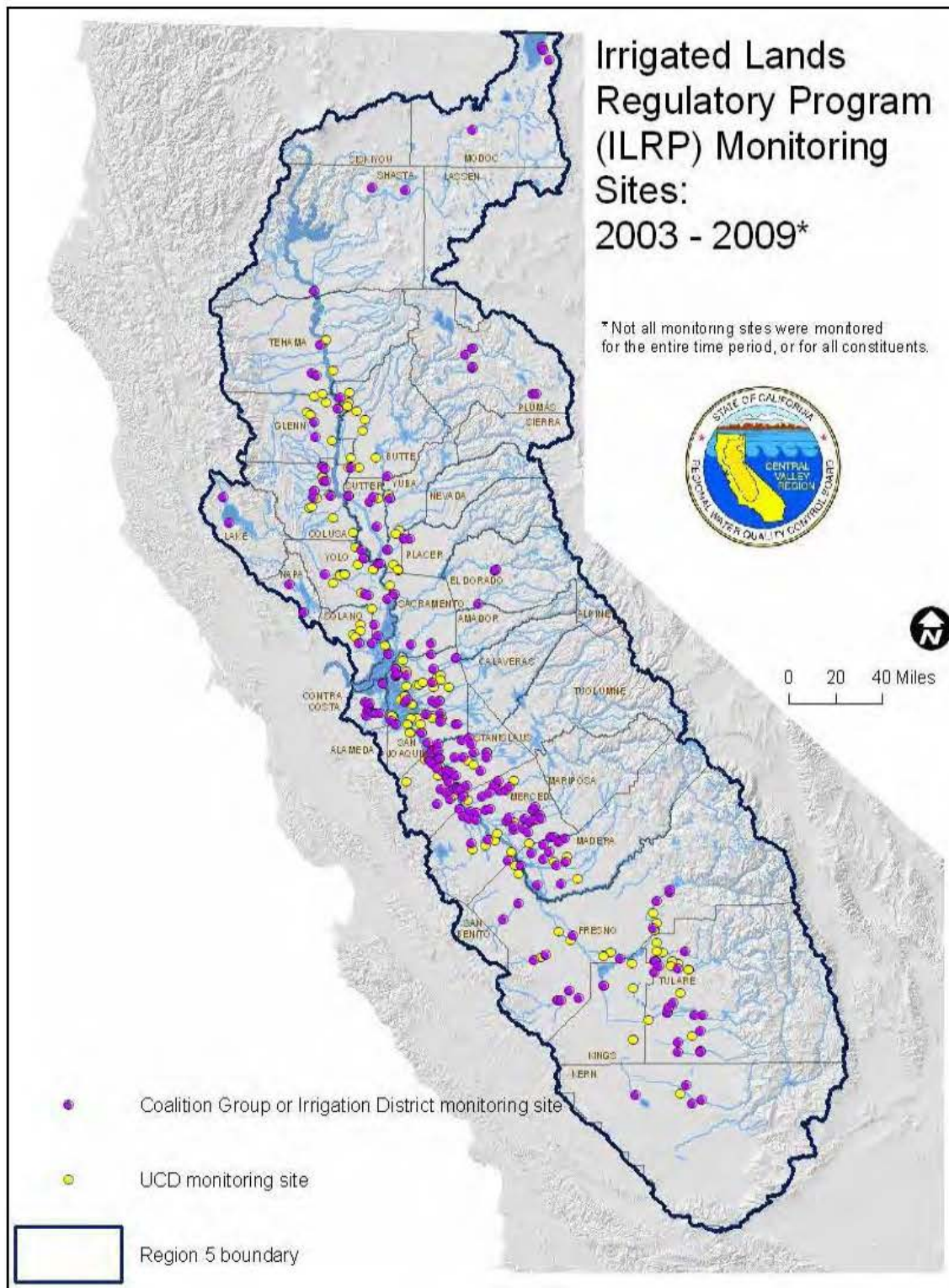
### **University of California at Davis Irrigated Lands Monitoring Project**

In November 2002, the Central Valley Water Board executed an interagency agreement with UC Davis to conduct a water quality evaluation of the agricultural drains throughout the Central Valley. A technical advisory committee was established to assist in developing and implementing the pilot monitoring program. The advisory committee included members from the Association of Northern California Water Agencies, agricultural groups, environmental groups, DPR, Department of Fish and Game, and UC Davis.

UC Davis developed the study plan entitled Investigation of Water Quality in Agricultural Drains of the Central Valley. The objectives of this study were to: (1) evaluate water quality, primarily through use of aquatic species toxicity testing, in a limited number of agricultural drains in the San Joaquin River and Sacramento River watersheds; (2) identify the cause of any water quality impairments; (3) determine the sources of contaminants based on the identified cause of impairments; and (4) recommend water quality investigation designs and approaches for future monitoring and assessment of agricultural runoff and drainage waters based on the lessons learned from the project. The Central Valley Water Board contracted with the University of California, Davis Aquatic Toxicology Laboratory (UC Davis ATL) to conduct this investigation. The [Study Plan, final investigation report, and various appendices](#) are available on the Central Valley Water Board's website.



**Figure 9. ILRP monitoring Site Locations**



In December 2003, a 3-year continuation of the UC Davis project was initiated, and interagency agreements were executed. This additional investigative work

was contracted to the UC Davis John Muir Institute of the Environment and to the California Department of Fish and Game. The additional investigation is known as Phase II of the UC Davis project. Phase II was designed to collect additional data to further characterize the quality of water in drains and other channels influenced by agricultural discharges in the Central Valley Region. The Phase II study includes bioassays using three water species and one sediment test species to evaluate toxicity, the analysis of water and sediment for general chemical parameters and many common agricultural chemicals, and further use of toxicity identification evaluation procedures. The project also includes the analysis of drainage samples during both irrigation and stormwater runoff events over a 2-year period to establish baseline water quality information and to allow the evaluation of seasonal and temporal changes in water quality. The Phase II [quarterly status reports](#) are available on the Central Valley Water Board's website. UC Davis samples were collected during 2003 through 2007. See Figure 9 for monitoring site locations.

### **Results of Monitoring: March 2003–June 2009**

Coalition group and irrigation district samples discussed in this summary were collected between July 2004 and June 2009, although not all sites were monitored the entire time period, and not all monitoring constituents were collected at all sites.<sup>14</sup> Samples collected by UC Davis for the ILRP were collected between March 2003 and November 2007. Coalition groups and irrigation districts continue to collect monitoring data each month.

### **Management Plans in the Central Valley Region: An Overview**

The current ILRP requires that coalition groups develop water quality management plans when monitoring shows exceedances of water quality objectives<sup>15</sup>. There are 51 surface water subbasins<sup>16</sup> in the Central Valley Region, although not all contain irrigated agricultural lands. Thirty-five subbasins have been sampled by coalition groups, and 29 of those subbasins (83 percent) have a management plan required for at least one waste constituent. Most management plans are in the San Joaquin River Basin. See Table 3 and Figure 10 for more information on management plans and monitoring sites.

### **Pesticides**

There have been many individual analyses conducted for about 34 pesticides by coalition groups and irrigation districts since July 2004, and to date management

---

<sup>14</sup> Much of the Sacramento Valley Water Quality Coalition monitoring data that were collected in 2004 through 2006 is not included in this summary because of ongoing QA/QC review.

<sup>15</sup> Under the current ILRP, a management plan is required when there have been two or more exceedances of a water quality objective for a particular waste constituent at a particular monitoring site. The management plan describes how the coalition group and growers in the watershed will address the exceedances and prevent them in the future. Management plans must be approved by the Central Valley Water Board Executive Officer.

<sup>16</sup> Interagency Watershed Boundary Dataset, 2009.  
<http://www.ncgc.nrcs.usda.gov/products/datasets/watershed/>

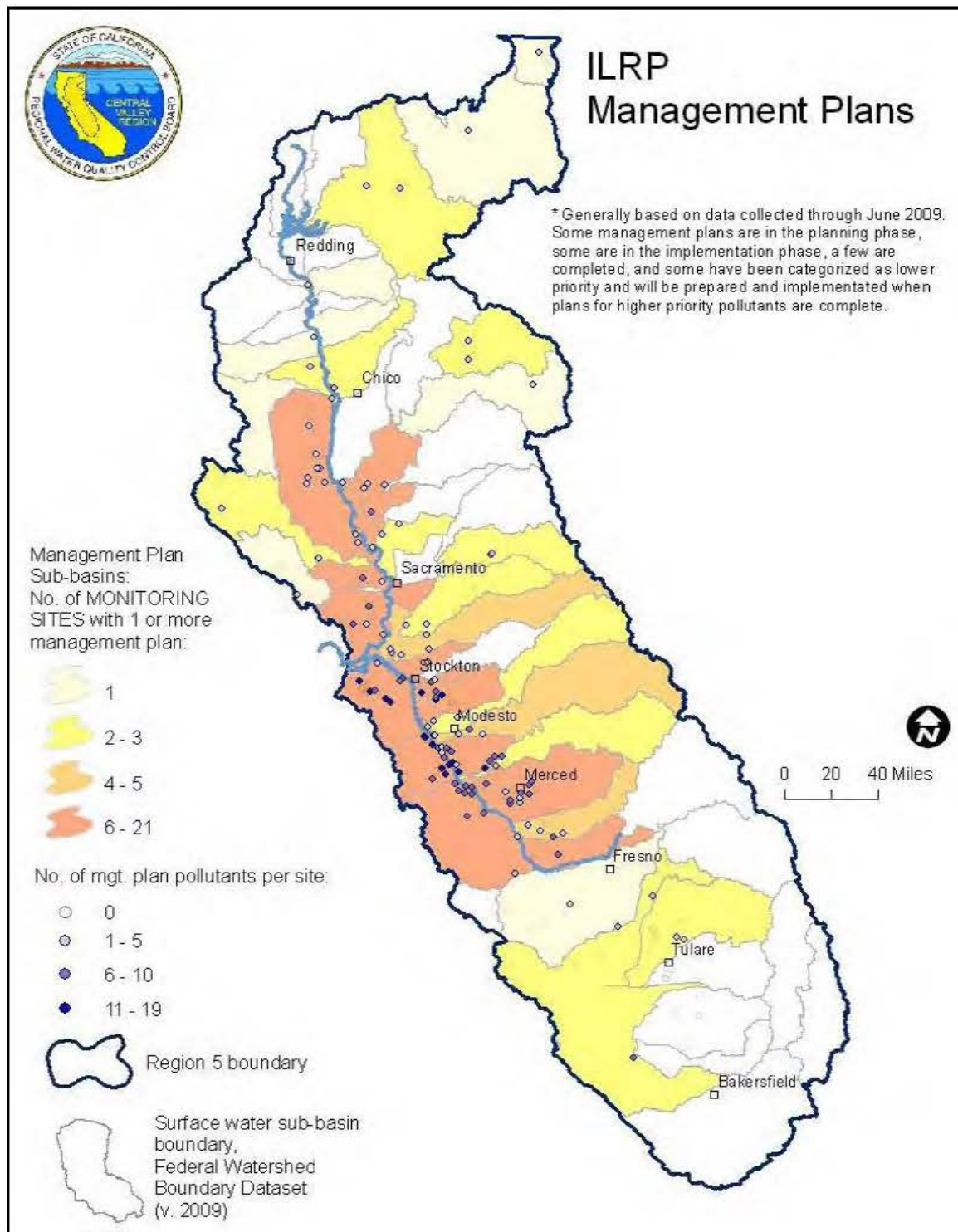
plans are required for 12 pesticides (approximately 35 percent of sampled pesticides). Other pesticides have been detected at levels both below and exceeding water quality objectives, but the requirements to develop a management plan have been triggered for only 12 of the 34 pesticides.

**Table 3. Number of Management Plans by Constituent and Surface Water Basin<sup>a</sup>**

|                                                                           | Sacramento River Basin | San Joaquin River Basin | Tulare–Buena Vista Lakes Basin |
|---------------------------------------------------------------------------|------------------------|-------------------------|--------------------------------|
| <b>Metals</b>                                                             |                        |                         |                                |
| Arsenic                                                                   |                        | 12                      | 1                              |
| Boron                                                                     | 2                      | 9                       | 1                              |
| Cadmium                                                                   |                        | 3                       | 1                              |
| Copper                                                                    |                        | 22                      |                                |
| Lead                                                                      |                        | 14                      |                                |
| Nickel                                                                    |                        | 3                       |                                |
| Selenium                                                                  | 1                      | 1                       |                                |
| <b>Pesticides, Registered</b>                                             |                        |                         |                                |
| Chlorpyrifos                                                              | 5                      | 43                      |                                |
| Diazinon                                                                  | 1                      | 8                       |                                |
| Dimethoate                                                                |                        | 3                       |                                |
| Disulfoton                                                                |                        | 1                       |                                |
| Diuron                                                                    | 1                      | 11                      |                                |
| Malathion                                                                 | 1                      | 1                       |                                |
| Methyl-parathion                                                          |                        | 3                       |                                |
| Simazine                                                                  |                        | 2                       |                                |
| Thiobencarb                                                               |                        | 1                       |                                |
| <b>Pesticides, Legacy</b>                                                 |                        |                         |                                |
| DDD                                                                       |                        | 1                       |                                |
| DDE                                                                       | 7                      | 15                      |                                |
| DDT                                                                       | 1                      | 7                       |                                |
| Dieldrin                                                                  |                        | 3                       |                                |
| <b>Salts, Nutrients, Bacteria, Field Parameters</b>                       |                        |                         |                                |
| Ammonia                                                                   |                        | 2                       |                                |
| DO                                                                        | 22                     | 53                      |                                |
| EC/TDS                                                                    | 10                     | 35                      |                                |
| E-coli                                                                    | 24                     | 55                      | 1                              |
| Nitrate                                                                   |                        | 5                       |                                |
| pH                                                                        | 14                     | 35                      | 1                              |
| Toxicity                                                                  |                        |                         |                                |
| Water Column                                                              | 15                     | 52                      | 5                              |
| Sediment                                                                  | 3                      | 27                      | 2                              |
| <b>Totals</b>                                                             | <b>107</b>             | <b>427</b>              | <b>12</b>                      |
| <sup>a</sup> Management plans are water body–/waste constituent–specific. |                        |                         |                                |



**Figure 10. Central Valley Hydrologic Subbasins with ILRP Management Plans**



In the upper Sacramento River Basin, generally north of Tehama County, as well as in the foothill regions of both the Sacramento and San Joaquin River Basins,

there is infrequent or no use of agricultural pesticides in most areas (CA DPR Pesticide Use Reports). Pesticide analysis frequency in most of these low-use areas reflects this. Irrigated and non-irrigated pasture is the dominant agricultural use in these areas.

### **Management Plan Pesticides**

Of the approximately 34 pesticides sampled in surface waters by coalition groups and irrigation districts, 12 pesticides have exceeded Basin Plan water quality objectives at least twice in 3 years at one or more monitoring sites: chlorpyrifos, diazinon, diuron, malathion, thiobencarb, dimethoate, methyl-parathion, simazine, dieldrin, DDD, DDE, and DDT. Table 4 provides a monitoring summary for data collected by coalitions and irrigation districts for the 12 management plan pesticides.

Four of the 12 pesticides are considered legacy pesticides as they are no longer registered for use in California (dieldrin, DDD, DDE, and DDT)<sup>17</sup>, leaving eight currently registered pesticides with management plan(s) required for surface water exceedances. As shown in Table 4, three of the eight pesticides (dimethoate, methyl-parathion, and thiobencarb) need management plan development in only one surface water subbasin, and two more pesticides (malathion and simazine) need management plan development in two subbasins. The remaining three pesticides (chlorpyrifos, diazinon, and diuron) have shown more widespread exceedances (12, 5, and 7 subbasins, respectively). See Figures 11–14 for maps showing locations of pesticide exceedances<sup>18</sup>. These maps and data summaries were created using data downloaded from the ILRP website in November 2009.

A management plan identifies the “watershed,” or area that drains to the monitoring site, in which management practices will be implemented to address the water quality problems. The figures developed, mainly as visual aids, for this discussion show surface water subbasins (i.e., watersheds) shaded in colors based on the number of sites within that subbasin that have shown two or more exceedances of water quality objectives. It is important to note that water bodies in the entire subbasin are not necessarily above water quality objectives. Also, these subbasin watershed boundaries (Interagency Federal Watershed Boundary Dataset 2009) are not necessarily the boundaries defined by a coalition where they need to address an identified problem.

---

<sup>17</sup> There may be some ongoing new deposition of DDD and DDE as a result of use of certain currently registered pesticides that subsequently can degrade to DDD and DDE, as well as some new deposition of DDT as a result of currently registered pesticide use that may contain some DDT (such as dicofol).

<sup>18</sup> Pesticide maps are based on management plans required for data generally collected through June 2009. The maximum allowable pesticide concentrations (“trigger limits”) for several pesticides are currently interim limits; the ILRP Technical Issues Committee (TIC) is working on establishing permanent trigger limits which protect all beneficial uses, in collaboration with pesticide TMDLs underway.

**Table 4. Management Plan Pesticides: Coalition and Water District Monitoring Data Summary for Sites with Two or More Samples Collected (Per Analyte) between July 2004 and June 2009**

| Pesticide        | Number of Analyses<br>(Number of Sites, Number of Subbasins <sup>a</sup> ) | Number of Exceedances<br>(Number of Sites, Number of Subbasins) | Number (%) of Sampled Subbasins under a Management Plan | Toxicity Rank <sup>b</sup> | Currently Registered for Legal Use in CA? |
|------------------|----------------------------------------------------------------------------|-----------------------------------------------------------------|---------------------------------------------------------|----------------------------|-------------------------------------------|
| chlorpyrifos     | 2,200 (155, 22)                                                            | 275 (74, 17)                                                    | 12 (55%)                                                | very high                  | yes                                       |
| diazinon         | 2,200 (155, 22)                                                            | 28 (17, 6)                                                      | 5 (23%)                                                 | very high                  | yes                                       |
| diuron           | 1,730 (155, 22)                                                            | 148 (60, 11)                                                    | 7 (32%)                                                 | high                       | yes                                       |
| malathion        | 1,865 (121, 24)                                                            | 29 (21, 10)                                                     | 2 (8%)                                                  | very high                  | yes                                       |
| thiobencarb      | 1,376 (110, 21)                                                            | 27 (12, 6)                                                      | 1 (5%)                                                  | n/a <sup>c</sup>           | yes                                       |
| dimethoate       | 2,036 (133, 25)                                                            | 35 (12, 4)                                                      | 1 (4%)                                                  | high                       | yes                                       |
| methyl-parathion | 1,334 (85, 19)                                                             | 18 (9, 1)                                                       | 1 (5%)                                                  | n/a <sup>c</sup>           | yes                                       |
| simazine         | 1,720 (135, 22)                                                            | 25 (16, 2)                                                      | 2 (9%)                                                  | high                       | yes                                       |
| Dieldrin         | 1,724 (155, 30)                                                            | 32 (15, 7) <sup>d</sup>                                         |                                                         | –                          | no                                        |
| DDD              | 1,703 (135, 27)                                                            | 8 (7, 5) <sup>d</sup>                                           |                                                         | –                          | no                                        |
| DDE              | 1,681 (134, 28)                                                            | 189 (38, 12) <sup>d</sup>                                       |                                                         | –                          | no                                        |
| DDT              | 1,730 (134, 28)                                                            | 73 (32, 13) <sup>d</sup>                                        |                                                         | –                          | no                                        |

<sup>a</sup> Interagency Watershed Boundary Dataset, version 2009.

<sup>b</sup> Relative-Risk Evaluation for Pesticides Used in the Central Valley Pesticide Basin Plan Amendment Project Area, Final Staff Report, Central Valley Water Board, February 2009.

<sup>c</sup> These pesticides were not in the relative-risk target list because of low reported total pounds used.

<sup>d</sup> In almost every analysis for dieldrin, DDD, DDE, and DDT, the method detection limit (MDL) and reporting limit (RL) were 10 to 100 times higher than the water quality objective; therefore, the data do not necessarily represent all results above water quality objectives.

## Chlorpyrifos, diazinon, and diuron: widespread problems

### *Chlorpyrifos*

From July 2004 through June 2009, coalition groups and irrigation districts collected approximately 2,200 chlorpyrifos samples at 155 monitoring sites in 22 subbasins throughout the Central Valley Region. At 88 percent of these sites (136), there were anywhere from two to 63 chlorpyrifos samples collected; at the remaining sites there was one sample collected during this time period. Fifty-five percent of the subbasins sampled are now under a chlorpyrifos management plan. Sixty percent of the management plan subbasins are in the San Joaquin River Basin, stretching south from Stockton to the Madera-Fresno County line. This area also coincides with heavy chlorpyrifos use. See Figure 11 for chlorpyrifos data.

Chlorpyrifos is used in valley floor agricultural operations from Sacramento County north through Butte County, but to a lesser extent than in the San Joaquin River and Tulare Lake Basin. There is heavy reported use of chlorpyrifos

in the Tulare Lake Basin, but the frequency of coalition group detections and/or exceedances was much lower than in the San Joaquin River Basin.

UC Davis sampling showed six sites in the Tulare Lake Basin, eight sites in the San Joaquin River Basin, and five sites in the Sacramento Basin with two or more samples above 0.015 micrograms per liter ( $\mu\text{g/l}$ ) chlorpyrifos (Sacramento and San Joaquin Rivers Basin Plan numeric water quality objective).

#### *Diazinon*

Diazinon use is not as widespread in the Central Valley as is chlorpyrifos use. From July 2004 through June 2009, coalition groups and irrigation districts collected approximately 2,200 diazinon samples at 147 monitoring sites in 26 subbasins throughout the Central Valley Region. At 90 percent of these sites (132), anywhere from 2 to 63 diazinon samples were collected; at the remaining sites one sample was collected. Nineteen percent (five) of the subbasins sampled are now under a diazinon management plan, and four of these five subbasins are in the San Joaquin River Basin. See Figure 11 for diazinon data.

UC Davis monitoring data show geographic distribution of diazinon exceedances similar to ILRP program monitoring; most are in the San Joaquin River Basin.

#### *Diuron*

From June 2004 through June 2009, coalition groups and irrigation districts collected approximately 1,730 diuron samples at 155 monitoring sites in 22 subbasins throughout the Central Valley Region. At 94 percent of these sites (146), anywhere from 2 to 36 diuron samples were collected. Thirty-two percent (7) of the subbasins sampled are now under a diuron management plan; six of these subbasins are in the San Joaquin River Basin, and one is in the Lower Sacramento River Basin. See Figure 12 for diuron data.

#### **Dimethoate, Methyl-Parathion, and Simazine: Localized Problems**

Dimethoate, methyl-parathion, and simazine have shown more localized water quality objectives exceedance distributions, despite widespread sampling and analyses. Simazine and dimethoate applications appear to be fairly widespread in the Central Valley, similar to chlorpyrifos, but exceedance levels are not nearly as widespread as chlorpyrifos exceedance levels. Simazine has low water solubility, which may explain the low exceedance levels, while dimethoate has very high water solubility. They both have an average half-life in water of around 1 to 2 months. Methyl-parathion applications are not as widespread. See Figures 12 and 13 for a map of exceedance distribution for dimethoate, methyl-parathion, and simazine.

Five monitoring sites are under a management plan for both dimethoate and methyl-parathion, all in the Middle San Joaquin–Lower Merced–Lower Stanislaus Subbasin, west of the San Joaquin River. Six sites in two San Joaquin River subbasins are under a simazine management plan.

UC Davis monitoring results showed an additional site in the San Joaquin River Basin with more than one dimethoate exceedance. The UC Davis monitoring also found four additional sites with multiple methyl-parathion exceedances. Three of these sites are in the Lower Sacramento River Basin, and the fourth is in the San Joaquin River Basin.

### **Malathion and Thiobencarb**

Six monitoring sites in four subbasins have shown two or more malathion exceedances; three sites (in two subbasins) are in the Sacramento River Basin, and three sites (in two subbasins) are in the San Joaquin River Basin. For thiobencarb, there are four coalition group monitoring sites (in two subbasins) with two or more exceedances in the San Joaquin River Basin. Thiobencarb results above the performance goals caused by rice applications in the Sacramento River Basin are addressed through the Rice Pesticide Program, rather than through an ILRP management plan. See Figure 14 for malathion and thiobencarb data.

UC Davis monitoring resulted in an additional three sites (in different subbasins from the coalition group exceedances sites) showing two or more malathion exceedances—one in the Sacramento River Basin and two in the San Joaquin River Basin (both in the same subbasin). UC Davis monitoring also resulted in five more sites with more than one thiobencarb exceedance, all in the Sacramento River Basin.

There have been no sites with two or more malathion or thiobencarb exceedances in the Tulare Lake Basin in either the coalition group or UC Davis monitoring programs.

Malathion and thiobencarb exceedances caused by rice applications in the Sacramento River Basin are addressed through the Central Valley Water Board's Rice Pesticide Program, rather than the ILRP.

### **Dieldrin, DDD, DDE, DDT**

In almost every analysis for these pesticides, the method detection limit (MDL) and reporting limit (RL) were 10 to 100 times higher than the water quality objective. Because MDLs and RLs were higher than water quality objectives, the data do not provide precise information regarding water quality conditions for dieldrin, DDD, DDE, and DDT.

Coalition group monitoring showed 189 detections of DDE, 73 of DDT, 32 of dieldrin, and 8 of DDD. Because the MDLs are orders of magnitude higher than applicable water quality objectives, all detections were exceedances.

### **Turbidity and Total Suspended Solids**

Although sediment often is considered one of the most common agricultural surface water inputs in the Central Valley, currently no management plans are required. While excessive sediment discharges have been observed by the



Central Valley Water Board and coalition group monitoring teams, samples are rarely flagged as exceedances of objectives because of difficulties evaluating and implementing the background-dependent sliding Basin Plan objectives for turbidity. In addition, there are currently no objectives for total suspended solids (TSS).

### **Water Column Toxicity**

Water column toxicity is widespread throughout the Central Valley. There are currently 54 monitoring sites in 18 subbasins under water column toxicity management plans. The majority of monitoring sites exhibiting more than one water column toxicity event are in the San Joaquin River Basin (38). There have also been 11 monitoring sites in the Sacramento River Basin and five in the Tulare Lake Basin exhibiting more than one water column toxic event.

UC Davis monitoring measured water column toxicity (two or more times per site) at 16 additional sites in the Sacramento River Basin, 14 more sites in the San Joaquin River Basin, and six more sites in the Tulare Lake Basin.

See Figure 15 for a map of water column toxicity management plans and UC Davis monitoring results.

### **Sediment Toxicity**

Sediment toxicity to the benthic invertebrate *Hyallela azteca* is widespread throughout the San Joaquin River Basin (80 percent [32 out of 40] of management plan sites occur in this basin). There are also four management plan sites in the Tulare Lake Basin and two in the Sacramento River Basin. As with water column toxicity distribution, there are currently no sediment toxicity management plan sites in surface water subbasins north of the Chico area.<sup>19</sup>

UC Davis monitoring measured *Hyallela azteca* toxicity (two or more times per site) at one additional site in the Sacramento River Basin, two sites in the San Joaquin River Basin, and five sites in the Tulare Lake Basin.

See Figure 15 for a map of sediment toxicity management plan locations and UC Davis monitoring results.

### **Nitrate**

Coalition group surface water sampling to date has revealed five monitoring sites where there has been more than one exceedance of nitrate water quality objectives. All five sites are in the Middle San Joaquin–Lower Merced–Lower Stanislaus subbasin, in Stanislaus and northern Merced Counties, just east of the San Joaquin River. These results may indicate that there are not widespread

---

<sup>19</sup> Lassen Creek, in the Goose Lake Coalition Watershed, completed implementation of a management plan for water flea toxicity in 2008, and it was concluded that the toxicity was not caused by agricultural waste discharge.

elevated nitrate levels in Central Valley surface waters receiving agricultural runoff. UC Davis monitoring results are very similar to coalition group results.

See Figure 16 for a map of nitrate management plan locations and UC Davis monitoring results.

### ***E. coli***

The fecal pathogen indicator *E. coli* is the most common parameter with surface water exceedances of water quality objectives in the ILRP; it was detected in 99 percent of all samples. Fecal contamination is a concern because certain pathogenic bacteria found in feces can cause gastrointestinal illness. Most *E. coli* strains are harmless, but because *E. coli* is ubiquitous in fecal matter, can survive outside the intestine for days to weeks, and is a relatively inexpensive and reliable test, it is a good indicator organism for fecal contamination and thus potentially more harmful pathogens.

There were approximately 960 exceedances of the *E. coli* water quality criteria<sup>20</sup> out of the approximately 2,370 samples at 156 monitoring sites between July 2004 and June 2009<sup>21</sup>, or about 41 percent of all *E. coli* samples. To date, there are 106 monitoring sites in 26 surface water subbasins that have shown two or more *E. coli* exceedances of water quality criteria. Refer to Figure 16 for a map of *E. coli* data in the Central Valley.

*E. coli* samples were not collected as part of the UC Davis monitoring effort.

### **Electrical Conductivity and Total Dissolved Solids**

There are currently electrical conductivity (EC) and/or total dissolved solids (TDS) management plans required for 46 monitoring sites in 10 surface water subbasins. Four subbasins are in the Lower Sacramento River Basin, five are in the San Joaquin River Basin, and one is in the Tulare Lake Basin. Ten of the 46 monitoring sites are in the Sacramento River Basin, 35 are in the San Joaquin River Basin, and one is in the Tulare Lake Basin. Refer to Figure 20 for a map of EC and TDS data in the Central Valley.

### **Metals**

Current ILRP program monitoring requires that coalition groups monitor for nine metals (arsenic, boron, cadmium, copper, lead, nickel, selenium, molybdenum, zinc). To date, there are management plans required for seven of the nine metals. Table 5 summarizes management plan information for metals.

### **Metal Use in Agriculture**

Arsenic, boron, and copper are active ingredients in some pesticides. Boron, copper, molybdenum, selenium, and zinc are used in some fertilizer products.

---

<sup>20</sup> EPA ambient water quality criteria, single sample maximum of 235 MPN/100 ml.

<sup>21</sup> Does not include samples collected 2004 through 2006 by the Sacramento Valley Water Quality Coalition because of ongoing QA/QC work.

PVC plastic irrigation pipes, as well as lead piping or other equipment used in various on-farm operations, can contain lead. Metals can be found in subsurface drainage discharge (e.g., boron, selenium) and also may be associated with sediment in tailwater discharge.

There are 15 cadmium and lead pesticides that are no longer registered for use in California. The Central Valley Water Board could not find any information on manufactured agricultural crop application products containing nickel.

**Table 5. Number of Management Plans Required for Metals in Number of Subbasins**

| <b>Metal</b> | <b>Sacramento River Basin</b> | <b>San Joaquin River Basin</b> | <b>Tulare–Buena Vista Lakes Basin</b> | <b>Total</b> |
|--------------|-------------------------------|--------------------------------|---------------------------------------|--------------|
| Arsenic      | 0                             | 13 (5)                         | 1                                     | 14 (6)       |
| Boron        | 3 (2)                         | 9 (2)                          | 1                                     | 13 (5)       |
| Cadmium      | 0                             | 13 (5)                         | 1                                     | 14 (6)       |
| Copper       | 0                             | 23 (7)                         | 0                                     | 23 (7)       |
| Lead         | 0                             | 22 (7)                         | 0                                     | 22 (7)       |
| Nickel       | 0                             | 6 (3)                          | 0                                     | 6 (3)        |
| Selenium     | 1                             | 1                              | 0                                     | 1            |

Sewage sludge (biosolids) applied as fertilizer or soil amendment to agricultural land is another potential source of metal in agricultural runoff. Biosolids can contain arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc. There are approximately 10,000 to 50,000 acres of irrigated agricultural land in the Central Valley Region where biosolids are applied.<sup>22</sup>

See Figures 17–20 for the locations of metal management plan sites.

### **Surface Water Map Legends**

Figures 11 through 20 are side-by-side maps showing the distribution of management plans and other pertinent data throughout the Central Valley. Each figure contains two legend columns (one to the left of each map). Please note that the first map legend (legend to the far left) on each page includes information that applies to both maps, so refer to both legend columns for each map.

<sup>22</sup> Personal communication with State Water Board biosolids program staff.



Figure 11. Chlorpyrifos and Diazinon Use, Monitoring Data, and Management Plans

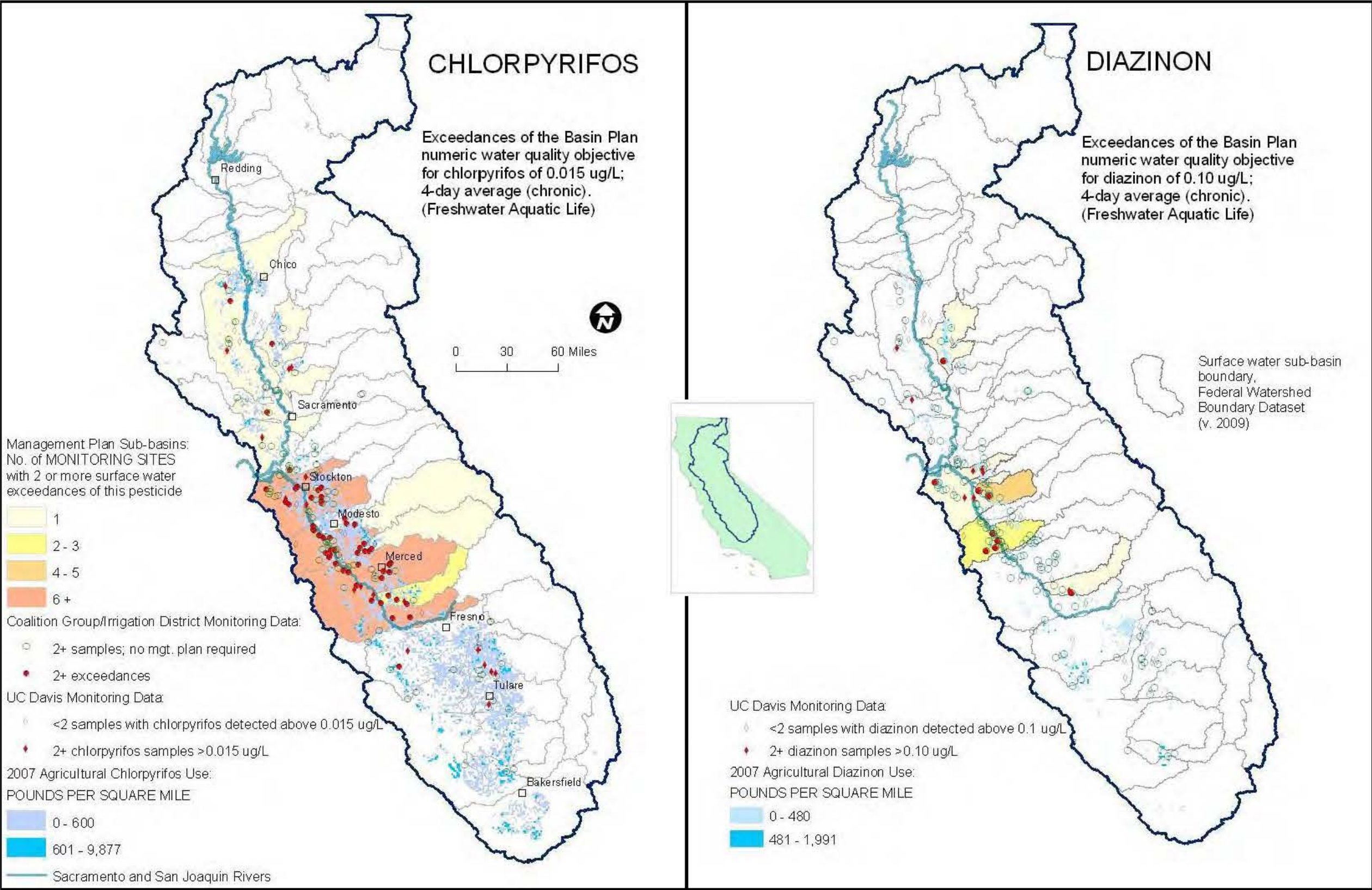




Figure 12. Diuron and Dimethoate Use, Monitoring Data, and Management Plans

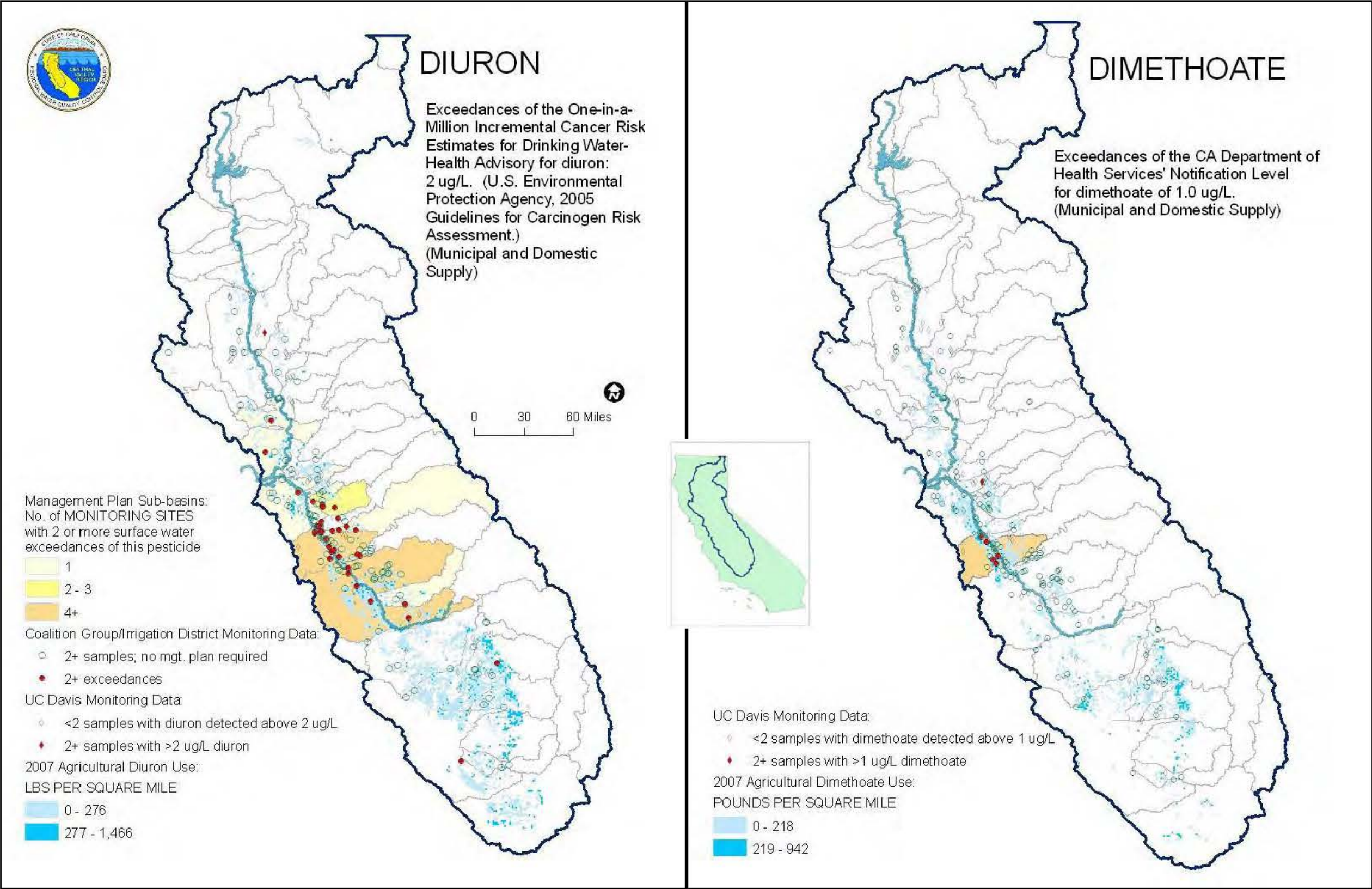




Figure 13. Methyl-Parathion and Simazine Use, Monitoring Data, and Management Plans

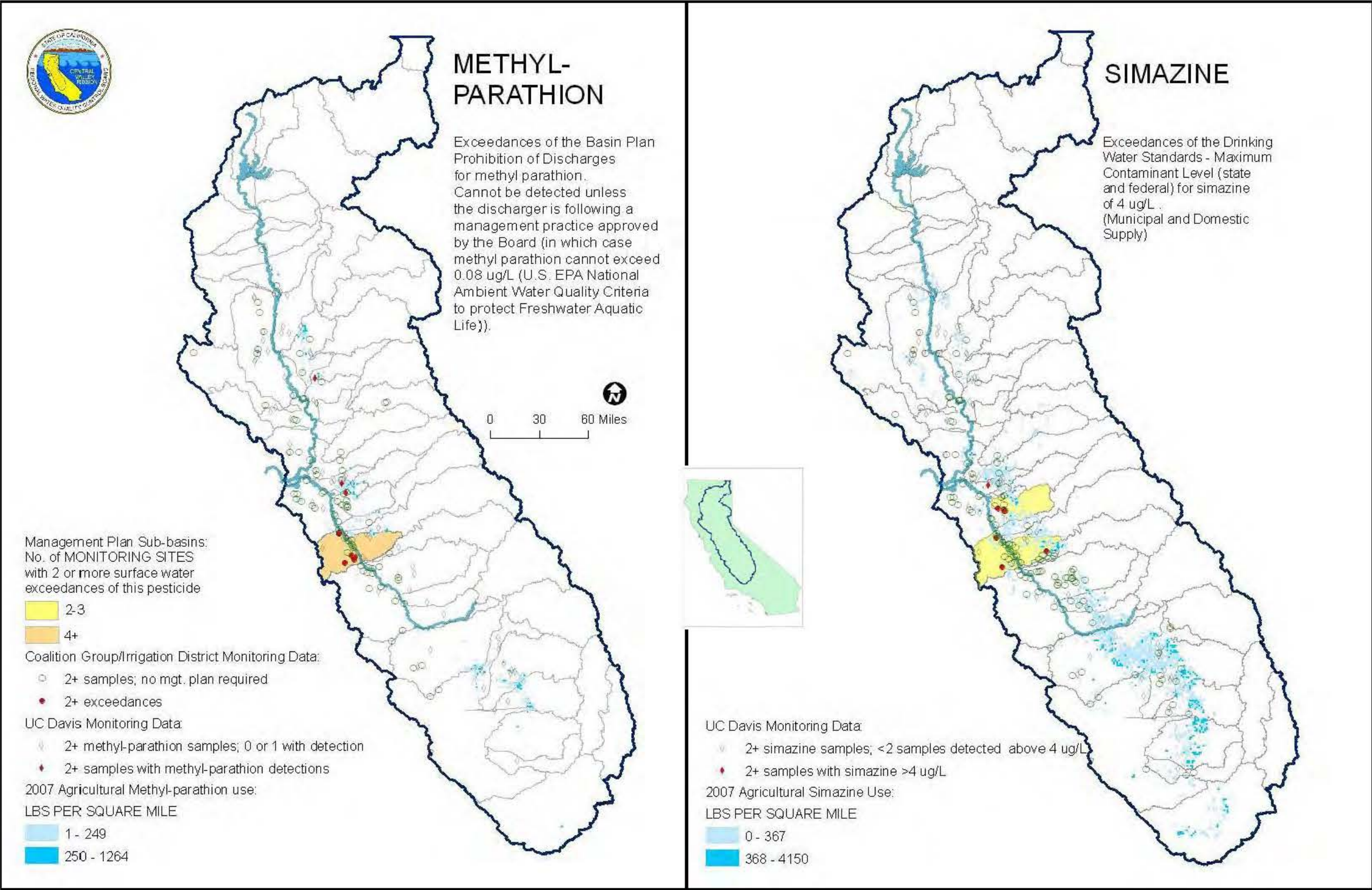




Figure 14. Malathion and Thiobencarb Use, Monitoring Data, and Management Plans

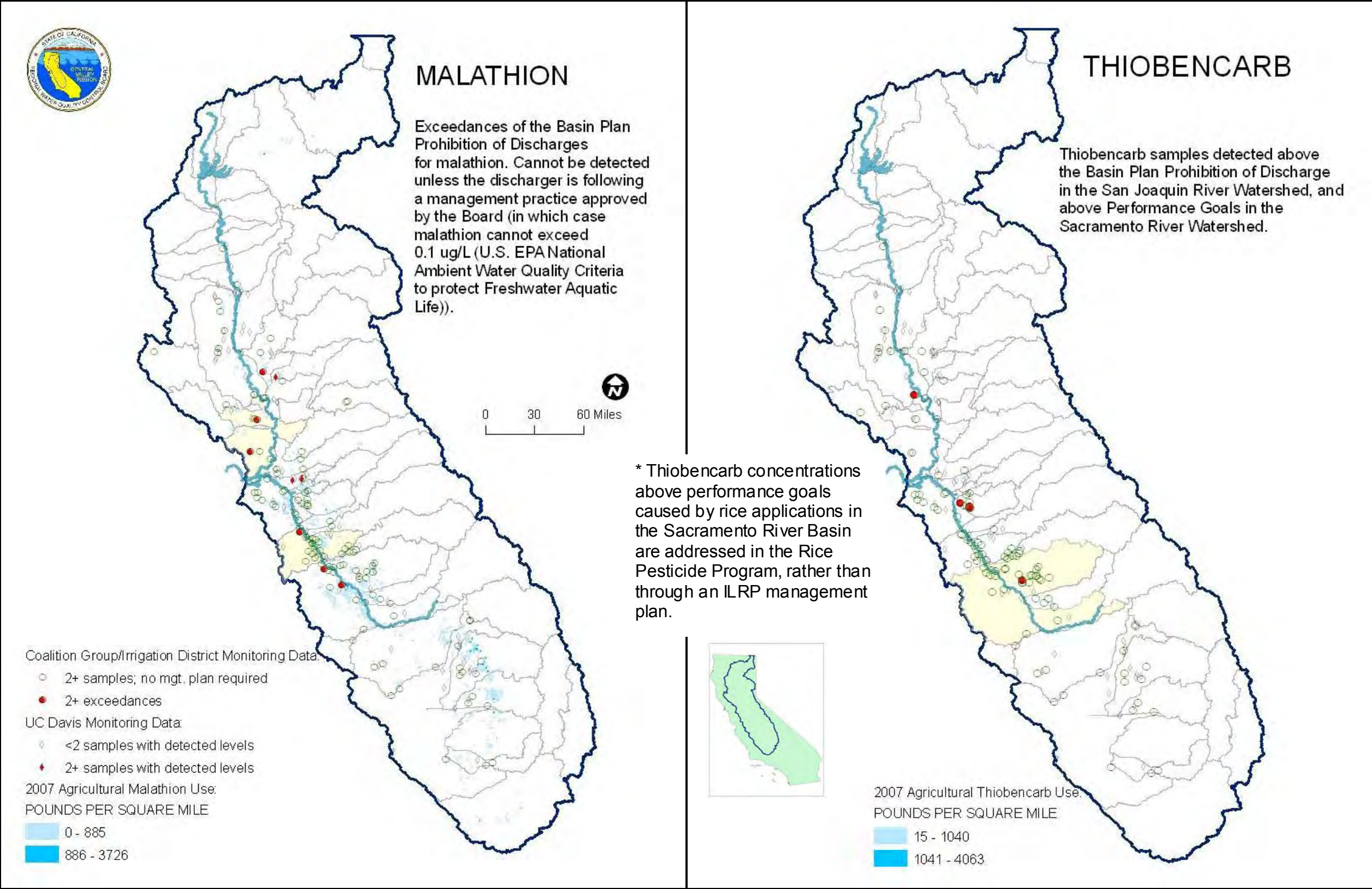




Figure 15. Water Column and Sediment Toxicity Monitoring Data and Management Plans

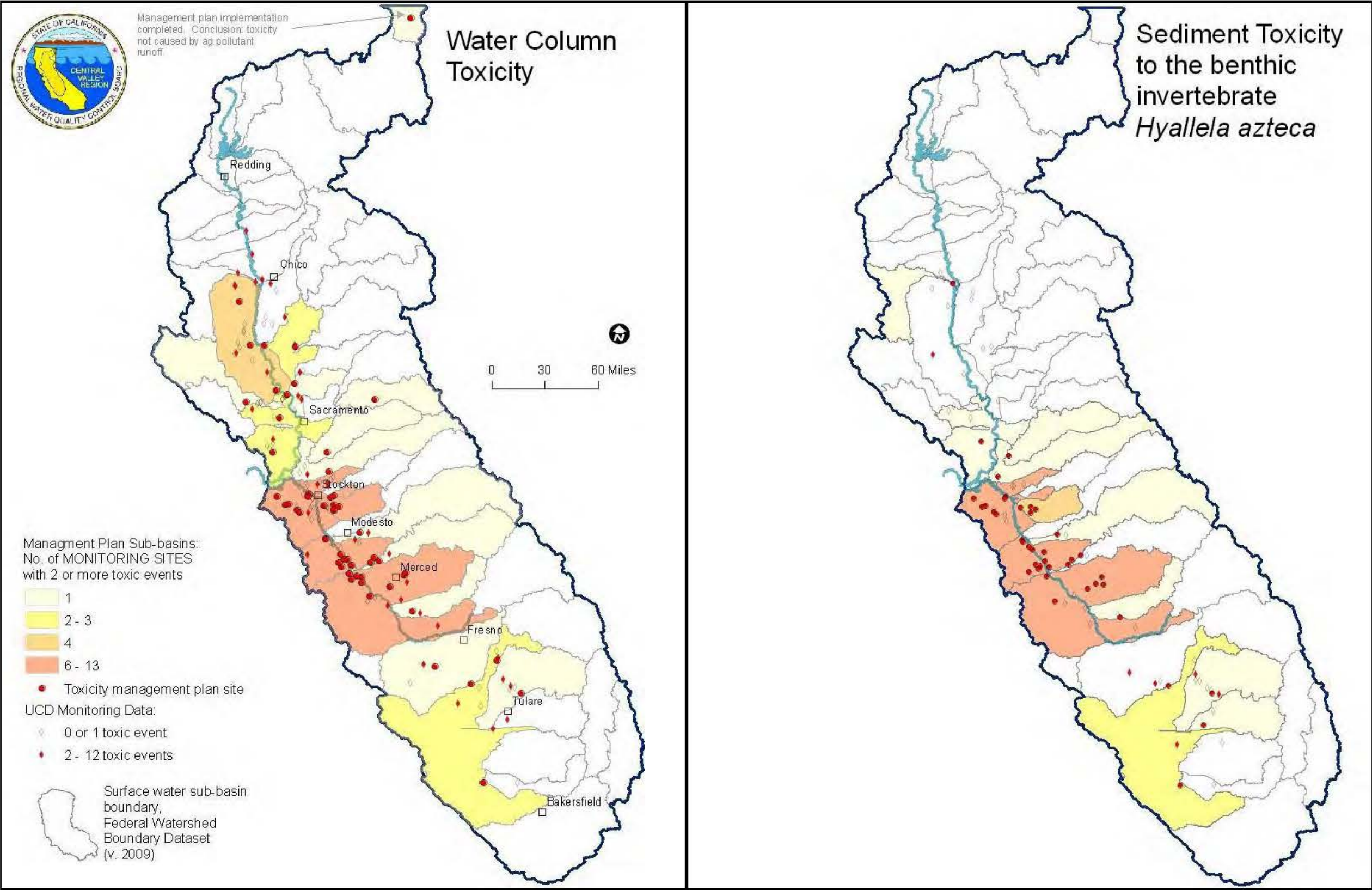




Figure 16. *E. coli* and Nitrate Monitoring Data and Management Plans

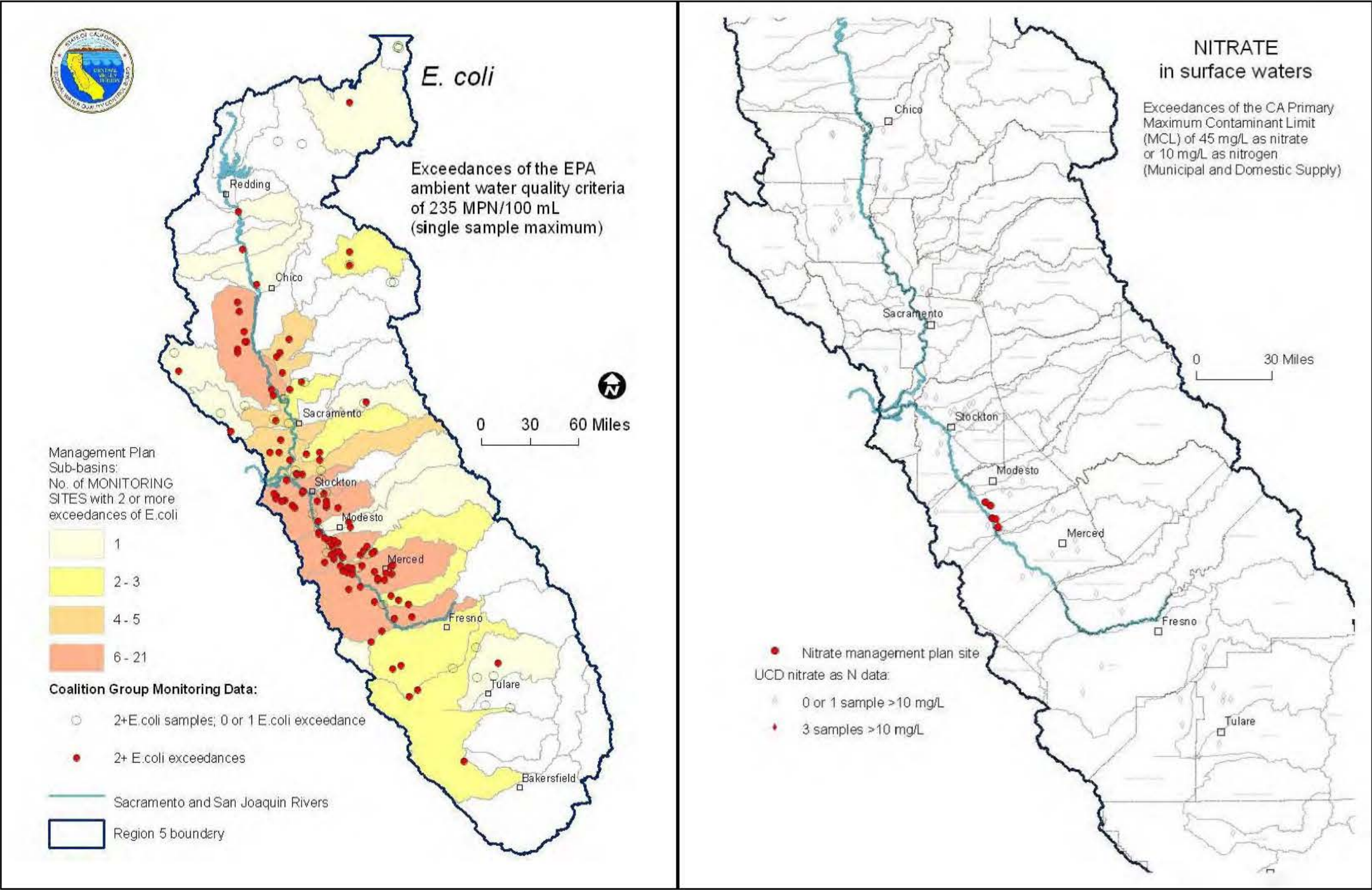




Figure 17. Arsenic and Boron Monitoring Data and Management Plans

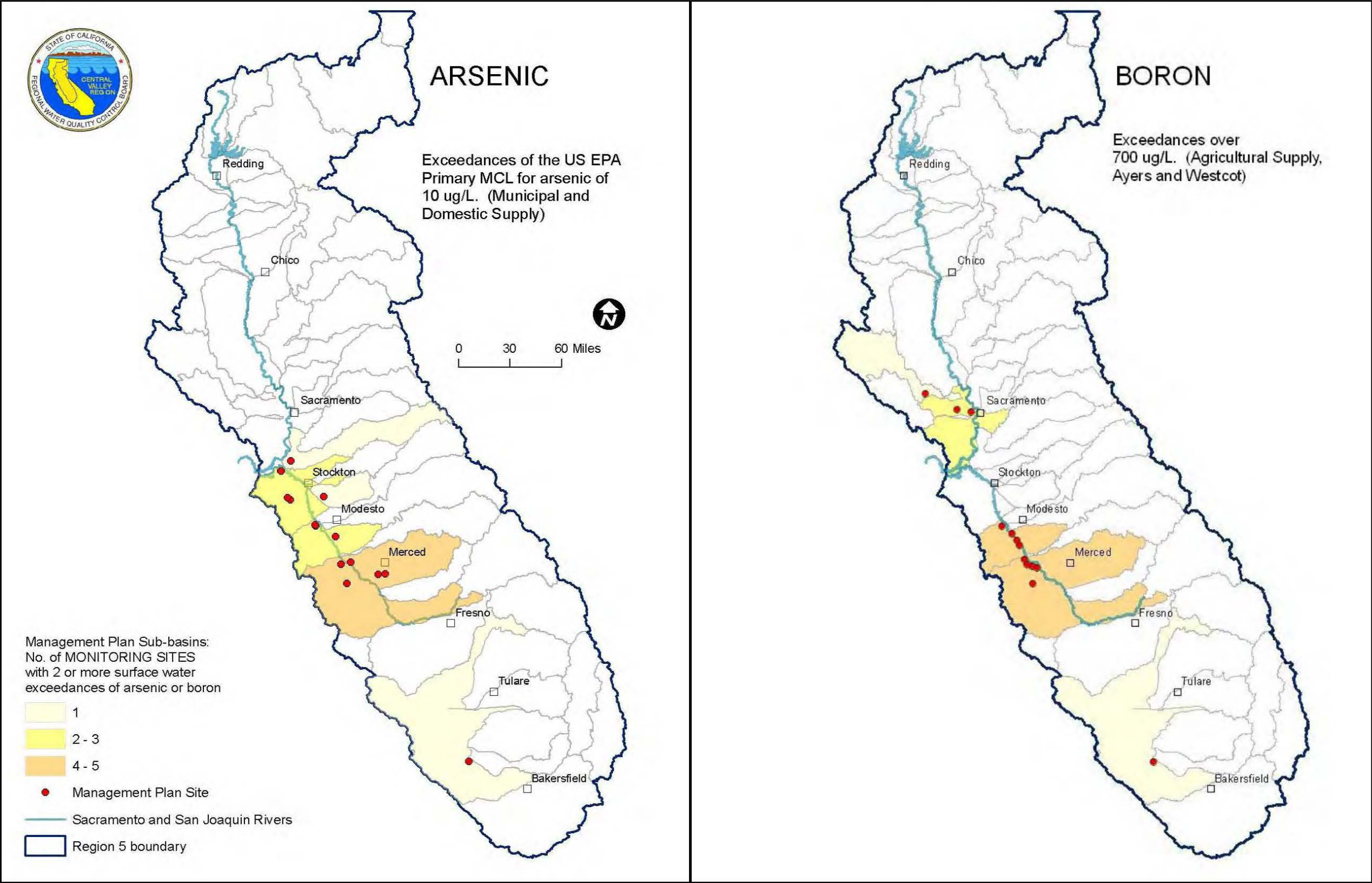




Figure 18. Copper and Cadmium Monitoring Data and Management Plans

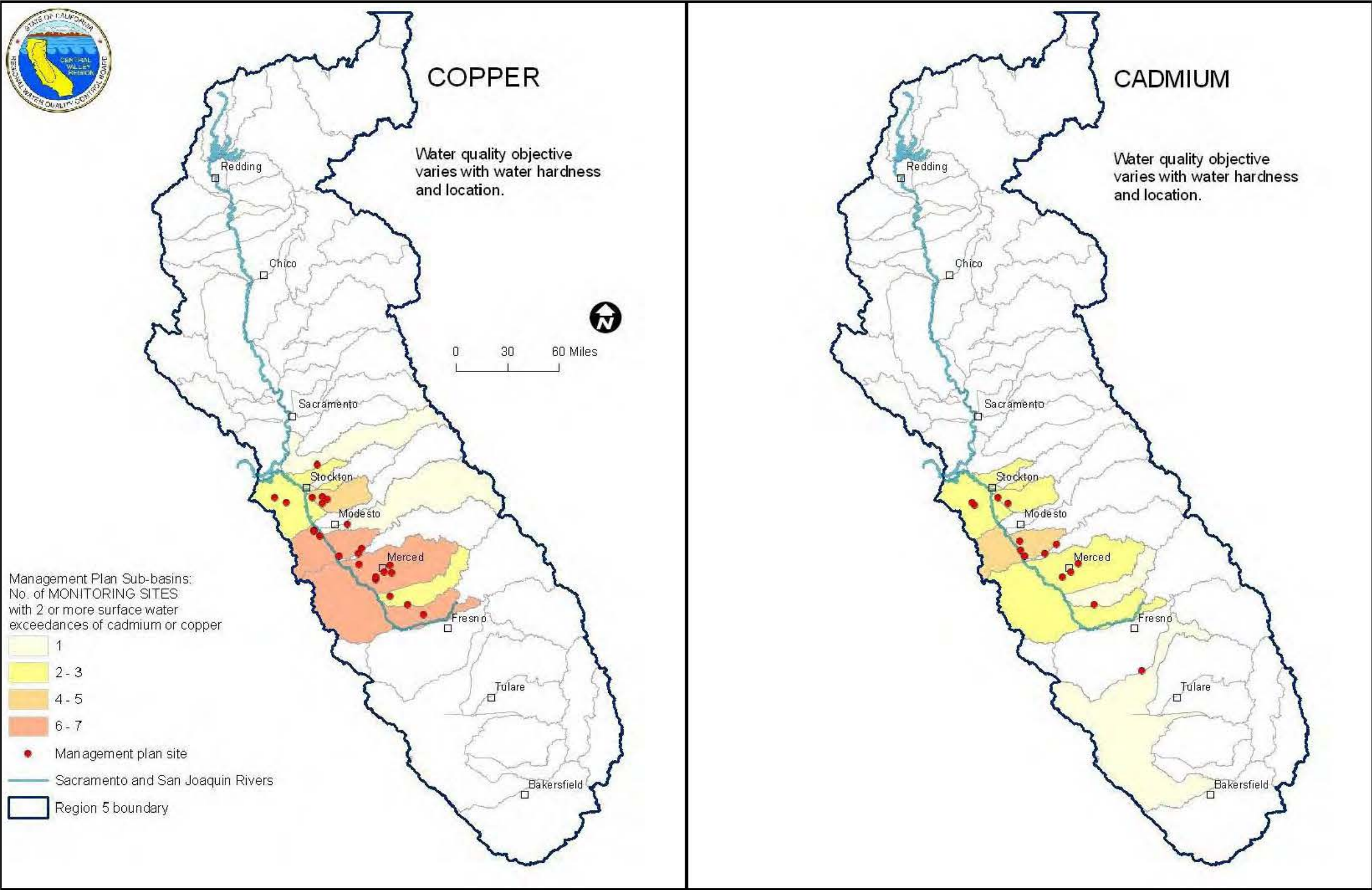


Figure 19. Lead and Nickel Monitoring Data and Management Plans

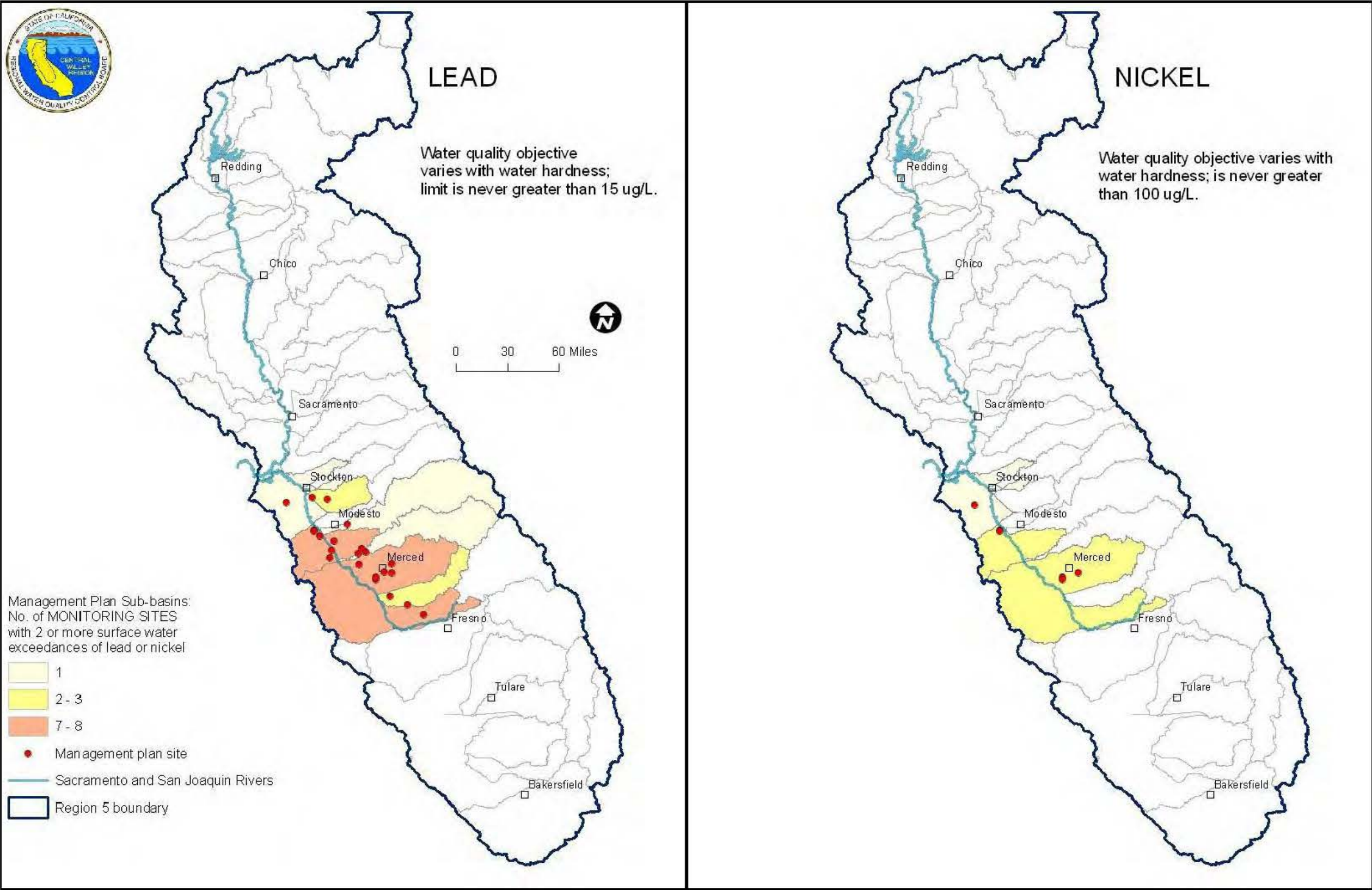
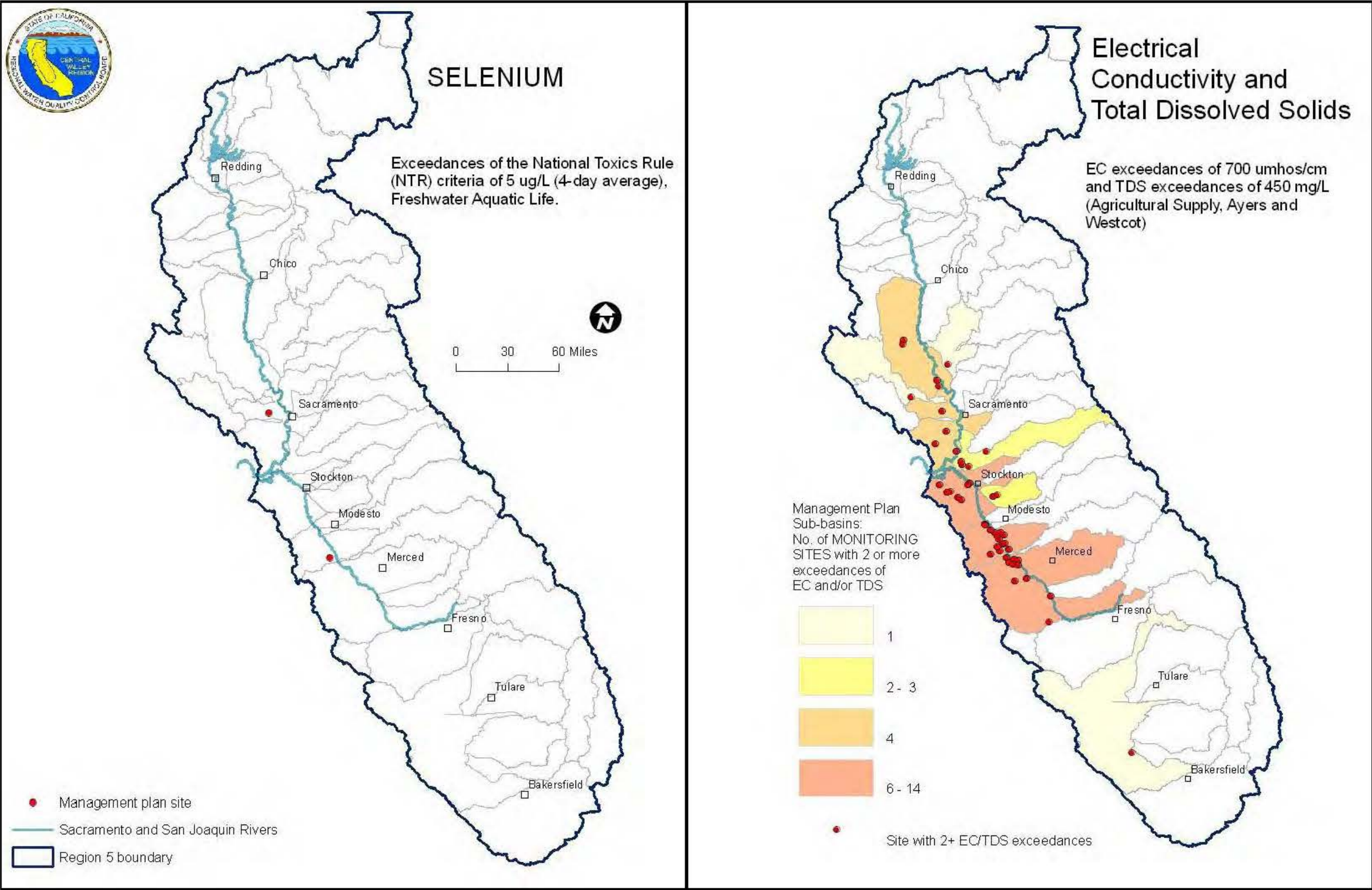




Figure 20. Selenium, Electrical Conductivity, and Total Dissolved Solids Monitoring Data and Management Plans



## 2. Groundwater summary

The above surface water summary section briefly discusses monitoring information collected as part of the current ILRP. Because the current ILRP does not address discharge to groundwater, this section (1) summarizes studies and other information collected for Central Valley groundwater; (2) provides more detail than the surface water section regarding potential pathways of waste discharge (i.e., how waste may move to groundwater); and (3) briefly discusses potential effects of the waste discharge (e.g., impacts on drinking water).

To inform the development of groundwater protection requirements for the long-term ILRP, the Central Valley Water Board developed the attached *Draft Groundwater Nitrate Summary Report* ([Appendix B](#)). Nitrate was used as an indicator parameter because of its widespread use in agriculture, groundwater's vulnerability to nitrate degradation, and the relatively large amount of data that has been published regarding nitrate impacts in the Central Valley. This section summarizes the main findings of *Draft Groundwater Nitrate Summary Report*.

The application of irrigation water, which may contain nutrients and pesticides as well as dissolved mineral elements (salts), can result in leaching of contaminants below the rootzone and impact on underlying aquifers. See Figure B-2 of [Appendix B](#) for a graphical depiction of potential pathways of waste to groundwater.

### Nutrients

Nutrients, primarily phosphorus and nitrogen, are used to promote plant growth. Nutrients can enter groundwater through two ways: (1) run-in, and (2) leaching. Run-in transports surface water and its dissolved constituents directly to groundwater through porous or fractured bedrock, sinkholes, or poorly constructed wells. Leaching is the process by which surface water and its dissolved constituents move through the soil profile in response to percolating rain, melting snow, or irrigation water.

Although phosphorus tends to bind to soil, phosphorus leaching to groundwater has been documented to occur in the Central Valley (Bennett et al. 2005 and 2006; Dawson et al. 2008; Shelton et al. 2008;), especially in soils that are low in clay, organic carbon, iron, and aluminum; and in soils where downward flow occurs through preferential pathways (root holes, worm burrows, and desiccation cracking).

Phosphorus has not been identified as a threat to human health, and no guidelines have been set for drinking water. However, phosphorus contamination of groundwater may lead to surface water impacts. This has been documented to occur in portions of the Central Valley through discharges from subsurface tile drainage systems (San Joaquin River—Lee and Jones-Lee 2007) and through direct discharge of groundwater into surface water (Merced River—Wildman et

al. 2009). In surface water, excess phosphorus can lead to excess algae and plant growth (eutrophication) of lakes, ponds, and small streams.

Nitrate derived from both agricultural and non-agricultural sources has resulted in degradation and/or pollution of groundwater beneath agricultural areas in California's Central Valley (Burow et al. 1998, 2008; Suen 2008; Green et al. 2008; Harter et al. 2005; Singleton et al. 2007; Esser et al. 2009; McNab et al. 2007). The most significant sources of non-agricultural nitrate detected in groundwater in agricultural areas include leakage from septic tanks, residential and commercial use of fertilizers, leakage from sewage pipes and mains, leakage beneath landfills, and discharges from food processing facilities (Paul et al. 2007; Central Valley Water Board 2008). Major sources of agriculturally derived nitrate consist of fertilization using natural (manure) or synthetic nitrogen sources (chemical fertilizers) and concentrated animal feeding operations (Burow et al. 1998, 2008; Suen 2008; Green et al. 2008; Harter et al. 2001; Singleton et al. 2007; Esser et al. 2009).

Nitrate impacts on groundwater beneath agricultural areas are most effectively determined by means of shallow (installed in first encountered groundwater) monitoring wells constructed with short screen lengths (Burow et al. 1998, 2007; Fuhrer et al. 1999; California GAMA Program 2008). While nitrate impacts may be detected most effectively in shallow wells, intensive pumping and recharge through irrigation can result in a vertically downward groundwater flux. This downward migration of nitrate may result in increasing concentrations in the deeper domestic and public-supply wells over time (Burow et al. 2007).

Determining the specific source(s) of nitrate contained in groundwater can be difficult. However, a variety of chemical and physical methods have been developed for this purpose. Nitrate isotopic composition, age determination of the water, presence or absence of co-contaminants, and major and trace element chemical composition of the groundwater have been used successfully to identify multiple sources of nitrate within a plume of affected groundwater (Kendall 1998; Esser et al. 2009; Buszka et al. 2006; Suen 2008).

While some disagreement exists between investigators, a common group of physical and chemical factors has been identified as affecting nitrate leaching beneath agricultural lands (CDFA 1989; State Water Board 1994; Green et al. 2007; Harter et al. 2005; Fuhrer et al. 1999; Burow and Green 2008; Burow et al. 2008; Domagalski et al. 2008; and Dinnes et al. 2002). Physical factors include nitrogen application rates, water inputs (rainfall, type of irrigation, and frequency of irrigation), leaching rates (soil type and structure), evapotranspiration, and depth to groundwater. Chemical factors include soil mineralogy, pH, bulk density, soil organic matter, and denitrification.

Nitrate vulnerability maps developed for the nation and exclusively for California depict two parallel bands of high aquifer vulnerability extending along both sides of the Central Valley from the Bakersfield area to just north of Fresno. A second



discontinuous band of high aquifer vulnerability extends through the center of the Central Valley from near Merced northward to the area around Colusa. A separate area of high vulnerability is depicted near Redding (see Figures B-5, B-6, B-7, B-8 of [Appendix B](#)).

Non-nitrate vulnerability maps prepared by the State Water Board (Hydrogeologically Vulnerable Areas—Figure B-9 of [Appendix B](#)) and DPR (Groundwater Protection Areas—Figure B-10 of [Appendix B](#)) are analogous to the nitrate vulnerability maps with the exception of the southwestern portion of the Central Valley (nitrate vulnerability maps have both an eastern and western band of high vulnerability, while the State Water Board and DPR maps depict only the eastern band).

State Water Board and USGS well sampling maps depicting areas in the Central Valley where groundwater quality has been affected by nitrates are in general agreement with the vulnerability maps (see Figures B-16 and B-17 of [Appendix B](#)). Caution must be exercised, however, in using these maps to evaluate the extent of nitrate impacts in the Central Valley. Sampling-induced bias (sampling deeper waters below shallow, nitrate-affected waters or sampling wells with long screen intervals), coupled with the lack of sampling in some regions, may distort or underestimate the actual area of impact.

Studies of trends in nitrate concentrations in groundwater in the Central Valley have focused predominantly on the eastern side of the San Joaquin Valley. Nitrogen fertilizer data were compared with the results of groundwater sampling to show that increases in nitrate concentrations over time corresponded to fertilizer application rates in focused study areas (Burow and Green 2008) (see Figure B-19 of [Appendix B](#)).

## **Pesticides**

A wide variety of pesticides is applied to commercial, residential, governmental, and agricultural properties to control weeds, insects, fungus, and disease. Numerous studies have established that pesticides, which typically are applied at the land surface, can move downward through the unsaturated zone to reach the water table at detectable concentrations (Suen 2008; Tesoriero et al. 2007; Burow et al. 2008). DPR's Groundwater Protection Program establishes requirements for use of pesticides throughout the Central Valley that are aimed to protect vulnerable groundwater from pesticides. The Groundwater Protection Program is described in [Section V.B.2](#) of this report.

Pesticides migrate to groundwater much as nutrients do, primarily through run-in, or leaching. The most important attenuation processes for pesticides are sorption, volatilization, and degradation. These processes are most active in the soil profile because of interactions between the pesticide and particles of clay or organic matter and breakdown by active microbial processes (British Geological Survey 2009). Many factors determine whether a pesticide will leach to groundwater, including pesticide properties, soil characteristics, site conditions,

and management practices. The pesticides most susceptible to leaching are those with high solubility in water, low adsorption to soil, and long-term persistence. When these pesticides are applied to sites with sandy soils, shallow depth to groundwater, and either a wet climate or extensive use of irrigation, the risk of groundwater degradation is high. Pesticide impacts on groundwater beneath agricultural areas, like nitrates, are determined most effectively by means of shallow (installed in first encountered groundwater) monitoring wells constructed with short screen lengths (Burow et al. 1998, 2007; Fuhrer et al. 1999; California GAMA Program 2008).

Pesticides are commonly detected in water quality studies (GAMA, National Water-Quality Assessment [NAWQA]), although usually at low levels (Bennett et al. 2006; Burton et al. 2008; Dawson 2001). While concentrations of pesticides rarely exceeded the standards and criteria for drinking water, two pesticides—DBCP and EDB—repeatedly have been detected throughout the State at concentrations higher than State-established maximum contaminant levels (MCLs). Both of these are soil fumigants that have long been banned, but both continue to persist in the water in many areas (2002, 305 (b) Report).

### **Salinity**

Increasing salinity is likely the largest long-term chronic water quality impairment to surface and groundwater in the Central Valley. Salinity, including nitrate, from past and current sources impairs beneficial uses of waters throughout the valley landscape and results in pollution of drinking water sources for some communities in the Central Valley.

Irrigated agriculture often leads to increased recharge, sometimes resulting in the leaching of salts from the unsaturated zone into groundwater. In irrigated areas groundwater salinization can result from irrigation with saline water, downward movement of salts in the unsaturated zone or dissolution of saline minerals, and the concentration of salts owing to plant water uptake.

### **Pathogens**

Groundwater in some areas is much more susceptible to bacterial contamination than groundwater in other areas. The most susceptible groundwater occurs in areas where the soils are gravelly or highly fractured. Preliminary data indicate some bacterial leaching to groundwater below areas that have been fertilized with manures. Exclusion zones that prohibit the application of certain chemicals around wells can reduce or prevent groundwater bacterial contamination.

## **D. Small Communities and Drinking Water**

As described in [Section III.A](#), Industry Summary, irrigated agricultural operations apply fertilizers containing nitrogen. Leaching of nitrate from fertilizer application is one of many sources of nitrate in Central Valley groundwater. Concerns regarding difficulties that small Central Valley communities have in obtaining high quality drinking water because of nitrate pollution have been expressed by

residents and environmental justice groups during long-term ILRP public scoping meetings and by long-term ILRP Advisory Workgroup members.<sup>23</sup> Small community water systems are defined by the California Department of Public Health (DPH) as those that service populations of fewer than 12,600 individuals, have fewer than 4500 water connections, or provide water to individual public schools.

The cost of treating high nitrate levels in public drinking water is a major issue for small communities, particularly those that provide water to residents from a single domestic drinking water well. Larger community systems can blend water from multiple sources to meet water quality standards. Some Central Valley communities have been forced to address nitrate contamination by drilling new, deeper wells, consolidating with other communities, or installing nitrate treatment systems. Other communities simply do not have the financial ability to make required changes to their water systems to mitigate impacts attributable to nitrate. To address this problem, one of the goals of the long-term ILRP is to “ensure that irrigated agricultural discharges do not impair Central Valley communities’ and residents’ access to safe and reliable drinking water.”

In order to evaluate the extent of nitrate impacts on small community water supplies, information obtained from long-term ILRP Advisory Workgroup members (environmental justice groups and DPH) has been used in conjunction with DPH’s Drinking Water Source Assessment Program (DWSAP) to estimate the number of Central Valley small communities that may be having difficulties obtaining safe and reliable drinking water. The DWSAP provides information on:

- water quality impacts on public water supply wells, including a delineation of the area around a drinking water source through which contaminants might move and reach the drinking water supply;
- an inventory of possible contaminating activities (PCAs) that might lead to the release of microbiological or chemical contaminants in the delineated area; and
- a determination of the PCAs to which the drinking water source is most vulnerable.

The assessment assigns a risk ranking for each type of PCA. The assessments focus only on the source water zones or areas located around and adjacent to a drinking water source that have been identified as the PCA. ***In order to maintain the potential link to irrigated agricultural operations (as opposed to septic system or other PCAs), only communities with agricultural operations listed as one of the PCAs were considered further in this analysis.***

---

<sup>23</sup> See Central Valley Water Board’s September 29, 2008 Irrigated Lands Regulatory Program Public Workshop Comments Response Summary.

Appendix C contains a combined list of the DPH and Balazs (2008) datasets for communities with nitrate MCL exceedances from 2005 to third quarter 2009. Other information included in the table is population, number of connections, PCAs, and whether the community has been approved for Proposition 84 or 50 funding.<sup>24</sup> Considering the information in Appendix C, it is estimated that there are 45 small community systems with high nitrate concentrations (e.g., exceeding State MCLs) that have agriculture listed as a PCA. Of these communities, 19 are currently receiving Proposition 84 and/or 50 grants and loans (Table 6).

**Table 6. Small Community Systems with High Nitrate Levels with Agricultural Possible Contaminating Activities**

|                                                                                                                        |    |
|------------------------------------------------------------------------------------------------------------------------|----|
| Systems with DPH source water assessment with agriculture identified as PCA                                            | 45 |
| Systems with DPH source water assessment with agriculture identified as PCA and receiving Proposition 84 or 50 funding | 19 |
| DPH = California Department of Public Health.<br>PCA = possible contaminating activities.                              |    |

In conducting this analysis, the Central Valley Water Board also has made an effort to estimate a range of costs that these communities may be facing in order to obtain safe and reliable drinking water. This information is used qualitatively in [Section IX](#) of this report to evaluate long-term ILRP alternatives.

Once a nitrate MCL exceedance has occurred, responding to it can be complicated and expensive. Based on a review of the most recent list of projects being considered for funding under Proposition 84 and past Proposition 50 funding, small communities have proposed one or more of the following types of projects: (1) drilling new wells; (2) consolidating water supplies; (3) removing nitrates in existing water supplies, or (4) conducting feasibility projects/studies (DPH 2009).

If the source of drinking water is groundwater, the cost of a small drinking water system is dependent on several factors—one is well replacement. Well replacement includes, but is not limited to, factors such as the geology of the water supply area, well design and depth, well drilling, well development and pumping rate, and wellhead protection (Harter 2003). General costs for replacing a well are given in Table 7. There are also ongoing costs to maintain a well and treat a domestic drinking water supply over time (Table 8).

Based on the information in Tables 7 and 8, estimated costs for well replacement are between \$76,500 and \$1,085,000 with 1 year of associated operation and maintenance costs (Simmons 2010; Newkirk and Darby 2008). In order to provide a measure of confidence, the estimated costs for well replacement have

<sup>24</sup> State grants and low interest loans are available to help communities obtain safe and reliable drinking water sources through Propositions 84 and 50. These programs are administered by DPH.

been compared with Proposition 84 and 50 nitrate project cost ranges. A review of DPH's Proposition 84 second round project priority funding list (204 total projects, 28 of which are nitrate projects) shows a range of cost from \$58,000 to \$2,000,000 for small community infrastructure improvements for chemical and nitrate contaminants. Projects specifically identified by Proposition 50 (20 projects) for nitrate exceedances ranged from \$324,000 to \$2,000,000. There is general agreement between the actual costs of funded Proposition 84/50 projects addressing nitrate contamination and the well replacement estimate given in Tables 7 and 8.

**Table 7. Well Replacement Cost Estimate**

| Well Size (gpm)                                                             | General Cost Assumptions                |
|-----------------------------------------------------------------------------|-----------------------------------------|
| 10 to 30 gpm                                                                | \$25,000 to \$50,000 (\$37,500 average) |
| 30 to 100 gpm                                                               | \$100,000                               |
| 1000 gpm to 2000 gpm                                                        | Can be as high as \$1,000,000           |
| Sources: Simmons 2010; Newkirk and Darby 2008.<br>gpm = gallons per minute. |                                         |

**Table 8. Well Operation and Maintenance Cost Estimate**

| Items                                          | Cost Ranges                                             |
|------------------------------------------------|---------------------------------------------------------|
| Labor per person                               | \$30,000 to \$60,000 per year                           |
| Power for <100 gpm size                        | \$3,000 to \$5,000                                      |
| Administration/fees                            | \$2,000 per year                                        |
| Analytical costs—groundwater                   | \$2,000 per year with no treatment or compliance issues |
| Maintenance—groundwater                        | \$1000 per year if done by operator                     |
| Sources: Simmons 2010; Newkirk and Darby 2008. |                                                         |

Costs beyond well replacement become very difficult to estimate (University of Minnesota 2006). Projects from the Proposition 84 funding list identify costs for nitrate treatment in the Central Valley ranging from \$58,000 to \$2,000,000. In this analysis, well replacement was considered the preferred method for obtaining a safe and reliable water supply in estimating costs to Central Valley communities. This is mainly because other costs are difficult to estimate without significant area-specific information (e.g., consolidation may be a good option where other supplies are nearby).

### *Cost Estimate*

For the 19 communities receiving Proposition 84/50 funding (see Table 6), the cost estimates described below are based on the total funding amount (e.g., total project funding amounts, see Appendix C). For the 26 communities that are not listed to receive funding, estimated costs are based on the range given in Tables 7 and 8 for well replacement projects (\$76,500–\$1,085,000). Total Proposition 84/50 funding for the 19 communities with nitrate exceedances and agriculture listed as a PCA is \$18.5 million. The potential range of costs for the remaining



26 communities to obtain safe and reliable drinking water is estimated between \$2 and \$29 million. Total costs for the 45 communities are estimated to fall in the range of \$20.5–\$47.5 million.

It is important to note that agriculture fertilizer use is only one of several potential sources of nitrate in groundwater. An effort was made in this analysis to include only systems that DPH considers vulnerable to agricultural operations. However, information is not available to characterize whether current agricultural operations are contributing nitrate to these community water systems (e.g., past operations could have caused contamination), the amount of contribution, or whether other sources are primarily responsible. This analysis was developed to ensure that the Central Valley Water Board is aware of the problems Central Valley communities are facing to obtain safe drinking water, and also to inform any decision that may affect the discharge of nitrate to groundwater supply.

## **IV. LEGAL AND REGULATORY REQUIREMENTS**

### **A. California Water Code**

The CWC requires that the State Water Board or Regional Water Boards adopt water quality control plans (Basin Plans). A Basin Plan must identify the beneficial uses of State ground and surface waters, establish water quality objectives for the reasonable protection of the beneficial uses, and establish a program of implementation for achieving the water quality objectives.

Section 13263 of the CWC authorizes the State and Regional Water Boards to issue WDRs for projects or activities that would discharge waste to ground or surface waters within State boundaries.

CWC, Section 13260 requires that:

*...any person discharging waste, or proposing to discharge waste that could affect the quality of the waters of the State, [to] file a report of discharge (an application for waste discharge requirements) along with a filing fee, in anticipation that the Regional Water Board will provide waste discharge requirements."*

In the event a discharger files a report of waste discharge, the Regional Water Board is obligated to prescribe WDRs except where the Board finds that a waiver of WDRs for a specific type of discharge is in the public interest. Waivers of WDRs are limited to 5 years in duration, carry specific conditions aimed to protect water quality, and may be terminated at any time by the Water Board.

The long-term ILRP will be implemented using Central Valley Water Board adopted WDRs, waivers of WDRs, and/or conditional Basin Plan prohibitions (hereafter referred to as ~~implementation mechanisms~~). The CWC establishes requirements that the Water Board must consider when adopting implementation

mechanisms. For example, the CWC requires that waivers and WDRs be consistent with any applicable water quality control plan. CWC requirements for the implementation mechanisms are shown in Table 9.

**Table 9. California Water Code Requirements for Implementation Mechanisms**

|                                                                                                                                                                    | WDR | Waiver | Conditional Prohibition |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|--------|-------------------------|
| Implement any relevant water quality control plans that have been adopted [13263, 13269]                                                                           | ✓   | ✓      |                         |
| Take into consideration the beneficial uses to be protected—past, present, and probable future [13263, 13241]                                                      | ✓   |        | ✓                       |
| Consider the water quality objectives reasonably required to protect beneficial uses [13263]                                                                       | ✓   |        |                         |
| Consider other waste discharges [13263]                                                                                                                            | ✓   |        |                         |
| Consider the need to prevent nuisance [13263]                                                                                                                      | ✓   |        |                         |
| Environmental characteristics of the hydrographic unit under consideration, including the quality of water available thereto [13241]                               | ✓   |        | ✓                       |
| Water quality conditions that could reasonably be achieved through the coordinated control of all factors that affect water quality in the area [13241]            | ✓   |        | ✓                       |
| Economic considerations [13141, 13241]                                                                                                                             | ✓   | ✓      | ✓                       |
| Identification of potential sources of financing [13141]                                                                                                           | ✓   | ✓      | ✓                       |
| The need to develop housing in the region [13241]                                                                                                                  | ✓   |        | ✓                       |
| The need to develop and use recycled water [13241]                                                                                                                 | ✓   |        | ✓                       |
| The action is in the public interest [13269]                                                                                                                       |     | ✓      |                         |
| Monitoring to support the development and implementation of the program (may be waived where discharges do not pose a significant threat to water quality) [13269] |     | ✓      |                         |
| WDR = Waste discharge requirements.                                                                                                                                |     |        |                         |

As shown in Table 9, the CWC requires that the Water Board consider the above factors when developing implementation mechanisms for the long-term ILRP. Therefore, these factors will be used to evaluate potential long-term program alternatives (see Evaluation of Long-Term Program Alternatives, [Section IX](#)).

## B. California Environmental Quality Act

The basic goal of the California Environmental Quality Act (CEQA) (Pub. Res. Code, Section 21000 *et seq.*) is to develop and maintain a high-quality environment now and in the future, while the specific goals of CEQA are for California's public agencies to:

(1) identify the significant environmental effects of their actions; and, either

(2) avoid those significant environmental effects, where feasible; or

(3) mitigate those significant environmental effects, where feasible.

CEQA applies to "projects" proposed to be undertaken or requiring approval by State and local government agencies, where projects are activities that have the potential to have a physical impact on the environment.

The Central Valley Water Board's current ILRP establishes that the Board will develop a PEIR for a long-term ILRP that will protect State waters. The purpose of the PEIR is to provide State and local agencies and the general public with detailed information on the potentially significant environmental effects that proposed long-term ILRP alternatives are likely to have and to list ways in which the significant environmental effects may be minimized.

The Central Valley Water Board has developed a Draft PEIR that considers the range of alternatives described in this report. The findings of the Draft PEIR have been used in the evaluation of long-term program alternatives and development of a recommended alternative for Central Valley Water Board consideration ([Section IX.D](#)).

### **C. Nonpoint-Source Program**

Section 13369 of the CWC requires that the State Water Board develop a nonpoint-source implementation program that includes the following elements:

- non-regulatory implementation of best management practices (BMPs),
- regulatory-based incentives for BMPs, and
- the adoption and enforcement of WDRs that will require the implementation of BMPs.

The State Water Board's [Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program](#) (NPS Policy) provides guidance to the Regional Water Boards on how to develop, structure, and enforce a nonpoint-source pollution control implementation program, which fulfills the requirements of the CWC.

Any nonpoint-source pollution control implementation program must comply with State or Regional Water Board WDRs, conditional waivers, and/or Basin Plan prohibitions. Such programs may be developed by the State or Regional Water Boards; an individual discharger; or by a coalition of dischargers in cooperation with a third-party representative, organization, or government agency.

The Regional Water Board has the primary responsibility for ensuring that an appropriate nonpoint-source pollution control implementation program is in place. Given the extent and diversity of nonpoint-source pollution discharges, the Regional Water Board needs to be as creative and efficient as possible in

devising approaches to prevent or control nonpoint-source pollution. For example, the current ILRP coalition group waiver allows the Central Valley Water Board to reach multiple growers while interfacing with a single third-party group.

Before approving a nonpoint-source pollution control implementation program, the Regional Water Board must find that the program will promote attainment of water quality objectives. The nonpoint-source program also must meet the requirements of the five key structural elements described below.

1. Implementation programs must, at a minimum, address NPS pollution in a manner that achieves and maintains water quality objectives and beneficial uses, including any applicable antidegradation requirements.
2. A nonpoint-source control implementation program must include a description of the management practices and other program elements that are expected to be implemented to ensure attainment of the implementation program's stated purpose, the process to be used to select or develop management practices, and the process to be used to ensure and verify proper management practice implementation.

The Regional Water Board must be able to determine that there is a high likelihood that the program will attain water quality objectives. This includes examining factors such as the level of discharger participation and the effectiveness of the management practices implemented.

3. Where the Regional Water Board determines it is necessary to allow time to achieve water quality objectives, the nonpoint-source pollution control implementation program must include a specific time schedule and corresponding quantifiable milestones designed to measure progress toward reaching the specified requirements.
4. An NPS pollution control implementation program must include sufficient feedback mechanisms so that the Regional Water Board, dischargers, and the public can determine whether the program is achieving its stated purpose, or whether additional or different management practices or other actions are required.
5. The Regional Water Board must make clear, in advance, the potential consequences for failure to achieve a nonpoint-source pollution control implementation program's stated objectives.

As part of the fifth element, the Regional Water Board needs to explain how non-compliance can be addressed in third-party programs. This explanation should include information concerning the criteria for measuring program success, what constitutes failure, and the actions that may be taken in response to failure. Individual dischargers need to be informed regarding what individual discharger actions or inactions will lead to enforcement. This explanation is necessary so that participating dischargers understand the

ramifications of noncompliance, even if that noncompliance is by a third party they have selected as their representative. Ultimately, the ineffectiveness of a group through which a discharger participates in nonpoint-source control efforts cannot be used as an excuse for lack of individual discharger compliance.

In cases of individual noncompliance, selective enforcement actions may be taken. In cases of third-party noncompliance, an effort to revise the third-party program is an alternative. Generally, prior to initiating major revisions to a program, informal contact with dischargers, group representatives, or other third parties would be attempted in order to redirect unsuccessful efforts. Although the direction and efforts of a particular third-party program would be undertaken as a group effort, if the group or third party fails to follow through on their commitments, Regional Water Board enforcement action would be taken against individual dischargers—not the third party.

Waste discharges from irrigated agricultural operations are considered nonpoint-source discharges. Therefore, the requirements of the NPS Policy are applicable to the long-term ILRP. The NPS Policy's five key elements will be used to evaluate potential long-term program alternatives (see Evaluation of Long-Term Program Alternatives, Section IX.A.3).

#### **D. Central Valley Regional Water Quality Control Plans**

Section 13240 of the CWC requires that the Regional Water Board formulate and adopt a water quality control plan, or Basin Plan, for all areas in the region. The Central Valley Water Board has two basin plans: one for the Tulare Lake Basin and one for the Sacramento River and San Joaquin River Basins.

The Basin Plans establish beneficial uses to be protected in Central Valley ground and surface waters (e.g., municipal supply, agricultural supply, warm and cold freshwater habitat, contact recreation); water quality objectives to protect the beneficial uses; and implementation plans to achieve the water quality objectives. Basin Plan adopted water quality objectives ensure the reasonable protection of beneficial uses in Central Valley ground and surface waters. For example, Basin Plans contain fecal coliform water quality objectives for any waters designated for contact recreation. The fecal coliform water quality objectives are designed to ensure the health and safety of people using waters for contact recreation.

All Water Board permits, WDRs, and waivers of WDRs must implement provisions of the Basin Plan. The long-term ILRP therefore must (1) require that Central Valley ground and surface waters accepting waste from irrigated agricultural operations meet applicable Basin Plan water quality objectives, and (2) be consistent with Basin Plan policies and implementation provisions, including time schedules, where applicable.



Basin Planning efforts look at all pollutant sources and identify what needs to be done to achieve water quality protection. For example, Central Valley Salinity Alternatives for Long-Term Sustainability (or CV-SALTS) has the goal of developing sustainable solutions to the increasing salt and nitrate concentrations in Central Valley surface and groundwater. The ILRP is relying on CV-SALTS to identify the actions that need to be taken by irrigated agriculture and others to address these constituents.

Recent Basin Plan amendments have addressed discharges of pesticides, oxygen-demanding substances, and salt from irrigated lands in specific portions of the Central Valley. Future Basin Plan amendments also are expected to include new requirements for waste discharges from irrigated agricultural lands. Examples of programs developing amendments include the methylmercury TMDLs, Central Valley pesticide TMDL, organochlorine pesticide TMDL, and the CV-SALTS program. The methylmercury TMDL has been approved by the Central Valley Water Board, and will be reviewed by the U.S. Environmental Protection Agency (USEPA). If approved by USEPA, the TMDL would establish new methylmercury loading limits for Central Valley surface waters.

As described above, the long-term ILRP is required to implement Basin Plan provisions, including new provisions adopted in a Basin Plan amendment. Therefore, it is important that the long-term ILRP be flexible enough to implement these and other future Basin Plan water quality requirements.

## **E. State Antidegradation Policy**

Basin Plan water quality objectives are developed to ensure that ground and surface water beneficial uses are protected. The quality of some State ground and surface waters is higher than established Basin Plan water quality objectives. For example, nutrient levels in good quality waters may be very low, or not detectable, while existing water quality standards for nutrients may be much higher. In such waters, some degradation of water quality may occur without compromising protection of beneficial uses.

State Water Board [Resolution 68-16 Statement of Policy with Respect to Maintaining High Quality of Waters in California](#) (Resolution 68-16) was adopted in October of 1968 to address high quality waters in the State. Title 40 of the Code of Federal Regulations, Section 131.12—Antidegradation Policy (40 CFR 131.12) was developed in 1975 to ensure water quality necessary to protect existing uses in waters of the United States. Resolution No. 68-16 applies to discharges to all high quality waters of the State, including groundwater and surface water (CWC Section 13050[e]); 40 CFR 131.12 applies only to surface waters.

The requirement to implement the Antidegradation Policy is contained in Resolution No. 68-16 (provision 2 presented below) and in the Central Valley Water Board's Water Quality Control Plans. The Water Quality Control Plan for

the Tulare Lake Basin, Second Edition (Revised January 2004) contains the statement (page IV-20),

*—The Regional Water Board will apply the directives of Resolution No. 68-16 in considering whether to allow a certain degree of degradation to occur or remain. In conducting this type of analysis, the Regional Water Board will evaluate the nature of any proposed, existing, or materially changed discharge that could affect the quality of waters within the region. Any discharge of waste to high quality waters must apply best practicable treatment or control not only to prevent a condition of pollution or nuisance from occurring, but also to maintain the highest water quality possible consistent with the maximum benefit to the people of the State.”*

The Basin Plan for the Sacramento River Basin and the San Joaquin River Basin, Fourth Edition (Revised September 2009), states that the Regional Water Board actions must conform with State Water Board plans and policies and among these policies is Resolution 68-16.

Resolution 68-16 requires that:

- 1. ~~Whenever the existing quality of water is better than the quality established in policies as of the date on which such policies become effective, such existing high quality will be maintained until it has been demonstrated to the State that any change will be consistent with maximum benefit to the people of the State, will not unreasonably affect present and anticipated beneficial use of such water and will not result in water quality less than that prescribed in the policies.”~~*
- 2. ~~Any activity which produces or may produce a waste or increased volume or concentration of waste and which discharges or proposes to discharge to existing high quality waters will be required to meet waste discharge requirements which will result in the best practicable treatment or control of the discharge necessary to assure that (a) a pollution or nuisance will not occur and (b) the highest water quality consistent with maximum benefit to the people of the State will be maintained.”~~*

For discharges to surface waters only, the Federal Antidegradation Policy (Section 131.12, Title 40, CFR) requires:

- 1. ~~Existing instream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected.~~*
- 2. ~~Where the quality of the waters exceed levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water, that quality shall be maintained and protected unless the State finds, after full satisfaction of the intergovernmental coordination and public participation provisions of the State’s continuing planning~~*

*process, that allowing lower water quality is necessary to accommodate important economic or social development in the area in which the waters are located. In allowing such degradation or lower water quality, the State shall assure water quality adequate to protect existing uses fully. Further, the State shall assure that there shall be achieved the highest statutory and regulatory requirements for all new and existing point sources and all cost-effective and reasonable best management practices for nonpoint source control.*

3. *When high quality waters constitute an outstanding National resource, such as waters of National and State parks and wildlife refuges and waters of exceptional recreational or ecological significance, that water quality shall be maintained and protected.*
4. *In those cases where potential water quality impairment associated with a thermal discharge is involved, the antidegradation policy and implementing method shall be consistent with section 316 of the Act."*

The State Water Board has interpreted Resolution No. 68-16 to incorporate the Federal Antidegradation Policy in situations where the policy is applicable. (SWRCB Order No. WQ 86-17.)

Administrative Procedures Update 90-004, Antidegradation Policy Implementation for NPDES Permitting, provides guidance for the Regional Boards in implementing Resolution No. 68-16 and 40 CFR 131.12, as these provisions apply to NPDES permitting. APU 90-004 is not controlling in the context of the irrigated lands long-term program because nonpoint discharges from agriculture are exempt from NPDES permitting.

## **1. Definitions**

A number of key terms are relevant to application of Resolution No. 68-16 and 40 CFR 131.12 to the long-term ILRP. These terms are described below.

### **High Quality Waters**

Resolution 68-16 refers to ~~existing~~ quality of water [that] is better than quality established in policies as of the date such policies become effective,"<sup>25</sup> and 40 CFR 131.12 refers to ~~quality of waters~~ [that] exceed levels necessary to support propagation of fish, shellfish, and wildlife and recreation." Such waters are ~~high quality waters~~" under the State and federal antidegradation policies. In other words, high quality waters are waters with a baseline background quality of better quality than that necessary to protect beneficial uses (the term ~~baseline~~" is

---

<sup>25</sup> Such policies would include policies such as State Water Board Resolution No. 88-63, Sources of Drinking Water Policy, establishing beneficial uses, and water quality control plans.

discussed below).<sup>26</sup> The CWC directs the State Water Board and the Regional Water Boards to establish water quality objectives for the reasonable protection of beneficial uses. Therefore, where water bodies contain levels of water quality constituents or characteristics that are better than the established water quality objectives, such waters are considered high quality waters.

Both State and federal guidance indicates that the definition of high quality waters may be established by constituent or parameter [State Water Board Order No. WQ 91-10; US EPA Water Quality Handbook, Chapter 4 Antidegradation (40 CFR 131.12) (“EPA Handbook”)]. Waters can be of high quality for some constituents or beneficial uses but not for others.

With respect to degraded groundwater, a portion of the aquifer may be degraded with waste while another portion of the same aquifer may not be degraded with waste. The portion not degraded is high quality water within the meaning of Resolution No. 68-16. See State Water Board Order No. WQ 91-10.

### **Baseline Condition**

The term “baseline” is not used in the State or federal antidegradation policies but is a significant concept for application of the antidegradation law. In order to determine whether a water body is a high quality water with regard to a given constituent, the quality of that water at some baseline point must be compared to the water quality objectives. That baseline is not necessarily current conditions and may be very complicated to determine. Generally, baseline quality is the best quality of the receiving water that has existed since 1968,<sup>27</sup> unless subsequent lowering was a result of regulatory action consistent with State and federal antidegradation policies. If poorer water quality was permitted consistent with State and federal antidegradation policies, the most recent water quality resulting from permitted action is the baseline water quality to be considered in an antidegradation analysis. If degradation in the water quality was attributable to activity not permitted in compliance with the antidegradation policy, the baseline is not current conditions. Conversely, if water quality conditions have improved since 1968, baseline would be reevaluated to represent the higher water quality.

In the context of the long-term ILRP, which aims to regulate discharges to a very large number of water bodies, each with numerous constituents, determination of a baseline water quality is a near impossible task. There is no comprehensive, waste constituent-specific information for all Central Valley surface and groundwater accepting agricultural wastes available for 1968 conditions, nor are comprehensive data available on changes in water quality since 1968.

---

<sup>26</sup> USEPA Water Quality Handbook, Chapter 4 Antidegradation (40 CFR 131.12), defines “high quality waters” as “those whose quality exceeds that necessary to protect the section 101(a)(2) goals of the Act [Clean Water Act], regardless of use designation.”

<sup>27</sup> The year 1968 represents the year in which the State antidegradation policy was adopted. For purposes of application of the federal antidegradation policy only, the relevant year would be 1975. Because the State policy applies to all waters of State, 1968 is the appropriate year in this analysis.

In some cases, current water quality may be the appropriate baseline. Trends in agricultural irrigation practices since 1968 may indicate reduction in potential waste discharge. [Section III.A](#) of this report, Industry Summary, describes a general increase in efficient irrigation practices (drip, sprinkler) from 1970 to 2000. Irrigation water provides crops with water and a means for movement of waste constituents off site in tailwater discharge. Also, application of irrigation water may move waste constituents to groundwater through leaching losses. More efficient water use would work to minimize tailwater discharge and leaching of water that could carry waste to groundwater. Trends showing more efficient water use have been motivated by increased demand on fresh water supplies. This trend likely will continue into the future with or without increased Central Valley Water Board regulation.

This analysis is qualitative in nature. However, the logic of the analysis is appropriate given that technology has advanced over time, irrigation water has become more expensive, and irrigation water is not a “waste” that irrigated agricultural operations are tasked with “discharging” (it is a purchased commodity that can cut into profits). Considering this, it makes sense that operations, over time, would use better technology to reduce costs, thereby reducing use. Nevertheless, it cannot be assumed that current water quality is always the appropriate baseline for Central Valley water bodies.

Given the complexity of determining the baseline quality in the long-term ILRP context and the significant variation in conditions over the broad areas covered by the program, any antidegradation analysis in support of an order implementing the long-term program will assume that at least some of the waters into which agricultural discharges will occur are high quality waters because unpermitted degradation has occurred since 1968. Moreover, available data show that currently existing quality of certain water bodies is better than the water quality objectives. Degradation of such waters can be permitted only consistent with the State and federal antidegradation policies.

Additionally, data collected by the Central Valley Water Board, dischargers, educational institutions, and others demonstrate that many water bodies in the Central Valley Region are already impaired for various constituents associated with irrigated agricultural activities, including pesticides (e.g., diazinon, chlorpyrifos, soil fumigants), salt, sediment, and nitrate. Many surface water bodies have been listed as impaired for these constituents pursuant to Clean Water Act Section 303(d) (see ECR and [Section III.C](#) of this report for information on surface and groundwater quality). The antidegradation policies, as interpreted in State Board Orders, require at a minimum that where a water body is already impaired, any discharge to that water body must not cause or contribute to an exceedance of water quality objectives.

### **Best Practicable Treatment or Control**

Resolution 68-16 requires that any activity that results in discharge to existing high quality waters meet WDRs that result in best practicable treatment and



control (BPTC). Neither the CWC nor Resolution 68-16 defines the term ~~best~~ practicable treatment or control.” The federal antidegradation provision, 40 CFR 131.12, does not contain a similar provision that would apply to nonpoint sources.<sup>28</sup>

Several State Water Board water quality orders have evaluated what level of treatment or control is technically achievable using ~~best efforts~~.” In determining BPTC, the discharger should compare the proposed method to existing proven technology; evaluate performance data (through treatability studies), compare alternative methods of treatment or control, and consider the method currently used by the discharger or similarly situated dischargers. (SWRCB Order Nos. WQ 81-5, WQ 82-5, WQ 90-6, and WQ 2000-07).<sup>29</sup>

The Regional Water Board may not ~~specify~~ the design, location, type of construction, or particular manner in which compliance may be had with [a] requirement, order, or decree” (CWC 13360). However, the Regional Water Board still must require the discharger to demonstrate that the proposed manner of compliance constitutes BPTC (SWRCB Order No. WQ 2000-7).

The requirement of BPTC is discussed in greater detail below.

### **Maximum Benefit to People of the State**

Resolution 68-16 requires that where degradation of water quality is permitted, such degradation must be consistent with the ~~maximum~~ benefit to people of the State.” Only after ~~intergovernmental coordination and public participation~~” and a determination that ~~allowing lower water quality is necessary to accommodate important economic or social development in the area in which the waters are located~~” does 40 CFR 131.12 allow for degradation.

Factors considered in determining whether degradation of water quality is consistent with maximum benefit to people of the State include economic and social costs, tangible and intangible, of the proposed discharge compared to the benefits, as well as the environmental aspects of the proposed discharge.

---

<sup>28</sup> 40 CFR 131.12(a)(2) requires that the ~~State~~ shall assure that there shall be achieved the highest statutory and regulatory requirements for all new and existing point sources and *all cost-effective and reasonable best management practices for nonpoint source control*.” The EPA Handbook, Chapter 4, clarifies this as follows: ~~Section 131.12(a)(2) does not mandate that States establish controls on nonpoint sources. The Act leaves it to the States to determine what, if any, controls on nonpoint sources are needed to provide attainment of State water quality standards (See CWA Section 319). States may adopt enforceable requirements, or voluntary programs to address nonpoint source pollution. Section 40 CFR 131.12(a)(2) does not require that States adopt or implement best management practices for nonpoint sources prior to allowing point source degradation of a high quality water. However, States that have adopted nonpoint source controls must assure that such controls are properly implemented before authorization is granted to allow point source degradation of water quality.~~” Accordingly, in the context of nonpoint discharges, the BPTC standard established by state law controls.

<sup>29</sup> This approach is summarized in Questions and Answers, State Water Board, Resolution No. 68-16, February 16, 1995.

Closely related to the BPTC requirement, consideration must be given to alternative treatment and control methods and whether a lower water quality can be abated through reasonable means, and the implementation of feasible alternative treatment or control methods should be considered.

USEPA guidance clarifies that the federal antidegradation provision ~~is~~ not a no growth rule and was never designed or intended to be such. It is a policy that allows public decisions to be made on important environmental actions. Where the State intends to provide for development, it may decide under this section, after satisfying the requirements for intergovernmental coordination and public participation, that some lowering of water quality in "high quality waters" is necessary to accommodate important economic or social development" (EPA Handbook for Developing Watershed Plans to Restore and Protect Our Waters, Chapter 4). Similarly, under Resolution 68-16, degradation is permitted where important economic or social factors are demonstrated.

## **2. Application of Antidegradation Requirements to the Long-Term Irrigated Lands Regulatory Program**

Very little guidance has been provided in State or federal law with respect to applying the antidegradation policy to a program or general permit where multiple water bodies are affected by various discharges, some of which may be high quality waters and some of which may by contrast have constituents at levels that already exceed water quality objectives. It is not possible to identify all areas in a large geographic region where existing water quality may be higher than background baseline quality and ensure that the antidegradation policies are followed through a uniform set of requirements in addressing such waters. Instead, any program instituted to permit a type of discharge or category of discharge needs to be protective of beneficial uses throughout the entire geographical area to which the program applies and provide a means to evaluate and implement BPTC to minimize degradation on a site-specific basis where such degradation may be occurring.<sup>30</sup>

As stated, given the complexity of determining baseline background water quality and in applying the antidegradation policy to a wide set of water bodies and constituents, the long-term ILRP assumes that some of the water bodies receiving irrigated agricultural discharges are high quality waters. From a programmatic standpoint, irrigated land waste discharges have the potential to cause degradation of surface and groundwater, and the requirements of the anti-degradation policies must be followed. Moreover, existing data show that some

---

<sup>30</sup> In the context of anti-degradation analysis in Basin Planning, the State Board has stated that: "The State and Regional Boards can and should focus their attention on establishing objectives for those situations where objectives are most needed to assure protection of beneficial uses, postponing until later site-specific approvals the determination whether discharges in a particular area should be allowed to reduce water quality to the level set by these objectives." State Water Resources Control Board, Office of Chief Counsel, October 7, 1987 Memorandum on the Federal Antidegradation Policy. This guidance is instructive in the context of the ILRP.

waters already have constituents associated with irrigated agricultural discharges in levels at or exceeding water quality objectives. Accordingly, the long-term ILRP must comply with the antidegradation policies by requiring that:

- at a minimum, irrigated agricultural waste discharges may not cause or contribute to exceedances of water quality objectives;
- because it is expected that there may be degradation of some Central Valley high quality waters receiving irrigated agricultural discharges, maximum benefit to the people of the State must be shown;
- the requirements implementing the long-term ILRP must result in use of BPTC where irrigated agricultural waste discharges may cause water quality degradation.

Any long-term ILRP must ensure that all these requirements are met.

### **3. Water Quality Objectives and Beneficial Uses**

As described above, Resolution 68-16 and Section 40 CFR 131.12 are both site-specific evaluations that are not easily employed to address large areas or broad implementation for classes of discharges. As a floor, any regulatory program must prohibit agricultural discharges from causing or contributing to exceedances of water quality objectives to ensure that beneficial uses are protected, and that a pollution or nuisance is not caused.<sup>31</sup> It should be noted that, where natural background conditions exceed water quality objectives for a given constituent in a water body, the objectives do not require improvement over natural conditions. See Policy for Application of Water Quality Objectives contained in the Basin Plan for the Sacramento River and San Joaquin River Basins (IV-16 *et seq.*) and the Basin Plan for the Tulare Lake Basin (IV-21 *et seq.*).

### **4. Consistency with Maximum Benefit to the People of the State**

Some degradation of existing high quality waters is permissible if it is consistent with maximum benefit to the people of the State. Irrigated agricultural operations provide the people of the State employment, food, fiber products, and revenue. Irrigated agricultural industry information is described in more detail in the Industry Summary, [Section III.A](#) of this document. Direct State benefits from the industry include those listed below.

- Central Valley agriculture supplies 12 percent of U.S. agricultural output by value (Great Valley Center 2009). Eight of the nation's top ten producing counties are in California.
- Central Valley agriculture supplies food for the nation.

---

<sup>31</sup> See SWRCB Order Nos. WQ 81-5; WQ 2000-07.

- California farmers employ about 448,000 workers with a total employee compensation of more than 5 billion dollars (USDA, National Agricultural Statistics Service, December 2009). The Central Valley accounts for approximately 50 percent of all of the farm workers in the State and approximately 49 percent of their payroll (USDA 2007).
- California's agricultural sector produces \$39 billion in goods and services each year (USDA 2008).
- California accounted for 100 percent of U.S. exports of raisins, dried plums, olives, dates, kiwis, figs, almonds, walnuts, pistachios, and garlic (UC Davis 2009).
- California accounts for more than 90 percent of the nation's exports of wine, table grapes, plums, apricots, broccoli, and celery.
- California provides food for the international market, accounting for 13 to 15 percent of the nation's total agricultural export (USDA 2007).

It is important to realize that there are not only direct benefits of irrigated agriculture but also indirect benefits that should be considered. Additional industries that depend on irrigated agriculture provide employment and revenue for the people of the State, including hauling companies, equipment suppliers, distributors, consulting engineers, etc.

The numerous benefits that the people of the State enjoy from irrigated agriculture do come at a price. This price is illustrated in the Water Quality Data Summary for Ground and Surface Waters Accepting Irrigated Agricultural Waste, [Section III.C](#) of this report. From the summary, it is clear that waste discharges from irrigated agriculture can cause and have caused degradation of Central Valley surface and groundwater. In some cases the degradation has led to exceedances of water quality objectives and threatens beneficial uses.

One concern in the development of the long-term ILRP has been the safety and availability of drinking water. The Central Valley Water Board is aware of a number of small communities throughout the Central Valley that find it difficult to obtain safe and reliable drinking water because of nitrate pollution. There are pervasively high nitrate levels in groundwater throughout the Central Valley (groundwater summary, [Section III.C.2](#)). Because of the limited number of residents, small communities have to face major expense in developing safe drinking water supplies (see [Section III.D](#)). Total costs for these communities are estimated at \$20.5–\$47.5 million. Because of this concern, one of the goals of the long-term ILRP is to ensure that irrigated agricultural discharges do not impair Central Valley communities' and residents' access to safe and reliable drinking water.

The groundwater summary, [Section III.C.2](#), of this report describes several sources of nitrate discharges to groundwater supplies, one of which is fertilizer application to irrigated agriculture (also see Draft Groundwater Nitrate Summary

Report, [Appendix B](#)). While irrigated agriculture is a source of nitrate, it is generally unknown whether the groundwater quality impacts have been caused by current or past practices, or whether other sources have caused the impacts. In these cases all sources of nitrate need to be determined and reduced in order to prevent further degradation and bring groundwater nitrate levels back into compliance with objectives. The long-term ILRP would work to achieve these goals for one source of nitrate (current discharges from irrigated agriculture).

In summary, while the implementation of antidegradation requirements in the long-term ILRP aims to prevent degradation, it is also assumed that there may be cases where some degradation of high quality waters would occur from irrigated agricultural waste discharge. Considering, however, that:

- Central Valley communities depend on irrigated agriculture for employment,
- the State and nation depend on Central Valley agriculture for food,
- the long-term ILRP would work to prevent further degradation of surface and groundwater, and
- the long-term ILRP would ensure that all State waters in the Central Valley meet applicable water quality objectives.

Continued waste discharge associated with irrigated agricultural operations that may cause degradation of high quality waters is consistent with the maximum benefit to the people of the State.

## **5. BPTC**

As discussed, without site-specific information on high quality waters and each agricultural input to those waters, it is not possible to do a -site- or discharge-” specific antidegradation analysis to support the general orders/waivers for the long-term ILRP as a whole. Instead, implementation of the program must work to achieve site-specific antidegradation requirements through implementation of BPTC and representative monitoring to confirm the effectiveness of the BPTC measures in preventing or minimizing degradation. Any regulatory program adopted will rely on implementation of practices and treatment technologies that constitute BPTC, based to the extent possible on existing data, and require monitoring of water quality to ensure that the selected practices in fact constitute BPTC where degradation of high quality waters is or may be occurring.

With regard to selection of measures and practices, the Central Valley Water Board and USEPA recognize that there is often site-specific, crop-specific, and regional variability that affects the selection of appropriate management measures,<sup>32</sup> as well as design constraints and pollution-control effectiveness of

---

<sup>32</sup> Management Measures are defined as (40 CFR 130.2 (m)), -Best practical and economically achievable measures to control the addition of pollutants to waters of the United States through



various practices. Local officials and other practitioners need the flexibility to choose management practices that best achieve a management measure's performance expectations given their own unique circumstances. Management measures developed for agriculture are to be used as an overall system of measures to address nonpoint-source pollution sources on any given site. In most cases, not all of the measures will be needed to address the nonpoint sources at a specific site. Operations may have more than one source to address and may need to employ two or more of the measures to address the multiple sources. Where more than one source exists, the application of the measures should be coordinated to produce an overall system that adequately addresses all sources for the site in a cost-effective manner.

Available State and federal guidance on management practices may serve as informational sources and recommended approaches for addressing nonpoint-source irrigated agricultural discharges for the long-term ILRP.

The State Water Board, California Coastal Commission, and other State agencies have identified seven management measures to address agricultural nonpoint sources of pollution that affect State waters. The agricultural management measures include practices and plans installed under various NPS programs in California, including systems of practices commonly used and recommended by the USDA as components of resource management systems, water quality management plans, and agricultural waste management systems. ([http://www.waterboards.ca.gov/water\\_issues/programs/nps/docs/guidance/agricmms.pdf](http://www.waterboards.ca.gov/water_issues/programs/nps/docs/guidance/agricmms.pdf))

The National Management Measures to Control Nonpoint Source Pollution from Agriculture (EPA 841-B-03-004, July 2003; <http://www.epa.gov/nps/agmm/>), — *is a technical guidance and reference document for use by State, local, and tribal managers in the implementation of nonpoint source pollution management programs. It contains information on the best available, economically achievable means of reducing pollution of surface and ground water from agriculture.*

Additionally, in order to guide the proper selection of management measures, the Central Valley Water Board will establish goals for the selection of management measures. The selection of appropriate management measures must include analysis of site-specific conditions, waste types, discharge mechanisms, and crop types. Considering this, as well as CWC 13360's mandate that the Regional Water Board not specify the manner of compliance with its requirements, selection must be done at the local or farm level. The goals for local selection of management measures include:

- minimize waste discharge off site in surface water,
- minimize erosion,

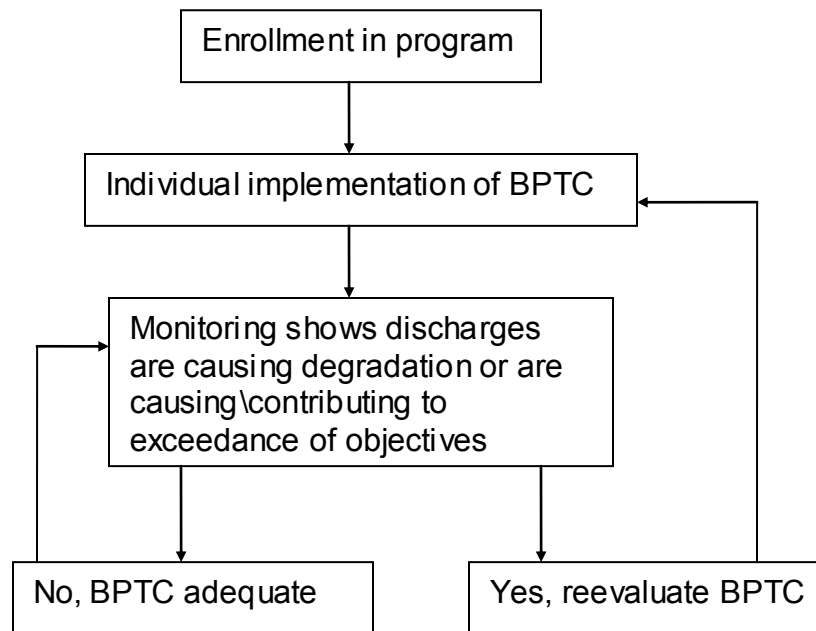
---

the application of nonpoint pollution control practices, technologies, processes, siting criteria, operational methods, best management practices, or other alternatives.”

- minimize percolation of waste to groundwater,
- work to match nutrient application to predicted crop uptake, and
- implement wellhead protection measures.

Implementation of management measures that meet the above goals would be expected to constitute BPTC. However, where degradation is occurring, irrigated agricultural operators must *demonstrate* that any set of practices proposed for implementation represents BPTC and will be required to consider existing water quality data or conduct monitoring in support of this demonstration. It is expected that this will be an iterative process whereby the effectiveness of any set of practices in minimizing degradation will be periodically reevaluated as necessary and/or as more recent and detailed water quality data become available. Figure 21 is a logic flow diagram summarizing the antidegradation approach for the long-term ILRP.

**Figure 21. Flow Diagram for Long-Term ILRP Antidegradation Approach**



The iterative process shown in Figure 21 is intended, over time, to bring all water bodies accepting agricultural wastes into compliance with water quality objectives (where agriculture is the source of exceedance) and evaluate and prevent degradation.

## **F. Enforcement Policy**

The State Water Board's [2009 Water Quality Enforcement Policy](#) (Enforcement Policy) describes how the State and Regional Water Boards will conduct enforcement activities. Water Code Section 13000 grants the State and Regional Water Boards the authority to implement and enforce water quality laws, regulations, policies, and plans to protect groundwater and surface waters of the State.

The goal of the Enforcement Policy is to protect and enhance the quality of the waters of the State by defining an enforcement process that addresses water quality problems in the most efficient, effective, and consistent manner.

The Enforcement Policy states that a good enforcement program relies on well-developed compliance monitoring systems designed to identify and correct violations, help establish an enforcement presence, collect evidence needed to support enforcement actions where there are identified violations, and help target and rank enforcement priorities. Compliance with regulations is critical to protecting public health and the environment. The Enforcement Policy aims to ensure that the most effective and timely methods be used to ensure that the regulated community stays in compliance. The Enforcement Policy also states that tools such as providing assistance, training, guidance, and incentives are commonly used by the Water Boards and work very well in many situations; however, there is a point at which this cooperative approach should make way for a more forceful approach.

Without a strong enforcement program to back up the cooperative approach, the entire regulatory framework would be in jeopardy. Enforcement is a critical ingredient in creating the deterrence needed to encourage the regulated community to anticipate, identify, and correct violations. Appropriate penalties and other consequences for violations offer some assurance of equity between those who choose to comply with requirements and those who violate them. It also improves public confidence when government is ready, willing, and able to back up its requirements with action.

The Enforcement Policy requires that the Water Boards strive to be fair, firm, and consistent in taking enforcement actions. This includes ensuring the fair treatment of people of all races, cultures, and income levels, including minority and low-income populations, consistent with the goals in California Environmental Protection Agency's ([Cal-EPA's Intra-Agency Environmental Justice Strategy, August 2004](#)).

## **V. OTHER REGULATORY PROGRAMS**

### **A. U.S. Environmental Protection Agency Federal Insecticide, Fungicide, and Rodenticide Act**

The [Federal Insecticide, Fungicide, and Rodenticide Act](#) (FIFRA), Title 7, United States Code Section 136, establishes pesticide regulation and use requirements to protect applicators, consumers, and the environment.

FIFRA requires that all new pesticides undergo registration requirements to assess the materials' efficacy, toxicity, and dose requirements. Manufacturers are required to gather the data to evaluate pesticides for registration. Pesticide information gathered during the registration process then is used to develop pesticide use labels that instruct users on the proper use of the material. Pesticide use labels are regulatory requirements, and if the instructions are not followed, users are subject to enforcement under the law.

Because of safety or toxicity concerns, some pesticides are allowed only for "restricted use" under FIFRA. Restricted use pesticides can be used only by, or under the direct supervision of, a certified applicator. In California, DPR administers the certification program for restricted use pesticide applicators.

### **B. California Department of Pesticide Regulation Programs**

DPR is responsible for regulating the registration, sale, and use of pesticides in California. The State's pesticide statutes and regulations are in addition to the federal statutes and regulations for pesticide use pursuant to FIFRA (described above). In general, State regulations establish a system of tracking and reporting pesticide use; permit requirements for the use of restricted pesticides; regulations for the application of certain pesticides, including restrictions on the time and place of use; and requirements for licensing and training applicators. The regulations aim to avoid the overuse of pesticides, protect surface water and groundwater supplies, and minimize worker and other human exposure. These requirements are embodied in Title 3 of the CCR, commencing with Section 6000. DPR relies on County Agricultural Commissioners (CACs) to carry out permitting and inspection functions under these regulations.

In addition, DPR is charged with collaborating with CACs and manufacturers to:

1. provide for the proper, safe, and efficient use of pesticides essential for production of food and fiber and for protection of the public health and safety;
2. protect the environment by prohibiting, regulating, or ensuring proper use of pesticides;
3. ensure agricultural and pest control workers of safe working conditions where pesticides are present;

4. permit agricultural and structural pest control by competent and responsible licensees and permittees under strict control of the director and commissioners;
5. ensure that pesticides are properly labeled and are appropriate for the use designated by the label, and that State or local governmental dissemination of information on pesticide uses of any registered pesticide product is consistent with the uses for which the product is registered; and
6. encourage development and implementation of pest management systems, stressing application of biological and cultural pest control techniques with selective pesticides when necessary to achieve acceptable levels of control with the least possible harm to nontarget organisms and the environment.

DPR's requirements aimed at protecting waters from pesticides work toward some of the same general goals as the Central Valley Water Board's programs (e.g., protecting beneficial uses of waters by reducing pesticide discharge associated with agricultural operations). Because of this similarity, it is important to consider how DPR and the long-term ILRP can work together to achieve the missions of both agencies while minimizing duplication of regulatory requirements. DPR's surface and groundwater programs are described in more detail below.

## **1. Surface Water Protection Program**

The Surface Water Protection Program addresses both agricultural and nonagricultural sources of pesticide residues in surface waters. It has preventive and response components that work to reduce the presence of pesticides in surface waters. The preventive component includes user outreach to promote compliance with label requirements and management practices that reduce pesticide runoff. Prevention also relies on DPR's registration process in which pesticide environmental fate and potential adverse effects on surface water quality are evaluated.

The response component includes the development and implementation of mitigation options to meet water quality goals, recognizing the value of self-regulating efforts to reduce pesticides in surface water as well as regulatory authorities of DPR and the Water Boards. DPR's Surface Water Protection Program also conducts numerous investigations on a wide range of research topics related to the identification of pesticides in surface water and sediment, their sources, and the validation of management practices that reduce off-site transport. In the past, DPR's investigations have assisted the Water Boards in the development of TMDLs and other basin planning activities.

To promote cooperation to protect water quality from the adverse effects of pesticides, DPR and the State Water Board signed a Management Agency Agreement (MAA) in 1997. The MAA, and its companion document, "The



California Pesticide Management Plan for Water Quality," strive to coordinate interaction, facilitate communication, promote problem solving, and ultimately ensure the protection of water quality.

Under the California Pesticide Management Plan for Water Quality, DPR will investigate pesticides of concern and help develop recommended use practices designed to reduce or eliminate the impact of pesticides on surface water quality. Management practices designed to reduce contamination usually will be implemented initially through voluntary and cooperative efforts. Depending on the source of the residue problems, mitigation may include outreach programs to educate residential and professional users on ways to reduce pesticides in urban waters as well as programs targeted at modifying use practices among agricultural pesticide users. If the revised use practices (which are voluntarily adopted by pesticide users) do not adequately mitigate the impacts, DPR can use its wide-ranging regulatory authority to impose use restrictions. DPR may modify the use of pesticides by regulation or permit conditions to prevent excessive amounts of residues from reaching surface water. DPR has the role of evaluating the feasibility of these modifications and conditions, and of promulgating any necessary regulations. Although the State and Regional Water Boards independently could use their authorities to regulate the discharge of pesticides, they often will work with DPR first to address these issues.

## **2. Groundwater Protection Program**

Under general authority and the specific provisions of the Pesticide Contamination Prevention Act, as amended (PCPA) (Food and Agricultural Code [FAC] Sections 13142 *et seq.*), DPR has developed a program to prevent contamination of groundwater from the legal applications of pesticides. The PCPA requires:

- pesticide manufacturers to submit environmental fate data for agricultural use pesticides;
- DPR to establish in regulation a list of pesticides with the potential to pollute groundwater;
- DPR to conduct monitoring to determine whether these pesticides are present in groundwater;
- DPR to develop and maintain a Statewide database of wells sampled for pesticides and publish an annual report on the contents of the database;
- State and local agencies to report to DPR all results of wells sampled for pesticides;
- DPR to investigate reports of pesticides detected in groundwater and determine whether these detections are a result of legal agricultural use;
- DPR to formally review pesticides detected in groundwater, with the assistance of the State Water Board and the Office of Environmental

Health Hazard Assessment, to determine whether continued use can be allowed; and

- DPR to adopt regulations to prevent further contamination of groundwater.

In addition to the above mandated activities, DPR's Groundwater Protection Program has incorporated scientific approaches to:

- provide a spatial analysis to identify areas vulnerable to movement of pesticide residues to groundwater,
- understand the pathways for movement of residues from agricultural applications to groundwater,
- develop mitigation measures to prevent pesticide contamination of groundwater that are matched to the specific pathway of movement to groundwater,
- develop an approach that identifies pesticide products with a high risk to move to groundwater during the registration process before they are allowed for use in California, and
- track the effectiveness of regulations through annual monitoring of domestic drinking water wells located in groundwater protection areas.

### **Pesticide Contamination Prevention Act—Mandated Activities**

#### *Require Pesticide Manufacturers to Submit Environmental Fate Data*

The PCPA required registrants of agricultural use pesticides to submit data for physical and chemical properties that describe persistence and mobility of pesticide products (FAC Section 13143). Data initially are received and reviewed for consistency by DPR and entered into the pesticide chemistry database. DPR scientists analyze these data using models developed to identify pesticides with a potential to move to groundwater. These data are available to the public upon request.

#### *Groundwater Protection List*

As prescribed in the PCPA, DPR scientists developed a procedure to identify and then list in regulation pesticide active ingredients with the potential to pollute California's groundwater. The PCPA identified physical and chemical properties associated with either mobility or persistence. Using the data collected in the Pesticide Chemistry Data Base, specific trigger values were identified for water solubility, soil adsorption coefficient normalized to organic carbon content (Koc), hydrolysis half-life, soil aerobic metabolism half-life, and soil anaerobic half-life. The procedure used to determine these trigger values, denoted as the specific numerical values (SNVs), compared the distribution for each chemical property between a list of pesticides that were known to contaminate groundwater as a result of legal agricultural use and a list of pesticides that had been sampled but not detected in groundwater. This procedure was first reported by Wilkerson and

Kim (1986) and is available at: <<http://www.cdpr.ca.gov/docs/emon/pubs/ehapreps/eh8602.pdf>>.

The current SNVs, reported by Johnson (1991), are available at: <<http://www.cdpr.ca.gov/docs/emon/pubs/ehapreps/eh9106.pdf>>.

Pesticides that are identified as having the potential to leach to groundwater according to the SNV process are placed on a list called the ~~b~~-2" list. In accordance with the PCPA, an annual report for this list is produced that:

- identifies pesticides with data gaps for environmental fate properties,
- lists the active ingredients that meet the SNV trigger values, and
- reports the sale and use of the listed active ingredients.

The current report is available at: <<http://www.cdpr.ca.gov/docs/emon/pubs/ehapreps/eh0902.pdf>>.

The final step in identifying a pesticide active ingredient with the potential to pollute groundwater is to place it on the groundwater protection list (GWPL). The GWPL, denoted as the Section 6800 list in Title 3 of the California Code of Regulations, contains active ingredients from the b-2 list with certain application characteristics, as specified on the product label. The PCPA requires that pesticide active ingredients on the b-2 list be added to the GWPL if their product labels indicate they are ~~intended~~ to be applied to or injected into the soil by ground-based application equipment or by chemigation, or the label of the pesticide requires or recommends that the application be followed, within 72 hours, by flood or furrow irrigation" (FAC Section 13145(d)). Each active ingredient has many products, so each label is reviewed for the prescribed uses. If any one label indicates a prescribed use, the active ingredient is placed on the GWPL.

### *Monitoring*

The purpose of developing the GWPL was to provide a method to increase the efficiency and reduce cost of monitoring, ensuring the best use of State resources. There are approximately 90 registered pesticide active ingredients on the GWPL. This represents about a third of all pesticide active ingredients used in agriculture. Analytical methods are usually not available to measure each one at the low concentrations normally encountered in well water, so a lengthy analytical method development is required prior to well monitoring. The GWPL list has been further prioritized using a combination of data on:

- detections in groundwater in the United States or other countries,
- amount of pesticide used in California, and
- results from a calibrated model using environmental fate data that compares pesticide movement among active ingredients.

The result is a prioritized list of active ingredients, identifying the order for analytical method development and, subsequently, well water monitoring. DPR scientists also have developed spatial information that allows targeted sampling that produces the highest probability of detecting residues in wells. Spatial databases used to determine sites for sampling include pesticide use, soil properties, depth to groundwater, and previous detections.

Standard operating procedures have been developed to ensure the integrity of the sample and the well site selected. Pertinent procedures are available at the DPR website at: <<http://www.cdpr.ca.gov/docs/emon/pubs/sopfield.htm>>. The criteria for well selection include ensuring that the wellheads are protected from direct contamination so that any measured pesticides are the result of legal pesticide use. These standards have been developed to support regulatory actions that have been taken. Scientifically based regulations require data of the highest quality for validation.

#### *Statewide Database of Wells Sampled for Pesticides*

The PCPA requires State and local agencies to report the results of all wells sampled for pesticides to DPR. The law also requires DPR to maintain a Statewide database of well monitoring results. The database is entitled the 'well inventory database' (WIDB). An annual report on data included in the database is also required in law. This annual report contains:

- number of wells sampled,
- number of wells with detections,
- location of the wells reported by county,
- agencies responsible for sampling and analyzing samples,
- an analysis to determine the probable source of detection, and
- actions taken by the DPR Director and the State Water Board to prevent pesticides from migrating to groundwater.

The principal agencies that submit pesticide monitoring results to DPR are public health agencies that sample public drinking water wells for pesticides. In addition to the PCPA requirement that all State and local agencies report results of well monitoring for pesticides to DPR, DPR has requested data from all known sources of groundwater monitoring data, such as the USGS. As of May 2009, the WIDB contains more than 1.8 million separate records for analyses conducted from approximately 23,000 unique public water system and rural domestic and irrigation wells. Data are available for approximately 350 unique pesticide active ingredients, including both parent and breakdown products, and for all of California's 58 counties. The analyses are from pesticides currently registered, no longer registered, and never registered in California. The number of wells sampled for pesticides varies from three in rural mountainous Alpine County, with little reported pesticide use, to more than 4,000 wells in Fresno County. The median number of wells that have been sampled per county to date is 150.

Although the greatest number of well samples is received from public drinking water well systems, data generated from DPR sampling, which targets rural domestic, drinking-water wells, have a much higher rate of detection. The higher rate of detection is attributable to a combination of the targeted sampling approach taken by DPR, the relative shallowness of domestic wells sampled by DPR compared to the depth of municipal wells, and the proximity of domestic wells to agricultural use sites.

#### *Investigate Reports of Detections*

When a pesticide is detected in groundwater, the following actions are taken.

1. Quality control and assurance data are reviewed to determine the quality of the analytical methodology.
2. DPR confirms the detection by analyzing a backup sample or re-sampling the well.
3. Once a detection is confirmed, additional wells are located and sampled in the area near the original detection to determine the extent of contamination and whether the detection was a result of legal agricultural use.
4. DPR determines whether the detected concentration poses an immediate threat to public health, and if so, may immediately suspend the use of the pesticide.
5. If residues do not pose an immediate threat to public health, DPR follows the response process outlined in the PCPA (FAC Sections 13149 and 13150) with respect to determination of agricultural use and notification of the pesticide registrant; convenes the subcommittee of the Pesticide Registration and Evaluation Committee (PREC), which is composed of staff from the Office of Environmental Health Hazard Assessment, the State Water Board, and DPR; and takes action to prevent further contamination.

Essentially, where a pesticide has been detected in groundwater and the detection is confirmed as a result of legal agricultural use (i.e., no evidence of illegal pesticide use or point sources), the pesticide is regulated by DPR specifically to prevent further contamination; see discussion below on Groundwater Protection Areas (GWPA's) and 6800(a) list.

#### *Regulations to Prevent Contamination (Groundwater Protection Areas)*

DPR has adopted regulations on use of all active ingredients found in California's groundwater as a result of legal agricultural use. The first set of regulations targeted only sections of land where residues had been detected in well water. Since then, a new set of regulations enacted in 2004 provided an additional layer of prevention by including areas of land that had soil and depth to groundwater properties similar to sections of land where residues previously had been found. These vulnerable areas are denoted as GWPA's. GWPA's are 1-square mile



sections of land that are identified in regulation as a vulnerable soil condition with a 10-year average depth to groundwater of 70 feet or less. GWPAs are shown in Figure B-10 of [Appendix B](#).

An important aspect of GWPAs is that they are designated with respect to the pathway for movement of residues to groundwater. Areas designated as 'leaching' have coarse-textured, sandy soil where residues move directly down from sites of application with water as it recharges groundwater. GWPAs have been designated as 'runoff' areas where residues move in runoff water generated by rainfall or irrigation to sensitive sites that facilitate rapid movement of surface water to subsurface soils. Description of the method to describe GWPAs, the management practices specific to each condition, and their geographic location are available at DPR's website at: <[http://www.cdpr.ca.gov/docs/emon/grndwtr/gwp\\_regs.htm](http://www.cdpr.ca.gov/docs/emon/grndwtr/gwp_regs.htm)>.

To date, DPR has reviewed eight pesticide active ingredients under the formal review process and adopted regulations to prevent their continued movement and the movement of their breakdown products to groundwater. The eight active ingredients are atrazine, simazine, bromacil, diuron, prometon, aldicarb, bentazon, and norflurazon. Regulations were adopted to limit the maximum application rates of aldicarb by crop, and to prohibit aldicarb use on cotton, potatoes, sugar beets, dried beans, citrus, and field-grown ornamentals from September 1 to March 1 of each year (CCR Section 6458). The other seven pesticides are listed in Section 6800(a) and are designated "restricted materials." Issuance of a permit from the CAC is required before a product containing a 6800(a) listed active ingredient can be used within a GWPA. CACs are required to enforce pesticide laws and regulations in each county. There are currently more than 3,500 GWPAs that cover approximately 2.3 million acres in California.

Before application of a restricted material (which requires a permit), the permit holder must submit a notice of intent to the CAC generally 48 hours before the application occurs. This allows the CAC time to review the proposed application, to make sure conditions of the permit are appropriate for the time and site of application, or need to be modified, and allows the CAC to plan any inspection of the application. In GWPAs, growers are required to select one of the management practices specified in regulation for the 6800(a) listed materials and the practice is specified as an enforceable condition of the permit. Applicability of management practices is based on soil characteristics. For example, in a runoff area, the applicator could be required to retain all irrigation and rainfall drainage/runoff through the field for 6 months following the application. CACs have the authority to conduct inspections to determine whether permit conditions have been met.

In addition to groundwater protection regulations described above, these regulations apply.

- Prohibit pesticide use below the high water line in areas that recharge groundwater basins.
- Prohibit pesticide use below the high water line in canals.
- Regulate uses for roadside applications.
- Prevent backflow of pesticide residues into wellheads during mixing and loading, and chemigation—CACs inspect backflow prevention equipment.
- Protect wellheads from exposure to agricultural runoff by making sure wellheads are above the grade of drainage or protected by a berm, or by prohibiting the mixing, loading, storage, and rinsing of application equipment and containers within 100 feet of an unprotected wellhead and prohibiting the application of all preemergent herbicides listed in Section 6800 within 100 feet of an unprotected wellhead—CACs inspect wellhead protection.

### **Additional Groundwater Protection (Non-Mandated)**

#### *Understand Pathways of Movement to Groundwater*

Investigations of the pathways of movement to groundwater were initiated in the 1980s. The first major DPR groundwater study measured the effect of the amount of water applied and irrigation method on the movement of bromide (a tracer for water movement) and atrazine, an herbicide detected in wells. The results of this study led to an understanding of the importance of irrigation control in coarse-textured, sandy soils. Additional studies have been conducted to determine the pathway in soils with a hardpan layer where runoff water predominates and also in cracking clay soils.

#### *Develop Mitigation Measures*

Upon the discovery that there were multiple pathways for pesticide movement to groundwater, a logical extension was to provide guidance on mitigation measures based on each pathway. Mitigation measures are based on the major profiling soil property. In coarse-textured soils, control of irrigation percolation water is of paramount importance. In contrast, for soils where runoff is the pathway of off-site movement, one key option is the incorporation of residues from the surface application into the soil matrix.

#### *Develop an Approach to Identify Potential Leaching before Registration*

The regulations DPR has adopted to protect groundwater apply after pesticides have been registered. To enhance the groundwater protection program, DPR also assesses the groundwater contamination potential of new pesticide products before they are registered for use. A modeling approach has been developed that uses the environmental fate data submitted by the pesticide companies to

determine whether the new product is likely to leach to groundwater. Using this modeling approach, DPR has identified new products with high potential to move to groundwater. For these pesticides, DPR may request the pesticide company to add restrictive mitigation measures on the label and/or conduct additional studies on the fate of the product under California conditions. If mitigation is not deemed possible, DPR also could decide not to register the pesticide for use in California.

#### *Monitoring Well Network to Track Effectiveness of Regulations*

The ultimate measure of the effectiveness of DPR's regulations to prevent movement of pesticide residues to groundwater will be observation of decreasing trends in concentrations in wells where residues previously have been measured. Decreases in concentration in domestic drinking water wells directly relate to a decrease in exposure to residues. In 1999, a monitoring program was initiated to monitor the concentration of pesticide residues in wells known to be contaminated. Permission to sample domestic wells was obtained from approximately 35 owners located in coarse-textured soils in Fresno County, and from approximately 35 owners in soils containing a hardpan layer, a predominant condition in Tulare County; these areas correspond to leaching and runoff pathways to groundwater, respectively. DPR plans to conduct and make available an in-depth statistical analysis of these data during 2010.

#### **Coordination of Groundwater Programs**

Throughout the development of the long-term ILRP, the Central Valley Water Board has been asked to coordinate closely with DPR and CACs to ensure that there is no overlap of groundwater regulations, imposing unnecessary burden on both the State and irrigated agricultural operations. In response to this concern, one of the objectives of the long-term ILRP is to coordinate with other regulatory programs.

This section provides recommendations for coordination of groundwater protection components of the long-term ILRP and DPR's Groundwater Protection Program.

#### *Regulatory Authorities*

In general, DPR has regulatory authority to establish requirements on the *use* of pesticides in order to protect human health and the environment. The Water Board has regulatory authority to establish requirements on the *discharge* of any type of wastes to surface and groundwater to protect human health and the environment. While DPR has authority to require management practices, the Water Board cannot require specific practices. In fact, the CWC prohibits the Water Board from requiring specific technologies or practices [13360]. Instead, the Water Board establishes requirements on the waste discharge (e.g., waste constituent limitations). This gives the discharger freedom in choosing appropriate technology or practices to meet the WDRs.

The difference in Water Board and DPR regulatory authorities highlights the need for coordination between programs. For example, reported detection of pesticide residues in groundwater by either the Water Board or DPR would initiate an investigation. DPR would collect additional information to support the current regulatory process. While DPR proceeds with regulatory actions for the new detections, the long-term ILRP could immediately review the data and inform growers using the pesticide in the affected area of the need to implement practices to prevent further degradation of groundwater. The information collected (monitoring data and practices implemented) could be integrated into DPR's geographic approach to require management practices in other areas of the State with similar vulnerable characteristics.

### *Groundwater Monitoring*

DPR conducts groundwater monitoring for pesticides to review the effectiveness of the Groundwater Protection Program and also to determine whether pesticides are reaching groundwater. DPR does not sample for all pesticides or their breakdown products, nor is sampling conducted in all areas where pesticides may reach groundwater. DPR's monitoring is targeted using geophysical models in order to maximize efficiency of samples collected. Over the years, DPR has developed vast knowledge and expertise in modeling and sampling for pesticides in groundwater. If the ILRP were to include a groundwater monitoring component, DPR and the Central Valley Water Board could coordinate on development of monitoring plans and sampling efforts to provide information necessary for both programs. In this coordination, the ILRP could make use of DPR's experience and knowledge in devising appropriate monitoring plans and groundwater models to reduce the amount of sampling needed, and also share well monitoring results to avoid duplication of sampling efforts.

### *Wellhead Protection*

DPR has developed wellhead protection requirements for pesticide use. CACs enforce these requirements. The Central Valley Water Board is concerned that other wastes (e.g., nutrients, pathogens) could be discharged to groundwater through unprotected wellheads. Also, there is potential for backflow into unprotected wellheads during fertigation. As described above, the Central Valley Water Board does not have the authority to require specific practices to protect wellheads. However, the Board could require that operations protect wellheads from waste discharge. If the ILRP were to require wellhead protection, the Central Valley Water Board and DPR could coordinate on education programs and CAC review of practices during inspections.

## **C. Grassland Bypass Project**

Before the [Grassland Bypass Project](#) began in 1996, drainage water from farms in the 97,000-acre Grassland Drainage Area was discharged into Salt Slough and other channels used to deliver water to wetland areas. This drainage water

contains high concentrations of selenium, salts, and other constituents that are harmful to wildlife.

The project prevents discharge of subsurface agricultural drainage water into wildlife refuges and wetlands in central California. The drainage water is conveyed instead through a segment of the San Luis Drain to Mud Slough, a tributary of the San Joaquin River.

The Central Valley Water Board issued WDRs to the Bureau of Reclamation and the San Luis and Delta-Mendota Water Authority (Authority). The WDRs specify maximum monthly and annual loads of selenium that may be discharged into Mud Slough and the San Joaquin River. The WDRs include monthly monitoring for molybdenum and nutrients (nitrate, ammonia, total kjeldahl nitrogen, total phosphate, and orthophosphate); weekly analyses of salinity, selenium, boron, and other parameters; and chronic toxicity testing. The WDRs also outline a program to monitor stormwater releases from the Grassland Drainage Area into the Grassland wetland supply channels, should they occur.

The project improves water quality in the wildlife refuges and wetlands, sustains the productivity of 97,000 acres of farmland, and fosters cooperation between area farmers and regulatory agencies in drainage management reduction of selenium and salt loading. Since implementation of the project, all discharges of drainage water from the Grassland Drainage Area into wetlands and refuges have been eliminated. The project has reduced the load of selenium discharged from the Grassland Drainage Area by 61 percent (from 9,600 lbs to 3,700 lbs). The load of salts has been reduced by 39 percent (from 187,300 tons to 113,600 tons). Prior to the project, the monthly mean concentration of selenium in Salt Slough was 16 parts per billion. Since October 1996, the concentration has been less than the water quality objective of 2 parts per billion.

The Grassland Bypass Project WDRs are a successful example of where the Central Valley Water Board has been able to interface with one primary entity, while establishing goals for a large group of growers. In this situation, the Bureau of Reclamation and the Authority have taken legal responsibility for the project's waste discharge. These entities are responsible for ensuring that growers using the bypass achieve the goals of the WDRs. This framework, where an entity takes legal responsibility for a shared waste discharge, has been considered in the development of the long-term ILRP.

#### **D. Central Valley Regional Water Board Dairy Order**

[Waste Discharge Requirements General Order No. R5-2007-0035](#) for Existing Milk Cow Dairies (Dairy General Order) is an example of where the Central Valley Water Board has developed a program applicable to a large number of operations (approximately 1,400 Central Valley dairies). Also, some of the waste discharge concerns facing dairy operations are similar to irrigated agricultural operations (e.g., nutrient and pesticide leaching to groundwater). For these



reasons, the framework of the Dairy General Order has been considered in the development of the long-term ILRP. In fact, one of the alternatives considered in this report (Alternative 5) is modeled after the Dairy General Order. The requirements of the Dairy General Order are described below.

California regulations governing discharges from confined animal facilities are contained in Title 27 of the California Code of Regulations (CCR), Division 2, Subdivision 1, Chapter 7, Subchapter 2, Article 1 (Title 27). Confined animal facilities are defined as "... any place where cattle, calves, sheep, swine, horses, mules, goats, fowl, or other domestic animals are corralled, penned, tethered, or otherwise enclosed or held and where feeding is by means other than grazing." Designation as a confined animal facility under these State regulations is not based on facility size. CWC Section 13260 requires that any person who owns and/or operates any confined animal facility in the Central Valley must file a report of waste discharge (ROWD) with the appropriate Regional Water Board.

The Central Valley Water Board adopted the Dairy General Order in May 2007. The Dairy General Order implements the CWC and regulations relevant to confined animal facilities and serves as general WDRs for discharges of waste to land from existing milk cow dairies. Approximately 1,400 dairies currently are regulated under the Dairy General Order and 16 dairies are regulated under individual WDRs.

## **1. Required Reports and Notices**

The Dairy General Order requires that the dairy operations prepare and submit reports for a variety of issues or conditions as discussed below.

### **Existing Conditions Report**

The Existing Conditions Report (this is not the ECR associated with the ILRP) provided additional information on existing conditions at the dairy, not contained in the ROWD originally submitted for coverage under the Dairy General Order. The Existing Conditions Report requires the operation to complete a Preliminary Dairy Facility Assessment, which includes a whole farm nitrogen balance and a ratio of nitrogen applied to nitrogen uptake by crops.

### **Waste Management Plan**

The Waste Management Plan requires a description and an evaluation of the existing milk cow dairy's design, construction, operation, and maintenance for flood protection and waste containment. The Waste Management Plan also requires the discharger to propose modifications and a schedule for modifications necessary to bring the dairy facility into compliance with the Dairy General Order's specifications and prohibitions.

### **Nutrient Management Plan**

A dairy operation that applies manure, bedding, or process wastewater to land for nutrient recycling is required to develop and implement management

practices that control nutrient losses and describe these in a Nutrient Management Plan. The Nutrient Management Plan must be certified by a certified specialist (Professional Soil Scientist, Professional Agronomist, or Crop Advisor) maintained at the dairy, submitted to the Central Valley Water Board upon request, and ultimately provided for protection of both surface water and groundwater. Groundwater monitoring will be used to determine whether implementation of the Nutrient Management Plan is protective of groundwater quality.

### **Proposed Interim Facility Modifications**

If an operation's Preliminary Dairy Facility Assessment shows that the whole farm nitrogen balance ratio is greater than 1.65 and/or that the existing retention pond(s) total storage capacity is less than the total storage capacity required, the operation is required to submit Proposed Interim Facility Modifications as necessary to balance nitrogen and/or Proposed Interim Facility Modifications as necessary to improve storage capacity, respectively.

### **Salinity Report**

The dairy operation is required to submit a report that identifies sources of salt in waste generated at the dairy, evaluates measures that can be taken to minimize salt in the dairy waste, and certifies that the operation will implement the approved measures identified to minimize salt in the dairy waste. If a third party (for example, the California Dairy Quality Assurance Program) produces an industry-wide report that is acceptable to the Central Valley Water Board, the dairy operation may refer to that report rather than generating an individual report, but must certify that the appropriate measures will be implemented to reduce salt in waste discharged.

## **2. Monitoring and Reporting Program**

The Dairy Monitoring and Reporting Program (MRP) includes: monitoring, record-keeping, and reporting requirements. Monitoring requirements include monitoring of discharges of manure and process wastewater, stormwater, and tailwater from the production area and land application areas and groundwater monitoring in order to determine whether the dairy is in compliance with the Dairy General Order.

Monitoring requirements include monitoring of nutrients applied to (both process wastewater and manure) and removed from (using plant tissue analyses) land application areas in order for the dairy to develop and implement a Nutrient Management Plan that will minimize leaching of nutrients and salts to groundwater and transport of these constituents to surface water. Monitoring requirements also include periodic visual inspections of the dairy to ensure the dairy is being operated and maintained to ensure continued compliance with the Dairy General Order.

## **Surface Water**

The Dairy General Order requires monitoring of any discharges to surface water, including surface water upstream and downstream of the discharge and discharges of tailwater to surface water to ensure that no unforeseen impacts are occurring.

Storm water may contain dairy wastes if the stormwater is allowed to contact manured areas or commingle with wastewater from the dairy. The Dairy General Order prohibits discharges of stormwater from the production area to surface water and any discharge of stormwater to surface water from the land application areas being used for nutrient utilization, unless that discharge is from land that has been managed consistent with a certified Nutrient Management Plan. The application of waste to lands not owned, leased, or controlled by the permittee without written permission from the landowner or in a manner not approved by the Central Valley Water Board, is prohibited.

Consistent with Title 27, the Dairy General Order prohibits the direct or indirect discharge of waste from the production area to surface water except when authorized by an NPDES permit. The Dairy General Order also prohibits discharges of: (1) wastewater to surface waters from cropland, and (2) waste to surface waters that causes pollution or nuisance, or that causes or contributes to an exceedance of any applicable water quality objective. Irrigation supply water that comes into contact or is blended with waste or wastewater is considered wastewater. The land application of manure or process wastewater to cropland for other than nutrient recycling also is prohibited.

Manure and process wastewater cannot be applied closer than 100 feet to any down-gradient surface waters, open tile line intake structures, sinkholes, agricultural or domestic well heads, or other conduits to surface waters, unless a 35-foot-wide vegetated buffer or physical barrier is substituted for the 100-foot setback, or alternative conservation practices or field-specific conditions will provide pollutant reductions equivalent to or better than the reductions achieved by the 100-foot setback.

## **Groundwater**

The Dairy General Order requires dairies to monitor groundwater to ensure that groundwater protection is being achieved. Groundwater monitoring at existing dairies is required to determine background groundwater quality; determine existing groundwater conditions near retention ponds, corrals, and land application areas; and determine the effect of the improved management practices required in the Dairy General Order on groundwater quality.

Many of the existing milk cow dairies covered under the Dairy General Order have been operating for many years, and it was expected that groundwater quality already may be affected at many of these dairies because of the past operations. For example, groundwater samples collected from 425 water supply wells (domestic and agricultural—stock watering and irrigation) on 88 dairies in

Tulare County between August 2000 and June 2006 showed that approximately 39 percent of the wells sampled had nitrate concentrations greater than the State MCL for drinking water.

It was deemed impractical to require all existing dairies to install monitoring wells within a short time period because of the limited number of professionals available to design and install groundwater monitoring systems and the limited Central Valley Water Board staff to review monitoring well installation and sampling plans. To determine the existing groundwater conditions at each dairy within the shortest time period requires establishment of priorities. The Dairy General Order requires each dairy to immediately begin sampling of each on-site domestic and agricultural well and discharges from any subsurface (tile) drains. The Dairy General Order also requires installation of groundwater monitoring wells to determine whether a dairy is in compliance with the groundwater limitations of the order. Currently, facilities are being required to install monitoring wells based on an evaluation of the threat to water quality at each site. It was anticipated that this will occur in phases of approximately 100 to 200 dairies per year, unless the Central Valley Water Board determines that an alternative method of groundwater monitoring is appropriate. The dairy industry is developing a proposed alternative method of groundwater monitoring for Central Valley Water Board review.

### **3. RecordKeeping and Reporting Requirements**

The Dairy General Order requires that the dairy maintain records for 5 years and make available to the Central Valley Water Board, upon request, any reports or records required by the Dairy General Order.

#### **Priority Reporting of Significant Events**

Dairies are required to report any noncompliance that endangers human health or the environment or any noncompliance with listed prohibitions contained in the Dairy General Order, within 24 hours of becoming aware of the occurrence. A written report must be submitted to the Central Valley Water Board office within 2 weeks of becoming aware of the incident.

#### **Annual Reporting**

An annual monitoring report is due each year. The annual report consists of a general section, groundwater reporting section, and stormwater reporting section.

### **E. State Water Board Stormwater Program**

The federal Clean Water Act (CWA) provides that discharges from point sources to waters of the United States are prohibited, unless authorized by NPDES permits (CWA Section 301[a]). In 1987, the CWA was amended to specify the requirements for NPDES permits for stormwater discharges (CWA Section 402[p]). California's Stormwater Program is administered by the State and Regional Water Boards. [The Stormwater Program](#) has three main focus areas:

construction, industrial, and municipal. These focus areas are described in more detail below.

In general, the Stormwater Program requires that industrial, construction, and municipal entities develop and implement management practices to reduce waste discharge associated with stormwater runoff. Operations are required to develop plans outlining the types and locations of management practices that must be implemented on site to reduce waste discharge. Monitoring includes self-monitoring (visual inspection, sampling), reporting, and a Water Board inspection program.

Even though stormwater waste discharge is considered a point source, there are similarities between the Stormwater Program and the ILRP. These similarities include: concern with waste discharges associated with runoff from land areas and coverage of vast numbers of operations and land area. The Stormwater Program was considered when evaluating potential long-term ILRP alternatives.

## **1. Construction Stormwater Program**

Construction projects disturbing one or more acres are required to obtain coverage under the General Permit for Discharges of Storm Water Associated with Construction Activity ([Construction General Permit, 99-08-DWQ](#)). Effective July 1, 2010, all construction projects are required to obtain coverage under the [Construction General Permit Order 2009-0009-DWQ](#) adopted on September 2, 2009. Construction activity subject to this permit includes clearing, grading, and disturbances to the ground such as stockpiling or excavation but does not include regular maintenance activities performed to restore the original line, grade, or capacity of the facility.

The Construction General Permit requires the development and implementation of a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP should contain a site map(s) that shows the construction site perimeter, existing and proposed buildings, lots, roadways, stormwater collection and discharge points, general topography both before and after construction, and drainage patterns across the project. The SWPPP must list BMPs the discharger will use to minimize wastes in stormwater runoff and the placement of those BMPs. Additionally, the SWPPP must contain a visual monitoring program, a chemical monitoring program for "non-visible" pollutants to be implemented if there is a failure of BMPs, and a sediment monitoring plan if the site discharges directly to a water body listed on the 303(d) list for sediment.

## **2. Industrial Stormwater Program**

The Industrial Stormwater General Permit Order 97-03-DWQ ([General Industrial Permit](#)) is an NPDES permit that regulates discharges associated with ten broad categories of industrial activities. Stormwater discharges associated with industrial activity are required to meet technology-based standards and water



quality-based standards. Applicable technology-based standards require that discharges of conventional pollutants achieve the best practicable control technology currently achievable (BCT) and that discharge of toxic pollutants achieve the best available technology economically achievable (BAT). The applicable water quality-based technology is that discharges meet water quality objectives.

USEPA regulations and guidance documents, and applicable decisions by federal courts, clarify that industrial stormwater permits must contain requirements that ensure that discharges of stormwater associated with industrial activity must achieve BCT for conventional pollutants and BAT for toxic pollutants and must not cause or contribute to exceedance of water quality standards in receiving waters. These permits are not required to include numeric effluent limitations (except for effluent limitation guidelines adopted for specified industries by USEPA) or to require monitoring except for annual visual inspections. Instead, USEPA recommends that permit requirements be stated as BMPs.

The State Water Board's Industrial Stormwater Program requires that operations:

1. develop and implement SWPPPs that include BMPs;
2. implement BMPs that will achieve BAT and BCT and will comply with water quality standards;
3. eliminate unauthorized non-stormwater discharges; and
4. conduct monitoring, including visual and analytical stormwater monitoring.

The Industrial Stormwater Program contains minimum BMPs that all operations must incorporate into their SWPPPs. The purpose of the minimum BMPs is to ensure that this General Permit will result in compliance with BAT and BCT and that facilities will have uniform practices. In light of the great diversity of industrial activities throughout the State, however, the program also requires that all facilities develop additional site-specific BMPs.

The Industrial Stormwater Program requires that operations achieve strict compliance with water quality standards, with the incorporation of receiving water limitations into the permit. Where there is a violation of the limitation, operations must revise their SWPPPs and improve BMPs within a short time period.

Program monitoring includes monitoring for a spectrum of indicator parameters and also for additional parameters associated with specified industries. In addition, the program requires a one-time suite of monitoring for metals, chemical oxygen demand (COD), and semi-volatile organic compounds (SVOC). The purpose for the monitoring of indicator parameters and industry-specific parameters is to evaluate the runoff from individual sites. The purpose for the metals, COD, and SVOC screening is to develop a database of the constituents

of concern and the levels at which they are generally found in runoff. The State Water Board intends to use this database to develop numeric effluent limitations.

### **3. Municipal Stormwater Program**

The [Municipal Storm Water Program](#) regulates stormwater discharges from municipal separate storm sewer systems (MS4s). MS4 program requirements were developed in two phases. Under Phase I, which started in 1990, the Water Boards adopted NPDES permits for medium (serving between 100,000 and 250,000 people) and large (serving more than 250,000 people) municipalities. Most of these permits are issued to a group of co-permittees encompassing an entire metropolitan area. There are 26 Water Board Phase I MS4 permits throughout California, covering over 1,000 entities. There is also one Statewide permit for Caltrans.

As part of Phase II, the State Water Board adopted a general permit for the discharge of stormwater from small MS4s (WQ Order No. 2003-0005-DWQ). This general permit provides coverage for smaller municipalities, including nontraditional small MS4s, which are governmental facilities such as military bases, public campuses, prisons, and hospital complexes.

The MS4 permits require the municipalities to develop and implement a Storm Water Management Plan/Program with the goal of reducing the discharge of pollutants from their stormwater system to the maximum extent practicable (MEP). MEP is the performance standard specified in Section 402(p) of the CWA. The management programs specify what BMPs will be used to address certain program elements. The program elements include public education and outreach; illicit discharge detection and elimination; construction and post-construction runoff control; and pollution prevention/good housekeeping for municipal operations. In general, medium and large municipalities are required to conduct water quality monitoring, while small municipalities are not.

### **F. Local Groundwater Management Plans**

There are local programs in place that provide varying degrees of groundwater management and oversight in some areas of the Central Valley. A brief description of local groundwater management programs follows.

Assembly Bill 3030, which is codified in CWC Section 10750, authorizes local agencies in groundwater basins to prepare and adopt groundwater management plans with the following recommended components.

1. Control of saline water intrusion
2. Identification and management of wellhead protection areas and recharge areas
3. Regulation of the migration of contaminated groundwater

4. The administration of a well-abandonment program
5. Mitigation of conditions of overdraft
6. Replenishment of groundwater extracted by water producers
7. Monitoring of groundwater levels and storage
8. Facilitating conjunctive use operations
9. Identification of well construction policies
10. The construction and operation by the local agency of groundwater contamination cleanup, recharge, storage, conservation, water recycling, and extraction projects
11. The development of relationships with State and federal regulatory agencies
12. The review of land use plans and coordination with land use planning agencies to assess activities that create a reasonable risk of groundwater contamination

Senate Bill 1938 imposed additional groundwater management program requirements on local agencies seeking State funds, administered by DWR, for construction of groundwater projects. These requirements include a groundwater management plan that includes components relating to the monitoring and management of groundwater levels in the basin, groundwater quality degradation, inelastic land surface subsidence, and changes in surface flow and surface water quality that directly affect groundwater levels or quality.

Local agencies throughout the Central Valley have developed groundwater management programs pursuant to CWC Section 10750. However, there are areas throughout the Central Valley not covered by local agency groundwater management plans; participation in these plans is voluntary, and local agencies that administer the programs do not have authority to require implementation of management practices or participation in monitoring programs.

## **G. Programs Developed by Other Regional Water Boards**

### **1. Central Coast Water Board**

The Central Coast Regional Water Board adopted a conditional waiver of WDRs for irrigated lands operations ([Order R3-2004-0117](#)). Commercial irrigated farming operations that discharge waste (nutrients, salts, pesticides) to surface or groundwaters are required to submit an application to the Central Coast Water Board for enrollment under the Central Coast Irrigated Lands Conditional Waiver.

The Central Coast Irrigated Lands Conditional Waiver requires that growers:

- conduct water quality monitoring or join a cooperative monitoring program developed by the Central Coast Water Board (Central Coast Water Board monitoring requirements for irrigated lands operations are described in [Monitoring and Reporting Program R3-2004-0117](#));
- comply with applicable water quality standards, protect beneficial uses, and prevent nuisance;
- develop an individual farm water quality management plan (FWQMP); and
- attend farm water quality training.

The strategy for protecting water quality described in the waiver includes controlling pollutants at the source through the development and implementation of pollutant minimization management practices.

## **2. Los Angeles Water Board**

The Los Angeles Water Board adopted a conditional waiver of WDRs for irrigated lands operations ([Order R4-2005-0080](#)). Irrigated lands operations that discharge waste to surface waters or groundwaters must be covered by the Los Angeles Water Board Irrigated Lands Waiver or submit an application for WDRs.

The Los Angeles Water Board Irrigated Lands Waiver requires that growers:

- submit a notice of intent to comply with the waiver or participate in a discharger group that submits a notice of intent to comply with the waiver;
- conduct individual or participate in group water quality monitoring (Los Angeles Water Board monitoring requirements for irrigated lands operations are described in Monitoring and Reporting Programs CI-8835 for individual operations, and CI-8836 for groups under the Los Angeles Regional Water Board Irrigated Lands Waiver);
- comply with applicable water quality standards (e.g., Basin Plan); and
- if necessary, develop and implement a water quality management plan to reduce pollutant loading to surface waters.

## **3. Colorado River Basin Water Board**

Because agricultural discharges, primarily irrigation return flows, constitute the largest volume of pollution entering surface waters in the Colorado River Basin, the Colorado River Basin Water Board established priorities for dealing with the agricultural drain systems based on a watershed approach. Drainage entities (e.g., water districts) were identified in each watershed, and the Colorado River Basin Water Board is working closely with these entities to implement agricultural pollution controls.

#### **4. Lahontan Water Board**

The Lahontan Water Board adopted a waiver of WDRs for grazing operations, or Grazing Waiver, in the East Walker River watershed ([Resolution R6T-2007-0019](#)). The Grazing Waiver covers waste discharges from grazing operations in the Bridgeport Valley and East Walker Tributaries that are in existence as of June 2007.

The waiver requires that operations submit an application and a ranch water quality management plan to reduce fecal coliform discharges so that Lahontan Basin Plan objectives are achieved. The ranch quality management plan is then reviewed and accepted by the Lahontan Water Board.

Grazing operations must conduct visual inspections and submit annual reports to the Lahontan Water Board. However, if ranch operators attend a ranch water quality training course every 4 years, the annual reporting requirement is relaxed to one report every 2 years. The waiver also requires watershed-based fecal coliform monitoring during the irrigation season (April 15–October).

#### **5. San Diego Regional Water Board**

The San Diego Water Board adopted a [waiver of WDRs for agricultural and nursery operations](#). The San Diego Water Board waiver covers potential pollutant discharges from agricultural and nursery operations to ground and surface waters.

The San Diego Regional Water Board agricultural and nursery waiver requires:

1. implementation of water quality management practices,
2. enrollment by January 2011,
3. annual self-assessment,
4. 2-hours of water quality management practices education every year, and
5. regional (group) or individual monitoring and annual reporting of results.

#### **6. San Francisco Bay Water Board**

The San Francisco Bay Water Board adopted a [conditional waiver](#) of WDRs for grazing lands in the Tomales Bay Watershed. This waiver requires that grazing operations encompassing 50 acres or more: (1) submit a notice of intent to comply with the requirements of the waiver, and (2) complete a ranch water quality plan.



## **VI. LONG-TERM PROGRAM DEVELOPMENT PROCESS**

In fall 2008, the Central Valley Water Board convened the Stakeholder Advisory Workgroup to provide staff with input on the development of the long-term ILRP. The Workgroup reflected a range of stakeholder interests representing local government, industry, agricultural, and environmental coalitions throughout the Central Valley.

The main goal of the Workgroup was to provide staff with input on the development of the long-term ILRP. Central Valley Water Board staff and the Workgroup developed long-term program goals and objectives and a range of proposed alternatives for consideration in a PEIR and economics analysis. In August 2009 the Workgroup approved a series of long-term ILRP goals and objectives and a range of proposed alternatives for the long-term ILRP. The Workgroup process, long-term ILRP goals and objectives, and range of alternatives are included in the December 2009 “Proposed Long-Term Irrigated Lands Regulatory Program Alternatives” document (Alternatives Document—Appendix A). The economic and environmental impacts of these alternatives have been considered in a Draft PEIR and Draft ILRP Economics Report.

In this report, (1) the alternatives are evaluated for policy considerations and whether the alternatives meet established goals and objectives, (2) the results of the Draft PEIR and Draft ILRP Economics Report are summarized and considered, and (3) a Central Valley Water Board staff–recommended long-term ILRP is developed using the evaluation process.

## **VII. GOALS AND OBJECTIVES OF THE LONG-TERM IRRIGATED LANDS REGULATORY PROGRAM**

### **A. Irrigated Lands Definition**

Irrigated agricultural lands include lands where water is applied to produce crops, fiber, or livestock for commercial sale or use. For the purposes of this ILRP, irrigated agricultural lands also include managed wetlands and nurseries.

### **B. Program Goals and Objectives**

The overall goals of the ILRP are to (1) restore and/or maintain the highest reasonable quality of State waters<sup>33</sup> considering all the demands being placed on the water, (2) minimize waste discharge from irrigated agricultural lands<sup>34</sup> that could degrade the quality of State waters, (3) maintain the economic viability of agriculture in California’s Central Valley, and (4) ensure that irrigated agricultural discharges do not impair Central Valley communities’ and residents’ access to

---

<sup>33</sup> California Water Code section 13050 defines State waters as any surface water or groundwater, including saline waters, within the boundaries of the state.

<sup>34</sup> See definition under section VII.A.

safe and reliable drinking water. In accordance with these goals, the objectives of the ILRP are to those listed below.

- Restore and/or maintain appropriate beneficial uses established in [Central Valley Water Board Water Quality Control Plans](#) by ensuring that all state waters within the Central Valley meet applicable water quality objectives.
- Encourage implementation of management practices that improve water quality in keeping with the first objective without jeopardizing the economic viability for all sizes of irrigated agricultural operations in the Central Valley or placing an undue burden on rural communities to provide safe drinking water.
- Provide incentives for agricultural operations to minimize waste discharge to state waters from their operations.
- Coordinate with other Central Valley Water Board programs, such as the Grassland Bypass Project waste discharge requirements for agricultural lands, total maximum daily load development, CV-Salts, and waste discharge requirements for dairies.
- Promote coordination with other regulatory and non-regulatory programs associated with agricultural operations (e.g., the California Department of Pesticide Regulation [DPR], the California Department of Public Health [DPH] Drinking Water Program, the California Air Resources Board, the California Department of Food and Agriculture, Resource Conservation Districts, the University of California Extension, Natural Resource Conservation Service, National Organic Program, California Agricultural Commissioners, State Water Resources Control Board Groundwater Ambient Monitoring and Assessment program, United States Geological Survey, and local groundwater programs [SB 1938, AB 3030, Integrated Regional Water Management Plans]) to minimize duplicative regulatory oversight while ensuring program effectiveness.

## **VIII. ALTERNATIVES FOR THE LONG-TERM IRRIGATED LANDS PROGRAM**

The five alternatives evaluated in this report were developed by Central Valley Water Board staff and the Stakeholder Advisory Workgroup. These alternatives are described in detail in the Alternatives Document (Appendix A).

The five alternatives share common programmatic elements. Understanding of these elements and how they may be used to build the program alternatives is essential because the evaluation and associated staff recommendation developed in this report are described in terms of the common programmatic elements. These common elements are described below.

**Program organization:** dictates how the requirements for the long-term program will be applied. Program requirements could apply to all irrigated lands or be tailored for different geographical locations, crop types, or based on relative threat to water quality.

**Lead entity:** describes the mechanism for Water Board interaction with growers. The Water Board could (1) work through third-party groups that do not have direct responsibility for the waste discharge, but represent the growers, (2) work directly with growers, or (3) work with an entity that includes multiple growers and has legal responsibility for the discharge (e.g., some water districts or a joint powers authority).

1. *Third-party*—A number of growers are represented by a single entity. Under this option, the “single entity” is not responsible for the discharge of waste, but takes responsibility for meeting program requirements that apply to a broader region. This is analogous to the current coalition-based program.
2. *Direct Water Board administration*—In this approach, the Central Valley Water Board would work directly with growers. Growers would directly enroll in a waiver or WDRs. This approach is similar to the point source and stormwater permitting programs at the Water Board.
3. *Third party with Joint Powers Authority (JPA)*—This approach would be mechanically similar to the third-party approach. The main difference would be that the third party in this case would form a JPA, which would take responsibility for compliance with program requirements and managing the discharge of waste. An example of this type of program is the Grassland Bypass Project (described above).

**Monitoring:** Requirements must be established to ensure that a regulatory program is having the intended effects and to ensure that regulated entities are discharging waste in accordance with established requirements. While monitoring is a requirement in any Central Valley Water Board regulatory program, the type of monitoring could differ greatly, depending on the specific problems the regulatory program is addressing. Options for monitoring in the ILRP include watershed-based/regional, farm-based, and watershed+farm-based.

1. *Watershed-based/regional:* In this monitoring scheme, water bodies or groundwater basins are monitored for compliance with water quality objectives or limitations. Watershed-based/regional monitoring can be used effectively to determine whether there is a problem in the watershed or groundwater basin, but has significant limitations when it comes to the determination of problem sources, especially where there are non-agricultural waste sources in the watershed/basin (e.g., natural sources, municipalities, septic systems). Navigating the confounding influences of additional waste sources can add significant costs to watershed-based monitoring programs,

and there are questions regarding how the costs of such monitoring will be shared among other potential waste sources in addition to irrigated agriculture. Benefits of watershed or regional monitoring include the ability to spread monitoring costs to all agricultural waste sources; the absence of the need for individual growers to sample and report field discharge events; and potential cost savings if the monitoring is effectively coordinated with other waste sources.

2. *Farm-based*: Farm-based monitoring would require that each grower conduct water quality monitoring. For surface water discharge, the waste discharge characteristics of runoff from each farm would be determined. However, with this approach, it will be difficult to characterize the actual effects agricultural waste discharges are having on receiving water bodies. A good example is where a farm discharges to a large river. Farm-based monitoring would not necessarily provide enough information to tell whether the discharge is affecting the river's water quality. The cost is likely to be significant for growers with multiple fields and multiple discharge points. For groundwater, a farm-based approach could determine whether a grower is affecting groundwater quality. However, the cost of this type of analysis likely will be significant (e.g., drilling several wells, analyzing background concentrations).
3. *Watershed-based/regional+farm-based*: This type of monitoring is some combination of watershed-based/regional and farm-based monitoring. An example would be requiring photographic monitoring of installed management practices in addition to watershed-based/regional monitoring.

**Implementation mechanism:** Long-term program requirements will need to be established in an enforceable regulatory mechanism. Options include conditional waivers of WDRs (waiver), WDRs, and conditional prohibitions of discharge. While all three mechanisms are enforceable and could be applied to a wide variety of discharges, there are some differences that should be considered.

1. *Waivers [CWC 13269]*: can be applied to a type or class of discharges. Waivers can contain enforceable discharge conditions and monitoring requirements. To enroll in a waiver, the enrollee must meet the conditions of the waiver, including any specified management measures. Under a waiver, the Water Board has the option of waiving the requirement to submit a report of waste discharge and any program fees.
2. *WDRs [CWC 13263]*: can be issued for individual waste discharges or for a general class of waste discharges. WDRs can contain enforceable waste discharge limitations and monitoring requirements. WDRs cannot be used to require specific management practices. Instead, WDRs can be used to establish discharge limitations or a requirement to develop management plans and practices that will minimize waste discharge. In order to obtain WDRs, an individual must file a report of waste discharge, or equivalent application (e.g., notice of intent to comply with general WDRs), with the

Water Board. The Water Board will use the submitted information to establish WDRs or enroll operations into general WDRs.

3. *Conditional Prohibition of Discharge [CWC 13243]*: can be established in the Basin Plan for any type of discharge. The Basin Plan would need to be amended to include a conditional prohibition of discharge. Conditional prohibitions can contain enforceable limitations and monitoring requirements. Conditional prohibitions also can be used to require specific types of management practices. A report of waste discharge or other application is not required to discharge under a conditional prohibition.

Table 10 summarizes the long-term ILRP alternatives in terms of the above common elements. For detailed descriptions of the alternatives, see Appendix A.

**Table 10. Summary of Proposed ILRP Alternatives**

| Number | Alternative                               | Lead Entity <sup>a</sup>                     | WQ Plans <sup>b</sup>      | Monitoring |
|--------|-------------------------------------------|----------------------------------------------|----------------------------|------------|
| 1      | No change                                 | Third party                                  | Yes, regional <sup>c</sup> | Regional   |
| 2      | Third-party lead entity                   | Third party                                  | Yes, regional <sup>c</sup> | Regional   |
| 3      | Individual fwqmp                          | CVWB <sup>d</sup>                            | Yes, farm                  | Farm       |
| 4      | Direct oversight with regional monitoring | Responsible legal entity <sup>e</sup> ; CVWB | Yes, farm                  | Regional   |
| 5      | Direct oversight with farm monitoring     | CVWB                                         | Yes, farm                  | Farm       |

<sup>a</sup> Describes Central Valley Water Board interaction with growers.  
<sup>b</sup> Water Quality Management Plans (WQ Plans)—could be on the farm or regional level.  
<sup>c</sup> Water quality management plans are required only where water quality problems have been identified.  
<sup>d</sup> CVWB = Central Valley Regional Water Quality Control Board.  
<sup>e</sup> Legal entity assuming responsibility for waste discharge (e.g., Joint Powers Authority).

## IX. EVALUATION OF LONG-TERM PROGRAM ALTERNATIVES

In this section each alternative is evaluated for consistency with the goals of the long-term program and applicable laws and policies. The evaluation measures are summarized below.

- Program goals and objectives
- CWC
- NPS Policy
- State Antidegradation Policy

In this analysis, a qualitative system is used to establish a measure of how well the alternatives fulfill the above evaluation measures. The qualitative system is based on whether alternatives are expected to meet existing requirements (i.e., would the alternative be consistent with goals/policy/laws).



The qualitative system provides a method for succinctly summarizing the overall results of the evaluation. Overall results of the ranking system are summarized below in Table 11. Table 11 classifies each alternative as consistent, partially consistent, or not consistent. The overall classification is taken from the results of each specific evaluation (described in the sections below). When an alternative is evaluated as consistent for every measure of a complete set of measures (e.g., all NPS Policy measures—Key Elements 1–5), it is rated “consistent.” Alternatives that receive a mixture of consistent/partially consistent are classified overall as “partially consistent.” Where an alternative is evaluated as not consistent with any one measure, it is rated “not consistent.”

**Table 11. Overall Summary of Evaluation Results**

|                        | Alternatives |                      |                |
|------------------------|--------------|----------------------|----------------|
|                        | Consistent   | Partially Consistent | Not Consistent |
| Goals and Objectives   | 2            | 3,4                  | 1,5            |
| California Water Code  | 2,3,4,5      |                      | 1              |
| Nonpoint Source Policy | 4,5          | 2,3                  | 1              |
| Antidegradation        | 4,5          | 2,3                  | 1              |

In addition to the evaluation described above, Sections IX.B–D provide discussions of (1) how effectively the Central Valley Water Board could administer each alternative, (2) overall results of the economics report, and (3) overall results of the Draft PE IR, respectively. While the results of these analyses have not been qualitatively rated, they are considered in the development of the recommended long-term ILRP ([Section X.A](#)).

## **A. Consistency with Program Goals and Objectives and Policies**

The qualitative scoring system for the goals and objectives and policy evaluation measures uses the following factors.

- Alternative is consistent with the requirement.
- Alternative is partially consistent with the requirement.
- Alternative is not consistent with the requirement.

### **1. Program Goals and Objectives**

In this section, each alternative is evaluated against the goals and objectives of the long-term program. Goals 1 and 2 and Objectives 1 and 2 are similar in nature and have been evaluated together; Goals 3 and 4 have been evaluated separately, and Objectives 4, 5 have been evaluated together. Table 12 summarizes the results of the program goals and objectives evaluation.

**Table 12. Summary of Program Goals and Objectives Evaluation**

|                      | Goals 1,2<br>Objectives 1,2 | Goal 3 | Goal 4 | Objective 3 | Objectives 4,5 |
|----------------------|-----------------------------|--------|--------|-------------|----------------|
| <b>Alternative 1</b> |                             |        |        |             |                |
| Consistent           |                             | ✓      |        |             | ✓              |
| Partially Consistent | ✓                           |        |        |             |                |
| Not Consistent       |                             |        | ✓      | ✓           |                |
| <b>Alternative 2</b> |                             |        |        |             |                |
| Consistent           | ✓                           | ✓      | ✓      | ✓           | ✓              |
| Partially Consistent |                             |        |        |             |                |
| Not Consistent       |                             |        |        |             |                |
| <b>Alternative 3</b> |                             |        |        |             |                |
| Consistent           | ✓                           |        | ✓      | ✓           |                |
| Partially Consistent |                             | ✓      |        |             | ✓              |
| Not Consistent       |                             |        |        |             |                |
| <b>Alternative 4</b> |                             |        |        |             |                |
| Consistent           | ✓                           | ✓      | ✓      | ✓           |                |
| Partially Consistent |                             |        |        |             | ✓              |
| Not Consistent       |                             |        |        |             |                |
| <b>Alternative 5</b> |                             |        |        |             |                |
| Consistent           | ✓                           |        | ✓      |             |                |
| Partially Consistent |                             |        |        |             | ✓              |
| Not Consistent       |                             | ✓      |        | ✓           |                |

### **Consideration of Goals 1, 2 and Objectives 1, 2**

#### **Goals:**

- (1) *Restore and/or maintain the highest reasonable quality of State waters considering all the demands being placed on the water*
- (2) *Minimize waste discharge from irrigated agricultural lands that could degrade the quality of State waters*

#### **Objectives:**

- (1) *Restore and/or maintain appropriate beneficial uses established in [Central Valley Water Board Water Quality Control Plans](#) by ensuring that all State waters meet applicable water quality objectives*
- (2) *Encourage implementation of management practices that improve water quality in keeping with the first objective without jeopardizing the economic viability for all sizes of irrigated agricultural operations in the Central Valley or placing an undue burden on rural communities to provide safe drinking water*

[Objective 2 requires that alternatives encourage the implementation of management practices that improve water quality without jeopardizing

economic viability of irrigated agriculture or placing an undue burden on rural communities to provide safe drinking water. Maintaining economic viability of agriculture and ensuring communities have access to safe and reliable access to drinking water have been evaluated as part of Goals 3 and 4, respectively. The remaining portion of this objective, “encourage implementation of management practices that improve water quality,” is evaluated in this section.]

The key to achieving the above goals and objectives in the long-term program will be successful implementation of management practices that will minimize waste discharge from agricultural operations. The minimization of waste discharge will work toward restoring and/or maintaining water quality, beneficial uses, and ensuring that drinking water supplies are not affected further by agricultural waste discharge.

Each of the five alternatives requires that growers: “Prevent nuisance conditions and/or exceedance of water quality objectives in State waters associated with waste discharge from their irrigated agricultural lands.” This requirement establishes that irrigated agricultural operations would need to work toward preventing exceedance of water quality objectives caused by their discharge. To comply with this requirement, operations would be expected to implement management measures to control sources of waste discharge that could be leading to exceedances of water quality objectives.

As stated above, successful implementation of management measures will work to achieve Goals 1, 2 and Objectives 1, 2. There are some key differences between the alternatives that will help in the evaluation of these goals and objectives. These differences are whether the alternatives require implementation of management measures for surface and groundwater. Alternatives requiring that growers develop and implement the most effective management measures would best meet Goals 1, 2 and Objectives 1, 2.

### **Alternative 1**

Under Alternative 1, the current surface water program would be continued. In this configuration, third-party groups would develop regional surface water management plans in response to identified water quality problems. Irrigated agricultural operations would be required to implement management measures identified in the plans. The implementation of the identified management measures would work toward reducing waste discharge to surface waters.

Alternative 1 would not establish any new Central Valley Water Board requirements for discharges to groundwater from irrigated agricultural lands.

As described in [Section III.C.2](#) of this report, a considerable number of wells in the Central Valley have high levels of nitrate (also see the Draft Groundwater Nitrate Summary Report, [Appendix B](#)). The use of chemical nitrogen-based fertilizers has been found to be a potential cause of nitrate contamination of

groundwater in agricultural areas [Suen 2008]. There are no requirements currently in place to address potential non-pesticide waste discharges (e.g., nitrate, salts) from irrigated agricultural operations to groundwater. Many management measures that would benefit surface water quality also would benefit groundwater quality. Examples would include irrigation efficiency, nutrient management, and cover crops. However, focusing only on surface water quality management practices could lead to additional discharge to groundwater (e.g., encouraging percolation of waste into groundwater).

Alternative 1 would not work to implement management measures to protect groundwater from irrigated agricultural waste discharges. *Considering that there are significant groundwater nitrate impacts in the Central Valley, and that irrigated agricultural operations have the potential to contribute nitrates to groundwater, Alternative 1 is partially consistent with Goals 1, 2 and Objectives 1, 2.*

### **Alternative 2–5**

Under Alternative 2, third-party groups would develop regional surface and groundwater management plans. These plans would specify management measures that would work to restore and/or maintain the highest reasonable surface and groundwater quality. Growers would be required to implement management measures identified in the plans.

Under Alternatives 3, 4, and 5 growers would develop individual FWQMPs. These plans would specify management measures that would minimize waste discharge to surface and groundwater. Growers would be required to implement the practices identified in their plans.

The implementation of management measures to protect surface and groundwater would work to reduce waste discharge associated with agriculture. *Alternatives 2–5 are consistent with Goals 1, 2 and Objectives 1, 2.*

## **Consideration of Goal 3**

### **Goal 3**

*(3) Maintain the economic viability of agriculture in California's Central Valley.*

Goal 3 requires that the Central Valley Water Board consider the economic impacts of each alternative on the overall viability of agriculture throughout the Central Valley. The Board contracted an economic analysis in order to evaluate whether alternatives are consistent with this goal. [Section IX.C](#) (Economic Impacts) of this report discusses costs and considers how well the alternatives meet this goal.

## Consideration of Goal 4

### Goal 4

*(4) Ensure that irrigated agricultural discharges do not impair Central Valley communities' and residents' access to safe and reliable drinking water*

As described in [Section III.D](#) of this report, there are a number of wells throughout the Central Valley with high levels of nitrate (Draft Groundwater Nitrate Summary Report, [Appendix B](#)). There are also Central Valley communities with groundwater supplies that exceed the State MCL for nitrate. Many of the residents of these communities must search elsewhere for reliable sources of water (purchasing bottled water, higher treatment costs, etc.). There are a number of communities identified in this report ([Section III.D](#)) facing significant costs to obtain a reliable source of drinking water. The use of nitrogen-based fertilizers is a source of nitrogen in the Central Valley [Suen 2008, Ruddy 2006]. Other agricultural waste products that could affect drinking water sources are salts, pesticides, and pathogens.

Considering the number of wells with nitrate levels above the State drinking water MCL and communities with affected drinking water, key factors in evaluating the alternatives for consistency with Goal 4 include whether groundwater quality management measures would be required.

### Alternative 1

Alternative 1 would not require the implementation of management measures to protect groundwater. In particular, the alternative would not address waste discharges to groundwater potentially causing or contributing to existing nitrate pollution conditions described in [Section III.C.2](#) of this report (also see the Draft Groundwater Nitrate Summary Report, [Appendix B](#)). Without requirements to address waste discharge to groundwater, the alternative may lead to further loss of reliable Central Valley drinking water supplies. *Alternative 1 is not consistent with the requirements of Goal 4.*

### Alternatives 2–5

Under Alternative 2, third-party groups would develop regional surface and groundwater management plans. These plans would specify management measures that would work to restore and/or maintain the highest reasonable surface and groundwater quality. Alternatives 3–5 would require each irrigated agricultural operation to develop and implement FWQMPs to minimize discharge to surface and groundwater. Operations would be required to implement management practices identified in the plans. Alternatives 2–5 would include requirements to implement management measures to protect surface and groundwater quality and ultimately work to promote reliable drinking water sources for Central Valley communities. *Alternatives 2–5 are consistent with Goal 4.*



## Consideration of Objective 3

### Objective 3

*(3) Provide incentives<sup>35</sup> for agricultural operations to minimize waste discharge to State waters from their operations.*

### Alternatives 1 and 5

In Alternatives 1 and 5, all irrigated agricultural operations would be subject to the same requirements. The incentive to minimize waste discharge to State waters ultimately would be connected to whether the grower is complying with the established requirements. These alternatives do not provide additional incentives for irrigated agricultural operations to minimize waste discharge voluntarily, such as reduced monitoring. *Alternatives 1 and 5 are not consistent with Objective 3.*

### Alternatives 2–4

Alternatives 2–4 provide incentives for irrigated agricultural operations to minimize waste discharge. These incentives are summarized below.

- Alternative 2: Reduced water quality monitoring for operations participating in an area or watershed management objectives plan.
- Alternative 3: Central Valley Water Board certification that operations are implementing practices that are protective of surface and groundwater quality.
- Alternative 4: Tiered system that would establish reduced requirements and/or monitoring for operations with low-threat nutrient and/or pesticide use.

*Alternatives 2–4 are consistent with Objective 3.*

## Consideration of Objectives 4, 5

### Objectives:

- (4) Coordinate with other Central Valley Water Board programs, such as the Grassland Bypass Project WDRs for agricultural lands, total maximum daily load development, CV-Salts, and WDRs for dairies.*
- (5) Promote coordination with other regulatory and non-regulatory programs associated with agricultural operations (e.g., the California Department of Pesticide Regulation [DPR], the California Department of Public Health [DPH] Drinking Water Program, the California Air Resources Board, the California Department of Food and Agriculture, Resource Conservation Districts, the University of California Extension, Natural Resource Conservation Service,*

---

<sup>35</sup> Incentives could include financial, monitoring reductions, certification, or technical help.

*National Organic Program, California Agricultural Commissioners, State Water Resources Control Board Groundwater Ambient Monitoring and Assessment program, United States Geological Survey, and local groundwater programs [SB 1938, AB 3030, Integrated Regional Water Management Plans]) to minimize duplicative regulatory oversight while ensuring program effectiveness.*

Objectives 4, 5 essentially require that alternatives promote coordination with Central Valley Water Board programs and other regulatory and non-regulatory agencies. One important distinction in the alternatives that will help with this evaluation is the size of the management unit that would be used in program implementation. The range of alternatives includes management units at the field, farm, and regional levels. Management at the regional level would likely better facilitate coordination with other programs and agencies. For example, management at the watershed level would promote coordination with other agencies and programs that have waste discharges to the same watershed (e.g., municipal wastewater discharges). Management at the farm level would not work to promote coordination with other Water Board programs and regulatory and non-regulatory agencies. For example, rather than trying to coordinate at the regional level, coordination potentially would need to take place on thousands of individual farms.

### **Alternatives 1 and 2**

These alternatives would be managed at the regional level. Management at the regional level would promote coordination with other programs and regulatory and non-regulatory agencies. The regional configuration for water quality plans and monitoring would facilitate efficient coordination with other programs operating at the regional level (e.g., Water Board watershed-based loading limits, local groundwater programs, air quality management districts). *Alternatives 1 and 2 are consistent with Objectives 4, 5.*

### **Alternatives 3–5**

These alternatives would be managed at the farm level. The Central Valley Water Board would work directly with irrigated agricultural operations in program implementation. In the farm-level configuration, the Central Valley Water Board would be able to coordinate with other programs and regulatory and non-regulatory agencies, but the farm-level management would not *promote* this coordination. The Central Valley Water Board would be required to provide coordination and management between individual growers and other programs/agencies. *Alternatives 3–5 are partially consistent with Objectives 4, 5.*

## **2. California Water Code**

Table 13 summarizes CWC requirements for developing a long-term program for irrigated agricultural waste discharge. As shown in the table, requirements vary depending on the regulatory mechanism the Central Valley Water Board adopts to establish program requirements. The Central Valley Water Board could

choose to adopt a waiver of WDRs, WDRs, a Basin Plan conditional prohibition of discharge, or a mixture of these to establish the long-term program. Because the Board may choose to adopt any of the three mechanisms, program alternatives are evaluated against each of the CWC requirements regardless of the mechanisms for which it would apply.

The qualitative ranking system described in the above section is used in this evaluation (e.g., consistent, partially consistent, not consistent with requirements). Table 13 summarizes the results of the CWC evaluation.

**Table 13. Summary of California Water Code Evaluation**

|                      | <b>13263<br/>13269</b> | <b>13241</b> | <b>13141</b> |
|----------------------|------------------------|--------------|--------------|
| <b>Alternative 1</b> |                        |              |              |
| Consistent           |                        | ✓            | ✓            |
| Partially Consistent |                        |              |              |
| Not Consistent       | ✓                      |              |              |
| <b>Alternative 2</b> |                        |              |              |
| Consistent           | ✓                      | ✓            | ✓            |
| Partially Consistent |                        |              |              |
| Not Consistent       |                        |              |              |
| <b>Alternative 3</b> |                        |              |              |
| Consistent           | ✓                      | ✓            | ✓            |
| Partially Consistent |                        |              |              |
| Not Consistent       |                        |              |              |
| <b>Alternative 4</b> |                        |              |              |
| Consistent           | ✓                      | ✓            | ✓            |
| Partially Consistent |                        |              |              |
| Not Consistent       |                        |              |              |
| <b>Alternative 5</b> |                        |              |              |
| Consistent           | ✓                      | ✓            | ✓            |
| Partially Consistent |                        |              |              |
| Not Consistent       |                        |              |              |

### **Consideration of California Water Code Sections 13263 and 13269**

CWC Section 13263 requires that the following factors be considered when developing WDRs:

- requirements shall implement any relevant water quality control plans that have been adopted, and
- shall take into consideration the beneficial uses to be protected, the water quality objectives reasonably required for that purpose, other waste discharges, the need to prevent nuisance, and
- the provisions of Section 13241.

*CWC Section 13269 requires that conditional waivers of WDRs be consistent with any applicable State or regional water quality control plan and in the public interest. Waivers of WDRs also must include the performance of individual, group, or watershed-based monitoring unless the Board waives the monitoring because the discharge(s) do not pose a significant threat to water quality.*

In the long-term ILRP, WDRs or conditional waivers of WDRs would be established for waste discharges from irrigated agricultural operations to State waters. Each of the five alternatives requires that irrigated agricultural operations: ~~Prevent nuisance conditions and/or exceedance of water quality objectives in State waters associated with waste discharge from their irrigated agricultural lands.~~ This requirement establishes that irrigated agricultural operations would need to work toward preventing exceedance of water quality objectives caused by their discharge.

### **Alternative 1**

Alternative 1 would not establish requirements for waste discharges to groundwater. This alternative therefore would not consider Basin Plan beneficial uses for groundwater that need to be protected or water quality objectives reasonably required. There are Central Valley communities with groundwater supplies that exceed State MCLs for nitrate (10 milligrams per liter [mg/l] nitrate as nitrogen or 45 mg/l nitrate nitrogen); therefore, beneficial uses have been affected and general nuisance conditions exist. In general, irrigated agricultural operations discharge waste to groundwater (pesticides, nitrates, salts leaching). Considering that this alternative would not implement requirements to prevent nuisance and protect beneficial uses for groundwater, it is reasonable to assume that it would not be in the public interest. *Therefore, Alternative 1 is not consistent with these sections of the CWC.*

### **Alternatives 2–5**

Through the development and implementation of ground and surface water quality management plans (SQMPs), Alternatives 2–5 would consider surface and groundwater beneficial uses to be protected, the water quality objectives reasonably required for that purpose, and the need to prevent nuisance. These alternatives also establish water quality and/or visual/management practice monitoring programs as required by Section 13269<sup>36</sup>. Considering that these alternatives would work to prevent nuisance and protect beneficial uses, it is reasonable to assume that they would be in the public interest.

---

<sup>36</sup> Alternative 3 establishes monitoring to evaluate the effectiveness of implemented management practices (e.g., monitoring that an installed tailwater return system is preventing off-site discharge, review of erosion prevention practices after storm events, visual monitoring of turbidity in field discharge, review of nutrient applications and estimated crop uptake). This monitoring is intended to fulfill CWC section 13269 requirements: "... The conditions of the waiver shall include, but need not be limited to, the performance of individual, group, or watershed-based monitoring...Monitoring requirements shall be designed to support the development and implementation of the waiver program, including, but not limited to, verifying the adequacy and effectiveness of the waiver's conditions."

The means by which each alternative would work toward protecting beneficial uses would be through development and implementation of water quality management plans. CWC Section 13263 requires that “other waste discharges” be considered in WDRs. Other waste discharges would be considered in the development of management plans. In the alternatives, the lead entity (third party or Central Valley Water Board) would be responsible for coordinating management plan requirements with other discharges.

*Alternatives 2–5 exhibit the aspects necessary to be consistent with these sections of the CWC.*

### **Consideration of California Water Code Section 13241**

CWC Section 13263 requires that six factors listed under Section 13241 be considered in the development of those components of the long-term ILRP relying on WDRs. These factors are:

- (a) Past, present, and probable future beneficial uses of water*
- (b) Environmental characteristics of the hydrographic unit under consideration, including the quality of water available thereto*
- (c) Water quality conditions that could reasonably be achieved through the coordinated control of all factors that affect water quality in the area*
- (d) Economic considerations*
- (e) The need for developing housing in the region*
- (f) The need to develop and use recycled water*

These factors will need to be considered not for the full program, but for any WDRs developed to implement the long-term ILRP, regardless of the regulatory alternative. *Since any WDRs for the long-term ILRP will incorporate a consideration of Section 13241 factors, the alternatives are considered to be consistent with Section 13241 of the CWC.*

### **Consideration of California Water Code Section 13141**

CWC Section 13141 requires that:

*— .prior to implementation of any agricultural water quality control program, an estimate of the total cost of such a program, together with an identification of potential sources of financing, shall be indicated in any regional water quality control plan.”*

The set of regulatory actions under the long-term ILRP could include a Basin Plan amendment. The estimated total cost of each alternative and potential



sources of financing are described below in the Economic Impacts section of this report. *Therefore, the alternatives are consistent with Section 13141 of the CWC.*

### 3. NPS Policy

The long-term ILRP would regulate waste discharges from irrigated agricultural lands to State waters as an NPS program. Accordingly, the long-term ILRP must meet the provisions of the State Water Board's NPS Policy. Under the NPS Policy, the Regional Water Board must find that the program will promote attainment of water quality objectives. The nonpoint-source program also must meet the requirements of five key structural elements. The NPS Policy is described in [Section IV.C](#) of this document. In this section, each of the alternatives is evaluated against the requirements of the NPS Policy.

The qualitative ranking system described in the above section is used in this evaluation (e.g., consistent, partially consistent, not consistent with requirements). Table 14 summarizes the results of the NPS Policy evaluation.

**Table 14. Summary of Nonpoint Source Policy Evaluation**

|                      | Element 1 | Element 2 | Element 3 | Element 4 | Element 5 |
|----------------------|-----------|-----------|-----------|-----------|-----------|
| <b>Alternative 1</b> |           |           |           |           |           |
| Consistent           | ✓         |           |           |           | ✓         |
| Partially Consistent |           |           | ✓         |           |           |
| Not Consistent       |           | ✓         |           | ✓         |           |
| <b>Alternative 2</b> |           |           |           |           |           |
| Consistent           | ✓         | ✓         | ✓         |           | ✓         |
| Partially Consistent |           |           |           | ✓         |           |
| Not Consistent       |           |           |           |           |           |
| <b>Alternative 3</b> |           |           |           |           |           |
| Consistent           | ✓         | ✓         | ✓         |           | ✓         |
| Partially Consistent |           |           |           | ✓         |           |
| Not Consistent       |           |           |           |           |           |
| <b>Alternative 4</b> |           |           |           |           |           |
| Consistent           | ✓         | ✓         | ✓         | ✓         | ✓         |
| Partially Consistent |           |           |           |           |           |
| Not Consistent       |           |           |           |           |           |
| <b>Alternative 5</b> |           |           |           |           |           |
| Consistent           | ✓         | ✓         | ✓         | ✓         | ✓         |
| Partially Consistent |           |           |           |           |           |
| Not Consistent       |           |           |           |           |           |

## Consideration of Key Element 1

### Key Element 1

*–An NPS control implementation program’s ultimate purpose shall be explicitly stated. Implementation programs must, at a minimum, address NPS pollution in a manner that achieves and maintains water quality objectives and beneficial uses, including any applicable antidegradation requirements.”*

Element 1 can be broken into three components: (1) statement of the program’s purpose, (2) achievement and maintenance of water quality objectives and beneficial uses, and (3) compliance with antidegradation requirements. Because the latter two components of this key element are primary aspects of other applicable regulation, they will be analyzed in separate sections of this report: consideration of Goals and Objectives and CWC, [Sections IX.A.1–2](#) (component 2) and Antidegradation Policy, [Section IX.A.4](#) (component 3).

The first component of NPS Policy Key Element 1 states that the NPS control implementation program’s ultimate purpose shall be explicitly stated. The purpose of the long-term program is explicitly stated in the Goals and Objectives. As given in the Goals and Objectives, the ultimate purpose of all program alternatives is the same. *All program alternatives are consistent with this requirement.*

## Consideration of Key Element 2

### Key Element 2

*–An NPS control implementation program shall include a description of the MPs [management practices] and other program elements that are expected to be implemented to ensure attainment of the implementation program’s stated purpose(s), the process to be used to select or develop MPs, and the process to be used to ensure and verify proper MP implementation.”*

Successful implementation of water quality management measures will work toward achieving the Goals and Objectives of the long-term program. The Draft PEIR and Draft ILRP Economics Report discuss the types of management practices that may be implemented for all of the alternatives. The discussion below evaluates how the specific management practices to be implemented will be identified under each alternative.

### Alternative 1

Alternative 1 would require the development and implementation of SQMPs where there are exceedances of Basin Plan water quality objectives. The management plans would describe practices that would be implemented to work toward achievement of applicable water quality objectives and preventing nuisance conditions. The process used to select or develop management practices would include third-party groups working with irrigated agricultural

operations and technical experts. Management plans also would need to be approved by the Central Valley Water Board. Proper management practices implementation would be verified using water quality monitoring and management practices tracking.

This alternative would not establish any new Central Valley Water Board requirements for discharges to groundwater from irrigated lands; rather, it would rely on DPR's Groundwater Protection Program and existing local groundwater programs. DPR's Groundwater Protection Program does not address discharges of nitrates or salts to groundwater. Local groundwater programs do not cover all areas accepting waste discharges from irrigated agricultural operations and provide varying degrees of groundwater management and oversight. The Goals and Objectives of the long-term program require protection of State waters, which include surface and groundwater. Irrigated agricultural operations may discharge waste to groundwater. Alternative 1 would not require implementation of groundwater quality management measures to protect groundwater from irrigated agricultural waste discharges. *Alternative 1 is not consistent with Key Element 2 of the NPS Policy.*

## **Alternative 2**

Alternative 2 is similar to Alternative 1, except that it includes requirements to protect groundwater, and it would allow reduced surface water monitoring in lower threat circumstances.

This alternative would require that third-party groups develop groundwater quality management plans (GQMPs), with the possibility of existing local groundwater management plans being substituted for GQMPs with Central Valley Water Board approval. GQMPs would be consistent with Key Element 2 as they would use groundwater data and other information to develop required water quality management practices in high-priority areas. Under this alternative, management practice tracking would be used to verify proper management practices implementation. Where existing local groundwater management plans would be substituted for GQMPs, monitoring for nitrates and salts would be required. Local groundwater management plans would have a process for recommending management practices for growers. *Alternative 2 is consistent with Key Element 2.*

## **Alternatives 3–5**

*Alternatives 3–5 are consistent with Key Element 2*, which requires the program to describe (a) management practices that will be implemented, (b) the process used to select or develop practices, and (c) the process to be used to ensure and verify proper implementation. Alternatives 3–5 require individual FWQMPs for each enrolled operation, which would describe the measures to be implemented as well as those already in use (meets item (a) above). Water Board staff and/or another entity would be conducting a specified number of grower site inspections annually, aimed at verifying proper management practice implementation (item (c) above).

## Consideration of Key Element 3

### Key Element 3

*Where an RWQCB determines it is necessary to allow time to achieve water quality requirements, the NPS control implementation program shall include a specific time schedule, and corresponding quantifiable milestones designed to measure progress toward reaching the specified requirements."*

It must be noted that nitrates, salts and other constituents found in groundwater may be naturally occurring or elevated by agricultural, non-agricultural, or a combination of sources. It is also possible that the elevated conditions were caused by past conditions or land uses. Agricultural use of fertilizers is one of several sources that can cause degradation of groundwater quality (see [Section III.C.2](#) above). These issues make evaluation of causes of groundwater degradation difficult and widen the potential responsibility for protection of groundwater quality. For example, irrigated agriculture may be one of several sources, and bringing elevated groundwater waste levels down may require a concerted effort by all sources. Also, it must be acknowledged that groundwater moves at a relatively slow rate; therefore, implementation of management practices will take months to years to effect any measurable change in groundwater quality.

For waste discharge to surface water, it is less difficult to determine sources of elevated waste constituents. However, there are cases where elevated waste conditions exist, and irrigated agriculture is one of several potential sources (e.g., fecal coliform, sediment).

Considering that irrigated agriculture is not the only source of waste affecting Central Valley surface and groundwater, time schedules should include goals for the implementation of measures to minimize discharge of waste from irrigated agricultural operations that would work toward meeting applicable water quality objectives. Consequently, the evaluation of alternatives for consistency with Element 3 is based on whether management plans or other aspects would provide these goals and time schedules.

### Alternative 1

For surface water quality aspects, Alternative 1 is consistent with Element 3 because it requires that management plans include a time schedule for implementation of management practices to achieve water quality requirements (see current program requirements for management plans).

There are a number of wells throughout the Central Valley with nitrate levels above the State MCL for drinking water (see [Section III.C.2](#) and Draft Groundwater Nitrate Summary Report, [Appendix B](#)). In general, irrigated agricultural operations discharge waste (e.g., nitrate) to groundwater. This alternative would not establish a time schedule to reduce waste discharge from agricultural operations in order to work toward reducing groundwater nitrate

levels (i.e., ultimately work to restore and/or maintain the municipal beneficial use). *Alternative 1 is partially consistent with Element 3.*

## **Alternative 2**

For surface water quality aspects, Alternative 2 is consistent with Element 3 because it requires that management plans include a time schedule for implementation of management practices to achieve water quality requirements (see current program requirements for management plans). For groundwater, GQMPs would be developed within 4 years of adoption of the new program and evaluated every 5 years and updated if needed. Although not explicitly stated, it is assumed that GQMPs, similar to SQMPs for this alternative, would include a time schedule for management measures implementation and other goals aimed at working toward meeting water quality objectives in groundwater. *Alternative 2 is consistent with Element 3.*

## **Alternatives 3–5**

In Alternatives 3–5, irrigated agricultural operations would be required to develop and implement an individual FWQMP within 2 years of enrollment in the program. The “implementation” of the FWQMP within 2 years would provide the specific date and quantifiable milestones required by Element 3.

Alternatives 3–5 also require that the Central Valley Water Board:

*“In an iterative process, require additional monitoring, information, and/or management measures where applicable water quality objectives are not being met.”*

Where water quality objectives are not being met, this requirement establishes that irrigated agricultural operations may need to implement additional management measures. In the implementation of this requirement, it is assumed that the Central Valley Water Board would require that irrigated agricultural operations provide a time schedule for implementation of additional practices.

*Alternatives 3–5 are consistent with Element 3.*

## **Consideration of Key Element 4**

### **Key Element 4**

*“An NPS control implementation program shall include sufficient feedback mechanisms so that the RWQCB, dischargers, and the public can determine whether the program is achieving its stated purpose(s), or whether additional or different MPs [management practices] or other actions are required.”*

The goals of the program include restoring and/or maintaining the highest reasonable quality of State waters, minimizing waste discharge from irrigated agricultural lands, and restoring and/or maintaining appropriate Basin Plan beneficial uses. Agricultural operations would work to achieve these goals



through implementation of water quality management measures. Feedback mechanisms for determining whether these goals would be met include water quality monitoring and tracking of practices implemented.

### **Alternative 1**

The surface water component of Alternative 1 would be consistent with Element 4 because it includes feedback mechanisms to determine whether the program is achieving its stated purpose. Coalition groups would be required to (1) track existing management measures and the progress of additional practice implementation required in management plans; (2) collect water quality data over time and use the data to determine whether management plans are effective at achieving water quality requirements. All of this information would be reported to the Central Valley Water Board at least annually.

The goals of the long-term ILRP include maintaining the highest reasonable quality of State waters. State waters include groundwater. *Considering that Alternative 1 does not include feedback mechanisms for waste discharge to groundwater, it is not consistent with Element 4.*

### **Alternative 2**

Alternative 2 is similar to Alternative 1, except that it includes requirements to protect groundwater and it would allow reduced surface water monitoring in lower threat circumstances. As described in Alternative 1, the surface water aspects of Alternative 2 would provide feedback mechanisms consistent with Element 4. These mechanisms would include tracking of management practices and watershed-based surface water quality monitoring.

The groundwater component of this alternative would require the development of GQMPs, or the use of existing local groundwater management plans. GQMPs would be evaluated for efficacy every 5 years, which would serve as a feedback mechanism. Additionally, limited groundwater quality monitoring data (collected under local groundwater management plans) as well as results of management practice tracking (required under GQMPs) would serve as feedback mechanisms. Under coalition-developed GQMPs, feedback mechanisms would not include groundwater quality monitoring to determine whether practices implemented would be maintaining and/or restoring beneficial uses or the highest reasonable groundwater quality. *Considering that Alternative 2 would require management practices tracking without monitoring to provide feedback on the efficacy of the practices, it is partially consistent with Element 4.*

### **Alternative 3**

Under Alternative 3, irrigated agricultural operations would be required to submit an annual report to the Central Valley Water Board on the status of FWQMP implementation and an evaluation of the performance of those practices. In addition, Central Valley Water Board staff or another entity would be conducting a specified number of grower site inspections annually. This alternative would not

require surface or groundwater quality monitoring. The results of inspections and grower reporting would provide feedback for Board staff, growers, and the public on whether the program is working toward achieving the goals and objectives.

The individual FWQMP and associated annual reports do not require water quality monitoring, but do require evaluation of management practice effectiveness. For some pollutants, visual inspection of management practices may effectively determine whether the practices are effective. Examples would include: (1) if no visible amounts of sediment are being discharged, it is a reasonable assumption that sediment is not being discharged at levels exceeding water quality objectives and hydrophobic pesticides that bind to soil particles are not being discharged at high levels; and (2) the absence of any runoff means no waste is being discharged to surface waters. However, there could be waste constituents exceeding water quality objectives that visual management practice evaluation would be unable to quantify (e.g., colorless, odorless hydrophilic pesticides).

Considering that grower reporting on management practices and visual inspections will not be able to fully quantify whether management practices are achieving water quality goals, Alternative 3 is partially consistent with Element 4.

#### **Alternatives 4 and 5**

These alternatives include the feedback mechanisms that Alternative 3 includes, as well as water quality monitoring programs for surface and groundwater. *Alternatives 4 and 5 are consistent with Element 4.*

### **Consideration of Key Element 5**

#### **Key Element 5**

*~~Each RWQCB shall make clear, in advance, the potential consequences for failure to achieve an NPS control implementation program's stated purposes.~~*

Compliance with this element is the responsibility of the Central Valley Water Board. The potential consequences for failure to achieve the long-term ILRP's stated purpose would be the same regardless of the chosen program alternative and would include the following steps:

1. require, in an iterative process, additional monitoring information and/or management practices where water quality objectives are not being met;
2. impose enforcement action where iterative process is unsuccessful, program requirements are not met, or time schedules are not met; and
3. require submittal of an ROWD to work individually with the Central Valley Water Board.

*Central Valley Water Board staff will ensure consistency with Key Element 5 by including the above potential consequences in the adopted long-term ILRP alternative.*

#### **4. Antidegradation**

The long-term ILRP must meet the provisions of State and federal antidegradation policies. Applicable antidegradation provisions are described in [Section IV.E](#) of this document. Antidegradation provisions are aimed at site-specific analyses. The long-term ILRP would be applied Central Valley-wide. At this time, it is not feasible to conduct a conventional analysis of waste loadings, assimilative capacities, and socioeconomic concerns to determine consistency with maximum public benefit for every Central Valley irrigated agricultural waste discharge. Instead, the following programmatic approach has been developed for practically applying antidegradation provisions for a Central Valley wide ILRP:

***Implementation of the program must work to achieve site-specific antidegradation requirements through iterative implementation of BPTC and representative monitoring (i.e., where monitoring indicates degradation, BPTC would evolve to prevent such degradation).***

This iterative process (shown graphically in Figure 21) is intended, over time, to bring all water bodies accepting agricultural wastes into compliance with water quality objectives (where agriculture is the source of exceedance) and evaluate and prevent degradation from occurring. In this section, each of the alternatives is evaluated against the above approach for implementing antidegradation requirements.

The qualitative ranking system described in the above sections is used in this evaluation (e.g., consistent, partially consistent, not consistent with requirement). Table 15 summarizes the results of the antidegradation evaluation.

**Table 15. Summary of Antidegradation Evaluation**

|                      | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 | Alternative 5 |
|----------------------|---------------|---------------|---------------|---------------|---------------|
| Consistent           |               |               |               | ✓             | ✓             |
| Partially consistent |               | ✓             | ✓             |               |               |
| Not consistent       | ✓             |               |               |               |               |

##### **Alternative 1**

This alternative would rely on watershed-based surface water monitoring to determine whether exceedances of water quality objectives are occurring in agriculturally dominated waterways. Where monitoring shows two or more exceedances in a 3-year period, coalition groups would be required to develop SQMPs. These plans would identify management practices necessary to work toward achieving surface water quality objectives.

Alternative 1 would establish a regional surface water monitoring program that could evaluate trends and determine whether water quality objectives are being met. The alternative would not establish a groundwater monitoring program to evaluate whether current agricultural discharges are causing degradation of groundwater quality or whether water quality objectives are being met. There are existing groundwater monitoring programs that can provide information on existing water quality, but the programs (with the exception of DPR's Groundwater Protection Program) are not geared to determine whether agricultural discharges are affecting groundwater quality.

Alternative 1 would not establish requirements for operations to implement BPTC where trends in surface or groundwater monitoring show degradation attributable to agricultural waste discharges. The alternative would require management plans to work toward mitigating agriculturally related exceedances of surface water quality objectives.

Alternative 1 would not implement the iterative BPTC and monitoring process for addressing degradation to groundwater. Through development and implementation of SQMPs, Alternative 1 would partially implement the iterative process for addressing degradation to surface waters (i.e., proposed process is geared toward identifying exceedances and not degradation). *Alternative 1 is not consistent with the proposed antidegradation approach.*

## **Alternative 2**

Alternative 2 is similar to Alternative 1, except that it includes requirements to protect groundwater and it would allow reduced surface water monitoring in lower threat circumstances.

For addressing potential degradation in surface waters, Alternative 2 would be similar to Alternative 1 (partially consistent with the proposed antidegradation approach). Alternative 2 also proposes the development of GQMPs that would identify priority areas, potential sources of waste discharge to groundwater, and management practices that would work to prevent groundwater degradation. The alternative would allow substitution of local groundwater management plans where plans have goals consistent with Basin Plan objectives, establish monitoring and reporting, recommend groundwater quality management practices, evaluate effectiveness of existing practices, and have the ability to amend the plan.

Under local groundwater management plans, management practices could be recommended based on information collected. Where degradation is occurring, antidegradation provisions require management practices implementing BPTC. Under third-party-developed GQMPs, groundwater quality management practices would be identified and implemented to the "maximum extent practicable."

Groundwater quality monitoring would not be required under GQMPs to determine whether degradation is occurring and/or evaluate BPTC effectiveness. *Alternative 2 is partially consistent with the proposed antidegradation approach.*

### **Alternative 3**

Alternative 3 would require all operations to develop individual FWQMPs. FWQMPs would be certified by the Central Valley Water Board or authorized certifying entity. Implementation of certified FWQMPs would be considered BPTC. Surface and/or groundwater quality monitoring would not be required under Alternative 3 to determine effectiveness of BPTC and whether degradation is occurring. *Consequently, Alternative 3 is partially consistent with the proposed antidegradation approach.*

### **Alternative 4**

Alternative 4 would require all operations to develop individual FWQMPs. The alternative also would require individual and/or regional surface and groundwater monitoring. Implementation of FWQMPs would constitute BPTC. Results of surface and groundwater quality monitoring could be used to determine effectiveness of BPTC and/or whether discharges are causing degradation. *Alternative 4 is consistent with the proposed antidegradation approach.*

### **Alternative 5**

Alternative 5 would require all operations to develop individual FWQMPs. The alternative also would require individual surface and groundwater monitoring. Implementation of FWQMPs would constitute BPTC. Results of surface and groundwater quality monitoring could be used to determine effectiveness of BPTC and/or whether discharges are causing degradation. *Alternative 5 is consistent with the proposed antidegradation approach.*

## **B. Predicted Effectiveness of Administration Based on Existing Programs**

This section discusses how effectively the Central Valley Water Board could administer the alternatives. This discussion is based on information collected from similar existing programs. For example, where alternatives would allow for third-party group lead entities, this discussion uses information on existing third-party run programs. This evaluation is conducted irrespective of current program funding, as costs are evaluated below in the Economic Impacts section.

### **Alternative 1**

Alternative 1 would be continuation of the current program. Under the current program, third-party water quality coalition groups have organized, enrolled growers, collected fees, collected water quality data, and reported to the Central Valley Water Board. In the current program, coalition groups have worked with the Central Valley Water Board to develop SQMPs where applicable water quality objectives have not been met. These plans have been developed for watersheds throughout the Central Valley. Currently, coalition groups are implementing management plans. It will take time to evaluate whether the plans are effective at improving water quality.



The current program also requires management practice verification and efficacy evaluation. Coalition groups have attempted to track the progress of management practice implementation through the results of periodic surveys sent to growers. In general, coalition groups have had difficulty gathering and analyzing information from enrolled growers. This is attributable in part to a lower return rate than expected on surveys, as coalition groups do not have regulatory authority to require that growers provide responses to information requests. The lack of regulatory authority also may hinder expeditious implementation of management practices in areas where management plans have been developed. This is a concern for the Central Valley Water Board because the implementation of practices is the chief means for improving water quality.

Enforcement of program requirements is the Board's responsibility. The authorities of the Central Valley Water Board are directly linked to individual discharging entities, e.g., growers with tailwater discharges. The Central Valley Water Board does not have any direct enforcement authority over a third-party group that is not responsible for the waste discharge (i.e., the Board cannot take enforcement against the coalition). Also, in the current program, the Central Valley Water Board does not have access to information linking individual growers to implemented management practices, operations, or specific discharge information. This makes enforcement of program requirements difficult, as the Board does not have a direct relationship with individual growers (e.g., practices in place, distances to water bodies).

## **Alternative 2**

Alternative 2 would continue the current program's established third-party (coalition) framework for regulating irrigated agricultural lands.

## **Alternative 3**

Alternative 3 proposes a significantly different administrative framework from Alternatives 1 and 2. Under Alternative 3, growers would apply for enrollment and submit individual FWQMPs and monitoring information directly to the Central Valley Water Board. The current third-party framework would not continue to administer the program, but could continue as third-party certification entities. The third-party certification entities would be approved by the Central Valley Water Board to review and certify grower-developed FWQMPs. The third parties also could conduct grower site inspections.

The type of individual attention required to administer this alternative—enrolling individual growers, reviewing and certifying plans, inspection, negotiating individual monitoring, and review of monitoring—is a concern, considering that there are an estimated 34,000 (see [Section III.A.2](#), Industry Summary) growers in the Central Valley. The Central Valley Water Board or certification entity would need to review, certify, and negotiate monitoring for more than 560 FWQMPs per month to certify all plans within 5 years. The Board also would need to review up to 34,000 individual monitoring reports annually and inspect 5 percent (1,700) of growers annually.

Administration and individual certification of FWQMPs, negotiation of monitoring, inspection, and review of individualized monitoring would be similar to the certification and inspection program for organic farms. Third-party certification agencies such as California Certified Organic Farmers (CCOF) provide certification, monitoring, and inspection for organic farms. To do this CCOF employs one individual per 23 clients<sup>37</sup> (or organic growers). CCOF takes an average of 3 to 6 months to review and certify an organic farm once the application has been received. If the Central Valley Water Board or other third-party entity were to implement this alternative, a staffing ratio similar to the organic certification program may be necessary to negotiate and certify FWQMPs, review monitoring, and conduct inspections in a timely manner (up to 1,500 personnel based on the CCOF ratio). However, this staffing ratio is considered a significant overestimate because CCOF's program includes a higher inspection/review frequency than Alternative 3 (comprehensive annual inspection frequency versus 5 percent annual inspection frequency). Staffing requirements for Alternative 3 likely would be between that described for Alternative 5 (see below) and the estimate based on CCOF's staffing ratio.

#### **Alternative 4**

Administration and implementation of Alternative 4 would be similar to Alternative 3, where growers would apply for enrollment directly with the Central Valley Water Board and develop individual FWQMPs. The current third-party framework would not continue to administer the program but would conduct regional monitoring, provide grower education, and potentially conduct grower site inspections. Key differences of Alternative 4 are listed below.

- Individual FWQMPs would be developed by growers, but would not be certified (FWQMPs would be reviewed as part of an inspection process).
- The alternative would implement a tiering system using monitoring data and other information (e.g., geophysical parameters, pesticide/fertilizer use) to prioritize requirements.
- 15 hours of farm water quality training is required for irrigated agricultural owners/operators.
- Regional and/or individual surface and groundwater monitoring would be required.

The administration framework of Alternative 4 is similar to the Central Coast Water Board's ILRP, where growers enroll directly with the Water Board and third-party entities conduct regional monitoring for growers. However, the Central Coast Water Board's program is not similar in scope to the Central Valley Water Board's program. Table 16 provides a summary of the differences between the programs.

---

<sup>37</sup> Estimate based on discussion with CCOF representatives.

**Table 16. Scope of Central Coast and Central Valley Water Board ILRPs**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Central Valley         | Central Coast |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|---------------|
| Estimated irrigated acres                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 7,529,621 <sup>a</sup> | 591,000       |
| Estimated operations                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 34,000                 | 2,500         |
| Current staff members (PY)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 17.75                  | 3.5           |
| Operations:staff ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 1915                   | 714           |
| Irrigated acres:staff ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 424,204                | 168,857       |
| <sup>a</sup> Total irrigated agricultural acreage calculations range from 6.5 million (2007 USDA Agricultural Census) to more than 8 million (2006–2008 CA Department of Conservation's Farmland Monitoring and Mapping Program, ECR). Seven million acres is cited here as a measure of the most current information. The ECR, which is the baseline for environmental and economic review (Draft PEIR/Economics Report), estimates approximately 8 million acres of irrigated agricultural lands in the Central Valley. |                        |               |

Central Coast Water Board staff and Central Coast coalition representatives have indicated, in discussion with Central Valley Water Board staff, that program difficulties include:

- working with the numerous growers under the program to identify specific sources of water quality problems;
- conducting necessary follow-up and organizing implementation of effective management practices to address identified water quality problems;
- evaluating individual compliance with program requirements; and
- monitoring progress toward improving water quality over time.

These would be chief concerns for Central Valley Water Board implementation because of the numerous growers and large land area in relation to the smaller Central Coast program. It is estimated that 48 staff members would be necessary to administer in the Central Valley a program similar to that of the Central Coast Water Board. This approximation was developed using the ratio of Central Coast Water Board staff to estimated growers (3.5:2500). This is a low estimate considering that the Central Coast Water Board's current program does not establish a tier system, inspection program, groundwater monitoring, or certified nutrient management plan requirements.

### **Alternative 5**

Under Alternative 5, growers would apply for enrollment with the Central Valley Water Board, develop individual FWQMPs, conduct individual monitoring, and submit data and reports directly to the Central Valley Water Board. The current third-party framework would not continue to administer the program, conduct monitoring, or provide other support.

Alternative 5 is based on the Central Valley Water Board's Dairy Program. There are approximately 1,400 Central Valley dairies enrolled under the Dairy Program.

The Central Valley Water Board employs 15 staff members to administer and enforce the Dairy Program. It is estimated that 360 staff members would be necessary to administer Alternative 5. This approximation was developed using the ratio of Dairy Program staff to the estimated number of dairy operations (15:1400).

The Dairy Program has effectively enrolled Central Valley dairies (over 90 percent compliance), implemented individual monitoring, and required the development of nutrient management at the farm level.

## **C. Economic Impacts**

The CWC and goals of the long-term ILRP require that costs, economic impacts, and sources of funding be considered when developing a new regulatory program for agriculture. The Central Valley Water Board's contractor, ICF International, and subcontractors Mark Roberson, Ph.D., TCW Economics, and Stephen Hatchett, Ph.D., conducted an analysis of these issues (ICF International 2010). Overall, the analysis estimates the costs and associated economic effects of each alternative on irrigated agricultural operations and the State. To consider the complexities of the five programmatic alternatives, including the potential for multiple direct and indirect economic effects, the analysis relies on the application of analytical tools (models) to estimate potential effects of the estimated costs to agriculture and affected regional economies.

In this summary, the overall findings of the Draft ILRP Economics Report are discussed in light of evaluating the alternatives. The reader is directed to the Draft ILRP Economics Report for additional information concerning the methods, assumptions, and results of the economic analysis. The evaluation of each alternative, to determine consistency with Goal 3 of the Program, is based on a measure of change from the current program (Alternative 1) because many of the costs of Alternative 1 have already been incurred. This also permits a degree of consistency with the baseline for the PEIR analysis because that baseline is the existing conditions as determined in the ECR at a point where the current ILRP requirements were already in place.<sup>38</sup>

### **1. Estimated Costs**

Estimated total annual costs for each alternative are summarized in Table 17 (from Tables 2-18 through 2-22 of the economics report). (As indicated above, the reader is directed to the economics report for more detailed information on costs.) Most of the costs for the alternatives are attributable to the estimated cost of implementing management practices. In Alternatives 1, 2, and 4 the estimated

---

<sup>38</sup> Costs associated with Alternative 1 admittedly include both costs that already have been incurred since the program was implemented in the early 2000s and incremental costs that have not yet been realized. These incremental costs would be associated with implementing water quality management practices to achieve current program goals. Consideration is given to the impact of these incremental costs in the discussion of Alternative 1 that follows.

costs for implementing management practices are more than 90 percent of the total costs. In Alternatives 3 and 5, the estimated costs for implementing management practices are 82 and 72 percent of the total costs, respectively.

Because the ILRP would not specify a set of required management practices, estimating the costs of management practices for the long-term ILRP is complex and imprecise. The CWC, in fact, prohibits the Water Board from specifying the manner of compliance with water quality requirements [Section 13363]. As a consequence, the Central Valley Water Board had to make a set of assumptions about the types of water quality management practices that irrigated agricultural operations would likely implement to solve existing water quality problems. For example, in areas with multiple surface water quality problems, it is assumed that aggressive source control measures (e.g., pressurized irrigation, tailwater return) would be implemented. It is unknown, however, whether the assumed types of practices actually would be needed. To illustrate how this uncertainty may affect the economic analysis, Appendix A of the economics report indicates that estimated costs for pasture lands would be reduced by 61 percent if tailwater return systems were not implemented—as assumed in the current cost scenario.

It is generally presumed that operations initially would select the least expensive types of practices to be in compliance. If these practices solve the water quality problem, potentially more expensive, structural practices presumably would not be necessary. Furthermore, some of the structural hardware practices assumed to be implemented for purposes of the economic analysis are likely to be implemented in the future even without the ILRP in response to increasing water supply reliability concerns throughout the Central Valley. Because this iterative decision-making process in which less expensive practices are implemented first could not be captured fully in the cost analysis, the estimated costs presented in Table 17 for the alternatives likely overestimates the actual costs of implementation. As a result, the estimated costs in Table 17 for implementing management practices should be considered an estimate of *potential*, not required, costs of the program for implementing specific practices.

As shown in Table 17, the estimated costs associated with Alternatives 1, 2, and 4 are similar (less than 10 percent difference between them). Costs associated with Alternative 3 would be higher than Alternative 1 by approximately 20 percent. Much of the additional cost in Alternative 3 is attributable to increased administration costs associated with the Central Valley Water Board administration and certification of individual water quality plans, and higher monitoring costs than Alternative 1. Alternative 5 costs are estimated to be much higher (about 176 percent) than those under the current program, primarily because of individual monitoring costs and mandated certified nutrient management.



**Table 17. Summary of Average Estimated Annualized Costs (\$000,000) by Alternative**

|                                                                                                                                                            | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 | Alternative 5 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------------|---------------|---------------|---------------|
| Total administration (planning, etc.)                                                                                                                      | 5.4           | 6.5           | 70            | 20            | 67            |
| Monitoring                                                                                                                                                 | 6.8           | 10.6          | 35            | 23            | 302           |
| Management practices                                                                                                                                       | 466           | 468           | 468           | 468           | 952           |
| <b>Total</b>                                                                                                                                               | <b>478</b>    | <b>485</b>    | <b>574</b>    | <b>511</b>    | <b>1,321</b>  |
| Percent Change from Alternative 1                                                                                                                          | 0             | 1.4           | 20            | 7             | 176           |
| Source: Irrigated Lands Regulatory Program Economics Report<br>Totals may not exactly equal the sum of individual cost categories as a result of rounding. |               |               |               |               |               |

Full implementation of Alternative 1 is considered the continuation of the existing program (i.e., Alternative 1 would continue in the absence of the long-term ILRP). As described above, management practice costs account for much of the estimated costs in Table 17. Because the base condition for the cost analysis, as gathered for the ECR, reflects conditions from the early 2000s before significant implementation of Alternative 1 occurred, a substantial portion of the \$466 million in estimated annual costs for management practices under Alternative 1 likely has already been incurred by growers. Also, because the cost of management practices would be similar for all alternatives, except Alternative 5, the costs presented in Table 17 likely overstate the annual cost in the future for all of the alternatives.

## **2. Consideration of ILRP Goal 3—Economic Impacts**

In this section, results of the economic analyses are considered to evaluate whether the long-term program alternatives are consistent with Goal 3, which is to:

*“Maintain the economic viability of agriculture in California’s Central Valley.”*

Determining the economic viability of agriculture involves considering the magnitude of relative changes in certain quantitative economic indicators in the context of current and likely future economic conditions for the industry. Quantitative analyses of economic indicators include estimated changes in farm income and production, and secondarily, estimated employment effects on the farm economy in affected regions.

The long-term ILRP also would indirectly affect other sectors of the economy in the Central Valley besides agriculture. Spending associated with constructing and maintaining equipment needed for implementing water quality management

practices would contribute to supporting jobs in the regional economy; however, the shift in spending to construct and maintain equipment would negatively affect other sectors of the regional economies. These potential effects on other sectors of the regional economy were quantified in the economics analysis and report but are not identified in this summary.

It should be noted that the long-term ILRP also would have beneficial economic effects that cannot easily be quantified. Important examples of these benefits are (1) reduced water supply and treatment costs associated with improvements in water quality for irrigation and drinking; (2) reduced costs for maintaining irrigation ditches and canals associated with less erosion; and (3) reduced pumping and water supply costs associated with reductions in water usage.

In general, the ILRP would institute requirements that include: (1) the implementation of water quality management practices to control sources of waste discharge from irrigated agricultural operations, (2) monitoring, and (3) reporting. The Central Valley Water Board recognizes that under all of the alternatives, these requirements would increase production costs. The resulting reduced profitability may affect an individual grower's economic viability, and, in some cases, result in the loss of agricultural land from production.

When profitability is reduced, loss of production can occur at a range of scales, from individual fields, to farms, and potentially to substantial portions of an agricultural sector. Loss of production on an individual scale is not likely to undermine agricultural viability throughout the region. Therefore, to determine compatibility with Goal 3, the Board has considered each alternative's impact on the overall viability of Central Valley agriculture. To do so, it has evaluated whether an alternative's costs are likely to have a widespread destabilizing effect on a particular sector of the agricultural economy. The indicators used to assess this effect in each affected basin (Sacramento, San Joaquin, and Tulare Lake) include: changes in total irrigated acreage, changes in the total value of agricultural production, changes in total net revenue in agricultural sectors, and changes in jobs in affected agricultural sectors.

The Central Valley Water Board also considered the estimated effects of the alternatives on the regional economies that are directly and indirectly linked to irrigated agriculture. Although this analysis is not directly pertinent to Goal 3, it is relevant to disclosure of the full range of economic impacts of the ILRP alternatives on regional economies. Results of analyzing the impacts on the regional economies are described in the economics report.

Lastly, a qualitative-based procedure is used to evaluate the consistency of changes attributable to the alternatives with program goals and objectives. Using this indicator-based qualitative approach, alternatives are deemed consistent, partially consistent, or not consistent with the program goal of maintaining the economic viability of agriculture in the Central Valley."

## Alternative 1

Alternative 1 represents a continuation of the current program. The following results compare Alternative 1 to an existing base condition of irrigated crop production and income that reflects the early 2000s prior to substantial implementation of the current program. As described above in the Estimated Costs section, the costs presented in Table 17 likely overestimate the incremental costs associated with implementing Alternative 1 because the base conditions are from the early 2000s. In some cases, the estimated cost of implementing water quality management practices (which is the major share of costs, i.e., more than 90 percent) may not be applicable because the practices have already been implemented. Also, the practices assumed for implementation in the analysis are not required by the long-term ILRP, and less expensive practices are likely to be implemented to solve water quality problems under all of the alternatives.

Economic modeling for the long-term ILRP has been conducted to predict impacts on irrigated agriculture by estimating change in production acreage and value of production based on increased costs. Results are reported by general crop category and basin (Sacramento River, San Joaquin River, Tulare Lake). Table 18 provides a summary of the crop types within the general categories.

**Table 18. Crop Category Definition**

| Abbreviated Crop Category                                                                                                                                                   | Aggregated Crop Category    | ECR Crop Category                                           |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|-------------------------------------------------------------|
| FFGO                                                                                                                                                                        | Field, Forage, Grain, Other | Field Crops, Grain and Hay, Irrigated Pasture, Rice, Cotton |
| ORVIN                                                                                                                                                                       | Orchard, Vineyard           | Citrus and Subtropical, Deciduous Orchard, Vineyard         |
| VEGT                                                                                                                                                                        | Vegetable, Truck            | Vegetable and Truck                                         |
| Source: Irrigated Lands Regulatory Program Economics Report<br>Idle (IDLE) and Semi-agricultural and Incidental (SEMI) were not included in the aggregated crop categories. |                             |                                                             |

Analysis of farm income and production suggests that production acreage under full implementation of Alternative 1 would be reduced by approximately 395 thousand acres, or 5.0 percent, compared to the early 2000s base condition. The change in production acreage by crop category between full implementation of Alternative 1 and the base condition is greatest in the FFGO crop category, with a total reduction of approximately 384 thousand acres across basins, or 8.0 percent, accounting for 97 percent of the total estimated change. The change in acreage in VEGT and ORVIN was considerably smaller, approximately 6 and 4 thousand acres (0.9, 0.2 percent), respectively.

The value of annual production is estimated to decline by approximately \$336 million, or 2.5 percent, compared to the existing condition. Changes in the value of production were greatest in the FFGO crop category, with an estimated

total reduction of approximately \$304 million, or 8.2 percent across basins, accounting for 90 percent of the total predicted change. The change in the value of annual production in VEGT and ORVIN was considerably less, approximately \$19 and \$13 million (0.9, 0.2 percent), respectively.

The overall reduction in estimated production acreage and value associated with the full implementation of Alternative 1 would be concentrated on the FFGO crop category. Because cost estimates of the management practices likely overestimate the actual costs of the program, the resulting effect on production and crop value also are likely overestimated. As stated in Section 3.4.1.1 of the economics report:

*...management practices assumed to be implemented for the analysis are relatively expensive, especially for lower-revenue crops in the FFGO category. As a result, crops such as irrigated pasture, hay, and some small grains would have difficulty supporting such costs. The analysis indicated large reductions in their acreages in the regions where those costs were incurred. Irrigated pasture, hay, and other field crops (excluding rice and cotton) accounted for over 95 percent of the acreage reduction shown in Table 3-7. To the extent growers of these crops could identify less expensive ways to comply, such as avoiding the use of certain pesticides, the acreage and revenue impacts would be substantially reduced. For example, Appendix A describes how a lower-cost management practice on irrigated pasture would affect direct costs. Further, sensitivity analysis using CVPM indicated that if grower costs per acre for FFGO crops were reduced by 50 percent, the total acreage impact in Alternative 1 would be reduced by 75 percent."*

Full implementation of Alternative 1 is considered the "no-change" condition (i.e., Alternative 1 would continue in the absence of the long-term ILRP). Even so, under this alternative there likely would be a loss of individual operations and production acreage.<sup>39</sup>

From the perspective of the regional agricultural economies, reductions in agricultural production and increases in compliance spending under Alternative 1 would result in agriculture-related job losses in all three basins. Estimated job reductions in agricultural sectors would be 1,180 jobs in the Sacramento River Basin region, 881 jobs in the San Joaquin River Basin region, and 238 jobs in the Tulare Basin region. Most of the job losses would occur in the FFGO sector as a result of reductions in irrigated field crop acreage. These agriculture-related losses would be offset somewhat by increased spending in other industrial sectors driven by program compliance and management practice implementation.

---

<sup>39</sup> The Central Valley Water Board has considered the potential consequences of these impacts; described further in the economic analysis.

The above estimated losses are a concern for the Water Board, and potentially could be reduced substantially by implementing less expensive management practices and by taking advantage of available funding mechanisms (see Potential Funding section below). Because many of the management practices are believed to have been implemented already, or would be implemented even without a long-term ILRP, these estimated effects are not expected to have a widespread destabilizing effect on a particular sector of the agricultural economy or undermine the overall viability of Central Valley agriculture. *Alternative 1 is consistent with maintaining the economic viability of agriculture.*

## **Alternative 2**

Alternative 2 would impose additional costs for new program requirements, monitoring, and oversight. Tables 19 and 20 show the estimated changes in production acreage and value by basin relative to full implementation of Alternative 1. As shown in the tables, under Alternative 2, production acreage is estimated to decrease by an additional 0.2 percent. From the perspective of the regional agricultural economies, reductions in agricultural production under Alternative 2 would result in relatively minor additional job reductions in the agricultural sectors in all three basins, compared to Alternative 1. Changes in employment would include reductions of 10 jobs in the Sacramento River Basin region, 43 jobs in the San Joaquin River Basin region, and five jobs in the Tulare Basin region. Similar to Alternative 1, these job losses in the agricultural sector would be somewhat offset by increased spending in other industrial sectors driven by program compliance and management practice implementation. Combined across all three basins, employment changes in agricultural sectors would result in a decrease of 58 jobs.

The estimated reduction in production acreage, value, and agriculture-related jobs under Alternative 2 is not appreciably different from under Alternative 1. *Therefore, Alternative 2 is consistent with maintaining the economic viability of agriculture.*

## **Alternative 3**

Tables 19 and 20 show the estimated changes in production acreage and value by basin relative to full implementation of Alternative 1. As shown in the tables, under Alternative 3, production acreage and value are estimated to decrease an additional 0.8 and 0.3 percent, respectively. Changes in agriculture-related employment would include reductions of 108 jobs in the Sacramento River Basin region and 98 jobs in the San Joaquin River Basin region; there would be an estimated net increase of seven jobs in the Tulare Basin region as a result of compliance spending affecting agricultural sectors. Similar to Alternative 1, the job losses in the agricultural sector in the Sacramento River and San Joaquin River Basin regions would be offset somewhat by increased spending driven by program compliance and management practice implementation in non-agricultural sectors. Combined across all three basins, employment changes in agricultural sectors would result in a decrease of 199 jobs.



The estimated reduction in production acreage and value under Alternative 3 is not appreciably different from under Alternative 1. However, the estimated reduction of 199 agriculture-related jobs is a concern. While the estimated losses are not expected to have a widespread destabilizing effect on Central Valley agriculture, the loss of agriculture-related jobs could have local and regional destabilizing economic impacts. *Therefore, Alternative 3 is partially consistent with maintaining the economic viability of agriculture.*

#### **Alternative 4**

As shown in Tables 19 and 20, under Alternative 4, overall production acreage and value are estimated to decrease by an additional 0.2 and 0.1 percent, respectively. Changes in agriculture-related employment would include reductions of 26 jobs in the San Joaquin River Basin region, and net increases of nine jobs in the Sacramento River Basin region and 26 jobs in the Tulare Basin region as a net result of compliance spending on jobs. Similar to Alternative 1, the job losses in the agricultural sector in the San Joaquin River Basin would be offset somewhat by increased spending in non-agricultural sectors driven by program compliance and management practice implementation. Combined across all three basins, employment changes in agricultural sectors would result in a net increase of an estimated nine jobs (Table 21).

The estimated reduction in production acreage, value, and agriculture-related jobs under Alternative 4 is not appreciably different from under Alternative 1. *Therefore, Alternative 4 is consistent with maintaining the economic viability of agriculture.*

#### **Alternative 5**

Tables 19 and 20 show the estimated changes in production acreage and value by basin relative to full implementation of Alternative 1. As shown in the tables, under Alternative 5, production acreage and value are estimated to decrease by an additional 4.4 and 2.1 percent, respectively. In terms of production acreage and value, this reduction equates to a loss of an additional 297,700 acres of irrigated agricultural operations and 269 million dollars per year in production value.

While the estimated additional reductions in production acreage and value, by themselves, do not appear severe, they would be in addition to estimated reductions in production acreage and production value associated with the “fully implemented” Alternative 1 of 395 thousand acres and 336 million dollars per year, respectively. As described above, the reductions associated with Alternative 1 likely overestimate the actual effects primarily because it is believed that growers will implement more cost-effective measures than those assumed for the analysis. However, the additional losses described for Alternative 5 versus Alternative 1 are most likely not an overestimation. The estimated additional costs are not associated with assumed management practices but reflect the costs of required administration and monitoring.

Much of the estimated reduction in production acreage is in the FFGO category. Because the FFGO category contains crop types with low production value per acre (see economics report), the estimated losses may affect a single crop type even more severely than what is estimated for the category (e.g., irrigated pasture—heavily affected, versus rice—less affected).

Under Alternative 5, changes in agriculture-related employment would include estimated reductions of 880 jobs in the Sacramento River Basin region, 714 jobs in the San Joaquin River Basin region, and 34 jobs in the Tulare Basin region. Similar to Alternative 1, these job losses in the agricultural sector would be somewhat offset by increased spending in non-agricultural sectors driven by program compliance and management practice implementation. Combined across all three basins, employment changes in agricultural sectors would result in a decrease of an estimated 1,628 jobs (Table 21).

Under Alternative 5, the reduction in production acreage, value, and agriculture-related jobs in the three basins is a concern for the Water Board that potentially could be reduced by implementing less expensive management practices and by taking advantage of available funding mechanisms (see Potential Funding section below). However, implementation of the alternative could have a widespread destabilizing effect on Central Valley agriculture (especially for lower-profitability FFGO crop types). *Alternative 5 is not consistent with maintaining the economic viability of agriculture.*

**Table 19. Summary of Changes in Total Irrigated Acreage (000) by Basin from Alternative 1**

| Basin                                                                                                      | Alternative 2 | Alternative 3 | Alternative 4 | Alternative 5 |
|------------------------------------------------------------------------------------------------------------|---------------|---------------|---------------|---------------|
| Sacramento River                                                                                           | -1.9          | -23.8         | -0.3          | -140.7        |
| Percent Change                                                                                             | -0.1%         | -1.3%         | -0.02%        | -7.4%         |
| San Joaquin River                                                                                          | -8.9          | -25.6         | -12.3         | -125.8        |
| Percent Change                                                                                             | -0.5%         | -1.5%         | -0.7%         | -7.5%         |
| Tulare Lake                                                                                                | -0.4          | -2.9          | -1.0          | -31.1         |
| Percent Change                                                                                             | -0.0%         | -0.1%         | -0.0%         | -1.0%         |
| Total                                                                                                      | -11.2         | -52.3         | -13.6         | -297.7        |
| Percent Change                                                                                             | -0.2%         | -0.8%         | -0.2%         | -4.4%         |
| Source: Irrigated Lands Regulatory Program Economics Report<br>Totals may not sum as a result of rounding. |               |               |               |               |

**Table 20. Summary of Changes in Total Value of Production (\$000,000) by Basin from Alternative 1**

| Basin                                                                                                      | Alternative 2 | Alternative 3 | Alternative 4 | Alternative 5 |
|------------------------------------------------------------------------------------------------------------|---------------|---------------|---------------|---------------|
| Sacramento River                                                                                           | -1.3          | -18.3         | -4.5          | -118.4        |
| Percent Change                                                                                             | -0.0%         | -0.6%         | -0.1%         | -3.6%         |
| San Joaquin River                                                                                          | -5.5          | -19.2         | -9.2          | -108.1        |
| Percent Change                                                                                             | -0.2%         | -0.6%         | -0.3%         | -3.2%         |
| Tulare Lake                                                                                                | -0.6          | -3.3          | -1.2          | -42.2         |
| Percent Change                                                                                             | -0.0%         | -0.1%         | -0.0%         | -0.7%         |
| Total                                                                                                      | -7.4          | -40.9         | -14.9         | -268.7        |
| Percent Change                                                                                             | -0.1%         | -0.3%         | -0.1%         | -2.1%         |
| Source: Irrigated Lands Regulatory Program Economics Report<br>Totals may not sum as a result of rounding. |               |               |               |               |

**Table 21. Summary of Changes in Agriculture Sector Jobs by Basin from Alternative 1**

| Basin                                                                                                                                                                                                                          | Alternative 2 | Alternative 3 | Alternative 4 | Alternative 5 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------------|---------------|---------------|
| Sacramento River                                                                                                                                                                                                               | -10           | -108          | 9             | -880          |
| San Joaquin River                                                                                                                                                                                                              | -43           | -98           | -26           | -714          |
| Tulare Lake                                                                                                                                                                                                                    | -5            | 7             | 26            | -34           |
| Total                                                                                                                                                                                                                          | -58           | -199          | 9             | -1628         |
| Source: Irrigated Lands Regulatory Program Economics Report<br>Represents net impacts on jobs (full- and part-time) in agricultural sectors resulting from changes in agricultural production and compliance-related spending. |               |               |               |               |

### 3. Potential funding

The economics report describes potential funding for irrigated agricultural operations. As indicated in the report, funding that is targeted toward lands, crops, or growers having the greatest potential for losses and economic hardship would be most effective at reducing the impact. Many of the funding mechanisms would help reduce and defray costs associated with implementing water quality management practices, thereby reducing the economic impact of the alternatives. Potential funding mechanisms include those listed below.

- Federal Farm Bill—Title II of the 2008 Farm Bill (the Food, Conservation, and Energy Act of 2008, in effect through 2012) authorizes funding for conservation programs such as the Environmental Quality Incentives Program (EQIP) and the Conservation Stewardship Program.
- The State Water Board, Division of Financial Assistance, currently administers two programs that improve water quality: the Agricultural Drainage Management Loan Program and the Agricultural Drainage Loan Program. Both of these programs were implemented to address the

management of agricultural drainage into surface water. The State Water Board also administers CWA funds that can be used for agricultural water quality improvements.

- The Agricultural Water Quality Grant Program provides funding to reduce or eliminate the discharge of nonpoint-source pollution from agricultural lands into surface and groundwater. It is funded through bonds authorized by Proposition 84.
- The State Water Pollution Control State Revolving Fund Program also has funding authorized through Proposition 84. It provides loan funds to a wide variety of point source and nonpoint-source water quality control activities.
- Other funding programs, including Integrated Regional Water Management grants that were authorized and funded by Proposition 50 and now by Proposition 84.
- Potential funding provided by the Safe, Clean, and Reliable Drinking Water Supply Act of 2010, passed by the Legislature as SBx7-2, and if approved by voters in November 2010, would provide grant and loan funding for a wide range of water-related activities, including agricultural water quality improvement, watershed protection, and groundwater quality protection.

#### **D. Environmental Impacts**

The Central Valley Water Board's current ILRP establishes that the Board will develop a PEIR for a long-term ILRP that will protect State waters. The purpose of the PEIR is to provide State and local agencies and the general public with detailed information on the significant environmental impacts that proposed long-term ILRP alternatives are likely to have and to list ways to avoid or mitigate those impacts.

The Central Valley Water Board developed the 2010 *Draft Irrigated Lands Regulatory Program Program Environmental Impact Report* (Draft PEIR) with assistance from environmental consultant ICF International (ICF International 2010). The Draft PEIR programmatically evaluates the environmental impacts of the five alternatives described in the Alternatives Document (Appendix A). In most CEQA documents, the lead agency has identified the proposed project as the "preferred project", which receives a more detailed environmental evaluation than the other alternatives. However, in the ILRP Draft PEIR, no preferred project has been identified by the Central Valley Water Board. The Central Valley Water Board agreed to equally evaluate all five alternatives developed by the Stakeholder Advisory Workgroup as part of the process to identify a preferred alternative. The potential environmental impacts of each of the five alternatives have been equally analyzed to determine and compare anticipated impacts. The overall results of the Draft PEIR are summarized in this section and were considered in the development of the recommended long-term ILRP. The reader

is directed to the Draft PEIR for in-depth discussion regarding the environmental impacts of the long-term ILRP alternatives.

## **1. Potentially Significant Impacts Common to All Alternatives**

In general, potential environmental impacts of long-term ILRP alternatives are associated with implementation (e.g., construction and operation) of water quality management practices and construction of monitoring wells. In developing the Draft PEIR, the Central Valley Water Board has assumed that irrigated agricultural operations would implement management practices in areas throughout the region to address water quality concerns. The management practices analyzed, as shown below, are not a mandatory part of any alternative but are identified in the Draft ILRP Economics Report as practices likely to be implemented to meet water quality and other management goals on irrigated lands, including fields, managed wetlands, and nurseries. The analyzed management practices are representative of those most likely to have environmental and economic impacts. These water quality management practices include:

- nutrient management;
- improved water management;
- tailwater recovery system;
- pressurized irrigation;
- sediment trap, hedgerow, or buffer;
- cover cropping or conservation tillage; and
- wellhead protection.

The above practices may be implemented to a similar degree under any of the five alternatives; therefore, associated environmental impacts are not expected to vary widely. The reader is directed to the ECR for more detail on the above practices and other potential practices. Water quality information from the ECR (e.g., pesticide/nutrient levels) has been used to provide spatial focus for implementation of management practices. For example, it is assumed that a mixture of the above types of practices (pressurized irrigation, etc.) likely would be implemented in an area with high levels of chlorpyrifos, while additional practices would not necessarily be implemented in areas without water quality concerns. Details of the process used to estimate the spatial implementation of management practices are discussed in the Draft ILRP Economics Report.

Potentially significant impacts can also occur in the process of drilling groundwater monitoring wells. Alternatives 2, 4, and 5 would require groundwater monitoring. Under Alternatives 2 and 4, it has been assumed that groundwater monitoring would be conducted mainly using existing wells. It is assumed that Alternative 5 would involve installation of a substantial number of new monitoring wells.



Water quality management practices that involve construction or disturbance of land have the potential to cause environmental impacts, as do those that limit or redirect existing surface water flow patterns. For example, construction of a tailwater recovery system would involve excavation, use of pumping equipment, and ongoing maintenance.

Because the Draft PEIR is a program-level analysis, there are limitations involved with determining the potential significance of these types of impacts. These limitations are discussed below.

- The long-term ILRP would not specify required practices; therefore, it is uncertain which of the above practices, if any, would be implemented in a particular location. Growers will choose from the many available management practices to meet water quality goals; some practices may be inappropriate for some crop types, soil conditions, or other considerations.
- Most impacts associated with management practices and construction of monitoring wells would be potentially significant only in areas with sensitive resources (e.g., endangered species habitat, sensitive plant communities).

Considering the above limitations, the programmatic analysis estimates the types of practices that may be implemented and potential impacts of those practices. The environmental impacts estimated as potentially significant at a programmatic level in the Draft PEIR would only be potentially significant at a project level in certain areas or under certain conditions (e.g., increasing particulate matter in air in a nonattainment area as a result of diesel emissions). The combination of a grower's choice of management practice and where that practice is implemented may result in significant environmental impacts under certain conditions for the following resource areas:

- Cultural resources (potential loss of resources from construction and operation of practices and monitoring wells)
- Noise and vibration (exposure of sensitive land uses to noise from construction and operation of practices and monitoring wells)
- Air quality (generation of construction and operational emissions from management practices and monitoring wells)
- Climate change (cumulative: potential increase in greenhouse gas emissions)
- Vegetation and wildlife (loss of habitat, wildlife, and wetland communities from reduced surface water discharge and construction and operation of practices and monitoring wells)

- Fisheries (loss of habitat from construction of management practices and monitoring wells, and toxicity attributable to coagulant additives)

\* The above is a generalized summary of affected resource areas. The reader is directed to the Draft PEIR for specific impacts and discussion.

In practice, the impacts described above can be reduced to a less than significant level through the employment of alternate practices (e.g., altered use of a pesticide rather than construction of a tailwater return system) or by choosing a location that avoids sensitive areas (e.g., installing a sedimentation basin in a portion of the property that is already developed rather than in an area that provides riparian habitat). Where no alternate practice or less sensitive location for the practice exists, irrigated agricultural operations that choose to employ these practices would be directed to avoid impacts to sensitive resources by following project-level mitigation measures that will be required for a grower to qualify for coverage under the implementation mechanism (e.g., WDRs/ waivers) of the chosen ILRP alternative. Specific mitigation measures will be identified<sup>40</sup> in conjunction with the Board's development of the ILRP implementation mechanisms. Performance standards for development of such mitigation, and program-level mitigation measures, are discussed in each resource section of the PEIR.

It is also very important to note that although there may be instances of site-specific impacts from these practices, there also are positive environmental benefits at a regional scale that should be considered. A few examples of these environmental benefits are reduction of toxic air contaminants (TACs) through reduced fertilizer and pesticide applications; reduction of diesel pumping emissions through improved water management; reduction of fugitive (PM10/PM2.5) dust by reducing the amount of exposed soil (cover cropping); and potential for increased surface water flows resulting from improved water management.

Another factor in considering the potential impacts of this program is that many of the practices could be adopted for other or multiple reasons. For example, wellhead protection is required by the DPR; the San Joaquin Valley Air Pollution Control District requires growers to select conservation management practices that protect air quality, but would also protect water quality (e.g., cover crops); and growers may make a business decision to improve their water, pesticide, and nutrient management practices to reduce costs.

Protection of water quality is the primary mission of the Water Boards. As described in the ECR, and in Section III.C of this report, there are numerous water bodies in the Central Valley that currently do not meet water quality

---

<sup>40</sup> Such mitigation measures will include those identified in the PEIR and may include other mitigation measures necessary to meet the mitigation performance standards described in the PEIR. Should any additional identified mitigation measures potentially cause environmental impacts, additional environmental impact analysis will be conducted.

objectives. Implementation of water quality management practices and associated monitoring to determine whether practices are effective is the only way to meet project goals of restoring and/or maintaining the highest reasonable water quality and maintaining the viability of Central Valley agriculture. The following programmatic mitigation will be required as part of any Central Valley Water Board ILRP policy, or implementation mechanism, in order to meet ILRP water quality goals and prevent significant environmental impacts on sensitive resources.

*Where an irrigated agricultural operation/third-party group determines that a proposed management practice/monitoring well may affect a sensitive resource, the ILRP will require that the irrigated agricultural operation/third party either (1) select a different management practice (or location of practice/monitoring well) that meets water quality goals, but does not involve impacts on a sensitive resource; (2) implement the mitigation measures described in the implementation mechanism (e.g., WDRs/ waiver) for the potentially affected resource; or (3) work with the Central Valley Water Board to obtain an individual waste discharge permit and site-specific CEQA analysis.*

Inclusion and implementation of this requirement in ILRP implementation mechanisms would reduce the significant impacts described above, except for climate change, to less than significant. Due to the unavailability of enforceable mitigation, the identified impacts to the area of climate change,<sup>41</sup> which may result from anticipated regulatory compliance actions, are considered significant and unavoidable at the programmatic level.

## **2. Alternative-Specific Potentially Significant Impacts**

In addition to the above impacts, there are a number of potentially significant impacts that are specific to alternatives. Resource areas that have alternative-specific potentially significant impacts are:

- hydrology and water quality (contribute to degradation of groundwater—Alternative 1), and
- agriculture resources (loss of farmland from increased regulatory costs).

### **Hydrology and Water Quality**

Alternative 1 would involve full implementation of the current ILRP. The Draft PEIR indicates that the surface water focus of Alternative 1 may lead to continued degradation of groundwater from agricultural practices. This potentially significant impact can be mitigated to less than significant through the development of a groundwater management plan that would be implemented by irrigated agricultural operations. The groundwater management plan would need

---

<sup>41</sup> There are also significant and unavoidable impacts in the area of agriculture resources. These impacts are described below, under -Agriculture resources.”

to identify practices that would minimize waste discharge to groundwater from irrigated agricultural operations.

Alternatives 2–5 would require development of groundwater management plans—regional for Alternative 2, and individual for Alternatives 3–5. Alternative 2 is essentially Alternative 1 with groundwater management plan requirements. The groundwater management plans identified for Alternatives 2–5 would establish management practices that would work to minimize waste discharge to groundwater. *The measure described as mitigation for Alternative 1 would be a required part of the program under Alternatives 2–5.*

### **Agriculture Resources**

The Economic Impacts section of this report summarizes economic modeling that has been conducted for the long-term ILRP. The modeling estimates economic impacts on irrigated agriculture by estimating change in production acreage and value of production based on increased regulatory costs.

Predicted reductions in production acreage are a concern, not only from the standpoint of economic health, but also from the perspective of agricultural land as a resource. As described in the Economic Impacts section, there is a predicted reduction in production acreage because of increased costs for each of the five alternatives, with the least estimated reduction under full implementation of Alternative 1<sup>42</sup> and the highest estimated reduction under Alternative 5.

A high percentage of the cost of the alternatives would be attributable to implementation of water quality management practices. The predicted reductions in production acreage are considered an overestimation because of (1) lack of information regarding already implemented management practices, (2) the ILRP could not require specific management practices (CWC 13360) (it is likely that operators would implement less expensive practices in order to prevent high costs), and (3) there are funding mechanisms that could help mitigate the cost of management practice implementation ([see Section IX.C.3](#)). Nevertheless, there likely will be some reduction in production acreage as a result of increased regulatory costs imposed by the alternatives. Much of the production acreage losses are estimated to be within the FFGO (field crops, grain and hay, irrigated pasture, rice, cotton; see Table 18) crop category. There is a substantial percentage of prime farmland<sup>43</sup> (more than 40 percent) within the FFGO category. The loss of prime farmland production acreage is considered a significant impact. Therefore, each of the alternatives may result in significant environmental impacts on agriculture resources.

---

<sup>42</sup> Note that baseline conditions for this analysis are early 2000s, coinciding with the information collected in the ECR. Full implementation of Alternative 1 would be realized upon implementation of management practices that would work to solve water quality problems identified in the ECR. The current program, Alternative 1, is considered partially implemented at this time.

<sup>43</sup> Prime farmland is defined in section 5.10.2 of the Draft PEIR.

Mitigation measures to reduce the scope of the impact on agriculture resources include reducing costs of alternatives to irrigated agricultural operations, allowing additional time for implementation, and providing financial assistance. It is not anticipated that these mitigation measures would reduce the predicted environmental impacts to less than significant. Therefore, the impacts identified for agricultural resources are considered significant and unavoidable.

*Selection of requirements with lower administration and monitoring costs, along with additional time for implementation, and financial assistance programs would work to reduce the scope of this significant impact. Reducing administration and monitoring costs would allow irrigated agricultural operations and the Central Valley Water Board to focus limited resources on implementation of water quality management practices.*

## **X. RECOMMENDED PROGRAM ALTERNATIVE**

In the above evaluation of proposed long-term program alternatives, each alternative was found to achieve some of the program evaluation measures but not others. As is shown in Table 11, of the five alternatives proposed, no single alternative achieved complete consistency with all evaluation measures. However, after review of each of the alternatives and their common elements (lead entity, monitoring type), it is clear that a program that more completely satisfies the evaluation measures can be developed by selecting from the best-performing elements of the proposed alternatives.

### **A. Best-Performing Program Elements**

In this section, the elements of alternatives that best achieve evaluation measures are considered in the development of a recommended program alternative.

#### **1. Waste Discharge to Groundwater**

*Options:        Include groundwater requirements—Alternatives 2–5  
                    Do not include groundwater requirements—Alternative 1*

All the alternatives except Alternative 1 contain requirements for protecting groundwater from irrigated agricultural waste discharge. Alternative 1 did not fully meet the goals of the long-term ILRP, CWC requirements for protecting beneficial uses, and antidegradation requirements. This is mainly because Alternative 1 would not address waste discharge to groundwater from irrigated agricultural operations.

The Draft PEIR identifies significant environmental impacts on groundwater under full implementation of Alternative 1 mainly because of continued waste discharge to groundwater associated with agricultural operations.



*Recommendation: Include groundwater requirements.*

## **2. Implementation Mechanism**

*Options: Conditional waiver of WDRs  
WDRs  
Conditional Basin Plan prohibition*

There are no requirements that establish the type of implementation mechanism for the long-term ILRP. Accordingly, the implementation mechanism could be any of the above.

Program goals and objectives establish that long-term program requirements should be coordinated with other regulatory and non-regulatory programs. Developing implementation mechanisms that are geographically based would facilitate this coordination. Regional water quality planning and monitoring could be coordinated with other programs. Also, this approach would allow for addressing water quality concerns that may have multiple inputs in a watershed or basin. Developing geographically based implementation mechanisms also would allow the Central Valley Water Board to prioritize requirements more effectively, working to provide more targeted water quality protection while reducing costs.

There are some key differences between waivers and WDRs that should be considered in light of developing geographically based implementation mechanisms with prioritized requirements. These differences are:

- **Waivers:** must be reviewed every 5 years and lower fees could be established to reflect lower level of staff oversight.
- **General WDRs:** do not expire (no required review period).

Because waivers allow for lower fees, they could be most effectively used to implement ILRP requirements in lower-priority areas. Program requirements and fees could be reduced in these areas to help facilitate focusing limited resources in higher-priority areas. The required 5-year review period would provide assurance that waste discharge conditions have not changed in a way that could degrade State waters. General WDRs could be used most effectively in higher-priority areas, allowing the Central Valley Water Board, third-party groups, and irrigated agricultural operations to focus on solving problems instead of renewing regulatory requirements.

Where geographically based general WDRs and waivers are ineffective, individual WDRs could be required. This would provide additional oversight and more clear enforcement mechanisms. Fees also would be higher for individual WDRs, mainly because of the additional oversight.

*Recommendation: A series of area-, geographically based, or commodity-based implementation mechanisms with prioritized requirements.*

*Implementation mechanisms could include waivers in low-priority areas and general WDRs in high-priority areas. Individual WDRs could be developed and implemented as an enforcement tool.*

### **3. Lead Entity**

*Options: Third party established in Alternatives 1 and 2*

*Third party established in Alternative 4*

*Central Valley Water Board established in Alternatives 3 and 5*

The range of alternatives contains three different lead entity structures. Alternatives 1 and 2 would be fully implemented by a third party (e.g., water quality coalition group). In Alternative 4, the third party would be responsible for regional monitoring and reporting. In Alternatives 3 and 5, the Central Valley Water Board would be the lead entity. Program goals and objectives and policy requirements do not require that the lead entity be the Central Valley Water Board or a third party.

The environmental and economic impact analyses, summarized in [Sections IX.C–D](#), provide that administration costs should be minimized in order to mitigate the scope of significant environmental impacts on agriculture resources and minimize economic impacts on irrigated agriculture. The administrative costs of the third-party lead entity structure established in Alternatives 1 and 2 are less than the administration costs under Alternatives 3–5.

As described in [Section IX.B](#), enforcement of program requirements can be difficult in the third-party framework. This is because the Board cannot enforce program requirements directly upon the third party; rather, enforcement must be conducted directly upon the irrigated agricultural operation. There may be cases where individual operations may be unaware of third-party non-compliance, and also unaware of program requirements. This potential problem can be mitigated by (1) requiring individual operations to enroll directly with the Central Valley Water Board so that they are aware of the program and requirements, (2) requiring that third-party groups provide the Board with information regarding non-compliant operations, and (3) requiring that third-party groups provide transparency and communication of requirements to growers.

*Recommendation: Third-party structure established in Alternatives 1 and 2 with additional structural and third-party transparency requirements described above.*

#### **4. Program Organization**

*Options: Requirements similar for all operations—Alternatives 1,3,5  
Requirements tiered—Alternatives 2 and 4*

Alternatives 1, 3, and 5 would apply requirements in a nature similar to all irrigated agricultural operations. Alternatives 2 and 4 contain systems for prioritizing waste discharges based on monitoring and other threat factors (e.g., pesticide/fertilizer use). Program goals and objectives contain requirements to provide incentives for irrigated agricultural operations to implement water quality management practices. A tiered system would provide these incentives by allowing reduced requirements for lower threat or priority operations.

The environmental and economic impact analyses, summarized in [Sections IX.C–D](#), provide that program costs should be minimized in order to mitigate the scope of significant environmental impacts on agriculture resources and minimize economic impacts on irrigated agriculture. Tiering program requirements would help to reduce costs for some operations; however, administration of a tiering system may be more costly. Tiering systems that would apply to individual growers would be more costly. In order to keep administration costs to a minimum, any tiering system should be geographically based, or generalized to a class of waste discharges.

*Recommendation: Establish geographically based tiering system to reduce costs for lower threat areas.*

#### **5. Water Quality Management Plans**

*Options: Regional water quality management plans—Alternatives 1 and 2  
Individual water quality management plans—Alternatives 3–5*

Alternatives 1 and 2 would establish regional water quality management plans in areas where water quality objectives are not being met. Alternatives 3–5 would require that each individual operation develop water quality management plans regardless of whether there is an identified water quality concern (e.g., water quality objectives not being met).

Program goals and objectives establish that long-term program requirements should be coordinated with other regulatory and non-regulatory programs. Regional water quality plans would facilitate this type of coordination. For example, where a water quality problem is attributable to multiple sources, an overarching regional plan could be developed to address the concern.

Antidegradation requirements establish that BPTC must be implemented where degradation of water quality is occurring. Regional and individual water quality plans would work to implement BPTC. However, the approach outlined in Alternatives 1 and 2 would require plans only in areas that already have exceedances of water quality objectives. In order to meet antidegradation

requirements, regional plans also should be developed in areas where irrigated agricultural waste discharges are causing degradation.

As described in [Section IX.B](#), it is difficult for the Central Valley Water Board to directly enforce program requirements, such as implementation of management measures, in the third-party regional approach. This is because Board enforcement authority applies to the entity discharging waste to State waters. In the regional water quality management plan approach described under Alternatives 1 and 2, the Board would not have a direct relationship with each irrigated agricultural operation (the entity discharging waste) and would not have information regarding the method(s) and practices the operation has or plans to implement to work toward solving identified water quality concerns. Conversely, the individual water quality management plan approach would provide the information necessary for the Board to directly enforce program requirements. Essentially, operations would be required to implement the management practices identified in the individual water quality management plan.

The environmental and economic impact analyses, summarized in [Sections IX.C–D](#), provide that costs should be minimized. Requiring that every irrigated agricultural operation develop a water quality plan, regardless of whether there are water quality problems, would drive program costs higher and may not necessarily benefit water quality (see [Section IX.B](#), describing difficulties the Central Coast Water Board has had in ensuring individual plans address water quality problems).

*Recommendation: Regional water quality plans similar to those described in Alternatives 1 and 2 with additional requirements to (1) ensure the plans are designed to implement BPTC to minimize degradation and address exceedances of water quality objectives, and (2) develop individual water quality management plans where regional plans have been ineffective.*

## **6. Monitoring**

*Options: Third-party regional monitoring—Alternatives 1 and 2  
Individual monitoring—Alternative 3  
Third-party regional + individual monitoring—Alternative 4  
Individual monitoring—Alternative 5*

Alternatives 1 and 2 would establish regional monitoring programs. The regional monitoring under these alternatives would not implement a groundwater monitoring program, except in areas that have local groundwater management plans. The individual monitoring under Alternative 3 would not include water quality monitoring. Alternative 4 would include a regional surface and groundwater quality monitoring program in addition to individual monitoring. Alternative 5 would include individual surface and groundwater quality monitoring.

The policy analysis, [Sections IX.A.2–4](#), explains that feedback monitoring is necessary to determine whether management practices are effective (NPS Policy, antidegradation). This is especially important given the iterative nature of each of the alternatives. Regional or individual monitoring therefore should be a component of the long-term ILRP.

The benefits and drawbacks of regional and individual monitoring are described in [Section VIII](#). In general, regional monitoring (1) costs less overall than individual monitoring (see [Section IX.C.1](#), Estimated costs), (2) could be used to determine whether there is a water quality concern and whether implemented practices are effectively addressing these concerns, (3) would not be effective at determining waste contributions of individual operations, and (4) does not easily facilitate determination of whether other sources (e.g., municipal, natural, industrial) of waste are causing a water quality problem, mainly because individual source contributions would be unknown.

There is a need to minimize costs of the long-term ILRP (economic analysis and PEIR, [Sections IX.C–D](#)). The individual monitoring proposed in Alternative 5 is very costly. Regional monitoring programs proposed in Alternatives 2 and 4 are less costly than individual monitoring and could be used to provide the required feedback.

Program goals and objectives establish that long-term program requirements should be coordinated with other regulatory and non-regulatory programs. Regional water quality monitoring would facilitate this type of coordination. For example, monitoring conducted by DPR and local groundwater programs could be coordinated with regional monitoring under the long-term ILRP. This would reduce costs and help involved agencies fulfill their missions.

As described above, limitations of regional monitoring programs include the inability to determine individual contributions of waste. This is of particular concern where a water quality problem has been identified and there are multiple sources of the problem, with irrigated agricultural operations being one of the sources. In these situations, irrigated agricultural operations would need to minimize their waste contributions to such water quality problems.

*Recommendation: Regional surface and groundwater monitoring described in Alternatives 2 and 4 with the understanding that inability of regional monitoring to determine irrigated agricultural waste contributions will not excuse action to work toward minimizing contributions to identified water quality problems. Individual monitoring would be required if the third-party entity fails to provide the necessary information.*

## **7. Time Schedule for Compliance**

The NPS Policy requires the establishment of a time schedule for compliance with water quality objectives. The five alternatives do not establish time



schedules for compliance. However, time schedules could be developed in water quality management plans.

*Recommendation: Develop a general time schedule that would defer, where appropriate, to more specific time schedules developed as part of water quality management plans.*

## **B. Recommended Long-Term Irrigated Lands Regulatory Program**

This section describes the recommended long-term ILRP. The recommended long-term ILRP has been developed from the elements of the five programmatic alternatives evaluated in this report joined with State policy requirements, the findings of the Draft PEIR and economics report, and information developed from the Draft Groundwater Nitrate Summary Report ([Appendix B](#)). The rationale for the main components of the recommended program is given in the above section ([Section X.A](#)). In addition to the evaluation conducted in this report, the Central Valley Water Board conducted several stakeholder meetings during April and May 2010 to discuss many of the aspects of the recommended long-term program—as a “Straw Proposal.” Stakeholder concerns and the above evaluation have been used to identify the most workable long-term ILRP given the numerous constraints.

This section includes the following topics:

- Scope
- Goals and objectives
- Timeframe for implementation
- Implementation mechanism
- Lead entity
- Regulatory requirements
- Monitoring provisions
- Time schedule for compliance

### **1. Scope**

The scope of the long-term ILRP includes all discharges from irrigated lands that could affect the quality of waters of the State in the Central Valley region. Irrigated lands include land irrigated to produce crops for commercial purposes; nurseries; private and public managed wetlands; irrigated pasture. Waste discharges from irrigated lands include discharges to surface water, such as irrigation return flows, tailwater, drainage water, subsurface drainage generated by irrigating crop land or by installing and operating systems to lower the water table below irrigated lands (tile drains), stormwater runoff flowing from irrigated

lands, and non-runoff discharges (e.g., aerial drift or overspray of pesticides).<sup>44</sup> Waste discharges from irrigated lands also include discharge to groundwater, such as leaching of waste to groundwater, waste discharge to groundwater as a result of backflow of waste into wells (e.g., backflow during chemigation), and irrigated agricultural waste discharged into unprotected wells.<sup>45</sup>

Operations associated with irrigated agriculture involving the application of materials and constituents directly or indirectly to land may leach waste into groundwater, potentially causing degradation, or causing or contributing to exceedances of water quality objectives. Because all irrigated agricultural operations could affect groundwater quality, they have been considered in the scope of the long-term ILRP. There may be cases where leaching of waste could not affect groundwater quality; however, this would be difficult to determine without intensive site-specific information. In implementing the long-term ILRP, the Central Valley Water Board would consider such site-specific information, as provided by irrigated agricultural operations, to reevaluate whether a particular waste discharge could affect groundwater quality.

## **2. Goals and Objectives**

The goals and objectives would be those adopted by the Advisory Workgroup, given in [Section VII](#) of this report.

## **3. Timeframe for Implementation**

The changes proposed for the long-term ILRP would require the development of new institutional structures and will likely add 2 million additional acres to the program.<sup>46</sup> To minimize the disruption to the current surface water program and provide a smooth transition to the new program, a phased 3-year implementation timeframe is proposed prior to the new requirements taking full effect.

Compliance during this transition will be based on completing required actions for each phase. The primary actions, completion dates, and responsible parties are described in Table 22. Upon adoption of the long-term program, Central Valley Water Board staff will develop a more detailed time line with interim milestones to ensure the primary actions are completed on time.

---

<sup>44</sup> The Central Valley Water Board recognizes that DPR is the lead State agency for regulating pesticide use. In implementing the long-term ILRP, the Board intends to work closely with DPR where waste discharge associated with overspray or other pesticide wastes cause water quality problems.

<sup>45</sup> Irrigated lands that are regulated under another Water Board order (e.g., WDRs, including NPDES permits) would not be regulated under the ILRP. However, if the other Water Board order governs only some of the waste discharge activities (e.g., application of wastewater to crop land), the owner/operator of the irrigated lands must obtain regulatory coverage for all discharges of waste through the ILRP or by obtaining appropriate changes in their existing WDRs.

<sup>46</sup> The estimated additional 2 million acres would be attributable to the increased scope of the long-term ILRP to include waste discharge to groundwater. This number is estimated by subtracting the irrigated acreage in the current ILRP from DWR estimates of total irrigated acreage in the Central Valley.

**Table 22. Long-Term ILRP Timeframe for Implementation**

| Phase/Action                                                                                                                                                                                                                                                         | Completion Date<br>(from Adoption of<br>Long-Term Program) <sup>a</sup> | Responsible Party                                   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|-----------------------------------------------------|
| Identification of geographic areas/commodities receiving orders <sup>b</sup> and responsible third-party groups                                                                                                                                                      | 3 months                                                                | Central Valley Water Board/third parties            |
| Board issuance of geographic/commodity specific orders                                                                                                                                                                                                               | 12 months                                                               | Central Valley Water Board                          |
| Enrollment of new participants/operations <sup>c</sup>                                                                                                                                                                                                               | 30 months                                                               | Operations/Central Valley Water Board               |
| New program fully in effect                                                                                                                                                                                                                                          | 3 years                                                                 | Central Valley Water Board/third parties/operations |
| <sup>a</sup> Date of Central Valley Water Board certification of Final PEIR and direction to implement recommended ILRP.<br><sup>b</sup> WDRs and waivers.<br><sup>c</sup> Irrigated agricultural lands, or operations, as defined in <a href="#">Section X.B.1.</a> |                                                                         |                                                     |

Although staff anticipate that it will take 12 months to adopt all the new orders for the program, staff will bring 2–3 orders to the Board for consideration every quarter to ensure all necessary orders are adopted within the 12-month time frame. The current ILRP conditional waivers for surface water will need to be renewed for this time period to ensure that current ILRP participants are in compliance while the new orders are developed.

Current ILRP participants would be enrolled automatically (i.e., grandfathered into new program; reapplication would not be required) as the relevant provisions are established. The Central Valley Water Board will coordinate with current ILRP management plans to address surface water quality problems. These efforts would continue as part of the long-term ILRP.

#### **4. Implementation Mechanism**

Irrigated agricultural operations vary considerably throughout the Central Valley. Environmental conditions also vary considerably. These variations lead to non-uniformities in discharge waste parameters and also associated management practices that would be best suited to reduce waste discharge. For example, in areas with fine clay soils, implementing management practices to reduce potential leaching of waste to groundwater may not address the main discharge pathways (e.g., tailwater discharge, runoff to unprotected wellheads). In some cases, management practices have been identified that could intensify waste discharge; examples would include holding tailwater in an area with coarse soils and shallow groundwater.

On numerous occasions stakeholders have urged that the program be flexible and allow irrigated agricultural operations to implement practices that make the

most sense at their particular sites. Staff agree with these stakeholder concerns and have noted that the variability of conditions and agricultural operations must be given primary consideration when developing regulatory requirements. In order to address these concerns, a series of general WDRs and conditional waivers, based on local conditions, would be developed.

General orders or waivers would be developed for similar areas/watersheds/commodities, with the regulatory and monitoring requirements tailored to the conditions and waste discharge pathways. These orders and associated requirements generally would be geographically based. However, there may be occasions where commodity-based requirements are appropriate. One such example would be rice, because of commodity-specific water quality management practices and general geographic continuity. To provide a degree of flexibility while limiting the number of orders that must be developed, a total of 8–12 tailored orders would be developed. This proposal would establish prioritization factors for determining the type of requirements (e.g., planning, management) and monitoring that would generally be applied. The ideas for this prioritization system have already been developed in long-term ILRP Alternatives 2 and 4 by the Advisory Workgroup (low threat, and tiered program, see Alternatives Document, Appendix A). The prioritization factors are described below in the Regulatory Requirements section.

Developing general orders and waivers for specific areas/commodities would provide the Board and third-party groups the opportunity to tailor requirements most effectively to applicable waste discharge conditions. For example, areas with multiple surface water concerns because of pesticides would not be subject to the same requirements as areas with minimal pesticide concerns. This approach also would facilitate effective coordination with other water quality programs.

Throughout the development of the long-term ILRP, the Central Valley Water Board has been urged to coordinate with DPR's Groundwater Protection Program, other regulatory programs, and local groundwater management programs. Developing orders specific to geographic areas would allow the Central Valley Water Board to coordinate and consider existing practices and monitoring associated with DPR, local groundwater management programs, and other programs and consider existing local regulatory efforts, thus minimizing duplication of efforts and multiple overlapping regulatory requirements.

The implementation mechanisms that will be developed include:

**Conditional waiver of waste discharge requirements**—applicable to lower priority (see description below) areas/watersheds/commodities. Benefits of establishing waivers for these areas would include potential program fee reduction and the requirement for reassessment every 5 years. Periodic reassessment would provide assurance that waste discharge conditions have not changed in a way that could degrade State waters.

**General waste discharge requirements**—applicable to higher priority (see description below) areas/watersheds/commodities. Benefits of establishing general WDRs for higher-priority areas include increased stability. Higher priority areas would be those where agricultural operations are causing or contributing to a water quality problem. Once adopted, general WDRs would require that irrigated agricultural operations implement practices and programs to solve water quality problems. This may take longer than 5 years. General WDRs do not expire and would allow the Central Valley Water Board, third-party groups, and irrigated agricultural operations to focus on solving problems instead of renewing regulatory requirements.

***In general, there would be a single, main regulatory mechanism for waste discharges to surface and groundwater applicable to a geographic area or in some cases, a commodity. Where a large geographic area has multiple low and high-priority sub-areas, the mechanism would be WDRs [high/low prioritization is defined below in the Regulatory Requirements section]. The requirements of the WDRs then may be tailored to address the sub-areas. An example of this approach can be seen where an area encompasses vulnerable groundwater areas. The requirements inside the vulnerable groundwater areas may be different from the requirements outside the vulnerable areas.***

**Conditional prohibition of discharge**—applicable to irrigated agricultural operations whose waste discharge could affect the quality of the State's waters that have not obtained necessary regulatory coverage within 1 year of adoption of applicable long-term ILRP order (WDRs/waivers); or 1 year of obtaining the irrigated lands or converting the land use to one that meets the irrigated lands definition. The prohibition would be applicable only to irrigated agricultural operations with waste discharges that could affect the quality of State waters that have not obtained coverage under the ILRP. The prohibition will be established through amendments to the two Central Valley Basin Plans.

**No regulatory program**—where evidence has been provided to the Central Valley Water Board and the Board has concurred that the irrigated lands operation could not affect the quality of the State's waters. This determination would include a thorough review of site-specific information that would be used to characterize and determine whether irrigated lands waste discharge can affect the quality of the State's ground and/or surface waters.<sup>47</sup>

---

<sup>47</sup> This option is identified because the Central Valley Water Board can have a regulatory program only if the discharge of waste could affect the quality of waters of the State. The Central Valley Water Board currently does not have information identifying any irrigated agricultural areas in which such an option could apply. Given the potential discharge pathways to ground and surface waters from irrigated agriculture, staff expects that this option may not be applicable or may apply in only limited, site-specific circumstances.



## 5. Lead Entity

As part of the ILRP, specific lead entities will need to be identified. This section describes the likely lead entity categories and their roles and responsibilities.

### Third Party

A coalition or other third-party group would be responsible for general administration of the ILRP. In order to be approved by the Central Valley Water Board for administration of this alternative, third-party groups would need to agree to assume the following responsibilities.<sup>48</sup>

1. Provide members and the Central Valley Water Board an organizational or management structure identifying persons responsible for ensuring that program requirements are fulfilled.
2. Agree to provide or make available to group members the annual summaries of expenditures of fees used to comply with the ILRP.<sup>49</sup>
3. Notify potentially affected third-party group members each time the group has received a notice of violation or other enforcement action from the Central Valley Water Board and provide information regarding the reason for the enforcement.
4. Develop and implement monitoring/management practice tracking plans.
5. Conduct required water quality monitoring.
6. Work with the Central Valley Water Board to inform growers of program requirements, provide coordination to ensure that water quality concerns are addressed, and provide informational materials on potential environmental impacts of water quality management practices.<sup>50</sup>
7. Work cooperatively with the Central Valley Water Board to ensure all third-party group members are providing any required information and taking necessary steps to address any identified water quality issues.
8. If a monitoring well is proposed that may affect a sensitive resource (e.g., endangered species habitat, sensitive plant communities), the third party

---

<sup>48</sup> To represent irrigated agricultural operations, a third party must receive Central Valley Water Board approval to act as a representative (similar to the current ILRP). In its application for approval as a third party, the applying entity must demonstrate that its governance structure is accountable to its members and it has the capacity to carry out the responsibilities identified in this program. Third-party entities would not be required to submit a Report of Waste Discharge.

<sup>49</sup> It is not the intent of this provision for the Central Valley Water Board to review and approve these reports. The intent is to promote accountability and transparency on the part of the third-party entities.

<sup>50</sup> Informing irrigated agricultural operations of potential environmental impacts of water quality management practices is required to ensure that operations have the information to select practices that do not have an impact on sensitive resources (see [section IX.D.1](#)).

must (1) select a different monitoring well location that meets water quality goals, but does not involve impacts on the resource, or (2) implement the mitigation measures described in the implementation mechanism (e.g., WDRs/ waiver) for the potentially affected resource, or (3) work with the Central Valley Water Board to obtain a site-specific CEQA analysis.<sup>51</sup>

Additional third-party requirements are included below in the regulatory requirements section.

### **General Central Valley Water Board Role and Responsibilities**

1. Require 100 percent ILRP participation.<sup>52</sup> In implementing this requirement, the Central Valley Water Board would work with third-party groups to identify non-participants. The Board would be responsible for enforcement of the 100 percent participation goal. Third-party groups would be required to assist the Board by providing non-participant information.
2. Enroll irrigated agricultural operations in the ILRP and provide them with approval to join a third-party group. Automatically enroll current ILRP participants in the long-term ILRP.
3. Review and approve monitoring plans.
4. Review and approve SQMPs.
5. Review and approve GQMPs (and, where applicable, local groundwater management plans requested to substitute for GQMPs).
6. Review monitoring reports.
7. Review overall program performance with regard to achieving ILRP objectives.
8. Respond to individual problems and complaints dealing with irrigation discharge and informing/coordinating with the responsible third-party group.
9. In an iterative process, require additional monitoring, information, and/or management measures where applicable water quality objectives are not being met or degradation is occurring.
10. Enforce ILRP requirements.

The Central Valley Water Board will be the lead entity working directly with operators (1) who have chosen not to enroll with a third-party entity, (2) where a

---

<sup>51</sup> This requirement is considered to ensure that any installed monitoring wells do not cause unintended environmental impacts on sensitive resources (see [section IX.D.1](#) and Draft PEIR).

<sup>52</sup> Where irrigated agricultural operations have a waste discharge that would be regulated under the ILRP.

third-party entity is unavailable or has demonstrated noncompliance with ILRP requirements, or (3) who, through their action or inaction, demonstrate that direct Central Valley Water Board oversight is required to ensure compliance with the ILRP.

## 6. Regulatory Requirements

The regulatory requirements for the long-term ILRP include planning and implementation of water quality management practices that would reduce waste discharge to State waters associated with irrigated agricultural operations. Under the current ILRP and other programs, there have been vast amounts of water quality data collected characterizing impacts on Central Valley waters associated with irrigated lands (Central Valley Water Board and Jones and Stokes [2008], *Existing Conditions Report* or “ECR”). The ECR also suggests that there are watersheds and groundwater basins with irrigated agricultural operations with little to no measured water quality impacts.<sup>53</sup>

In general, irrigated agricultural operations have the potential to discharge waste; however, the overall impact of the waste discharge is dictated by various conditions such as:

- management practices,
- commodity type,
- cultural practices,
- other sources, and
- environmental conditions (annual rainfall, geology, intensity of operations).

This concept, coupled with availability and adequacy of water quality data must be the building block of any successful long-term ILRP. This ILRP incorporates the importance of the above conditions as “priority factors” (described later in this section) that will be used to establish general threat conditions and associated regulatory requirements to be applied using the area/watershed/commodity-specific implementation mechanisms. The implementation mechanisms would be tailored to the discharge pathways (mode by which waste is reaching State waters, e.g., leaching to groundwater through coarse soils).

Regulatory requirements for irrigated agricultural operations would include those following.

1. Submit an application to the Central Valley Water Board to enroll in the program (if not already enrolled in the current program); where required, join a third-party group; and pay applicable program fees. Irrigated agricultural operations would not be required to submit a formal report of waste discharge unless applying for individual WDRs, or in cases of enforcement.

---

<sup>53</sup> In some cases, monitoring data is not available. Inadequate monitoring data would not provide justification that an area does not have impacts.

2. Implement water quality management practices in accordance with any water quality management plans, including GQMPs. Water quality management practices could be instituted on an individual basis, or be installed to serve a group of growers discharging to a single location (e.g., combined tailwater return or wetlands serving a group of growers).
3. Prevent nuisance conditions and/or exceedance of water quality objectives in State waters associated with waste discharge from their irrigated agricultural lands.
4. Provide the third-party group with information requested for compliance with the ILRP.
5. Where a management practice is proposed, for compliance with the ILRP, and the irrigated agricultural operation determines that it may affect a sensitive resource (e.g., endangered species habitat, sensitive plant communities), the irrigated agricultural operation must (1) select a different management practice that meets water quality goals, but does not involve impacts on a sensitive resource, or (2) locate the management practice outside of sensitive resource areas, or (3) implement the mitigation measures described in the implementation mechanism (e.g., WDRs/ waiver) for the potentially affected resource, or (4) work with the Central Valley Water Board to obtain an individual waste discharge permit and site-specific CEQA analysis.<sup>54</sup>

Irrigated agricultural operations that do not meet the above requirements would be required to work directly with the Central Valley Water Board and obtain WDRs or an individual waiver of WDRs.

### **Priority Factors**

The long-term ILRP would use the following factors to determine the priority (e.g., high or low) and the associated requirements for a given area:

1. irrigated agricultural operations—identified as causing or contributing to a water quality problem for surface and/or groundwater (e.g., exceedance of water quality objectives, degradation of water quality<sup>55</sup>);
2. located in a high-threat area based on environmental conditions (e.g., DPR/State Water Board groundwater vulnerability area,\* intensity of

---

<sup>54</sup> This requirement is considered to ensure that implemented water quality management practices do not cause unintended environmental impacts on sensitive resources (see [section IX.D.1](#) and Draft PEIR).

<sup>55</sup> Degradation is considered here to comply with State Water Board Resolution 68-16, *State Antidegradation Policy*.

operations,<sup>56</sup> geology, proximity to surface water bodies, or in an area of shallow groundwater);

3. management practices in place to protect water quality; and
4. demonstrated non-compliance with ILRP.

***\* DPR/State Water Board groundwater vulnerability areas are considered here as priority factors. The Central Valley Water Board reviewed these vulnerability areas along with Central Valley groundwater quality data for nitrate (Nitrate Summary Report [Appendix B]). One general conclusion from the Nitrate Summary Report is that: "State Water Board and USGS Maps depicting areas...where groundwater quality has been impacted by nitrates are in general agreement with the vulnerability maps." As groundwater in these areas is generally vulnerable to pesticides and nitrates, it is likely that there is vulnerability to other groundwater waste discharge associated with irrigated agriculture (e.g., salts). Therefore, these are considered priority areas for implementing management practices to protect groundwater quality. There are approximately 2 million acres of State Water Board/DPR vulnerability areas throughout the Central Valley.***

The general requirements that would be applied under high and low-priority scenarios are given below as a two-tier system. Tier 1 requirements would be applicable in low-priority areas, and Tier 2 requirements would be applicable in higher-priority areas. The requirements established in any given area would be applied separately to surface and groundwater depending on the above factors. However, the decision on the type of implementation mechanism would be based on whether the area contains high-priority areas for surface or groundwater. The implementation mechanism then would be tailored to the appropriate high-priority waste discharge(s). Figure 22 contains a flowchart summarizing the proposed prioritization process.

Third-party groups and the Central Valley Water Board would identify low and high-priority areas in the development of watershed/area/commodity-specific implementation mechanisms during the 3-year transition period.<sup>57</sup> The Central Valley Water Board intends to use existing information in this prioritization. However, there will be the flexibility for third-party groups and other interested parties to provide additional information during the process. The Central Valley Water Board will make the final determination regarding area/discharge priority. Examples of high-priority areas for surface water would be those under SQMPs in the current ILRP (where irrigated agricultural operations are a source of the

<sup>56</sup> Consideration of intensity of operations would include information such as estimations of amount of waste discharge, relative amount of irrigated agricultural use compared to other land uses in the geographic area, and pesticide use.

<sup>57</sup> During this process, there would be opportunity for public input.



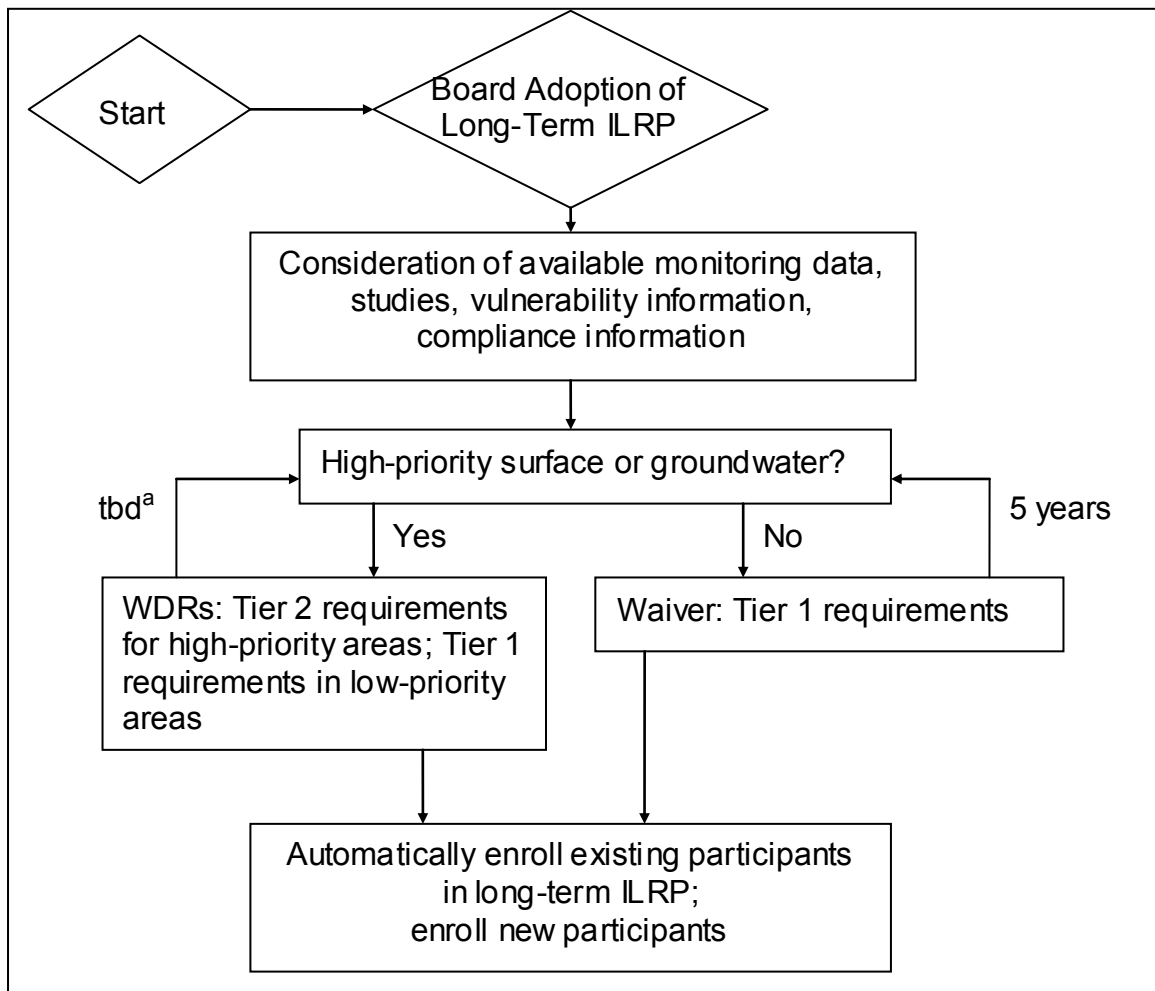
water quality concern). Area priority may be re-classified by the Central Valley Water Board based on review of new information collected during program implementation (see feedback loop in Figure 22).

### **Tier 1**

Tier 1 requirements would be applicable in low-priority areas described using the factors above. These requirements would be aimed to ensure that irrigated agricultural operations maintain or improve the existing level of water quality protection (e.g., maintain or improve existing management objectives unless they are found as not benefiting water quality). Management objectives would establish goals for water quality protection that irrigated agricultural operations would achieve through implementation of specific management practices. Operations would be required to continue achievement of current water quality protection (e.g., management objectives); however, the management practices that are used may change or evolve over time. This flexibility is especially important where a less expensive, perhaps more protective practice or technology becomes available that meets the same objective. The Central Valley Water Board does not wish to limit irrigated agricultural operations to singular practices, only to ensure that they continue meeting their existing level of water quality protection.

Under this tier, the Central Valley Water Board considers the existing level of management objectives as BPTC, and protective of surface and groundwater quality. Third-party groups are required to describe the area's existing water quality management objectives in a report to the Central Valley Water Board. Management practices tracking, every 5 years, would be the method by which the Central Valley Water Board would evaluate, in general, whether operations are continuing to meet existing management objectives.

**Figure 22. Flowchart Summarizing Proposed Prioritization Process**



<sup>a</sup> Reassessment time frame dependent on time schedule for compliance with water quality objectives.

## **Tier 2**

Tier 2 requirements would be applicable in high-priority areas.

### *High-Priority Surface Water*

Third-party group develop and implement an SQMP.

An SQMP must be developed for the watershed represented by the monitoring site for any parameter that exceeds water quality objectives two or more times in a 3-year period. Surface water quality management plans developed under the existing ILRP would be accepted under the long-term ILRP. Under SQMPs, irrigated agricultural operations are required to implement management practices

to achieve BPTC<sup>58</sup> of the constituent of concern. Monitoring and other collected information would be used to assess the effectiveness of management practices and whether BPTC has been achieved. Additional practices/monitoring may be necessary, in an iterative process, to address water quality concerns. Required elements of SQMPs are given in Appendix D.

Based on information provided by the third party and other interested stakeholders, the Central Valley Water Board's Executive Officer will: (1) approve the SQMP; (2) conditionally approve the SQMP and require revisions to address other surface waters or constituents of concern; (3) conditionally approve the SQMP and require other revisions necessary to meet program requirements and goals; or (4) disapprove the SQMP or portions of the SQMP. Review of the SQMP by the Central Valley Water Board and the associated action by the Executive Officer will be based on findings as to whether the SQMP meets program requirements and goals and contains the information required for a SQMP (see appendix D).

*Periodic Review of Approved SQMPs:* At least every 2 years, the Central Valley Water Board will meet with third-party groups and other interested parties to evaluate the sufficiency of SQMPs and to determine whether and, generally, how they should be updated to reflect priorities based on new information. The Executive Officer also may require revision of the SQMP based on available information indicating that exceedances of water quality objectives or degradation of surface water require the inclusion of additional surface water bodies or constituents of concern(s) in the SQMP. The general requirements for a SQMP are identified in Appendix D.

#### *High-Priority Groundwater*

Third-party group develop and submit for Central Valley Water Board approval a GQMP within 18 months of issuance of the geographic/commodity specific WDRs by the Central Valley Water Board [except in areas where a local groundwater management plan has been developed and approved (by the Central Valley Water Board) for substitution].<sup>59</sup> Under GQMPs or local groundwater management plans, irrigated agricultural operations would be required to implement management practices to achieve BPTC of the constituent of concern.<sup>60</sup> Monitoring and other collected information would be used to assess

---

<sup>58</sup> BPTC is considered here to comply with State Water Board Resolution 68-16, *State Antidegradation Policy*.

<sup>59</sup> Where local agencies have developed local groundwater management plans (e.g., AB 3030, SB 1938, Integrated Regional Water Management plans) that meet the requirements of GQMPs, the Central Valley Water Board may approve the local groundwater management plan to be substituted for the GQMP. However, irrigated agricultural operations still would be required to enroll with an approved third-party group. The third-party group would be the responsible lead entity for ILRP administration, monitoring and reporting.

<sup>60</sup> For example, where the constituent of concern is nitrate, and the discharge pathway of concern is leaching to groundwater, the GQMP would need to include nutrient budgeting and efficient irrigation. In such cases, plan implementation would be tracked, and groundwater monitoring data

the effectiveness of management practices and whether BPTC has been achieved. Additional practices/monitoring may be necessary, in an iterative process, to address water quality concerns.

As part of GQMP development, the third party would collect and evaluate available groundwater data, identify groundwater quality management areas (GMAs) of concern, identify constituents of concern in the GMAs, prioritize the GMAs and constituents of concern, identify agricultural practices that may be causing or contributing to the problem, and identify agricultural management practices that should be employed by local growers to address the constituents of concern. Based on information provided by the third party and other interested stakeholders, the Central Valley Water Board's Executive Officer will: (1) approve the GQMP; (2) conditionally approve the GQMP and require revisions to address other GMAs or constituents of concern; (3) conditionally approve the GQMP and require other revisions necessary to meet program requirements and goals; or (4) disapprove the GQMP or portions of the GQMP. Review of the GQMP by the Central Valley Water Board and the associated action by the Executive Officer will be based on findings as to whether the GQMP meets program requirements and goals and contains the information required for a GQMP (see appendix D).

*Periodic review of approved GQMPs:* At least every 5 years, the Central Valley Water Board will meet with third-party groups and other interested parties to evaluate the sufficiency of GQMPs, and to determine whether and, generally, how they should be updated to reflect priorities based on new information. The Executive Officer also may require revision of the GQMP based on available information indicating that exceedances of water quality objectives or degradation of groundwater require the inclusion of additional GMA(s) or constituents of concern(s) in the GQMP. The general requirements for a GQMP are identified in Appendix D.

Individual FWQMPs would be required if objectives are not met, improvements in water quality do not occur within the approved time schedule for implementation, or where irrigated agricultural operations are not implementing requirements in SQMPs/GQMPs. FWQMPs would be aimed to minimize waste (e.g., nutrients, pesticides, sediment, pathogens) discharge to surface water and groundwater (to include wellhead protection practices<sup>61</sup>)—this plan also would be kept on the site

---

and/or other information would be reviewed to determine whether program objectives are being met. Plan requirements may need to be iteratively adjusted based on program tracking/monitoring feedback.

<sup>61</sup> DPR has developed wellhead protection requirements for pesticides that are codified in California Code of Regulations, Title 3, Section 6609. Wellhead protection measures for the ILRP would include similar types of practices instituted to prevent other agricultural wastes (e.g., nutrients) from entering wellheads.

and submitted to the Central Valley Water Board/third-party group upon request. FWQMP requirements are summarized in Appendix D.<sup>62</sup>

### **Optional Certified Farm Water Quality Management Plan**

This is an **optional** program component that would not apply geographically, but at the individual farm level. In this option, the operation would implement a certified<sup>63</sup> FWQMP. It is envisioned that these plans would be developed by commodity groups or other third parties for operations with similar waste discharges; however, individual operations would be required to implement practices in the certified plan. Individual operations also could develop and implement their own certified FWQMP. The certified FWQMP must address discharges to both ground and surface water. Irrigated agricultural operations implementing certified plans would be considered lower priority because there has been on-farm verification (by an approved certifier) of practices implemented to control waste discharge to surface and ground water. The approved certifier(s) would be the lead entity for this option.

## **7. Monitoring provisions**

The general goals of the ground and surface water quality monitoring efforts are to determine:

- whether the discharge of waste from irrigated lands are in compliance with applicable water quality objectives, total maximum daily loads (TMDLs), and implementation plans in the Basin Plans;
- the extent of management practice implementation;
- the effectiveness of implemented management practices and whether those practices achieve BPTC;
- the effectiveness of any applicable regional ground or SQMP; and
- compliance with the requirements or conditions of applicable WDRs or waivers of WDRs.

---

<sup>62</sup> There may be cases where regional management plans fail to be effective at meeting the goals of the long-term ILRP. This could be attributable to a variety of reasons, such as individual grower refusal to participate in the regional management plan or third-party failure to implement plan objectives. In such cases, the Central Valley Water Board would need to ensure that program goals are achieved through establishing requirements at the individual operation level. This is mainly because the permitting and enforcement authorities of the Central Valley Water Board are applicable to the entity responsible for the waste discharge. Coalitions are third-party groups, not responsible for the waste discharge. This option would be exercised only as part of iterative enforcement where regional management plans have failed or enforcement directed toward individuals not in compliance is necessary. Certification of the individual plans would not be required.

<sup>63</sup> Certification includes Central Valley Water Board approved Certification Entity review and certification of the plan. As part of certification program, the Certification Entity would conduct an initial certification inspection and a minimum annual inspection frequency of 5% of operations with approved plans. Certification entities would report results to the Central Valley Water Board.



Monitoring requirements will be tailored to address the concerns specific to the areas or commodities for which they would apply. The monitoring requirements will be developed during the development of implementation mechanisms (WDRs, waivers). The Central Valley Water Board intends that regional monitoring programs would be coordinated with DPR surface and groundwater monitoring, local groundwater management plans, the Central Valley Water Board Dairy Program, and other existing programs. The primary goal of this coordination is to prevent duplicative monitoring programs. For example, existing water quality data (e.g., Surface Water Ambient Monitoring Program, SWAMP data; DPR groundwater data; etc.) could be used, and the monitoring parameters would be tailored to the farm inputs and water quality issues in the watershed or groundwater basin.

Areas with surface and/or groundwater quality problems (e.g., exceedance of water quality objectives, degradation of water quality), where irrigated agricultural operations have not been identified as a source but may be a potential contributor, would be required to work with the Central Valley Water Board and other potential sources (e.g., municipalities, dairies) to conduct monitoring and applicable source studies.

Areas with insufficient information available to determine prioritization would be required to complete assessment monitoring or studies within 5 years of long-term program adoption.<sup>64</sup> The goal of the assessment would be to determine whether irrigated agricultural operations are causing degradation of surface or groundwater quality. However, the Central Valley Water Board does not intend to monitor every water body in the Central Valley as part of the long-term ILRP. Therefore, “representative” monitoring and other information (see priority factors two and three above) will be considered first in tier classification.

### **Tier 1 and Optional Certified FWQMP**

#### *Surface Water*

Monitoring would consist of tracking of management practices and watershed-based assessment monitoring 1 year every 5 years (similar to the assessment monitoring required under the current ILRP). Monitoring and tracking results would be submitted in a report every 5 years to the Central Valley Water Board. Additional monitoring may be required where assessment monitoring identifies a water quality concern.

#### *Groundwater*

One year every 5 years, participate in regional groundwater monitoring program (see regional groundwater monitoring for Tier 2 below). Additional monitoring may be required where monitoring identifies a water quality concern.

---

<sup>64</sup> Date of Central Valley Water Board certification of Final PEIR and direction to implement recommended ILRP.

## **Tier 2**

### *Surface Water*

Watershed-based assessment and special project monitoring similar to the monitoring required under the current ILRP (Central Valley Water Board Order No. R5-2008-0005).

Under this monitoring scheme, third-party groups will work with the Central Valley Water Board to develop monitoring plans during the development of implementation mechanisms. These plans would specify monitoring parameters and site locations. Monitoring also would include gathering management practices tracking information from member growers and summarizing the information. Monitoring and tracking results would be submitted in an annual report to the Central Valley Water Board.

### *Groundwater*

Participate in regional groundwater monitoring. The Central Valley Water Board and third parties will engage and coordinate with local groundwater management agencies and other programs conducting groundwater monitoring in meeting this requirement so as to prevent duplication of monitoring. Regional groundwater monitoring would consist of the following components.

1. Regional monitoring for constituents of concern to provide baseline groundwater information and track trends in groundwater quality over time. Nutrient/pesticide application tracking and associated modeling may be used to evaluate discharges to groundwater in place of monitoring, where technically feasible and appropriate.
2. Targeted site-specific studies to evaluate the effects of changes in management practices on groundwater quality (this would occur only at a selected number of sites—the Fertilizer Research and Education Program [FREP] would be approached as a potential funding source for this monitoring).
3. Gathering management practices tracking information from member growers.
4. Submitting an annual report to the Central Valley Water Board summarizing management practice tracking and the regional and targeted site-specific monitoring results.
5. Using a database system to compile existing groundwater quality data and data collected during regional and site-specific monitoring (e.g., the GAMA/GeoTracker database may be a potential system).

Figure 23 illustrates how the Central Valley Water Board envisions the application of the prioritization scheme and associated requirements.

## 8. Time schedule for compliance<sup>65</sup>

Priority surface and groundwater quality issues are identified below and would be subject to the compliance time schedules described. It is likely that the practices to address the priority issues also will lead to improvement or achievement of objectives for the non-priority issues. Through periodic review of the ILRP, the Central Valley Water Board will determine whether additional compliance time schedules need to be established for the non-priority water quality issues.

The following general time schedules apply when irrigated lands are causing or contributing to a discharge that results in exceedances of water quality objectives. The Executive Officer or Water Board may modify these schedules based on evidence that meeting the compliance date is technically or economically infeasible (e.g., where irrigated agriculture demonstrates reduction in contributions, but cannot influence complete compliance because of other sources; where irrigated agriculture has implemented best practical treatment or control and water quality objectives are not achieved).

Management plan time schedules developed under the current ILRP would continue to apply in the long-term ILRP. Any other applicable time schedule for compliance or priorities established in the Central Valley Water Board's Basin Plans would take precedence over the schedules below.

### Priority Surface Water Quality Issues

1. Which water bodies are considered priority?—specific water bodies with beneficial uses identified in the Basin Plans; streams tributary to water bodies in the Basin Plan with aquatic life uses based on the “tributary rule”;<sup>66</sup> tributary streams with identified municipal or domestic drinking water intakes; water bodies with specific compliance time schedules established in the Basin Plans.
2. Which beneficial uses are considered priority?—aquatic life, drinking water, and human consumption uses<sup>67</sup> in the above water bodies.
3. Which pollutants are considered priority?—those pollutants that cause or contribute to a violation of water quality objectives associated with the priority beneficial uses and water bodies.

---

<sup>65</sup> The State Water Board's NPS Policy requires the establishment of a time schedule for compliance with water quality objectives.

<sup>66</sup> Resolution R5-2005-0137 describes the application of the tributary rule. Agricultural drains and other constructed conveyances (not identified in the Basin Plans) would not be considered priority.

<sup>67</sup> In the Basin Plans, the specific beneficial uses within these general categories include Warm Freshwater Habitat, Cold Freshwater Habitat, Estuarine Habitat, Preservation of Biological of Special Significance; Rare, Threatened, or Endangered Species; Migration of Aquatic Organisms; Spawning, Reproduction, and/or Early Development; Municipal and Domestic Supply; Commercial and Sport Fishing; Shellfish Harvesting; and Water Contact Recreation.

*Compliance time schedule—5 to 10 years.* For watershed areas with multiple water body/pollutant issues to address, compliance schedules may be staggered between 5 and 10 years, but cannot exceed 10 years.

### **Priority Groundwater Quality Issues**

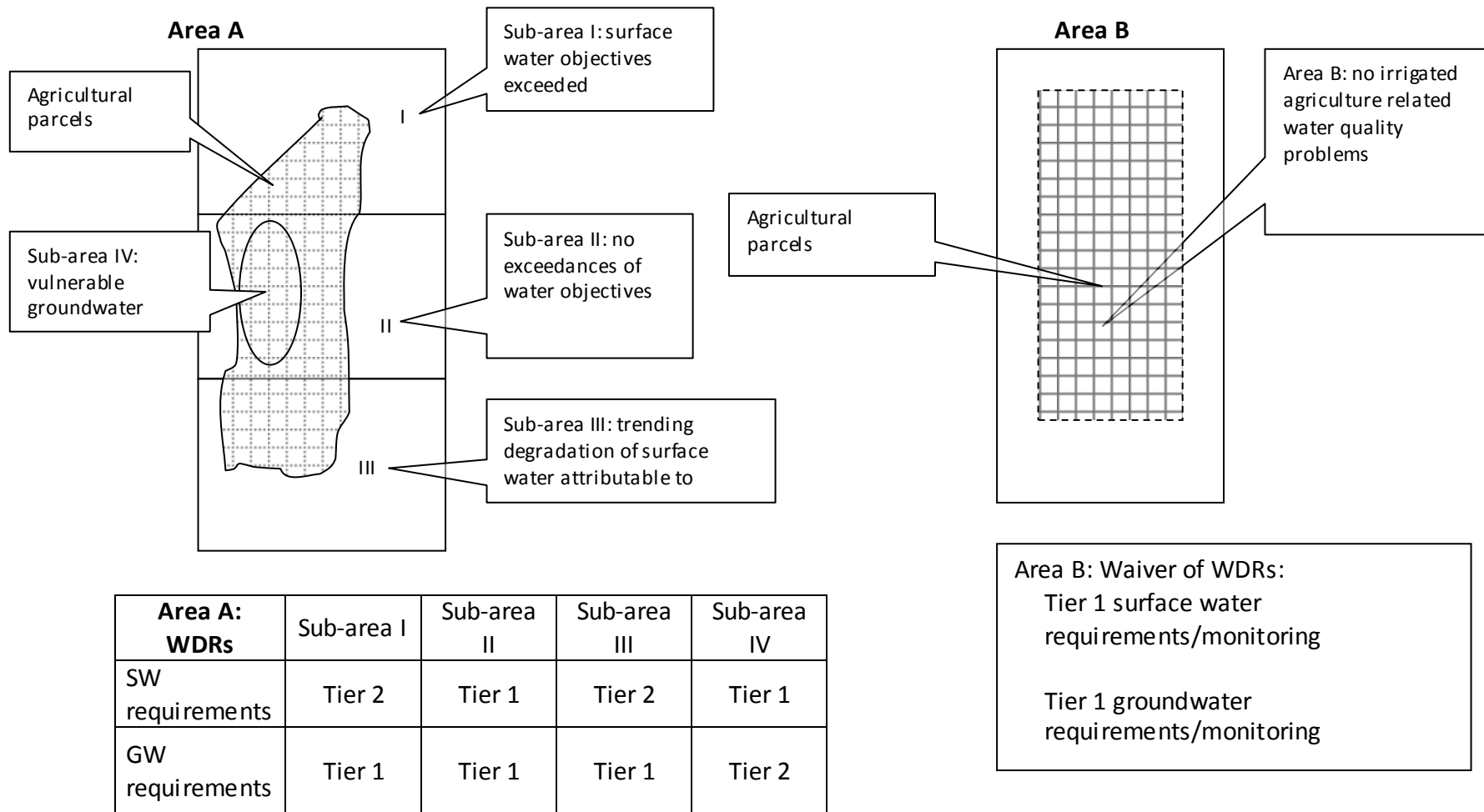
1. Which groundwater aquifers are considered priority?—aquifers with identified municipal or domestic drinking water wells; aquifers in which drinking wells were closed because of exceedances of water quality objectives.
2. Which beneficial uses are considered priority?—drinking water uses (i.e., municipal and domestic supply).
3. Which pollutants are considered priority?—those pollutants that cause or contribute to a violation of water quality objectives or degradation of groundwater quality associated with drinking water uses.

*Compliance time schedule—5 to 10 years.* For areas with multiple aquifer/pollutant issues to address, compliance schedules may be staggered between 5 and 10 years, but cannot exceed 10 years. Compliance is considered to be demonstrated improvement in water quality or reduction in discharge based on evaluation of available data of first encountered groundwater in the high-priority aquifer. However, with Central Valley Water Board approval, compliance can be demonstrated through documented implementation of management practices, assessment of water quality data, and/or groundwater quality modeling.

## **9. Fees**

Fees charged will be dependent on the amount of State funding allocated through legislative appropriation and the State Water Board's analysis of the level of staff effort required to implement the program. The Central Valley Water Board will recommend that the fee structure reflect the differing levels of effort for the different tiers and oversight of irrigated agricultural operations as individuals versus as part of a third-party group.

**Figure 23. Long-Term ILRP Prioritization Scheme Example**





## **XI. EVALUATION OF RECOMMENDED LONG-TERM IRRIGATED LANDS REGULATORY PROGRAM**

In this section the recommended ILRP is evaluated for consistency with the evaluation measures considered in [Section IX](#). The measures include: program goals and objectives, CWC, NPS Policy, and State Antidegradation Policy. The recommended ILRP has been developed using the components of Alternatives 1–5. The evaluation in this section is based on the results of the evaluation of the five alternatives conducted in [Section IX](#). In order to fully understand the evaluation conducted in this section, the reader should be familiar with, and is referred to [Section IX](#).

The qualitative system described in [Section IX](#) is used to establish a measure of how well the recommended alternative fulfills the evaluation measures. The qualitative system is based on whether alternatives are expected to meet existing requirements (i.e., would the alternative be consistent with goals/policy/laws).

In addition to the evaluation, [Sections XI.B–D](#) provide a discussion of (1) how effectively the Central Valley Water Board could administer the recommended ILRP, (2) estimated economic impacts of the recommended ILRP, and (3) anticipated environmental impacts of the recommended ILRP.

### **A. Consistency with Program Goals and Objectives and Policies**

The qualitative scoring system for the goals and objectives and policy evaluation measures uses the following factors:

- recommended alternative is consistent with the requirement,
- recommended alternative is partially consistent with the requirement, and
- recommended alternative is not consistent with the requirement.

#### **1. Program Goals and Objectives**

In this section, the recommended alternative is evaluated against the goals and objectives of the long-term program—considering the results of the full evaluation of Alternatives 1–5 ([Section IX.A](#)). Goals 1, 2 and Objectives 1, 2 are similar in nature and have been evaluated together; Goals 3, 4 have been evaluated separately, and Objectives 4, 5 have been evaluated together.

#### **Consideration of Goals 1, 2 and Objectives 1, 2**

See [Section VII.B](#) for a description of these goals and objectives. The evaluation of Alternatives 1–5, conducted in [Section IX.A.1](#), stated that successful implementation of management measures will work to achieve Goals 1, 2 and Objectives 1, 2. Alternatives requiring implementation of management measures for surface and groundwater were found to be consistent with these goals and

objectives. The recommended long-term ILRP will require that third-party groups develop regional surface and groundwater management plans. These plans would specify management measures that would work to restore and/or maintain the highest reasonable surface and groundwater quality. Irrigated agricultural operations would be required to implement management measures identified in the plans. *The recommended long-term ILRP is consistent with Goals 1, 2 and Objectives 1, 2.*

### **Consideration of Goal 3**

Goal 3 requires that the Central Valley Water Board consider the economic impacts of each alternative on the overall viability of agriculture throughout the Central Valley. The Board contracted an economic analysis to evaluate whether alternatives are consistent with this goal. [Section XI.C](#) (Recommended ILRP Economic Impacts) of this report provides a discussion of costs and consideration of how well the recommended ILRP meets this goal.

### **Consideration of Goal 4**

Goal 4 requires that the ILRP ensure that irrigated agricultural discharges do not impair Central Valley communities' and residents' access to safe and reliable drinking water. The evaluation of Alternatives 1–5, conducted in [Section IX.A.1](#), described that key factors in evaluating the alternatives for consistency with Goal 4 include whether groundwater quality management measures would be required. Alternatives 2–5 were found to be consistent with Goal 4. Under the recommended ILRP, third-party groups would develop regional surface and groundwater management plans (similar to the plans required under Alternative 2, with additional requirements to develop individual plans where regional management is ineffective). These plans would specify management measures that would work to restore and/or maintain the highest reasonable surface and groundwater quality. The recommended long-term ILRP would include requirements to implement management measures to protect surface and groundwater quality and ultimately work to promote reliable drinking water sources for Central Valley communities. *The recommended ILRP is consistent with Goal 4.*

### **Consideration of Objective 3**

The evaluation of Alternatives 1–5, conducted in [Section IX.A.1](#), describes that factors for consistency with Objective 3 include whether the ILRP would provide incentives for operations to minimize waste discharge. Alternatives that provide reduced oversight and monitoring for lower-priority/threat operations were found to be consistent with this objective (Alternatives 2–4). The recommended ILRP provides a prioritization system that would allow reduced monitoring, fees, and management requirements in lower-priority areas (similar to the prioritization systems given in Alternatives 2 and 4). *The recommended ILRP is consistent with Objective 3.*

## Consideration of Objectives 4, 5

Objectives 4, 5 essentially require that the ILRP promote coordination with Central Valley Water Board programs and other regulatory and non-regulatory agencies. As described in [Section IX.A.1](#), ILRP management at the regional level would likely better facilitate coordination with other programs and agencies. Management at the farm level would not work to promote coordination with other Water Board programs and regulatory and non-regulatory agencies (e.g., tens of thousands of individual FWQMPs would be much more difficult to coordinate than regional management plans). Because of the proposed regional approach, Alternatives 1 and 2 are consistent with Objectives 4, 5, While the individual approach described in Alternatives 3–5 (e.g., individual FWQMPs) is partially consistent with the objectives (coordination can occur with some difficulty). The recommended ILRP will be managed at the regional level, similar to Alternatives 1 and 2. *The recommended ILRP is consistent with Objectives 4, 5.*

## 2. California Water Code

Table 9 summarizes CWC requirements for developing a long-term program for irrigated agricultural waste discharges. As shown in the table, requirements vary depending on the regulatory mechanism the Central Valley Water Board adopts to establish program requirements (implementation mechanism). Under the recommended ILRP, the Central Valley Water Board will adopt waivers of WDRs in low-priority areas, WDRs in higher-priority areas, and a Basin Plan conditional prohibition of discharge. As the Board will be adopting all of the three mechanisms, the recommended ILRP is evaluated against each of the CWC requirements regardless of the mechanisms for which it would apply.

### Consideration of California Water Code Sections 13263 and 13269

In general, these sections of the CWC require that implementation mechanisms be consistent with any applicable State or regional water quality control plan; in the public interest; include the performance of individual, group, or watershed-based monitoring unless the Central Valley Water Board waives the monitoring because the discharge(s) do not pose a significant threat to water quality; take into consideration the beneficial uses to be protected and the water quality objectives reasonably required for that purpose; other waste discharges; the need to prevent nuisance; and the provisions of Section 13241.

ILRP components that would work to achieve the above requirements, as described in [Section IX.A.2](#), include requirements to develop surface and groundwater management plans and monitoring. Alternatives 2–5 were found to be consistent with these sections of the CWC. Alternative 1 is not consistent, mainly because of lack of requirements to protect groundwater beneficial uses. The recommended ILRP would include requirements to develop surface and groundwater management plans (similar to Alternative 2) and monitoring requirements (similar to Alternative 4). *The recommended ILRP is consistent with these sections of the CWC.*

### **Consideration of California Water Code Section 13241**

CWC Section 13263 requires that six factors listed under Section 13241 be considered in the development of those components of the long-term ILRP relying on WDRs (see [Section IX.A.2](#) for a description of the components). These factors will not need to be considered for the full recommended program, only for WDRs developed. The recommended ILRP will include development of WDRs for high-priority areas. *Because WDRs for the recommended ILRP will incorporate a consideration of Section 13241 factors, the ILRP is considered to be consistent with Section 13241 of the CWC.*

### **Consideration of California Water Code Section 13141**

CWC Section 13141 requires that:

*— .prior to implementation of any agricultural water quality control program, an estimate of the total cost of such a program, together with an identification of potential sources of financing, shall be indicated in any regional water quality control plan.”*

The recommended ILRP includes a Basin Plan amendment (as part of the conditional prohibition of discharge). The estimated total cost of the recommended ILRP is described below in [Section XI.C.1](#) (Recommended ILRP Economic Impacts). Potential sources of financing are described above in [Section IX.C.3](#) of this report. The estimated total cost and potential sources of financing will be incorporated into the Basin Plans. *The recommended ILRP is consistent with Section 13141 of the CWC.*

## **3. Nonpoint-Source Policy**

The recommended ILRP would regulate waste discharges from irrigated agricultural lands to State waters as an NPS program. Accordingly, the long-term ILRP must meet the provisions of the State Water Board's NPS Policy. The NPS Policy is described in [Section IV.C](#) of this document. In this section, the recommended ILRP is evaluated against the five key elements of the NPS Policy in light of the full evaluation of Alternatives 1–5 (see [Section IX.A.3](#)).

### **Consideration of Key Element 1**

The evaluation in [Section IX.A.3](#) found that Alternatives 1–5 all meet the requirements of Key Element 1. This is mainly because the key element requires, in part, that the NPS control implementation program's ultimate purpose be explicitly stated (other portions of this key element are evaluated as part of other sections, see [Section IX.A.3](#) for more information). The purpose of the long-term program is explicitly stated in the Goals and Objectives. As given in the Goals and Objectives, the ultimate purpose of all program alternatives is the same. *All program alternatives, including the recommended ILRP, are consistent with this requirement.*

## Consideration of Key Element 2

In general, Key Element 2 requires that an NPS implementation program include a description of the management practices expected to be implemented to ensure attainment of the program's purpose (goals and objectives), and the process used to select and ensure proper implementation of management practices. Successful implementation of water quality management measures will work toward achieving the goals and objectives of the long-term program. The Draft PEIR and Draft ILRP Economics Report discuss the types of management practices that may be implemented for all of the alternatives, including the recommended ILRP. ILRP components that would work to achieve consistency with Key Element 2 include water quality management plans to protect surface and groundwater and tracking of implemented practices. Alternatives 2–5 are consistent with Key Element 2 because they include requirements to develop surface and groundwater quality management plans and mechanisms to ensure implementation of practices (tracking, inspections). The recommended ILRP includes requirements to develop surface and groundwater quality management plans and tracking requirements to verify implementation. *The recommended ILRP is consistent with Key Element 2.*

## Consideration of Key Element 3

If the Central Valley Water Board determines that it is necessary to allow time to achieve water quality requirements in an NPS program, Key Element 3 requires that the program include a time schedule with quantifiable milestones. In [Section IX.A.3](#), Alternatives 2–5 were found to be consistent with this element because time schedules would be included in surface and groundwater quality management plans. Alternative 1 is not consistent with this element because there are recognized exceedances of groundwater quality objectives (e.g., nitrates), and the alternative would not require groundwater protection requirements or a time schedule for working toward achieving water quality objectives. *The recommended ILRP includes a time schedule for working to achieve water quality objectives and therefore is consistent with Key Element 3.*

## Consideration of Key Element 4

Key Element 4 requires that an NPS program include feedback mechanisms so that the Central Valley Water Board, regulated operations, and the public can determine whether the program is effective. In [Section IX.A.3](#), only Alternatives 4 and 5 were found to be fully consistent with this key element. This is because Alternatives 4 and 5 include surface and groundwater quality monitoring to provide feedback on whether the ILRP is meeting goals and objectives (e.g., maintaining beneficial uses). The recommended long-term ILRP includes regional surface and groundwater quality monitoring similar to Alternative 4. *The recommended ILRP is consistent with Key Element 4.*



## Consideration of Key Element 5

Key Element 5 requires that the Central Valley Water Board make clear, in advance, the potential consequences for failure to achieve an NPS control implementation program's stated purposes.

Compliance with this element is the responsibility of the Central Valley Water Board. The potential consequences for failure to achieve the long-term ILRP's stated purpose would be the same regardless of the chosen program alternative and would include the following steps:

1. require, in an iterative process, additional monitoring information, and/or management practices where water quality objectives are not being met;
2. specify enforcement action where iterative process is unsuccessful, program requirements are not met, or time schedules are not met; and
3. require submittal of an ROWD to work individually with the Central Valley Water Board.

*The Central Valley Water Board will ensure consistency with Key Element 5 by including the above potential consequences in waivers and WDRs adopted to implement the ILRP.*

### 4. Antidegradation

Applicable antidegradation provisions and the ILRP's strategy for meeting the provisions are described in Sections [IV.E](#) and [IX.A.4](#) of this report. Generally, to be consistent with antidegradation provisions, the ILRP must include the following programmatic approach:

***Implementation of the program must work to achieve site-specific antidegradation requirements through iterative implementation of BPTC and representative monitoring (e.g., where monitoring indicates degradation, BPTC would evolve to prevent such degradation).***

In [Section IX.A.4](#), only Alternatives 4 and 5 were found to be fully consistent with antidegradation provisions. Alternative 2 was found to be partially consistent with antidegradation requirements. This is because the regional surface and groundwater management plan approach would require implementation of management practices where there are exceedances of water quality objectives, whereas the antidegradation provisions require implementation of management practices (BPTC) where degradation is occurring. Also, inconsistent with the programmatic approach described above, Alternative 2 would not require groundwater quality monitoring. The recommended ILRP includes Alternative 2's regional ground and surface water management approach, but includes (1) provisions to ensure that management practices (BPTC) would be required

where degradation is occurring, and (2) regional surface and groundwater monitoring similar to Alternative 4. *The recommended ILRP is consistent with the antidegradation approach.*

## **B. Recommended Irrigated Lands Regulatory Program Predicted Effectiveness of Administration Based on Existing Programs**

This section provides a discussion of how effectively the Central Valley Water Board could administer the recommended ILRP. This discussion is based on the evaluation and discussion conducted on Alternatives 1–5 in [Section IX.B](#).

The lead entity structure and regional management approach of the recommended ILRP are similar to Alternative 2. Accordingly, it is anticipated that the effectiveness of administration challenges for third-party frameworks (Alternatives 1 and 2) would be similar for the recommended ILRP. However, the recommended ILRP includes additional transparency and individual management plan enforcement requirements aimed to ensure the effectiveness of the third-party framework. These additional measures are described below.

### **Enrollment and Transparency Requirements**

As described in [Section IX.B](#), enforcement of program requirements can be difficult in the third-party framework. This is because the Board cannot enforce program requirements directly upon the third party; rather, enforcement must be conducted directly upon the irrigated agricultural operations. There may be cases where the individual operations may be unaware of third-party non-compliance, and also unaware of program requirements. This potential problem is mitigated in the recommended ILRP by (1) requiring individual operations to enroll directly with the Central Valley Water Board so that they are aware of the program and requirements, (2) requiring that third-party groups provide the Board with information regarding non-compliant operations, and (3) requiring that third-party groups provide transparency and communication of requirements with growers.

### **Individual Water Quality Plans Where Regional Approach is Ineffective**

In the proposed regional water quality management plan approach, the Board would not have a direct relationship with each irrigated agricultural operation (the entity discharging waste) and would not have information regarding the specific method(s) and practices the operation has or plans to implement to work toward solving identified water quality concerns. This potential problem is mitigated in the long-term ILRP by requiring, where a regional water quality plan is ineffective, that individual water quality management plans be developed as an enforcement step.

With the above requirements, the recommended ILRP is estimated to have the effectiveness of administration benefits described in [Section IX.B](#) for Alternatives 1 and 2 (e.g., regional management efficiencies), with added enforcement

effectiveness similar to the direct implementation approach described for Alternative 5.

Because the recommended ILRP includes the third-party, regional administration framework, almost identical to Alternative 2, Central Valley Water Board staffing levels are anticipated to be similar to Alternative 2. One difference that must be considered is that the long-term ILRP would require that the Central Valley Water Board develop a series of 8–12 WDRs and waivers. Developing these implementation mechanisms will involve considerable staff time.

Alternative 2 does not contain a measure of how many waivers or WDRs would be developed, but the underlying assumption is that there would be a couple of mechanisms that would have multiple requirements to address the different conditions found throughout the Central Valley. Having multiple implementation mechanisms likely would require more staff time up front, as requirements are developed and adopted by the Central Valley Water Board. However, as some of the requirements need to be reevaluated, the evaluation need not include the entire Central Valley program, as would be the case under Alternative 2, only specific geographic areas that need reevaluation. This will work to reduce staffing costs in the long run. Also, the amount of staff work involved with developing an implementation mechanism that could fit the many conditions found throughout the Central Valley under Alternative 2 actually may be comparable to developing a series of smaller, more manageable implementation mechanisms. For these reasons, the staffing levels for the recommended ILRP are estimated to be similar to that described for Alternative 2 (see economics report for Alternative 2 staffing costs).

## **C. Recommended Irrigated Lands Regulatory Program Economic Impacts**

### **1. Estimated costs**

The recommended ILRP contains the third-party lead entity structure, regional surface and groundwater management planning, and regional surface water quality monitoring approach similar to Alternative 2; management practices tracking and regional groundwater monitoring similar to Alternative 4; and a tiering system based on systems described by Alternatives 2 (watershed or area management objectives plan) and 4 (pesticide and nutrient use). Therefore, overall potential costs of the recommended ILRP are estimated using the costs for these components of Alternatives 2 and 4 given in Tables 2-19 and 2-21 of the economics report.<sup>68</sup> Estimated costs of management practices implementation are equal for Alternatives 2–4.

---

<sup>68</sup> The recommended ILRP provides the option for individual operations to develop certified water quality management plans in order to obtain reduced monitoring and reporting requirements.

Total administrative costs are estimated to be similar to the costs shown for Alternative 2 in Table 2-19 of the economics report (average \$0.15 per acre annually—greater than Alternative 1).<sup>69</sup> Total surface water monitoring and reporting costs are estimated to be similar to the costs shown for Alternative 2 (no change from Alternative 1). Total regional groundwater monitoring and reporting costs are estimated to be similar to the costs shown for Alternative 4 in Table 2-21 of the economics report minus the Tier 3 individual monitoring (average \$0.96 per acre annually—greater than Alternative 1). Tracking costs are estimated to be similar to the costs shown for Alternative 4 in Table 2-21 of the economics report (average \$0.42 per acre annually—greater than Alternative 1). Estimated management practices costs are equal under Alternatives 2 and 4 (average \$0.27 per acre annually—greater than Alternative 1). Estimated average per acre annualized costs relative to full implementation of Alternative 1 (for the recommended ILRP) are summarized below.

|                                          |                                        |
|------------------------------------------|----------------------------------------|
| Administration                           | \$0.15 per acre annually               |
| Monitoring and reporting                 | \$0.96 per acre annually               |
| Tracking                                 | \$0.42 per acre annually               |
| Management practices                     | \$0.27 per acre annually               |
| Total estimated additional cost per acre | \$1.79 per acre annually <sup>70</sup> |

The total estimated cost of the recommended ILRP, 492 million dollars per year, is greater than Alternative 2 (485 million dollars per year) but less than Alternative 4 (511 million dollars per year) and is 2.9 percent greater than Alternative 1 (see Table 17 for estimated costs of each alternative).

As described in the economics report and [Section IX.C](#) of this report, stated potential costs for management practices are likely an overestimate.

## 2. Consideration of ILRP Goal 3—Economic Impacts

Goal 3 requires that the economic viability of agriculture in California's Central Valley be maintained. In [Section IX.C.2](#), Alternatives 1, 2, and 4 were found to be consistent with Goal 3. Alternative 3 is partially consistent with Goal 3, and Alternative 5 is not consistent with Goal 3 because of predicted economic impacts on agriculture resulting from the substantial predicted cost increase. Total estimated costs to agricultural operations/State of the recommended ILRP are greater than Alternative 2, but less than Alternative 4. Both Alternatives 2 and 4 are consistent with Goal 3. *Therefore, the recommended ILRP is consistent with Goal 3.*

---

Because this is not a mandatory requirement of the recommended ILRP, potential costs of that option are not reflected in this analysis.

<sup>69</sup> Per acre average changes from full implementation of Alternative 1 (continuation of the current program) have been computed by subtracting Alternative 1 costs from recommended ILRP costs and dividing by the estimated irrigated agricultural acreage shown in Table 16 of this report.

<sup>70</sup> Totals may not sum as a result of rounding.

[Section IX.C.2](#) of this report also summarizes estimated regional changes in total irrigated acreage, value of production, and jobs in the Central Valley attributable to implementation of Alternatives 2 and 4. It is estimated that predicted changes from implementation of the recommended ILRP would be bracketed by the changes predicted for Alternatives 2 and 4. Recommended ILRP estimated changes in total irrigated acreage, value of production, and jobs relative to Alternative 1 are summarized below (see Tables 19–21 of this report).

|                     |                                          |
|---------------------|------------------------------------------|
| Irrigated acreage   | -0.2%                                    |
| Value of production | -0.1%                                    |
| Jobs (lost/gained)  | -58 (Alternative 2) to 9 (Alternative 4) |

#### **D. Recommended Irrigated Lands Regulatory Program Environmental Impacts**

Potential significant environmental impacts of all five alternatives are associated with implementation of water quality management practices, construction of monitoring wells, and potential loss of agriculture resources. Loss of agricultural resource lands has been estimated using economic modeling procedures, considering the potential costs of each alternative. Alternatives with lower costs are estimated to result in less loss of agriculture resources (see [Section IX.C.2](#)). Additionally, Alternative 1 may have significant environmental impacts on groundwater quality because of failure to institute requirements to protect groundwater quality.

As described above, the recommended ILRP has been developed from the components of Alternatives 2 and 4. Management practices implemented under the recommended ILRP are estimated to be the same as those implemented under Alternatives 2 and 4. Therefore, potentially significant environmental impacts associated with implementation of management practices for the recommended ILRP are in the range of those described for Alternatives 2 and 4 in the Draft PEIR. Similarly, potentially significant impacts on agriculture resources under the recommended ILRP would be in the range of those estimated under Alternatives 2 and 4.

The recommended ILRP may result in significant impacts under certain conditions, for the following resource areas\* (described in the Draft PEIR and summarized in [Section IX.D](#) of this report):

- cultural resources (potential loss of resources from construction and operation of practices and monitoring wells);
- noise and vibration (exposure of sensitive land uses to noise from construction and operation of practices and monitoring wells);
- air quality (generation of construction and operational emissions from management practices and monitoring wells);



- climate change (cumulative: potential increase in greenhouse gas emissions);
- vegetation and wildlife (loss of habitat, wildlife, wetland communities from reduced surface water discharge, construction, and operation of practices and monitoring wells);
- fisheries (loss of habitat from construction of management practices and monitoring wells, toxicity attributable to coagulant additives); and
- agriculture resources (potential loss of Prime Farmland).

\* a generalized summary of affected resource areas. The reader is directed to the Draft PEIR for specific impacts and discussion.

The identified potential impacts of implementing management practices and construction of monitoring wells are indirect, and can be avoided through the employment of alternate practices (e.g., altered use of a pesticide rather than construction of a tailwater return system). Where no alternate practice or less sensitive location for the practice exists, irrigated agricultural operations that choose to employ these practices would be directed to avoid impacts to sensitive resources by following project-level mitigation measures that will be required for a grower to qualify for coverage under the implementation mechanism (e.g., WDRs/ waivers) of the chosen ILRP alternative. Specific mitigation measures will be identified<sup>71</sup> in conjunction with the Board's development of the ILRP implementation mechanisms. Performance standards for development of such mitigation, and program-level mitigation measures, are discussed in each resource section of the PEIR. The recommended ILRP contains the following programmatic strategy as an environmental commitment intended to reduce the potential for significant impacts to sensitive resources:

*Where an irrigated agricultural operation/third-party group determines that a proposed management practice/monitoring well may impact a sensitive resource, the ILRP will require that the irrigated agricultural operation/third party (1) select a different management practice (or location of practice/monitoring well) that meets water quality goals, but does not involve impacts on a sensitive resource, or (2) implement the mitigation measures described in the implementation mechanism (e.g., WDRs/ waiver) for the potentially affected resource, or (3) work with the Central Valley Water Board to obtain an individual waste discharge permit and site-specific CEQA analysis.*

Inclusion and implementation of this requirement in ILRP implementation mechanisms would reduce the significant impacts described above, except for climate change and agriculture resources, to less than significant. Due to the

---

<sup>71</sup> Such mitigation measures will include those identified in the PEIR and may include other mitigation measures necessary to meet the mitigation performance measures described in the PEIR. Should any additional identified mitigation measures potentially cause environmental impacts, additional environmental impact analysis will be conducted.

unavailability of enforceable mitigation, the identified impacts to the areas of climate change and agriculture resources, which may result from anticipated regulatory compliance actions, are considered significant and unavoidable at the programmatic level.

## **XII. NEXT STEPS**

Five programmatic long-term ILRP alternatives have been considered in the Draft PEIR, economics report, and policy analysis. The recommended long-term ILRP has been developed from the components of the five alternatives using the findings of these analyses.

Adoption of the long-term program will include Central Valley Water Board certification of the final PEIR and adoption of the policies and framework governing the long-term ILRP, as described above. Specific requirements will be established subsequently through Basin Plan amendments (e.g., for the conditional prohibition of discharge), requirements established in WDRs, or conditions established in waivers of WDRs. Those subsequent actions must be consistent with the general policies and framework established through the Board's adoption of the long-term program. However, the issuance of those specific orders or amendments may require additional environmental, cost, or policy analysis. To the extent such analysis is required, the appropriate supplemental documentation will be developed by staff and provided for public review.

The final PEIR and recommended long-term ILRP will be scheduled for a Central Valley Water Board hearing. At this hearing, the Board will consider:

1. the five programmatic alternatives,
2. the recommended program alternative,
3. the final PEIR and economics report,
4. this report, and
5. public comments

The Central Valley Water Board would have the option of certifying the PEIR and directing staff to implement the recommended long-term program at the hearing. Alternatively, the Board could direct staff to make changes to the recommended program, require changes be made to the PEIR, certify the PEIR and one or a combination of the five alternatives, or take no action.

## REFERENCES

- Agricultural Water Management Council. 2009. Efficient water management irrigation district achievements. Available:  
<http://www.agwatercouncil.org/Publications/AWMC-Final/menu-id-86.html>
- Anning, D.W., S.A. Thiros, L.M. Bexfield, T.S. McKinney, and J.M. Green. 2009. National Water Quality Assessment program, Southwest Principal Aquifers Regional Ground-Water Quality Assessment: US Geological Survey Fact Sheet 2009–3015, March 2009.
- Balazs C. 2008. Just Water? Social Disparities in Nitrate Contaminated Drinking Water in California's Central Valley, Doctoral Dissertation, University of California, Berkeley, CA.
- Bartholomay R.C., J.M. Carter, S.L. Qi, P.J. Squillace, and G.L. Rowe. 2007. Summary of Selected U.S. Geological Survey Data on Domestic Well Water Quality for the Centers for Disease Control's National Environmental Public Health Tracking Program: U.S. Geological Survey, Scientific Investigations Report 2007–5213, 57 p. Available:  
<http://pubs.usgs.gov/sir/2007/5213/downloads/sir2007–5213web.pdf>
- Barton L., L.A. Schipper, G.F. Barkle, M. McLeod, T.W. Speir, M.D. Taylor, A.C. McGill, A.P. van Schaik, N.B. Fitzgerald, and S.P. Pandey. 2005. Land Application of Domestic Effluent onto Four Soil Types: *Journal of Environmental Quality*, Vol. 34:p. 635–643.
- Bennett, G.L., K. Belitz, and B.J. Milby Dawson. 2006. California GAMA Program—Ground-water quality data in the northern San Joaquin basin study unit, 2005: U.S. Geological Survey Data Series 196, 122 p. Available:  
[http://pubs.usgs.gov/ds/2006/196/ds\\_196.pdf](http://pubs.usgs.gov/ds/2006/196/ds_196.pdf)
- Bowman, D.C., C.T. Cherney, and T.W. Ruffy, Jr. 2002. Fate and Transport of Nitrogen Applied to Six Warm-Season Turfgrasses: *Crop Science Society of America*, Vol. 42, p. 833–841.
- Brand, M.R., R.J. McAvoy, and E.G. Corbett. 1993. Nitrate loading to the soil profile underlying two containerized nursery crops supplied controlled release fertilizer: *Journal of Environmental Horticulture* Vol. 11, p. 82–85.
- British Geological Survey. 2009. Groundwater Information Sheet, The Impact of Agriculture: National Environmental Resource Council, 6 p.
- Burow, K.R., J.L. Shelton, and N.M. Dubrovsky. 1998. Occurrence of nitrate and pesticides in groundwater beneath three agricultural land-use settings in the eastern San Joaquin Valley, California: USGS Water-Resources Investigations Rep. 97-4284. USGS, Sacramento, CA

- Burow, K.R., S.V. Stork, and N.M. Dubrovsky. 1998. Nitrate and Pesticides in Ground Water in the Eastern San Joaquin Valley, California: Occurrence and Trends: USGS Water-Resources Investigations Rep. 98-4040A.
- Burow, K.R., N.M. Dubrovsky, and J.L. Shelton. 2007. Temporal trends in concentrations of DBCP and nitrate in groundwater in the eastern San Joaquin Valley, California, USA: *Hydrogeology Journal* (2007) 15: 991–1007.
- Burow, K.R., and C.T. Green. 2008. Spatial and Temporal Trends in Nitrate Concentrations in the Eastern San Joaquin Valley Regional Aquifer and Implications for Nitrogen Fertilizer Management, California Plant and Soil Conference: Conservation of Agricultural Resources, February 5 & 6, 2008, Visalia, California, 47–52 p.
- Burow, K.R., J.L. Shelton, N.M. Dubrovsky. 2008. Regional Nitrate and Pesticide Trends in Ground Water in the Eastern San Joaquin Valley, California: *Journal of Environmental Quality*, Vol. 37: 249–263 p.
- Burton, C.A., and K. Belitz. 2008. Ground-water quality data in the southeast San Joaquin Valley, 2005– 2006—Results from the California GAMA Program: U.S. Geological Survey Data Series 351, 103 p. Available: <http://pubs.usgs.gov/ds/351/>
- Buszka, P.M., L.R. Watson, and T.K. Greeman. 2006. Hydrogeology, Ground-Water-Age Dating, Water Quality, and Vulnerability of Ground Water to Contamination in a Part of the Whitewater Valley Aquifer System near Richmond, Indiana, 2002–2003: U.S. Geological Survey Scientific Investigations Report 2006–5281, 120 p. Available: <http://pubs.usgs.gov/sir/2006/5281/pdf/sir2006–5281.pdf>
- California Code of Regulations, Sections 21000–21194 (California Environmental Quality Act), 1970. Available: <http://www.leginfo.ca.gov/cgi-bin/waisgate?WAISdocID=6474966502+0+0+0&WALSaction=retrieve>
- California Code of Regulations, Sections 13000–16104 (Porter-Cologne Water Quality Control Act). 2010. Available: [http://www.waterboards.ca.gov/laws\\_regulations/docs/portercologne.pdf](http://www.waterboards.ca.gov/laws_regulations/docs/portercologne.pdf)
- California Department of Food and Agriculture. 1961–2008. Fertilizing Materials Tonnage Reports.
- California Department of Food and Agriculture. 1989. Nitrate and Agriculture in California: Nitrate Working Group, February 1989.
- California Department of Food and Agriculture, About Fertilizers, Criteria for Nitrate-Sensitive Areas, Map 2.

California Department of Food and Agriculture, *California Agricultural Resource Directory 2008–2009*.

California Department of Pesticide Regulation. Groundwater Protection Program. Available: <http://www.cdpr.ca.gov/docs/emon/grndwtr/index.htm>

California Department of Public Health. 2009. Proposition 84 Section 75022—Second Round Project Priority List Small Community Infrastructure Improvements for Chemical and Nitrate Contaminants.

California Environmental Protection Agency. 1997. Office of Environmental Health Hazard Assessment, public health goals for nitrate and nitrite in drinking water.

California Environmental Protection Agency. 2004. Intra-agency Environmental Justice Strategy. Available: <http://www.calepa.ca.gov/EnvJustice/Documents/2004/Strategy/Final.pdf>

California Natural Resources Agency. 2009. California Environmental Quality Act Guidelines. Available: <http://ceres.ca.gov/ceqa/guidelines/>

California Regional Water Quality Control Board, Central Coast Region. 2004. Order No. R3-2004-0117 Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands. Available: [http://www.waterboards.ca.gov/centralcoast/board\\_decisions/adopted\\_orders/2004/2004\\_0117\\_wdr\\_conditional\\_ag\\_waiver.pdf](http://www.waterboards.ca.gov/centralcoast/board_decisions/adopted_orders/2004/2004_0117_wdr_conditional_ag_waiver.pdf)

California Regional Water Quality Control Board, Central Coast Region. 2004. Monitoring and Reporting Program No. R3-2004-0117 for Dischargers Enrolled under Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands. Available: [http://www.waterboards.ca.gov/centralcoast/board\\_decisions/adopted\\_orders/2004/2004\\_0117\\_mrp\\_conditional\\_ag\\_waiver.pdf](http://www.waterboards.ca.gov/centralcoast/board_decisions/adopted_orders/2004/2004_0117_mrp_conditional_ag_waiver.pdf)

California Regional Water Quality Control Board, Central Valley Region. 1995 (rev. 2004). Water Quality Control Plan for the Tulare Lake Basin. Available: [http://www.waterboards.ca.gov/centralvalley/water\\_issues/basin\\_plans/index.shtml](http://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/index.shtml)

California Regional Water Quality Control Board, Central Valley Region. 1996. Grassland Bypass Project. Available: [http://www.waterboards.ca.gov/centralvalley/water\\_issues/grassland\\_bypass/](http://www.waterboards.ca.gov/centralvalley/water_issues/grassland_bypass/)

California Regional Water Quality Control Board, Central Valley Region. 1998 (rev. 2009). Water Quality Control Plan for the Sacramento and San Joaquin River Basins. Available: [http://www.waterboards.ca.gov/centralvalley/water\\_issues/basin\\_plans/index.shtml](http://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/index.shtml)



- California Regional Water Quality Control Board, Central Valley Region. 2006. Coalition Group Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands. Available:  
[http://www.waterboards.ca.gov/centralvalley/water\\_issues/irrigated\\_lands/index.shtml](http://www.waterboards.ca.gov/centralvalley/water_issues/irrigated_lands/index.shtml)
- California Regional Water Quality Control Board, Central Valley Region. 2007. Waste Discharge Requirements General Order No. R5-2007-0035 for Existing Milk Cow Dairies. Available:  
[http://www.waterboards.ca.gov/centralvalley/board\\_decisions/adopted\\_orders/general\\_orders/r5-2007-0035.pdf](http://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/general_orders/r5-2007-0035.pdf)
- California Regional Water Quality Control Board, Central Valley Region. 2008. Coalition Group MRP Plans, Irrigated Lands Regulatory Program. Available:  
[http://www.waterboards.ca.gov/centralvalley/water\\_issues/irrigated\\_lands/monitoring/monitoring\\_and\\_reporting\\_program\\_plans/index.shtml](http://www.waterboards.ca.gov/centralvalley/water_issues/irrigated_lands/monitoring/monitoring_and_reporting_program_plans/index.shtml)
- California Regional Water Quality Control Board, Central Valley Region. 2008. Staff Report, Regulation of Food Processing Waste Discharges to Land.
- California Regional Water Quality Control Board, Central Valley Region. 2009. Relative-Risk Evaluation for Pesticides Used in the Central Valley Pesticide Basin Plan Amendment Project Area, Final Staff Report. Available:  
[http://www.waterboards.ca.gov/centralvalley/water\\_issues/tmdl/central\\_valley\\_projects/central\\_valley\\_pesticides/risk\\_evaluation/index.shtml](http://www.waterboards.ca.gov/centralvalley/water_issues/tmdl/central_valley_projects/central_valley_pesticides/risk_evaluation/index.shtml)
- California Regional Water Quality Control Board, Central Valley Region, and Jones and Stokes. 2008. Irrigated Lands Regulatory Program Existing Conditions Report. Available:  
[http://www.waterboards.ca.gov/centralvalley/water\\_issues/irrigated\\_lands/long\\_term\\_program\\_development/rev\\_existing\\_conditions\\_report/](http://www.waterboards.ca.gov/centralvalley/water_issues/irrigated_lands/long_term_program_development/rev_existing_conditions_report/)
- California Regional Water Quality Control Board, Central Valley Region, and ICF Jones & Stokes. 2009. Long-term Irrigated Lands Regulatory Program Alternatives. Available:  
[http://www.waterboards.ca.gov/centralvalley/water\\_issues/irrigated\\_lands/long\\_term\\_program\\_development/ilrp\\_longterm\\_alts\\_final.pdf](http://www.waterboards.ca.gov/centralvalley/water_issues/irrigated_lands/long_term_program_development/ilrp_longterm_alts_final.pdf)
- California Regional Water Quality Control Board, Los Angeles Region. 2005. Order No. R4-2005-0080 Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands in the Los Angeles Region. Available:  
[http://www.waterboards.ca.gov/losangeles/water\\_issues/programs/tmdl/waivers/05\\_1220/order%20no.%20%20r4-2005-0080.pdf](http://www.waterboards.ca.gov/losangeles/water_issues/programs/tmdl/waivers/05_1220/order%20no.%20%20r4-2005-0080.pdf)

- California Regional Water Quality Control Board, Los Angeles Region. 2005. Monitoring and Reporting Program No. CI-8835 for Individual Dischargers under Order No. R4-2005-0080. Available:  
[http://www.waterboards.ca.gov/losangeles/water\\_issues/programs/tmdl/waivers/05\\_1220/mrp%20individual.pdf](http://www.waterboards.ca.gov/losangeles/water_issues/programs/tmdl/waivers/05_1220/mrp%20individual.pdf)
- California Regional Water Quality Control Board, Los Angeles Region. 2005. Monitoring and Reporting Program No. CI-8836 for Discharger Groups under Order No. R4-2005-0080. Available:  
[http://www.waterboards.ca.gov/losangeles/water\\_issues/programs/tmdl/waivers/05\\_1220/mrp%20group.pdf](http://www.waterboards.ca.gov/losangeles/water_issues/programs/tmdl/waivers/05_1220/mrp%20group.pdf)
- California Regional Water Quality Control Board, Lahontan Region. 2007. Resolution No. R6T-2007-0019 Waiver of Waste Discharge Requirements for Grazing Operations in the East Walker River Watershed (Bridgeport Valley and Tributaries) of the Lahontan Region. Available:  
[http://www.waterboards.ca.gov/lahontan/board\\_decisions/adopted\\_orders/2007/docs/r6t\\_2007\\_0019\\_grazingwaiverwdr.pdf](http://www.waterboards.ca.gov/lahontan/board_decisions/adopted_orders/2007/docs/r6t_2007_0019_grazingwaiverwdr.pdf)
- California Regional Water Quality Control Board, San Diego Region. 2007. Conditional Waiver No. 4—Discharges from Agricultural and Nursery Operations. Available:  
[http://www.waterboards.ca.gov/sandiego/board\\_decisions/waivers/docs/Conditional\\_Waiver\\_4\\_Final.pdf](http://www.waterboards.ca.gov/sandiego/board_decisions/waivers/docs/Conditional_Waiver_4_Final.pdf)
- California State Water Resources Control Board. 1968. Resolution No. 68-16, Statement of Policy with Respect to Maintaining High Quality of Waters in California. Available:  
[http://www.waterboards.ca.gov/board\\_decisions/adopted\\_orders/resolutions/1968/rs68\\_016.pdf](http://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/1968/rs68_016.pdf)
- California State Water Resources Control Board. 1981. Order No. WQ 81-5. Available:  
[http://www.swrcb.ca.gov/board\\_decisions/adopted\\_orders/water\\_quality/1981/wq1981\\_05.pdf](http://www.swrcb.ca.gov/board_decisions/adopted_orders/water_quality/1981/wq1981_05.pdf)
- California State Water Resources Control Board. 1982. Order No. WQ 82-5. Available:  
[http://www.swrcb.ca.gov/board\\_decisions/adopted\\_orders/water\\_quality/1982/wq1982\\_05.pdf](http://www.swrcb.ca.gov/board_decisions/adopted_orders/water_quality/1982/wq1982_05.pdf)
- California State Water Resources Control Board. 1987. Office of Chief Counsel Memorandum on the Federal Antidegradation Policy.
- California State Water Resources Control Board. 1990. Municipal Stormwater Program. Available:  
[http://www.waterboards.ca.gov/water\\_issues/programs/stormwater/municipal.shtml](http://www.waterboards.ca.gov/water_issues/programs/stormwater/municipal.shtml)

- California State Water Resources Control Board. 1990. Order No. WQ 90-6.  
Available:  
[http://www.swrcb.ca.gov/board\\_decisions/adopted\\_orders/water\\_quality/1990/wq1990\\_06.pdf](http://www.swrcb.ca.gov/board_decisions/adopted_orders/water_quality/1990/wq1990_06.pdf)
- California State Water Resources Control Board. 1992. Memorandum from the Office of Chief Counsel, State Water Resources Control Board, regarding implementation of State and Regional Water Board requirements at Federal facilities. July 7.
- California State Water Resources Control Board. 1994. Nutrient TAC Report: Nonpoint Source (NPS) Pollution Control Program, Plant Nutrient Management TAC, November 1994. Available:  
[http://www.swrcb.ca.gov/water\\_issues/programs/nps/docs/tacrpts/tac\\_nutrient.doc](http://www.swrcb.ca.gov/water_issues/programs/nps/docs/tacrpts/tac_nutrient.doc)
- California State Water Resources Control Board. 1997. Industrial Storm Water General Permit Order 97-03-DWQ. Available:  
[http://www.waterboards.ca.gov/water\\_issues/programs/stormwater/docs/induspmnt.pdf](http://www.waterboards.ca.gov/water_issues/programs/stormwater/docs/induspmnt.pdf)
- California State Water Resources Control Board. 1998. NPS/CZARA Fact Sheet No. 1: Agricultural Management Measures. Available:  
[http://www.waterboards.ca.gov/water\\_issues/programs/nps/docs/guidance/agricmms.pdf](http://www.waterboards.ca.gov/water_issues/programs/nps/docs/guidance/agricmms.pdf)
- California State Water Resources Control Board. 1999. General Permit for Discharges of Storm Water Associated with Construction Activity (Construction General Permit, 99-08-DWQ). Available:  
[http://www.waterboards.ca.gov/water\\_issues/programs/stormwater/docs/finalconstpermit.pdf](http://www.waterboards.ca.gov/water_issues/programs/stormwater/docs/finalconstpermit.pdf)
- California State Water Resources Control Board. 2000. Order No. WQ 2000-07.  
Available:  
[http://www.swrcb.ca.gov/board\\_decisions/adopted\\_orders/water\\_quality/2000/wq2000\\_07.pdf](http://www.swrcb.ca.gov/board_decisions/adopted_orders/water_quality/2000/wq2000_07.pdf)
- California State Water Resources Control Board, Division of Clean Water Programs, Groundwater Special Studies Unit, Groundwater Information Sheet—Nitrate/Nitrite Revised: October 23, 2002.
- California State Water Resources Control Board. 2004. Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program.  
Available:  
[http://www.waterboards.ca.gov/water\\_issues/programs/nps/docs/oalfinalcopy052604.doc](http://www.waterboards.ca.gov/water_issues/programs/nps/docs/oalfinalcopy052604.doc)

- California State Water Resources Control Board, Division of Water Quality, GAMA Program, Groundwater Information Sheet—Nitrate / Nitrite Revised: February 2008.
- California State Water Resources Control Board. 2009. Construction General Permit Order 2009-0009-DWQ. Available: [http://www.waterboards.ca.gov/water\\_issues/programs/stormwater/docs/cons\\_tpermits/wqo\\_2009\\_0009\\_complete.pdf](http://www.waterboards.ca.gov/water_issues/programs/stormwater/docs/cons_tpermits/wqo_2009_0009_complete.pdf)
- California State Water Resources Control Board. 2009. Water Quality Enforcement Policy. Available: [http://www.waterboards.ca.gov/water\\_issues/programs/enforcement/docs/enf\\_policy\\_final111709.pdf](http://www.waterboards.ca.gov/water_issues/programs/enforcement/docs/enf_policy_final111709.pdf)
- California State Water Resources Control Board, Septic Tanks Program. Available: [http://www.waterboards.ca.gov/water\\_issues/programs/septic\\_tanks/](http://www.waterboards.ca.gov/water_issues/programs/septic_tanks/)
- Centers for Disease Control and Prevention. 1995. A survey of the quality of water drawn from domestic wells in nine Midwest states. Atlanta: US Department of Health and Human Services.
- Colangelo, D.J., and M.H. Brand. 2001. Nitrate Leaching beneath a Containerized Nursery Crop Receiving Trickle or Overhead Irrigation: *Journal of Environmental Quality*, Vol. 30, p. 1564–1574.
- Daughton, C.G. 2007. Pharmaceuticals in the Environment: Sources and Their Management, Chapter 1, 1–58, *In Analysis, Fate and Removal of Pharmaceuticals in the Water Cycle* (M. Petrovic and D. Barcelo, Eds.), *Wilson & Wilson's Comprehensive Analytical Chemistry* series (D. Barcelo, Ed.), Volume 50, Elsevier Science, 564p.
- Dawson, B.J. 2001. Ground-Water Quality in the Southeastern Sacramento Valley Aquifer, California, 1996: U.S. Geological Survey, Water-Resources Investigations Report 01-4125, p.30.
- Dawson, B.J. 2001a, 2001. Shallow ground-water quality beneath rice areas in the Sacramento Valley, California, 1997: U.S. Geological Survey Water-Resources Investigations Report 2001-4000, 33p.
- Dawson, B.J., G.L.Bennett, and K. Belitz. 2008. Ground-Water Quality Data in the Southern Sacramento Valley, California, 2005—Results from the California GAMA Program: U.S. Geological Survey Data Series 285, 93 p. <http://pubs.usgs.gov/ds/285/ds285.pdf>

- Dinnes, D.L., D.L. Karlen, D.B. Jaynes, T.C. Kaspar, J.L. Hatfield, T.S. Colvin, and C.A. Cambardella. 2002. Nitrogen Management Strategies to Reduce Nitrate Leaching in Tile-Drained Midwestern Soils: *Agronomy Journal*, Vol. 94, p. 153–171.
- Domagalski, J.L., S.P. Phillips, E.R. Bayless, C. Zamora, C. Kendall, R.A. Wildman, and J.G. Hering. 2008. Influences of the unsaturated, saturated, and riparian zones on the transport of nitrate near the Merced River, California, USA: *Hydrogeology Journal*, 2008, vol.16, pp. 675–690.
- Dubrovsky, N.M., C.R. Kratzer, L.R. Brown, J.M. Gronberg, and K.R. Burow. 1998. Water quality in the San Joaquin–Tulare Basins, California, 1992–95: USGS Circ. 1159.
- Dubrovsky, N.M., S. Ator, R. Coupe, K. McCarthy, D. Lampe, M. Sandstrom, and N. Baker. 2008. Comparative Study of Transport Processes of Nitrogen, Phosphorus, and Herbicides to Streams in Five Agricultural Basins, USA: *Journal of Environmental Quality*, Vol. 37, p. 1158–1169.
- Eimers, J.L., and T.B. Spruill. 1997. Relating Minimum Soil Infiltration Rate to Nitrate-Nitrogen Concentrations in Shallow Ground Water in the Coastal Plain of Albemarle-Pamlico Drainage Basin, North Carolina and Virginia: Albemarle-Pamlico Estuarine Study Comprehensive Conservation and Management Plan Implementation Forum, June 5–6.
- Engelsjord, M.E., B.E. Branham, and B.P. Horgan. 2004. The Fate of Nitrogen-15 Ammonium Sulfate Applied to Kentucky Bluegrass and Perennial Ryegrass Turfs: *Crop Science Society of America*, Vol. 44, p. 1341–1347.
- Esser, B., B. Hudson, J. Moran, H. Beller, T. Carlsen, B. Dooher, P. Krauter, W. McNab, V. Madrid, D. Rice, and M. Verce. 2002. Nitrate Contamination in California Groundwater: An Integrated Approach to Basin Assessment and Resource Protection: Lawrence Livermore National Laboratory under Contract W-7405-ENG-48.
- Esser, B.K., H.R. Beller, S.F. Carle, G.B. Hudson, S.R. Kane, R.N. Leif, T.E. LeTain, W.M. McNab, and J.E. Moran. 2009. California GAMA Program: Impact of Dairy Operations on Groundwater Quality: Lawrence Livermore National Laboratory under Contract W-7405-ENG-48, August 17, 2009.
- Faunt, C.C., ed. 2009. Groundwater availability of the Central Valley Aquifer, California. U.S. Geological Survey Professional Paper 1766, 225 p.
- Fisher, L.H., and R.W. Healy. 2008. Water movement within the unsaturated zone in four agricultural areas across the United States: *Journal of Environmental Quality*, Vol. 37, p. 1051–1063.



- Frank, K.W., K.M. O'Reilly, J.R. Crum, and R.N. Calhoun. 2005. The Fate of Nitrogen Applied to a Mature Kentucky Bluegrass Turf: Crop Science Society of America, Vol. 46, p. 209–215.
- Fuhrer, G.J., Gilliom, R.J., Hamilton, P.A., Morace, J.L., Nowell, L.H., Rinella, J.F., Stoner, J.D., Wentz, D.A., . 1999. The Quality of our Nation's Waters: Nutrients and Pesticides: U.S. Geological Survey Circular; 1225.
- Gold, A.J., W.R. DeRagon, W.M. Sullivan, and J.L. Lemunyon. 1990. Nitrate-nitrogen Losses to Groundwater from Rural and Suburban Land Uses: *Journal of Soil and Water Conservation*, March–April 1990, Vol. 45, Number 2.
- Great Valley Center. 2009. The state of the Great Central Valley of California: supporting the economic, social, and environmental well-being of California's Great Central Valley. Great Valley Center, Modesto, CA.  
[http://www.greatvalley.org/artman2/uploads/1/econindicators09\\_final.pdf](http://www.greatvalley.org/artman2/uploads/1/econindicators09_final.pdf)
- Green, C.T., L.H. Fisher, and B.A. Bekins. 2008. Nitrogen Fluxes through Unsaturated Zones in Five Agricultural Settings across the United States: *Journal of Environmental Quality*, May–June 2008, Vol. 37, pp. 1073–1085.
- Haller, L, P. McCathy, T. O'Brien, J. Riehle, and T. Stuhldreher. 1996. Nitrate Pollution of Groundwater. <http://www.reopure.com/nitratinfo.html>
- Harter, T., H. Davis, M.C. Mathews, and R.D. Meyer. 2001. Monitoring Shallow Groundwater Nitrogen Loading from Dairy Facilities with Irrigated Forage Crops: American Society of Agricultural Engineers Meeting Presentation, ASAE Paper Number 01-2103, *2001 ASAE Annual International Meeting, Sacramento, CA, July 30–August 1, 2001*.
- Harter, T. 2003. Water Well Design and Construction, PUBLICATION 8086 University of California, Division of Agriculture and Natural Resources.  
[http://groundwater.ucdavis.edu/Publications/Harter\\_FWQFS\\_8086.pdf](http://groundwater.ucdavis.edu/Publications/Harter_FWQFS_8086.pdf)
- Harter, T., Y.S. Onsoy, K. Heeren, M. Denton, G. Weissmann, J.W. Hopmans, and W.R. Horwath. 2005. Deep vadose zone hydrology demonstrates fate of nitrate in eastern San Joaquin Valley: *California Agriculture*, Vol. 59, No.2, p.124–132.
- Harter, T. 2009. Agricultural Impacts on Groundwater Nitrate: Southwest Hydrology, July/August 2009, p. 22–23 and 35.
- Helperin, A.N., D.S. Beckman, and D. Inwood. 2001. California's Contaminated Groundwater—Is the State Minding the Store? : National Resources Defense Council, April 2001.

- Hull, L.C. 1984, Geochemistry of ground water in the Sacramento Valley, California. U.S. Geological Survey, Sacramento, CA. Professional paper 1401-B.
- ICF International. 2010. *Irrigated Lands Regulatory Program Program Environmental Impact Report EIR*. Draft. July. (ICF 05508.05.) Prepared for: Central Valley Regional Water Quality Control Board, Rancho Cordova, CA.
- ICF International. 2010. *Technical Memorandum Concerning the Economic Analysis of the Irrigated Lands Regulatory Program*. Draft. July. (ICF 05508.05.) Prepared for: Central Valley Regional Water Quality Control Board, Rancho Cordova, CA.
- Jagucki, M.L., B.C. Jurgens, K.R. Burow, and S.M. Ebets. 2009. Assessing the Vulnerability of Public-Supply Wells to Contamination: Central Valley Aquifer System near Modesto, California: U.S. Geological Survey Fact Sheet 2009-3036, April 2009.
- Johnson, B. 1991. Setting Revised Specific Numerical Values: Environmental Hazards Assessment Program, California Department of Food and Agriculture. <http://www.cdpr.ca.gov/docs/emon/pubs/ehapreps/eh9106.pdf>
- Johnston, W.E. and A.F. McCalla. 2004. Whither California: up, down, or out? Some thoughts about the future. Giannini Foundation Special Report 04-1.
- Kaown, D., Y. Hyun, G. Bae, and K. Lee. 2007. Factors Affecting the Spatial Pattern of Nitrate Contamination in Shallow Groundwater: *Journal of Environmental Quality*, Vol. 36 p. 1479–1487.
- Kendall, C. and J.J. McDonnell. 1998. Tracing nitrogen sources and cycling in catchments: *In Isotope Tracers in Catchment Hydrology*, Amsterdam, Elsevier, pp. 519–576.
- Kubin, E. 1998. Leaching of nitrate nitrogen into the groundwater after clear felling and site preparation: *Boreal Environmental Research*, Vol. 3, p. 3–8, July 1998.
- Law, N.L., L.E. Band, and J.M. Grove. 2004. Nutrient Input from Residential Lawn Care Practices: *Journal Environmental Planning and Management*, Vol. 47: p.737–755.
- Landon, M.K., and K. Belitz. 2008. Ground-water quality data in the Central Eastside San Joaquin Basin 2006: Results from the California GAMA Program: U.S. Geological Survey Data Series 325, 88 p.
- Landon, M.K., and M.S. Fram. 2009. Occurrence and Distribution of Nitrate in Groundwater in the Central Valley: presentation Irrigated Lands Regulatory Program Workshop, April 15, 2009.

- Lee, G.F. and A. Jones-Lee. 2007. Water Quality Issues of Irrigated Agricultural Runoff/Discharges San Joaquin River, Central Valley, California: *Agriculture and the Environment—2007 Conference*, Central Coast Agricultural Water Quality Coalition, Monterey, CA November 2007.
- Longe, E.O., and L.O. Enekwechi. 2007. Investigation on potential groundwater impacts and influence of local hydrogeology on natural attenuation of leachate at a municipal landfill: *International Journal of Science and Technology*, Vol. 4 (1), p. 133–140.
- Loper, C.A., K.J. Breen, T.M. Zimmerman, and J.W. Clune. 2009. Pesticides in ground water in selected agricultural land-use areas and hydrogeologic settings in Pennsylvania, 2003–07: U.S. Geological Survey Scientific Investigations Report 2009–5139, 121 p.  
<http://pubs.usgs.gov/sir/2009/5139/sir2009-5139.pdf>
- McNab, W.W., M.J. Singleton, J.E. Moran, and B.E. Esser. 2007. Assessing the Impact of Animal Waste Lagoon Seepage on the Geochemistry of an Underlying Shallow Aquifer: *Environmental Science & Technology*, Vol. 41, p. 753–758.
- Meixner, T., M.E. Fenn, and P.M. Wohlgemuth. 2003. Fire Disturbance and Nitrogen Deposition Impacts at the Watershed Scale in Southern California: U. S. Department of Agriculture, Agriculture Research Service, First Interagency Conference on Research in the Watersheds, Oct. 27–30, 2003.
- Mills, G.A., B. Vrana, I. Allan, D.A. Ivarez, J.N. Huckins, and R. Greenwood. 2007. Trends in monitoring pharmaceuticals and personal-care products in the aquatic environment by use of passive sampling devices: *Anal Bioanal Chem*, Vol. 387 p.1153–1157.
- Minnesota Department of Agriculture. 2006. A Co-occurrence of Nitrate and Pesticides.
- Moran, J.E., B.K. Esser, G.B. Hudson, and M.J. Singleton. 2005. The Effects of Agricultural Nitrate Sources on Groundwater Supplies in California: Geological Society of America *Abstracts with Programs*, Vol. 37, No. 7, p. 247, October 2005.
- Moran J.E., M.J. Singleton, S.F. Carle, and B.K. Esser. 2007. Intrinsic and Extrinsic Chemical and Isotopic Tracers for Characterization of Groundwater Systems: Illinois State Geological Survey: 3D workshop.  
<http://www.isgs.illinois.edu/research/3DWorkshop/2007/pdf-files/moran.pdf>
- Mueller, D.K., P.A. Hamilton, D.R. Helsel, K.J. Hitt, and B.C. Ruddy. 1995. Nutrients in Ground Water and Surface Water of the United States—An Analysis of Data through 1992. U.S. Geological Survey, Reston, VA. Water Resources Investigations Report 95-4031.

- Munoz-Arboleda, F., R. Mylavarapu, C. Hutchinson, and K. Portier. 2008. Nitrate-Nitrogen Concentrations in the Perched Ground Water under Seepage-Irrigated Potato Cropping Systems: *Journal of Environmental Quality*, Vol. 37 p. 387–394.
- Natural Resources Conservation Service. 2009. Watershed Boundary Dataset (WBD) User Guide.
- Newkirk, D., and J. Darby. 2008. Evaluation and Design of Small Water Systems Cost Estimating and SWS Grants/Funding, University of California Davis Press.
- Nolan, B.T., and B.C. Ruddy. 1996. Nitrate in Ground Water of the United States—Assessing the Risk: U.S. Geological Survey Fact Sheet FS-092-96.
- Nolan, B.T., B.C. Ruddy, K.J. Hitt, and D.R. Helsel. 1997. Risk of nitrate in groundwaters of the United States—a national perspective: *Environmental Science and Technology*, v. 31, n. 8, p. 2229–2236.
- Nolan B.T., B.C. Ruddy, K.J. Hitt, and D.R. Helsel. 1998. A national look at nitrate contamination of ground water: *Water Conditioning and Purification Magazine*, vol. 39, number 12, p. 76–79.
- Nolan, B.T. 2001. Relating Nitrogen Sources and Aquifer Susceptibility to Nitrate in Shallow Ground Waters of the United States. *Ground Water*, 39(2):290–299.
- Nolan, B.T., K.J. Hitt, and B.C. Ruddy. 2002. Probability of Nitrate Contamination of Recently Recharged Groundwaters in the Conterminous United States: *Environmental Science & Technology*, Vol. 36, No. 10, p. 2138–2145.
- Nolan, B.T., and K.J. Hitt. 2006. Vulnerability of Shallow Groundwater and Drinking-Water Wells to Nitrate in the United States: *Environmental Science & Technology*, Vol. 40, No. 24, p. 7834–7840.
- Onsoy, Y.S., T. Harter, T.R. Ginn, and W.R. Horwath. 2005. Spatial Variability and Transport of Nitrate in a Deep Alluvial Vadose Zone: *Vadose Zone Journal* Vol. 4, p. 41–54.
- Orang, M., R. Snyder, and S. Matyac. 2005. Survey of Irrigation Methods in California. California Department of Water Resources and University of California, Davis. *California Water Plan Update 2005*. Volume 4, pg 299–318.
- Pang, L., C. Nokes, J. Sumunek, H. Kikkert, and R. Hector. 2006. Modeling the Impact of Clustered Septic Tank Systems on Groundwater Quality: *Vadose Zone Journal*, Vol. 5, P. 599–609.

- Panno, S.V., K.C. Hackley, W.R. Kelly, and H. Hwang. 2006. Isotopic Evidence of Nitrate Sources and Denitrification in the Mississippi River, Illinois: *Journal of Environmental Quality*, Vol. 35 p. 495–504.
- Paul, A.P., R.L. Seiler, T.G. Rowe, and M.R. Rosen. 2007. Effects of agriculture and urbanization on quality of shallow ground water in the arid to semiarid western United States, 1993–2004: U.S. Geological Survey Scientific Investigations Report 2007–5179, 56 p.
- Peralta, J.M., and C.O. Stockle. 2002. Dynamics of nitrate leaching under irrigated potato rotation in Washington State: a long-term simulation study: Agriculture, *Ecosystems & Environment*, Vol. 88, Issue 1, p. 23–34.
- Power, J.F., R. Wiese, and D. Flowerday. 2001. Managing Farming Systems for Nitrate Control: A research Review from Management Systems Evaluation Areas: *Journal of Environmental Quality*, Vol. 30 p. 1866–1880.
- Simmons, H. Provost & Pritchard Consulting. Telephone communication with Central Valley Water Board staff. March 10, 2010.
- Puckett, L.J., and W.B. Hughes. 2005. Transport and Fate of Nitrate and Pesticides: Hydrogeology and Riparian Zone Processes: *Journal of Environmental Quality*, Vol. 34 p. 2278–2292.
- Puckett, L.J., C. Zamora, H. Essaid, J.T. Wilson, H.M. Johnson, M.J. Brayton, and J.R. Vogel. 2008. Transport and Fate of Nitrate at the Ground-Water / Surface-Water Interface: *Journal of Environmental Quality*, Vol. 37 p. 1034–1050.
- Raciti, S.M., P.M. Groffman, and T.J. Fahey. 2008. Nitrogen Retention in Urban Lawns and Forests. *Ecological Applications*: Vol. 18, No. 7, pp. 1615–1626.
- Ristvey, A.G., J.D. Lea-Cox, and D.S. Ross. 2004. Nutrient Uptake, Partitioning and Leaching Losses from Container-Nursery Production Systems: *Acta Horticulturae*, Vol. 630, p. 321–328.
- Rosen, M.R., and W.W. Lapham. 2008. Introduction to the U.S. Geological Survey National Water-Quality Assessment (NAWQA) of Ground-Water Quality Trends and Comparison to Other National Programs: *Journal of Environmental Quality*, Vol. 37 p. S190-S198.
- Ruddy, B.C., D.L. Lorenz, D.K. Mueller. 2006. County-Level Estimates of Nutrient Inputs to the Land Surface of the Conterminous United States, 1982–2001. U.S. Geological Survey, Reston, VA. Scientific Investigations Report 2006-5012.



- Rupert, M.G. 2008. Decadal-Scale Changes of Nitrate in Ground Water of the United States, 1988–2004: *Journal of Environmental Quality*, Vol. 37 p. 240–248.
- Scanlon, B.R., R.C. Reedy, D.A. Stonestrom, D.E. Prudic, and K.F. Dennehy. 2005. Impact of land use and land cover change on groundwater recharge and quality in the southwestern US: *Global Change Biology* (2005) Vol. 11, p.1577–1593.
- Schoups, G., J.W. Hopmans, C.A. Young, J.A. Vrugt, W.W. Wallender, K.K. Tanji, S. Panday. 2005. *Sustainability of Irrigated Agriculture in the San Joaquin Valley, California*. Proceedings of the National Academy of Sciences of the United States of America, Volume 102 No. 43.
- Seiler, R.L., S.D. Zaugg, J.M. Thomas, and D.L. Howcroft. 1999. Caffeine and Pharmaceuticals as Indicators of Waste Water Contamination in Wells: *Ground Water*, May–June 1999, Vol. 37, No.3, p. 405–510.
- Shelton, J.L., I. Pimentel, M.S. Fram, and K. Belitz. 2008. Ground-water quality data in the Kern County subbasin study unit, 2006—Results from the California GAMA Program: U.S. Geological Survey Data Series 337, 75 p. <http://pubs.usgs.gov/ds/337/pdf/ds337.pdf>
- Singleton, M.J., B.K. Esser, J.E. Moran, G.B. Hudson, W.W. McNab, and T. Harter. 2007. Saturated Zone Denitrification: Potential for Natural Attenuation of Nitrate Contamination in Shallow Groundwater Under Dairy Operations: *Environmental Science & Technology*, Vol. 41, p. 759–765.
- Spalding, R.F., D.G. Watts, J.S. Schepers, M.E. Burbach, M.E. Exner, R.J. Poreda, and G.E. Martin. 2001. Controlling Nitrate Leaching in Irrigated Agriculture: *Journal of Environmental Quality*, Vol. 30 p. 1184–1194.
- Standley, L.J., R.A. Rudel, C.H. Swartz, K.R. Attfield, J. Christian, M. Erickson, and J.G. Brody. 2008. Wastewater-Contaminated Groundwater as a Source of Endogenous Hormones and Pharmaceuticals to Surface Water Ecosystems: *Environmental Toxicology and Chemistry*, Vol. 27, Issue 12, p. 2457–2468.
- Stewart, I.T., and K. Loague. 2004. Assessing Ground Water Vulnerability with the Type Transfer Function Model in the San Joaquin Valley, California: *Journal of Environmental Quality*, Vol. 33 p. 1487–1498.
- Suen, C.J. 2008. Using Isotopic Ratios and Major Minerals Data to Identify the Sources of Ground Water and Ground Water Nitrate in Relation to Pesticide Residues: California Department of Pesticide Regulation, Environmental Monitoring Branch, June 24, 2008.

- Suen, C.J. 2008. Metadata Guide for Salinity Data Sources for the Central Valley of California. California Water Institute, California State University, Fresno, for the California Regional Water Quality Control Board, Central Valley Region, Rancho Cordova, CA.
- Tesoriero, A.J., D.A. Saad, K.R. Burow, E.A. Frick, L.J. Puckett, and J.E. Barbash. 2007. Linking ground-water age and chemistry data along flow paths: Implications for trends and transformations of nitrate and pesticides: *Journal of Contaminant Hydrology*, 94 (2007), p. 139–155.
- Thiros, S.A., 1999, Quality of shallow ground water in areas of recent residential and commercial development in Salt Lake Valley, Utah, 1999: U.S. Geological Survey Fact Sheet 106-00.
- Tomer, M.D., and M.R. Burkart. 2003. Long-Term Effects of Nitrogen Fertilizer Use on Ground Water in Two Small Watersheds: *Journal of Environmental Quality*, Vol. 32 p. 2158–2171.
- Townsend, M.A., and D.P. Young. 1995. Factors Affecting Nitrate Concentrations in Ground Water in Stafford County, Kansas: Kansas Geological Survey, Current Research in Earth Sciences, Bulletin 238, part 1.
- Troiano, J., F. Spurlock, and J. Marade. 1999. Update of the California Vulnerability Soil Analysis for Movement of Pesticides to Ground Water: October 14, 1999. California Department of Pesticide Regulation, Sacramento, CA. EH 00-05.
- University of California, Davis. 2009. Global Markets and Trade; University of California Agricultural Issues Center.
- University of Minnesota. 2006. Drinking Water Protection Series, Nitrate Contamination—What is the Cost? Minnesota Department of Agriculture.
- U.S. Census Bureau. 2004. The American housing survey for the United States, 2003. US Department of Commerce, Washington, DC.
- U.S. Code of Federal Regulations Title 40 Section 131.12, Antidegradation Policy.
- USDA Economic Research Service, State Fact Sheets: California, 2008 estimates.
- USDA National Agricultural Statistics Service, 2007 Census of Agriculture. <http://www.agcensus.usda.gov/>

- USDA National Agricultural Statistics Service. 2009. California Agricultural Overview.  
[http://www.nass.usda.gov/Statistics\\_by\\_State/California/Publications/California\\_Ag\\_Statistics/2008cas-oww.pdf](http://www.nass.usda.gov/Statistics_by_State/California/Publications/California_Ag_Statistics/2008cas-oww.pdf)
- USEPA, Federal Insecticide, Fungicide, and Rodenticide Act, Title 7, United States Code section 136.  
[http://www.law.cornell.edu/uscode/html/uscode07/usc\\_sup\\_01\\_7\\_10\\_6\\_20\\_II.html](http://www.law.cornell.edu/uscode/html/uscode07/usc_sup_01_7_10_6_20_II.html)
- USEPA, 1990, National pesticide survey: project summary. Washington, DC.
- USEPA. 1998. Office of Water Standards and Applied Sciences Division Environmental *Impacts of Animal Feeding Operations, December 31, 1998*.
- USEPA. 2002. Onsite Wastewater Treatment Systems Manual, Chapter 3, page 3–11, EPA/625/R-00/008. February. Available:  
<http://www.epa.gov/nrmrl/pubs/625r00008/html/600R00008chap1.htm>
- USEPA. 2002. Chapter1: Background and Use of Onsite Wastewater Treatment Systems, EPA600/R-00/008.
- USEPA. 2003. National Management Measures to Control Nonpoint Source Pollution from Agriculture (EPA 841-B-03-004).  
<http://www.epa.gov/nps/agmm/>
- USEPA. 2008. Handbook for Developing Watershed Plans to Restore and Protect Our Waters: Chapter 4.  
[http://www.epa.gov/nps/watershed\\_handbook/#contents](http://www.epa.gov/nps/watershed_handbook/#contents)
- USEPA. 2009. National Primary Drinking Water Regulations, U.S. Environmental Protection Agency. <http://www.epa.gov/safewater/contaminants/>
- USGS. 1999. The quality of our nation's waters: nutrients and pesticides. Circular 1225, US Department of the Interior, Reston, VA.
- USGS. 2006. County-Level Estimates of Nutrient Inputs to the Land Surface of the Conterminous United States, 1982–2001. Scientific Investigations Report 2006-5012.
- USGS. 2007. U.S. Geological Survey Scientific Investigations Report 2007–5179, 56 p.
- USGS and USDA, Natural Resources Conservation Service. 2009. Federal guidelines, requirements, and procedures for the national Watershed Boundary Dataset: U.S. Geological Survey Techniques and Methods 11–A3, 55 p.

- USGS. The Reston Chlorofluorocarbon Laboratory,  $^3\text{H}/^3\text{He}$  Dating Background: Online at <http://water.usgs.gov/lab/>.
- Van der Schans, M.L., T. Harter, A. Leijnse, M.C. Mathews, and R.D. Meyer. 2009. Characterizing sources of nitrate leaching from an irrigated dairy farm in Merced County, California: *Journal of Contaminant Hydrology*, Vol. 110, Issue 1–2, 3 November 2009, p. 9–21.
- Wakida, F.T., and D.N. Lerner. 2005. Non-agricultural Sources of Groundwater Nitrate: A Review and Case Study: *Water Research*, Vol. 39, Issue 1, January 2005, pages 3–16.
- Wakida, F.T. 2008. Sources of Nitrate in Urban Groundwater: *Science Topics*, 22 August 2008.
- Wallace, J., and M. Lowe. 1998. The Potential Impact of Septic Tank Soil-Absorption Systems on Water Quality in the Principal Valley-Fill Aquifer, Ogden Valley, Weber County, Utah—Assessment and Guidelines: Utah Geological Survey, Report Investigation 237, May 1998.
- Ward, M.H., B.A. Kilfoy, P.J. Weyer, K.E. Anderson, A.R. Folsom, J.R. Cerhan. 2010. Nitrate Intake and the Risk of Thyroid Cancer and Thyroid Disease. *Epidemiology*. Mar 23.
- Watanabe, N., T.H. Harter, and B.A. Bergamaschi. 2008. Environmental Occurrence and Shallow Ground Water Detection of the Antibiotic Monensin from Dairy Farms: *Journal of Environmental Quality*, Vol. 37 p. S-78-S-85.
- Widory, D., E. Petelet-Giraud, P. Negrel, and B. Ladouche. 2005. Tracking the Sources of Nitrate in Groundwater Using Coupled Nitrogen and Boron Isotopes: A Synthesis: *Environmental Science and Technology*, Vol. 39, p. 539–548.
- Wiederholt, R., and B. Johnson. 2005. Nitrogen Behavior in the Environment: North Dakota State University, NM-1299, November.
- Wildman, R.A. Jr., J.L. Domagalski, and J.G. Hering. 2009. Hydrologic and Biogeochemical Controls of River Subsurface Solutes under Agriculturally Enhanced Ground Water Flow: *Journal of Environmental Quality*, 2009, Vol. 38, pp. 1830–1840.
- Wilkison, D.H. 1998. USGS research at Management Systems Evaluation Areas, 1991–95: USGS Fact Sheet 042-98, 4 p.
- Williams, A.G., J.F. Dowd, D. Scholefield, N.M. Holden, and L.K. Deeks. 2003. Preferential Flow Variability in a Well-Structured Soil: *Soil Science Society of America Journal*, Vol. 67, p. 1272–1281.

- Wu, L., J. Letey, C. French, Y. Wood, and D. Birkle. 2005. Nitrate leaching hazard index developed for irrigated agriculture. *Journal of Soil and Water Conservation*. 60, 4, 90A-95A.
- Xu, Y., L.A. Baker, and P.L. Johnson. 2007. Trends in Ground Water Nitrate Contamination in the Phoenix, Arizona Region: *National Ground Water Association, Ground Water Monitoring & Remediation*, Vol 27, No.2, Spring 2007, p. 49–56.
- Zhao, C., C. Hu, W. Huang, X. Sun, Q. Tan, and H. Di. 2009. A Lysimeter study of Nitrate Leaching and Optimum Nitrogen Application rates for Intensively Irrigated Vegetable Production System in Central China: *Journal of Soils and Sediments*, Online First, Article 43, 28 March 2009.

### **Internet Links**

- Dairy Program, Central Valley Regional Water Board:  
[http://www.waterboards.ca.gov/centralvalley/water\\_issues/dairies](http://www.waterboards.ca.gov/centralvalley/water_issues/dairies))
- Waste Discharges to Land, Central Valley Regional Water Board:  
[http://www.waterboards.ca.gov/centralvalley/water\\_issues/waste\\_to\\_land/](http://www.waterboards.ca.gov/centralvalley/water_issues/waste_to_land/)
- Watershed Boundary Dataset (WBD):  
<http://www.ncgc.nrcs.usda.gov/products/datasets/watershed/>





## **APPENDIX A**

### **DECEMBER 2009 PROPOSED LONG-TERM IRRIGATED LANDS REGULATORY PROGRAM ALTERNATIVES**



**PROPOSED**

# **LONG-TERM IRRIGATED LANDS REGULATORY PROGRAM ALTERNATIVES**

**PREPARED FOR:**

Long-Term Irrigated Lands Regulatory Program  
Stakeholder Advisory Workgroup

**PREPARED BY:**

Central Valley Regional Water Quality Control Board  
ICF Jones & Stokes

December 2009

Central Valley Regional Water Quality Control Board and ICF Jones & Stokes. 2009. *Proposed Long-Term Irrigated Lands Regulatory Program Alternatives*. December. (ICF J&S 05508.05.) Sacramento, CA. Prepared for: Long-Term Irrigated Lands Regulatory Program Stakeholder Advisory Workgroup, Sacramento, CA.



# Contents

---

|                                                                                               | Page     |
|-----------------------------------------------------------------------------------------------|----------|
| <b>Proposed Long-Term Irrigated Lands Regulatory Program Alternatives—December 2009 .....</b> | <b>1</b> |
| Introduction.....                                                                             | 1        |
| Goals and Objectives of the Long-Term Irrigated Lands Regulatory Program.....                 | 2        |
| Alternatives Development and Screening.....                                                   | 3        |
| CEQA Requirements.....                                                                        | 3        |
| Stakeholder Process.....                                                                      | 4        |
| Alternatives Development Process.....                                                         | 4        |
| Alternatives Screening .....                                                                  | 5        |
| Alternatives .....                                                                            | 6        |
| Alternative 1—No Change Alternative (Maintain Current Program) .....                          | 7        |
| Alternative 2—Third-Party Lead Entity.....                                                    | 10       |
| Alternative 3—Individual Farm Water Quality Management Plan.....                              | 14       |
| Alternative 4—Direct Oversight with Regional Monitoring.....                                  | 16       |
| Alternative 5—Direct Oversight with Farm Monitoring .....                                     | 24       |
| <br><b>Attachment A Alternatives Matrix</b>                                                   |          |
| <b>Attachment B Area or Watershed Management Objectives Plans</b>                             |          |
| <b>Attachment C Groundwater Quality Management Plans</b>                                      |          |
| <b>Attachment D Local Groundwater Management Plan</b>                                         |          |
| <b>Attachment E Minimum ILRP Application Requirements</b>                                     |          |
| <b>Attachment F FWQMP Requirements</b>                                                        |          |
| <b>Attachment G Alternative 4 Tier System Matrix</b>                                          |          |

## Tables

|         | On Page                                       |
|---------|-----------------------------------------------|
| Table 1 | Summary of Proposed ILRP Alternatives ..... 6 |
| Table 2 | Monitoring Requirements ..... 10              |

## Acronyms and Abbreviations

|                            |                                                                                        |
|----------------------------|----------------------------------------------------------------------------------------|
| Basin Plan                 | Water Quality Control Plan                                                             |
| Central Valley Water Board | California Regional Water Quality Control Board, Central Valley Region                 |
| CEQA                       | California Environmental Quality Act                                                   |
| Conditional Waiver         | Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands |
| DPH                        | California Department of Public Health                                                 |
| DPR                        | California Department of Pesticide Regulation                                          |
| DWR                        | California Department of Water Resources                                               |
| EIR                        | Environmental Impact Report                                                            |
| FREP                       | Fertilizer Research and Education Program                                              |
| FWQMP                      | Farm Water Quality Management Plan                                                     |
| GAMA                       | Groundwater Ambient Monitoring and Assessment                                          |
| GMAs                       | groundwater management areas (GMAs)                                                    |
| GQMPs                      | groundwater quality management plans                                                   |
| GW                         | groundwater categories                                                                 |
| ILRP                       | Irrigated Lands Regulatory Program                                                     |
| IWMP                       | Irrigation Water Management Plan                                                       |
| JPA                        | joint powers authority                                                                 |
| MOU                        | Memorandum of Understanding                                                            |
| NMP                        | Nutrient Management Plan                                                               |
| NRCS                       | National Resources Conservation Service                                                |
| PRC                        | Public Resources Code                                                                  |
| RCD                        | Resource Conservation Districts                                                        |
| SW                         | surface water categories                                                               |
| UC                         | University of California                                                               |
| WDRs                       | waste discharge requirements                                                           |
| Workgroup                  | Long-Term Irrigated Lands Regulatory Program Stakeholder Advisory Workgroup            |
| WQMP                       | Water Quality Management Plan                                                          |

# Proposed Long-Term Irrigated Lands Regulatory Program Alternatives December 2009

---

## Introduction

The California Regional Water Quality Control Board, Central Valley Region (Central Valley Water Board) Irrigated Lands Regulatory Program (ILRP) was initiated in 2003 with the adoption of a Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands (Conditional Waiver). Under the 2003 Conditional Waiver, the Central Valley Water Board directed staff to prepare an Environmental Impact Report (EIR) for a long-term ILRP. The 2003 Conditional Waiver expired in 2006, at which time a Revised Conditional Waiver was adopted that continues the Conditional Waiver until June 2011.

The Central Valley Water Board must develop recommendations for a long-term ILRP by summer 2009 in order to have enough time to complete the necessary California Environmental Quality Act (CEQA) and economic review prior to the expiration of the interim program in June 2011. Proposed modifications to the ILRP must be approved by the Central Valley Water Board and may include:

- Establishing subcategories and related requirements for different types of agricultural operations and/or geographic areas.
- Adding requirements to protect groundwater from potential impacts related to irrigated agriculture.
- Considering various regulatory approaches, such as use of management practice requirements, technology performance standards, narrative or numeric water quality-based limits, or a combination of approaches.

This draft provides a summary of 1) the overall goals of the Central Valley Water Board's ILRP, 2) the process that was used to develop the proposed alternatives in collaboration with stakeholders, and 3) the range of proposed ILRP alternatives that were developed by the Long-Term ILRP Stakeholder Advisory Workgroup (Workgroup) and Central Valley Water Board staff. All alternatives must be consistent with program goals and meet minimum statutory requirements. To this end, each alternative advanced for evaluation in the EIR will be reviewed by Central Valley Water Board staff and may be subject to modifications. However, any such modifications will be done only after discussion with Workgroup members.

During the course of reviewing the alternatives, Central Valley Water Board staff may identify other feasible alternatives that are more cost effective, are less likely to have a negative impact on the environment, or have other desirable characteristics. If such alternatives are developed by staff, those alternatives will be discussed with the Workgroup prior to their inclusion for evaluation in the EIR.

# Goals and Objectives of the Long-Term Irrigated Lands Regulatory Program

Irrigated agricultural lands include lands where water is applied to produce crops, fiber, or livestock for commercial sale or use. For the purposes of this ILRP, irrigated agricultural lands also include managed wetlands, nurseries, and water districts<sup>1</sup>. Understanding that irrigated agriculture in the Central Valley provides valuable food and fiber products to communities worldwide, the overall goals of the ILRP are to 1) restore and/or maintain the highest reasonable quality of state waters<sup>2</sup> considering all the demands being placed on the water, 2) minimize waste discharge from irrigated agricultural lands<sup>3</sup> that could degrade the quality of state waters, 3) maintain the economic viability of agriculture in California's Central Valley, and 4) ensure that irrigated agricultural discharges do not impair Central Valley communities and residents access to safe and reliable drinking water. In accordance with these goals, the objectives of the ILRP are to:

- Restore and/or maintain appropriate beneficial uses established in [Central Valley Water Board Water Quality Control Plans](#) by ensuring that all state waters meet applicable water quality objectives.<sup>4</sup>
- Encourage implementation of management practices that improve water quality in keeping with the first objective without jeopardizing the economic viability for all sizes of irrigated agricultural operations in the Central Valley or placing an undue burden on rural communities to provide safe drinking water.
- Provide incentives<sup>5</sup> for agricultural operations to minimize waste discharge to state waters from their operations.
- Coordinate with other Central Valley Water Board programs, such as the Grasslands Bypass Project waste discharge requirements for agricultural lands, the Westlands Water District's effort to develop waste discharge requirements for agricultural lands, total maximum daily load development, CV-Salts, and waste discharge requirements for dairies.
- Promote coordination with other regulatory and non-regulatory programs associated with agricultural operations (e.g., the California Department of Pesticide Regulation [DPR], the California Department of Public Health [DPH] Drinking Water Program, the California Air Resources Board, the California Department of Food and Agriculture, Resource Conservation Districts, the University of California Extension, Natural Resource Conservation Service, National Organic Program, California Agricultural Commissioners, State Water Resources Control Board Groundwater Ambient Monitoring and Assessment program, United States Geological Survey, and local groundwater programs [SB 1938, AB 3030, Integrated Regional Water Management Plans]) to minimize duplicative regulatory oversight while ensuring program effectiveness.

---

<sup>1</sup> Water districts would be included only if it accepts or receives discharges from irrigated lands, and discharges or threatens to discharge waste to waters of the state.

<sup>2</sup> California Water Code section 13050 defines state waters as any surface water or groundwater, including saline waters, within the boundaries of the state.

<sup>3</sup> Irrigated agricultural lands include managed wetlands, nurseries, and water districts.

<sup>4</sup> This objective did not receive Workgroup consensus and consequently was not recommended by the Workgroup. In general, concerns regarding this proposed objective have to do with whether there should be some qualifier that accounts for the feasibility and reasonableness of restoring all state waters to applicable water quality objectives.

<sup>5</sup> Incentives could include financial, monitoring reductions, certification, or technical help.

# Alternatives Development and Screening

## CEQA Requirements

In accordance with State CEQA Guidelines Section 15126.6(a), EIRs must evaluate a “range of reasonable alternatives to the project, or to the location of the project, which would feasibly attain most of the basic objectives of the project.” State CEQA Guidelines Section 21061.1 defines *feasible* as “capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, legal, social, and technological factors.” Selecting a range of project alternatives for evaluation is the responsibility of the lead agency, which must “publicly disclose its reasoning for selecting those alternatives.” [State CEQA Guidelines Section 15126.6(a)].

State CEQA Guidelines Section 15126.6(c) also directs that EIRs should “identify any alternatives that were considered...but were rejected as infeasible,” and “briefly explain the reasons” for the determination. It explains that alternatives may be rejected due to “(i) failure to meet most of the basic project objectives, (ii) infeasibility, and (iii) inability to avoid significant environmental impacts.” The factors that will be weighed to determine the feasibility of ILRP alternatives include economic viability<sup>6</sup>, consistency with existing plans or planning documents, regulatory limitations, and jurisdictional authority.

Considered alternatives must include the specific alternative of “no project,” or conditions at the time the notice of preparation is published. When the project is the revision of an existing land use or regulatory plan, policy, or ongoing operation, the “no project” alternative is the continuation of the existing plan, policy or operation into the future. [State CEQA Guidelines Section 15126.6(d)–(e)]. In this instance, the “no project” scenario will be presented as the “proposed project”, the project against which the range of identified alternatives is compared.

In most CEQA documents, the lead agency has identified the proposed project as the “preferred project”, and thus the alternatives may typically receive a reduced level of analysis in comparison. However, in this document, no preferred project will be identified by the Central Valley Water Board. Instead, each chosen project alternative will receive a full measure of analysis, to the extent necessary to determine and compare all anticipated impacts.

An EIR “shall include sufficient information about each alternative to allow meaningful evaluation, analysis, and comparison with the proposed project.” [State CEQA Guidelines Section 15126.6(d)]. The State CEQA Guidelines Section 15126.6(b) provides that the discussion of alternatives should focus on alternatives “which are capable of avoiding or substantially lessening any significant effects of the project, even if these alternatives could impede to some degree the attainment of the project objectives or would be more costly.”

The final decision regarding the feasibility of alternatives lies with the decision maker for a given project, who must make the necessary findings addressing the potential feasibility of reducing the severity of significant environmental effects. (Public Resources Code [PRC] 21081, State CEQA Guidelines Section 15091).

---

<sup>6</sup> Unlike other CEQA lead agencies, Regional Water Boards are directed by California Water Code section 13241 to consider economics when establishing water quality objectives.



## Stakeholder Process

In fall 2008, the Central Valley Water Board convened the Workgroup to provide staff with input on the development of the ILRP. The Workgroup includes a range of stakeholder interests representing local government, industry, agricultural, and environmental coalitions throughout the Central Valley.

The Workgroup operates under a [Charter](#) document that contains a plan for communicating Workgroup recommendations to the Central Valley Water Board, establishes the Workgroup structure, and clarifies roles and responsibilities. Workgroup meetings conducted to date are summarized here.

- October 9, 2008: [Organizational Workgroup Meeting](#).
- December 17, 2008: [Workgroup Meeting to Discuss Strategy](#).
- February 2, 2009: Groundwater Information Session.
- February 17, 2009: [Workgroup Meeting to Present Participant Proposed Alternatives](#).
- April 15, 2009: Groundwater Nitrate Information Session.
- May 19, 2009: [Workgroup Meeting to Discuss Proposed Long-term ILRP alternatives](#).
- August 20, 2009: [Final Workgroup Meeting to Discuss Proposed Long-term ILRP alternatives](#).

The Workgroup meetings provide a forum for stakeholder input and deliberation. Because the ILRP is complex, information sessions were arranged to share technical information.

## Alternatives Development Process

Alternatives that will be evaluated in the EIR need to meet the goals and objectives for the ILRP and be substantially different so that the alternatives can be compared to each other. Initially, Central Valley Water Board staff proposed a two-phase process for developing alternatives.

- **Phase I:** Develop a comprehensive list of alternatives and prioritize the alternatives using an evaluation measures-based (e.g., effectiveness, cost) quantitative scoring system. The goal of the Phase I step is to develop a comprehensive list of alternatives that could meet the goals and objectives for the ILRP for further Workgroup consideration.
- **Phase II:** Collaboratively screen the comprehensive list of alternatives to determine which alternatives would be evaluated in the EIR for the ILRP.

At the December 17 Workgroup meeting, the Workgroup decided to refine the approach for evaluating alternatives by combining the two phases into a shortened process. It was decided that the Workgroup and Central Valley Water Board staff would develop a range of alternatives that could meet the objectives of the ILRP, and sort through those alternatives as they were being developed. Ultimately, the Workgroup will provide input to assist the Central Valley Water Board in determining the alternatives to be evaluated in the EIR.

Central Valley Water Board staff developed a template and program matrix to assist Workgroup participants in the development of alternatives. The template and matrix were included in a [Workgroup Strategy Document](#) dated January 9, 2009. The Workgroup Strategy Document included

1 a discussion of minimum requirements for alternatives, a Workgroup meeting schedule, and a  
2 process for selecting ILRP alternatives for EIR analysis.

3 On February 17, 2009, Workgroup participants presented proposed ILRP alternatives. After the  
4 February 17 Workgroup meeting Central Valley Water Board staff began working with Workgroup  
5 participants that proposed alternatives to develop the details of their alternatives. Central Valley  
6 Water Board staff have also developed additional alternatives as necessary to represent a range of  
7 possible programs to evaluate in the EIR (per the State CEQA Guidelines requirements). Many of the  
8 proposed alternatives that were presented were combined, or additional features were added, to  
9 develop complete alternatives that could meet the goals and objectives of the program.

10 At the final Workgroup meeting on August 20, 2009 the Workgroup voted on the proposed range of  
11 alternatives and each program goal and objective. The workgroup came to consensus that the  
12 proposed range of alternatives should be evaluated in the Environmental Impact Report. Also, the  
13 Workgroup has come to consensus on each of the proposed program goals and all but one of the  
14 proposed objectives (see Goals and Objectives section). Following the August 20 meeting,  
15 Workgroup participants provided additional written comments on the proposed alternatives. The  
16 additional written comments will be considered during the EIR process.

## 17 Alternatives Screening

18 In order to be considered alternatives under CEQA, ILRP alternatives must meet the goals and  
19 objectives of the project (as defined above). At a minimum, alternatives must also meet statutory  
20 requirements established in applicable state policy and regulations (e.g., the [California Water Code](#);  
21 the [Central Valley Water Board Water Quality Control Plan](#), or the *Basin Plan*; the [State Water](#)  
22 [Resources Control Board Policy for Implementation and Enforcement of the Nonpoint Source](#)  
23 [Pollution Control Program](#); and the [State Antidegradation Policy](#)). Alternatives that do not meet  
24 minimum statutory requirements will not be considered for inclusion in the ILRP.

25 An effort has been made throughout the development process to ensure that the alternatives meet  
26 statutory requirements as well as the goals and objectives for the program. This effort included  
27 circulating an alternative development template (included in the Workgroup Strategy Document)  
28 and Central Valley Water Board staff conducted meetings with Workgroup participants.

29 The Central Valley Water Board staff-recommended ILRP will be selected from among the  
30 alternatives considered in the EIR. Rather than the typical EIR approach of starting with a project  
31 and then looking at alternatives to that project, the EIR will be used as a tool to inform decision  
32 makers during the selection process. In explanation, each alternative will be evaluated equally in the  
33 EIR. In addition to environmental analysis, economics and policy considerations will also be  
34 evaluated in order to inform the selection of a staff-recommended ILRP alternative that would be  
35 considered by the Central Valley Water Board. As part of the policy analysis, each alternative will  
36 need to be evaluated to determine how well the alternative implements minimum statutory  
37 requirements and other required policy. [Chapter 2 of the ILRP Existing Conditions Report](#)  
38 summarizes the main policies and statutory requirements that will be considered.

39 In addition to the aforementioned requirements for alternatives, the Workgroup Strategy Document  
40 includes the following guidance for determining which alternatives will be evaluated in the EIR.

- 41 • **Consensus alternatives.** All ILRP alternatives that receive Workgroup consensus (as defined in  
42 Section 3.7 of the [Workgroup Charter](#)) for further consideration will be evaluated in the EIR.

- **Non-consensus alternatives.** Central Valley Water Board staff will make an effort to include non-consensus ILRP alternatives that are feasible and reasonable in the EIR analysis.

As required under the State CEQA Guidelines Section 15126.6(c), the EIR will also briefly describe those alternatives that were considered but rejected as infeasible. The reasons for their infeasibility will be summarized in the EIR.

## Alternatives

Proposed ILRP alternatives are summarized in Table 1 and Attachment A. In order to evaluate the environmental, economic, and policy impacts of the alternatives, additional detail may be necessary. During the evaluation process, Central Valley Water Board staff will work to provide any necessary detail in a consistent manner over the entire range of alternatives. For example, assumptions would need to be made in order to estimate how a particular requirement may affect growers (e.g., costs of management plan development). In this scenario, any assumptions made for this evaluation would be applied, as appropriate, to all alternatives containing the particular requirement.

In conjunction with each alternative (described below), irrigated agricultural lands operations would have the option to work individually with the Central Valley Water Board to obtain an individual waiver of waste discharge requirements or waste discharge requirements.

Information submitted to the Central Valley Water Board under the ILRP would be required in an electronic format where feasible, unless there is a need for the information to remain confidential.

**Table 1. Summary of Proposed ILRP Alternatives**

| No. | Alternative                                           | Lead Entity <sup>a</sup>                      | WQ Plans <sup>b</sup>                          | Monitoring        |
|-----|-------------------------------------------------------|-----------------------------------------------|------------------------------------------------|-------------------|
| 1   | No Change                                             | Third-Party                                   | To address water quality problems <sup>c</sup> | Regional          |
| 2   | Third-Party Lead Entity                               | Third-Party                                   | Yes, regional                                  | Regional          |
| 3   | Individual Farm Water Quality Management Plan (FWQMP) | CVWB <sup>d</sup>                             | Yes, farm                                      | Farm              |
| 4   | Direct Oversight with Regional Monitoring             | Responsible Legal Entity <sup>e</sup><br>CVWB | Yes, farm                                      | Regional and Farm |
| 5   | Direct Oversight with Farm Monitoring                 | CVWB                                          | Yes, farm                                      | Farm              |

<sup>a</sup> Describes Central Valley Water Board interaction with growers. For more information on lead entity see Attachment II, page 3, of the Workgroup Strategy Document at: [http://www.waterboards.ca.gov/centralvalley/water\\_issues/irrigated\\_lands/long\\_term\\_program\\_development/advisory\\_wrgrp\\_strategy.pdf](http://www.waterboards.ca.gov/centralvalley/water_issues/irrigated_lands/long_term_program_development/advisory_wrgrp_strategy.pdf).

<sup>b</sup> Water quality management plans (WQ Plans)—could be on the farm or regional level.

<sup>c</sup> Water quality management plans are required only where water quality problems have been identified.

<sup>d</sup> CVWB = Central Valley Regional Water Quality Control Board.

<sup>e</sup> Legal entity assuming responsibility for waste discharge (e.g., Joint Powers Authority).

# **Alternative 1—No Change Alternative (Maintain Current Program)**

## **Surface Water**

Under this alternative, the Central Valley Water Board would renew the current program. This would be considered the “no project” alternative per CEQA guidance at Title 14, California Code of Regulations, Section 15126.6(e)(3)(A): “When the project is the revision of an existing land use or regulatory plan, policy or ongoing operation, the “no project” alternative will be the continuation of the existing plan, policy, or operation into the future.”

Coalition groups would continue to function as lead entities representing growers (irrigated landowners, wetland managers, nursery owners, and water districts). This alternative would be based on continuing watershed monitoring to determine whether operations are causing water quality problems. Where monitoring indicates a problem, third-party groups and growers would be required to implement management practices to address the problem and work toward compliance with applicable water quality standards.

## **Groundwater**

This alternative would not establish any new Central Valley Water Board requirements for discharges to groundwater from irrigated agricultural lands. However, local programs in place provide varying degrees of groundwater management and oversight in some areas of the Central Valley (i.e., these programs were not developed to specifically meet the goals of this ILRP). The following is a brief description of the local groundwater management programs.

Assembly Bill 3030, which is codified in the California Water Code section 10750, authorizes local agencies within groundwater basins to prepare and adopt groundwater management plans with the following recommended components:

1. Control of saline water intrusion.
2. Identification and management of wellhead protection areas and recharge areas.
3. Regulation of the migration of contaminated groundwater.
4. The administration of a well abandonment program.
5. Mitigation of conditions of overdraft.
6. Replenishment of groundwater extracted by water producers.
7. Monitoring of groundwater levels and storage.
8. Facilitating conjunctive use operations.
9. Identification of well construction policies.
10. The construction and operation by the local agency of groundwater contamination cleanup, recharge, storage, conservation, water recycling, and extraction projects.
11. The development of relationships with state and federal regulatory agencies.
12. The review of land use plans and coordination with land use planning agencies to assess activities that create a reasonable risk of groundwater contamination.

1 Local agencies throughout the Central Valley have developed groundwater management programs  
2 pursuant to California Water Code section 10750. However, areas throughout the Central Valley are  
3 not covered by local agency groundwater management plans.

4 Senate Bill 1938 imposed additional groundwater management program requirements on local  
5 agencies seeking state funds, administered by the California Department of Water Resources (DWR),  
6 for construction of groundwater projects. These requirements include a groundwater management  
7 plan that includes components relating to the monitoring and management of groundwater levels  
8 within the basin, groundwater quality degradation, inelastic land surface subsidence, and changes in  
9 surface flow and surface water quality that directly affect groundwater levels or quality.

10 In addition to local groundwater management plans, the DPR regulates the use of pesticides that  
11 pose a threat to groundwater (Groundwater Protection Program). The DPR's Groundwater  
12 Protection Program requires that growers implement management practices to prevent pesticides  
13 from moving to groundwater. The DPR also conducts monitoring for pesticides to evaluate  
14 management practices and overall program effectiveness.

15 This alternative would not establish new Central Valley Water Board requirements for regulating  
16 irrigated agricultural discharges to groundwater. The alternative would recognize that local  
17 groundwater management programs currently exist in some localities and that the DPR currently  
18 implements a groundwater protection program to protect groundwater quality from pesticide  
19 impacts.

## 20 **Implementation Mechanisms and Lead Entity**

21 Under this alternative, the Central Valley Water Board would renew the current program through a  
22 waiver of waste discharge requirements or through waste discharge requirements. Third-party  
23 water quality coalition groups<sup>7</sup> would continue to function as lead entities. These coalition groups  
24 would continue to work on behalf of the members to ensure all Central Valley Water Board  
25 requirements are met.

26 As in the current program, coalition groups would be approved by the Central Valley Water Board  
27 prior to functioning as a lead entity. Specifically, coalition groups would:

- 28 1. Enroll member growers.
- 29 2. Develop monitoring plans.
- 30 3. Conduct required water quality monitoring.
- 31 4. Develop and implement surface water quality management plans where surface water  
32 monitoring results indicate two or more exceedances of any applicable water quality objective  
33 in a three-year period.
- 34 5. Inform growers of program requirements and provide coordination to ensure water quality  
35 concerns are addressed.

---

<sup>7</sup> Water quality coalition groups have formed throughout the Central Valley to function as representative or "lead" entities in the administration of the current ILRP. Coalitions represent growers, provide education, organize monitoring, and work with the Central Valley Water Board to help ensure that the current program is effectively implemented.



## **General Central Valley Water Board Role and Responsibilities**

1. Require 100% ILRP participation.<sup>8</sup>
2. Review and approve monitoring plans.
3. Review monitoring reports.
4. Review and approve surface water quality management plans.
5. Review overall program performance with regard to achieving ILRP objectives.
6. Respond to individual problems and complaints dealing with irrigation discharge.
7. Enforce ILRP requirements.

## **Regulatory Requirements**

In order to be eligible for this alternative, growers would be required to:

1. Submit an application to the Coalition group to enroll in the program and pay applicable program fees. The Coalition group would apply for coverage on behalf of members. Required application information would include name and contact information of owner/operator and parcel numbers. Coalition groups would collect the application information for each member grower and report the information to the Central Valley Water Board.
2. Implement water quality management practices in accordance with any water quality management plans. Water quality management practices could be instituted on an individual basis, or be installed to serve a group of growers discharging to a single location (e.g., combined tailwater return or wetlands serving a group of growers).
3. Prevent nuisance conditions and/or exceedance of water quality objectives in state waters associated with waste discharge from their irrigated agricultural lands.
4. Provide the Coalition group with information requested for compliance with the ILRP.

Growers who do not meet these requirements would be required to work directly with the Central Valley Water Board and obtain waste discharge requirements or an individual waiver of waste discharge requirements.

## **Monitoring Provisions**

Monitoring under this alternative would be the same as the watershed-based assessment and core monitoring required under the current ILRP. Under this monitoring scheme, coalition groups would work with the Central Valley Water Board to develop monitoring plans for Central Valley Water Board approval. These plans would specify monitoring parameters and site locations. Required monitoring would include the parameters and frequencies shown in Table 2.<sup>9</sup>

---

<sup>8</sup> Where growers have a waste discharge that would be regulated under the ILRP.

<sup>9</sup> The current ILRP monitoring program provides flexibility to reduce the monitoring shown in Table 2.

**Table 2. Monitoring Requirements**

| <b>Assessment Monitoring for 1 Year Out of Every 3 Years</b>                         |                               |
|--------------------------------------------------------------------------------------|-------------------------------|
| <b>Parameter</b>                                                                     | <b>Frequency</b>              |
| 303(d) listed constituents with agricultural source                                  | Monthly                       |
| Water column toxicity, pesticides, metals, nutrients, pathogens, physical parameters | Monthly                       |
| Toxicity identification evaluation—as needed                                         | Monthly                       |
| Sediment toxicity                                                                    | Twice per year                |
| Photo monitoring                                                                     | During every monitoring event |
| <b>Continuing Core Monitoring</b>                                                    |                               |
| <b>Parameter</b>                                                                     | <b>Frequency</b>              |
| General physical parameters, nutrients, pathogens                                    | Monthly                       |
| Parameters/constituents of concern as determined by the Central Valley Water Board   | Monthly                       |
| Photo monitoring                                                                     | During every monitoring event |

## Alternative 2—Third-Party Lead Entity

Under this alternative, the Central Valley Water Board would develop a single or series of regulatory mechanisms (e.g., waivers, waste discharge requirements, conditional prohibition of discharge) for waste discharge from irrigated agricultural lands to ground and surface water. The series of regulatory mechanisms would be designed to provide flexibility in establishing requirements for growers considering the variety of environmental conditions and agricultural operations throughout the Central Valley.

Under this alternative, third-party groups (e.g., water quality coalitions) would function as lead entities representing growers. Regulation of discharges to surface water under this alternative would be similar to Alternative 1 (current ILRP). However, this alternative allows for a reduction in monitoring under lower threat circumstances and where watershed or area management objectives plans are developed. This alternative also includes requirements for development of groundwater quality management plans to minimize discharge of waste to groundwater from irrigated agricultural lands. This alternative relies on coordination with the DPR for regulating discharges of pesticides to groundwater.

## Implementation Mechanisms and Lead Entity Responsibilities

Implementation mechanisms for this alternative could include conditional waivers of waste discharge requirements, waste discharge requirements, or conditional prohibitions of discharge.

Under this alternative, a coalition or other third-party group would be responsible for general administration of the ILRP. In order to be approved by the Central Valley Water Board for administration of this alternative, third-party groups would need to agree to assume the following responsibilities.

1. Enroll member growers. Provide summary member information to the Central Valley Water Board (see Regulatory Requirement No. 1).

2. Provide members and the Central Valley Water Board an organizational or management structure identifying persons responsible for ensuring that program requirements are fulfilled.
3. Agree to provide or make available to group members the annual summaries of expenditures of fees used to comply with the ILRP.
4. Notify potentially affected third-party group members each time the group has received a notice of violation or other enforcement action from the Central Valley Water Board and provide information regarding the reason for the enforcement.
5. Develop and implement monitoring/management practice tracking plans.
6. Conduct required water quality monitoring.
7. Develop and implement surface water quality management plans (similar to the current ILRP) where surface water monitoring results indicate two or more exceedances of any applicable water quality objective in a 3-year period.
8. Develop groundwater quality management plans for third-party identified groundwater management areas within 4 years of adoption of the ILRP by the Central Valley Water Board *(except in areas where a local groundwater management plan has been developed and approved (by the Central Valley Water Board) for substitution—see the section titled “Groundwater Quality Management Plan” below)*.
9. Inform growers of program requirements and provide coordination to ensure that water quality concerns are addressed.

#### **Optional Watershed or Area Management Objectives Plan (surface water)**

Third-party groups would have the option of developing a watershed or area management objectives plan. The goal of this plan would be to meet source control management objectives that would reduce the threat to surface water quality from waste discharge associated with irrigated agriculture. In areas implementing a Central Valley Water Board–approved watershed or area management objectives plan, surface water monitoring would be reduced. The Central Valley Water Board may require revision of the plan to include additional management objectives (in an iterative approach to address identified water quality concerns), revoke approval, or decline to approve a plan and the associated reduction in monitoring for the following reasons.

- a. Evidence exists that effective implementation of the plan may allow an exceedance, caused by waste discharge from irrigated agricultural lands, of applicable water quality objectives in surface waters.
- b. Available surface water quality monitoring data shows continuing exceedances of applicable water quality objectives within the area or watershed (where agriculture is a contributing source).
- c. Changes in agricultural operations or environmental conditions limit the plan’s applicability within the area or watershed.
- d. Evidence exists that growers are not implementing the plan.

The plan would specify optional water quality management practices that could be implemented to achieve plan objectives (see Attachment B). This plan would be developed consistent with the area or watershed commodity types, common agricultural practices, pesticides commonly used, and local land characteristics. Optional practices would be provided to allow growers to adapt to their specific

conditions for compliance with the ILRP. The plan would also consider the results of previous water quality sampling, including results from monitoring conducted under the current ILRP. This plan need not include a requirement that every grower implement a list of specific practices. It could, for example, involve implementing management practices that serve a group of growers.

The plan would be developed by local agencies with expertise in agriculture. The third-party group would also be responsible for the following when developing and implementing the watershed or area management objectives plan.

1. Informing local growers of the requirements in the watershed or area management objectives plan through an education and outreach program.
2. Obtaining local grower input for plan development.
3. Determining local needs for compliance.
4. Facilitating and developing a verification program for ensuring implementation of the management plan.

#### **Groundwater Quality Management Plans**

Third-party groups would be required to develop groundwater quality management plans (GQMPs) designed to minimize waste discharge to groundwater from irrigated agricultural lands. As part of GQMP development, the third party would collect and evaluate available groundwater data, identify groundwater management areas (GMAs) of concern, identify constituents of concern within the GMAs, prioritize the GMAs and constituents of concern, identify agricultural practices that may be causing or contributing to the problem, and identify agricultural management practices that should be employed by local growers to address the constituents of concern. See Attachment C for additional GQMP requirements.

*Periodic review of approved GQMPs:* Every 5 years, the Central Valley Water Board and third-party groups would meet and confer to evaluate the sufficiency of GQMPs, and to determine whether and, generally, how they should be updated to reflect new priorities based on new information.

*Where local agencies have developed local groundwater management plans (e.g., AB 3030, SB 1938, Integrated Regional Water Management plans) that meet the requirements shown in Attachment D, the Central Valley Water Board may approve the local groundwater management plan to be substituted for the GQMP. However, growers would still be required to enroll with an approved third-party group. The third-party group would be the responsible lead entity for ILRP administration, monitoring and reporting.*

#### **General Central Valley Water Board Role and Responsibilities**

1. Require 100% ILRP participation.<sup>8</sup>
2. Review and approve monitoring plans.
3. Review and approve surface water quality management plans.
4. Review and approve GQMPs (*and, where applicable, local groundwater management plans requested to substitute for GQMPs*) and groundwater management areas.
5. Review and approve *optional* area or watershed management objectives plans.
6. Review monitoring reports.

7. Review overall program performance with regard to achieving ILRP objectives.
8. Respond to individual problems and complaints dealing with irrigation discharge and informing/coordinating with the responsible third-party group.
9. In an iterative process, require additional monitoring, information, and/or management measures where applicable water quality objectives are not being met.
10. Enforcing ILRP requirements.

## Regulatory Requirements

In order to be eligible for this alternative, growers would be required to:

1. Submit an application to the third-party group to enroll in the program and pay applicable program fees. The third-party group would apply for coverage on behalf of members. Required application information would include name and contact information of owner/operator and parcel numbers. Coalition groups would collect the application information for each member grower and report the information to the Central Valley Water Board.
2. Implement water quality management practices in accordance with any water quality management plans, including GQMPs and/or watershed or area management practices plans. Water quality management practices could be instituted on an individual basis, or be installed to serve a group of growers discharging to a single location (e.g., combined tailwater return or wetlands serving a group of growers).
3. Prevent nuisance conditions and/or exceedance of water quality objectives in state waters associated with waste discharge from their irrigated agricultural lands.
4. Provide the third-party group with information requested for compliance with the ILRP.

Growers who do not meet the above requirements would be required to work directly with the Central Valley Water Board and obtain waste discharge requirements or an individual waiver of waste discharge requirements.

## Monitoring Provisions

Growers would be required to track implemented management practices and submit the results to the third-party group. The third-party group would report summary results to the Central Valley Water Board.

The third-party group would be required to summarize ground and surface water monitoring and tracking results in an annual monitoring report to the Central Valley Water Board.

### Surface Water

Surface water monitoring under this alternative would consist of **one** of the following options:

- Watershed-based assessment and core monitoring similar to the monitoring required under the current ILRP (Central Valley Water Board Order No. R5-2008-0005). Under this monitoring scheme, third-party groups would work with the Central Valley Water Board to develop monitoring plans for Central Valley Water Board Executive Officer approval. These plans would specify monitoring parameters and site locations.



- Optional watershed or area management objectives plan—Where the Central Valley Water Board has approved a watershed or area management objectives plan, monitoring would consist of tracking the progress in implementing the watershed or area management objectives plan and watershed-based assessment monitoring for one year every five years (similar to the assessment monitoring required under the current ILRP).

## **Groundwater**

*Where a local groundwater management plan has been substituted for a GQMP, monitoring would consist of groundwater quality monitoring for, at minimum, nitrates and salts.*

For all other cases, groundwater monitoring under this alternative would consist of:

1. Tracking the level of GQMP management practice implementation through grower completion of acknowledgement forms. Growers completing acknowledgment forms would agree to implement GQMP-identified groundwater quality management practices to the maximum extent practicable.
2. Results of any focused studies of selected agricultural management practices, constituents, or physical settings to inform refinement of GMAs and constituent prioritization, or of practices that provide needed groundwater protection from degradation by constituents of concern.

## **Alternative 3—Individual Farm Water Quality Management Plan**

In this alternative, growers would have the option to work directly with the Central Valley Water Board or another implementing entity (e.g., Agricultural Commissioners) in the development of a farm water quality management plan (FWQMP). Growers would individually apply for a conditional waiver or waste discharge requirements that would require they obtain Central Valley Water Board approval of their FWQMP.

On-farm implementation of effective water quality management practices would be the mechanism to reduce or eliminate waste discharged to state waters. This alternative would provide incentive for individual growers to participate by providing growers with Central Valley Water Board certification that they are implementing farm management practices to protect state waters.

This alternative relies on coordination with the DPR for regulating discharges of pesticides to groundwater.

## **Implementation Mechanisms and Lead Entity**

Implementation mechanisms for this alternative could include conditional waivers of waste discharge requirements or waste discharge requirements.

Under this alternative, growers would be lead entities working directly with the Central Valley Water Board and would be responsible for applying for coverage, developing FWQMPs, and conducting any required reporting.

### **General Central Valley Water Board Role and Responsibilities:**

1. Enroll growers.
2. Require 100% ILRP participation.<sup>8</sup>

3. Review applications and determine priorities for FWQMP review and approval. Criteria for priority would include size of operation, likelihood for water quality impacts (potential impacts to surface and groundwater would be considered), and operations in areas with documented problems. In the review and approval of FWQMPs, Central Valley Water Board staff would conduct inspections of ranch/farm operations, as needed, to evaluate existing irrigated production areas and management practices, and verify that management practices referenced in the FWQMP are accurate and appropriate. Any needed changes to existing operations would be discussed, negotiated, and documented in the FWQMP.
4. Negotiate and enter into a memorandum of understanding (MOU) with technical service providers wanting to assume the role of assisting growers in the development of an FWQMP. The Central Valley Water Board may choose to delegate FWQMP review and approval authority to the technical service entity.
5. Conduct a specified number of grower site inspections annually. Site inspection priority will be determined by the Central Valley Water Board using factors such as complaints received regarding discharge, size of operations, types of operations, and location of operations in regard to water quality problems. The Central Valley Water Board may work with, or contract with, another entity to conduct these inspections in the most efficient manner (e.g., County Agricultural Commissioners, or other entity). Site inspections would include evaluation of FWQMPs, management practices, etc.
6. Follow up and coordinate with growers to ensure that FWQMPs and implemented management practices are addressing identified water quality problems. This would include providing information to help focus grower-developed FWQMPs (e.g., results of monitoring and studies showing constituents of concern for different geographic areas).
7. Review monitoring reports (monitoring would be specified in the FWQMP).
8. Review overall program performance with regard to achieving ILRP objectives.
9. Respond to individual problems and complaints dealing with irrigation discharge.
10. Issue certification that the participating grower is implementing management practices that protect water quality (following FWQMP review and approval).
11. In an iterative process, require additional monitoring, information, and/or management measures where applicable water quality objectives are not being met.
12. Enforce ILRP requirements.

## Regulatory Requirements

For program compliance, growers would be required to complete the following.

1. Submit an application to the Central Valley Regional Water Board to enroll in the program and pay fees. See Attachment E for application information requirements.
2. Working either directly with the Central Valley Water Board and/or with another implementing entity (coalition, private consultant, etc.), within **two years** of enrollment in the program, develop and implement an FWQMP aimed to minimize waste discharge to surface and groundwater (to include wellhead protection practices). Proposed FWQMP requirements are summarized in Attachment F.

3. Water quality management practices could be instituted on an individual basis, or be installed to serve a group of growers discharging to a single location (e.g., combined tailwater return or wetlands serving a group of growers).
4. Submit the FWQMP for review and approval by the Central Valley Water Board.
5. Maintain and update the approved FWQMP as operations and conditions change.
6. Prevent nuisance conditions and/or exceedance of water quality objectives in state waters associated with waste discharge from their irrigated agricultural lands.
7. Allow inspection of the production area by the Central Valley Water Board, or representative, to verify satisfactory implementation of management practices and accuracy of the FWQMP.

## Monitoring Provisions

Unless specifically required in response to water quality problems, owners/operators would not be required to conduct water quality monitoring of adjacent receiving waters or underlying groundwater. Required monitoring would include evaluation of management practice effectiveness (e.g., monitoring that an installed tailwater return system is preventing off-site discharge, review of erosion prevention practices after storm events, visual monitoring of turbidity of field discharge, and review of nutrient applications and estimated crop uptake). An annual report to the Central Valley Water Board would be required that discusses the status of management practice implementation and an evaluation of the performance of those practices.

Requirements for individual ranch/farm monitoring would be agreed to by the owner/operator and the Central Valley Water Board and would be included in the FWQMP. The Central Valley Water Board and/or the MOU entity would conduct annual site inspections on a selected number of operations and review available applicable water quality monitoring data as additional means of monitoring the implementation of management practices and program effectiveness.

## Alternative 4—Direct Oversight with Regional Monitoring

Under this alternative, the Central Valley Water Board would develop waste discharge requirements and/or a conditional waiver of waste discharge requirements for waste discharge from irrigated agricultural lands to ground and surface water. Growers, or legal entities<sup>10</sup> responsible for a group of growers' waste discharges, would apply directly with the Central Valley Water Board to obtain coverage ("direct oversight"). However, this alternative would also include an option for third-party-run regional monitoring instead of individual grower monitoring. This alternative would require that growers develop and implement individual FWQMPs to minimize discharge of waste to surface and groundwater from irrigated agricultural lands.

Under this alternative, discharge of waste to surface water and groundwater would be regulated using a tiered approach. Growers' fields would be placed under one of three tiers based on the field's threat to water quality. The tiers represent fields with minimal (Tier 1), low (Tier 2), and high (Tier 3) potential threat to water quality. Requirements to avoid or minimize discharge of waste would be

---

<sup>10</sup> For example, a Joint Powers Authority. Under the Water Code, the discharger, as the party with operational control over waste discharges, is generally the party that is accountable for compliance with permit conditions. Accordingly, any proposal for a legal entity other than the discharger to assume responsibility for waste discharges under Alternative 4 would require careful legal scrutiny of the structure and powers of the entity to ensure consistency with the Central Valley Water Board's statutory mandates.

the least stringent for Tier 1 fields and the most stringent for Tier 3 fields. This would allow for less regulatory oversight for low threat operations while establishing necessary requirements to protect water quality from higher-threat discharges.

This alternative relies on coordination with the DPR for regulating discharges of pesticides to groundwater.

## **Criteria for Tier System<sup>11</sup>**

### ***Tier 1 (Minimal Threat)***

Tier 1 fields would be those that have a minimal potential to affect water quality. Such fields are defined as those where the discharge is so minimal that it will not result in any detectable change in water quality.

Tier 1 applicability would be based on a site-specific evaluation of an agricultural waste discharge's potential impact to surface water and/or groundwater quality, considering such factors as the existing water quality, hydrogeologic conditions, nitrogen loading, crop types, irrigation practices, pesticides used, distance to surface water bodies, and whether the field is in a DPR Groundwater Protection Area.

### ***Tier 2 (Low Threat)***

Tier 2 fields would be those that have a low potential to affect water quality and would be defined as those fields that meet each of the following conditions:

1. Have low-threat pesticide and fertilizer use. Low-threat pesticide and fertilizer operations are those that (a) for groundwater, do not use pesticides that have been found in or have the potential to move to groundwater as evaluated by the DPR's Groundwater Protection Program (Title 3, California Code of Regulations section 6800) or for surface water, do not use pesticides that have the potential to cause exceedance of applicable surface water quality objectives as defined using monitoring data;<sup>12</sup> and (b) have fertilizer application rates that are not expected to result in nitrogen exceedances in a groundwater basin.
2. Are not located in a vulnerable hydrologic environment. Vulnerable hydrologic environments would be defined by:
  - a. **Groundwater.** Square-mile sections of land where monitoring data from one well confirms any **one** of the following: (i) nitrate concentrations are greater than the maximum contaminant level (elevated nitrate levels), (ii) have measurable levels of agriculturally used pesticides, or (iii) salts, pathogens (where manure is used) are above an applicable water quality objective. DPR Groundwater Protection Areas would also be considered vulnerable hydrologic environments. Information on the DPR's Groundwater Protection Areas is available at: [http://www.cdpr.ca.gov/docs/emon/grndwtr/gwp\\_regs.htm](http://www.cdpr.ca.gov/docs/emon/grndwtr/gwp_regs.htm).  
  
Square-mile sections where agriculture is not a source of high levels of pesticides, salts, pathogens, or nitrate may not be considered "vulnerable hydrologic environments" under this alternative.

<sup>11</sup> Attachment G includes a matrix summarizing the tier system.

<sup>12</sup> This is defined as any pesticide for which monitoring data has shown two or more exceedances of applicable water quality objectives in three or more subbasins (Federal Watershed Boundary Dataset).

- b. **Surface water.** Subwatersheds where monitoring data confirms two or more exceedances of an applicable water quality objective for agriculturally used pesticides, nutrients, salts, sediment, or pathogens within a 3-year period (where agriculture is a contributing source).

### **Tier 3 (High Threat)**

Tier 3 fields would be those that have a high potential to affect surface water and/or groundwater quality and would be those fields that do not meet the Tier 1 or 2 criteria. Tier 3 fields would include fields that have low-threat fertilizer or pesticide use but are located in a vulnerable hydrologic environment. Tier 3 would also include fields that are not located in a vulnerable hydrologic environment, but have high-threat fertilizer and/or pesticide use. A field may move from Tier 3 to Tier 2 or vice versa depending upon changes in fertilizer or pesticide use or available information on groundwater vulnerability.

*Growers could be in different tiers for surface water or groundwater discharge. For example, a field may be in a vulnerable environment for groundwater (Tier 3), but minimal threat to surface water (Tier 1) if all applied water immediately percolates, and does not run off.*

## **Implementation Mechanisms and Lead Entity**

Implementation mechanisms for this alternative could include waivers of waste discharge requirements and/or waste discharge requirements.

Under this alternative, growers would be lead entities in working directly with the Central Valley Water Board and would be responsible for applying for coverage, developing FWQMPs, and conducting any required monitoring and reporting. This alternative would also allow for the formation of responsible legal entities that could serve a group of growers that discharge to the same general location and share monitoring locations. In such cases, the legal entity would be required to assume responsibility for member grower waste discharge, be approved by the Central Valley Water Board, and would be ultimately responsible for compliance with ILRP requirements.<sup>13</sup>

For monitoring under this alternative, growers would have the option to enroll in a third-party group regional monitoring program instead of conducting individual monitoring. In cases where responsible legal entities are formed, these entities would be responsible for conducting monitoring.

Where third-party groups fail to adequately conduct monitoring, each grower would be responsible for conducting individual monitoring. Third-party monitoring groups must be approved by the Central Valley Water Board and would need to agree to assume the following responsibilities.

1. Provide members and the Central Valley Water Board an organizational or management structure identifying persons responsible for ensuring that monitoring requirements are fulfilled.
2. Agree to provide or make available to group members summaries of expenditures of fees for compliance with the ILRP.
3. Develop monitoring plans.
4. Conduct required water quality monitoring.

---

<sup>13</sup> See footnote 10.



5. Notify potentially affected third-party group members each time the group has received a notice of violation or other enforcement action from the Central Valley Water Board and provide information regarding the reason for the enforcement.

#### **General Central Valley Water Board Role and Responsibilities:**

1. Enroll growers and or responsible legal entities (where applicable).
2. Require 100% ILRP participation.<sup>8</sup>
3. Review and approve monitoring plans of third parties and any responsible legal entity.
4. Review monitoring reports.
5. Follow up and coordinate with growers to ensure that FWQMPs and implemented management practices are addressing identified water quality problems. This would include developing tier system information (e.g., delineating hydrologic vulnerable areas), informing the growers about the tiers that apply to them in regard to waste discharge, and providing information to help focus grower-developed FWQMPs (e.g., results of monitoring and studies showing constituents of concern for different geographic areas). Where responsible legal entities are formed, those legal entities would be responsible for follow-up and coordination with growers; the Central Valley Water Board would work with the legal entities.
6. Review overall program performance in regard to achieving ILRP objectives.
7. Respond to individual problems and complaints dealing with irrigation discharge.
8. Conduct a specified number of grower site inspections annually. Site inspection priority will be determined by the Central Valley Water Board using factors such as complaints received regarding discharge, size of operations, types of operations, and location of operations in regard to water quality problems. The Central Valley Water Board may work with or contract with another entity to conduct these inspections in the most efficient manner (e.g., County Agricultural Commissioners). Site inspections would include evaluation of FWQMPs, nutrient management plans (NMPs), management practices, monitoring information, nutrient budget, etc.
9. In an iterative process, require additional monitoring, information, and/or management measures where applicable water quality objectives are not being met.
10. Enforce ILRP requirements.

#### **Regulatory Requirements**

Specific regulatory requirements for *all* growers would include the following.

1. Submit an application to the Central Valley Water Board to enroll in the program or be a member of a legal entity that has assumed responsibility for their waste discharge. The legal entity would apply for coverage on behalf of members. Required application information would include the following in addition to the requirements shown in Attachment E.
  - a. Available site-specific groundwater monitoring data for nitrates, salts, and pathogens.
  - b. Information necessary to determine whether the operation would be in Tier 1, 2, or 3 in regard to each field's potential threat to water quality.

Where applicable, responsible legal entities would collect the application information for each member grower and report summary information to the Central Valley Water Board.

2. Within **two years** of enrollment in the program, prepare and implement an FWQMP aimed to minimize waste (e.g., nutrients, pesticides, sediment, and pathogens) discharge to surface water and groundwater (to include wellhead protection practices). This plan would also be kept on the site and submitted to the Central Valley Water Board upon request. Proposed FWQMP requirements are summarized in Attachment F. Where applicable, the FWQMP would be submitted to responsible legal entities upon request.

Water quality management practices could be instituted on an individual basis, or be installed to serve a group of growers discharging to a single location (e.g., combined tailwater return or wetlands serving a group of growers).

3. Maintain and update the FWQMP as operations and conditions change.
4. Allow inspection of the production area by the Central Valley Water Board, or representative, to verify satisfactory implementation of management practices and accuracy of the FWQMP.
5. Prevent nuisance conditions and/or exceedance of water quality objectives in state waters associated with waste discharge from their irrigated agricultural lands.
6. Keep and maintain facility records of each field's nutrient budget. These records would be made available to the Central Valley Water Board (or, where applicable, responsible legal entity) during an inspection or upon request.
7. Within **two years** of enrollment in the program, complete 15 hours of farm water quality education.
8. Submit an annual certified statement to the Central Valley Water Board (or, where applicable, responsible legal entity) indicating whether changes have been made to fertilizer or pesticide use or if additional information is available on existing water quality that would change a field's potential impact to surface or groundwater, thus allowing (or requiring) the field to move from one tier to another.

#### **Additional Requirements—Tier 1 Operations Only:**

Submit a site-specific evaluation to the Central Valley Water Board or, where applicable, responsible legal entity, demonstrating that waste discharge from irrigated agricultural operations has minimal potential impact to surface water and/or groundwater quality. The site-specific evaluation would include the following information:

1. **For waste discharge to groundwater**—information on operations, existing groundwater quality, depth to groundwater, groundwater flow direction, description of subsurface sediments, nutrient and irrigation management practices.
2. **For waste discharge to surface water**—information on operations, existing surface water quality, distance to surface water bodies, identification of conduits to surface water (e.g., pipes, ditches, canals), estimated volume and waste composition of water discharged off the site, nutrient and irrigation management practices.

This evaluation would be tailored to the discharge considered a minimal threat. For example, where surface water discharge is considered a minimal threat, the required information would be tailored

to the surface water discharge. These site-specific evaluations would be subject to Central Valley Water Board review and approval.

### **Additional Requirements—Tier 3 Operations Only:**

1. Where Tier 3 characterization is based on fertilizer application rate or the section of land is defined as a vulnerable hydrologic environment in regard to nitrate: Develop and implement an NMP, if commercial fertilizers or manure are used, that is certified by a crop specialist and that provides protection for both surface and groundwater. Certified crop specialist is defined as a specialist certified in developing NMPs. The definition includes professional soil scientists, professional agronomists, professional crop scientists, or crop advisors certified by the American Society of Agronomy; technical service providers certified in nutrient management in California by the Natural Resources Conservation Service; or other specialists approved by the Executive Officer. The NMP must consider the rate, timing, and method of nutrient applications that do not exceed the crop's nutrient requirements considering the stage of plant growth; all nutrient sources; soil and climatic conditions; crop water use requirements, and minimum leaching requirements to reduce deep percolation of irrigation water to groundwater.

Growers would be required to update and maintain the NMP at the facility and submit it to the Central Valley Water Board upon request. Where applicable, the NMP must be submitted to responsible legal entities upon request.

2. ***Where the section of land is defined as a vulnerable hydrologic environment in regard to pesticides:*** Develop and implement management practices to minimize the potential discharge of pesticides to surface water and groundwater (e.g., DPR-recommended management practices for using the pesticide). These additional practices would be included in the FWQMP.

Growers who do not meet these requirements would work directly with the Central Valley Water Board and obtain waste discharge requirements or an individual waiver of waste discharge requirements.

## **Monitoring Provisions**

All growers would be required to conduct the following tracking and submit the results to the Central Valley Water Board (or an approved third-party monitoring group) annually.

1. Nutrient Tracking:
  - a. All nutrients applied (commercial fertilizers, manure, irrigation water, etc.).
  - b. Ratio of nutrients applied to the needs of the crop(s) (as recommended by the University of California Western Fertilizer Handbook [9<sup>th</sup> Edition] or from historic crop removal rates).
2. Pesticide Tracking:
  - a. Types and amounts of pesticides applied—The Central Valley Water Board would coordinate with the DPR and Agricultural Commissioners to gather this information.
3. Implemented Management Practices Tracking

In addition to these tracking requirements, growers in Tiers 2 and 3 would have the option of conducting individual monitoring **or** forming third-party groups to conduct regional monitoring programs (see below).

## Surface Water Monitoring

All growers in Tiers 2 and 3 for surface water discharge may elect to conduct individual monitoring or participate in regional monitoring by a third-party group or responsible legal entity.

### Individual Monitoring

Individual monitoring would consist of the following for ***Tier 3 operations:***

1. Discharge Monitoring:

- a. Tailwater discharges (constituents of concern<sup>14</sup>) during the first discharge of the irrigation season and once mid-season.
- b. Stormwater discharges (constituents of concern) during the first event of the wet season (between October 1 and May 31) and once during the peak storm season (typically February).
- c. Discharges of subsurface (tile) drainage systems (constituents of concern) annually.

***Tier 2 operations*** would be required to conduct the above monitoring for 1 year every 5 years (additional monitoring would apply where exceedances of applicable water quality objectives are found if agricultural discharges are a contributing source).

Monitoring results would be submitted in an annual report to the Central Valley Water Board.

### Regional Monitoring

Growers could form third-party groups to conduct regional monitoring programs. These groups would work with the Central Valley Water Board to identify monitoring sites and specific monitoring parameters (e.g., visual, chemical, etc.). Growers would be ultimately responsible for ensuring that monitoring requirements are carried out according to the requirements in the regional monitoring program. If legal entities are formed that serve a group of growers, the legal entity would be responsible for regional monitoring.

Regional monitoring would include regional water quality monitoring for constituents of concern<sup>14</sup>. Monitoring locations would be limited to waters of the state that are mainly runoff/discharge from irrigated agricultural operations in order to determine whether they are meeting applicable water quality objectives and to determine if agricultural discharges are causing or contributing to a violation of applicable water quality objectives.

***Tier 2 growers would be required to participate in water quality monitoring (e.g., water chemistry monitoring) for only 1 year every 5 years.***

Monitoring would also include gathering nutrient/pesticide use and management practices tracking information from member growers and summarizing the information. Monitoring and tracking results would be submitted in an annual report to the Central Valley Water Board.

---

<sup>14</sup> Constituents of concern may be prioritized for monitoring using the tier system. For example, where a grower is in Tier 3 for nutrient use, but does not have high threat pesticide use, monitoring may be reduced to Tier 2 for pesticide use.

## Groundwater Monitoring

All growers in Tiers 2 and 3 for groundwater discharge would be required to conduct the following groundwater monitoring.

### Individual Monitoring

**Tier 3 operations** would be required to conduct individual monitoring. Individual monitoring would consist of semiannual (spring/fall) sampling of each existing domestic well and/or monitoring well present on each field parcel for nitrate, phosphorus, total dissolved solids, and pathogens (when manure is applied). Each grower would be required to submit an annual report on their monitoring results to the Central Valley Water Board.

**Tier 2 operations** would be required to conduct the above individual monitoring **or** participate in regional monitoring.

### Regional Monitoring

All **Tier 3 operations** would be required to participate in a regional monitoring program in addition to the individual monitoring described above. **Tier 2 operations** that do not conduct individual monitoring would also be required to participate in a regional monitoring program. Regional monitoring would consist of:

1. Regional monitoring for constituents of concern to provide baseline groundwater information and track trends in groundwater quality over time.
2. Targeted site-specific studies to evaluate the effects of changes in management practices on groundwater quality (this would occur only at a selected number of sites—the Fertilizer Research and Education Program [FREP] would be approached as a potential funding source for this monitoring).
3. Gathering nutrient/pesticide use and management practices tracking information from member growers.
4. Submitting an annual report to the Central Valley Water Board summarizing nutrient, pesticide, and management practice tracking and the regional and targeted site-specific monitoring results.
5. Utilizing a database system to compile existing groundwater quality data and data collected during regional and site-specific monitoring (e.g., the State Water Resources Control Board's Groundwater Ambient Monitoring and Assessment [GAMA]/GeoTracker database could be used).

The Central Valley Water Board, the agricultural industry, and other stakeholders would identify organization(s) or entities, such as the U.S. Geological Survey, the University of California, Lawrence Livermore National Laboratory, or the DWR, suitable to conduct the regional monitoring and the criteria for this monitoring. These organizations or entities could be funded by additional annual fees, dues, or other funding mechanisms such as grant money.

Where legal entities are formed to take responsibility of waste discharge from a group of growers, these entities would be responsible for regional monitoring.



## Alternative 5—Direct Oversight with Farm Monitoring

This program would consist of general waste discharge requirements designed to protect surface water and groundwater from discharges associated with irrigated agriculture.

All growers would be required to apply for and obtain coverage under the general waste discharge requirements. This alternative would include requirements to (1) develop and implement an FWQMP; (2) monitor discharges of tailwater, drainage water, and storm water to surface water; applications of irrigation water, nutrients, and pesticides; and groundwater; (3) keep records of irrigation water and pesticide applications and nutrients applied, harvested, and moved off the site; and (4) submit an annual monitoring report.

This program would rely on coordination with the DPR Groundwater Protection Program for protecting groundwater from agricultural use of pesticides.

## Implementation Mechanisms and Lead Entity

Under this alternative, the Central Valley Water Board would develop general waste discharge requirements for irrigated agriculture.

In this alternative, growers would be the lead entity in working with the Central Valley Water Board. The Central Valley Water Board would adopt the waste discharge requirements, enroll individual operations under the program, provide regulatory oversight and enforce the requirements of the program.

### General Central Valley Water Board Role and Responsibilities:

1. Enroll growers.
2. Require 100% ILRP participation.<sup>8</sup>
3. Review monitoring reports.
4. Develop a prioritization scheme for determining where monitoring wells would be required in order to assess potential impacts to groundwater quality and overall program effectiveness.
5. Follow up and coordinate with growers to ensure that FWQMPs and implemented management practices are addressing identified water quality problems. This would include providing information to help focus grower-developed FWQMPs (e.g., results of monitoring and studies showing constituents of concern for different geographic areas).
6. Review overall program performance in regard to achieving ILRP objectives.
7. Responding to individual problems and complaints dealing with irrigation discharge.
8. Conduct a specified number of grower site inspections annually. Site inspection priority will be determined by the Central Valley Water Board using factors such as complaints received regarding discharge, size of operations, types of operations, and location of operations in regard to water quality problems. The Central Valley Water Board may work with, or contract with, another entity to conduct these inspections in the most efficient manner (e.g., County Agricultural Commissioners). Site inspections would include evaluation of FWQMPs, NMPs, management practices, monitoring information, nutrient budget, etc.

9. In an iterative process, require additional monitoring, information, and/or management measures where applicable water quality objectives are not being met.
10. Enforce ILRP requirements.

## Regulatory Requirements

Specific regulatory requirements for growers would include the following.

1. Submit an application to the Central Valley Water Board to enroll in the program. Required application information would include the following in addition to the requirements shown in Attachment E.
  - a. Available site-specific groundwater monitoring data for nitrates, salts, and pathogens.
  - b. Information to determine the whole farm nitrogen balance (estimated total nitrogen applied to crops, acreages of crops grown and the crop nitrogen needs).
2. Within **two years** of enrollment in the program, prepare and implement an FWQMP aimed to minimize waste (e.g., nutrients, pesticides, sediment, and pathogens) discharge to surface water and groundwater (to include wellhead protection practices)—this plan would also be kept on the site and submitted to the Central Valley Water Board upon request. Proposed FWQMP requirements are summarized in Attachment F.
3. Maintain and update the FWQMP as operations and conditions change.
4. Develop and implement an NMP, if commercial fertilizers or manure are used, that is certified by a crop specialist and that provides protection for both surface and groundwater. *Certified crop specialist* is defined as a specialist certified in developing NMPs. The definition includes professional soil scientists, professional agronomists, professional crop scientists, or crop advisors certified by the American Society of Agronomy; technical service providers certified in nutrient management in California by the Natural Resources Conservation Service; or other specialists approved by the Executive Officer. The NMP must consider the rate, timing, and method of nutrient applications that do not exceed the crop's nutrient requirements considering the stage of plant growth; all nutrient sources; soil and climatic conditions; crop water use requirements; and minimum leaching requirements to reduce deep percolation of irrigation water to groundwater.

Growers would be required to update and maintain the NMP at the facility and submit it to the Central Valley Water Board upon request.
5. Allow inspection of the production area by the Central Valley Water Board, or representative, to verify satisfactory implementation of management practices and accuracy of the FWQMP and NMP.
6. Prevent nuisance conditions and/or exceedance of water quality objectives in state waters associated with waste discharge from their irrigated agricultural lands.
7. Keep and maintain facility records of each field's nutrient budget. These records would be made available to the Central Valley Water Board during an inspection or upon request.

## Monitoring Provisions

Each operation would be required to conduct the following monitoring for each field and submit the results to the Central Valley Water Board annually.

### 1. Discharge Monitoring:

- a. Tailwater discharges (constituents of concern) monthly.
- b. Stormwater discharges (constituents of concern) during the first event of the wet season (between October 1 and May 31) and once during the peak storm season (typically February).
- c. Discharges of subsurface (tile) drainage systems (constituents of concern) annually.

### 2. Nutrient Tracking:

- a. All nutrients applied (commercial fertilizers, manure, irrigation water, etc.).
- b. Soil nitrogen and phosphorus once every 5 years.

### 3. Pesticide Tracking: Types and amounts of pesticides applied—The Central Valley Water Board will coordinate with the DPR and Agricultural Commissioners to gather this information.

### 4. Groundwater Monitoring:

- a. Sample all supply wells annually for nitrate and electrical conductivity (or total dissolved solids) and for major cations and anions if elevated concentrations of nitrate or electrical conductivity are detected.
- b. Install monitoring wells, or use a Central Valley Water Board approved alternative technology (e.g., well point or direct push method) to collect groundwater quality samples semiannually if requested by the Executive Officer. Locations chosen for groundwater monitoring will be prioritized based on Central Valley Water Board staff-developed vulnerability factors. These factors would include nitrate concentrations in the supply wells, nitrate concentrations in domestic wells adjacent to the property, location of property relative to a DPR Groundwater Protection Area, distance from an artificial recharge area as identified by the DWR or Central Valley Water Board, distance between the property and the nearest off-property domestic well, distance from the property to the nearest off-property municipal well, number of crops grown per year per field, NMP completed by deadline, and whole farm nitrogen balance.

## Attachment A

# Alternatives Matrix

---





Attachment A  
Alternatives Matrix

| No. | Alternative Description and Summary                                                                                                                                                                                                                                                                                                                                                                                                                                         | Lead Entity        | Lead Entity Responsibilities                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | CVWB Responsibilities                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Growers' Regulatory Requirements                                                                                                                                                                                                                                                                                    | SW Monitoring                                                                                                                                | GW Monitoring                                                                                                                                                                                                                                                                                                  | Tracking                      |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| 1   | <b>No Change</b> - CEQA "No Project" alternative. Renewal and continuation of the current program. Coalition groups function as lead entities. Where monitoring indicates a problem, third-party groups and growers implement management practices in response.                                                                                                                                                                                                             | Coalition groups   | 1. Enroll member growers.<br>2. Develop monitoring plans.<br>3. Conduct monitoring.<br>4. Develop and implement surface water quality management plans where monitoring data shows two or more exceedances of an applicable water quality objective.<br>5. Inform/coordinate with growers.                                                                                                                                                                                                                                                                                                                                                                                              | 1. Require 100% participation.<br>2. Review and approve monitoring plans.<br>3. Review monitoring reports.<br>4. Review and approve surface water quality management plans.<br>5. Review ILRP performance.<br>6. Respond to complaints.<br>7. Enforce ILRP.                                                                                                                                                                                                                                                                                                                                                                             | 1. Submit application and pay fees.<br>2. Implement water quality management practices.<br>3. Prevent nuisance conditions and/or exceedance of WQOs.<br>4. Provide requested information to Coalition group.                                                                                                        | Watershed-based (same as current ILRP)                                                                                                       | None                                                                                                                                                                                                                                                                                                           | None                          |
| 2   | <b>Third-Party Lead Entity</b> - Third-party groups would function as lead entities representing growers. Regulation of discharges to surface water would be similar to Alternative 1. This alternative allows for a reduction in surface water monitoring under lower threat circumstances and where management plans are developed. This alternative also requires the development of groundwater quality management plans to minimize discharge of waste to groundwater. | Third-party groups | 1. Enroll member growers and provide member information to the CVWB.<br>2. Provide members and CVWB an organizational or management structure.<br>3. Make ILRP expenditure summaries available to members.<br>4. Notify affected group members of CVWB enforcement against the third-party.<br>5. Develop monitoring/management practice tracking plans.<br>6. Conduct monitoring.<br>7. Develop and implement surface water quality management plans where monitoring data shows two or more exceedances of an applicable water quality objective.<br>8. Develop groundwater quality management plans within four-years of adoption of the ILRP.<br>9. Inform/coordinate with growers. | 1. Require 100% participation.<br>2. Review and approve monitoring plans.<br>3. Review and approve surface water quality management plans.<br>4. Review and approve groundwater quality management plans.<br>5. Review and approve <i>optional</i> watershed/area management objectives plans.<br>6. Review monitoring reports.<br>7. Review ILRP performance.<br>8. Respond to complaints.<br>9. Require additional monitoring and practices where WQOs are not being met.<br>10. Enforce ILRP.                                                                                                                                        | 1. Submit application and pay fees.<br>2. Implement water quality management practices in accordance with any approved plans.<br>3. Prevent nuisance conditions and/or exceedance of WQOs.<br>4. Provide ILRP information to third-party group.                                                                     | Watershed-based (same as current ILRP) with option for reduced monitoring where <i>optional</i> watershed/area management plan is developed. | Regional monitoring for at a minimum nitrates and salts (under a local groundwater management plan).<br><br><i>or</i><br><br>Tracking implementation of required management practices along with a limited number of site specific studies (under third-party developed groundwater quality management plans). | Management practice tracking. |
| 3   | <b>Individual Farm Water Quality Management Plans</b> - Individual growers would work with the CVWB, or designated implementing agency, to develop an individual farm water quality management plan. The CVWB would approve the plan.                                                                                                                                                                                                                                       | CVWB               | See CVWB responsibilities.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1. Enroll growers.<br>2. Require 100% participation.<br>3. Review applications, prioritize review of farm water quality management plans.<br>4. Negotiation MOUs with technical service providers.<br>5. Conduct grower site inspections.<br>6. Coordinate with growers to ensure plans/practices are addressing water quality problems.<br>7. Review monitoring reports.<br>8. Review ILRP performance.<br>9. Respond to complaints.<br>10. Certify participating growers are implementing practices that protect water quality.<br>11. Require additional monitoring and practices where WQOs are not being met.<br>12. Enforce ILRP. | 1. Submit application and pay fees.<br>2. Within 2-years, develop and implement a farm water quality management plan.<br>3. Submit plan for CVWB approval.<br>4. Maintain and update plan as needed.<br>5. Prevent nuisance conditions and/or exceedance of WQOs.<br>6. Allow inspection by CVWB or representative. | Monitoring of management practices (e.g., visual monitoring, inspection of proper operation).                                                | Monitoring of management practices (e.g., visual monitoring, inspection of proper operation).                                                                                                                                                                                                                  | Management practice tracking. |

Attachment A  
Alternatives Matrix

| No. | Alternative Description and Summary                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Lead Entity            | Lead Entity Responsibilities                                                                                                                                                                                                                                                                                                | CVWB Responsibilities                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Growers' Regulatory Requirements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | SW Monitoring                                                                                                                                            | GW Monitoring                                                                                                                                                          | Tracking                                               |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|
| 4   | <b>Direct Oversight with Regional Monitoring -</b><br>Individual growers or "legal entities" assuming responsibility for waste discharge would work directly with the CVWB. This alternative provides the option for third-party group conducted monitoring and reporting. Under this approach, regulatory requirements would be scaled using tiered, threat-based criteria. Higher threat operations would be required to implement additional management practices and more extensive monitoring than lower threat operations. Under this alternative all growers would be required to develop an individual farm water quality management plan. | CVWB or "legal entity" | Third-party monitoring group:<br><br>1. Provide members and CVWB an organizational or management structure.<br>2. Make ILRP expenditure summaries available to members.<br>3. Notify affected group members of CVWB enforcement against the third-party.<br>4. Develop monitoring/tracking plans.<br>5. Conduct monitoring. | 1. Enroll growers or "legal entities."<br>2. Require 100% participation.<br>3. Review and approve monitoring plans.<br>4. Review monitoring reports.<br>5. Coordinate with growers to ensure plans/practices are addressing water quality problems; assign growers to appropriate tier or tiers.<br>6. Review ILRP performance.<br>7. Respond to complaints.<br>8. Conduct grower site inspections.<br>9. Require additional monitoring and practices where WQOs are not being met.<br>10. Enforce ILRP. | 1. Submit application and pay fees.<br>2. Within 2-years, develop and implement a farm water quality management plan - the plan would be kept onsite and submitted to the CVWB upon request.<br>3. Maintain and update plan as needed.<br>4. Allow inspection by CVWB or representative.<br>5. Prevent nuisance conditions and/or exceedance of WQOs.<br>6. Maintain facility records of each field's nutrient budget.<br>7. Complete 15 hrs of farm water quality education within 2-years.<br>8. Submit annual certified statement to CVWB regarding appropriate tier application.<br><b>Tier 1 Only:</b> submit site-specific evaluation to CVWB demonstrating minimal potential impact of waste discharge to SW and/or GW.<br><b>Tier 3 Only:</b> develop a nutrient management plan and/or implement additional pesticide management practices. | Tiers 2 and 3 would conduct individual monitoring, or participate in regional monitoring, with Tier 2 operations having reduced monitoring requirements. | Tier 3 operations would conduct individual monitoring <i>and</i> participate in regional monitoring; Tier 2 operations would choose individual or regional monitoring. | Nutrient/pesticide applications, management practices. |
| 5   | <b>Direct Oversight with Farm Monitoring -</b><br>Individual growers would work directly with the CVWB. Growers would be required to develop and implement a farm water quality management plan and nutrient management plan.                                                                                                                                                                                                                                                                                                                                                                                                                      | CVWB                   | See CVWB responsibilities.                                                                                                                                                                                                                                                                                                  | 1. Enroll growers.<br>2. Require 100% participation.<br>3. Review monitoring reports.<br>4. Develop prioritization scheme for installation of monitoring wells.<br>5. Coordinate with growers to ensure plans/practices are addressing water quality problems.<br>6. Review ILRP performance.<br>7. Respond to complaints.<br>8. Conduct grower site inspections.<br>9. Require additional monitoring and practices where WQOs are not being met.<br>10. Enforce ILRP.                                   | 1. Submit application and pay fees.<br>2. Within 2-years, develop and implement a farm water quality management plan - the plan would be kept onsite and submitted to the CVWB.<br>3. Maintain and update the plan as needed.<br>4. Develop and implement a nutrient management plan if commercial fertilizer or manure are used.<br>5. Allow inspection by CVWB or representative.<br>6. Prevent nuisance conditions and/or exceedance of WQOs.<br>7. Maintain facility records of each field's nutrient budget.                                                                                                                                                                                                                                                                                                                                    | Individual farm monitoring for constituents of concern in tailwater and stormwater.                                                                      | Individual supply well monitoring. Installation and sampling of monitoring wells where CVWB requires -based on vulnerability factors.                                  | Nutrient/pesticide applications, management practices. |

## Attachment B

# Area or Watershed Management Objectives Plans

---

The implementation of water quality management practices is based on the premise that individual group members will be actively involved in implementing an area or watershed management objectives plan. Throughout much of the Central Valley Regional Water Board area, watershed management plans have been or are being developed by local management entities (RCDs, watershed alliances, district organizations, etc.). These plans typically include the identification of principal watershed issues and concerns and describe appropriate actions to address those issues and concerns. While they may include water quality impacts from agricultural discharge as a watershed concern, these plans are usually more general than envisioned for an ILRP area or watershed management objectives plan.

For an ILRP area or watershed management objectives plan, the expectation would be the identification of a set of management objectives and management practices that, if implemented, would be effective in addressing agricultural discharge-related impacts to water quality. Typically these management objectives and practices would be developed for crop types (e.g. wild rice, vineyards, and citrus) or general agricultural operations (e.g. livestock management with irrigated pasture and other animal forage production, i.e. ranch operations) that are common to that geographic or watershed area. Management objectives tend to be more general (e.g. “manage irrigation water to eliminate, reduce, or slow the direct discharge of tailwater to adjacent watercourses”), while management practices are the more specific method used to achieve the management objective (e.g. collect tailwater in ponds or wetlands, recycle tailwater, discharge tailwater to vegetated buffers zones, and modify irrigation methods). Selection of the appropriate management practice is typically done on a site-specific or property-specific basis.

In summary, an area or watershed management objectives plan would include management objectives (by crop type or type of agricultural operation), common management practices that could be used to achieve the management objective, the approach to be used by the coalition (or other third party) to promote the implementation of management objectives and practices, and the approach to be used to track the watershed-wide level of management practice implementation and its effectiveness.

Where watershed management plans already exist, these more specific area or watershed management practice plans could be made part of that broader watershed management plan.



## Attachment C

# Groundwater Quality Management Plans

---

Groundwater quality management plans (GQMPs) for third-party group identified groundwater management areas (GMAs) would include the following:

- Identification of GMAs and constituents of concern based on available data from existing groundwater management programs, including but not limited to the State Water Resources Control Board's Groundwater Ambient Monitoring and Assessment, the U.S. Geological Survey, the DPH, the DPR, and the DWR.
- Prioritization of GMAs and constituents of concern for implementation of agricultural management practices based on available data, and also based on the risk of contamination due to soil type, known agricultural practices, crops grown, climate, proximity to wells, aquifer condition and uses, and other factors determined to be relevant and appropriate by the third party. Where an identified constituent of concern is a pesticide that is subject to the DPR's ground water protection program, the GQMP would defer to DPR's regulatory program for that pesticide and any requirements associated with the use of that pesticide.
- Identification of appropriate agricultural practices for high-priority constituents in high-priority GMAs.
- Describe how information regarding agricultural practices would be distributed to growers in high-priority areas. For example, such information would be prepared by the third parties for distribution by the county agricultural commissioner (CAC) offices at the time that growers file pesticide use reports, when they file an application for a private applicator's license, or when they obtain a restricted materials permit. When the information is distributed by the CAC or other identified entity, growers would sign a form acknowledging that they have received information regarding agricultural management practices for the protection of groundwater in the high-priority area, and that they will implement the practices to maximum extent practicable. Once executed, the CAC or other entity would then transmit completed forms back to the third party for assembly and annual reporting purposes.
- Include a tracking and reporting program that annually documents to the Central Valley Water Board implementation of agricultural management practices within the high-priority areas. Implementation of agricultural practices would be inferred by acknowledgement forms from the CACs office.
- The GQMP may include focused studies of selected agricultural management practices, constituents, or physical settings to inform refinement of GMA and constituent prioritization, or of practices that provide needed groundwater protection from degradation by constituents of concern. The results of focused studies would be documented in the annual report.
- The GQMP would not include or address issues related to groundwater supply, including issues regarding the volume of groundwater pumped or used by growers within a groundwater management area.





## Attachment D

# Local Groundwater Management Plan

---

In order to be substituted for GQMPs under Alternative 2, local groundwater management plans would be required to contain the following elements:

1. Program goals must be consistent with Basin Plan water quality objectives for groundwater.
2. Monitoring for groundwater quality.
3. Reporting of monitoring results in an aggregated manner.
4. Where necessary, recommended groundwater quality management practices.
5. Evaluation of effectiveness of existing groundwater management policies/practices.
6. Ability to amend the plan if objectives are not being met.



## Attachment E

# Minimum ILRP Application Requirements

---

Minimum required information for application<sup>15</sup> for coverage under Alternatives 3, 4, and 5 would include:

- a. Name and contact information of owner/operator.
- b. Discharge location and operations.
- c. Receiving water information.
- d. Irrigation method(s).
- e. Site map.
- f. Parcel numbers, acreages, and crop types.
- g. Location of any potential conduits to groundwater (e.g., active, inactive, or abandoned wells; dry wells, recharge basins, or ponds, etc.).

---

<sup>15</sup> This “application” would be a Notice of Intent to comply with program requirements.





## Attachment F

### FWQMP Requirements

---

Alternatives 3, 4, and 5 would require that irrigated agricultural operations develop individual farm water quality management plans (FWQMPs). For guidance and consistency, the Central Valley Water Board would develop a standard FWQMP template, but it is expected that, at a minimum, plans would describe those practices needed or currently in use to achieve water quality protection. Growers would be encouraged to work with technical service organizations such as resource conservation districts and the University of California Cooperative Extension in the development of FWQMPs.

FWQMP content would at a minimum include 1) name and contact information of owner/operator; 2) description of operations including number of irrigated acres, crop types, and chemical/fertilizer application rates and practices; 3) maps showing the location of irrigated production areas, discharge points and named water bodies; 4) applicable information on water quality management practices used to achieve general ranch/farm management objectives and reduce or eliminate discharge of waste to ground and surface waters; 5) measures instituted to comply with California Code of Regulations, Title 3, Section 6609 requirements for wellhead protection (from pesticide contamination) along with methods for wellhead protection from fertilizer use; and 6) identification of any potential conduits to groundwater aquifers on the property (e.g. active, inactive, or abandoned wells; dry wells, recharge basins, or ponds) and steps taken, or to be taken, to ensure all identified potential conduits do not carry contamination to groundwater.



## Attachment G

### Alternative 4 Tier System Matrix

|                                       | Tier 1                                                                                                        | Tier 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Tier 3                                                                                                                                                                                         |
|---------------------------------------|---------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Definition <sup>a</sup>               | Fields with minimal potential to affect water quality                                                         | Fields with low potential to affect water quality:<br>1. <i>Surface water</i> -not a potential source of a water quality problem within the sub-watershed; does not use pesticides that have been identified as causing water quality problems in three or more sub-basins<br>2. <i>Groundwater</i> -low threat fertilizer use; no use of Title 3, California Code of Regulations section 6800 pesticides; not within a vulnerable hydrologic one mile section of land as identified by well data | Fields with waste discharge to surface and/or groundwater that do not meet Tier 1 or 2                                                                                                         |
| Specific requirements <sup>b</sup>    | Submit site specific information demonstrating minimal potential to affect surface and/or groundwater quality |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Nutrient management plans and/or additional pesticide management practices                                                                                                                     |
| Surface water monitoring <sup>b</sup> |                                                                                                               | <i>Individual</i> tailwater, stormwater, tile drainage monitoring for constituents of concern one year out of every five years<br><br><b>Or</b><br><i>Regional</i> ambient water quality monitoring for constituents of concern one year out of every five years                                                                                                                                                                                                                                  | <i>Individual</i> tailwater, stormwater, tile drainage monitoring for constituents of concern<br><br><b>Or</b><br><i>Regional</i> ambient water quality monitoring for constituents of concern |

|                                                                                                                                                                                                                                                            | <b>Tier 1</b> | <b>Tier 2</b>                                                                                                                                                                                                    | <b>Tier 3</b>                                                                                                                                                                                                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Groundwater monitoring <sup>b</sup>                                                                                                                                                                                                                        |               | <i>Individual</i> semiannual monitoring of onsite wells for nitrate, phosphorus, total dissolved solids, and pathogens<br><b><i>Or</i></b><br><i>Regional</i> groundwater monitoring for constituents of concern | <i>Individual</i> semiannual monitoring of onsite wells for nitrate, phosphorus, total dissolved solids, and pathogens<br><b><i>And</i></b><br><i>Regional</i> groundwater monitoring for constituents of concern |
| a. An operation may be in a different tier for surface and groundwater discharges.<br>b. The requirements summarized in this matrix are those specific to each tier. See Alternative 4, Regulatory Requirements, for requirements that apply to all tiers. |               |                                                                                                                                                                                                                  |                                                                                                                                                                                                                   |

**APPENDIX B**

**CENTRAL VALLEY WATER BOARD  
DRAFT GROUNDWATER NITRATE SUMMARY REPORT**





## **APPENDIX B**

### **Draft Groundwater Nitrate Summary Report**

#### **A. Abstract**

Nitrate derived from both agricultural and non-agricultural sources has resulted in degradation of groundwater beneath agricultural areas in California's Central Valley. Such discharges must be considered when developing a long-term irrigated lands regulatory program and an Environmental Impact Report (EIR) to protect State waters. The first step in this evaluation process is to conduct a review of available nitrate literature for information on: source identification techniques, nitrate leaching factors, vulnerability studies, known areas of impact and trends.

Determining the specific source(s) of nitrate contained in groundwater requires the use of a variety of chemical and physical methods that have been demonstrated to be effective for this purpose.

While some disagreement exists between the investigators, a common group of physical and chemical factors has been identified as affecting nitrate leaching beneath agricultural lands. Physical factors include: nitrogen application rates, water inputs (rainfall, type of irrigation, and frequency of irrigation), leaching rates (soil type and structure), evapotranspiration, and depth to groundwater. Chemical factors include: soil mineralogy, pH, bulk density, soil organic matter, and denitrification.

Comparisons of nitrate and non-nitrate vulnerability maps with maps depicting areas in the Central Valley where groundwater quality has been affected by nitrates show general agreement. However, sampling-induced bias (sampling deeper waters below shallow nitrate-affected waters or sampling wells with long screen intervals) coupled with the lack of sampling in some regions may distort or underestimate the area of impact.

Studies of trends in nitrate concentrations in groundwater in the Central Valley have focused predominantly on the eastern side of the San Joaquin Valley. Increases in nitrate concentrations in these focused areas corresponded to fertilizer application rates.

#### **B. Introduction**

Agricultural waste discharges can impact groundwater quality. Consequently, potential impacts on groundwater attributable to such discharges must be considered when developing a long-term irrigated lands regulatory program and an EIR to protect State waters. Identification of areas where groundwater quality

already has been affected by constituents associated with irrigated agriculture is an important consideration. Identifying such areas in the Central Valley can help the California Regional Water Quality Control Board, Central Valley Region (Central Valley Water Board) and affected stakeholders in the prioritization and development of programs to protect groundwater from agricultural waste discharges.

Nitrate was selected as the indicator parameter for this study because of its widespread use in agriculture, groundwater's vulnerability to nitrate degradation, and the relatively large amount of data that has been published regarding nitrate impacts in the Central Valley. The choice to focus on nitrate as the topic of this study does not mean that it is the only agriculturally derived substance known to affect groundwater quality. Pesticides, nutrients, salts, and pathogens all have been shown to negatively affect groundwater quality as a result of agricultural operations. However, nitrate is arguably the most studied of these constituents with hundreds of published reports providing information on a variety of nitrate sources, leaching factors, vulnerability areas, known areal impact in the Central Valley, and trends of impacts over time.

## **1. Report Objectives**

The objectives of this report are to:

1. identify the major sources of nitrate that may affect groundwater in the Central Valley;
2. investigate methods that may be used to identify a specific source of nitrate;
3. evaluate factors that affect the leaching of nitrate and its detection;
4. review published nitrate vulnerability studies for the Central Valley;
5. identify areas in the Central Valley where groundwater quality has been affected by nitrates; and
6. provide a discussion of trends in nitrate concentrations in groundwater in the Central Valley.

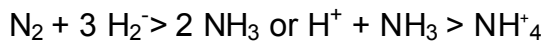
## **C. Nitrogen Cycle**

The nitrogen cycle (Figure B-1) is the process by which nitrogen is converted between its various chemical forms. This transformation can be carried out through both biological and non-biological processes.

### **1. Nitrogen**

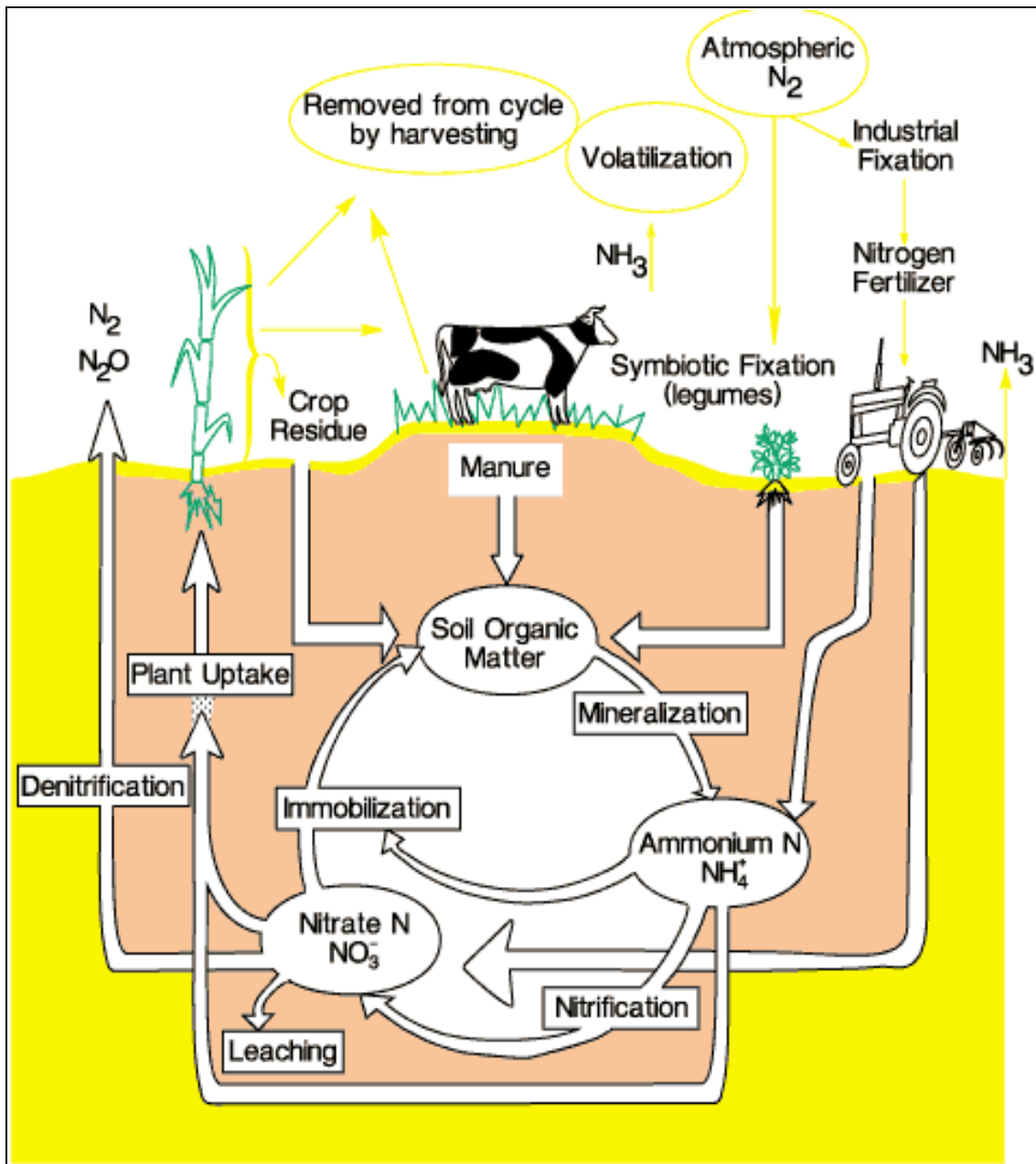
Nitrogen ( $N_1$ ) is an essential element for life, composing one of the primary building blocks for amino acids and proteins. Nitrogen in the form of nitrogen gas

(N<sub>2</sub>) is the most abundant component in the earth's atmosphere, making up approximately 78 percent by volume. However, gaseous nitrogen must be 'fixed' (converted from N<sub>2</sub> into ammonia [NH<sub>3</sub>]) so that it can be used by plants. There are two main ways that nitrogen fixation occurs: biological and non-biological. Biological fixation is performed by bacteria converting nitrogen into ammonia and ammonium.



Non-biological processes include lightning and industrial formation. Lightning produces energy that combines nitrogen (N<sub>2</sub>) and water (H<sub>2</sub>O) to form ammonia (NH<sub>3</sub>) and nitrates (NO<sub>3</sub>). Industrial formation uses nitrogen gas (N<sub>2</sub>) combined with hydrogen (H), a catalyst, very high pressure, and high temperature to produce ammonia (NH<sub>3</sub>).

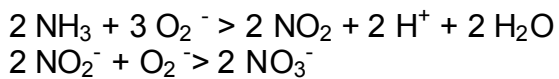
**Figure B-1. The Nitrogen Cycle in the Soil and Vadose Zone in an Agricultural Setting**



Source: From Lawrence Livermore National Laboratory 2002.

### **Nitrification**

Nitrification occurs by the following reactions:





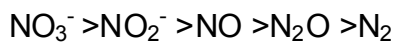
Aerobic bacteria use oxygen to convert ammonia and ammonium. Nitrosomonas bacteria convert nitrogen into nitrite ( $\text{NO}_2^-$ ), and then nitrobacteria convert nitrite to nitrate ( $\text{NO}_3^-$ ). Plants use the nitrate as a nutrient and animals obtain nitrogen by eating plants.

### **Decay or Ammonification**

When plants and animals die, bacteria convert nitrogen nutrients back into ammonium salts and ammonia. This conversion process is called ammonification.

### **Denitrification**

Denitrification is the process through which oxidized forms of nitrogen such as nitrate ( $\text{NO}_3^-$ ) and nitrite ( $\text{NO}_2^-$ ) are converted to dinitrogen ( $\text{N}_2$ ) and, to a lesser extent, nitrous oxide gas ( $\text{N}_2\text{O}$ ), which is returned to the atmosphere, completing the cycle. Denitrification is an anaerobic process that is carried out by denitrifying bacteria (pseudomonas, alkaligenes and bacillus), which convert nitrate to dinitrogen in the following sequence:



## **D. Sources of Nitrate in Groundwater**

There are many sources of nitrogen, both natural and anthropogenic, that potentially could lead to the increased nitrate concentrations in groundwater (Figure B-2). Natural sources of nitrate include: nitrate contained in buried soil layers (caliche), nitrate contained in sedimentary rocks, nitrate produced by microorganisms in soils (fixation by bacteria), nitrate produced by lightning during thunderstorms, and nitrates contained in forested soils (decayed organic matter). Natural sources of nitrate that may contribute a high concentration of nitrate to the groundwater usually are derived from an anthropogenic disturbance. One example of this is the effect of logging in forested areas. Natural, mature forests conserve nitrogen, but human disturbances (logging) and fire can lead to nitrate leaching and potential increases of nitrogen in groundwater (Meixner et al. 2003; Kubin 1998).

### **1. Major Non-Agricultural Sources of Nitrate**

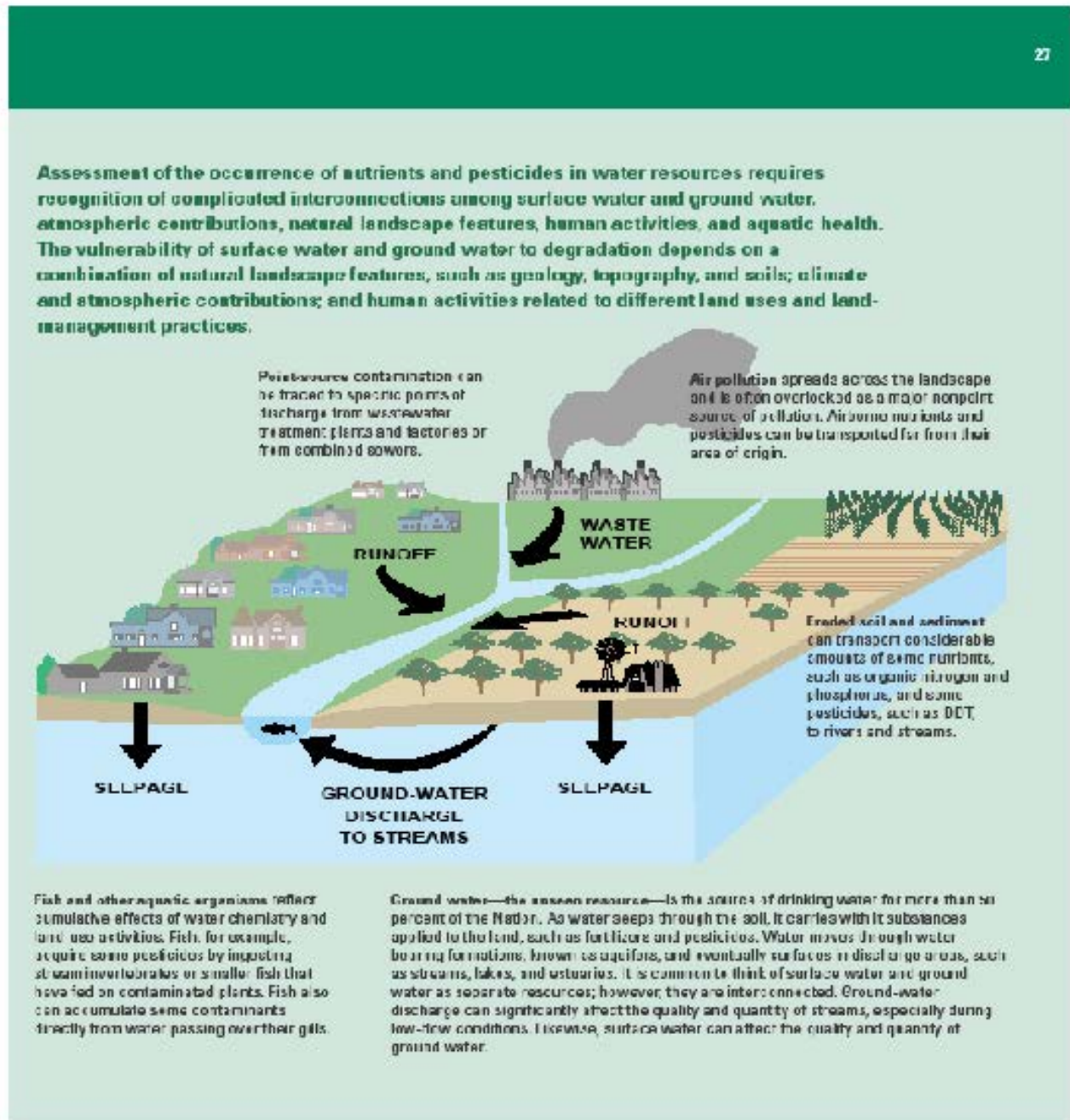
Studies have identified various forms of non-agriculturally derived nitrogen (nitrate, nitrite, ammonia, kjeldahl nitrogen) in aquifers in predominantly agricultural regions (Wakida and Lerner 2005; Paul et al. 2007; Central Valley Water Board 2008). The most significant sources for non-agricultural nitrate include: leakage from septic tanks, residential use of fertilizers, leakage from sewage pipes and mains, landfills, and food processing facilities.

### **Septic Systems**

According to the United States Environmental Protection Agency (USEPA), the concentration of total nitrogen in effluents from a typical septic tank system

ranges from 26 to 75 milligrams per liter (mg/l), with ammonia making up 4–13 mg/l and nitrite/nitrate composing <1 mg/l (U.S. EPA, *Onsite Wastewater Treatment Systems Manual*, February 2002).

**Figure B-2. From: Fuhrer, G.J., et al., 1999, The Quality of Our Nation's Waters—Nutrients and Pesticides: U.S. Geological Survey Circular 1225, 27 p**



The USEPA estimates that up to 20 percent of the septic systems nationwide do not function properly because of poor location, improper design, or lack of

maintenance (USEPA 2002). While leaking from individual septic systems does contribute to nitrate loading into groundwater, the most important factor affecting groundwater contamination by septic tank failures is the density of systems per given area: the more numerous the systems the higher potential for nitrate groundwater impact (Pang et al. 2006; Wallace and Lowe 1998).

### **Residential Fertilizer Use**

Studies have been conducted to investigate nitrogen inputs to groundwater from residential lawn care. One such study (Law et al. 2004) found that approximately 53 percent of the total nitrogen budget in a portion of Baltimore County, Maryland, was from lawn fertilization. A second study conducted in southern New England (Gold et al. 1990) identified soil water percolate concentrations from fertilized and unfertilized lawn treatments as having concentrations of less than 1.7 mg/l of nitrate as nitrogen. Bowman and others (2002) tested a variety of grasses under worst-case conditions (sand-filled column irrigated twice a day). The results of the study found that initial leaching losses were high following the first nitrogen applications (ranged from 48 to 100 percent of the applied  $\text{NO}_3\text{-N}$  [nitrate as nitrogen] and 4 to 16 percent of the applied  $\text{NH}_4\text{-N}$  [ammonium as nitrogen]). Subsequent nitrogen applications resulted in substantially reduced nitrate losses (1-3 mg/l  $\text{NO}_3\text{-N}$ ), while  $\text{NH}_4$  leaching was essentially eliminated. This low-threat level for nitrate leaching from turfgrass also has been reported by Engelsjord et al. (2004); Frank et al. (2005); and Raciti et al. (2008).

### **Leaking Sewage Pipes/Mains and Landfills**

Very little has been published regarding the nitrate contribution to groundwater beneath developed areas resulting from leaking sewage pipes or sewer mains. However, both of these sources are cited in a variety of publications as being potential significant sources of nitrate to groundwater (Wakida 2008; Thios 1999—USGS Fact Sheet 106-00).

Nitrate impact on groundwater from landfill leachate is a well known problem (Wakida and Lerner 2005; Wakida 2008; Longe and Enekwechi 2007). Leachate results from percolation of water and liquid waste through solid waste. Generally, leachate is a high-saline liquid, containing metals and rich in ammonium and organic matter. In landfills where leachate enters groundwater, the high levels of ammonium may oxidize to form nitrate (Longe and Enekwechi 2007).

### **Food Processing Facilities**

In California, the leaching of nitrate from food processing facilities is well documented in the State Water Resources Control Board (State Water Board) and the Central Valley Water Board files. An informational item presented to the Central Valley Water Board (March 17, 2006) detailed groundwater monitoring data collected from 105 food processing facilities that documented that almost half had affected groundwater with nitrates. A Central Valley Water Board staff report (February 26, 2008) documented nitrate impacts on groundwater from wineries, vegetable processors, and a processor of rice and soy products.

## **2. Agricultural Sources of Nitrate: Nursery and General Agricultural Use of Fertilizer and Animal Wastes**

### **Nursery Use of Fertilizers**

Container production of nursery crops is a potential source of nitrate release to the environment. The frequent irrigations in conjunction with high nutrient applications result in a high potential for the leaching of nitrate through the soil (Ristvey et al. 2004; Colangelo and Brand 2000; Brand et al. 1993). Colangelo and Brand (2000) studied irrigation volumes and associated nitrate concentration produced by overhead sprinkler and trickle irrigation systems (drip irrigation). They found that the frequent high-volume irrigation of the overhead sprinkler system resulted in lower nitrate concentrations in the leachate, but rapid nitrate leaching through the soil columns (more water produced a dilute solution that rapidly migrated through the soil column). Drip irrigation produced a higher nitrate concentration in the leachate, but a lower leaching rate through the soil column (less water produced a higher nitrate concentration that moved slowly through the soil column). Concentrations of nitrate-N (nitrate as nitrogen) in leachate from both irrigation methods approached or exceeded the 10 mg/l USEPA drinking water standard either late in the growing season or during the early winter months in both years of the study (Colangelo and Brand 2000).

### **General Agricultural Use of Fertilizers**

A large number of investigators have researched the occurrence of nitrate in groundwater beneath agricultural operations (Burow et al. 1998; Suen 2008; Moran et al. 2005; Green et al. 2008; Harter et al. 2001; Fuhrer et al. 1999). High concentrations of nitrate in shallow groundwater were found to be widespread and strongly related to agricultural land use. Based on comparisons with background concentrations, human activities have increased nitrate concentrations in groundwater in the continental United States for about two-thirds of agricultural areas studied, compared to about one-third of urban areas (Fuhrer et al. 1999).

The National Water-Quality Assessment Program (NAWQA) reported that nitrate concentrations in shallow groundwater samples collected from domestic wells in agricultural areas in the San Joaquin–Tulare Lake Basins were among the highest in all of its study areas (Dubrovsky 1998). The study investigated groundwater quality in alluvial fans of the eastern San Joaquin Valley by collecting samples from three sets of wells: 30 domestic wells representative of the regional aquifer, 60 shallow domestic wells (median well depth 150 feet) situated in almond, vineyard, and row crops, and 20 multilevel monitoring wells in a 3.5-mile transect along a ground-water flow path. Nitrate concentrations were found to vary significantly beneath areas with different crops types (Dubrovsky 1998; Burow et al. 1998; and Spalding et al. 2001). Groundwater susceptibility to nitrate impact because of existing sediment texture was described as high for almond and vineyard crops and low for corn, alfalfa, and vegetables. Nitrate drinking-water standards were exceeded in 40 percent of the wells in almond

producing areas and 15 percent of wells in the vineyard areas (Dubrovsky 1998 - USGS Circular 1159).

In 2000, monitoring wells screened near the water table in agricultural areas in the eastern San Joaquin Valley had nitrate concentrations ranging from 0.04 to 34 milligrams per liter (mg/L), with a median of 16 mg/l (Burow and Green 2008). Nitrate concentrations were greater than the MCL of 10 mg/l of nitrogen in 67 percent of the wells tested.

### **Dairies and Confined Animal Feeding Operations**

In 1992, animal feeding operations in the continental United States produced approximately 133 million tons of manure (on a dry weight basis). This is 13 times the amount of human sanitary waste produced in the same year (USEPA 1998). Waste from agricultural livestock operations (beef, dairy, poultry, pork, sheep, goats, and horses) has been a longstanding concern with respect to contamination of water resources, particularly with respect to nutrients and pathogens.

In California, dairies constitute the largest population of confined feeding operations. Two main concentrations of dairies exist in California's Central Valley—one in the Kings/Tulare County area, and the second in the Merced/Stanslaus County area. Dairy facilities and similar confined animal operations pose a significant nitrate contamination threat to groundwater via oxidation of animal wastes and subsequent transport through the subsurface (Esser et al. 2009). Recent research shows that dairy operations are affecting underlying groundwater quality in California's San Joaquin Valley (Esser et al. 2009; Van der Schans et al. 2009; McNab et al. 2007; Singleton et al. 2007; Watanabe et al. 2008).

## **E. Methods Used for Identification of Nitrate Sources**

The variety of potential sources of nitrate both natural and anthropogenic make determining the exact source of nitrate in an aquifer difficult. However, investigators have developed a suite of techniques that may be applied for sourcing nitrate in groundwater. These include:

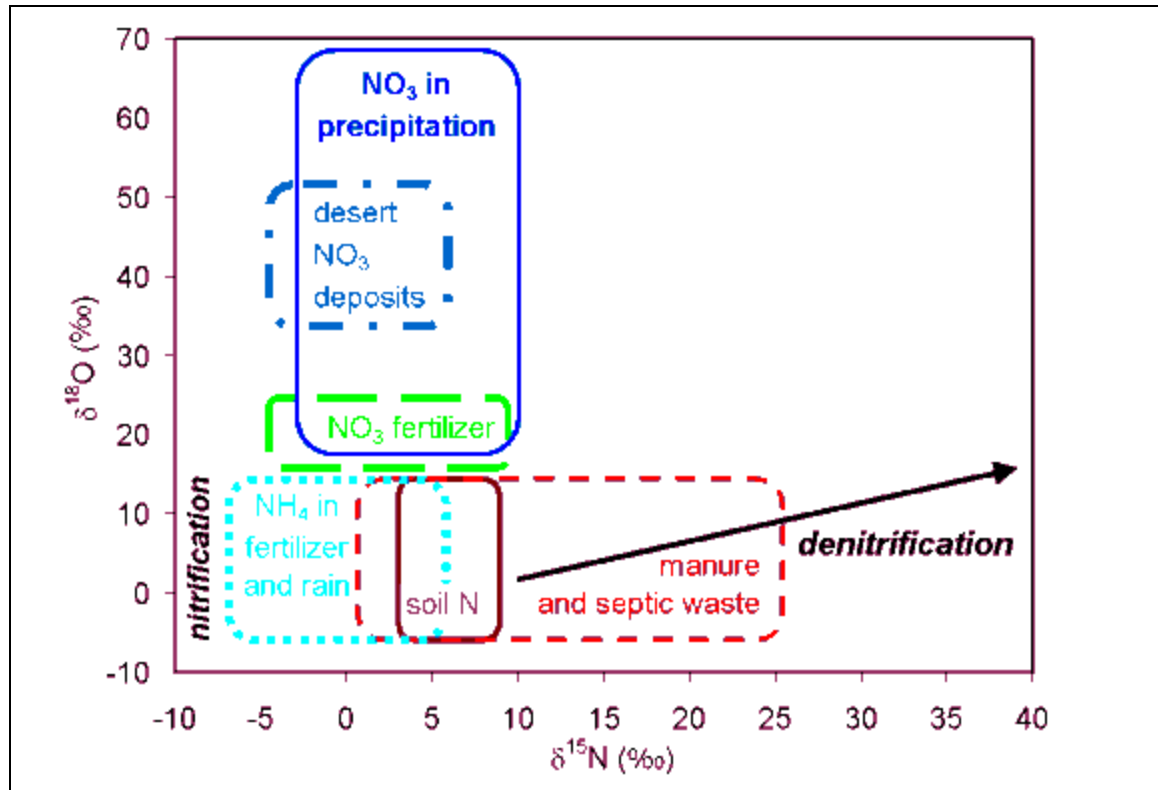
- determination of the nitrate isotopic composition of the groundwater,
- establishment of the mean age of the groundwater,
- identification of the presence or absence of co-contaminants, and
- identification of the major and trace element chemical composition of the water.

The nitrate molecule contains nitrogen, with stable isotopes  $^{14}\text{N}$  and  $^{15}\text{N}$ , and oxygen, with stable isotopes  $^{16}\text{O}$ ,  $^{17}\text{O}$ , and  $^{18}\text{O}$ . Measuring the isotopic composition of both elements can be diagnostic for distinguishing atmospheric and synthetic fertilizer sources from organic fertilizer and septic sources (Widory,



et al. 2005; Panno et al. 2006; Moran et al. 2007). However, overlap in the nitrogen and oxygen isotopic compositions of the various sources does occur particularly with respect to sources of nitrate from septic tank and manure application (Figure B-3). Because of this isotopic overlap, additional methods must be used to distinguish between the various sources of nitrate in groundwater.

**Figure B-3. Nitrogen and Oxygen Isotopic Compositions of Various Nitrate Sources (after Kendall 1998)**



Determining the age and location where groundwater is recharged aids in the identification of the nitrate source(s). Because nitrate travels without significant attenuation in oxygen-rich groundwaters, natural tracers of groundwater flow can help distinguish between ongoing and historical sources of nitrate. Tritium and chlorofluorocarbons typically are used as groundwater tracers and as a means for estimating groundwater age (Esser et al. 2009, Buszka et al. 2006). Tritium is a short lived radioactive isotope of hydrogen that is produced in the atmosphere naturally and by aboveground nuclear weapons testing. Tritium is incorporated into the water molecule, making it a suitable tracer for groundwater flow. Chlorofluorocarbons are anthropogenic organic compounds that have been produced since the 1930s for a number of industrial and domestic purposes ranging from aerosol propellants to refrigerants. By measuring chlorofluorocarbon concentrations in groundwater and determining or estimating the recharge temperature of the groundwater, an age can be assigned to the

groundwater sample (USGS chlorofluorocarbon [CFC] Lab <http://water.usgs.gov/lab/3h3he/background/>).

Trace concentrations of co-contaminants can be used to distinguish between nitrate derived from septic tanks and that produced by fertilizer sources (Esser et al. 2009; California GAMA Program 2006). Chemicals associated with high nitrate concentrations in groundwater from septic tanks include: N,N-diethyl-3-methylbenzamide (DEET), caffeine, ibuprofen, surfactants, triclosan (antibacterial agent), steroid estrogens, and widely prescribed antiepileptics such as carbamazepine (Seiler et al. 1999; Mills et al. 2007; Standley et al. 2008). In contrast, groundwater in surrounding farmlands may contain pesticides and their degradation products.

Waters associated with specific sources can often be distinguished by their major and trace element chemical compositions. Specific chemicals used for source identification are dissolved by water moving through the rock/soil matrix that composes the aquifer, or mixed with connate waters to provide a unique chemical signature. Graphical representations such as trilinear plots and pattern diagrams (Piper, Stiff) can be used to identify source areas and changes within water types. Nitrate isotope data in combination with other water quality variables, such as ions and ionic ratios, may be effective in distinguishing between various nitrogen sources and water types.

## **F. Factors That Affect Nitrate Leaching and Detection**

A large number of investigations have been conducted to evaluate the factors that affect nitrate leaching (CDFA 1989; State Water Board 1994; Green et al. 2007; Harter et al. 2005; Fuhrer et al. 1999; Burow and Green 2008; Burow et al. 2008; Domagalski et al. 2008; and Dinnes et al. 2002). While some disagreement exists between investigators, a common group of physical and chemical factors have been identified that have the potential to affect nitrate leaching. Physical factors include: nitrogen application rates, water inputs (rainfall, type of irrigation, and frequency of irrigation), leaching rates (soil type and structure), evapotranspiration, and depth to groundwater. Chemical factors include: soil mineralogy, pH, bulk density, soil organic matter, and denitrification.

### **1. Nitrogen Fertilizer Application**

Studies have shown that the rate/amount of nitrogen fertilizer applied is often, but not always, related to the concentration of nitrate in the soil pore water and in shallow groundwater (Zhao et al. 2009; Harter 2009; Kaown et al. 2007; Scanlon et al. 2005; Munoz-Arboleda et al. 2008; and Spalding et al. 2001). Under ideal conditions, only the amount of fertilizer used by the plant would be applied. However, in most cases, not all of the applied nitrogen is taken up by the plant, allowing some to move below the root zone. Nitrogen in the soil that is not returned to the atmosphere in the form of nitrogen gas or ammonia generally is converted to the nitrate form by bacteria. The mobility of nitrate in the soil profile

is dependent on the soil composition, soil structure, evapotranspiration, and the amount of water (see discussion below).

## **2. Water**

Water inputs have been shown to greatly affect nitrate leaching rates. Because nitrate is soluble in water and it is not readily absorbed by certain soils, its movement below the root zone is controlled partly by the volume of water percolating per unit of time (CDFA 1989). The amount of water that is available for percolation is dependent on the type of irrigation and the amount of precipitation (Green et al. 2008; Spalding et al. 2001; Central Valley Water Board 1994). A field study conducted by Powers and others (2001) concluded that nitrate leaching was greatly reduced by changing from furrow to sprinkler irrigation. A study of water movement through the unsaturated zone by Fisher and Healy (2008) found that the timing and intensity of precipitation and irrigation are major factors affecting the rate of groundwater recharge. In California, Fisher and Healy's study (conducted in an almond orchard in the San Joaquin Valley) found that virtually all groundwater recharge occurred when irrigation rates exceeded evapotranspiration for some period of time, typically 1 to 2 days. Rainfall was not a factor in groundwater recharge for this location; however, rainfall has been documented to be a major factor in nitrate leaching in areas with higher precipitation (Fisher and Healy 2008; Green, et al. 2008). Precipitation variability may result in cycles of nitrate leaching below the root zone, at times producing significant nitrate flux (Peralta and Stocke 2001). In addition to normal leaching through irrigation or precipitation events, nitrate may be moved below the root zone during pre-planting water application or through additional water applied for salinity control or frost protection (CDFA 1989).

## **3. Soil**

Soil type and texture greatly influence the potential for nitrate leaching. Soils have varied nitrate-retentive properties depending on their texture, organic matter content, and cation exchange capacity (Barton et al. 2005; Power et al. 2001; Onsoy et al. 2005; Green et al. 2008).

Coarse-grained soils are soils in which sand- to gravel-sized particles predominate. These soils contain relatively large grains with voids or spaces (porosity) between the grains. High porosity coupled with high permeability (interconnections between the pore spaces) allows water to move relatively freely through the soil matrix. Because these soils typically contain little organic matter and have a low cation exchange capacity, nitrate that is in the soil pore water will move downward with little impediment (Wiederholt and Johnson 2005). A coarse-grained soil above an aquifer usually is seen as a threat to the quality of the water in the aquifer (Nolan et al. 2002, 2006; Green et al. 2007; Central Valley Water Board 1994).

Fine-grained soils are composed of silt- or clay-sized particles. These soils, while high in porosity, are low in permeability and thus poorly drained. Fine-grained soils typically contain abundant organic material and have a high cation exchange capacity. Water characteristically moves very slowly through the matrix of such soils, and consequently this soil type is considered to pose a reduced threat to the quality of the water in the aquifer. However, many of these soils shrink when dry and swell when wet, producing cracks. These, cracks together with wormholes, sediment heterogeneity, and root traces produce preferential pathways through which practically all the flow of water occurs. Because water flows through a very small proportion of the soil volume, it can move very rapidly, carrying nitrate with it (Williams et al. 2003; Harter et al. 2005).

#### **4. Evapotranspiration**

A study of nitrogen movement through the unsaturated zone in five agricultural settings in the continental United States concluded that evapotranspiration rates greatly affect pore water nitrate concentrations (Green et al. 2008). Among areas with similar fertilizer and water inputs, locations with high evapotranspiration rates had high soil water nitrate concentrations and a corresponding low flux rate (the rate of flow of the nitrate concentration contained in the soil pore water per second per unit area). Through the process of repeated irrigation events, areas with high evapotranspiration rates, sandy soils, and shallow depth to groundwater were found to have high groundwater nitrate concentrations (Green et al. 2008). Areas with low evapotranspiration rates and high flux rates were associated with relatively constant, moderate groundwater nitrate concentrations.

#### **5. Depth to Groundwater**

The depth to groundwater is a major factor in nitrate impact (Eimers and Spruill 1997; Burow and Green 2008; Nolan and Hitt 2006; Green et al. 2008). Nitrate concentrations are highest and most variable near the water table, and variability and concentration decrease with depth (Burow et al. 2008; Dubrovsky et al. 1998) (Figure B-4). Concentrations of nitrate are higher in the shallow part of the aquifer system where domestic wells are typically screened, whereas concentrations are lower in the deep part of the aquifer system where public-supply wells are typically screened.

#### **6. Denitrification**

Denitrification is one of the major chemical factors affecting nitrate leaching and potential groundwater impact (Spalding and Parrott 1994; Schmidt and Nieman 1997; Puckett et al. 2008). Denitrification consists of a series of oxidation-reduction reactions that ultimately involve electron transfer between an electron donor and nitrate. Through denitrification, oxidized forms of nitrogen such as nitrate ( $\text{NO}_3^-$ ) and nitrite ( $\text{NO}_2^-$ ) are converted to nitric oxide (NO), nitrous oxide ( $\text{N}_2\text{O}$ ), and dinitrogen gas ( $\text{N}_2$ ). Potential changes or limiting conditions that affect

denitrification include the amount of organic matter, soil water content, soil oxygen supply, soil temperature, soil nitrate levels, and soil pH.

Once nitrate is in groundwater, denitrification can be an important process in controlling the nitrogen concentration over time. Groundwater can be classed as oxidizing, reducing, or a mixture of the two. The oxidation-reduction condition of a specific groundwater is a controlling factor in providing a source(s) of electron donors that react with nitrate in shallow aquifers. In denitrification, nitrate serves as the terminal electron acceptor for bacteria that derive energy from the oxidation of a reduced substance (Puckett et al. 2008). For electron donors, microbes commonly rely on organic carbon or, in the case of autolithotrophs, reduced forms of sulfur or iron (Green et al. 2008). Dissolved organic carbon (DOC) in recharging groundwater also can serve as an electron donor. N-species concentration data indicate that nitrogen gas ( $N_2$ ) is the primary end product of nitrate reduction in aquifers (Green et al. 2008; Esser et al. 2009).

## 7. Detection

In assessing nitrate impact on a single well or across a geographical area, the most important factors are: (1) sampling of first encountered groundwater (shallowest depth) and (2) sampling from wells constructed with short screen intervals (screen lengths) where the screen is positioned across the water table (Burow et al. 2007; California GAMA Program; Fuhrer et al. 1999). Fuhrer and others' (1999) discussion of nutrients detected in groundwater contains the statement on page 3 that *Nitrate levels in shallow ground water can change throughout the year, but typically the seasonal changes are noticeable only in the upper 5–10 feet below the water table in surficial aquifers.*"

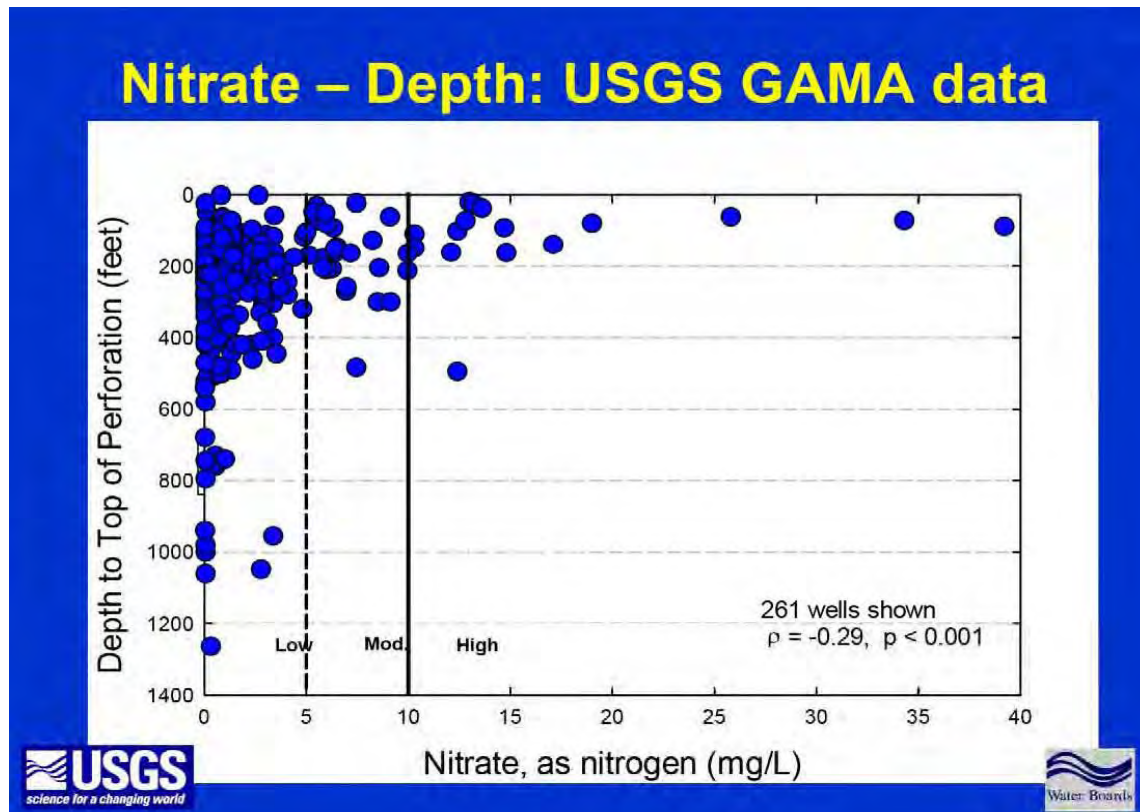
Nitrate concentration versus depth to top of the perforated portion of wells sampled by the GAMA program in the Central Valley is shown on Figure B-4. The graph shows that the highest concentrations of nitrate exist in the shallow groundwater (shallow perforation portion of the wells sampled). As the depth to the top of the well perforations increases, the nitrate concentration in the groundwater decreases. A similar graph has been produced by Burow and others (1998) in their study of the eastern San Joaquin Valley.

The importance of nitrate sampling in shallow wells with short screen intervals can be seen in the results of groundwater samples collected by the GAMA program from wells in the Kings study area of the Southeast San Joaquin study unit. Thirteen wells scattered across the study area were sampled and analyzed for nitrite plus nitrate as nitrogen. None of the sampled wells contained concentrations of nitrate above the nitrate MCL. All but one of the 13 wells was screened below 150 feet beneath ground surface (median top of screen depth was 269 feet below ground surface) and had screened intervals ranging from 120 to 320 feet in length (median screen length of 190 feet). Seven out of 15 flow path wells (generally shallow, short-screened wells used to evaluate effects of groundwater flow and aquifer characteristics) sampled in the same area had



nitrate concentrations above the nitrate MCL value (the eight flow path wells that were below the nitrate MCL were screened more than 150 feet below ground surface with a median screen length of 153 feet). The seven flow path wells that exceeded the nitrate MCL averaged a depth to the top of the screened interval of 104 feet with a median screen length of 32 feet. This same pattern was observed for the Central Eastside GAMA study unit (Merced, Modesto, and Turlock area) where 20 wells were sampled with no detections of nitrate above the MCL value, but nine shallower flow path wells in the same area exceeded the MCL for nitrate.

**Figure B-4. Nitrate Concentrations vs. Depth to the Top of the Well Screen: from Landon and Fram 2009**



## **G. Published Nitrate Vulnerability Studies/Maps for Nitrate Impacts on Groundwater in the Central Valley**

### **1. Nitrate Working Group**

The California Department of Food and Agriculture's (CDFA's) Nitrate Working Group produced a report entitled *Nitrate and Agriculture in California* in February 1989 (Nitrate Working Group Report). The report investigated the major sources of nitrate in groundwater, the concentration of nitrate in groundwater in specific

regions, and potential controls for crop and livestock production to reduce nitrate impact on groundwater.

The Nitrate Working Group Report concluded with a series of five recommendations. Those recommendations became the mission of CDFA's Nitrate Management Program (NMP), which later developed into the Fertilizer Research and Education Program (FREP). They included those below.

1. Identify nitrate-sensitive areas throughout California.
2. Prioritize those areas where action is most needed.
3. Organize voluntary nitrate management programs in high-priority areas in cooperation with local governments and agriculture.
4. Develop nitrate-reducing farming practices tailored to the high-priority areas that fit into the management programs, in cooperation with growers and other government agencies.

In implementing the first recommendation of the Nitrate Working Group, CDFA developed a map of nitrate-sensitive areas in California (Figure B-5). The map was developed using seven factors that are described below.

### **Groundwater Use**

Nitrate concentration is considered to be critical if groundwater is used for domestic or animal drinking supplies. If it is used only for cleaning, cooling, or irrigation of most crops, there is less concern.

### **Soil Type**

Sandy or other coarse-textured soils transmit water downward more rapidly, and nitrate with it. Also, these soils are less likely to create conditions in which nitrate turns to a gas and escapes from the soil (denitrification).

### **Irrigation Practices**

Inefficient irrigation systems that lead to large volumes of subsurface drainage increase the leaching of nitrates. Typically, these are surface flow systems with long irrigation runs. Well-managed sprinkler or drip systems, or surface flow systems with short runs, reduce the threat of nitrate leaching to groundwater.

### **Type of crop**

Crops most likely to increase nitrate leaching are those that (1) need heavy nitrogen fertilization and frequent irrigation, (2) have high economic value, so the cost of fertilizer is relatively small compared to revenue produced, (3) are not harmed by excess nitrogen, and (4) tend to take up a smaller fraction of the nitrogen applied. Many vegetable, fruit, nut, and nursery crops fit these criteria and therefore have more potential for nitrate leaching. Those with less potential include field crops such as alfalfa, wheat, and sugar beets.

**Climate**

High total rainfall, concentrated heavy rains, and mild temperatures lead to more leaching of nitrates.

**Distance from the Root Zone to Groundwater**

Less distance means a more immediate problem.

**Potential Impact**

This depends on such factors as population density and availability of an alternate water supply.

**Figure B-5. Nitrate Sensitive Areas: from California Department of Food and Agriculture (1989)**

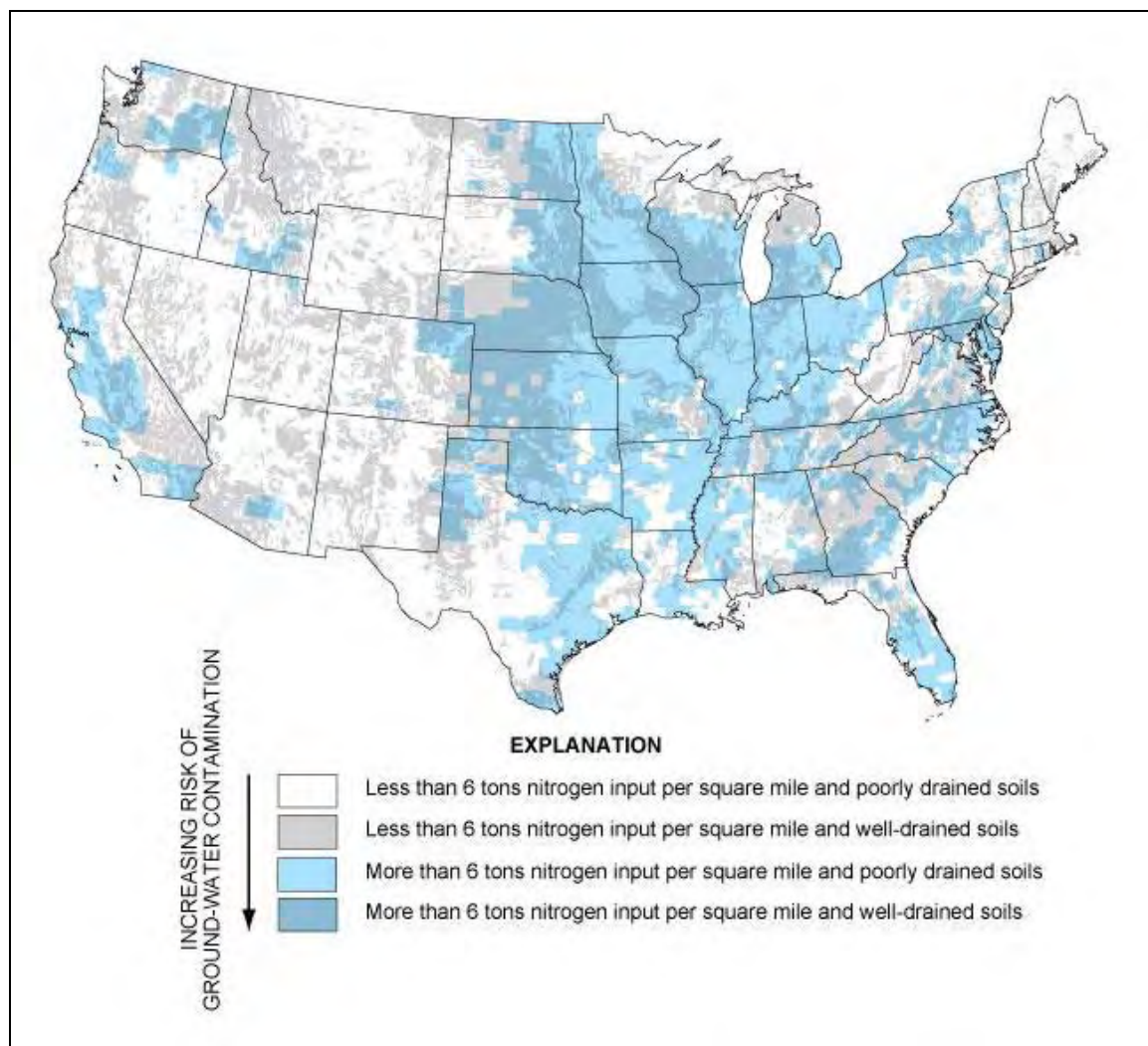


## 2. National Water Quality Assessment Program

In 1991, the U.S. Geological Survey (USGS) began NAWQA to address the need for consistent and scientifically sound information for managing the nation's water resources.

In 1996, Nolan and Ruddy used NAWQA data to produce a Fact Sheet (FS-092-96) entitled, *Nitrate in Ground Water of the United States—Assessing the Risk*. The Fact Sheet contained a map of the continental United States that depicted areas that were deemed to be the most vulnerable to nitrate contamination of groundwater (Figure B-6). Almost the entire portion of California's Central Valley is shown to be at a moderate to high risk of nitrate impact on groundwater.

**Figure B-6. Nitrate Vulnerability Map: from Nolan and Ruddy 1996**



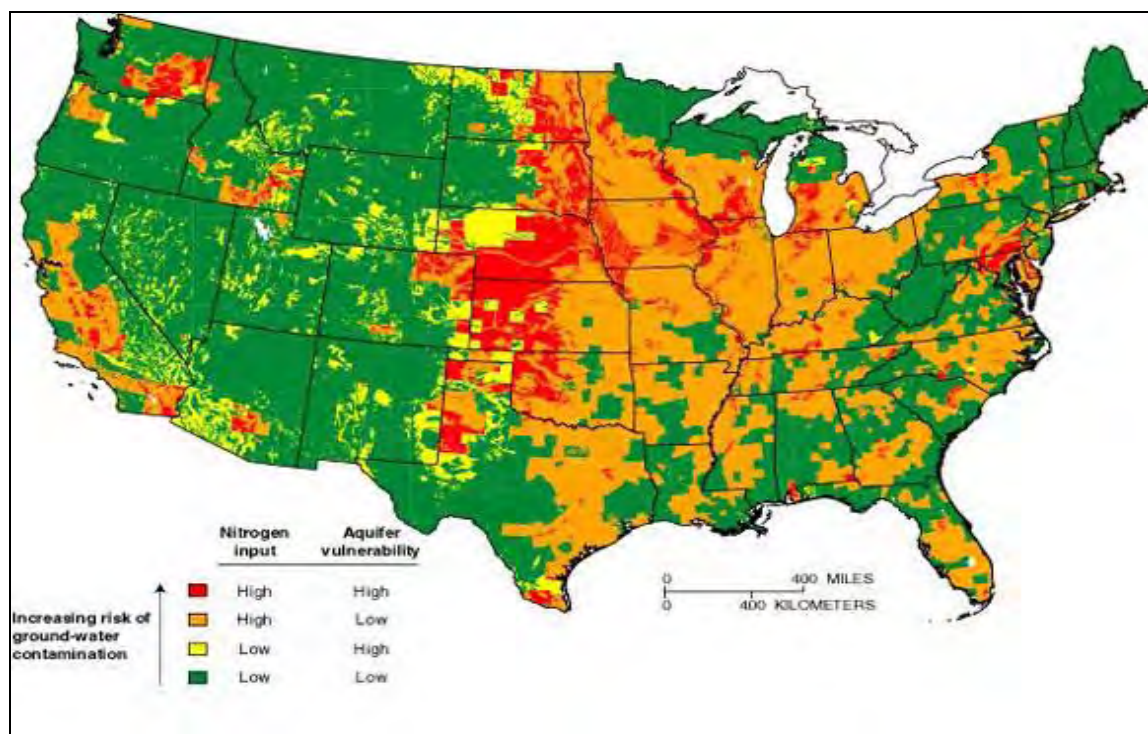
In 1999, the USGS produced a report entitled *The Quality of Our Nation's Waters—Nutrients and Pesticides* (USGS Circular 1225). A map contained in the report shows areas in the continental United States that were considered to



be vulnerable to nitrate impact on shallow groundwater (Figure B-7). Shallow groundwater nitrate data (less than 100 feet deep) collected through 1992 were used to confirm the risk pattern shown on the national map.

As depicted on Figures B-6 and B-7, California's Central Valley is shown as high nitrogen input area with two parallel bands of high aquifer vulnerability extending along both sides of the Central Valley from the Bakersfield area to just north of Fresno. A second discontinuous band of high aquifer vulnerability extends through the center of the Central Valley from near Merced northward to the area around Colusa. A separate area of high vulnerability is depicted near Redding.

**Figure B-7. Nitrate Vulnerable Areas: from USGS, The Quality of Our Nation's Waters—Nutrients and Pesticides; USGS Circular 1225 (1999)**



USGS Circular 1225 reported that "Nitrate in groundwater commonly originates from nonpoint sources such as fields on which inorganic fertilizer and animal manure are applied." Contamination was found generally to decrease with increasing depth to groundwater, and areas with a high risk of groundwater contamination by nitrate generally were found to have high nitrogen loading or high population density, well-drained soils, less extensive woodland relative to cropland, and shallow groundwater (less than 100 feet deep).

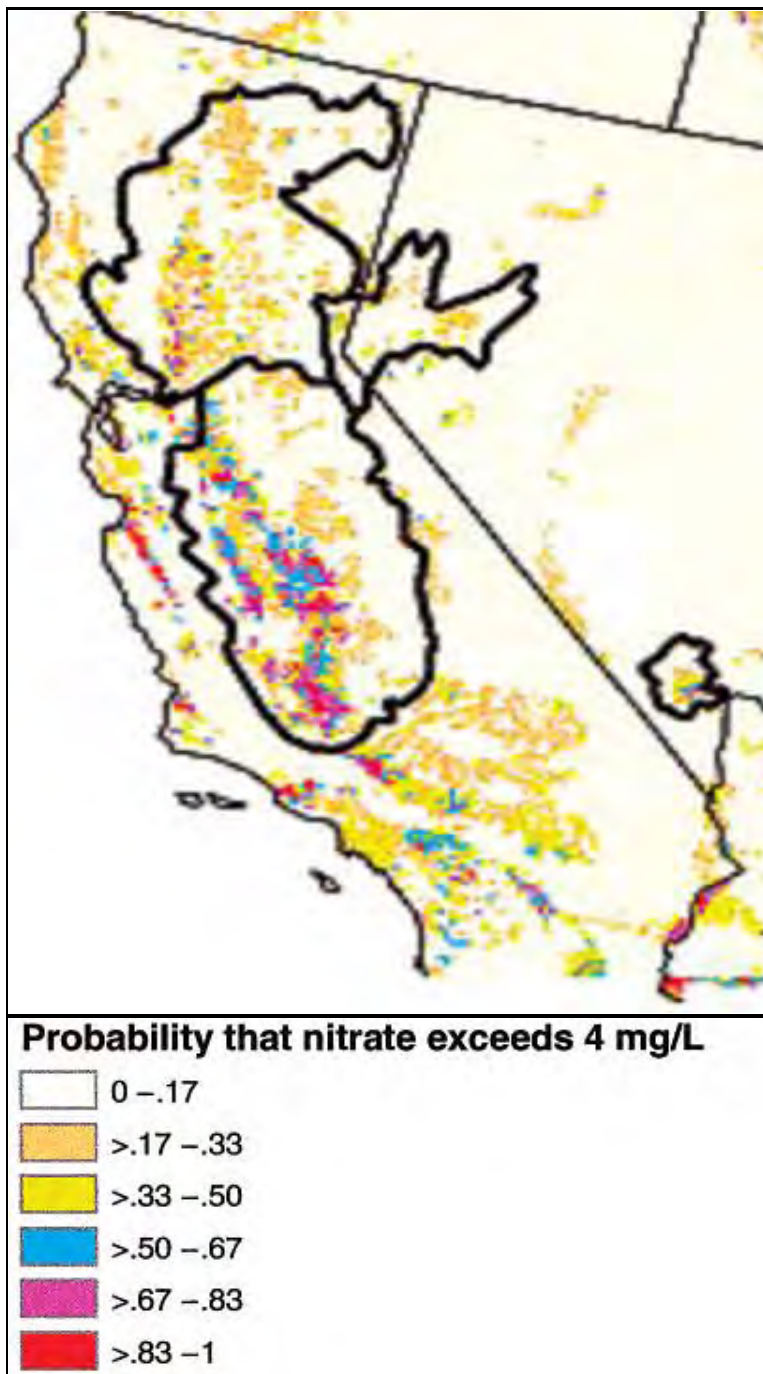
In 2002, Nolan and others produced *Probability of Nitrate Contamination of Recently Recharged Groundwaters in the Continental United States* (Nolan et al. 2002). This study used a logistic regression model to predict the probability of nitrate concentrations exceeding 4 mg/l in shallow groundwater in the continental



United States. The model included information such as: (1) nitrogen loading from inorganic fertilizer to the land surface, (2) percent crop land, (3) population density, (4) percentage of well-drained soils, (5) depth to seasonally high water table, and 6) presence or absence of rock fractures in the surficial aquifer.

The report by Nolan and others included a probability map for nitrate concentration in shallow groundwater in the continental United States (a portion of the map is presented as Figure B-8).

**Figure B-8. Modified from: Probability of Nitrate Contamination of Recently Recharged Groundwaters in the Conterminous United States (Nolan et al. 2002)**



Nolan and others' probability map was calibrated using a dataset of wells sampled between 1996 and 1999. The map appears to mirror the physical trends depicted in the 1996 and 1999 studies referenced above (two high probability

parallel regions in the southern Central Valley and a single central discontinuous belt extending into the northern portion of the valley).

### **Additional Vulnerability Studies**

While not developed specifically for nitrates, two additional vulnerability maps are included in this discussion of published data: (1) State Water Board Map of Hydrogeologically Vulnerable Areas and (2) California Department of Pesticide's (DPR's) Groundwater Protection Areas.

**Figure B-9. Map of Hydrogeologically Vulnerable Areas: from State Water Resources Control Board (2000)**



The State Water Board created a map displaying areas where published hydrogeologic information indicated conditions that may be more vulnerable to groundwater contamination (Figure B-9).

Data used to generate the map were derived primarily from California Department of Water Resources (DWR) bulletins (principally Bulletin 118 from 1975) and the USGS water supply, water resource, and open file reports. The justification for including or excluding specific groundwater basins/subbasins into the vulnerable category was based on infiltration rate; depositional soil type (alluvium, lacustrine, dune or channel deposits); whether the basin was developed or undeveloped; high or low population density; type of recharge; level of groundwater usage; and aquifer type (confined or unconfined aquifers).

DPR's Groundwater Protection Areas are shown on Figure B-10. DPR used its dataset of wells containing pesticide residues from legal agricultural use to evaluate whether there was a correlation between detections and local climate, soil, and depth to groundwater characteristics. Given the wide range of climatic and soil conditions associated with pesticide contamination of groundwater, DPR used an empirical statistical approach to determine whether vulnerable areas could be described. The results of the initial study were subsequently refined using an alternative procedure (canonical variates analysis) to improve characterization of vulnerable areas.

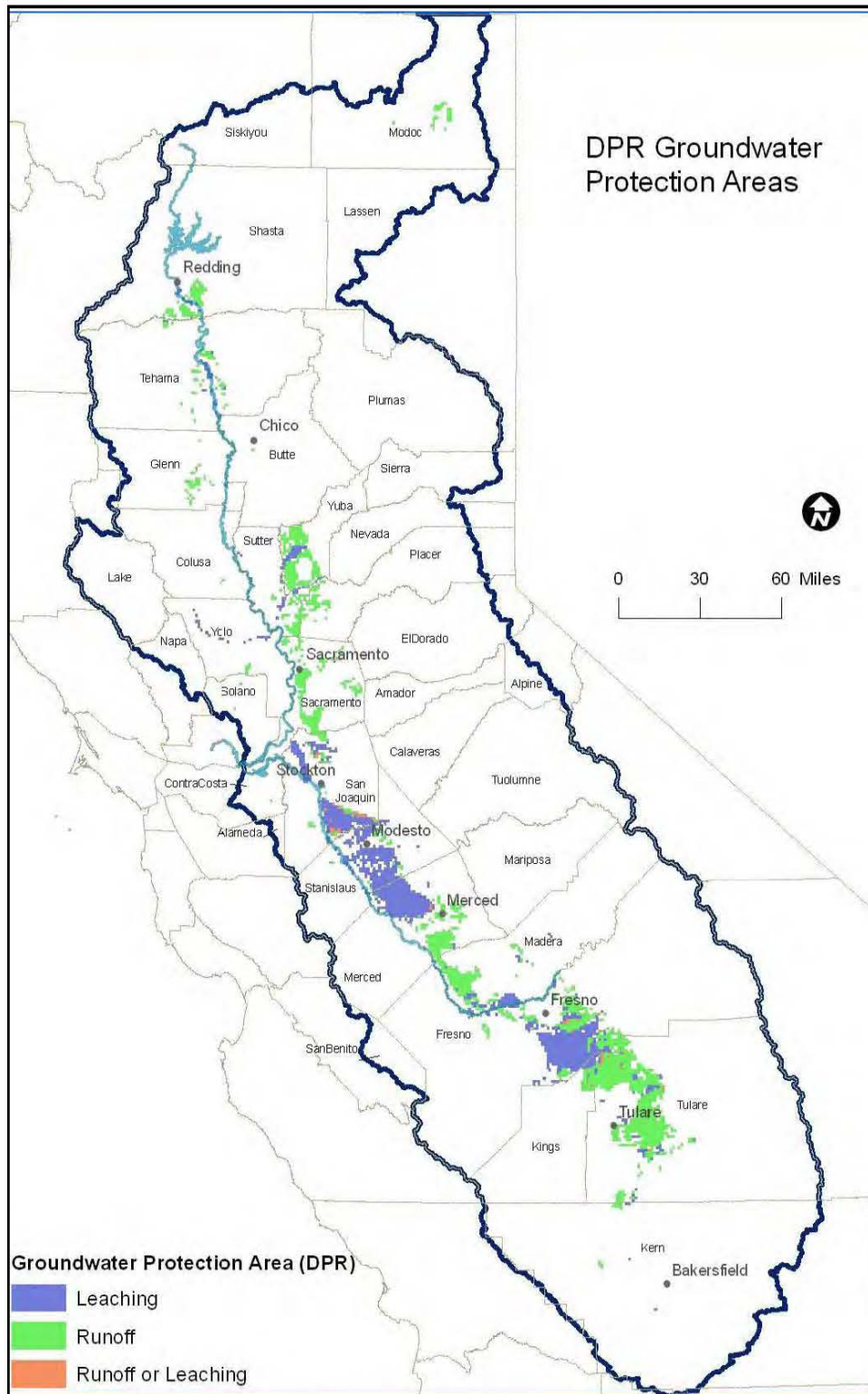
In 2008, DPR released the results of an investigation conducted to evaluate the relationship between nitrate and pesticide residues in groundwater (Suen 2008). The investigation was conducted in a portion of eastern San Joaquin Valley (Fresno and Tulare Counties). The study used nitrate isotope and anionic mixing trends to evaluate the source of groundwater nitrate. Suen concluded that the main source of nitrate in groundwater in the study area was the result of fertilizer application in the form of ammonium nitrate, with a secondary source attributed to nitrate from animal or human waste. With respect to pesticides, the study did not identify a significant correlation between nitrate and herbicide residues, but did find a correlation between herbicide metabolites and nitrate. Based on these results, the study concluded,

*Hence, the concentrations of ground water nitrate and other agrichemicals may provide a reasonably significant proxy for determining travel pathways for the movement of herbicide residues and metabolites in the vadose zone, thus provide additional data for groundwater transport model development and calibration (Suen 2008).*

A much stronger correlation between pesticide and nitrate movement through the vadose zone has been reported by a variety of investigators (Burrow et al. 2007; Loper et al. 2009; Minnesota Department of Agriculture 2006).



**Figure B-10. California Department of Pesticide Regulations Groundwater Protection Areas**





## **H. Known Groundwater Areas in the Central Valley That Have Been Affected by Nitrate**

The Nitrate Working Group Report used the STORET database (short for STORage and RETrieval) to investigate the occurrence of nitrate in California groundwater (CDFA 1989). Nitrate data collected between 1975 and 1987 was used to produce a map that depicts nitrate concentrations at or above the nitrate MCL (Figure B-11).

The discussion of the occurrence of nitrate contained in the Nitrate Working Group Report separated the State into nine geographical areas: (1) Southern California Coastal Area, (2) San Joaquin Valley, (3) Sacramento Valley, (4) Central Coast, (5) San Francisco Bay Area, (6) North Coast, (7) Northeastern Counties, (8) Mountain Counties, and (9) Desert Areas. This review focuses on two of these areas: the San Joaquin Valley and the Sacramento Valley).

### **1. The San Joaquin Valley**

The geographical area was broken down further into San Joaquin, Stanislaus, Merced, Madera, Fresno, Kings, Tulare, and Kern Counties. In San Joaquin County, nitrate above the MCL was reported to be concentrated in the Lodi, Manteca, Ripon, Escalon, and Tracy areas (central portion of the valley) as well as Westley and Crows Landing on the western side of the valley. The source of the nitrate was unknown but suspected to be fertilizer and animal waste.

Elevated nitrate concentrations in Merced County centered along Highway 99 (Atwater, Winton, Livingston, Delhi, and Hilmar) and in the vicinity of Gustine, Los Banos, and near Dos Palos along the western portion of the valley. The source of the nitrates was dairy waste and fertilizers.

In Madera County, nitrate levels above background were reported for Chowchilla, Dairyland, Berenda, and in Ripperdan near the San Joaquin River.

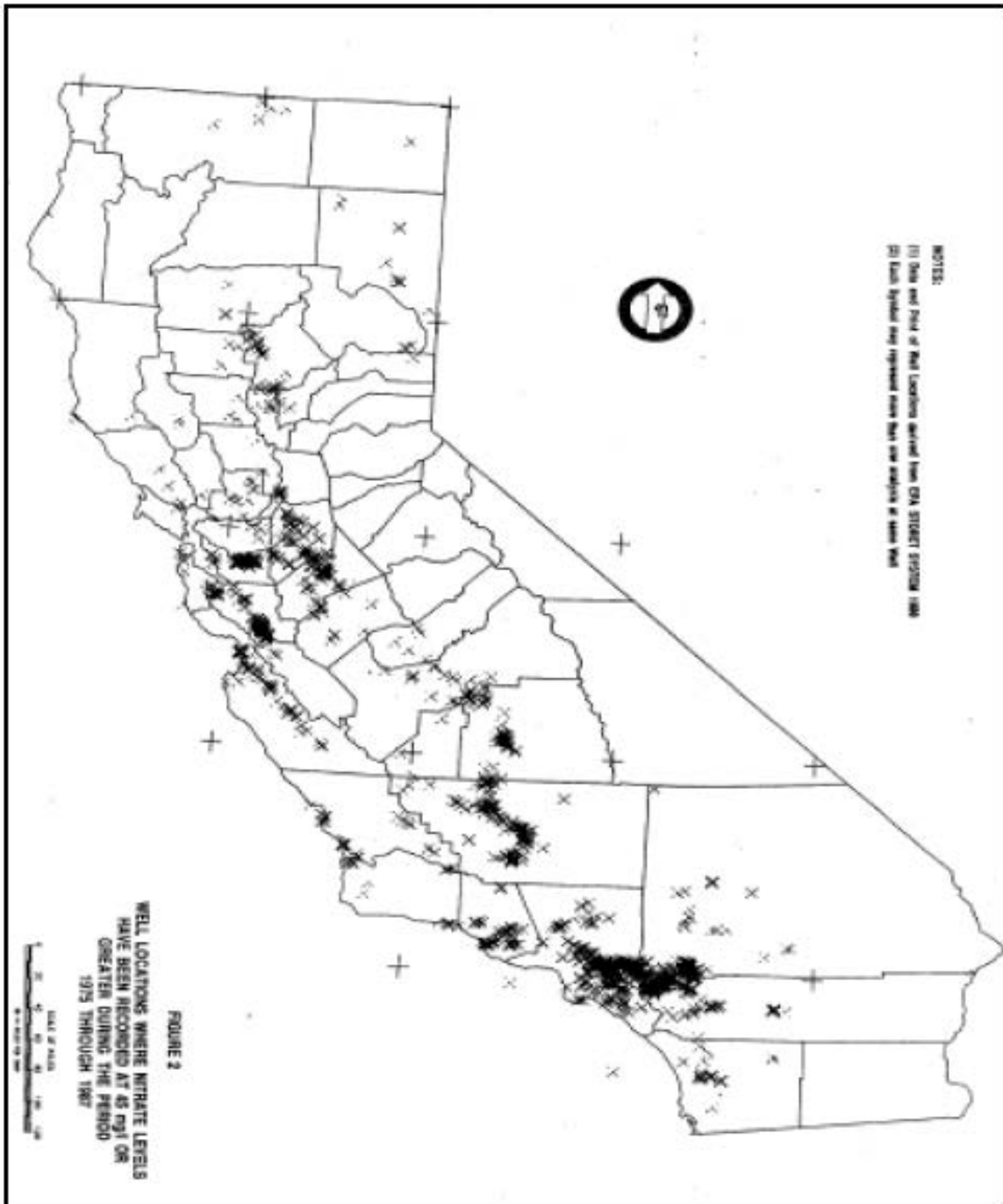
High nitrate concentrations in Fresno County included (listed from east to west): Kingsburg, Reedley, Orange Cove, the Fresno-Clovis area, Raisin City, Caruthers, Kerman, Mendota, Firebaugh, Cantua, Creek, and Coalinga. The majority of the nitrate problem was attributed to agricultural use of fertilizer with the exception of the Fresno-Clovis area, where it was attributed to septic tanks, winery waste, fertilizer use, and urban runoff.

Kings County was reported to be relatively free of high nitrate concentrations with the exception of the Hanford and Lemoore areas and the area of Avenal on the west side.

In Tulare County a discontinuous belt of high nitrate groundwater associated with a zone of unconsolidated sandy soils and agricultural operations was reported to extend through Dinuba, Yettem, Lemon Cove, Woodlake, Strathmore, Porterville,

Ducor, and Richgrove. Isolated high nitrate groundwater also was reported near Traver, Goshen, Visalia, and Tulare.

**Figure B-11. Public Supply Wells with Nitrate Concentrations above the Nitrate MCL during the Period 1975–1978: from California Department of Food and Agriculture, February 1989**



Kern County was reported to have high nitrate concentrations near Delano, McFarland, Wasco, Shafter, Famosa, Rosedale, Bakersfield, Arvin, Edison, and Lamont. Additional areas of high nitrate groundwater were reported for the Buena Vista Lake bed near Maricopa and Taft and in the area northwest of Lost Hills. With respect to the high nitrate concentrations in Kern County, the February 1989 Report states (page 18),

*In a 1982 ground water quality study performed by the Kern County Water Agency (KCWA) and the Kern County Health Department, it was shown that the areas of greatest nitrate concentrations in the unconfined ground waters were found to be in the sandy soils along the east side of the basin where agricultural development began many years ago. Areas where nitrate levels approached or exceeded the State MCL increased in size from an estimated 49 square miles in 1958 to 372 square miles in 1979.*

## **2. The Sacramento Valley**

The Nitrate Working Group Report subdivided the Sacramento Valley into Tehama, Butte, Glenn, Lake, Colusa, Sutter, Yolo, and Sacramento Counties. Page 19 of the February 1989 Report states,

*U.S. Geological Survey studies (1984) of about 700 wells in this area, concluded that nearly one-third of the wells in the Sacramento Valley are undergoing significant increases in nitrate concentrations. Data suggests the following most probable sources: (1) surface contamination in shallow wells; (2) pollution from septic systems; and (3) leaching of fertilizers applied to cropland, particularly orchard areas.*

The report states that Chico, Sutter, Knights Landing, Arbuckle, Yuba City, Gridley, Red Bluff, and Corning all have elevated nitrate concentrations in the groundwater.

The Sutter County Environmental Health Department conducted a limited sampling of private wells in the county in 1986. The sampling results indicated that 75 percent of the wells sampled were above the MCL for nitrate.

The Nitrate Working Group Report also:

- Looked at the problem of animal production in relation to nitrate pollution and concluded that dairies, beef feedlots and poultry ranches were significant sources. Counties containing the majority of these facilities were San Bernardino and Riverside (the Chino area) and Imperial in the south; Merced, Stanislaus, Fresno, Kern and Tulare in the San Joaquin Valley; and Sonoma County on the coast.

- Analyzed the mechanisms of nitrate movement through the soil. The report concluded that the best way to slow the migration of nitrate is to reduce the amount of water that drains out of the crop root zone.
- Reviewed the potential of fertilizer BMPs, the sources of nitrogen and the types of fertilizers, and application rates and methods.

### **3. State Water Resources Control Board—Division of Clean Water Programs**

The State Water Board, Division of Clean Water Program, Groundwater Special Studies Unit, produced a *Draft Groundwater Information Sheet, Nitrate/Nitrite* in October 2002. The draft information sheet was produced to provide general information regarding nitrate in groundwater.

California Department of Health Services (DHS) data for public supply wells were used to identify wells that exceeded the MCL for nitrate. Approximately 16,000 public supply wells were sampled; of these, 616 wells were identified as having nitrate concentrations above the MCL (Figure B-12). The top three regions identified as having public supply wells with nitrate concentrations above the MCL were the Central Valley, Los Angeles, and Santa Ana.

Nitrate impacts in the Central Valley (from south to north) appear as a discontinuous band of high nitrate groundwater extending northwestward from southern Kern County along the eastern side of the valley to the southern end of Madera County. A second, central band of high nitrate groundwater extends from the southeast to the northwest across the entire width of Stanislaus County. A southwest-to-northeast band of affected groundwater runs through Solano County and into Yolo County, and a forked band of impact extends along the Sutter/Yuba County line into the southern portion of Butte County.

The Nitrate/Nitrite Occurrence section of the draft information sheet points out that shallow groundwater unaffected by human activities generally contains less than 2 mg/l of nitrate. The major contributors of nitrate contamination to groundwater were stated to be fertilizer application, industry, septic systems, wastewater holding ponds, leaking sewer lines, sludge and manure application, and explosives.

A Revised Groundwater Information Sheet for Nitrate/Nitrite was issued by the State Water Board in February 2008. The revised information sheet used California Department of Public Health (CDPH) data from 1994 forward to evaluate nitrate impacts in approximately 15,000 active and standby public drinking water wells throughout California. Eight hundred and fifty-two (852) wells were identified as having nitrate concentrations above the MCL value (Figure B-13).

A comparison of the 2008 CDPH map with Nolan and others' (2002) map for *Probability of Nitrate Contamination of Recently Recharged Groundwaters in the*

*Conterminous United States* and the State Water Board's Map of Hydrogeologically Vulnerable Areas indicates general agreement with regard to potential versus actual nitrate impacts on groundwater.

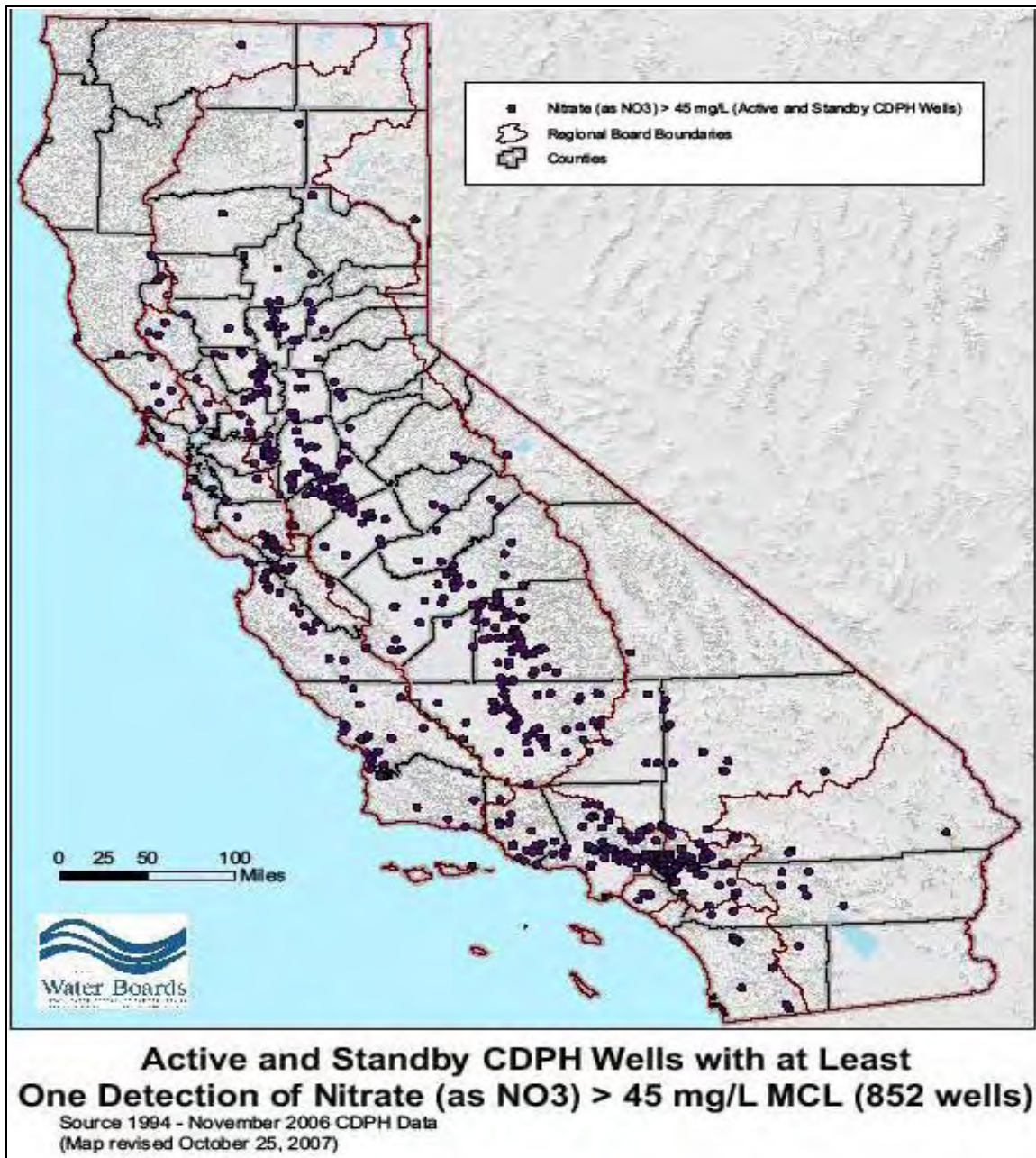
**Figure B-12. State Water Resources Control Board 2002**





The band of affected groundwater extends from Bakersfield northward into southern Madera County. Beginning in northern Merced County, a broader band of impact is seen through central Stanislaus County and into San Joaquin County. In San Joaquin County, the area of affected groundwater splits into three discontinuous north-trending bands. The westernmost band trends along the western edge of San Joaquin and Sacramento Counties, through the center of Solano and Yolo Counties, and along the border between Colusa and Sutter Counties.

**Figure B-13. State Water Resources Control Board 2008**



The central band extends through the center of Stanislaus, San Joaquin, and Sacramento Counties, then along the boundary between Sutter and Yuba Counties to its termination in southern Butte County. The eastern band roughly follows the boundary between San Joaquin and Calaveras Counties; the boundary of Sacramento, Amador, and El Dorado Counties; and passes through the western portions of Placer and Yuba Counties.

#### **4. State Water Resources Control Board—305b Report**

In 2002, the State Water Board submitted a water quality report to the USEPA pursuant to Section 305(b) of the federal Clean Water Act. The report provided water quality information to the general public and served as the basis for USEPA's National Water Quality Inventory Report to Congress. A portion of the nitrate exceedances contained in the 2002 305(b) report were used by the State Water Board to produce its 2008 nitrate map (Figure B-13 above).

The 305(b) report provided groundwater data for individual hydrologic regions that were composed of groundwater basins and subbasins as defined by DWR's Bulletin 118. Groundwater in the Central Valley was subdivided into three hydrologic regions: the Sacramento River Hydrologic Region; the San Joaquin River Hydrologic Region, and the Tulare Lake Hydrologic Region. Figures 4-2 through 4-4 of the [Existing Conditions Report](#) (Central Valley Water Board and ICF Jones and Stokes 2008) show the boundaries of these basins.

##### **Sacramento River Hydrologic Region**

Nine groundwater basins/subbasins were reported to have had at least one well that exceeded the nitrate MCL value based on water quality data obtained from public supply wells sampled by the DHS. The nine basins/subbasins were identified as: Scotts Valley, one well out of nine (1 [9]) tested exceeded the nitrate MCL, Colusa (2 [109]), Vina (4 [56]), East Butte (2 [32]), North Yuba (1 [35]), East Sutter (4 [41]), South American (1 [170]), Solano (8 [96]), and Yolo (1 [67]).

##### **San Joaquin River Hydrologic Region**

Seven groundwater basins/subbasins in this hydrologic region were reported to have had at least one well that exceeded the nitrate MCL value. These basins/subbasins were: the Eastern San Joaquin (7 [189]); Modesto (3 [114]); Turlock (8 [90]); Merced (2 [64]); Madera (1 [43]); Delta-Mendota (4 [51]); and Tracy (2 [36]).

##### **Tulare Lake Hydrologic Region**

Six groundwater basins/subbasins within this hydrologic region were reported to have had at least one well that exceeded the nitrate MCL value. These basins/subbasins were: Kings (23 [463]); Kaweah (13 [165]); Tule (6 [71]); Kern County (38 [475]); Kern River Valley (5 [76]); and Tehachapi Valley west (2 [30]).

## **5. Survey's National Water-Quality Assessment Program**

In 1996, the USGS sampled 29 domestic wells and 2 monitoring wells in the southeastern Sacramento Valley as part of the USGS's NAWQA Program (Dawson 2001a). The groundwater samples were analyzed for a variety of constituents, including nitrate. Dawson reported that the MCL for nitrate was exceeded in 1 of 31 wells (3 percent). Eight of the wells (26 percent) had nitrate values greater than 3 mg/l, which Dawson considered to represent background nitrate concentrations.

The NAWQA Program investigated the shallow ground-water quality beneath rice areas in the Sacramento Valley, California (Dawson 2001b). In 1997, the USGS installed and sampled 28 wells in rice areas in the Sacramento Valley to assess the shallow groundwater quality and to determine whether any effects on water quality could be related to human activities and particularly rice agriculture. None of the samples collected from the 28 wells had concentrations above the nitrate MCL value. Three wells had nitrate concentrations greater than 3 mg/l, a level that Dawson considered may indicate impact from human activities.

The San Joaquin Valley was also one of the hydrologic areas selected for study by the USGS NAWQA Program. The results of the groundwater quality investigations, and for nitrate in particular, were reported by Burow and others (1998a; 1998b) and are summarized by Dubrovsky and others (1998).

Dubrovsky and others (1998) in *Water Quality in the San Joaquin–Tulare Basins, California*, reported that 24 percent (21 of 88) of the domestic wells sampled during the 1993–95 study had nitrate concentrations that exceeded MCL value for nitrate and that 77 percent of the wells had nitrate concentrations greater than 2 mg/l, which they considered to represent background nitrate concentrations.

## **6. Groundwater Ambient Monitoring and Assessment**

The GAMA Program was created by the State Water Board in 2000. In 2003, the USGS prepared a report entitled *Framework for a Ground-Water Quality Monitoring and Assessment Program for California*. The report cites Assembly Bill 599, (Ground-Water Quality Monitoring Act of 2001) as identifying the need for developing and maintaining a monitoring program to assess the quality of California's groundwater. The major groundwater supply basins are a specific focus of the GAMA program.

The main goals of GAMA program are:

1. to improve Statewide groundwater monitoring; and
2. to increase the availability of groundwater quality information to the public.

In order to accomplish these goals, the GAMA program was divided into four projects: Priority Basin Project, Domestic Well Project, Special Studies Project and GeoTracker GAMA Project.

The Priority Basin Project was designed to provide a spatially unbiased assessment of raw groundwater quality in specific groundwater basins/subbasins, as well as to provide a statistically consistent basis for comparing water quality between basins throughout California. Samples were collected from water supply wells in each basin/subbasin using a randomized grid-based method to provide statistical representation of the study unit (grid wells). Additional wells were selected to evaluate changes in water chemistry along selected lateral or vertical ground-water flow paths in the aquifer (flow-path wells).

The GAMA Priority Basin Project was developed to assess groundwater quality (including nitrate) in key groundwater basins that account for more than 90 percent of all groundwater used in the State. Within the Central Valley, seven Priority Basins were investigated: Kern County Subbasin, the Southeast San Joaquin Valley, Madera-Chowchilla, Central Eastside, Northern San Joaquin Basin, Southern Sacramento Valley, and Middle Sacramento.

The results of the chemical analyses for nitrate in groundwater collected by the Priority Basin Project for the Central Valley region are as follows:

- **Kern County Subbasin**—two out of 17 samples had a nitrate concentration that exceeded the nitrate MCL value (sample set included 14 wells and three flow-path wells);
- **Southeast San Joaquin Valley**—six out of 44 samples had a nitrate concentration that exceeded the nitrate MCL value (28 wells and 16 flow-path wells). All six detections that exceeded the nitrate MCL value occurred in flow-path wells;
- **Madera-Chowchilla**—two out of 35 samples had a nitrate concentration that exceeded the nitrate MCL value (30 wells and five flow-path wells);
- **Central Eastside**—nine out of 39 samples had a nitrate concentration that exceeded the nitrate MCL value (20 wells, eight flow-path wells, and 11 monitoring wells). All nine detections that exceeded the nitrate MCL value occurred in the monitoring or flow-path wells;
- **Northern San Joaquin Basin**—zero out of 18 samples had a nitrate concentration that exceeded the nitrate MCL value (five wells, five flow-path wells, three monitoring wells, and five depth dependant samples);
- **Southern Sacramento Valley**—one out of 47 samples had a nitrate concentration that exceeded the nitrate MCL value (28 wells, 15 flow-path wells, and four depth-dependent samples); and



- **Middle Sacramento**—two out of 60 samples had a nitrate concentration that exceeded the nitrate MCL value (13 wells, 15 flow-path wells, and 22 wells completed beneath rice growing areas).

The GAMA Program includes a Domestic Well Project. This project is a voluntary groundwater monitoring program that provides water quality information on private (domestic) wells. Domestic wells were chosen for study for several reasons; domestic wells are generally shallower, are privately owned, supply a single household, and tend to be located in more rural settings where public water supply systems are not available. As of June 2009, this project has sampled five county focus areas: Yuba (2002), El Dorado (2003–2004), Tehama (2005), Tulare (2006), and San Diego (2008–2009). Two of these studies are situated in the Central Valley in areas of agricultural operations (Tehama [2005] and Tulare [2006]).

Tehama County was selected as a Domestic Well Project Focus Area because of the number of domestic wells in the county and the availability of well owner data. Two hundred and twenty-three (223) domestic wells were sampled, mostly near the county's major population centers. Well construction details (well depths only, no information provided regarding screen depth or water levels) were available for almost two-thirds of the wells sampled (144 out of 223). Based upon the available data, eighty-one (81) of the sampled wells are completed at depths less than 125 feet deep with the remaining sixty-three (63) wells completed below 125 feet, up to or exceeding 500 feet in depth.

The results of the Tehama County study found that nitrate was detected in 208 of the 223 samples at concentrations ranging from 1.1 to 60 mg/l (Figure B-14). Both nitrate ( $\text{NO}_3^-$ ) and nitrite ( $\text{NO}_2$ ) were detected at concentrations above their respective MCL values in two of the 223 wells sampled.

The results of the Tulare County study are being reevaluated and a written report is not currently available. However, Figure B-15 shows the nitrate concentrations obtained from the GAMA domestic well sampling program conducted in Tulare County. One hundred and eighty-one (181) domestic wells were sampled; 75 of which exceeded the nitrate MCL value (41 percent).

The results of the NAWQA and GAMA domestic well programs were combined by Bartholomay and others (2007) to produce a map of California depicting nitrate concentrations in groundwater in the Central Valley aquifer system (Figure B-16). The map distinguishes between the sources of the groundwater data by using circles (NAWQA) and squares (GAMA).

In 2009, Ekdahl and others used GeoTracker GAMA to investigate nitrate concentrations in California (Figure B-17). The GeoTracker GAMA system is an online database that uses Google Maps and databases generated by State and Regional Water Boards, DPH, DPR, Department of Water Resources (DWR), USGS, and Lawrence Livermore National Laboratory (LLNL). The GeoTracker



GAMA system provides data for more than 100,000 sampling locations and analytical results for a variety of constituents, including nitrate.

**Figure B-14. GAMA Voluntary Domestic Well Project—Tehama County (2005)**

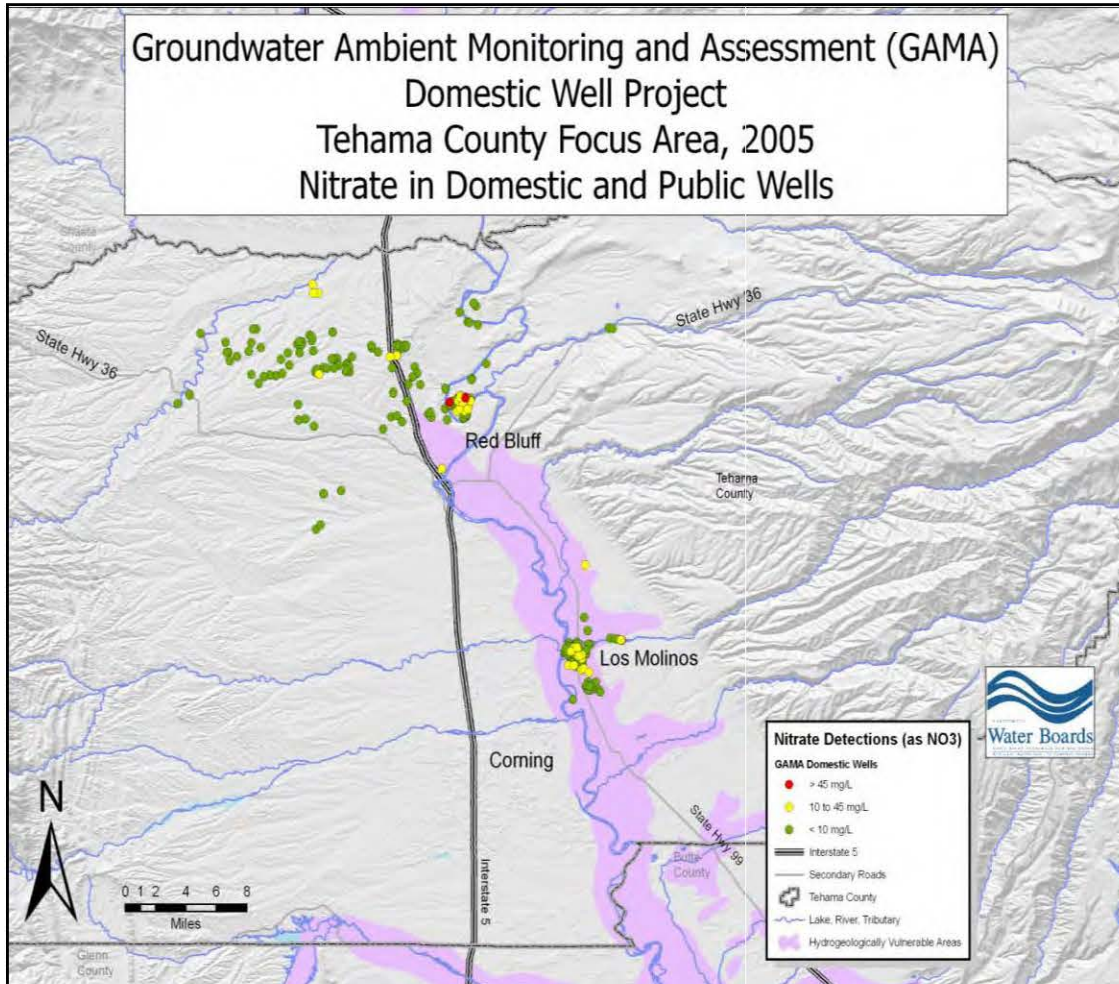


Figure B-15. GAMA Voluntary Domestic Well Project—Tulare County (2006)

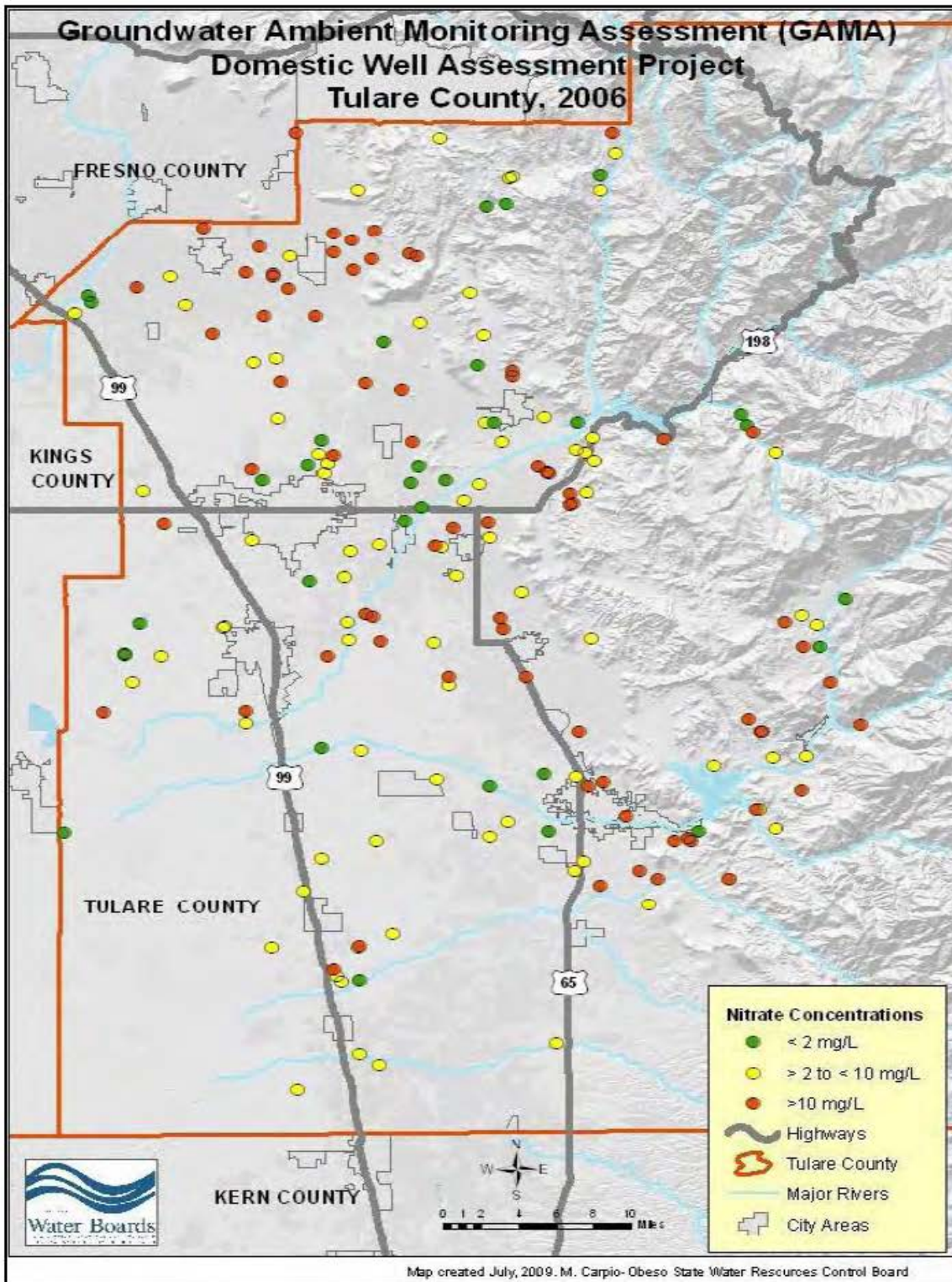




**Figure B-16 Concentration of nitrate in groundwater in California from Bartholomay and Others 2007, USGS Scientific Investigations Report 2007-5213**

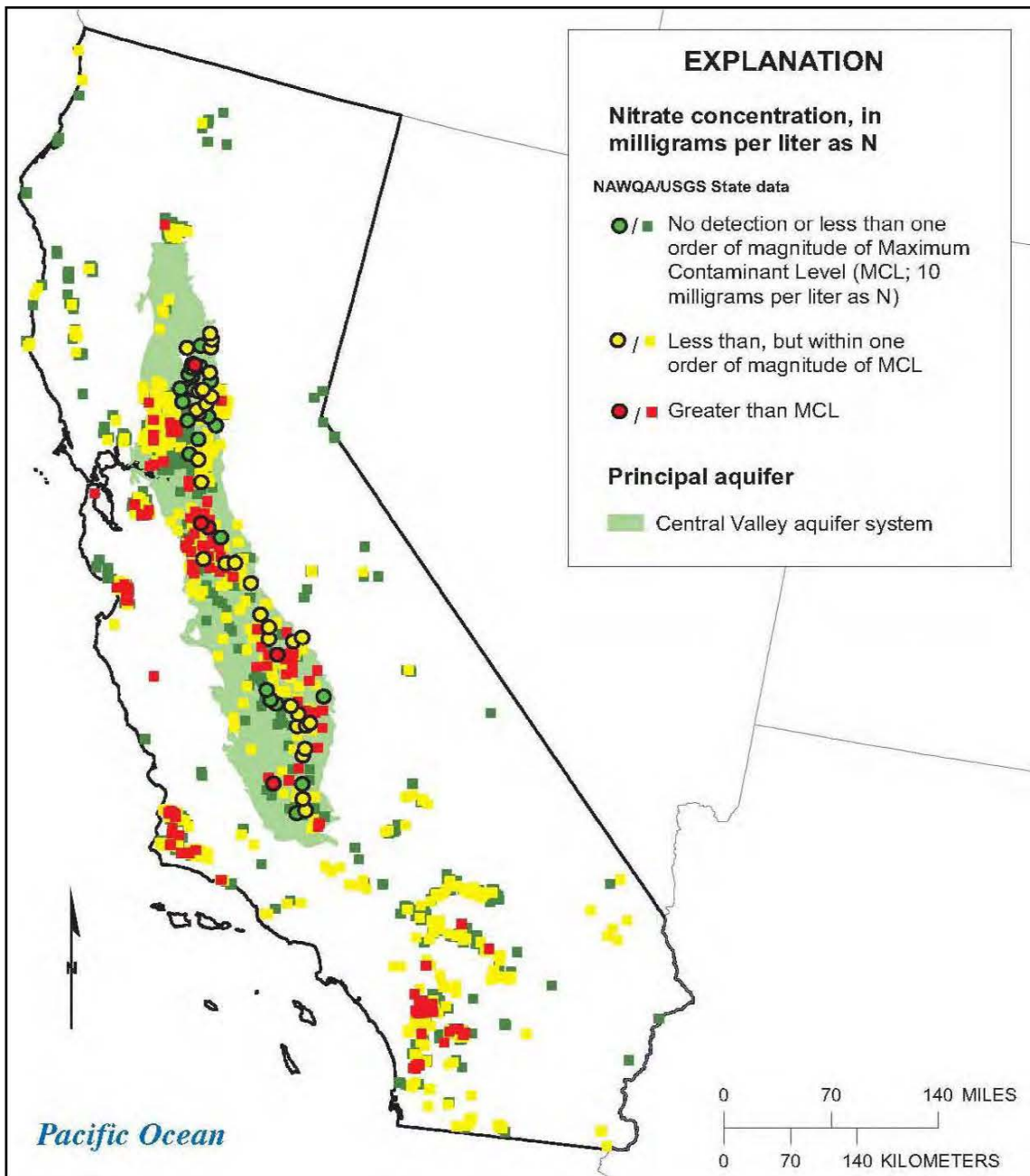
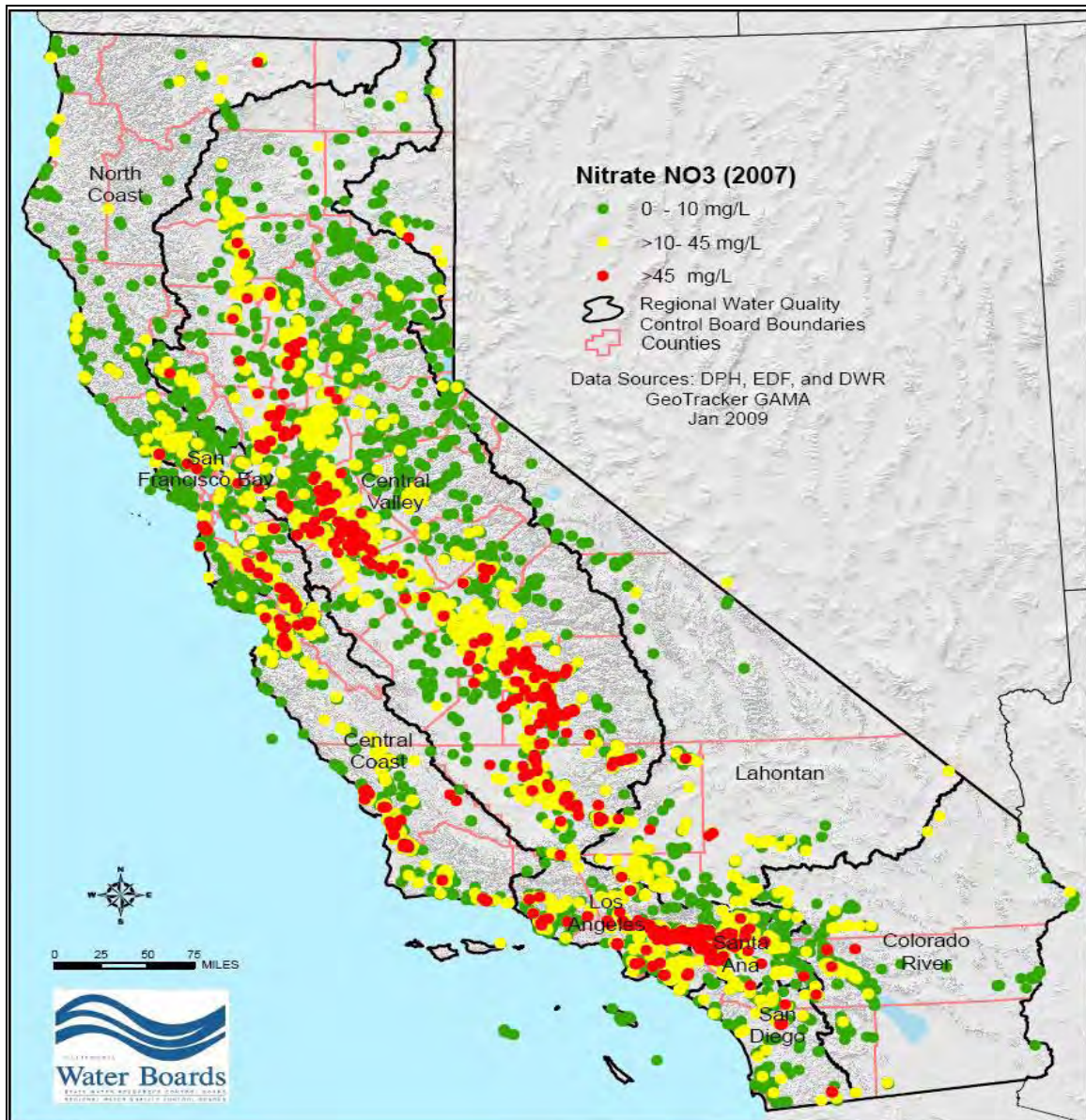


**Figure B-17. Nitrate in Groundwater. From: Erik J. Ekdahl, Maria de la Paz Carpio-Obeso, and John Borkovich, California State Water Resources Control Board 2009; in: Harter, T. 2009. Agricultural impacts on groundwater nitrate, Southwest Hydrology, July/August 2009, p.23–25**

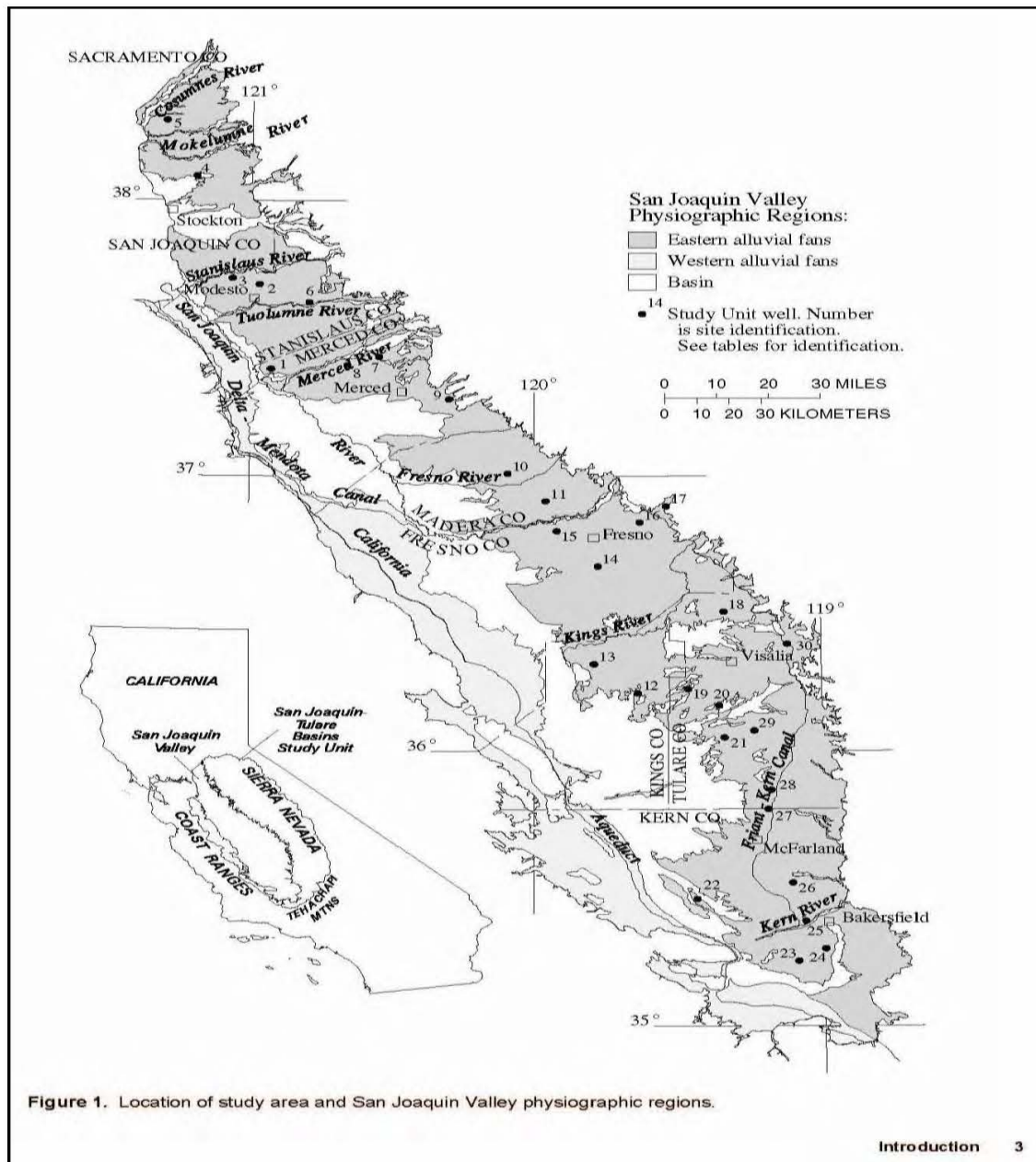


## **I. Trends in Nitrate Groundwater Concentrations in Portions of the Central Valley**

A variety of investigators have looked at the San Joaquin Valley groundwater nitrate concentrations over time (Burow et al. 1998, 2007, 2008; Rupert 2008; Rosen and Lapham 2008). In 1995, NAWQA (Burow et al. 1998) resampled 30 domestic supply wells in the eastern San Joaquin Valley that previously had been sampled by the USGS between 1986 and 1987 (Figure B-18). The median

nitrate concentration for 23 of the 30 wells in 1986–87 was 2.4 mg/l, (seven wells had no nitrate sample data) and in 1995 the median concentration for the full 30 wells was 4.6 mg/l. Nitrate exceeded the MCL value in two wells in 1986–87 and in five wells in 1995.

**Figure B-18. Eastern San Joaquin Study Area; from Burow et al. 1998**



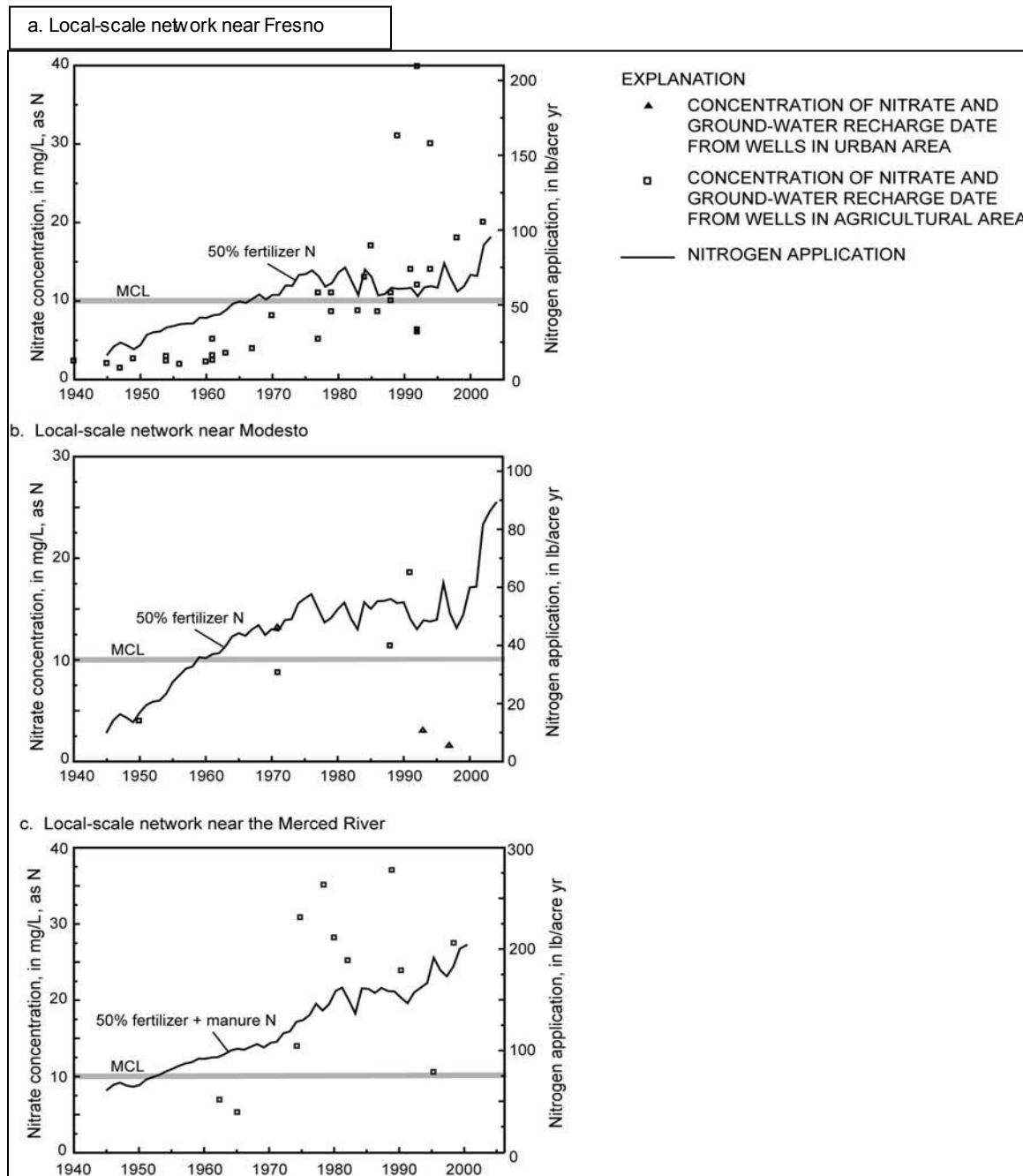
In 2002, 29 of the original 30 domestic wells in the regional aquifer were re-sampled for the third time (Burow et al. 2008). The median nitrate concentration for the re-sampled wells had risen from 2.3 mg/l in 1986–87 to 5.4 mg/l in 2003. Burow and others (2008) concluded that,



*The results of the analysis of regional- and local-scale nitrate concentration data indicate that widespread high concentrations of nitrate in the shallow part of the San Joaquin Aquifer system are likely to move to deeper parts of the ground-water flow system.*

The trend of nitrate concentrations in the shallow groundwater portion of the Eastern San Joaquin Study Area also has been investigated by means of focused studies using monitoring wells in three geographical areas: near Fresno, near Modesto, and near the Merced River (Burow and Green 2008).

**Figure B-19. Nitrate Concentration vs. Fertilizer Application over Time; from Burow and Green 2007**



Nitrogen fertilizer data were coupled with the results of groundwater sampling to show that nitrate concentrations increased over time and corresponded to fertilizer application rates in all three focus study areas (Figure B-19).

Burow and Green (2008) reported that,

*Analysis using county-level nitrogen applications and a wide range of chemical data from sampling vertical monitoring well transects showed that reconstructed nitrate concentrations are consistent with 50% of the applied nitrogen reaching the water table.*

Burow and others (2007) produced a report that expanded upon the data evaluation for the focused study areas of the Eastern San Joaquin Study Area. This study reported that the nitrate concentrations in monitoring wells completed in the shallowest part of the aquifer increased in concentration from 8 to 23 mg/l during the period of time from 1994–1995 to 2003. Nitrate concentrations varied considerably with groundwater depth, ranging from 2mg/l in the deepest monitoring wells to 30 to 40 mg/l in the shallow wells. This change in concentration versus depth is attributable in part to the age of the water. Based on CFC concentrations, groundwater less than 10 meters (m) below the water table is approximately 15 years old. The mean age of groundwater deeper than 60m below the water table is approximately 45 years old (Burow et al. 2007). Burow and others concluded that,

*Nitrate concentrations were highest and most variable in the shallow monitoring wells in the regional areal monitoring networks; the variability in nitrate concentrations and median values decreased with depth. Because of intensive pumping and irrigation recharge, the dominant ground water flowpaths in the aquifer system are vertically downward. High concentrations in the shallow part of the aquifer could be expected to move downward over time, which would result in increasing concentrations in the deeper domestic and public-supply wells in the future as water with high nitrate concentrations moves deeper in the groundwater system.*

Short-circuiting of the normal stratification (younger water at the top of the water table and progressively older water as you go deeper) also has been observed to occur in certain wells. Multiple completion wells (wells that have more than one screened interval) can allow younger, nitrate-affected water to enter in the upper portions of the well and be pulled down into deeper older levels because of vertical gradients or as a result of pumping. Wells that have insufficient or nonexistent well seals also allow vertical movement of younger water into deeper older water by migration through the filter pack material or native soil (vertical migration outside of the well casing).

## **J. Conclusions**

Nitrate derived from both agricultural and non-agricultural sources has resulted in degradation and/or pollution of groundwater beneath agricultural areas in California's Central Valley (Burow et al. 1998, 2008; Suen 2008; Green, et al. 2008; Harter et al. 2005; Singleton et al. 2007; Esser et al. 2009; McNab et al.

2007). The most significant sources of non-agricultural nitrate detected in groundwater in agricultural areas include leakage from septic tanks, residential and commercial use of fertilizers, leakage from sewage pipes and mains, leakage beneath landfills, and discharges from food processing facilities (Paul et al. 2007; Central Valley Water Board 2008). Major sources of agriculturally derived nitrate consist of fertilization using natural (manure) or synthetic nitrogen sources (chemical fertilizers) and concentrated animal feeding operations (Burow et al. 1998, 2008; Suen 2008; Green et al. 2008; Harter et al. 2001; Singleton et al. 2007; Esser et al. 2009).

Nitrate impacts on groundwater beneath agricultural areas are most effectively determined by means of shallow (installed in first encountered groundwater) monitoring wells constructed with short screen lengths (Burow et al. 1998, 2007; Fuhrer et al. 1999; California GAMA Program 2008). While nitrate impacts may be most effectively detected in shallow wells, intensive pumping and recharge through irrigation can result in a vertically downward groundwater flux. This downward migration of nitrate may result in increasing concentrations in the deeper domestic and public-supply wells over time (Burow et al. 2007).

Determining the specific source(s) of nitrate contained in groundwater may be difficult, however; a variety of chemical and physical methods have been developed for this purpose. Nitrate isotopic composition, age determination of the water, presence or absence of co-contaminants, and major and trace element chemical composition of the groundwater have been used to successfully identify multiple sources of nitrate within a plume of affected groundwater (Kendall 1998; Esser et al. 2009; Buszka et al. 2006; Suen 2008).

While some disagreement exists among the investigators, a common group of physical and chemical factors has been identified as affecting nitrate leaching beneath agricultural lands (California Department of Food and Agriculture 1989; State Water Board 1994; Green et al. 2007; Harter et al. 2005; Fuhrer et al. 1999; Burow and Green 2008; Burow et al. 2008; Domagalski et al. 2008; Dinnes et al. 2002). Physical factors include: nitrogen application rates, water inputs (rainfall, type of irrigation, and frequency of irrigation), leaching rates (soil type and structure), evapotranspiration, and depth to groundwater. Chemical factors include soil mineralogy, pH, bulk density, soil organic matter, and denitrification.

Nitrate vulnerability maps developed for the nation and exclusively for California, depict two parallel bands of high aquifer vulnerability extending along both sides of the Central Valley from the Bakersfield area to just north of Fresno. A third discontinuous band of high aquifer vulnerability extends through the center of the Central Valley from near Merced northward to the area around Colusa. A separate area of high vulnerability is depicted near Redding.

Non-nitrate vulnerability maps prepared by the State Water Board (Hydrogeologically Vulnerable Areas) and DPR (Groundwater Protection Areas) are analogous to the nitrate vulnerability maps with the exception of the

southwestern portion of the Central Valley (nitrate vulnerability maps have both an eastern and western band of high vulnerability, while the State Water Board and DPR maps depict only the eastern band).

State Water Board and USGS Maps depicting areas in the Central Valley where groundwater quality has been affected by nitrates are in general agreement with the vulnerability maps. Caution must be exercised, however, in using these maps to evaluate the extent of nitrate impacts in the Central Valley. Sampling-induced bias (sampling deeper waters below shallow, nitrate-affected waters or sampling wells with long screen intervals), coupled with the lack of sampling in some regions, may distort or underestimate the actual area of impact.

Studies of trends in nitrate concentrations in groundwater in the Central Valley have focused predominantly on the eastern side of the San Joaquin Valley. Nitrogen fertilizer data were compared with the results of groundwater sampling to show that increases in nitrate concentrations over time corresponded to fertilizer application rates in focused study areas (Burow and Green 2008).

## **K. Selected References and Bibliography**

Anning, D.W., S.A. Thiros, L.M. Bexfield, T.S. McKinney, and J.M. Green. 2009. National Water Quality Assessment program, Southwest Principal Aquifers Regional Ground-Water Quality Assessment: US Geological Survey Fact Sheet 2009–3015, March 2009.

Bartholomay R.C., J.M. Carter, S.L. Qi, P.J. Squillace, and G.L. Rowe. 2007. Summary of Selected U.S. Geological Survey Data on Domestic Well Water Quality for the Centers for Disease Control's National Environmental Public Health Tracking Program: U.S. Geological Survey, Scientific Investigations Report 2007–5213, 57 p. Available: <http://pubs.usgs.gov/sir/2007/5213/downloads/sir2007–5213web.pdf>

Barton L., L.A. Schipper, G.F. Barkle, M. McLeod, T.W. Speir, M.D. Taylor, A.C. McGill, A.P. van Schaik, N.B. Fitzgerald, and S.P. Pandey. 2005. Land Application of Domestic Effluent onto Four Soil Types: *Journal of Environmental Quality*, Vol. 34:p. 635–643.

Bennett, G.L., K. Belitz, and B.J. Milby Dawson. 2006. California GAMA Program—Ground-water quality data in the northern San Joaquin basin study unit, 2005: U.S. Geological Survey Data Series 196, 122 p. Available: [http://pubs.usgs.gov/ds/2006/196/ds\\_196.pdf](http://pubs.usgs.gov/ds/2006/196/ds_196.pdf)

Bowman, D.C., C.T. Cherney, and T.W. Ruffy, Jr. 2002. Fate and Transport of Nitrogen Applied to Six Warm-Season Turfgrasses: *Crop Science Society of America*, Vol. 42, p. 833–841.



- Brand, M.R., R.J. McAvoy, and E.G. Corbett. 1993. Nitrate loading to the soil profile underlying two containerized nursery crops supplied controlled release fertilizer: *Journal of Environmental Horticulture* Vol. 11, p. 82–85.
- Burow, K.R., J.L. Shelton, and N.M. Dubrovsky. 1998. Occurrence of nitrate and pesticides in groundwater beneath three agricultural land-use settings in the eastern San Joaquin Valley, California: USGS Water-Resources Investigations Rep. 97-4284. USGS, Sacramento, CA
- Burow, K.R., S.V. Stork, and N.M. Dubrovsky. 1998. Nitrate and Pesticides in Ground Water in the Eastern San Joaquin Valley, California: Occurrence and Trends: USGS Water-Resources Investigations Rep. 98-4040A.
- Burow, K.R., N.M. Dubrovsky, and J.L. Shelton. 2007. Temporal trends in concentrations of DBCP and nitrate in groundwater in the eastern San Joaquin Valley, California, USA: *Hydrogeology Journal* (2007) 15: 991–1007.
- Burow, K.R., and C.T. Green. 2008. Spatial and Temporal Trends in Nitrate Concentrations in the Eastern San Joaquin Valley Regional Aquifer and Implications for Nitrogen Fertilizer Management, California Plant and Soil Conference: Conservation of Agricultural Resources, February 5 & 6, 2008, Visalia, California, 47–52 p.
- Burow, K.R., J.L. Shelton, N.M. Dubrovsky. 2008. Regional Nitrate and Pesticide Trends in Ground Water in the Eastern San Joaquin Valley, California: *Journal of Environmental Quality*, Vol. 37: 249–263 p.
- Burton, C.A., and K. Belitz. 2008. Ground-water quality data in the southeast San Joaquin Valley, 2005– 2006—Results from the California GAMA Program: U.S. Geological Survey Data Series 351, 103 p. Available: <http://pubs.usgs.gov/ds/351/>
- Buszka, P.M., L.R. Watson, and T.K. Greeman. 2006. Hydrogeology, Ground-Water-Age Dating, Water Quality, and Vulnerability of Ground Water to Contamination in a Part of the Whitewater Valley Aquifer System near Richmond, Indiana, 2002–2003: U.S. Geological Survey Scientific Investigations Report 2006–5281, 120 p. Available: <http://pubs.usgs.gov/sir/2006/5281/pdf/sir2006–5281.pdf>
- California Department of Food and Agriculture. 1989. Nitrate and Agriculture in California: Nitrate Working Group, February 1989.
- California Department of Food and Agriculture, About Fertilizers, Criteria for Nitrate-Sensitive Areas, Map 2.
- California Regional Water Quality Control Board, Central Valley Region. 2008. Staff Report, Regulation of Food Processing Waste Discharges to Land.

- California Regional Water Quality Control Board, Central Valley Region, and Jones and Stokes. 2008. Irrigated Lands Regulatory Program Existing Conditions Report. Available:  
<[http://www.waterboards.ca.gov/centralvalley/water\\_issues/irrigated\\_lands/long\\_term\\_program\\_development/rev\\_existing\\_conditions\\_report/](http://www.waterboards.ca.gov/centralvalley/water_issues/irrigated_lands/long_term_program_development/rev_existing_conditions_report/)>.
- California State Water Resources Control Board, Division of Clean Water Programs, Groundwater Special Studies Unit, Groundwater Information Sheet—Nitrate/Nitrite Revised: October 23, 2002.
- California State Water Resources Control Board, Division of Water Quality, GAMA Program, Groundwater Information Sheet—Nitrate / Nitrite Revised: February 2008.
- Colangelo, D.J., and M.H. Brand. 2001. Nitrate Leaching beneath a Containerized Nursery Crop Receiving Trickle or Overhead Irrigation: *Journal of Environmental Quality*, Vol. 30, p. 1564–1574.
- Daughton, C.G. 2007. Pharmaceuticals in the Environment: Sources and Their Management, Chapter 1, 1–58, *In Analysis, Fate and Removal of Pharmaceuticals in the Water Cycle* (M. Petrovic and D. Barcelo, Eds.), *Wilson & Wilson's Comprehensive Analytical Chemistry* series (D. Barcelo, Ed.), Volume 50, Elsevier Science, 564p.
- Dawson, B.J. 2001. Ground-Water Quality in the Southeastern Sacramento Valley Aquifer, California, 1996: U.S. Geological Survey, Water-Resources Investigations Report 01-4125, p.30.
- Dawson, B.J. 2001a, 2001. Shallow ground-water quality beneath rice areas in the Sacramento Valley, California, 1997: U.S. Geological Survey Water-Resources Investigations Report 2001-4000, 33p.
- Dawson, B.J., G.L.Bennett, and K. Belitz. 2008. Ground-Water Quality Data in the Southern Sacramento Valley, California, 2005—Results from the California GAMA Program: U.S. Geological Survey Data Series 285, 93 p. <http://pubs.usgs.gov/ds/285/ds285.pdf>
- Dinnes, D.L., D.L. Karlen, D.B. Jaynes, T.C. Kaspar, J.L. Hatfield, T.S. Colvin, and C.A. Cambardella. 2002. Nitrogen Management Strategies to Reduce Nitrate Leaching in Tile-Drained Midwestern Soils: *Agronomy Journal*, Vol. 94, p. 153–171.
- Dubrovsky, N.M., C.R. Kratzer, L.R. Brown, J.M. Gronberg, and K.R. Burow. 1998. Water quality in the San Joaquin–Tulare Basins, California, 1992–95: USGS Circ. 1159.

- Dubrovsky, N.M., S. Ator, R. Coupe, K. McCarthy, D. Lampe, M. Sandstrom, and N. Baker. 2008. Comparative Study of Transport Processes of Nitrogen, Phosphorus, and Herbicides to Streams in Five Agricultural Basins, USA: *Journal of Environmental Quality*, Vol. 37, p. 1158–1169.
- Eimers, J.L., and T.B. Spruill. 1997. Relating Minimum Soil Infiltration Rate to Nitrate-Nitrogen Concentrations in Shallow Ground Water in the Coastal Plain of Albemarle-Pamlico Drainage Basin, North Carolina and Virginia: Albemarle-Pamlico Estuarine Study Comprehensive Conservation and Management Plan Implementation Forum, June 5–6.
- Engelsjord, M.E., B.E. Branham, and B.P. Horgan. 2004. The Fate of Nitrogen-15 Ammonium Sulfate Applied to Kentucky Bluegrass and Perennial Ryegrass Turfs: *Crop Science Society of America*, Vol. 44, p. 1341–1347.
- Esser, B.K., H.R. Beller, S.F. Carle, G.B. Hudson, S.R. Kane, R.N. Leif, T.E. LeTain, W.M. McNab, and J.E. Moran. 2009. California GAMA Program: Impact of Dairy Operations on Groundwater Quality: Lawrence Livermore National Laboratory under Contract W-7405-ENG-48, August 17, 2009.
- Fisher, L.H., and R.W. Healy. 2008. Water movement within the unsaturated zone in four agricultural areas across the United States: *Journal of Environmental Quality*, Vol. 37, p. 1051–1063.
- Frank, K.W., K.M. O'Reilly, J.R. Crum, and R.N. Calhoun. 2005. The Fate of Nitrogen Applied to a Mature Kentucky Bluegrass Turf: *Crop Science Society of America*, Vol. 46, p. 209–215.
- Fuhrer, G.J., Gilliom, R.J., Hamilton, P.A., Morace, J.L., Nowell, L.H., Rinella, J.F., Stoner, J.D., Wentz, D.A., 1999. The Quality of our Nation's Waters: Nutrients and Pesticides: U.S. Geological Survey Circular; 1225.
- Gold, A.J., W.R. DeRagon, W.M. Sullivan, and J.L. Lemunyon. 1990. Nitrate-nitrogen Losses to Groundwater from Rural and Suburban Land Uses: *Journal of Soil and Water Conservation*, March–April 1990, Vol. 45, Number 2.
- Green, C.T., L.H. Fisher, and B.A. Bekins. 2008. Nitrogen Fluxes through Unsaturated Zones in Five Agricultural Settings across the United States: *Journal of Environmental Quality*, May–June 2008, Vol. 37, pp. 1073–1085.
- Haller, L, P. McCathy, T. O'Brien, J. Riehle, and T. Stuhldreher. 1996. Nitrate Pollution of Groundwater. <http://www.reopure.com/nitrinfo.html>
- Harter, T., H. Davis, M.C. Mathews, and R.D. Meyer. 2001. Monitoring Shallow Groundwater Nitrogen Loading from Dairy Facilities with Irrigated Forage Crops: American Society of Agricultural Engineers Meeting Presentation, ASAE Paper Number 01-2103, 2001 ASAE Annual International Meeting, Sacramento, CA, July 30–August 1, 2001.

- Harter, T., Y.S. Onsoy, K. Heeren, M. Denton, G. Weissmann, J.W. Hopmans, and W.R. Horwath. 2005. Deep vadose zone hydrology demonstrates fate of nitrate in eastern San Joaquin Valley: *California Agriculture*, Vol. 59, No.2, p.124–132.
- Harter, T. 2009. Agricultural Impacts on Groundwater Nitrate: Southwest Hydrology, July/August 2009, p. 22–23 and 35.
- Helperin, A.N., D.S. Beckman, and D. Inwood. 2001. California's Contaminated Groundwater—Is the State Minding the Store? : National Resources Defense Council, April 2001.
- Jagucki, M.L., B.C. Jurgens, K.R. Burow, and S.M. Ebets. 2009. Assessing the Vulnerability of Public-Supply Wells to Contamination: Central Valley Aquifer System near Modesto, California: U.S. Geological Survey Fact Sheet 2009-3036, April 2009.
- Kaown, D., Y. Hyun, G. Bae, and K. Lee. 2007. Factors Affecting the Spatial Pattern of Nitrate Contamination in Shallow Groundwater: *Journal of Environmental Quality*, Vol. 36 p. 1479–1487.
- Kendall, C. and J.J. McDonnell. 1998. Tracing nitrogen sources and cycling in catchments: *In Isotope Tracers in Catchment Hydrology*, Amsterdam, Elsevier, pp. 519–576.
- Kubin, E. 1998. Leaching of nitrate nitrogen into the groundwater after clear felling and site preparation: *Boreal Environmental Research*, Vol. 3, p. 3–8, July 1998.
- Law, N.L., L.E. Band, and J.M. Grove. 2004. Nutrient Input from Residential Lawn Care Practices: *Journal Environmental Planning and Management*, Vol. 47: p.737–755.
- Landon, M.K., and K. Belitz. 2008. Ground-water quality data in the Central Eastside San Joaquin Basin 2006: Results from the California GAMA Program: U.S. Geological Survey Data Series 325, 88 p.
- Landon, M.K., and M.S. Fram. 2009. Occurrence and Distribution of Nitrate in Groundwater in the Central Valley: presentation Irrigated Lands Regulatory Program Workshop, April 15, 2009.
- Longe, E.O., and L.O. Enekwechi. 2007. Investigation on potential groundwater impacts and influence of local hydrogeology on natural attenuation of leachate at a municipal landfill: *International Journal of Science and Technology*, Vol. 4 (1), p. 133–140.

- Loper, C.A., K.J. Breen, T.M. Zimmerman, and J.W. Clune. 2009. Pesticides in ground water in selected agricultural land-use areas and hydrogeologic settings in Pennsylvania, 2003–07: U.S. Geological Survey Scientific Investigations Report 2009–5139, 121 p.  
<http://pubs.usgs.gov/sir/2009/5139/sir2009-5139.pdf>
- McNab, W.W., M.J. Singleton, J.E. Moran, and B.E. Esser. 2007. Assessing the Impact of Animal Waste Lagoon Seepage on the Geochemistry of an Underlying Shallow Aquifer: *Environmental Science & Technology*, Vol. 41, p. 753–758.
- Meixner, T., M.E. Fenn, and P.M. Wohlgemuth. 2003. Fire Disturbance and Nitrogen Deposition Impacts at the Watershed Scale in Southern California: U. S. Department of Agriculture, Agriculture Research Service, First Interagency Conference on Research in the Watersheds, Oct. 27–30, 2003.
- Mills, G.A., B. Vrana, I. Allan, D.A. Ivarez, J.N. Huckins, and R. Greenwood. 2007. Trends in monitoring pharmaceuticals and personal-care products in the aquatic environment by use of passive sampling devices: *Anal Bioanal Chem*, Vol. 387 p.1153–1157.
- Minnesota Department of Agriculture. 2006. A Co-occurrence of Nitrate and Pesticides.
- Moran, J.E., B.K. Esser, G.B. Hudson, and M.J. Singleton. 2005. The Effects of Agricultural Nitrate Sources on Groundwater Supplies in California: Geological Society of America *Abstracts with Programs*, Vol. 37, No. 7, p. 247, October 2005.
- Moran J.E., M.J. Singleton, S.F. Carle, and B.K. Esser. 2007. Intrinsic and Extrinsic Chemical and Isotopic Tracers for Characterization of Groundwater Systems: Illinois State Geological Survey: 3D workshop.  
<http://www.isgs.illinois.edu/research/3DWorkshop/2007/pdf-files/moran.pdf>.
- Munoz-Arboleda, F., R. Mylavarapu, C. Hutchinson, and K. Portier. 2008. Nitrate-Nitrogen Concentrations in the Perched Ground Water under Seepage-Irrigated Potato Cropping Systems: *Journal of Environmental Quality*, Vol. 37 p. 387–394.
- Nolan, B.T., and B.C. Ruddy. 1996. Nitrate in Ground Water of the United States—Assessing the Risk: U.S. Geological Survey Fact Sheet FS-092-96.
- Nolan, B.T., B.C. Ruddy, K.J. Hitt, and D.R. Helsel. 1997. Risk of nitrate in groundwaters of the United States—a national perspective: *Environmental Science and Technology*, v. 31, n. 8, p. 2229–2236.



- Nolan B.T., B.C. Ruddy, K.J. Hitt, and D.R. Helsel. 1998. A national look at nitrate contamination of ground water: Water Conditioning and Purification Magazine, vol. 39, number 12, p. 76–79.
- Nolan, B.T., K.J. Hitt, and B.C. Ruddy. 2002. Probability of Nitrate Contamination of Recently Recharged Groundwaters in the Conterminous United States: Environmental Science & Technology, Vol. 36, No. 10, p. 2138–2145.
- Nolan, B.T., and K.J. Hitt. 2006. Vulnerability of Shallow Groundwater and Drinking-Water Wells to Nitrate in the United States: Environmental Science & Technology, Vol. 40, No. 24, p. 7834–7840.
- Onsoy, Y.S., T. Harter, T.R. Ginn, and W.R. Horwath. 2005. Spatial Variability and Transport of Nitrate in a Deep Alluvial Vadose Zone: *Vadose Zone Journal* Vol. 4, p. 41–54.
- Pang, L., C. Nokes, J. Sumunek, H. Kikkert, and R. Hector. 2006. Modeling the Impact of Clustered Septic Tank Systems on Groundwater Quality: *Vadose Zone Journal*, Vol. 5, P. 599–609.
- Panno, S.V., K.C. Hackley, W.R. Kelly, and H. Hwang. 2006. Isotopic Evidence of Nitrate Sources and Denitrification in the Mississippi River, Illinois: *Journal of Environmental Quality*, Vol. 35 p. 495–504.
- Paul, A.P., R.L. Seiler, T.G. Rowe, and M.R. Rosen. 2007. Effects of agriculture and urbanization on quality of shallow ground water in the arid to semiarid western
- Peralta, J.M., and C.O. Stockle. 2002. Dynamics of nitrate leaching under irrigated potato rotation in Washington State: a long-term simulation study: Agriculture, Ecosystems & Environment, Vol. 88, Issue 1, p. 23–34.
- Power, J.F., R. Wiese, and D. Flowerday. 2001. Managing Farming Systems for Nitrate Control: A research Review from Management Systems Evaluation Areas: *Journal of Environmental Quality*, Vol. 30 p. 1866–1880.
- Puckett, L.J., and W.B. Hughes. 2005. Transport and Fate of Nitrate and Pesticides: Hydrogeology and Riparian Zone Processes: *Journal of Environmental Quality*, Vol. 34 p. 2278–2292.
- Puckett, L.J., C. Zamora, H. Essaid, J.T. Wilson, H.M. Johnson, M.J. Brayton, and J.R. Vogel. 2008. Transport and Fate of Nitrate at the Ground-Water / Surface-Water Interface: *Journal of Environmental Quality*, Vol. 37 p. 1034–1050.
- Raciti, S.M., P.M. Groffman, and T.J. Fahey. 2008. Nitrogen Retention in Urban Lawns and Forests. *Ecological Applications*: Vol. 18, No. 7, pp. 1615–1626.

- Ristvey, A.G., J.D. Lea-Cox, and D.S. Ross. 2004. Nutrient Uptake, Partitioning and Leaching Losses from Container-Nursery Production Systems: *Acta Horticulturae*, Vol. 630, p. 321–328.
- Rosen, M.R., and W.W. Lapham. 2008. Introduction to the U.S. Geological Survey National Water-Quality Assessment (NAWQA) of Ground-Water Quality Trends and Comparison to Other National Programs: *Journal of Environmental Quality*, Vol. 37 p. S190-S198.
- Rupert, M.G. 2008. Decadal-Scale Changes of Nitrate in Ground Water of the United States, 1988–2004: *Journal of Environmental Quality*, Vol. 37 p. 240–248.
- Scanlon, B.R., R.C. Reedy, D.A. Stonestrom, D.E. Prudic, and K.F. Dennehy. 2005. Impact of land use and land cover change on groundwater recharge and quality in the southwestern US: *Global Change Biology* (2005) Vol. 11, p.1577–1593.
- Seiler, R.L., S.D. Zaugg, J.M. Thomas, and D.L. Howcroft. 1999. Caffeine and Pharmaceutics as Indicators of Waste Water Contamination in Wells: *Ground Water*, May–June 1999, Vol. 37, No.3, p. 405–510.
- Shelton, J.L., I. Pimentel, M.S. Fram, and K. Belitz. 2008. Ground-water quality data in the Kern County subbasin study unit, 2006—Results from the California GAMA Program: U.S. Geological Survey Data Series 337, 75 p. <http://pubs.usgs.gov/ds/337/pdf/ds337.pdf>
- Singleton, M.J., B.K. Esser, J.E. Moran, G.B. Hudson, W.W. McNab, and T. Harter. 2007. Saturated Zone Denitrification: Potential for Natural Attenuation of Nitrate Contamination in Shallow Groundwater Under Dairy Operations: *Environmental Science & Technology*, Vol. 41, p. 759–765.
- Spalding, R.F., D.G. Watts, J.S. Schepers, M.E. Burbach, M.E. Exner, R.J. Poreda, and G.E. Martin. 2001. Controlling Nitrate Leaching in Irrigated Agriculture: *Journal of Environmental Quality*, Vol. 30 p. 1184–1194.
- Standley, L.J., R.A. Rudel, C.H. Swartz, K.R. Attfield, J. Christian, M. Erickson, and J.G. Brody. 2008. Wastewater-Contaminated Groundwater as a Source of Endogenous Hormones and Pharmaceuticals to Surface Water Ecosystems: *Environmental Toxicology and Chemistry*, Vol. 27, Issue 12, p. 2457–2468.
- Stewart, I.T., and K. Loague. 2004. Assessing Ground Water Vulnerability with the Type Transfer Function Model in the San Joaquin Valley, California: *Journal of Environmental Quality*, Vol. 33 p. 1487–1498.

- Suen, C.J. 2008. Using Isotopic Ratios and Major Minerals Data to Identify the Sources of Ground Water and Ground Water Nitrate in Relation to Pesticide Residues: California Department of Pesticide Regulation, Environmental Monitoring Branch, June 24, 2008.
- Tesoriero, A.J., D.A. Saad, K.R. Burow, E.A. Frick, L.J. Puckett, and J.E. Barbash. 2007. Linking ground-water age and chemistry data along flow paths: Implications for trends and transformations of nitrate and pesticides: *Journal of Contaminant Hydrology*, 94 (2007), p. 139–155.
- Thiros, S.A., 1999, Quality of shallow ground water in areas of recent residential and commercial development in Salt Lake Valley, Utah, 1999: U.S. Geological Survey Fact Sheet 106-00.
- Tomer, M.D., and M.R. Burkart. 2003. Long-Term Effects of Nitrogen Fertilizer Use on Ground Water in Two Small Watersheds: *Journal of Environmental Quality*, Vol. 32 p. 2158–2171.
- Townsend, M.A., and D.P. Young. 1995. Factors Affecting Nitrate Concentrations in Ground Water in Stafford County, Kansas: Kansas Geological Survey, Current Research in Earth Sciences, Bulletin 238, part 1.
- USEPA. 1998. Office of Water Standards and Applied Sciences Division Environmental *Impacts of Animal Feeding Operations, December 31, 1998*.
- USEPA. 2002. Onsite Wastewater Treatment Systems Manual, Chapter 3, page 3–11, EPA/625/R-00/008. February. Available: <http://www.epa.gov/nrmrl/pubs/625r00008/html/600R00008chap1.htm>
- USEPA. 2002. Chapter1: Background and Use of Onsite Wastewater Treatment Systems, EPA600/R-00/008.
- USGS. The Reston Chlorofluorocarbon Laboratory,  $^3\text{H}/^3\text{He}$  Dating Background: Online at <http://water.usgs.gov/lab/>.
- Van der Schans, M.L., T. Harter, A. Leijnse, M.C. Mathews, and R.D. Meyer. 2009. Characterizing sources of nitrate leaching from an irrigated dairy farm in Merced County, California: *Journal of Contaminant Hydrology*, Vol. 110, Issue 1–2, 3 November 2009, p. 9–21.
- Wakida, F.T., and D.N. Lerner. 2005. Non-agricultural Sources of Groundwater Nitrate: A Review and Case Study: *Water Research*, Vol. 39, Issue 1, January 2005, pages 3–16.
- Wakida, F.T. 2008. Sources of Nitrate in Urban Groundwater: *Science Topics*, 22 August 2008.

- Wallace, J., and M Lowe. 1998. The Potential Impact of Septic Tank Soil-Absorption Systems on Water Quality in the Principal Valley-Fill Aquifer, Ogden Valley, Weber County, Utah—Assessment and Guidelines: Utah Geological Survey, Report Investigation 237, May 1998.
- Watanabe, N., T.H. Harter, and B.A. Bergamaschi. 2008. Environmental Occurrence and Shallow Ground Water Detection of the Antibiotic Monensin from Dairy Farms: *Journal of Environmental Quality*, Vol. 37 p. S-78-S-85.
- Widory, D., E. Petelet-Giraud, P. Negrel, and B. Ladouche. 2005. Tracking the Sources of Nitrate in Groundwater Using Coupled Nitrogen and Boron Isotopes: A Synthesis: *Environmental Science and Technology*, Vol. 39, p. 539–548.
- Wiederholt, R., and B. Johnson. 2005. Nitrogen Behavior in the Environment: North Dakota State University, NM-1299, November.
- Wilkison, D.H. 1998. USGS research at Management Systems Evaluation Areas, 1991–95: USGS Fact Sheet 042-98, 4 p.
- Williams, A.G., J.F. Dowd, D. Scholefield, N.M. Holden, and L.K. Deeks. 2003. Preferential Flow Variability in a Well-Structured Soil: *Soil Science Society of America Journal*, Vol. 67, p.1272–1281.
- Xu, Y., L.A. Baker, and P.L. Johnson. 2007. Trends in Ground Water Nitrate Contamination in the Phoenix, Arizona Region: *National Ground Water Association, Ground Water Monitoring & Remediation*, Vol 27, No.2, Spring 2007, p. 49–56.
- Zhao, C., C. Hu, W. Huang, X. Sun, Q. Tan, and H. Di. 2009. A Lysimeter study of Nitrate Leaching and Optimum Nitrogen Application rates for Intensively Irrigated Vegetable Production System in Central China: *Journal of Soils and Sediments*, Online First, Article 43, 28 March 2009.





## **APPENDIX C**

### **SMALL COMMUNITY WATER SYSTEM NITRATE EXCEEDANCES—BALAZS'S (2008) REVIEW OF DEPARTMENT OF PUBLIC HEALTH DATA FOR 2005–2008 QUARTERLY SAMPLING AND DEPARTMENT OF PUBLIC HEALTH 2009 THIRD QUARTER NITRATE EXCEEDANCES**



## APPENDIX C

### Small Community Water System Nitrate Exceedances—Balazs's (2008) Review of DPH Data for 2005–2008 Raw Quarterly Sampling Results and DPH 2009 Third Quarter Nitrate Exceedances

| Small Drinking Water System Name<br>2005–2009 Nitrate MCL Exceedance<br>(From Balazs 2008 <sup>72</sup> and DPH) | City      | Population | Connection | Type of Activity Most<br>Vulnerable to Source (DPH)<br>Associated with MCL<br>exceedance | Agriculture<br>PCA <sup>73</sup> | Proposition 84 or 50<br>Funding        |
|------------------------------------------------------------------------------------------------------------------|-----------|------------|------------|------------------------------------------------------------------------------------------|----------------------------------|----------------------------------------|
| Century Mobile Home Park                                                                                         | Stockton  | 50         | 16         | No Completed Source Water<br>Assessments                                                 | NA                               |                                        |
| Cherry Lane Trailer Park                                                                                         | Stockton  | 100        | 43         | No Completed Source Water<br>Assessments                                                 | NA                               |                                        |
| Country Western Mobile Home Park                                                                                 | Modesto   | 120        | 60         | No Completed Source Water<br>Assessments                                                 | NA                               |                                        |
| El nido Mobile Home Park                                                                                         | El Nido   | 250        | 49         | No Completed Source Water<br>Assessments                                                 | NA                               |                                        |
| Fawcett Farms                                                                                                    | Los Banos | 50         | 18         | No Completed Source Water<br>Assessments                                                 | NA                               |                                        |
| Md#43 Miami Creek Knolls                                                                                         | Oakhurst  | 100        | 37         | No Completed Source Water<br>Assessments                                                 | NA                               | Yes (84), \$3,000,000<br>Consolidation |

<sup>72</sup> List indicating total number of potential quarterly nitrate exceedances. List generated by Carolina Balazs for CWF & Community Water Center as consultant (Balazs', 2008). System name, connection, and population from DPH databases. Variable on whether the system had any nitrate exceedances from 2005-08 is based on calculations from Balazs' 2008 dissertation work. Time period is 2005–2008. Systems may be in valley floor, foothills or sierras. If a system is not listed here it may be because there were no exceedances, or because there was no sampling data, or because of some combination of these factors. These numbers may or may not match DPH's Annual Review numbers, as Balazs's 2008 method of determining whether there was an exceedance is based on using raw samples to back-calculate violations may differ from DPH's tracking methods. Systems with "no data" violations are not listed in this list, as this document reflects systems that had nitrate exceedances.

<sup>73</sup> DPH's Drinking Water Source Assessment program possible contaminating activity (PCA)

| <b>Small Drinking Water System Name<br/>2005–2009 Nitrate MCL Exceedance<br/>(From Balazs 2008<sup>72</sup> and DPH)</b> | <b>City</b> | <b>Population</b> | <b>Connection</b> | <b>Type of Activity Most<br/>Vulnerable to Source (DPH)<br/>Associated with MCL<br/>exceedance</b>                                                           | <b>Agriculture<br/>PCA<sup>73</sup></b> | <b>Proposition 84 or 50<br/>Funding</b>                    |
|--------------------------------------------------------------------------------------------------------------------------|-------------|-------------------|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|------------------------------------------------------------|
| Md#85 Valeta Mutual Water Company                                                                                        | Madera      | 45                | 19                | No Completed Source Water Assessments                                                                                                                        | NA                                      | Yes (84), \$1,000,000 Nitrate removal & System replacement |
| Turlock Industrial Park Ltd                                                                                              | Turlock     | 60                | NA                | No Completed Source Water Assessments                                                                                                                        | NA                                      |                                                            |
| American Avenue Landfill                                                                                                 | Kerman      | 29                | NA                | No Completed Source Water Assessments                                                                                                                        | NA                                      |                                                            |
| Truckers Mini Mart                                                                                                       | Porterville | 25                | NA                | No Completed Source Water Assessments                                                                                                                        | NA                                      |                                                            |
| Turlock Industrial Park Ltd                                                                                              | Turlock     | 60                | NA                | No Completed Source Water Assessments                                                                                                                        | NA                                      |                                                            |
| Brock Mutual Water Company                                                                                               | Bakersfield | 500               | 156               | Septic systems—high density [ $>1/\text{acre}$ ]                                                                                                             | No                                      |                                                            |
| Buehner Houses                                                                                                           | Patterson   | 25                | 13                | Septic systems—low density [ $<1/\text{acre}$ ]                                                                                                              | No                                      |                                                            |
| Buehner Water System—Weber Complex                                                                                       | Patterson   | 100               | 35                | Automobile—Gas stations<br>Chemical/petroleum processing/storage<br>Injection wells/dry wells/sumps<br>Underground storage tanks—<br>Confirmed leaking tanks | No                                      |                                                            |
| Canyon Meadows Mutual Water                                                                                              | Bodfish     | 325               | 144               | Septic systems—high density [ $>1/\text{acre}$ ]<br>Housing—high density [ $>1 \text{ house}/0.5 \text{ acres}$ ]                                            | No                                      |                                                            |
| City of Modesto, De East Turlock                                                                                         | Modesto     | 500               | 38                | Photo processing/printing<br>sewer collection systems                                                                                                        | No                                      |                                                            |

| <b>Small Drinking Water System Name<br/>2005–2009 Nitrate MCL Exceedance<br/>(From Balazs 2008<sup>72</sup> and DPH)</b> | <b>City</b>   | <b>Population</b> | <b>Connection</b> | <b>Type of Activity Most<br/>Vulnerable to Source (DPH)<br/>Associated with MCL<br/>exceedance</b>                                                                                      | <b>Agriculture<br/>PCA<sup>73</sup></b> | <b>Proposition 84 or 50<br/>Funding</b>                                                               |
|--------------------------------------------------------------------------------------------------------------------------|---------------|-------------------|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|-------------------------------------------------------------------------------------------------------|
| Del Oro River Island #2                                                                                                  | Visalia       | 87                | 29                | Known contaminant plumes                                                                                                                                                                | No                                      | Yes (84) \$200,000 (2 Projects) and \$350,000 Correct Nitrate MCL Violation                           |
| Ducor CSD                                                                                                                | Ducor         | 850               | 125               | Chemical/petroleum processing/storage Historic gas stations Known Contaminant Plumes Septic systems—high density [ $>1/\text{acre}$ ] Underground storage tanks—Confirmed leaking tanks | No                                      |                                                                                                       |
| El monte Village M.H.P.                                                                                                  | Clovis        | 100               | 49                | Septic systems—high density [ $>1/\text{acre}$ ]                                                                                                                                        | No                                      |                                                                                                       |
| Gooselake Water Company                                                                                                  | Rosedale      | 102               | 31                | Septic systems—low density [ $<1/\text{acre}$ ]                                                                                                                                         | No                                      |                                                                                                       |
| Green Run Mobile Estates                                                                                                 | Turlock       | 100               | 46                | Septic systems—low density [ $<1/\text{acre}$ ] Underground storage tanks—Confirmed leaking tanks                                                                                       | No                                      |                                                                                                       |
| Hillview Water Co-Raymond                                                                                                | Weldon        | 243               | 82                | Septic systems—low density [ $<1/\text{acre}$ ]                                                                                                                                         | No                                      | Yes (84) \$2,000,000 Compliance for Nitrate and Arsenic                                               |
| Kern Valley Mutual Water                                                                                                 | Lake Isabella | 100               | 35                | Automobile—Repair shops Septic systems—low density [ $<1/\text{acre}$ ]                                                                                                                 | No                                      | Yes (84), \$400,000 Consolidation with Erskine Creek Water Co. to correct arsenic and uranium problem |



| <b>Small Drinking Water System Name<br/>2005–2009 Nitrate MCL Exceedance<br/>(From Balazs 2008<sup>72</sup> and DPH)</b> | <b>City</b> | <b>Population</b> | <b>Connection</b> | <b>Type of Activity Most<br/>Vulnerable to Source (DPH)<br/>Associated with MCL<br/>exceedance</b> | <b>Agriculture<br/>PCA<sup>73</sup></b> | <b>Proposition 84 or 50<br/>Funding</b>                                                                                             |
|--------------------------------------------------------------------------------------------------------------------------|-------------|-------------------|-------------------|----------------------------------------------------------------------------------------------------|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| Lsid—Tonyville                                                                                                           | Tonyville   | 400               | 50                | Septic systems—high density<br>[>1/acre] Wastewater treatment<br>plants and disposal facilities    | No                                      | Yes (84) \$1,038,000<br>Interconnection<br>(50) \$1,038,000<br>Interconnection                                                      |
| Modesto Mobile Home Park, LLC                                                                                            | Modesto     | 200               | 150               | Injection wells/dry wells/sumps                                                                    | No                                      |                                                                                                                                     |
| Oasis Property Owners Association                                                                                        | Bakersfield | 80                | 36                | Septic systems—low density<br>[<1/acre]                                                            | No                                      | Yes, (84) \$1,500,000<br>Consolidation with East<br>Niles CSD                                                                       |
| Patio Village Mobilehome Park                                                                                            | Ceres       | 75                | 49                | Injection wells/dry wells/sumps<br>Septic systems—high density<br>[>1/acre]                        | No                                      |                                                                                                                                     |
| Wilson Road Water Community                                                                                              | Bakersfield | 72                | 19                | Septic systems—low density<br>[<1/acre]                                                            | No                                      | Yes (84), \$97,000<br>Regional project to<br>consolidate with East<br>Niles CSD                                                     |
| Beef Packers                                                                                                             | Fresno      | 950               |                   | Wastewater treatment plants                                                                        | No                                      |                                                                                                                                     |
| Akin Water Co.                                                                                                           | Akin        | 50                | 22                | Known Contaminant Plumes<br>Septic systems—high density<br>[>1/acre]                               | Yes                                     | Yes (84), \$250,000<br>Consolidation to fix<br>Nitrate exceedances                                                                  |
| Beverly-Grand Mutual Water                                                                                               | Porterville | 108               | 28                | Septic systems—high density<br>[>1/acre]                                                           | Yes                                     | Yes (84) \$2,500,000<br>Consolidation with<br>Porterville to fix nitrate<br>problem<br>(50) \$425,000 Source<br>Water Consolidation |

| <b>Small Drinking Water System Name<br/>2005–2009 Nitrate MCL Exceedance<br/>(From Balazs 2008<sup>72</sup> and DPH)</b> | <b>City</b>   | <b>Population</b> | <b>Connection</b> | <b>Type of Activity Most<br/>Vulnerable to Source (DPH)<br/>Associated with MCL<br/>exceedance</b>                                                                                                                                                                                 | <b>Agriculture<br/>PCA<sup>73</sup></b> | <b>Proposition 84 or 50<br/>Funding</b>                                         |
|--------------------------------------------------------------------------------------------------------------------------|---------------|-------------------|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|---------------------------------------------------------------------------------|
| Central Water Co.                                                                                                        | Porterville   | 170               | 42                | Automobile—Gas stations<br>Chemical/petroleum<br>processing/storage Historic gas<br>stations<br>Known Contaminant Plumes<br>Septic systems—high density<br>[>1/acre] Underground storage<br>tanks—Confirmed leaking tanks                                                          | Yes                                     |                                                                                 |
| East Wilson Road Water Company                                                                                           | Bakersfield   | 35                | 14                | Septic systems—low density<br>[<1/acre] Crops, irrigated<br>[Berries, hops, mint, orchards,<br>sod, greenhouses]<br>Fertilizer/Pesticide/<br>Herbicide Application                                                                                                                 | Yes                                     | Yes (84), \$97,000<br>Regional project to<br>consolidate with East<br>Niles CSD |
| Edmundson Acres Water System                                                                                             | Arvin         | 550               | 84                | Agricultural Drainage Septic<br>systems—low density [<1/acre]<br>Crops, irrigated [Berries, hops,<br>mint, orchards, sod,<br>greenhouses,<br>Fertilizer/Pesticide/<br>Herbicide Application<br>Housing—high density [>1<br>house/0.5 acres] Sewage<br>sludge/biosolids application | Yes                                     |                                                                                 |
| Enos Lane Public Utility District                                                                                        | Calder Corner | 250               | 0                 | Grazing [> 5 large animals or<br>equivalent per acre] Septic<br>systems—low density [<1/acre]                                                                                                                                                                                      | Yes                                     | Yes (84) \$1,500,000<br>Consolidation with<br>Vaughn Water Company              |

| <b>Small Drinking Water System Name<br/>2005–2009 Nitrate MCL Exceedance<br/>(From Balazs 2008<sup>72</sup> and DPH)</b> | <b>City</b>  | <b>Population</b> | <b>Connection</b> | <b>Type of Activity Most<br/>Vulnerable to Source (DPH)<br/>Associated with MCL<br/>exceedance</b>                                                              | <b>Agriculture<br/>PCA<sup>73</sup></b> | <b>Proposition 84 or 50<br/>Funding</b>                                                                                                                                                                                    |
|--------------------------------------------------------------------------------------------------------------------------|--------------|-------------------|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Fairview Water Company, LLC                                                                                              | Bakersfield  | 100               | 49                | Crops, irrigated [Berries, hops, mint, orchards, sod, greenhouses]<br>Fertilizer/Pesticide/<br>Herbicide Application                                            | Yes                                     |                                                                                                                                                                                                                            |
| FCSA #32/Cantua Creek                                                                                                    | Cantua Creek | 230               | 35                | Agricultural Drainage                                                                                                                                           | Yes                                     |                                                                                                                                                                                                                            |
| Fcwwd #42/Alluvial & Fancher                                                                                             | Clovis       | 257               | 103               | Septic systems—low density<br>[<1/acre]                                                                                                                         | Yes                                     |                                                                                                                                                                                                                            |
| Harvest Moon Mutual Water Co                                                                                             | Rosedale     | 180               | 44                | Septic systems—low density<br>[<1/acre] Crops, irrigated<br>[Berries, hops, mint, orchards, sod, greenhouses]<br>Fertilizer/Pesticide/<br>Herbicide Application | Yes                                     |                                                                                                                                                                                                                            |
| Josephina and Enrique Water System                                                                                       | McFarland    | 32                | 8                 | Septic systems—high density<br>[>1/acre] Lagoons/liquid wastes<br>Fertilizer/Pesticide/<br>Herbicide Application                                                | Yes                                     |                                                                                                                                                                                                                            |
| Lemon Cove Water Co                                                                                                      | Lemon Cove   | 200               | 50                | Known Contaminant Plumes                                                                                                                                        | Yes                                     | Yes (84). (2) Projects \$1,000,000 and \$250,000 Lemon Cove Safe Drinking Water Project and Feasibility Study To Find Clean Water Source for Lemon (50) \$1,000,000 and \$250,000 Safe Drinking Water Improvement Projects |

| <b>Small Drinking Water System Name<br/>2005–2009 Nitrate MCL Exceedance<br/>(From Balazs 2008<sup>72</sup> and DPH)</b> | <b>City</b> | <b>Population</b> | <b>Connection</b> | <b>Type of Activity Most<br/>Vulnerable to Source (DPH)<br/>Associated with MCL<br/>exceedance</b>                                                                                                     | <b>Agriculture<br/>PCA<sup>73</sup></b> | <b>Proposition 84 or 50<br/>Funding</b>                                                                          |
|--------------------------------------------------------------------------------------------------------------------------|-------------|-------------------|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|------------------------------------------------------------------------------------------------------------------|
| Monterey Park Tract Community Service District                                                                           | Keyes       | 186               | 50                | Animal Feeding Operations as defined in federal regulation 2 Concentrated Animal Feeding Operations [CAFOs]<br>Septic systems—high density [>1/acre] Underground storage tanks—Confirmed leaking tanks | Yes                                     | Yes (84), \$400,000 Monterey Park Tract Safe Drinking Water Project<br>(50) \$1,426,000 Well Replacement Project |
| Norseman M.H.P.                                                                                                          | Kingsburg   | 70                | 31                | Known Contaminant Plumes                                                                                                                                                                               | Yes                                     | Yes (84) \$180,000 Nitrate & radiological contamination project                                                  |
| Rainbird Valley Mutual Water Company                                                                                     | Weldon      | 188               | 83                | Grazing [> 5 large animals or equivalent per acre] Septic systems—low density [<1/acre] Fertilizer/Pesticide/Herbicide Application                                                                     | Yes                                     |                                                                                                                  |
| Rodriguez Labor Camp                                                                                                     | Delano      | 110               | 35                | Known Contaminant Plumes<br>Septic systems—high density [>1/acre]                                                                                                                                      | Yes                                     | Yes (84), \$500,00 Consolidation with Richgrove CSD<br>(50) \$532,000 Well replacement                           |
| San Joaquin Estates Mutual                                                                                               | Bakersfield | 220               | 62                | Grazing [> 5 large animals or equivalent per acre] Septic systems—low density [<1/acre]                                                                                                                | Yes                                     | Yes (84) \$150,000 Regional consolidation project with East Niles CSD                                            |
| Seventh Standard Mutual                                                                                                  | Bakersfield | 110               | 22                | Other Animal operations Sewer collection systems                                                                                                                                                       | Yes                                     | Yes (84) \$400,000 Consolidation with Oildale MWC to correct nitrate problem                                     |

| <b>Small Drinking Water System Name<br/>2005–2009 Nitrate MCL Exceedance<br/>(From Balazs 2008<sup>72</sup> and DPH)</b> | <b>City</b> | <b>Population</b> | <b>Connection</b> | <b>Type of Activity Most<br/>Vulnerable to Source (DPH)<br/>Associated with MCL<br/>exceedance</b>         | <b>Agriculture<br/>PCA<sup>73</sup></b> | <b>Proposition 84 or 50<br/>Funding</b>                                                                                    |
|--------------------------------------------------------------------------------------------------------------------------|-------------|-------------------|-------------------|------------------------------------------------------------------------------------------------------------|-----------------------------------------|----------------------------------------------------------------------------------------------------------------------------|
| Sierra Mutual Water Co                                                                                                   | North Fork  | 39                | 15                | Known Contaminant Plumes                                                                                   | Yes                                     | Yes (84) \$1,000,000<br>Sierra Breeze—<br>Consolidation                                                                    |
| Son Shine Properties                                                                                                     | Edison      | 400               | 100               | Septic systems—low density<br>[<1/acre]                                                                    | Yes                                     | Yes (84) \$1,500,000<br>Consolidation with Arvin<br>CSD                                                                    |
| Soults Mutual Water Co.                                                                                                  | Tulare      | 100               | 36                | Known Contaminant Plumes                                                                                   | Yes                                     | Yes (84), \$820,000 Safe<br>Drinking water Project                                                                         |
| Sunnyside Convalescent Hosp                                                                                              | Fresno      | 116               | 3                 | Known Contaminant Plumes                                                                                   | Yes                                     |                                                                                                                            |
| Tooleville Water Co.                                                                                                     | Exeter      | 300               | 75                | Known Contaminant Plumes                                                                                   | Yes                                     | Yes (50), \$954,000<br>Source Water<br>Consolidation<br>(50) \$2,000,000 Safe<br>Drinking water Wheeling<br>through Exeter |
| Traver Water LLC                                                                                                         | Traver      | 500               | 180               | Historic gas stations Known<br>Contaminant Plumes<br>Underground storage tanks—<br>Confirmed leaking tanks | Yes                                     |                                                                                                                            |
| Triple R Mutual Water Co.                                                                                                | Springville | 400               | 130               | Known Contaminant Plumes                                                                                   | Yes                                     |                                                                                                                            |
| Valley View Estates Mutual Water Co                                                                                      | Keene       | 81                | 39                | Septic systems—low density<br>[<1/acre] Other Animal<br>operations                                         | Yes                                     | Yes (84), \$58,000<br>System high nitrate<br>levels—need for new<br>well                                                   |
| Westlake Village M H P                                                                                                   | Visalia     | 350               | 139               | Agricultural Drainage Sewer<br>collection systems<br>Wells—Agricultural/Irrigation                         | Yes                                     |                                                                                                                            |



| <b>Small Drinking Water System Name<br/>2005–2009 Nitrate MCL Exceedance<br/>(From Balazs 2008<sup>72</sup> and DPH)</b> | <b>City</b> | <b>Population</b> | <b>Connection</b> | <b>Type of Activity Most<br/>Vulnerable to Source (DPH)<br/>Associated with MCL<br/>exceedance</b>                                                                                                                                                                                | <b>Agriculture<br/>PCA<sup>73</sup></b> | <b>Proposition 84 or 50<br/>Funding</b>                                  |
|--------------------------------------------------------------------------------------------------------------------------|-------------|-------------------|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|--------------------------------------------------------------------------|
| Wheeler Farms Headquarters                                                                                               | Saco        | 25                | 13                | Pesticide/fertilizer/petroleum storage & transfer areas Septic systems—low density [<1/acre] Crops, irrigated [Berries, hops, mint, orchards, sod, greenhouses] Fertilizer/Pesticide/ Herbicide Application Crops, nonirrigated [e.g., Christmas trees, grains, grass seeds, hay] | Yes                                     | Yes (84), \$500,000 Treatment for arsenic and nitrate                    |
| Zonneveld Dairy                                                                                                          | Laton       | 141               | 34                | Animal Feeding Operations as defined in federal regulation 2 Concentrated Animal Feeding Operations [CAFOs]                                                                                                                                                                       | Yes                                     |                                                                          |
| Charlies                                                                                                                 | Porterville | 150               | NA                | Agricultural Drainage Septic systems—low density [<1/acre]                                                                                                                                                                                                                        | Yes                                     |                                                                          |
| El monte Village M H P                                                                                                   | Dinuba      | 100               | NA                | Septic systems—high density [>1/acre]                                                                                                                                                                                                                                             | Yes                                     |                                                                          |
| Fairmont School                                                                                                          | Sanger      | 540               | NA                | Fertilizer/Pesticide/ Herbicide Application Wells— Agricultural/Irrigation                                                                                                                                                                                                        | Yes                                     | Yes (84), \$158,000 Treatment to remove nitrate                          |
| Gleanings for the Hungry                                                                                                 | Sultana     | 31                | NA                | Agricultural Drainage Fertilizer/Pesticide/ Herbicide Application                                                                                                                                                                                                                 | Yes                                     |                                                                          |
| Lake Success Mobile Lodge                                                                                                | Porterville | 20                | NA                | Known Contaminant Plumes                                                                                                                                                                                                                                                          | Yes                                     | Yes (84), \$324,000 Nitrate exceeds MCL (50), \$324,000 Well Replacement |
| Lemon Cove-Sequoia Camp                                                                                                  | Lemon Cove  | 100               | NA                | Known Contaminant Plumes                                                                                                                                                                                                                                                          | Yes                                     |                                                                          |

| <b>Small Drinking Water System Name<br/>2005–2009 Nitrate MCL Exceedance<br/>(From Balazs 2008<sup>72</sup> and DPH)</b> | <b>City</b> | <b>Population</b> | <b>Connection</b> | <b>Type of Activity Most<br/>Vulnerable to Source (DPH)<br/>Associated with MCL<br/>exceedance</b>                                                           | <b>Agriculture<br/>PCA<sup>73</sup></b> | <b>Proposition 84 or 50<br/>Funding</b>                 |
|--------------------------------------------------------------------------------------------------------------------------|-------------|-------------------|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|---------------------------------------------------------|
| Prince Mart                                                                                                              | Lemon Cove  | 25                | NA                | Known Contaminant Plumes                                                                                                                                     | Yes                                     |                                                         |
| Sequoia Union School                                                                                                     | Lemon Cove  | 400               | NA                | Known Contaminant Plumes                                                                                                                                     | Yes                                     |                                                         |
| Sierra View Jr Academy                                                                                                   | Exeter      | 160               | NA                | Fertilizer/Pesticide/<br>Herbicide Application                                                                                                               | Yes                                     |                                                         |
| Styrotek                                                                                                                 | Delano      | 36                | NA                | Known Contaminant Plumes                                                                                                                                     | Yes                                     |                                                         |
| Sunnyside Union Elementary                                                                                               | Strathmore  | 550               | NA                | Agricultural Drainage<br>Pesticide/fertilizer/petroleum<br>storage & transfer areas Septic<br>systems—low density [<1/acre]<br>Wells—Agricultural/Irrigation | Yes                                     |                                                         |
| Visalia-Fresno South Koa                                                                                                 | Goshen      | 150               | NA                | Agricultural Drainage                                                                                                                                        | Yes                                     |                                                         |
| Waukena Market                                                                                                           | Waukena     | 140               | NA                | Historic gas stations Known<br>Contaminant Plumes<br>Underground storage tanks—<br>Confirmed leaking tanks                                                   | Yes                                     |                                                         |
| Fairways Tract Mutual                                                                                                    | Porterville | 250               | 58                | Sewer collection systems                                                                                                                                     | Yes                                     |                                                         |
| Watertek—Grandview Gardens                                                                                               | Porterville | 350               | 102               | Known Contaminant Plumes                                                                                                                                     | Yes                                     | Yes (84), \$250,000<br>Nitrate contamination<br>project |
| Lake Express Market                                                                                                      | Porterville | 25                | NA                | Automobile—Gas stations<br>Chemical/petroleum<br>processing/storage                                                                                          | Yes                                     |                                                         |

## **APPENDIX D**

# **RECOMMENDED IRRIGATED LANDS REGULATORY PROGRAM SURFACE AND GROUNDWATER QUALITY MANAGEMENT PLAN REQUIREMENTS**



## **APPENDIX D**

### **Recommended Irrigated Lands Regulatory Program Surface and Groundwater Quality Management Plan Requirements**

#### **Surface Water Quality Management Plan Requirements**

The Surface Water Quality Management Plan (SQMP) prepared by third-party groups must include the following elements.

1. Identification of the watershed areas and associated parameters addressed by the management plan. For exceedances in a water body that is representative of other water bodies/watersheds, those areas represented by the water body monitored must be identified in the management plan.
2. A summary and assessment of the available water quality data for surface waters and parameters addressed by the management plan.
3. Identification of irrigated agriculture source(s)—general practice(s) or specific location(s)—that may be the cause of the water quality problem. If the potential sources are not known, a study design must be included to determine the source(s) or to eliminate agriculture as a potential source. Source identification can include more intensive sampling in the watershed or field studies to quantify the relevant waste discharge from irrigated lands. In lieu of conducting additional source analysis, the management plan can focus on ensuring that all growers are implementing practices that achieve BPTC for the parameter(s) of concern.
4. Identification of practices to address the constituents of concern. The practices that growers will implement must be identified, along with an estimate of their effectiveness or any limitations on the effectiveness of the practice. Practices identified may include those that are required by local, State, or federal law.
5. Evaluation of management practice effectiveness. The approach for determining the effectiveness of the management practices implemented must be described. Acceptable approaches include field studies of management practices at representative sites and modeling or assessment to associate the degree of management practice implementation to changes in water quality.
6. Description of outreach to growers. The strategy for informing growers of the water quality issues that need to be addressed and relevant management practices must be described. The outreach strategy must describe the methods that will be used to inform growers and how the effectiveness of the



outreach efforts will be evaluated. The third party may conduct outreach efforts or work with the assistance of the County Agricultural Commissioners, U.C. Cooperative Extension, Natural Resources Conservation Service, Resource Conservation District, or other appropriate groups or agencies.

7. Tracking of management practice implementation. The process for tracking implementation of management practices must be described. The process must include a description of how the information will be collected from growers; the type of information being collected; how the information will be verified<sup>74</sup>; and how the information will be reported.
8. Monitoring plan to track changes in water quality. A monitoring plan for the constituent(s) of concern must be prepared to determine whether the management plan is improving water quality. The monitoring plan may need to include other sites or different timing or frequency of sample collection to adequately assess the effectiveness of the management plan. The monitoring plan must include an associated Quality Assurance Project Plan, and the data must be submitted electronically in a format required by the Central Valley Water Board.
9. Schedules and milestones. Milestones and schedules must be described for the actions to be taken (e.g., outreach, management practice implementation), as well as for the anticipated improvements in water quality (e.g., milestones for reduced frequency of exceedance; anticipated date for achieving water quality objectives). The schedule for achieving compliance with water quality objectives must be consistent with any compliance dates established in the relevant water quality control plan.

If the SQMP addresses multiple exceedances of different types of wastes at multiple locations, a prioritization of the water quality problems to be addressed may be developed. The prioritization may include considerations such as extent, magnitude, and duration or be based on a design that assumes that resolution of one type of contaminant (such as sedimentation) may help resolve other types of measured exceedances (such as pesticides, toxicity, dissolved oxygen, and pH). The assumptions and prioritizations will be developed in coordination with the Central Valley Water Board and must be included as part of the management plan to be approved by the Executive Officer.

At least annually, the third party must prepare a report that summarizes the progress in implementing the management plan. At a minimum, the report must include: (1) a summary of the grower outreach conducted; (2) results from evaluation of management practice effectiveness; (3) a summary of the degree of implementation of management practices; (4) an assessment of the monitoring

---

<sup>74</sup> The intent of data verification is to provide confidence that the information being reported is accurate. This may include field visits to a subset of growers reporting their data or other methods to confirm data validity.

data collected; and (5) a summary of progress in meeting milestones and schedules and any recommendations for changes to the management plan.

The Executive Officer of the Central Valley Water Board must approve the management plan. Changes to the management plan may be implemented by the third party only after approval by the Executive Officer.

At the request of the third party or upon recommendation by the Central Valley Water Board, the Executive Officer may exempt a third party from the development of a management plan. Such an exemption may be issued only if sufficient evidence is provided indicating that the implementation of management practices by growers will not result in water quality improvements. The Executive Officer also may require the third party or its members to develop a management plan or to take additional actions if monitoring data or other information indicates that water quality may be jeopardized. The Executive Officer also may increase the monitoring requirements where monitoring results, pesticide use patterns, or other indicators suggest that the increase is warranted.

### **Groundwater Quality Management Plan Requirements**

The groundwater quality management plan prepared by third-party groups must include the following elements.

1. Identification of the groundwater quality management areas and associated constituents of concern addressed by the management plan. For exceedances in a groundwater basin or aquifer that is representative of other basins/aquifers, those areas represented by the aquifer monitored must be identified in the management plan.
2. A summary and assessment of the available water quality data for the aquifers and parameters addressed by the management plan. Available data from existing groundwater quality programs can be used, including but not limited to the State Water Board's Groundwater Ambient Monitoring and Assessment, USGS, DPH, DPR, DWR, and local groundwater management programs.
3. Identification of irrigated agriculture source(s)—general practice(s) or specific location(s)—that may be the cause of the water quality problem. If the potential sources are not known, a study design must be included to determine the source(s) or to eliminate agriculture as a potential source. Source identification can include more intensive sampling in the relevant aquifer or field studies to quantify the relevant waste discharge from irrigated lands. In lieu of conducting additional source analysis, the management plan can focus on ensuring that all growers are implementing practices that achieve BPTC for the constituent(s) of concern.
4. Identification of practices to address the constituents of concern. The practices that growers will implement must be identified, along with an

estimate of their effectiveness or any limitations on the effectiveness of the practice. Practices identified may include those that are required by local, State, or federal law. Where an identified constituent of concern is a pesticide that is subject to DPR's groundwater protection program, the GQMP may refer to DPR's regulatory program for that pesticide and any requirements associated with the use of that pesticide.

5. Evaluation of management practice effectiveness. The approach for determining the effectiveness of the management practices implemented must be described. Acceptable approaches include field studies of management practices at representative sites and modeling or assessment to associate the degree of management practice implementation to changes in water quality.
6. Description of outreach to growers. The strategy for informing growers of the water quality issues that need to be addressed and relevant management practices must be described. The outreach strategy must describe the methods that will be used to inform growers and how the effectiveness of the outreach efforts will be evaluated. The third party may conduct outreach efforts or work with the assistance of the County Agricultural Commissioners, U.C. Cooperative Extension, Natural Resources Conservation Service, Resource Conservation District, or other appropriate groups or agencies.
7. Tracking of management practice implementation. The process for tracking implementation of management practices must be described. The process must include a description of how the information will be collected from growers, the type of information being collected, how the information will be verified<sup>75</sup>, and how the information will be reported.
8. Monitoring plan to track changes in water quality. A monitoring plan for the constituent(s) of concern must be prepared to determine whether the management plan is improving water quality. The monitoring plan may need to include other sites or a different depth to groundwater (e.g., monitor first encountered groundwater versus supply wells) or frequency of sample collection to adequately assess the effectiveness of the management plan. Monitoring may include focused studies of selected agricultural management practices, constituents, or physical settings to inform refinement of GMA and constituent prioritization, or of practices that provide needed groundwater protection from degradation by constituents of concern. The monitoring plan must include an associated Quality Assurance Project Plan, and the data must be submitted electronically in a format required by the Central Valley Water Board.

---

<sup>75</sup> The intent of data verification is to provide confidence that the information being reported is accurate. This may include field visits to a subset of growers reporting their data or other methods to confirm data validity.

9. Schedules and milestones. Milestones and schedules must be described for the actions to be taken (e.g., outreach, management practice implementation), as well as for the anticipated improvements in water quality (e.g., milestones for declining trends in concentrations of constituents of concern). The schedule for achieving compliance with water quality objectives must be consistent with any compliance dates established in the relevant water quality control plan.

The GQMP would not include or address issues related to groundwater supply, including issues regarding the volume of groundwater pumped or used by growers within a GMA.

If the GQMP addresses exceedances in multiple aquifers or for multiple constituents of concern, a prioritization of the water quality problems to be addressed may be developed. The prioritization may include considerations such as the threat to drinking water supply wells, aquifer condition; risk of contamination because of soil type, known agricultural practices/crops grown, and likelihood of irrigated agricultural contribution to the water quality problem. The assumptions and prioritizations will be developed in coordination with the Central Valley Water Board and must be included as part of the management plan to be approved by the Executive Officer.

At least annually, the third party must prepare a report that summarizes the progress in implementing the management plan. At a minimum, the report must include: (1) a summary of the grower outreach conducted; (2) results from evaluation of management practice effectiveness; (3) a summary of the degree of implementation of management practices; (4) an assessment of the monitoring data collected; and (5) a summary of progress in meeting milestones and schedules and any recommendations for changes to the management plan.

The GQMP may rely wholly or in part on a local groundwater plan to the extent that plan includes the required elements described above. The Executive Officer of the Central Valley Water Board must approve the GQMP, including any elements of the plan that rely on an existing local groundwater plan. Changes to the management plan may be implemented by the third party only after approval by the Executive Officer.

At the request of the third party or upon recommendation by the Central Valley Water Board, the Executive Officer may exempt a third party from the development of a management plan. Such an exemption may be issued only if sufficient evidence is provided indicating that the implementation of management practices by growers will not result in water quality improvements. The Executive Officer also may require the third party or its members to develop a management plan or to take additional actions if monitoring data or other information indicates that water quality may be jeopardized. The Executive Officer also may increase the monitoring requirements where monitoring results, pesticide use patterns, or other indicators suggest that the increase is warranted.

## **Individual FWQMP Requirements**

At a minimum, plans would describe those practices needed or currently in use to achieve ground and surface water quality protection. Growers would be encouraged to work with technical service organizations such as resource conservation districts and the University of California Cooperative Extension in the development of FWQMPs.

FWQMP content at a minimum would include (1) name and contact information of owner/operator; (2) description of operations, including number of irrigated acres, crop types, and chemical/fertilizer application rates and practices; (3) maps showing the location of irrigated production areas, discharge points and named water bodies; (4) applicable information on water quality management practices used to achieve general ranch/farm management objectives and reduce or eliminate discharge of waste to ground and surface waters; (5) measures instituted to comply with California Code of Regulations, Title 3, Section 6609 requirements for wellhead protection (from pesticide contamination) along with methods for wellhead protection from fertilizer use; and 6) identification of any potential conduits to groundwater aquifers on the property (e.g., active, inactive, or abandoned wells; dry wells; recharge basins; ponds) and steps taken, or to be taken, to ensure all identified potential conduits do not carry contamination to groundwater.

In addition to the minimum elements described above, the Executive Officer may require ground or surface water quality monitoring to evaluate the effectiveness of the practices implemented by the grower. Any such monitoring requirements will be issued as an order under 13267 of the CWC.



**Draft**

# **Technical Memorandum**

Concerning the Economic Analysis of the  
Irrigated Lands Regulatory Program

JULY 2010



PREPARED FOR:  
Central Valley Regional Water Quality Control Board  
11020 Sun Center Drive, Suite 200  
Rancho Cordova, CA 95670  
Contact: Adam Laputz



PREPARED BY:  
ICF International  
630 K Street, Suite 400  
Sacramento, CA 95814  
Contact: Megan Smith  
916.737.3000

WITH ASSISTANCE FROM:  
Mark Roberson, Ph.D.  
Stephen Hatchett, Ph.D.  
CH2MHill  
Thomas Wegge  
TCW Economics

**DRAFT**

**TECHNICAL MEMORANDUM CONCERNING  
THE ECONOMIC ANALYSIS OF THE  
IRRIGATED LANDS REGULATORY PROGRAM**

**PREPARED FOR:**

Central Valley Regional Water Quality Control Board  
11020 Sun Center Drive, Suite 200  
Rancho Cordova, CA 95670  
Contact: Adam Laputz

**PREPARED BY:**

ICF International  
630 K Street, Suite 400  
Sacramento, CA 95814  
Contact: Megan Smith  
916.737.3000

**WITH ASSISTANCE FROM:**

Mark Roberson, Ph.D.  
Stephen Hatchett, Ph.D.  
CH2MHill  
Thomas Wegge  
TCW Economics

**July 2010**



ICF International. 2010. *Technical memorandum concerning the economic analysis of the Irrigated Lands Regulatory Program*. Draft. July. (ICF 05508.05.) Sacramento, CA. Prepared with assistance from Mark Roberson; Stephen Hatchett, CH2MHill; and Thomas Wegge, TCW Economics; Sacramento, CA. Prepared for Central Valley Regional Water Quality Control Board, Rancho Cordova, CA.

# Contents

|                                          |     |
|------------------------------------------|-----|
| List of Tables and Figures .....         | iii |
| List of Acronyms and Abbreviations ..... | vii |

|                                                                                               | Page       |
|-----------------------------------------------------------------------------------------------|------------|
| <b>Chapter 1 Analytical Objectives and Approach .....</b>                                     | <b>1-1</b> |
| 1.1 Analytical Objectives and Approach .....                                                  | 1-1        |
| 1.2 Key Study Assumptions and Limitations.....                                                | 1-2        |
| <b>Chapter 2 Compliance and Management Practice Costs .....</b>                               | <b>2-1</b> |
| 2.1 Summary.....                                                                              | 2-1        |
| 2.2 Background and Existing Conditions .....                                                  | 2-1        |
| 2.2.1 Management Practices.....                                                               | 2-2        |
| 2.3 Assumptions and Application of Water Quality Management Practices .....                   | 2-5        |
| 2.3.1 When and Where Water Quality Management Practices Are Applied.....                      | 2-6        |
| 2.3.2 Water Quality Management Practice Cost Calculations .....                               | 2-13       |
| 2.4 Cost Information.....                                                                     | 2-17       |
| 2.4.1 Scope of Cost Information.....                                                          | 2-17       |
| 2.5 Water Quality Management Practices and Other Compliance Costs, by Alternative.....        | 2-23       |
| 2.5.1 Scope of the Output .....                                                               | 2-23       |
| 2.5.2 Alternative 1 – Full Implementation of Current Program (No Project<br>Alternative)..... | 2-23       |
| 2.5.3 Alternative 2 – Third-Party Lead Entity .....                                           | 2-23       |
| 2.5.4 Alternative 3 – Individual Farm Water Quality Management Plans .....                    | 2-24       |
| 2.5.5 Alternative 4 – Direct Oversight with Regional Monitoring.....                          | 2-24       |
| 2.5.6 Alternative 5 – Direct Oversight with Farm Monitoring .....                             | 2-24       |
| <b>Chapter 3 Farm Income and Production Analysis.....</b>                                     | <b>3-1</b> |
| 3.1 Introduction .....                                                                        | 3-1        |
| 3.2 Methodology and Model Description .....                                                   | 3-1        |
| 3.2.1 Use of Program Cost Information .....                                                   | 3-1        |
| 3.2.2 Basins and Crop Categories Defined .....                                                | 3-2        |
| 3.2.3 Central Valley Production Model .....                                                   | 3-2        |
| 3.2.4 Evaluation for Lands in Upper Watersheds.....                                           | 3-5        |
| 3.3 Existing Conditions Baseline (Early 2000s) .....                                          | 3-5        |
| 3.3.1 Irrigated Acreage and Crop Mix .....                                                    | 3-5        |
| 3.3.2 Value of Production.....                                                                | 3-6        |
| 3.3.3 Other Characteristics of Agriculture.....                                               | 3-6        |
| 3.4 Impacts of the Program Alternatives on Agricultural Acreage and Income.....               | 3-7        |
| 3.4.1 Alternative 1 – Change Relative to Early 2000s Existing Condition .....                 | 3-8        |
| 3.4.2 Alternative 2 – Change Relative to Alternative 1 .....                                  | 3-10       |
| 3.4.3 Alternative 3 – Change Relative to Alternative 1 .....                                  | 3-12       |

|                   |                                                                                                    |            |
|-------------------|----------------------------------------------------------------------------------------------------|------------|
| 3.4.4             | Alternative 4 – Change Relative to Alternative 1 .....                                             | 3-14       |
| 3.4.5             | Alternative 5 – Change Relative to Alternative 1 .....                                             | 3-16       |
| 3.5               | Summary and Discussion .....                                                                       | 3-18       |
| 3.5.1             | Summary Comparison of Alternatives 2–5 to Alternative 1 .....                                      | 3-18       |
| 3.5.2             | Potential Effects on the Livestock Sector .....                                                    | 3-19       |
| 3.5.3             | Available Funding Programs .....                                                                   | 3-20       |
| <b>Chapter 4</b>  | <b>Regional Economic Impacts .....</b>                                                             | <b>4-1</b> |
| 4.1               | Introduction .....                                                                                 | 4-1        |
| 4.2               | Methodology and Model Description .....                                                            | 4-1        |
| 4.3               | Existing Regional Economic Conditions .....                                                        | 4-4        |
| 4.3.1             | Total Industry Output .....                                                                        | 4-4        |
| 4.3.2             | Personal Income .....                                                                              | 4-7        |
| 4.3.3             | Employment .....                                                                                   | 4-10       |
| 4.4               | Regional Economic Impacts of the Program Alternatives .....                                        | 4-13       |
| 4.4.1             | Alternative 1 – Change Relative to 2007 Base Period Conditions .....                               | 4-13       |
| 4.4.2             | Alternative 2 – Change Relative to Alternative 1 .....                                             | 4-18       |
| 4.4.3             | Alternative 3 – Change Relative to Alternative 1 .....                                             | 4-22       |
| 4.4.4             | Alternative 4 – Change Relative to Alternative 1 .....                                             | 4-26       |
| 4.4.5             | Alternative 5 – Change Relative to Alternative 1 .....                                             | 4-30       |
| 4.5               | Summary and Conclusions .....                                                                      | 4-34       |
| 4.5.1             | Summary Comparison of Alternatives 2–5 to Alternative 1 .....                                      | 4-35       |
| 4.5.2             | Conclusions .....                                                                                  | 4-35       |
| 4.5.3             | Potential Effects from Changes in Livestock Production .....                                       | 4-36       |
| <b>Chapter 5</b>  | <b>Fiscal Effects .....</b>                                                                        | <b>5-1</b> |
| 5.1               | Introduction .....                                                                                 | 5-1        |
| 5.2               | Existing Fiscal Conditions .....                                                                   | 5-1        |
| 5.3               | Fiscal Effects of the Program Alternatives .....                                                   | 5-1        |
| 5.3.1             | Alternative 1 – Change Relative to Existing Conditions .....                                       | 5-1        |
| 5.3.2             | Alternative 2 – Change Relative to Alternative 1 .....                                             | 5-2        |
| 5.3.3             | Alternative 3 – Change Relative to Alternative 1 .....                                             | 5-2        |
| 5.3.4             | Alternative 4 – Change Relative to Alternative 1 .....                                             | 5-3        |
| 5.3.5             | Alternative 5 – Change Relative to Alternative 1 .....                                             | 5-3        |
| 5.4               | Potential Effects of the ILRP on Nitrate-Related Water-Quality Costs of Small<br>Communities ..... | 5-3        |
| <b>Chapter 6</b>  | <b>References Cited .....</b>                                                                      | <b>6-1</b> |
| 6.1               | Personal Communications .....                                                                      | 6-3        |
| <b>Appendix A</b> | <b>Variables Affecting Cost Analysis .....</b>                                                     | <b>1</b>   |
| A.1               | Land Use Information .....                                                                         | 1          |
| A.2               | Implemented Management Practices Baseline .....                                                    | 1          |
| A.3               | Farming Units and Operations .....                                                                 | 1          |
| A.4               | Management Practice Cost Allocation and Net Benefit .....                                          | 1          |
| A.5               | Management Practice Implementation .....                                                           | 2          |



# Tables and Figures

| Table                                                                                                                                                                                           | Page |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 2-1 Summary of Water Quality Management Practices Considered for This Analysis.....                                                                                                             | 2-2  |
| 2-2 Percent of Land Use under a Given Water Quality Management Practice .....                                                                                                                   | 2-3  |
| 2-3 Enrolled and Total Irrigated Acreage in the Central Valley Watersheds.....                                                                                                                  | 2-4  |
| 2-4 Enrolled and Total Growers in the Central Valley Watersheds.....                                                                                                                            | 2-5  |
| 2-5 Behavior and Affected Flow Path for Constituents of Concern .....                                                                                                                           | 2-6  |
| 2-6 Constituent of Concern Applicability by Land Use Type .....                                                                                                                                 | 2-9  |
| 2-7 Hardware Management Practice Applicability by Constituent .....                                                                                                                             | 2-12 |
| 2-8 Sample Cost Calculation for Meeting Water Quality Impacts Resulting from<br>Pesticide, Nutrient, and Sediments Issues on Deciduous Fruits and Nuts in the Delta-<br>Carbona Watershed ..... | 2-14 |
| 2-9 Costs for Water Quality Management Practices.....                                                                                                                                           | 2-17 |
| 2-10 Surface and Groundwater Monitoring Cost Breakdown for Use in All Alternatives .....                                                                                                        | 2-19 |
| 2-11 Estimated Cost per Acre for Current Program .....                                                                                                                                          | 2-20 |
| 2-12 Central Valley Water Board Cost for Current Program.....                                                                                                                                   | 2-20 |
| 2-13 Surface Water and Groundwater Characterization Costs for Alternative 4 .....                                                                                                               | 2-21 |
| 2-14 Groundwater Quality Monitoring Plan Development Cost for Alternative 4.....                                                                                                                | 2-21 |
| 2-15 Installation Cost of Groundwater Monitoring Well under Alternative 5.....                                                                                                                  | 2-21 |
| 2-16 Total Staffing Assumptions for Each Alternative.....                                                                                                                                       | 2-22 |
| 2-17 Tier Analysis Development Cost Based on the CV SALT Model Development for<br>Alternative 4 .....                                                                                           | 2-23 |
| 2-18 Costs by Hydrologic Basin for Alternative 1 – Full Implementation of Current<br>Program (No Project Alternative).....                                                                      | 2-25 |
| 2-19 Costs by Hydrologic Basin for Alternative 2 – Third-Party Lead Entity .....                                                                                                                | 2-25 |
| 2-20 Costs by Hydrologic Basin for Alternative 3 – Individual Farm Water Quality<br>Management Plans .....                                                                                      | 2-25 |
| 2-21 Costs by Hydrologic Basin for Alternative 4 – Direct Oversight with Regional<br>Monitoring .....                                                                                           | 2-26 |
| 2-22 Costs by Hydrologic Basin for Alternative 5 – Direct Oversight with Farm Monitoring.....                                                                                                   | 2-26 |
| 3-1 Crop Category Definition .....                                                                                                                                                              | 3-2  |
| 3-2 Counties by Basin .....                                                                                                                                                                     | 3-2  |
| 3-3 Existing Condition Irrigated Acreage by Crop Category and Basin .....                                                                                                                       | 3-5  |
| 3-4 Existing Condition Value of Irrigated Crop Production (2007\$, in millions) by Crop<br>Category and Basin .....                                                                             | 3-6  |
| 3-5 Existing Condition per Acre Value of Irrigated Crop Production (2007\$, in millions)<br>by Crop Category and Basin .....                                                                    | 3-6  |
| 3-6 Gross Farm Income (2007\$, in thousands per farm) and Average Acreage by Basin.....                                                                                                         | 3-7  |

|      |                                                                                                                   |      |
|------|-------------------------------------------------------------------------------------------------------------------|------|
| 3-7  | Alternative 1: Change in Irrigated Acreage (000) by Crop Category and Basin from Existing Condition .....         | 3-8  |
| 3-8  | Alternative 1: Change in Value of Production (\$000,000) by Crop Category and Basin from Existing Condition ..... | 3-9  |
| 3-9  | Alternative 1: Change in Net Revenue (\$000,000) by Crop Category and Basin from Existing Condition .....         | 3-10 |
| 3-10 | Alternative 2: Change in Irrigated Acreage (000) by Crop Category and Basin from Alternative 1 .....              | 3-11 |
| 3-11 | Alternative 2: Change in Value of Production (\$000,000) by Crop Category and Basin from Alternative 1 .....      | 3-11 |
| 3-12 | Alternative 2: Change in Net Revenue (\$000,000) by Crop Category and Basin from Alternative 1 .....              | 3-12 |
| 3-13 | Alternative 3: Change in Irrigated Acreage (000) by Crop Category and Basin from Alternative 1 .....              | 3-13 |
| 3-14 | Alternative 3: Change in Value of Production (\$000,000) by Crop Category and Basin from Alternative 1 .....      | 3-13 |
| 3-15 | Alternative 3: Change in Net Revenue (\$000,000) by Crop Category and Basin from Alternative 1 .....              | 3-14 |
| 3-16 | Alternative 4: Change in Irrigated Acreage (000) by Crop Category and Basin from Alternative 1 .....              | 3-14 |
| 3-17 | Alternative 4: Change in Value of Production (\$000,000) by Crop Category and Basin from Alternative 1 .....      | 3-15 |
| 3-18 | Alternative 4: Change in Net Revenue (\$000,000) by Crop Category and Basin from Alternative 1 .....              | 3-16 |
| 3-19 | Alternative 5: Change in Irrigated Acreage (000) by Crop Category and Basin from Alternative 1 .....              | 3-16 |
| 3-20 | Alternative 5: Change in Value of Production (\$000,000) by Crop Category and Basin from Alternative 1 .....      | 3-17 |
| 3-21 | Alternative 5: Change in Net Revenue (\$000,000) by Crop Category and Basin from Alternative 1 .....              | 3-18 |
| 3-22 | Summary of Changes in Total Irrigated Acreage (000) by Basin from Alternative 1 .....                             | 3-18 |
| 3-23 | Summary of Changes in Total Value of Production (\$000,000) by Basin from Alternative 1 .....                     | 3-19 |
| 3-24 | Summary of Changes in Total Net Revenue (\$000,000) by Basin from Alternative 1 .....                             | 3-19 |
| 3-25 | Potential Changes in Value of Livestock Production in the Study Area Compared to Alternative 1 .....              | 3-20 |
| 4-1  | Counties in the Sacramento River, San Joaquin River, and Tulare Lake Basin Regions .....                          | 4-1  |
| 4-2  | Industrial Output by Sector in the Sacramento River Basin, 2007 .....                                             | 4-5  |
| 4-3  | Industrial Output by Sector in the San Joaquin River Basin, 2007 .....                                            | 4-6  |
| 4-4  | Industrial Output by Sector in the Tulare Lake Basin, 2007 .....                                                  | 4-7  |
| 4-5  | Personal Income by Sector in the Sacramento River Basin, 2007 .....                                               | 4-8  |
| 4-6  | Personal Income by Sector in the San Joaquin River Basin, 2007 .....                                              | 4-9  |

|      |                                                                                                                                                           |      |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 4-7  | Personal Income by Sector in the Tulare Lake Basin, 2007 .....                                                                                            | 4-10 |
| 4-8  | Jobs by Sector in the Sacramento River Basin, 2007 .....                                                                                                  | 4-11 |
| 4-9  | Jobs by Sector in the San Joaquin River Basin, 2007.....                                                                                                  | 4-12 |
| 4-10 | Jobs by Sector in the Tulare Lake Basin, 2007.....                                                                                                        | 4-13 |
| 4-11 | Alternative 1: Change in Industrial Output, Personal Income, and Employment in the<br>Sacramento River Basin Relative to Base Period (2007) Levels.....   | 4-15 |
| 4-12 | Alternative 1: Change in Industrial Output, Personal Income, and Employment in the<br>San Joaquin River Basin Relative to Base Period (2007) Levels ..... | 4-16 |
| 4-13 | Alternative 1: Change in Value of Industrial Output, Personal Income, and<br>Employment in the Tulare Lake Basin from Base Period (2007) Levels.....      | 4-17 |
| 4-14 | Alternative 2: Change in Industrial Output, Personal Income, and Employment in the<br>Sacramento River Basin Relative to Alternative 1 Levels.....        | 4-19 |
| 4-15 | Alternative 2: Change in Industrial Output, Personal Income, and Employment in the<br>San Joaquin River Basin Relative to Alternative 1 Levels .....      | 4-20 |
| 4-16 | Alternative 2: Change in Value of Industrial Output, Personal Income, and<br>Employment in the Tulare Lake Basin from Alternative 1 Levels.....           | 4-21 |
| 4-17 | Alternative 3: Change in Industrial Output, Personal Income, and Employment in the<br>Sacramento River Basin Relative to Alternative 1 Levels.....        | 4-23 |
| 4-18 | Alternative 3: Change in Industrial Output, Personal Income, and Employment in the<br>San Joaquin River Basin Relative to Alternative 1 Levels .....      | 4-24 |
| 4-19 | Alternative 3: Change in Value of Industrial Output, Personal Income, and<br>Employment in the Tulare Lake Basin from Alternative 1 Levels.....           | 4-25 |
| 4-20 | Alternative 4: Change in Industrial Output, Personal Income, and Employment in the<br>Sacramento River Basin Relative to Alternative 1 Levels.....        | 4-27 |
| 4-21 | Alternative 4: Change in Industrial Output, Personal Income, and Employment in the<br>San Joaquin River Basin Relative to Alternative 1 Levels .....      | 4-28 |
| 4-22 | Alternative 4: Change in Value of Industrial Output, Personal Income, and<br>Employment in the Tulare Lake Basin from Alternative 1 Levels.....           | 4-29 |
| 4-23 | Alternative 5: Change in Industrial Output, Personal Income, and Employment in the<br>Sacramento River Basin Relative to Alternative 1 Levels.....        | 4-31 |
| 4-24 | Alternative 5: Change in Industrial Output, Personal Income, and Employment in the<br>San Joaquin River Basin Relative to Alternative 1 Levels .....      | 4-32 |
| 4-25 | Alternative 5: Change in Value of Industrial Output, Personal Income, and<br>Employment in the Tulare Lake Basin from Alternative 1 Levels.....           | 4-33 |
| 4-26 | Summary of Net Changes in Industrial Output (\$M) by Basin from Alternative 1 .....                                                                       | 4-35 |
| 4-27 | Summary of Net Changes in Personal Income (\$M) by Basin from Alternative 1 .....                                                                         | 4-35 |
| 4-28 | Summary of Net Changes in Employment (Number of Jobs) by Basin from<br>Alternative 1 .....                                                                | 4-35 |
| 4-29 | Potential Regional Economic Effects Resulting from Changes in Value of Livestock<br>Production in the Study Area, Compared to Alternative 1 .....         | 4-37 |
| 5-1  | Estimated Costs to the Central Valley Regional Water Quality Control Board to<br>Administer the Program Alternatives .....                                | 5-2  |

|     |                                                                                                                                      |     |
|-----|--------------------------------------------------------------------------------------------------------------------------------------|-----|
| 5-2 | Small Community Systems with High Nitrate Levels with Agricultural PCA.....                                                          | 5-4 |
| 5-3 | Well Replacement Costs.....                                                                                                          | 5-4 |
| 5-4 | Operation and Maintenance Costs for Wells (Groundwater Source).....                                                                  | 5-5 |
| A-1 | Total Management Practice Costs (2007\$) for Pasture Lands with and without the<br>Implementation of Tailwater Recovery Systems..... | 2   |

| <b>Figure</b> |                                                                                                                                                                                                   | <b>Page</b> |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| 1-1           | Economic Analysis Approach to the Irrigated Lands Regulatory Program.....                                                                                                                         | 1-1         |
| 2-1           | Application of Water Quality Management Practices Based on Surface Water<br>Constituents of Concern and Land Use.....                                                                             | 2-15        |
| 2-2           | Application of Water Quality Management Practices Based on Land Uses That are<br>Classified by the California Department of Pesticide Regulation as Vulnerable to<br>Leaching to Groundwater..... | 2-16        |
| 3-1           | Agricultural Areas Modeled by Central Valley Production Model.....                                                                                                                                | 3-4         |

# Acronyms and Abbreviations

---

|                            |                                                            |
|----------------------------|------------------------------------------------------------|
| 2008 Farm Bill             | Food, Conservation, and Energy Act of 2008                 |
| CCOF                       | California Certified Organic Farmer                        |
| Central Valley Water Board | Central Valley Regional Water Quality Control Board        |
| COC                        | constituent of concern                                     |
| CVPIA                      | Central Valley Project Improvement Act                     |
| CVPM                       | Central Valley Production Model                            |
| DO                         | dissolved oxygen                                           |
| DPH                        | California Department of Public Health                     |
| DPR                        | California Department of Pesticide Regulation              |
| DWR                        | California Department of Water Resources                   |
| ECR                        | ILRP Existing Conditions Report                            |
| EHSS                       | educational, health, social services                       |
| EIR/EIS                    | Environmental Impact Report/Environmental Impact Statement |
| EIS                        | Environmental Impact Statement                             |
| EQIP                       | Environmental Quality Incentives Program                   |
| FFGO                       | Field, Forage, Grain, Other                                |
| FIRE                       | finance, insurance, and real estate                        |
| GW                         | groundwater                                                |
| I/O                        | input/output                                               |
| IDLE                       | Idle                                                       |
| IID                        | Imperial Irrigation District                               |
| ILRP                       | Irrigated Lands Regulatory Program                         |
| MCL                        | maximum contaminant level                                  |
| management practices       | water quality management practices                         |
| NRCS                       | Natural Resources Conservation Service                     |
| NRCS                       | Natural Resource Conservation Service                      |
| ORVIN                      | Orchard, Vineyard                                          |
| PCA                        | potential contaminating activity                           |
| PCBs                       | polychlorinated biphenyls                                  |
| PEIR                       | Draft Program Environmental Impact Report                  |
| S&G                        | surface water and groundwater                              |
| SEMI                       | Semi-agricultural and Incidental                           |
| State Water Board          | State Water Resources Control Board                        |
| SW                         | surface water                                              |
| SWAMP                      | Surface Water Ambient Monitoring Program                   |
| UCCE                       | University of California Cooperative Extension             |
| USGS                       | U.S. Geological Survey                                     |
| VEGT                       | Vegetable, Truck                                           |



# Chapter 1

## Analytical Objectives and Approach

### 1.1 Analytical Objectives and Approach

The analysis of economic (and fiscal) effects for the long-term Irrigated Lands Regulatory Program (ILRP) focuses on addressing the following three analytical questions.

- How much currently is being spent annually by growers, landowners, and administering entities in the Central Valley on compliance with the ILRP pollution control implementation program?
- What are the expected additional costs, both to growers and administering entities, of compliance with the long-term ILRP alternatives?
- How is imposition of these additional costs expected to affect the economic viability of farming in the Central Valley?

To address these questions, an assessment of four study components (Figure 1-1)—compliance costs, net income effects on growers and landowners, potential impacts on regional farm economies, and effects on government entities associated with administering the program—was conducted.

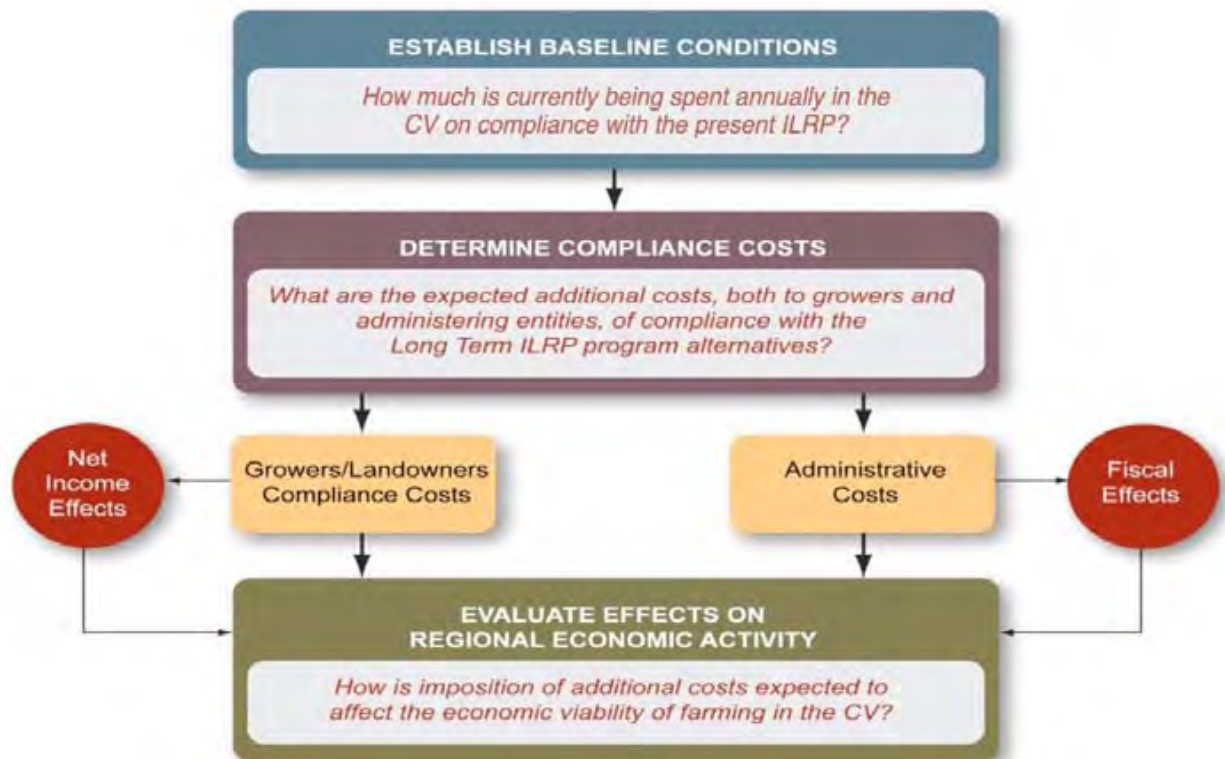


**Figure 1-1. Economic Analysis Approach to the Irrigated Lands Regulatory Program**

Baseline conditions on compliance costs (i.e., how much has been spent to date on implementing the program?) were characterized using information already collected and compiled for the ILRP

Existing Conditions Report (ECR) (ICF Jones & Stokes 2008). Evaluating program alternative effects involved assessing the incremental costs to growers and landowners of new compliance actions. For some alternatives, new compliance actions included the implementation of additional water quality management practices (management practices) to protect surface water and groundwater. The program alternatives in essence provide different ways to encourage widespread implementation of management practices and include different organizational structures to attain this. The alternatives vary with respect to lead responsibility to oversee the program (Central Valley Regional Water Quality Control Board [Central Valley Water Board] or other lead entity), and grower regulatory responsibility (e.g., preparing water quality plans, recordkeeping, changes in surface water monitoring practices, groundwater monitoring).

## 1.2 Key Study Assumptions and Limitations

The economic analysis was based on the following alternative-specific assumptions:

- Alternative 1 is the current management practices framework.
- Alternative 2 would be similar to the current framework for surface water, but would include groundwater management practices.
- Alternative 3 would lead to implementation of more widespread practices than Alternatives 1 and 2 because all growers would be required to develop a farm plan, regardless of whether water quality problems have been identified. Under Alternatives 1 and 2, management practices plans would be required where water quality concerns exist.
- Alternative 4 also would lead to more widespread practices than Alternatives 1 and 2, through the development of individual farm plans. Under this alternative, a tiered approach would be used to target known areas of concern. Alternative 4 would include nutrient management and wellhead protection. Nutrient management plans would be prepared for vulnerable areas (e.g., areas with identified nitrate problems). Alternative 4 would allow for regional monitoring.
- Alternative 5 would lead to more widespread practices than Alternatives 1 and 2 and would include nutrient management and wellhead protection for all growers. Individual surface water and groundwater monitoring would be required under this alternative.

Although Alternative 1 represents the continued implementation of current Central Valley Water Board policies, limited information was available to determine the extent of management practice implementation to date. Further, the existing conditions information used as the baseline for analysis dates from the early 2000s. As a result, changes from Alternative 1 relative to existing conditions do not capture implementation that has already occurred at the time of this report, and thus likely overstate the impacts of further implementation of Alternative 1.

Additionally, crop mix in the Central Valley also has changed over the last 6 to 8 years. In general, permanent crops such as orchards and vineyards have expanded in acreage, while certain field crops, especially cotton, have contracted in acreage. These crop mix changes are generally market-driven and, though expected to continue, could also halt or reverse. The effects of water supply shortages, whether related to drought or to regulatory constraints, were not explicitly considered in this analysis.

In addition to the alternative-specific objectives identified above, each of the components of the economic analysis (compliance and management practices costs, farm income and production, and regional economic effects) includes important analytical assumptions that define the study limitations. For the compliance and management cost analysis described in Chapter 2, costs reflect hardware and management changes for all crops based on an assessment of typical irrigation practices and chemical use. As described in Appendix A, a change in the underlying assumptions about land use, the baseline for management practices, farming units and operations, cost allocation and net benefits of management practices, and management practice implementation could substantially alter the study results.

The farm income and production analysis described in Chapter 3 also relies on assumptions concerning the implementation, monitoring, and reporting analysis in the cost analysis in Chapter 2. A regional model of Central Valley irrigated agricultural production formed the basis of the farm income and production analysis. As discussed further in Chapter 3, the model assumes that growers will react to increased costs and other compliance requirements by adjusting crop production as needed to maximize net income and stay in business. Results from the Central Valley were extrapolated to affected areas in the foothills and upper watersheds.

As indicated above, the costs of implementation, especially the cost of management practices, developed in the cost analysis reflect hardware and management changes for all crops based on an assessment of typical irrigation practices and chemical use. It is likely, however, that growers will find or develop less expensive ways to modify their production practices, and therefore direct impacts on their revenues and production would be less than those estimated in Chapter 3.

The analysis of farm income and production, as well as the assessment of regional economic effects, focuses on direct changes to irrigated agriculture. Other linked sectors such as livestock production and food processing are not comprehensively assessed. Potential effects of feed and forage production on livestock are discussed in general terms in Section 3.5.2, Potential Effects on the Livestock Sector, to illustrate the general magnitude and nature of such linked effects.

The analysis of regional economic effects using IMPLAN (Chapter 4) includes the effects of additional spending for compliance, monitoring, and reporting and the effects of losses in irrigated agricultural production and grower profitability. The effects on sectors providing inputs to irrigated crop production are captured in the regional economic impact analysis in Chapter 4. The analysis, however, does not address the potential losses to forward-linked regional economic activities, such as livestock production and food processing, that are dependent on irrigated agricultural products as inputs.

As indicated above, the IMPLAN results presented in Chapter 4 account for indirect and induced effects on suppliers and households, so-called “backward linkages,” caused by changes in agricultural production under the Program alternatives but do not account for “forward-linked” effects. A forward linkage is a connection between an industry producing a good or service that is an input to another production sector within the study area. For example, growers in the study area produce crops that are consumed as forage and feed by the livestock industry in the study area. Also, growers produce crops that are used for food processing within the study area. Losses to forward-linked economic activities would result from the direct losses in value of irrigated crop production. Because the regional economic analysis results presented in Chapter 4 do not include forward-linked effects, total regional impacts are understated.

Reductions in forage and feed crops described in Chapter 3 potentially would result in losses to regional livestock producers, and secondary impacts on other sectors of the economy, to the extent that livestock producers are dependent on regional forage and feed supplies. To address the potential magnitude of forward-linked effects of reduced livestock production, the order-of-magnitude results presented in Section 3.5.2 were carried forward into a limited analysis of regional economic impact effects, as presented in Section 4.5.3, Potential Effects from Changes in Livestock Production.

This limited analysis was intended to illustrate the additional economic effects of a key linked industry, namely the livestock production industry. It is not intended to provide a comprehensive evaluation of forward-linked effects. First, the output of the livestock production industry is further linked to sectors such as meat processing and dairy products. This additional link was not included. Second, crops besides forage and feed also are used as inputs by other sectors within the study area, such as food processing. An assessment of effects on these other forward-linked sectors was not part of this study. Results of the farm income analysis in Chapter 3 indicated that other crops would not be as affected as those linked to the livestock sector, so the forward-linked effects would also be smaller. Nevertheless, the exclusion of these additional forward-linked effects understates the total regional economic impacts of the Program alternatives.

## Chapter 2

# Compliance and Management Practice Costs

---

## 2.1 Summary

This summary covers the development and use of compliance components and associated costs to reduce water quality impacts originating from irrigated agriculture. This analysis is concerned only with impacts associated with irrigated agriculture. Costs that the grower would incur are associated with water quality management practices, farm planning, water quality monitoring, practice tracking, reporting, and education. Costs that the Central Valley Water Board or third-party entity would incur are for administration, information management, analysis and reporting, technical assistance, certification, inspection, and planning.

Costs for water quality management practices were based on land-use type, flow path of the constituent of concern (COC), and whether the constituent of concern is used on a particular land use. In addition, legacy (Group A, dichlorodiphenyltrichloroethane [DDT] etc.) and universal constituents of concern (pH, dissolved oxygen [DO], nutrients, toxicity) were assigned to appropriate land use types. Management practices were assumed to be 100 percent effective. When a practice is assigned to a particular land use, all acres in an affected area are considered. However, where there are existing practices, the areal extent of new practices is reduced appropriately. Cost information for management practices is from existing programs and standard cost guidelines prepared by various agricultural technical support agencies. Existing conditions information was taken from water quality coalition reports, and surveys and information conducted by other agricultural technical support agencies.

Costs for non-management compliance practices were developed by analyzing the service provided and areal extent that the service needed to cover. Cost component information was taken from existing programs implemented by water quality coalitions, agricultural technical support agencies, and other state regulatory agencies. There are two major cost drivers in the non-management practice cost components—additional Central Valley Water Board staff and monitoring. Additional Central Valley Water Board staff is required at various levels in the alternatives and was estimated based on similar Board programs such as the Dairy Program and Central Coast ILRP. Board staff is used to administer the program, inspect farming operations, and review and report on information submitted by growers and plan program components. Monitoring costs are for the collection, analysis, and reporting of water samples. Other compliance costs include farm planning, Board program planning, grower reporting, and data analysis.

## 2.2 Background and Existing Conditions

Information on watersheds, land uses, COCs, coalitions, and the Central Valley Water Board are contained in the ECR. This section provides background on the type of management practices selected to represent a range of activities suitable for analysis and describes existing conditions for the selected practices.



## 2.2.1 Management Practices

### 2.2.1.1 Management Practices Considered for This Analysis

The six water quality management practices listed in Table 2-1 were used in calculating the cost of water quality management practices by watershed and alternative. The method by which each of the management practices reduces impacts on water quality is discussed in the ECR. Although a wide variety of management practices could be used to reduce impacts on water quality, this suite of management practices is deemed sufficient from a programmatic point of view to encompass all flow path and management needs that must be addressed to reduce impacts on water quality. A complete discussion of the practices and their method of action is provided in Chapter 5 of the ECR. These practices also are analyzed for environmental effect in the 2010 Draft Program Environmental Impact Report (PEIR).

**Table 2-1. Summary of Water Quality Management Practices Considered for This Analysis**

| Management Practice           | Scope of Practice                                     |
|-------------------------------|-------------------------------------------------------|
| Nutrient management           | Matches crop need with fertilizer                     |
| Irrigation water management   | Reduces surface runoff and deep percolation           |
| Tailwater recovery system     | Reduces surface water discharge                       |
| Pressurized irrigation system | Reduces surface water discharge                       |
| Cover crop                    | Reduces sediment movement, improves infiltration      |
| Buffer strip-sediment trap    | Controls sediment movement                            |
| Abandoned well protection     | Prevents surface water from contaminating groundwater |

### 2.2.1.2 Existing Level of Management Practices

*Existing conditions* corresponds to the level of water quality management practices that are in the baseline. It is acknowledged that most practices are not implemented to improve water quality but rather to provide for another agronomic or economic need. For example, a surface-irrigated orchard might be converted to a pressurized system to save labor costs and to improve cultural practices. Therefore, adjustments were made to best capture costs attributable only to improvements in water quality. Conceptually, the best source of this type of information would be growers or grower coalitions. Because this information was not widely available, other sources were used to estimate the existing conditions (NRCS 2005; DWR 2001).

Existing conditions were assumed to be uniform across the Central Valley, but not between land use types. For example, all rice was assumed to have tailwater recovery capabilities because of the rice pesticide program and the method of rice water management (Central Valley Water Board 2009); alternately, vineyards are often under pressurized irrigation whereas pasture is often surface irrigated.

Table 2-2 identifies, by land use type, the existing implementation of management practices to determine compliance costs. For example, 60 percent of the citrus and subtropical acreage is assumed to currently use nutrient management. This means that new costs would not need to be considered for these acres. Sources used to estimate existing conditions include the ECR, Irrigation Methods Survey (DWR 2001), the University of California Cooperative Extension, professional

knowledge, and personal communications with agronomic professionals. For this analysis the existing level of practices was set the same for each watershed. This approach was taken because quantitative information for each watershed is not available. In addition, most of the management practices that have been implemented were not done for water quality reasons but rather for agronomic or water supply reasons. There are several exceptions to this, such as rice water recirculation programs. Another aspect of the management practices is that they are considered to be 100 percent effective. Although this may be an oversimplifying assumption, the fact that this program would prescribe significantly more practices than currently are being implemented would dramatically decrease the movement of COCs to water bodies. Also, a reviewer may be tempted to state that the initial condition leads to too many practices; however, regardless of the number of practices currently in place, there are still water quality impacts. To address these impacts, other management practices, in addition to what are in place, need to be implemented.

**Table 2-2. Percent of Land Use under a Given Water Quality Management Practice**

|                                      | Citrus and Subtropical | Deciduous Fruits and Nuts | Field Crops | Grain and Hay | Idle | Pasture | Rice | Semi Agricultural and Incidental | Truck, Nursery, and Berry Crops | Vineyards |
|--------------------------------------|------------------------|---------------------------|-------------|---------------|------|---------|------|----------------------------------|---------------------------------|-----------|
| <b>Nutrient management</b>           | 60                     | 60                        | 30          | 30            | 0    | 30      | 30   | 0                                | 60                              | 90        |
| <b>Irrigation water management</b>   | 90                     | 80                        | 70          | 30            | 0    | 30      | 100  | 0                                | 50                              | 90        |
| <b>Pressurized irrigation system</b> | 90                     | 80                        | 0           | 0             | 0    | 0       | 0    | 0                                | 50                              | 90        |
| <b>Tailwater recovery system</b>     | 0                      | 0                         | 10          | 10            | 0    | 10      | 100  | 0                                | 0                               | 90        |
| <b>Cover crop</b>                    | 25                     | 25                        | 0           | 100           | 0    | 100     | 0    | 0                                | 0                               | 25        |
| <b>Buffer hedgerow</b>               | 20                     | 20                        | 10          | 10            | 0    | 10      | 0    | 0                                | 20                              | 20        |

Present levels of abandoned well protections implemented are unknown.

Wetlands are discussed in subsequent sections in Chapter 2.

### 2.2.1.3 Acreage and Grower Data

The Central Valley Water Board provided information on the enrolled (current ILRP) and total irrigated acres per watershed (Table 2-3). This information was used to determine the fees that the State Water Resources Control Board (State Water Board) collects under Alternative 1 (enrolled acres) and the fees that would be collected under the other alternatives (irrigated acres). Leaching and runoff acres were provided by the Department of Pesticide Regulation (DPR) (Table 3-2) (DPR 2008). Leaching acres were used to determine which watersheds need groundwater management practices. Runoff acres were used to estimate acreage required for control of runoff moving to groundwater. Abandoned well counts are not readily available (Barry 2010) and an estimate of one well per 320 acres in areas considered for leaching was used for this analysis. Management plan acres represent the number of acres within a watershed that are currently under Board-required management plans (Table 2-3).

**Table 2-3. Enrolled and Total Irrigated Acreage in the Central Valley Watersheds**

| <b>Watershed</b>                | <b>Enrolled Acres</b> | <b>Irrigated Acres</b> | <b>Management Plan Acres</b> | <b>DPR Leaching</b> | <b>DPR Runoff</b> |
|---------------------------------|-----------------------|------------------------|------------------------------|---------------------|-------------------|
| Ahwahnee                        | 288                   | 914                    | 0                            | 914                 | 914               |
| American River                  | 69,428                | 173,756                | 76,962                       | 6,395               | 112,025           |
| Butte-Sutter-Yuba               | 173,438               | 607,798                | 462,322                      | 36,330              | 102,104           |
| Coast Range                     | 108                   | 8,506                  | 0                            | 0                   | 0                 |
| Colusa Basin                    | 122,254               | 605,903                | 454,435                      | 6,456               | 20,950            |
| Cosumnes River                  | 116,398               | 77,433                 | 52,146                       | 0                   | 40,896            |
| Delta-Carbona                   | 241,730               | 314,821                | 299,532                      | 45,269              | 10,853            |
| Delta-Mendota Canal             | 376,741               | 450,975                | 387,171                      | 13,646              | 2,203             |
| Grapevine                       | 3,869                 | 5,987                  | 0                            | 0                   | 0                 |
| Kaweah River                    | 6,228                 | 2,614                  | 389                          | 1,264               | 2,614             |
| Kern River                      | 2,172                 | 4,720                  | 0                            | 1,292               | 4,720             |
| Kings River                     | 10,834                | 2,695                  | 0                            | 0                   | 0                 |
| Lake-Napa                       | 36,564                | 38,617                 | 24,992                       | 0                   | 0                 |
| Mariposa                        | 11,434                | 535                    | 41                           | 0                   | 0                 |
| Merced River                    | 683                   | 2,619                  | 0                            | 0                   | 0                 |
| North Valley Floor              | 184,410               | 235,656                | 264,032                      | 22,418              | 22,770            |
| Pit River                       | 90,753                | 177,082                | 12,639                       | 0                   | 17,521            |
| San Joaquin River               | 4                     | 47                     | 0                            | 0                   | 47                |
| San Joaquin Valley Floor        | 641,645               | 1,126,599              | 951,593                      | 393,465             | 184,689           |
| Shasta-Tehama                   | 118,704               | 218,854                | 141,188                      | 24,048              | 74,782            |
| Solano-Yolo                     | 197,463               | 522,678                | 464,679                      | 13,072              | 12,935            |
| South Valley Floor              | 1,462,500             | 3,528,756              | 433,266                      | 487,467             | 482,994           |
| Southern Sierra                 | 27,263                | 1,426                  | 0                            | 626                 | 1,426             |
| Stanislaus River                | 247                   | 540.3                  | 0                            | 0                   | 0                 |
| Sunflower Valley                | 0                     | 515                    | 0                            | 0                   | 0                 |
| Temblor                         | 0                     | 5,694                  | 0                            | 0                   | 0                 |
| Tuolumne River                  | 19                    | 1,278                  | 0                            | 0                   | 0                 |
| Upper Feather Upper Yuba        | 57,788                | 68,792                 | 2,331                        | 473                 | 6,271             |
| Upper Mokelumne–Upper Calaveras | 3,945                 | 1                      | 0                            | 0                   | 0                 |
| <b>Totals</b>                   | <b>3,956,910</b>      | <b>8,185,811</b>       | <b>4,027,718</b>             | <b>1,053,135</b>    | <b>1,100,714</b>  |

DPR = California Department of Pesticide Regulation.

The Central Valley Water Board provided information on the number of enrolled growers by watershed (Table 2-4). Enrolled growers are those currently enrolled in the Board's program and are derived from the management plan acreage. Estimated growers are based on the total acreage in the ECR watersheds. Enrolled growers were used to determine fees in Alternative 1. The estimated growers were used to estimate fees for Alternatives 2–5.

**Table 2-4. Enrolled and Total Growers in the Central Valley Watersheds**

| <b>Watershed</b>                | <b>Enrolled Growers</b> | <b>Estimated Growers</b> |
|---------------------------------|-------------------------|--------------------------|
| Ahwahnee                        | 1                       | 3                        |
| American River                  | 596                     | 988                      |
| Butte-Sutter-Yuba               | 1,488                   | 3,456                    |
| Coast Range                     | 0                       | 15                       |
| Colusa Basin                    | 1,049                   | 3,446                    |
| Cosumnes River                  | 1,959                   | 864                      |
| Delta-Carbona                   | 2,186                   | 1,887                    |
| Delta-Mendota Canal             | 3,407                   | 2,703                    |
| Grapevine                       | 10                      | 10                       |
| Kaweah River                    | 38                      | 11                       |
| Kern River                      | 13                      | 19                       |
| Kings River                     | 66                      | 11                       |
| Lake-Napa                       | 314                     | 220                      |
| Mariposa                        | 74                      | 2                        |
| Merced River                    | 4                       | 11                       |
| North Valley Floor              | 1,192                   | 1,009                    |
| Pit River                       | 779                     | 1,007                    |
| San Joaquin River               | 0                       | 0                        |
| San Joaquin Valley Floor        | 4,146                   | 4,824                    |
| Shasta-Tehama                   | 1,019                   | 1,245                    |
| Solano-Yolo                     | 1,695                   | 2,988                    |
| South Valley Floor              | 4,647                   | 7,430                    |
| Southern Sierra                 | 166                     | 6                        |
| Stanislaus River                | 2                       | 2                        |
| Sunflower Valley                | 0                       | 368                      |
| Temblor                         | 0                       | 460                      |
| Tuolumne River                  | 0                       | 5                        |
| Upper Feather Upper Yuba        | 373                     | 295                      |
| Upper Mokelumne-Upper Calaveras | 1                       | 1                        |
| <b>Totals</b>                   | <b>25,227</b>           | <b>33,287</b>            |

## 2.3 Assumptions and Application of Water Quality Management Practices

This section covers assumptions regarding when and where to apply management practices. The selection of a particular management practice to apply is based on COCs, land use type, and the extent of existing practices.

### 2.3.1 When and Where Water Quality Management Practices Are Applied

The implementation of a particular management practice is a function of the land use type, the COC, and whether the constituent is registered for a particular land use (i.e., crop type). There are two categories of management practices—management practices and hardware. Management practices are based on labor to control water quality impacts, and hardware practices rely on equipment or construction to reduce impacts.

Management practices include nutrient and water management (Table 2-1). Hardware practices include cover cropping, sediment traps, tailwater recovery systems, and pressurized irrigation. Tailwater recovery and pressurized irrigation are used when high- and very high-priority COCs are present, cover cropping is used when there are soluble COCs, and sediment traps are used when sediment or sediment-attached COCs are present.

Water quality management practices are applied when there are documented COCs (Figure 2-1, Table 2-5). The practices applied for pesticides were based on the constituent's use by crop type (Footprint 2010; PAN 2010). Therefore, if a constituent is registered for a particular land use type, a management practice is applied to all acres of that land use. If the constituent is a legacy pesticide (one that is no longer used but persists in the area, such as most Group A pesticides and DDT), native (a constituent that occurs naturally in the soil, such as boron and sediment), or ubiquitous in either the soil or through the use of fertilizers (e.g., nutrients, DO, and pH), a management practice is applied to all acres in all land uses. The one land use type excepted from the application for universal constituents is idle land; nutrients, DO, and pH are not considered to originate from this land use type.

**Table 2-5. Behavior and Affected Flow Path for Constituents of Concern**

| Constituent <sup>a</sup>          | Constituent Behavior and Affected Flow Path |                     |                     |
|-----------------------------------|---------------------------------------------|---------------------|---------------------|
|                                   | Movement to Groundwater                     | Sediment Attachment | Flow Paths Affected |
| Aldrin (Group A)                  | Low                                         | High                | SW                  |
| Chlordane (Group A)               | Low                                         | High                | SW                  |
| Endosulfan (Group A)              | Low                                         | High                | SW                  |
| Endrin (Group A)                  | Low                                         | High                | SW                  |
| Heptachlor (Group A)              | Low                                         | High                | SW                  |
| Lindane (Group A)                 | Moderate                                    | Low                 | S&G                 |
| Toxaphene (Group A)               | Low                                         | High                | SW                  |
| Arsenic                           | Low                                         | High                | SW                  |
| Azinphos-methyl                   | Low                                         | High                | SW                  |
| Bacteria (fecal coliform/E. coli) | High                                        | Low                 | S&G                 |
| Bifenthrin (in sediment)          | Low                                         | High                | SW                  |
| Boron                             | Low                                         | Low                 | SW                  |
| Cadmium                           | Low                                         | High                | SW                  |
| Carbofuran                        | High                                        | Low                 | S&G                 |
| Chlorpyrifos <sup>b</sup>         | Low                                         | High                | SW                  |
| Copper                            | Low                                         | High                | SW                  |



| Constituent <sup>a</sup>                 | Constituent Behavior and Affected Flow Path |                     |                     |
|------------------------------------------|---------------------------------------------|---------------------|---------------------|
|                                          | Movement to Groundwater                     | Sediment Attachment | Flow Paths Affected |
| Cypermethrin                             | Low                                         | High                | SW                  |
| DDD                                      | Low                                         | High                | SW                  |
| DDE                                      | Low                                         | High                | SW                  |
| DDT                                      | Low                                         | High                | SW                  |
| Demeton                                  | Moderate                                    | Low                 | S&G                 |
| Diazinon <sup>b</sup>                    | High                                        | Low                 | S&G                 |
| Dieldrin                                 | Low                                         | High                | SW                  |
| Dimethoate <sup>b</sup>                  | Moderate                                    | Low                 | S&G                 |
| Disulfoton                               | Low                                         | Low                 | SW                  |
| Diuron <sup>b</sup>                      | Moderate                                    | Low                 | S&G                 |
| DO                                       | High                                        | Low                 | SW                  |
| EC                                       | High                                        | Low                 | S&G                 |
| Esfenvalerate                            | Low                                         | High                | SW                  |
| Esfenvalerate/fenvalerate, total         | Low                                         | High                | SW                  |
| Fenproprathin (in sediment)              | Low                                         | High                | SW                  |
| Group A Pesticides                       | Low                                         | High                | SW                  |
| Iron                                     | Low                                         | High                | SW                  |
| Lambda-cyhalothrin                       | Low                                         | High                | SW                  |
| Lead                                     | Low                                         | High                | SW                  |
| Linuron                                  | Moderate                                    | Low                 | S&G                 |
| Malathion <sup>b</sup>                   | Low                                         | High                | SW                  |
| Manganese                                | Low                                         | High                | SW                  |
| Methomyl                                 | High                                        | Low                 | S&G                 |
| Methyl parathion <sup>b</sup>            | Low                                         | High                | SW                  |
| Molinate/ordram                          | Moderate                                    | Low                 | S&G                 |
| Molybdenum                               | Low                                         | High                | SW                  |
| Nickel                                   | Low                                         | High                | SW                  |
| Nutrients                                | High                                        | Low                 | S&G                 |
| PCBs                                     | Low                                         | High                | SW                  |
| Permethrin                               | Low                                         | High                | SW                  |
| pH                                       | High                                        | Low                 | SW                  |
| Sediment                                 | Low                                         | High                | SW                  |
| Selenium                                 | Low                                         | High                | SW                  |
| Simazine <sup>b</sup>                    | High                                        | Low                 | S&G                 |
| Temperature                              | Low                                         | None                | SW                  |
| Thiobencarb <sup>b</sup>                 | Low                                         | High                | SW                  |
| Toxicity                                 | Low                                         | High                | SW                  |
| Toxicity (algae)                         | High                                        | High                | SW                  |
| Toxicity (minnow, flea, algae, sediment) | Low                                         | High                | SW                  |
| Zinc                                     | Low                                         | High                | SW                  |

| Constituent <sup>a</sup>                                                                                                                                                                                                                                                                                                                                                             | Constituent Behavior and Affected Flow Path |                     |                     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|---------------------|---------------------|
|                                                                                                                                                                                                                                                                                                                                                                                      | Movement to Groundwater                     | Sediment Attachment | Flow Paths Affected |
| GW = groundwater.<br>S&G = surface water and groundwater.<br>SW = surface water.<br>* Listed constituents are in the ECR as Section 303d and other listings.<br><sup>a</sup> Listed constituents are in the ECR as Section 303d and other listings.<br><sup>b</sup> Considered a high- or very high-priority constituent by the Central Valley Regional Water Quality Control Board. |                                             |                     |                     |

Table 2-6 provides an overview of the applicability of COCs by land use types. As an example, Table 2-6 shows the applicability of management practices for chlorpyrifos by land use type. Crops with a 1 are registered for use with chlorpyrifos and would require a management practice if chlorpyrifos is a COC in the watershed.

**Table 2-6. Constituent of Concern Applicability by Land Use Type**

| <b>Constituent*</b>                        | <b>All Land Use</b> | <b>Pesticide Used</b> | <b>Not Registered for Use</b> | <b>Citrus and Subtropical</b> | <b>Deciduous Fruits and Nuts</b> | <b>Field Crops</b> | <b>Grain and Hay</b> | <b>Idle</b> | <b>Pasture</b> | <b>Rice</b> | <b>Semi-agricultural and Incidental</b> | <b>Truck, Nursery, and Berry Crops</b> | <b>Vineyards</b> |
|--------------------------------------------|---------------------|-----------------------|-------------------------------|-------------------------------|----------------------------------|--------------------|----------------------|-------------|----------------|-------------|-----------------------------------------|----------------------------------------|------------------|
| Aldrin (Group A)                           | 1                   | 0                     | 1                             | 1                             | 1                                | 1                  | 1                    | 1           | 1              | 1           | 1                                       | 1                                      | 1                |
| Chlordane (Group A)                        | 1                   | 0                     | 1                             | 1                             | 1                                | 1                  | 1                    | 1           | 1              | 1           | 1                                       | 1                                      | 1                |
| Endosulfan (Group A)                       | 0                   | 1                     | 0                             | 1                             | 1                                | 1                  | 1                    | 0           | 1              | 0           | 0                                       | 1                                      | 1                |
| Endrin (Group A)                           | 1                   | 0                     | 1                             | 1                             | 1                                | 1                  | 1                    | 1           | 1              | 1           | 1                                       | 1                                      | 1                |
| Heptachlor (Group A)                       | 1                   | 0                     | 1                             | 1                             | 1                                | 1                  | 1                    | 1           | 1              | 1           | 1                                       | 1                                      | 1                |
| Lindane (Group A)                          | 1                   | 0                     | 1                             | 1                             | 1                                | 1                  | 1                    | 1           | 1              | 1           | 1                                       | 1                                      | 1                |
| Toxaphene (Group A)                        | 1                   | 0                     | 1                             | 1                             | 1                                | 1                  | 1                    | 1           | 1              | 1           | 1                                       | 1                                      | 1                |
| Arsenic                                    | 1                   | 0                     | 0                             | 1                             | 1                                | 1                  | 1                    | 1           | 1              | 1           | 1                                       | 1                                      | 1                |
| Azinphos-methyl                            | 0                   | 1                     | 0                             | 1                             | 1                                | 0                  | 0                    | 0           | 0              | 0           | 0                                       | 1                                      | 0                |
| Bacteria (fecal coliform/ <i>E. coli</i> ) | 1                   | 0                     | 0                             | 1                             | 1                                | 1                  | 1                    | 1           | 1              | 1           | 1                                       | 1                                      | 1                |
| Bifenthrin (in sediment)                   | 0                   | 1                     | 0                             | 0                             | 0                                | 1                  | 1                    | 0           | 0              | 0           | 0                                       | 1                                      | 0                |
| Boron                                      | 1                   | 0                     | 0                             | 1                             | 1                                | 1                  | 1                    | 1           | 1              | 1           | 1                                       | 1                                      | 1                |
| Cadmium                                    | 1                   | 0                     | 0                             | 1                             | 1                                | 1                  | 1                    | 1           | 1              | 1           | 1                                       | 1                                      | 1                |
| Carbofuran                                 | 0                   | 1                     | 0                             | 0                             | 0                                | 1                  | 1                    | 0           | 0              | 1           | 0                                       | 1                                      | 1                |
| Chlorpyrifos                               | 0                   | 1                     | 0                             | 1                             | 1                                | 1                  | 1                    | 0           | 0              | 0           | 0                                       | 1                                      | 1                |
| Copper                                     | 1                   | 0                     | 0                             | 1                             | 1                                | 1                  | 1                    | 1           | 1              | 1           | 1                                       | 1                                      | 1                |
| Cypermethrin                               | 0                   | 1                     | 0                             | 0                             | 0                                | 1                  | 0                    | 0           | 0              | 0           | 0                                       | 1                                      | 0                |
| DDD                                        | 1                   | 0                     | 1                             | 1                             | 1                                | 1                  | 1                    | 1           | 1              | 1           | 1                                       | 1                                      | 1                |
| DDE                                        | 1                   | 0                     | 1                             | 1                             | 1                                | 1                  | 1                    | 1           | 1              | 1           | 1                                       | 1                                      | 1                |
| DDT                                        | 1                   | 0                     | 1                             | 1                             | 1                                | 1                  | 1                    | 1           | 1              | 1           | 1                                       | 1                                      | 1                |
| Demeton                                    | 1                   | 0                     | 1                             | 1                             | 1                                | 1                  | 1                    | 1           | 1              | 1           | 1                                       | 1                                      | 1                |
| Diazinon                                   | 0                   | 1                     | 0                             | 0                             | 1                                | 1                  | 0                    | 0           | 0              | 0           | 0                                       | 1                                      | 1                |
| Dieldrin                                   | 1                   | 1                     | 1                             | 1                             | 1                                | 1                  | 1                    | 1           | 1              | 1           | 1                                       | 1                                      | 1                |
| Dimethoate                                 | 0                   | 1                     | 0                             | 1                             | 1                                | 1                  | 1                    | 0           | 0              | 0           | 0                                       | 1                                      | 1                |

| Constituent*                         | All Land Use | Pesticide Used | Not Registered for Use | Citrus and Subtropical | Deciduous Fruits and Nuts | Field Crops | Grain and Hay | Idle | Pasture | Rice | Semi-agricultural and Incidental | Truck, Nursery, and Berry Crops | Vineyards |
|--------------------------------------|--------------|----------------|------------------------|------------------------|---------------------------|-------------|---------------|------|---------|------|----------------------------------|---------------------------------|-----------|
| Disulfoton                           | 0            | 1              | 0                      | 0                      | 0                         | 1           | 1             | 0    | 0       | 0    | 0                                | 1                               | 0         |
| Diuron                               | 0            | 1              | 0                      | 1                      | 1                         | 1           | 1             | 0    | 0       | 0    | 0                                | 1                               | 1         |
| DO                                   | 1            | 0              | 0                      | 1                      | 1                         | 1           | 1             | 1    | 1       | 1    | 1                                | 1                               | 1         |
| EC                                   | 1            | 0              | 0                      | 1                      | 1                         | 1           | 1             | 1    | 1       | 1    | 1                                | 1                               | 1         |
| Esfenvalerate                        | 0            | 1              | 0                      | 0                      | 0                         | 1           | 1             | 0    | 0       | 0    | 0                                | 1                               | 0         |
| Esfenvalerate/<br>fenvalerate, total | 0            | 1              | 0                      | 0                      | 0                         | 1           | 1             | 0    | 0       | 0    | 0                                | 1                               | 0         |
| Fenproprathin<br>(in sediment)       | 0            | 1              | 0                      | 0                      | 0                         | 1           | 0             | 0    | 0       | 0    | 0                                | 1                               | 0         |
| Group A Pesticides                   | 1            | 0              | 1                      | 1                      | 1                         | 1           | 1             | 1    | 1       | 1    | 1                                | 1                               | 1         |
| Iron                                 | 1            | 0              | 0                      | 1                      | 1                         | 1           | 1             | 1    | 1       | 1    | 1                                | 1                               | 1         |
| Lambda-cyhalothrin                   | 0            | 1              | 0                      | 0                      | 0                         | 1           | 0             | 0    | 0       | 0    | 0                                | 1                               | 0         |
| Lead                                 | 1            | 0              | 0                      | 1                      | 1                         | 1           | 1             | 1    | 1       | 1    | 1                                | 1                               | 1         |
| Linuron                              | 0            | 1              | 0                      | 0                      | 0                         | 0           | 0             | 0    | 0       | 0    | 0                                | 1                               | 0         |
| Malathion                            | 0            | 1              | 0                      | 1                      | 1                         | 1           | 1             | 0    | 0       | 0    | 0                                | 1                               | 0         |
| Manganese                            | 1            | 0              | 0                      | 1                      | 1                         | 1           | 1             | 1    | 1       | 1    | 1                                | 1                               | 1         |
| Methomyl                             | 0            | 1              | 0                      | 1                      | 1                         | 1           | 1             | 0    | 0       | 0    | 0                                | 1                               | 1         |
| Methyl parathion                     | 0            | 1              | 0                      | 0                      | 1                         | 1           | 0             | 0    | 0       | 1    | 0                                | 1                               | 0         |
| Molinate/ordram                      | 0            | 1              | 0                      | 0                      | 0                         | 0           | 0             | 0    | 0       | 1    | 0                                | 0                               | 0         |
| Molybdenum                           | 1            | 0              | 0                      | 1                      | 1                         | 1           | 1             | 1    | 1       | 1    | 1                                | 1                               | 1         |
| Nickel                               | 1            | 0              | 0                      | 1                      | 1                         | 1           | 1             | 1    | 1       | 1    | 1                                | 1                               | 1         |
| Nutrients                            | 1            | 0              | 0                      | 1                      | 1                         | 1           | 1             | 1    | 1       | 1    | 1                                | 1                               | 1         |
| PCBs                                 | 1            | 0              | 1                      | 1                      | 1                         | 1           | 1             | 1    | 1       | 1    | 1                                | 1                               | 1         |
| Permethrin                           | 0            | 1              | 0                      | 0                      | 1                         | 1           | 1             | 0    | 0       | 0    | 0                                | 1                               | 0         |
| pH                                   | 1            | 0              | 0                      | 1                      | 1                         | 1           | 1             | 1    | 1       | 1    | 1                                | 1                               | 1         |
| Sediment                             | 1            | 0              | 0                      | 1                      | 1                         | 1           | 1             | 1    | 1       | 1    | 1                                | 1                               | 1         |
| Selenium                             | 1            | 0              | 0                      | 1                      | 1                         | 1           | 1             | 1    | 1       | 1    | 1                                | 1                               | 1         |
| Simazine                             | 0            | 1              | 0                      | 1                      | 1                         | 0           | 0             | 0    | 0       | 0    | 0                                | 1                               | 1         |

| <b>Constituent*</b>                         | <b>All<br/>Land<br/>Use</b> | <b>Pesticide<br/>Used</b> | <b>Not<br/>Registered<br/>for Use</b> | <b>Citrus and<br/>Subtropical</b> | <b>Deciduous<br/>Fruits and<br/>Nuts</b> | <b>Field<br/>Crops</b> | <b>Grain<br/>and Hay</b> | <b>Idle</b> | <b>Pasture</b> | <b>Rice</b> | <b>Semi-<br/>agricultural<br/>and<br/>Incidental</b> | <b>Truck,<br/>Nursery,<br/>and Berry<br/>Crops</b> | <b>Vineyards</b> |
|---------------------------------------------|-----------------------------|---------------------------|---------------------------------------|-----------------------------------|------------------------------------------|------------------------|--------------------------|-------------|----------------|-------------|------------------------------------------------------|----------------------------------------------------|------------------|
| Temperature                                 | 1                           | 0                         | 0                                     | 1                                 | 1                                        | 1                      | 1                        | 1           | 1              | 1           | 1                                                    | 1                                                  | 1                |
| Thiobencarb                                 | 0                           | 1                         | 0                                     | 0                                 | 0                                        | 0                      | 0                        | 0           | 0              | 1           | 0                                                    | 0                                                  | 0                |
| Toxicity                                    | 1                           | 0                         | 0                                     | 1                                 | 1                                        | 1                      | 1                        | 1           | 1              | 1           | 1                                                    | 1                                                  | 1                |
| Toxicity (algae)                            | 1                           | 0                         | 0                                     | 0                                 | 0                                        | 0                      | 0                        | 0           | 0              | 0           | 0                                                    | 0                                                  | 0                |
| Toxicity (minnow, flea,<br>algae, sediment) | 1                           | 0                         | 0                                     | 1                                 | 1                                        | 1                      | 1                        | 1           | 1              | 1           | 1                                                    | 1                                                  | 1                |
| Zinc                                        | 1                           | 0                         | 0                                     | 1                                 | 1                                        | 1                      | 1                        | 1           | 1              | 1           | 1                                                    | 1                                                  | 1                |

A value of 1 indicates that the constituent is used for that land use type.

\* Listed constituents are in the ECR as 303d and other listings.



Table 2-7 provides a summary of the applicability of hardware management practices by COC and land use type. A value of 1 indicates what hardware practice is used for that land use type.

Constituents of concern listed in Table 2-6 but not listed in Table 2-7 are managed through nutrient or water management practices.

**Table 2-7. Hardware Management Practice Applicability by Constituent**

| <b>Constituent*</b>                  | <b>Tailwater Recovery<br/>(Field, Pasture,<br/>Rice, Grain)</b> | <b>Pressure Irrigation<br/>(Citrus, Nuts,<br/>Truck, Vines)</b> | <b>Sediment Trap,<br/>Hedgerow, or<br/>Buffer</b> | <b>Cover Crop or<br/>Conservation<br/>Tillage</b> |
|--------------------------------------|-----------------------------------------------------------------|-----------------------------------------------------------------|---------------------------------------------------|---------------------------------------------------|
| Aldrin                               | 0                                                               | 0                                                               | 0                                                 | 1                                                 |
| Azinphos-methyl                      | 0                                                               | 0                                                               | 1                                                 | 0                                                 |
| Bifenthrin (in sediment)             | 0                                                               | 0                                                               | 1                                                 | 0                                                 |
| Carbofuran                           | 0                                                               | 0                                                               | 0                                                 | 1                                                 |
| Chlordane                            | 0                                                               | 0                                                               | 0                                                 | 1                                                 |
| Chlorpyrifos                         | 1                                                               | 1                                                               | 0                                                 | 0                                                 |
| Cypermethrin                         | 0                                                               | 0                                                               | 1                                                 | 1                                                 |
| DDD                                  | 0                                                               | 0                                                               | 1                                                 | 0                                                 |
| DDE                                  | 0                                                               | 0                                                               | 1                                                 | 0                                                 |
| DDT                                  | 0                                                               | 0                                                               | 1                                                 | 0                                                 |
| Demeton                              | 0                                                               | 0                                                               | 0                                                 | 1                                                 |
| Diazinon                             | 1                                                               | 1                                                               | 0                                                 | 0                                                 |
| Dieldrin                             | 0                                                               | 0                                                               | 1                                                 | 0                                                 |
| Dimethoate                           | 1                                                               | 1                                                               | 0                                                 | 0                                                 |
| Disulfoton                           | 0                                                               | 0                                                               | 0                                                 | 1                                                 |
| Diuron                               | 1                                                               | 1                                                               | 0                                                 | 0                                                 |
| Endosulfan                           | 0                                                               | 0                                                               | 0                                                 | 1                                                 |
| Endrin                               | 0                                                               | 0                                                               | 0                                                 | 1                                                 |
| Esfenvalerate                        | 0                                                               | 0                                                               | 1                                                 | 0                                                 |
| Esfenvalerate/<br>fenvalerate, total | 0                                                               | 0                                                               | 1                                                 | 0                                                 |
| Fenproprathin<br>(in sediment)       | 0                                                               | 0                                                               | 1                                                 | 0                                                 |
| Heptachlor                           | 0                                                               | 0                                                               | 0                                                 | 1                                                 |
| Lambda-cyhalothrin                   | 0                                                               | 0                                                               | 1                                                 | 0                                                 |
| Lindane                              | 0                                                               | 0                                                               | 0                                                 | 0                                                 |
| Linuron                              | 0                                                               | 0                                                               | 0                                                 | 1                                                 |
| Malathion                            | 1                                                               | 0                                                               | 1                                                 | 0                                                 |
| Methomyl                             | 0                                                               | 0                                                               | 0                                                 | 1                                                 |
| Methyl parathion                     | 0                                                               | 0                                                               | 0                                                 | 1                                                 |
| Molinate/ordram                      | 0                                                               | 0                                                               | 0                                                 | 0                                                 |
| Molybdenum                           | 0                                                               | 0                                                               | 0                                                 | 0                                                 |
| PCBs                                 | 0                                                               | 0                                                               | 1                                                 | 0                                                 |
| Permethrin                           | 0                                                               | 0                                                               | 1                                                 | 0                                                 |

| <b>Constituent*</b>                         | <b>Tailwater Recovery<br/>(Field, Pasture,<br/>Rice, Grain)</b> | <b>Pressure Irrigation<br/>(Citrus, Nuts,<br/>Truck, Vines)</b> | <b>Sediment Trap,<br/>Hedgerow, or<br/>Buffer</b> | <b>Cover Crop or<br/>Conservation<br/>Tillage</b> |
|---------------------------------------------|-----------------------------------------------------------------|-----------------------------------------------------------------|---------------------------------------------------|---------------------------------------------------|
| Sediment                                    | 0                                                               | 0                                                               | 1                                                 | 0                                                 |
| Simazine                                    | 1                                                               | 1                                                               | 0                                                 | 0                                                 |
| Thiobencarb                                 | 1                                                               | 1                                                               | 1                                                 | 0                                                 |
| Toxaphene                                   | 0                                                               | 0                                                               | 0                                                 | 1                                                 |
| Toxicity                                    | 1                                                               | 1                                                               | 0                                                 | 0                                                 |
| Toxicity (minnow, flea,<br>algae, sediment) | 1                                                               | 1                                                               | 0                                                 | 0                                                 |

\* Listed constituents are in the ECR as Section 303d and other listings.

Constituents classified by the Central Valley Water Board as high- or very high-priority (Table 2-7) pesticides were assigned a tailwater recovery system or pressurized irrigation. Other constituents were assumed to be covered by the two management practices (nutrients and water management) or were assigned cover cropping or sediment traps.

Irrigation impacts on groundwater quality are considered in Alternatives 2 through 5. A refined look at the threat to groundwater is required in Alternatives 4 and 5. The DPR Groundwater Protection Area (DPR 2010) results were used as the basis for assigning land to groundwater basins and the various threat tiers. Vulnerable areas for runoff and leaching represent the DPR estimate of lands that are susceptible to leachate moving to groundwater or surface runoff moving to a conduit that would convey constituents to groundwater (Troiano et al. 1999). This information was used in Alternatives 2, 3, 4, and 5 to assign management practices and monitoring to various areas of the Central Valley. The leaching flow path is addressed through the implementation of nutrient and water management practices. The runoff portion is covered through two management practices. One is to reroute runoff with buffer strips (sediment traps), and the other is to prevent surface water inflow to abandoned wells. Well protection was based on one well for every 320 acres of land in the areas that are designated as vulnerable to runoff.

Under all alternatives, water suppliers (irrigation or water districts) were assumed to be in full compliance with existing regulations. Because these entities do not apply high- or very high-priority COCs, their existing level of management practices were assumed to be sufficient to be in compliance with ILRP requirements.

Under Alternative 5 all land use types in watersheds in the study area without COCs were assigned nutrient practices. This practice is required to meet the certified farm plan requirement.

## 2.3.2 Water Quality Management Practice Cost Calculations

The costs for management practices were calculated for each watershed using the applicable management practices per acre. The existing level of practices was used to limit the number of acres to which a practice or group of practices must be applied.

The following factors can be varied to develop new costs: existing conditions, the applicability of a management practice to either a land use type or a COC, management practice cost, land use acreage, land use type, and whether groundwater is a component of the analysis. Output is compiled

and presented in both total costs and cost per acre. Sample calculations are presented below to represent how costs are determined for watersheds with and without COCs.

Sample calculations are provided in Table 2-8 for the 17,956 acres of deciduous fruits and nuts in the Delta-Carbona watershed with high-priority pesticides and sediment attached COC. In addition this watershed has vulnerable acreage, as identified by the DPR, for both leaching and runoff.

**Table 2-8. Sample Cost Calculation for Meeting Water Quality Impacts Resulting from Pesticide, Nutrient, and Sediments Issues on Deciduous Fruits and Nuts in the Delta Carbona Watershed**

| Management Practices              | Cost/Acre (\$) | Existing Condition | Applicable Acres | Total Cost (\$) |
|-----------------------------------|----------------|--------------------|------------------|-----------------|
| Nutrient Management               | 7.9            | 60%                | 7,812            | 56,740          |
| Irrigation Water Management       | 72             | 80%                | 3,591            | 258,566         |
| Pressurized Irrigation            | 160            | 80%                | 3,591            | 574,592         |
| Sediment Trap, Hedgerow or Buffer | 1              | 20%                | 14,364           | 14,364          |
| Cover Cropping                    | 48             | 25%                | 13,467           | 646,416         |
| Total                             |                |                    |                  | 1,536,315       |

In the watersheds without COCs the only practices considered are nutrient management and water management, but only if there are acres that are vulnerable to leaching. Costs for management practices are determined in the same manner as shown in Table 2-8, where costs per applicable acre are multiplied by the management practice cost.

In the DPR areas (Table 2-3) there are two additional considerations—protection of abandoned wells and the rerouting of surface runoff away from channels that have a connection to groundwater. Well protection was based on one abandoned well per 320 acres of land. In the DPR areas where there is runoff (Table 2-3), the acreage not served by a tailwater recovery system is considered applicable for the Sediment Trap/Hedgerow/Buffer Strip Management Practice. In addition to the cost of the management practice, a ratio of 1 acre of buffer strip is required for every 30 acres of irrigated lands. The land required for the Sediment Trap/Hedgerow/Buffer Strip management Practice is proportionally distributed on all irrigated lands within the watershed.

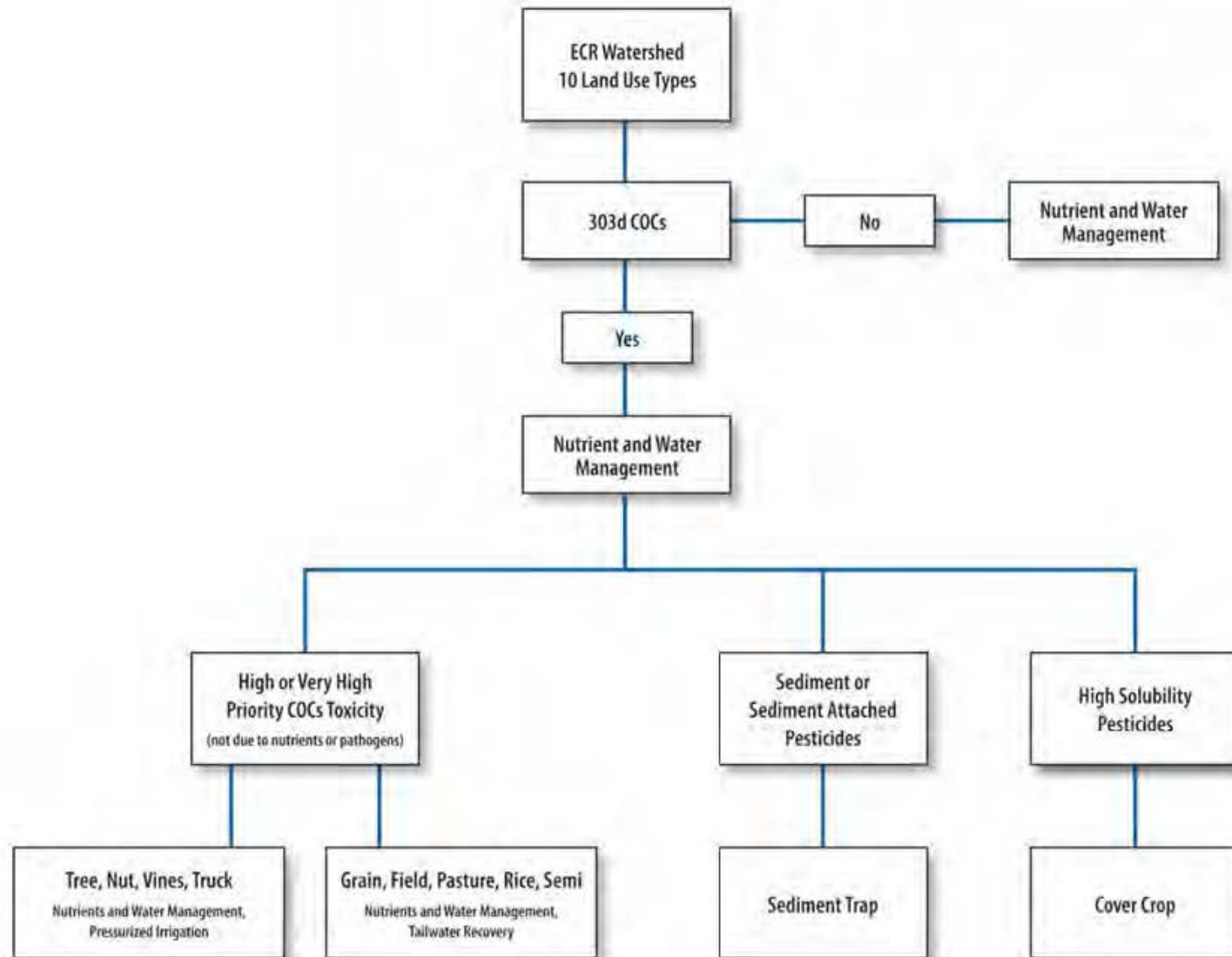


**Figure 2-1. Application of Water Quality Management Practices Based on Surface Water Constituents of Concern and Land Use**

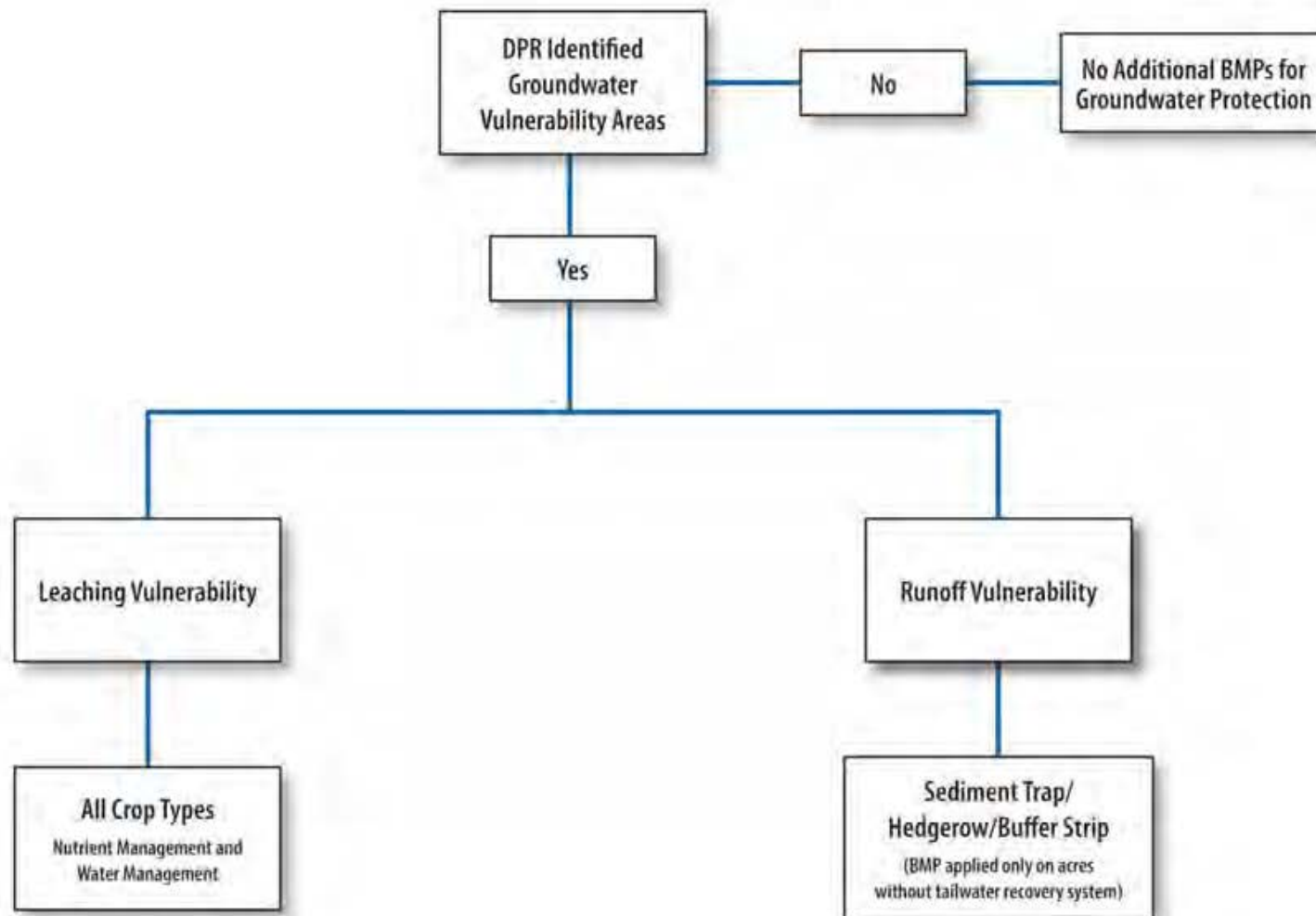


**Figure 2-2. Application of Water Quality Management Practices Based on Land Uses That Are Classified by the California Department of Pesticide Regulation as Vulnerable to Leaching to Groundwater**



## 2.4 Cost Information

This section reviews the information and assumptions used to determine costs of implementing management practices and compliance associated with each alternative. Water quality management practices include the costs of implementing a particular practice as determined in Section 2.3. Compliance costs include grower and Central Valley Water Board implementation and administration of the various alternatives. The compliance costs are for planning, administration, monitoring, and progress reports. Costs in Chapter 2 are reported in 2009 dollars.

### 2.4.1 Scope of Cost Information

Table 2-9 presents cost information for the management practices identified in Table 2-1. These costs were held constant for all operations regardless of location in the valley.

**Table 2-9. Costs for Water Quality Management Practices**

| Management Practice                                                                                                                       | Cost Range                                | Source of Information                                        |
|-------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|--------------------------------------------------------------|
| Nutrient management                                                                                                                       | \$5–\$9/acre-year<br>excludes idle land   | Blackman 2010; Fry 2010; Kasapligil 2010; and Rathburn 2010. |
| Irrigation water management                                                                                                               | \$50–\$88/acre-year<br>excludes idle land | Fry 2010; IID 2007.                                          |
| Tailwater recovery system                                                                                                                 | \$89/acre-year                            | NRCS 2010; IID 2007.                                         |
| Pressurized irrigation system                                                                                                             | \$160/acre-year                           | NRCS 2010; IID 2007.                                         |
| Cover crop                                                                                                                                | \$48/acre-year                            | Tourte and Buchanan 2003a, b, c.                             |
| Buffer strip-sediment trap                                                                                                                | \$1/acre-year                             | Tourte and Buchanan 2003a, b, c.                             |
| Abandoned well protection                                                                                                                 | \$250/well/year                           | Lewis 2010.                                                  |
| IID = Imperial Irrigation District, NRCS = Natural Resources Conservation Service, UCCE = University of California Cooperative Extension. |                                           |                                                              |

#### 2.4.1.1 Monitoring Costs

Monitoring costs include sample collection, analysis, reporting (costs to the landowner or coalition), administration, and Surface Water Ambient Monitoring Program (SWAMP) compatibility (Cone 2010; Chilcotte 2010). Monitoring is broken down by costs of sampling surface water, groundwater, and basic parameters and detailed chemistry, such as pesticides. Table 2-10 presents the monitoring cost for basic constituents and for pesticides. This information was derived from the Kings River Coalition (Cone 2010) and compared with cost information available from private laboratories. These costs were used when an individual grower conducts monitoring. If a coalition conducts monitoring, the costs were based on what the coalitions currently spend on monitoring (Table 2-11).

Sampling covers travel time to collect a sample and deliver it to the laboratory, laboratory analysis and reporting costs, and grower or coalition administration and SWAMP compliance costs. The alternatives have two types of sampling: basic, which covers nitrate and electrical conductivity, and comprehensive, which covers other constituents such as organic compounds and native elements

such as boron or selenium. Sampling location and frequency depend on the alternative. Information sources used for costing included Moss Landing SWAMP, Dellavalle Laboratories, coalition-supplied information, the Central Valley Water Board, DPR, and the U.S. Geological Survey (USGS) (Philips 2010).

**Table 2-10. Surface and Groundwater Monitoring Cost Breakdown for Use in All Alternatives**

| Water Quality Sampling Component                                   | Frequency of Sampling<br>(1x/y = 1 sample per year) |       |       |       | Surface Water<br>Characterization | Groundwater<br>Characterization |
|--------------------------------------------------------------------|-----------------------------------------------------|-------|-------|-------|-----------------------------------|---------------------------------|
|                                                                    | 1X/5yr                                              | 1X/yr | 2X/yr | 5X/yr |                                   |                                 |
| Equipment                                                          | 35                                                  | 35    | 35    | 35    | 35                                | 35                              |
| Water quality sample collection (1x/year, labor and vehicle costs) | 30                                                  | 150   | 300   | 750   | 75                                | 75                              |
| <b>Water Quality Sampling:</b>                                     |                                                     |       |       |       |                                   |                                 |
| Water quality lab testing (1x/year, laboratory costs)              |                                                     |       |       |       |                                   |                                 |
| Basic parameters (pH, EC, nitrates, and <i>E. coli</i> )           | 15                                                  | 75    | 150   | 375   | 75                                | 75                              |
| Information management                                             | 26                                                  | 130   | 260   | 650   | 65                                | 65                              |
| Total for Basic Sample (discharge or GW)                           | 106                                                 | 390   | 745   | 1,810 | 250                               | 250                             |
| Detailed chemistry (20 COC samples)                                | 300                                                 | 1,500 | 3,000 | 7,500 |                                   |                                 |
| Total for basic and with detailed chemistry                        | 406                                                 | 1,890 | 3,745 | 9,310 |                                   |                                 |
| <b>Detailed chemistry only (COCs)</b>                              |                                                     |       |       |       |                                   |                                 |
| Equipment                                                          | 35                                                  | 35    | 35    | 35    |                                   |                                 |
| Water quality sample collection (1x/year, labor and vehicle costs) | 30                                                  | 150   | 300   | 750   |                                   |                                 |
| Information management                                             | 26                                                  | 130   | 260   | 650   |                                   |                                 |
| Detailed chemistry (20 COC samples)                                | 300                                                 | 1,500 | 3,000 | 7,500 |                                   |                                 |
| Total for detailed chemistry                                       | 391                                                 | 1,815 | 3,595 | 8,935 |                                   |                                 |

Note: Costs include costs to address SWAMP quality assurance/quality control

COC = constituents of concern.

EC = electrical conductivity to measure salinity

GW = groundwater.

X/yr = times per year.

**Table 2-11. Estimated Cost per Acre for Current Program**

| <b>DRAFT Estimated Current Annual Cost for Compliance Actions</b> | <b>Average \$/acre</b> |
|-------------------------------------------------------------------|------------------------|
| Administration                                                    | \$0.41                 |
| Monitoring                                                        | \$0.79                 |
| State Board Ag Waiver Fees                                        | \$0.15                 |
| <b>Total</b>                                                      | <b>\$1.36</b>          |

**Table 2-12. Central Valley Water Board Cost for Current Program**

| <b>Classification</b>                       | <b>Cost/position</b> | <b>Positions</b> | <b>Total Cost</b>  |
|---------------------------------------------|----------------------|------------------|--------------------|
| Environmental Scientist                     | \$129,597            | 10.7             | \$1,386,688        |
| Senior Environmental Scientist              | \$168,441            | 2                | \$336,881          |
| Engineering Geologist                       | \$192,154            | 1.65             | \$317,054          |
| Senior Engineering Geologist                | \$248,399            | 0.2              | \$49,680           |
| Supervisory Engineering Geologist           | \$248,399            | 0.2              | \$49,680           |
| Water Resource Control Engineer             | \$191,520            | 1                | \$191,520          |
| Senior Water Resources Control Engineer     | \$247,131            | 1                | \$247,131          |
| Supervisory Water Resource Control Engineer | \$247,131            | 1                | \$247,131          |
| <b>Total</b>                                |                      | <b>17.75</b>     | <b>\$2,825,764</b> |

For a groundwater basin with existing domestic wells, sampling costs for groundwater were estimated at \$1.26/acre. This estimate was based on information supplied by the Kings River coalition (Cone 2009). The USGS and DPR estimate that areas vulnerable to leaching could be monitored for \$875,000 (Quagliaroli 2010) to \$1,500,000 annually (Philips 2010). The range is based on the type of constituents monitored.

Tracking and reporting are carried out by growers or by the coalitions to ensure that the required management practices are in place and functioning, and that this information is relayed to either the coalition or the Central Valley Water Board. It was assumed that a grower would need to spend \$100 (professional judgment) for tracking or reporting information per surface water and groundwater component.

Surface water or groundwater characterization is necessary to meet the Tier 1 requirements under Alternative 4. Using the Natural Resource Conservation Service (NRCS) time estimates (NRCS 2010), it was assumed that each review would result in a one-time cost of \$2,500 (Table 2-13) for evaluation plus testing for water quality. These costs are applied on a per-grower basis. Therefore, a grower who needed to conduct a site-specific evaluation of both surface water and groundwater would be required to spend \$5,000 in addition to costs for water quality testing.

**Table 2-13. Surface Water and Groundwater Characterization Costs for Alternative 4**

| <b>Surface Water and Groundwater Characterization Component</b>              | <b>Cost of Surface Water Characterization</b> | <b>Cost of Groundwater Characterization</b> |
|------------------------------------------------------------------------------|-----------------------------------------------|---------------------------------------------|
| Total chemical characterization costs (from Table 2-10)                      | \$250                                         | \$250                                       |
| Annualized chemical characterization cost (20 years)                         | \$16                                          | \$16                                        |
| Total physical characterization planning (well information, drainage review) | \$2,500                                       | \$2,500                                     |
| Annualized physical characterization                                         | \$162                                         | \$162                                       |
| Total annual characterization cost                                           | \$178                                         | \$178                                       |

Under Alternative 4, regional groundwater monitoring networks need to be designed. Note that this cost does not include the cost to sample the groundwater. Based on information from the Kings River Coalition (Cone 2009), it was assumed that the annualized cost of this network with a 20-year life would be \$2,027 for a 30,000-acre basin (Table 2-14). This amount was applied to the number of leaching acres identified in the DPR Groundwater Protection Areas.

**Table 2-14. Groundwater Quality Monitoring Plan Development Cost for Alternative 4**

| <b>Groundwater Planning Component</b>            | <b>Cost</b> |
|--------------------------------------------------|-------------|
| Capital for planning/30,000 acres                | \$40,000    |
| Annualized cost/30,000 acres                     | \$2,027     |
| Source: Cone 2010.                               |             |
| Note: Based on information from the Kings River. |             |

Alternative 5 potentially requires installation of groundwater wells. Table 2-15 shows the cost estimate for installing a single-screen monitoring well with a 20-year life (Swartz 2010).

**Table 2-15. Installation Cost of Groundwater Monitoring Well under Alternative 5**

| <b>Groundwater Planning Component</b>                                                         | <b>Cost</b> |
|-----------------------------------------------------------------------------------------------|-------------|
| Capital to install monitor well<br>(70-foot depth at \$70 per foot; single screen)            | \$5,000     |
| Annual cost of monitoring well<br>(used if required by groundwater maximum contaminant level) | \$253       |

Inspection costs include Central Valley Water Board staff or contracted personnel traveling to a grower's operation in order to verify adherence to the grower's farm plan. Inspection would include an office visit, record review, and inspection of the grower's operation. Under Alternatives 3, 4, and 5, 5 percent of all growers would be inspected annually.

Certification costs represent Central Valley Water Board staff or contracted personnel reviewing and approving farm plans. This review includes an office exercise and a field visit. This cost estimate was based on what the California Certified Organic Farmer (CCOF) charges growers for their certification service. This information is based on personal communication with Reid (2010).



Managed wetlands are land uses that are designated for habitat. The U.S. Army Corps of Engineers (USACE) Hamilton army airfield wetland restoration feasibility study found that the operation and maintenance costs for a wetland are approximately \$200 per acre per year (USACE 2006). This value was assumed to be the cost for wetlands to meet their requirements for management practices.

Administration costs cover any Central Valley Water Board costs required to address regulatory responsibilities. This cost includes enrollment, fee collection, certification, inspection, technical assistance, technical studies, data management, and reporting. An average staff cost of \$160,000 per year was used to cost out total staffing costs. This cost includes benefits and overhead. Under Alternative 1, there would be no additional costs above what the Central Valley Water Board is currently spending as described in Table 2-12; all other alternatives have additional Board administration costs. The primary driver of increased costs is for Board staff. Under Alternative 2, these costs would go up to address the consideration of groundwater. Under Alternatives 3 through 5, Board costs would increase considerably because the Board would have a significant role in program implementation. The following staffing assumptions were made for each alternative.

**Table 2-16. Total Staffing Assumptions for Each Alternative**

| Alternative | Staff Number | Staffing Assumption                                                                                      |
|-------------|--------------|----------------------------------------------------------------------------------------------------------|
| 1           | 17.25        | Existing staff level (Table 2-12)                                                                        |
| 2           | 19.75        | Staff for groundwater administration                                                                     |
| 3           | 400          | Central Valley Water Board, Dairy Program staffing plus additional for certification of individual plans |
| 4           | 56           | Central Coast Water Board staff:grower ratio                                                             |
| 5           | 356          | Central Valley Water Board, Dairy Program staffing                                                       |

Farm planning costs address the preparation of a farm plan. The cost was estimated at \$2,500 per grower (NRCS 2010) and was assumed to be valid for 20 years. When applicable, annual maintenance would be achieved through nutrient management planning, tracking, and reporting. These costs are covered elsewhere. A farm plan outline is attached at the end of this document.

Education cost covers growers' time and expenses to attend 15 hours of education. Courses would be conducted by professionals at \$120/hour, and it was assumed that 10 people would enroll in each class. Attendees were assumed to travel to three 5-hour classes at a distance of 25 miles at \$0.50/mile. Growers' time also was assumed to be \$120/hour. This estimate was based on personal communication with A. Schroeter (2010) of the Central Coast Regional Board.

Alternative 4 has a requirement that lands be regulated under their potential threat to surface or groundwater. Lands would be classified under three tiers levels for both surface and groundwater. It was assumed that a model would be needed to determine tiers. Costs for the tier analysis were based on the cost to develop the Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) model (Table 2-17). This model accounts for nitrate and salt loading by land use type within a defined basin. The model output assesses the potential for a land use type to affect groundwater for both salt and nitrate. This program currently is managed by the Central Valley Water Board, and the model development is being carried out by a consultant. The cost estimate was provided as a personal communication with Dickey (2010).

**Table 2-17. Tier Analysis Development Cost Based on the CV SALT Model Development for Alternative 4**

| <b>Model Development Component</b>                                             | <b>Cost</b> |
|--------------------------------------------------------------------------------|-------------|
| Total costs for data collection and model calibration (~16% of irrigated area) | \$600,000   |
| Cost to complete all areas (assumes initial development covered 16% of area)   | \$3,150,000 |
| Annualized cost to complete remaining area + annual maintenance of \$50,000    | \$253,977   |

Costs for wellhead protection on unprotected wells is based on creating a berm to prevent surface water from flowing to the well head. It is assumed that the grower would do this annually at a cost of \$250/well (DNRE 2010).

## 2.5 Water Quality Management Practices and Other Compliance Costs, by Alternative

### 2.5.1 Scope of the Output

This section describes the cost output for each alternative. The costs of management practices and other compliance components are based on the information developed in the previous sections. Output is by watershed and cost component. Water quality management practices for Alternative 1 cover surface water only, and Alternatives 2 through 5 cover surface and groundwater. The management practices costs for Alternatives 2 through 4 are identical. Because of the requirement for certified farm plans in Alternative 5, the costs for Alternative 5 include a nutrient management component for all acres regardless of COC or groundwater threat.

### 2.5.2 Alternative 1 – Full Implementation of Current Program (No Project Alternative)

Cost components in this alternative include Central Valley Water Board and third-party administration, and monitoring. Central Valley Water Board costs include administration and the management (collection from third parties, analysis, and reporting) of water quality information. Third-party administration includes working with growers to track practices, administration of water quality monitoring, and reporting of information to the Board. These costs are shown in Table 2-18.

### 2.5.3 Alternative 2 – Third-Party Lead Entity

This Alternative is essentially Alternative 1 plus additional costs for groundwater monitoring and for growers to report on the implementation of management measures to protect groundwater. An additional 2.5 Central Valley Water Board staff are required to administer the groundwater portion of this alternative. These costs are shown in Table 2-19.

### **2.5.4      Alternative 3 – Individual Farm Water Quality Management Plans**

This alternative is based on the Central Valley Water Board interacting directly with growers. Total Board staffing required to implement the program is 400. Duties covered by Board staff include administration, inspections, certifications, monitoring, and technical assistance. Additional direct grower costs in this alternative include preparation of farm planning, tracking, and reporting. These costs are shown in Table 2-20.

### **2.5.5      Alternative 4 – Direct Oversight with Regional Monitoring**

As with Alternative 3, this alternative is based on the Central Valley Water Board directly interacting with growers. Total Board staffing required to implement this alternative is 56. Additional staff are required for administering groundwater tier analysis, providing technical assistance to growers, inspections, and managing additional monitoring data. These costs are shown in Table 2-21.

### **2.5.6      Alternative 5 – Direct Oversight with Farm Monitoring**

As with Alternatives 3 and 4, this alternative is based on the Central Valley Water Board directly interacting with growers. Total Board staffing required to implement this alternative is 356. Board staff will be required to interact directly with growers and provide technical assistance when requested. Because each operator is responsible for submitting water quality information, there will be a considerable level of monitoring of information on practices and water quality analysis. These costs are shown in Table 2-22.

Table 2-18. Costs by Hydrologic Basin for Alternative 1 – Full Implementation of Current Program (No Project Alternative)

| Hydrologic Region | Grower Fees | Local Administration | Planning           | Surface Water Monitoring | Tracking           | Reporting          | Total Compliance Costs | Wetland MPs  | Management Practices |
|-------------------|-------------|----------------------|--------------------|--------------------------|--------------------|--------------------|------------------------|--------------|----------------------|
| Sacramento River  | \$243,726   | \$776,665            | Local <sup>1</sup> | \$1,529,794              | Local <sup>1</sup> | Local <sup>1</sup> | \$2,550,186            | \$15,734,182 | \$156,726,115        |
| San Joaquin River | \$437,130   | \$710,846            | Local <sup>1</sup> | \$2,498,733              | Local <sup>1</sup> | Local <sup>1</sup> | \$3,646,710            | \$0          | \$239,182,098        |
| Tulare Lake       | \$273,110   | \$1,204,829          | Local <sup>1</sup> | \$2,738,248              | Local <sup>1</sup> | Local <sup>1</sup> | \$4,216,187            | \$0          | \$54,673,020         |
| Totals            | \$953,966   | \$2,692,341          |                    | \$6,766,776              |                    |                    | \$10,413,083           | \$15,734,182 | \$450,581,233        |

Table 2-19. Costs by Hydrologic Basin for Alternative 2 – Third-Party Lead Entity

| Hydrologic Region | Grower Fees | Local Administration | Planning           | Inspection         | Surface Water Monitoring | Tracking           | Reporting          | Groundwater Reporting to Third Party | Groundwater Quality Sampling | Total Compliance Costs | Wetland MPs  | Management Practices |
|-------------------|-------------|----------------------|--------------------|--------------------|--------------------------|--------------------|--------------------|--------------------------------------|------------------------------|------------------------|--------------|----------------------|
| Sacramento River  | \$548,227   | \$776,665            | Local <sup>1</sup> | Local <sup>1</sup> | \$1,529,794              | Local <sup>1</sup> | Local <sup>1</sup> | \$1,080,996                          | \$136,596                    | \$4,072,279            | \$15,734,182 | \$156,726,115        |
| San Joaquin River | \$478,875   | \$710,846            | Local <sup>1</sup> | Local <sup>1</sup> | \$2,498,733              | Local <sup>1</sup> | Local <sup>1</sup> | \$1,100,830                          | \$584,298                    | \$5,373,583            | \$0          | \$240,970,414        |
| Tulare Lake       | \$600,406   | \$1,204,829          | Local <sup>1</sup> | Local <sup>1</sup> | \$2,738,248              | Local <sup>1</sup> | Local <sup>1</sup> | \$3,896                              | \$913,904                    | \$5,461,283            | \$0          | \$54,753,440         |
| Totals            | \$1,627,508 | \$2,692,341          |                    |                    | \$6,766,776              |                    |                    | \$2,185,722                          | \$1,634,798                  | \$14,907,145           | \$15,734,182 | \$452,449,969        |

Central Valley Water Board Annual Costs: \$1,798,531  
Additional Staff for GW mgt and Program Analysis/Reporting: \$372,438. These additional staff costs would be passed on to growers through increased program fees, and have been factored into the economic analysis that follows in Chapters 3 through 5.

MPs = management practices.

<sup>1</sup> Costs for these compliance components are included with local administration.

Table 2-20. Costs by Hydrologic Basin for Alternative 3 – Individual Farm Water Quality Management Plans

| Hydrologic Region | Grower Fees | Local Administration | Planning    | Inspection | Board Certification of Practices | Monitoring <sup>2</sup> | Tracking    | Reporting   | Total Compliance Costs | Wetland MPs  | Management Practices |
|-------------------|-------------|----------------------|-------------|------------|----------------------------------|-------------------------|-------------|-------------|------------------------|--------------|----------------------|
| Sacramento River  | \$548,227   | \$776,665            | \$1,656,936 | \$166,127  | \$134,723                        | \$11,874,774            | \$1,329,018 | \$1,329,018 | \$17,815,488           | \$15,734,182 | \$156,726,115        |
| San Joaquin River | \$478,875   | \$1,270,907          | \$1,393,538 | \$137,741  | \$111,703                        | \$9,845,732             | \$1,101,929 | \$1,101,929 | \$15,442,355           | \$0          | \$240,970,414        |
| Tulare Lake       | \$600,406   | \$1,350,869          | \$921,496   | \$101,429  | \$82,255                         | \$7,250,125             | \$811,430   | \$811,430   | \$11,929,439           | \$0          | \$54,753,440         |
| Totals            | \$1,627,508 | \$3,398,441          | \$3,971,970 | \$405,297  | \$328,682                        | \$28,970,631            | \$3,242,376 | \$3,242,376 | \$45,187,282           | \$15,734,182 | \$452,449,969        |

Central Valley Water Board Annual Costs: \$1,798,531  
Other Board Admin Staff: \$58,536,858. These additional staff costs would be passed on to growers through increased program fees, and have been factored into the economic analysis that follows in Chapters 3 through 5.

MPs = management practices.

<sup>1</sup> Costs for these compliance components are included with local administration.

<sup>2</sup> This cost is based on professional judgment and assumed to be 10% of Alternative 5 costs.

Table 2-21. Costs by Hydrologic Basin for Alternative 4 – Direct Oversight with Regional Monitoring

| Hydrologic Region | Grower Fees | Local Administration | Tier Analysis and Admin | Farm Planning | Inspection | Education   | Regional Surface Water Monitoring | Groundwater Monitor Tier 3 | Regional Groundwater Network Plan | Regional Groundwater Monitoring | Tracking    | Reporting   | Total Compliance Costs | Wetland MPs  | Management Practices |
|-------------------|-------------|----------------------|-------------------------|---------------|------------|-------------|-----------------------------------|----------------------------|-----------------------------------|---------------------------------|-------------|-------------|------------------------|--------------|----------------------|
| Sacramento River  | \$548,227   | \$776,665            | \$71,372                | \$1,684,042   | \$166,127  | \$1,741,013 | \$1,529,794                       | \$1,781,566                | \$57,361                          | \$733,702                       | \$1,329,018 | \$1,329,018 | \$11,747,922           | \$15,734,182 | \$156,726,115        |
| San Joaquin River | \$478,875   | \$1,270,907          | \$65,324                | \$1,393,538   | \$137,741  | \$1,443,527 | \$2,498,733                       | \$2,600,073                | \$121,396                         | \$1,624,789                     | \$1,101,929 | \$1,101,929 | \$13,838,785           | \$0          | \$240,970,414        |
| Tulare Lake       | \$600,406   | \$1,350,869          | \$110,718               | \$923,307     | \$101,429  | \$1,062,973 | \$2,738,248                       | \$1,498,287                | \$236,365                         | \$1,194,343                     | \$811,430   | \$811,430   | \$11,439,823           | \$0          | \$54,753,440         |
| Totals            | \$1,627,508 | \$3,398,441          | \$247,414               | \$4,000,887   | \$405,297  | \$4,247,513 | \$6,766,776                       | \$5,879,926                | \$415,122                         | \$3,552,835                     | \$3,242,376 | \$3,242,376 | \$37,026,529           | \$15,734,182 | \$452,449,969        |

Central Valley Water Board Annual Costs: \$1,798,531

Other Board Admin Staff: \$4,676,531. These additional staff costs would be passed on to growers through increased program fees, and have been factored into the economic analysis that follows in Chapters 3 through 5.

MPs = management practices.

Table 2-22. Costs by Hydrologic Basin for Alternative 5 – Direct Oversight with Farm Monitoring

| Hydrologic Region | Grower Fees | Local Administration | Tier Analysis and Administration | Farm Planning | Inspection | Surface Water Monitor | Groundwater Monitor 1 | Groundwater Monitor 2 (well) | Tracking    | Reporting   | Total Compliance Costs | Wetland MPs  | Management Practices |
|-------------------|-------------|----------------------|----------------------------------|---------------|------------|-----------------------|-----------------------|------------------------------|-------------|-------------|------------------------|--------------|----------------------|
| Sacramento River  | \$548,227   | \$776,665            | \$71,372                         | \$1,684,042   | \$166,127  | \$118,747,742         | \$465,993             | \$221,737                    | \$1,329,018 | \$1,329,018 | \$125,339,941          | \$15,734,182 | \$222,377,083        |
| San Joaquin River | \$478,875   | \$1,270,907          | \$65,324                         | \$1,396,290   | \$137,741  | \$98,457,323          | \$456                 | \$1,339,122                  | \$1,101,929 | \$1,101,929 | \$105,349,896          | \$0          | \$268,120,244        |
| Tulare Lake       | \$600,406   | \$1,350,869          | \$110,718                        | \$1,028,189   | \$101,429  | \$72,501,249          | \$3,164,576           | \$494,990                    | \$811,430   | \$811,430   | \$80,975,286           | \$0          | \$446,118,332        |
| Totals            | \$1,627,508 | \$3,398,441          | \$247,414                        | \$4,108,521   | \$405,297  | \$289,706,314         | \$3,631,026           | \$2,055,849                  | \$3,242,376 | \$3,242,376 | \$311,665,122          | \$15,734,182 | \$936,615,659        |

Central Valley Water Board Annual Costs: \$1,798,531

Other Board Admin Staff: \$55,482,437. These additional staff costs would be passed on to growers through increased program fees, and have been factored into the economic analysis that follows in Chapters 3 through 5.

<sup>1</sup> Costs for these compliance components are included with local administration.



## Chapter 3

# Farm Income and Production Analysis

---

### 3.1 Introduction

This section evaluates the effect of ILRP Alternatives on irrigated crop production and income for growers on potentially affected lands. The analysis considered the impact of additional operating costs and lands removed from production. The Central Valley Production Model (CVPM) (described below), was used to evaluate the regional changes in irrigated acres and value of crop production that could result from the alternatives. The additional operating costs were described in the previous section, Compliance and Management Practice Costs, and consisted of a combination of irrigation system and management changes, other physical water quality control actions, and monitoring and reporting costs. Only costs that would fall directly on growers, either as required direct expenditures or as fees, were used to assess impacts on farm income and production.

Potential cost savings or other benefits from the irrigation system changes also were considered. These included estimates of savings in a grower's costs for water, fertilizer, and labor and revenue increases resulting from improved crop yield and quality. These benefits were subtracted from the implementation cost of the irrigation system or management changes, so the analysis considered only the net cost to growers of implementing a change.

Alternative 1 represents a continuation of the current program (i.e., Alternative 1 would continue in absence of the long-term ILRP). The analysis compared Alternative 1 to an existing condition of irrigated crop production and income, and the other Alternatives were compared to Alternative 1. Changes in value of irrigated crop production also were used as part of the analysis in the next section, Regional Economic Impacts.

### 3.2 Methodology and Model Description

Impacts on farm income and production were analyzed by applying the assumed cost and land use changes by Alternative to a model of agricultural production, CVPM, which covers the Central Valley floor. The portions of the study region that fall outside the Central Valley floor were designated here as the upper watersheds and were analyzed by relating them to the nearest, most appropriate CVPM region. This approach provided a reasonable and consistent way to assess impacts on all affected lands even though the upper watershed lands were not modeled in detail by CVPM.

#### 3.2.1 Use of Program Cost Information

Program costs varied by alternative and fell into several general categories, including management practice implementation, nutrient management, groundwater monitoring, administration, and report preparation. For purposes of the farm income and production analysis, costs were estimated by region and crop category, and all were converted to an annualized cost per acre. Depending on the cost category, the annualized cost included amortized capital and construction, operation, maintenance, administration, and fees.

Costs applied either to all irrigated acres within a region, or to only some acres. For example, costs applied to only some lands more narrowly defined based on groundwater quality or specific water quality constituent. These conditions were described in the section above, Compliance and Management Practice Costs.

An alternative's costs were net costs, over and above costs incurred without the alternative being implemented. Costs in Chapter 3 are reported in 2007 dollars.

### 3.2.2 Basins and Crop Categories Defined

The ECR identified seven irrigated crop categories. For purposes of regional economic impact analysis, these seven categories were aggregated into three. The correspondence of the crop categories is shown in Table 3-1.

**Table 3-1. Crop Category Definition**

| <b>Abbreviated Crop Category</b> | <b>Aggregated Crop Category</b> | <b>Existing Conditions Crop Category*</b>           |
|----------------------------------|---------------------------------|-----------------------------------------------------|
| FFGO                             | Field, Forage, Grain, Other     | Field Crops, Grain and Hay, Irrigated Pasture, Rice |
| ORVIN                            | Orchard, Vineyard               | Citrus and Subtropical, Deciduous Orchard, Vineyard |
| VEGT                             | Vegetable, Truck                | Vegetable and Truck <sup>1</sup>                    |

\*Idle (IDLE) and Semi-agricultural and Incidental (SEMI) were not included in the aggregated crop categories.

<sup>1</sup>The vegetable and truck category includes nursery.

The ECR also defined three hydrologic basins and 30 watersheds falling within those three basins. The three basins are the Sacramento River Basin, the San Joaquin River Basin, and the Tulare Lake Basin. Eight of the watersheds are on the Central Valley floor. The regional economic impact analysis used aggregations of counties for its analysis, and the counties represented in each of the three basins are shown in Table 3-2.

**Table 3-2. Counties by Basin**

| <b>Basin</b>      | <b>Counties</b>                                                                                                                                              |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sacramento River  | Butte, Colusa, El Dorado, Glenn, Lake, Lassen, Modoc, Napa, Nevada, Placer, Plumas, Sacramento, Shasta, Sierra, Siskiyou, Solano, Sutter, Tehama, Yolo, Yuba |
| San Joaquin River | Amador, Calaveras, Contra Costa, Madera, Mariposa, Merced, San Joaquin, Stanislaus, Tuolumne                                                                 |
| Tulare Lake       | Fresno, Kern, Kings, Tulare                                                                                                                                  |

### 3.2.3 Central Valley Production Model

The CVPM is a regional model of irrigated agricultural production and economics that simulates the decisions of agricultural producers (farmers) in the Central Valley of California. The model assumes that farmers maximize profit subject to resource, technical, and market constraints. CVPM has been used to assess the impacts on irrigated agriculture of implementing a number of water-related policy changes. Studies or projects that have used CVPM include: Central Valley Project

Improvement Act (CVPIA) Programmatic Environmental Impact Statement (EIS) (Reclamation 1999); CALFED Bay-Delta Program Programmatic Environmental Impact Report/Environmental Impact Statement (EIR/EIS) (CALFED 2000); Upper San Joaquin River Basin Storage Investigation (Reclamation 2008); and preliminary assessments of CALFED surface storage projects (CALFED Bay-Delta Program unpublished). The model can be linked to hydrologic impact analysis in order to show how water supply changes affect agricultural production. It also can be used to assess how crop production, irrigated acreage, and revenue are affected by changes in production costs. A more complete description of the model's original development, calibration, and testing is provided as a technical appendix to Reclamation's Programmatic EIS for the CVPIA (Reclamation 1999).

The model covers 21 crop production regions in the Central Valley and 20 categories of crops. Wetlands are not considered irrigated cropland and therefore not included in the 20 crop categories. Figure 3-1 illustrates the model coverage.

The model's regions already correspond well with the ILRP watersheds in the Central Valley floor. The crop categories in CVPM can be aggregated directly into the smaller number of ILRP categories or into the three categories used for results display and for regional economic impact analysis.

CVPM uses data on land use, crop mix, and crop water use developed by the California Department of Water Resources (DWR) to support its analysis in the California Water Plan Update (DWR 2005). DWR developed water use based on three representative water years: 1998, 2000, and 2001. The data rely primarily on the same periodic land use surveys that form the basis of the ECR land use data, although DWR interpolated its surveys to create a comprehensive land use dataset for each of the three representative years.

County Agricultural Commissioners' Crop Reports provided estimates of prices and yields (California County Agricultural Commissioners, various counties 2000–2004). Crop production costs were drawn from crop production budgets prepared by the University of California (UC) Cooperative Extension Service (UC various years). DWR staff compiled appropriate budgets to create a budget of production costs for a representative crop in each category and region.

The data described above produced a baseline condition for CVPM, referred to in this report as the early 2000s baseline. CVPM was first calibrated to the early 2000s baseline data, and then the compliance and management practice costs, by region, crop, and alternative, were used to increase the annual cost of production within CVPM. As costs of production increased, the less productive and profitable lands were dropped from production, based on the profit-maximizing assumptions of the model. The resulting crop acreage, production, and value provided the basis for comparisons described below.

In addition to any cost-induced change in acreage, acreage lost to specific water quality protection actions like buffer strips was removed. The total of the two effects was the acreage change, by crop and region. The change in value of production also was calculated as a result of these two acreage changes. Note that CVPM estimated a price response as a result of the production change. That is, as aggregate production of a crop declined, its price rose in the model as a result of demand elasticity. This price effect is incorporated into the net revenue results shown below. However, value of production changes was used as input for the regional impact analysis, and was calculated and displayed using fixed prices, consistent with the assumptions needed for that analysis.

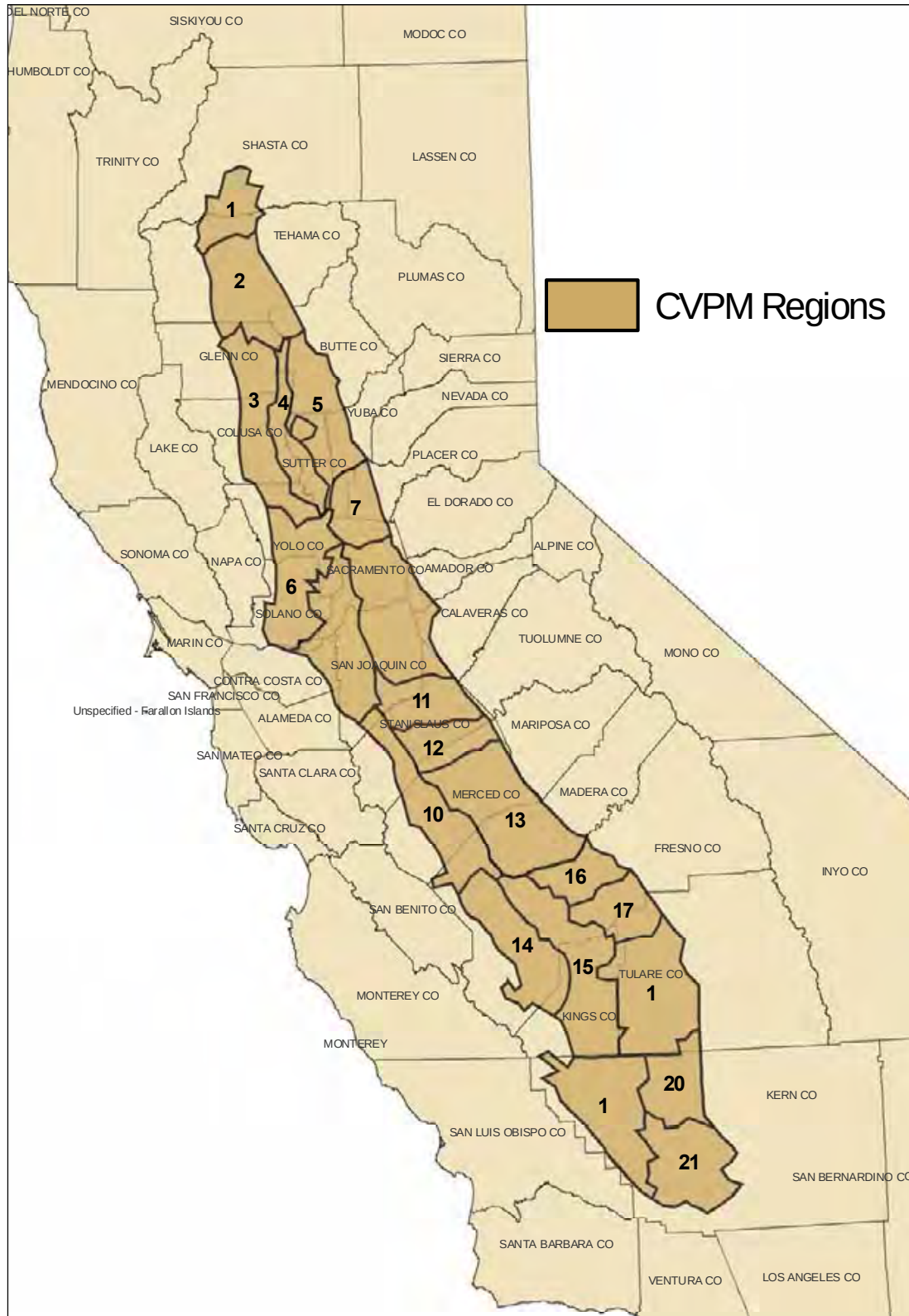


**Figure 3-1. Agricultural Areas Modeled by Central Valley Production Model**

### 3.2.4 Evaluation for Lands in Upper Watersheds

CVPM covers about 95 percent of the irrigated acreage in the study area. The remainder lies in the upper watersheds. The upper watersheds with the most irrigated acreage are Pit River, Upper Feather-Upper Yuba, Lake-Napa, and Cosumnes River. The majority of irrigated land in the upper watersheds grows irrigated pasture, grain and hay, and grapes. In order to assess the impact of alternatives on these lands, each upper watershed was paired with its nearest Central Valley region in CVPM. For each crop in the upper watershed, the percentage change in crop acreage of the corresponding CVPM region was calculated. Then this percentage change was further adjusted by the ratio of increased cost per acre in the upper watershed to the increased cost per acre in the CVPM region. The resulting factor was multiplied by the baseline upper watershed acreage to get the change resulting from the alternative's management practice and compliance cost. Finally, any additional acreage removed for water quality buffers was subtracted to get the total change.

## 3.3 Existing Conditions Baseline (Early 2000s)

Irrigated acreage reported in the ECR was drawn from crop surveys performed periodically by DWR for counties in the study area. The study area counties were surveyed during 1994 through 2006. These data are summarized by aggregated crop category for the three basins in Table 3-3.

Irrigated acreage from the ECR was used to represent the baseline condition prior to implementation of the Irrigated Lands Conditional Waiver Program (although some of the surveys were completed after the Waiver Program began). Note that subsequent analysis of Alternatives described below estimated changes in acreage using CVPM. Although CVPM uses baseline data from the years 1998, 2000, and 2001, the underlying data also are drawn from the DWR crop surveys and thus are largely consistent with the ECR acreage data.

### 3.3.1 Irrigated Acreage and Crop Mix

Irrigated acreage was used as a key measure of economic impact on growers. Table 3-3 summarizes the total baseline acreage by basin and the distribution of acreage by crop category within each basin.

**Table 3-3. Existing Condition Irrigated Acreage by Crop Category and Basin**

| Basin             | VEGT    | ORVIN     | FFGO      | Total     |
|-------------------|---------|-----------|-----------|-----------|
| Sacramento River  | 178,383 | 447,489   | 1,660,523 | 2,286,395 |
| San Joaquin River | 209,039 | 742,901   | 1,174,088 | 2,126,028 |
| Tulare Lake       | 286,991 | 1,202,700 | 1,960,888 | 3,450,579 |

The crop category FFGO (field, forage, grain, and other) has the largest acreage in each basin. In the FFGO category, rice and irrigated pasture constitute the largest crops in the Sacramento River Basin; cotton and irrigated pasture are the largest crops in both the San Joaquin River and Tulare Lake Basins. Deciduous fruit and nut trees are the largest crops in the ORVIN (orchards and vineyards) category in all three basins.



Irrigated lands in the upper watersheds have a large proportion of lands growing feed and forage crops such as hay, grain, and pasture. Many of these lands are part of integrated livestock operations or provide feed and forage to other producers in their local community. Several of the upper watersheds are important producers of wine grapes, including areas of Lake and Napa Counties and Sierra foothill areas of the Sacramento River and San Joaquin River Basins.

### 3.3.2 Value of Production

Value of production represents the revenue that growers of irrigated crops receive for selling the crops. The value is measured at the farm gate, not after processing or marketing. Table 3-4 summarizes the value of irrigated crop production in the three basins. For the Central Valley floor the value of irrigated crop production was estimated based on the CVPM data. For the irrigated lands in the upper watershed, per-acre values from CVPM were used with the acreage reported in the ECR to estimate the value of irrigated crop production.

**Table 3-4. Existing Condition Value of Irrigated Crop Production (2007\$, in millions) by Crop Category and Basin**

| Basin             | VEGT  | ORVIN   | FFGO    | Total   |
|-------------------|-------|---------|---------|---------|
| Sacramento River  | 516.5 | 1,808.9 | 1,138.3 | 3,462.7 |
| San Joaquin River | 647.6 | 2,046.0 | 809.2   | 3,502.8 |
| Tulare Lake       | 957.6 | 3,620.7 | 1,785.7 | 6,364.0 |

Table 3-5 displays the weighted average crop production value per acre by crop category and region. The values indicate that, on average, crops in the FFGO category provide a much smaller value of production per acre than crops in the VEGT (vegetable, truck) and ORVIN category. However, FFGO crops can range in value from less than \$200 per acre per year for irrigated pasture to more than \$1,000 per acre for rice or cotton. Other forages, grains, and oilseeds fall within this range.

**Table 3-5. Existing Condition per-Acre Value of Irrigated Crop Production (2007\$) by Crop Category and Basin**

| Basin             | VEGT  | ORVIN | FFGO | Total |
|-------------------|-------|-------|------|-------|
| Sacramento River  | 2,895 | 4,042 | 686  | 1,514 |
| San Joaquin River | 3,098 | 2,754 | 689  | 1,648 |
| Tulare Lake       | 3,337 | 3,010 | 911  | 1,844 |

The predominance of feed and forage crops in some parts of the study area, particularly the upper watersheds, results in a relatively low value of crop produced per acre. As noted above, these lands are important for dairy, beef cattle, and other livestock production.

### 3.3.3 Other Characteristics of Agriculture

Table 3-6 summarizes the average size and revenue of farms in the three basins. Farms in the Tulare Lake Basin are larger on average than those in the northern two basins. This is attributable to a

combination of crop mix, economies of scale, and patterns of original land development. Within each basin, farm size varies greatly.

**Table 3-6. Gross Farm Income (2007\$, in thousands per farm) and Average Acreage by Basin**

| Basin             | Farm Characteristics |
|-------------------|----------------------|
| Sacramento River  |                      |
| Gross Farm Income | 253.9                |
| Average Farm Size | 177.1                |
| San Joaquin River |                      |
| Gross Farm Income | 309.6                |
| Average Farm Size | 195.5                |
| Tulare Lake       |                      |
| Gross Farm Income | 764.0                |
| Average Farm Size | 450.0                |

Source: CVPM database for gross farm income; acreage and farm numbers data collected for the Existing Conditions Report.

Livestock production is an important part of the agricultural sector. Although the ILRP regulates only irrigated lands *per se*, many of these lands provide forage and feed to the livestock industry. Beef cattle, dairy cattle, and horses are especially dependent on forage and feed production. According to Agricultural Commissioners' annual reports for the counties falling substantially in the study area, more than \$1.8 billion in beef and dairy cattle were produced annually for the period 2005–2007 (escalated to 2007 dollars). An additional \$350 million per year was categorized in the reports as miscellaneous or unspecified livestock production, but likely included significant cattle production.

Aggregate net income by basin was not estimated as part of this analysis. Net income has a number of definitions that are used for different purposes. The definitions vary by, among other things, how they treat taxes and tax credits, whether they count family labor as a cost, and whether and how they estimate depreciation and imputed rents. Rather than estimate the total net income, this analysis estimated only changes in net income that may result from alternatives. The changes resulted from increased costs to growers, reduced revenue to growers (from land that is not kept in production) and costs that would have been spent to produce that revenue, and crop price changes induced by aggregate changes in production.

### 3.4 Impacts of the Program Alternatives on Agricultural Acreage and Income

In the results presented below, Alternative 1 was compared to the early 2000s existing conditions acreage and revenue. All other Alternatives were compared to Alternative 1.

In the period between the early 2000s and the time of this report, some and perhaps many of the management practices, or their functional equivalents, have been implemented on at least some lands. This analysis took into account the implementation to the extent possible, but extensive data were not available. Costs that could be identified as already incurred since the early 2000s were

subtracted from the costs of implementing practices, but it is likely that additional implementation has occurred beyond what could be identified. As a result, the estimates shown below probably overstate impacts of Alternative 1 implementation, or at least should be viewed as an upper range of potential impacts. This caution does not apply to the later comparisons between Alternatives 2–5 and Alternative 1.

### 3.4.1 Alternative 1 – Change Relative to Early 2000s Existing Condition

Alternative 1 represents a continuation of the current program. The following results compare Alternative 1 to an existing condition of irrigated crop production and income based on ECR CVPM data representing the early 2000s, prior to significant implementation of the current program.

#### 3.4.1.1 Acreage by Basin and Crop

The change in acreage by crop category between Alternative 1 and the existing condition is reported in Table 3-7. Changes were greatest in the FFGO crop category, with a total reduction of approximately 384 thousand acres across basins, or 97 percent of the total change. The change in acreage in VEGT and ORVIN was considerably smaller, approximately 6 and 4 thousand acres, respectively. Tulare Lake lost relatively little acreage. The Sacramento River and San Joaquin Valley River Basins showed similar levels of change, together approximately 92 percent of total. This was primarily a result of the distribution of lands subject to additional requirements; in Tulare Lake Basin relatively few lands are near designated impaired water bodies. In total, there was a reduction of approximately 395 thousand acres compared to the existing condition.

**Table 3-7. Alternative 1: Change in Irrigated Acreage (000) by Crop Category and Basin from Existing Condition**

| Basin             | VEGT  | ORVIN | FFGO   | Total  |
|-------------------|-------|-------|--------|--------|
| Sacramento River  | -3.4  | -1.6  | -192.5 | -197.5 |
| Percent Change    | -1.9% | -0.4% | -11.6% | -8.6%  |
| San Joaquin River | -2.6  | -1.9  | -162.3 | -166.8 |
| Percent Change    | -1.2% | -0.3% | -13.8% | -7.8%  |
| Tulare Lake       | -0.4  | -0.4  | -29.4  | -30.2  |
| Percent Change    | -0.1% | -0.0% | -1.5%  | -0.9%  |
| Total             | -6.4  | -3.9  | -384.2 | -394.5 |
| Percent Change    | -0.9% | -0.2% | -8.0%  | -5.0%  |

Totals may not sum as a result of rounding.

Some key analytical assumptions and data limitations contributed to the relatively large estimated change in acreage (and the associated change in value and income described below). The limited information on costs incurred between the early 2000s and today is discussed in Section 3.4 above.

More importantly, management practices assumed to be implemented for the analysis are relatively expensive, especially for lower-revenue crops in the FFGO category. As a result, crops such as irrigated pasture, hay, and some small grains would have difficulty supporting such costs. The analysis indicated large reductions in their acreages in the regions where those costs were incurred.

Irrigated pasture, hay, and other field crops (excluding rice and cotton) accounted for more than 95 percent of the acreage reduction shown in Table 3-7. To the extent growers of these crops could identify less-expensive ways to comply, such as avoiding the use of certain pesticides, the acreage and revenue impacts would be substantially reduced. For example, Appendix A describes how a lower-cost management practice on irrigated pasture would affect direct costs. Further, sensitivity analysis using CVPM indicated that if grower costs per acre for FFGO crops were reduced by 50 percent, the total acreage impact in Alternative 1 would be reduced by 75 percent.

### 3.4.1.2 Value of Production by Basin and Crop

The change in annual value of production by crop category between Alternative 1 and the existing condition is reported in Table 3-8. Changes were greatest in the FFGO crop category, with a total reduction of approximately \$304 million per year across basins, or 90 percent of the total change. The change in value of production in VEGT and ORVIN was considerably less, approximately \$19 and \$13 million, respectively. Tulare Lake Basin lands changed the least, consistent with the acreage results described above. The Sacramento River and San Joaquin Valley River Basins lost similar amounts of production value, together approximately 90 percent of the total. In all, value of production declined by approximately \$336 million per year compared to the existing condition.

**Table 3-8. Alternative 1: Change in Value of Production (\$000,000) by Crop Category and Basin from Existing Condition**

| Basin             | VEGT  | ORVIN | FFGO   | Total  |
|-------------------|-------|-------|--------|--------|
| Sacramento River  | -9.5  | -5.5  | -142.9 | -157.9 |
| Percent Change    | -1.8% | -0.3% | -12.6% | -4.6%  |
| San Joaquin River | -8.6  | -5.9  | -131.6 | -146.2 |
| Percent Change    | -1.3% | -0.3% | -16.3% | -4.2%  |
| Tulare Lake       | -1.3  | -1.2  | -29.9  | -32.4  |
| Percent Change    | -0.1% | -0.0% | -1.7%  | -0.5%  |
| Total             | -19.3 | -12.7 | -304.5 | -336.5 |
| Percent Change    | -0.9% | -0.2% | -8.2%  | -2.5%  |

Totals may not sum as a result of rounding.

### 3.4.1.3 Net Revenue by Basin and Crop

The change in annual net revenue by crop category between Alternative 1 and the existing condition is reported in Table 3-9. Changes were greatest in the FFGO crop category, with a total reduction of approximately \$250 million per year across basins, or 70 percent of the total change. The reduction in net revenue for VEGT and ORVIN was considerably less, approximately \$47 and \$63 million, respectively. Of the three basins, Tulare Lake Basin lands lost the smallest amount, while the Sacramento River and San Joaquin River Basins combined for approximately 90 percent of total. In total, net revenue declined approximately \$360 million per year compared to the existing condition.

**Table 3-9. Alternative 1: Change in Net Revenue (\$000,000) by Crop Category and Basin from Existing Condition**

| Basin             | VEGT   | ORVIN | FFGO   | Total  |
|-------------------|--------|-------|--------|--------|
| Sacramento River  | -21.5  | -25.3 | -88.1  | -134.9 |
| Percent Change    | -14.2% | -2.4% | -13.9% | -11.8% |
| San Joaquin River | -22.2  | -32.1 | -131.5 | -185.9 |
| Percent Change    | -12.2% | -2.8% | -29.4% | -22.8% |
| Tulare Lake       | -3.4   | -5.2  | -30.7  | -39.3  |
| Percent Change    | -1.2%  | -0.3% | -3.1%  | -2.6%  |
| Total             | -47.1  | -62.6 | -250.3 | -360.0 |
| Percent Change    | -12.3% | -2.4% | -20.7% | -5.3%  |

Totals may not sum as a result of rounding.

### 3.4.2 Alternative 2 – Change Relative to Alternative 1

As described above, Alternative 1 represents the continuation of the current Program. Alternative 2 would add costs for groundwater monitoring and reporting. Compliance costs were estimated to increase by about \$1 per acre per year over the Alternative 1 level. The following results compare Alternative 2 to Alternative 1.

#### 3.4.2.1 Acreage by Basin and Crop

The changes in acreage by crop category estimated to result from the additional costs and regulations of Alternative 2 are reported in Table 3-10. Changes were greatest in the FFGO crop category, with a total reduction of approximately 10 thousand acres across basins, or 93 percent of total. The change in acreage in VEGT and ORVIN was considerably smaller, approximately 0.1 and 0.6 thousand acres, respectively. Additional monitoring and reporting costs applied to relatively few lands in the Tulare Lake Basin, so its acreage changed little. The Sacramento River and San Joaquin River Basins had much greater proportion of lands subject to the additional monitoring and reporting costs. Approximately 96 percent of total change in acreage occurred in these basins, with the great majority of that occurring in the FFGO crop category. In total, there was a reduction of approximately 11 thousand irrigated acres, or about 0.2 percent, relative to Alternative 1.



**Table 3-10. Alternative 2: Change in Irrigated Acreage (000) by Crop Category and Basin from Alternative 1**

| Basin             | VEGT  | ORVIN | FFGO  | Total |
|-------------------|-------|-------|-------|-------|
| Sacramento River  | -0.02 | -0.02 | -1.9  | -1.9  |
| Percent Change    | -0.0% | -0.0% | -0.2% | -0.1% |
| San Joaquin River | -0.1  | -0.6  | -8.2  | -8.9  |
| Percent Change    | -0.0% | -0.1% | -1.0% | -0.5% |
| Tulare Lake       | -0.01 | -0.03 | -0.4  | -0.4  |
| Percent Change    | -0.0% | -0.0% | -0.0% | -0.0% |
| Total             | -0.1  | -0.6  | -10.5 | -11.2 |
| Percent Change    | -0.0% | -0.0% | -0.3% | -0.2% |

Totals may not sum as a result of rounding.

### 3.4.2.2 Value of Production by Basin and Crop

As illustrated in Table 3-11, the distribution of change in value of production across basins and crop categories was largely similar to the acreage results. The key difference was that the overall percent change in value, either by basin or in total, was about half the percent change in acreage. This reflected the relatively lower value per acre of production on the FFGO lands, which were disproportionately affected by the costs of the alternative.

Changes to the FFGO crop category were more than \$4 million per year across basins, or 60 percent of the total. The change in value of production for VEGT and ORVIN crops was considerably less, approximately \$3 and \$2.6 million, respectively. In total, a reduction of approximately \$7.4 million per year was estimated relative to Alternative 1.

**Table 3-11. Alternative 2: Change in Value of Production (\$000,000) by Crop Category and Basin from Alternative 1**

| Basin             | VEGT  | ORVIN | FFGO  | Total |
|-------------------|-------|-------|-------|-------|
| Sacramento River  | -0.1  | -0.1  | -1.1  | -1.3  |
| Percent Change    | -0.0% | -0.0% | -0.1% | -0.0% |
| San Joaquin River | -0.2  | -2.4  | -2.9  | -5.5  |
| Percent Change    | -0.0% | -0.1% | -0.4% | -0.2% |
| Tulare Lake       | -0.03 | -0.1  | -0.4  | -0.6  |
| Percent Change    | -0.0% | -0.0% | -0.0% | -0.0% |
| Total             | -0.3  | -2.6  | -4.4  | -7.4  |
| Percent Change    | -0.0% | -0.0% | -0.1% | -0.1% |

Totals may not sum as a result of rounding.

### 3.4.2.3 Net Revenue by Basin and Crop

The losses in net revenue of irrigated land estimated to result from the additional costs and regulations of Alternative 2 are reported in Table 3-12. Net revenue declined by an estimated total of \$6.3 million per year, or about 0.1 percent. Changes were greatest in the FFGO crop category, with

a total reduction of approximately \$3.4 million per year across basins. The ORVIN category was estimated to decline by \$2.5 million and VEGT by only about \$0.4 million. San Joaquin River Basin was most affected, accounting for 65 percent of the total reduction.

**Table 3-12. Alternative 2: Change in Net Revenue (\$000,000) by Crop Category and Basin from Alternative 1**

| Basin             | VEGT  | ORVIN | FFGO  | Total |
|-------------------|-------|-------|-------|-------|
| Sacramento River  | -0.1  | -0.4  | -0.9  | -1.4  |
| Percent Change    | -0.1% | 0.0%  | -0.2% | -0.1% |
| San Joaquin River | -0.2  | -1.9  | -2.1  | -4.2  |
| Percent Change    | -0.1% | -0.2% | -0.7% | -0.4% |
| Tulare Lake       | -0.1  | -0.3  | -0.3  | -0.7  |
| Percent Change    | 0.0%  | 0.0%  | 0.0%  | 0.0%  |
| Total             | -0.4  | -2.5  | -3.4  | -6.3  |
| Percent Change    | -0.1% | -0.1% | -0.5% | -0.1% |

Totals may not sum as a result of rounding.

### 3.4.3 Alternative 3 – Change Relative to Alternative 1

Alternative 3 would increase costs to growers by requiring them to prepare individual farm water quality management plans. Compliance costs were estimated to increase by about \$8–13 per acre per year over the Alternative 1 level.

#### 3.4.3.1 Acreage by Basin and Crop

The change in acreage by crop category between Alternative 3 and Alternative 1 was quite similar in distribution to the results from Alternative 2, as seen in Table 3-13. Changes were greatest in the FFGO crop category, with a reduction of approximately 50 thousand acres across basins. This was about 96 percent of the total reduction. The change in acreage in VEGT and ORVIN was considerably less, approximately 0.7 and 1.2 thousand acres, respectively. Tulare Lake Basin again changed relatively little because of the small extent of lands subject to the additional costs. In total, a reduction of approximately 52 thousand acres was estimated relative to Alternative 1, or about 0.8 percent of irrigated acreage.

**Table 3-13. Alternative 3: Change in Irrigated Acreage (000) by Crop Category and Basin from Alternative 1**

| Basin             | VEGT  | ORVIN | FFGO  | Total |
|-------------------|-------|-------|-------|-------|
| Sacramento River  | -0.3  | -0.3  | -23.2 | -23.8 |
| Percent Change    | -0.2% | -0.1% | -1.9% | -1.3% |
| San Joaquin River | -0.3  | -0.8  | -24.4 | -25.6 |
| Percent Change    | -0.2% | -0.1% | -2.8% | -1.5% |
| Tulare Lake       | -0.1  | -0.1  | -2.8  | -2.9  |
| Percent Change    | -0.0% | -0.0% | -0.2% | -0.1% |
| Total             | -0.7  | -1.2  | -50.3 | -52.3 |
| Percent Change    | -0.1% | -0.1% | -1.3% | -0.8% |

Totals may not sum as a result of rounding.

### 3.4.3.2 Value of Production by Basin and Crop

The change in value of production by crop type between Alternative 3 and Alternative 1 is reported in Table 3-14. Total value of irrigated crop production was estimated to fall by about \$41 million per year. Changes were greatest in the FFGO crop type, with a total reduction of approximately \$34 million across basins, or 84 percent of total. The change in value of production in VEGT and ORVIN was considerably less, approximately \$2.2 and \$4.6 million, respectively. About \$37.5 million (92 percent of the total change) occurred in the Sacramento River and San Joaquin River Basins.

**Table 3-14. Alternative 3: Change in Value of Production (\$000,000) by Crop Category and Basin from Alternative 1**

| Basin             | VEGT  | ORVIN | FFGO  | Total |
|-------------------|-------|-------|-------|-------|
| Sacramento River  | -0.9  | -1.0  | -16.4 | -18.3 |
| Percent Change    | -0.2% | -0.1% | -1.7% | -0.6% |
| San Joaquin River | -1.0  | -3.2  | -15.0 | -19.2 |
| Percent Change    | -0.2% | -0.2% | -2.2% | -0.6% |
| Tulare Lake       | -0.2  | -0.4  | -2.8  | -3.3  |
| Percent Change    | -0.0% | -0.0% | -0.2% | -0.1% |
| Total             | -2.1  | -4.6  | -34.2 | -40.9 |
| Percent Change    | -0.1% | -0.1% | -1.0% | -0.3% |

Totals may not sum as a result of rounding.

### 3.4.3.3 Net Revenue by Basin and Crop

The losses in net revenue of irrigated land estimated for Alternative 3 are reported in Table 3-15. Net revenue declined by an estimated total of almost \$48 million per year, or about 0.7 percent. Changes were greatest in the FFGO crop category, with a total reduction of approximately \$29 million per year across basins. The ORVIN category was estimated to decline by about \$14 million and VEGT by only about \$5 million. Sacramento River and San Joaquin River Basins dominated the losses and accounted for about 90 percent of total net revenue lost.

**Table 3-15. Alternative 3: Change in Net Revenue (\$000,000) by Crop Category and Basin from Alternative 1**

| Basin             | VEGT  | ORVIN | FFGO  | Total |
|-------------------|-------|-------|-------|-------|
| Sacramento River  | -2.1  | -5.3  | -13.4 | -20.8 |
| Percent Change    | -1.6% | -0.5% | -2.5% | -1.9% |
| San Joaquin River | -2.3  | -7.5  | -12.8 | -22.5 |
| Percent Change    | -1.4% | -0.7% | -4.0% | -2.7% |
| Tulare Lake       | -0.4  | -1.4  | -2.6  | -4.4  |
| Percent Change    | -0.1% | -0.1% | -0.3% | -0.2% |
| Total             | -4.8  | -14.2 | -28.7 | -47.7 |
| Percent Change    | -1.4% | -0.6% | -3.0% | -0.7% |

Totals may not sum as a result of rounding.

### 3.4.4 Alternative 4 – Change Relative to Alternative 1

Alternative 4 increases the intensity of water quality monitoring and the resulting cost to growers is higher. Compliance costs were estimated to increase by about \$3–5 per acre per year over the Alternative 1 level.

#### 3.4.4.1 Acreage by Basin and Crop

The change in acreage by crop type between Alternative 4 and Alternative 1 is reported in Table 3-16. Changes showed a pattern similar to those in Alternatives 2 and 3. Nearly 93 percent of the total acreage change occurred in the FFGO crop category, and 90 percent of the changes occurred in the San Joaquin River Basins. As in Alternatives 2, the small change in Sacramento River and Tulare Lake Basins resulted from relatively small area of land subject to some of the additional requirements. The change in acreage in VEGT and ORVIN categories was relatively small, approximately 0.3 and 0.8 thousand acres, respectively. In total, the analysis estimated a reduction of approximately 14 thousand acres relative to Alternative 1, or almost 0.2 percent of total irrigated acres.

**Table 3-16. Alternative 4: Change in Irrigated Acreage (000) by Crop Category and Basin from Alternative 1**

| Basin             | VEGT  | ORVIN | FFGO  | Total |
|-------------------|-------|-------|-------|-------|
| Sacramento River  | -0.1  | -0.1  | -0.1  | -0.3  |
| Percent Change    | -0.1% | -0.0% | -0.0% | -0.0% |
| San Joaquin River | -0.1  | -0.7  | -11.5 | -12.3 |
| Percent Change    | -0.1% | -0.1% | -1.3% | -0.7% |
| Tulare Lake       | -0.0  | -0.1  | -1.0  | -1.0  |
| Percent Change    | -0.0% | -0.0% | -0.1% | -0.0% |
| Total             | -0.3  | -0.8  | -12.6 | -13.6 |
| Percent Change    | -0.0% | -0.0% | -0.3% | -0.2% |

Totals may not sum as a result of rounding.

### 3.4.4.2 Value of Production by Basin and Crop

The change in value of production by crop type between Alternative 4 and Alternative 1 is reported in Table 3-17. Percent change in total value produced was similar to the percent change in acreage. About 74 percent of the total reduction in value occurred in the FFGO category. The change in value of production in VEGT and ORVIN is considerably less, approximately \$0.8 and \$3.1 million, respectively. The total reduction in value was approximately \$14.9 million per year relative to Alternative 1.

**Table 3-17. Alternative 4: Change in Value of Production (\$000,000) by Crop Category and Basin from Alternative 1**

| Basin             | VEGT  | ORVIN | FFGO  | Total |
|-------------------|-------|-------|-------|-------|
| Sacramento River  | -0.3  | -0.3  | -3.9  | -4.5  |
| Percent Change    | -0.1% | -0.0% | -0.4% | -0.1% |
| San Joaquin River | -0.5  | -2.6  | -6.1  | -9.2  |
| Percent Change    | -0.1% | -0.1% | -0.9% | -0.3% |
| Tulare Lake       | -0.1  | -0.2  | -0.9  | -1.2  |
| Percent Change    | -0.0% | -0.0% | -0.1% | -0.0% |
| Total             | -0.8  | -3.1  | -11.0 | -14.9 |
| Percent Change    | -0.0% | -0.0% | -0.3% | -0.1% |

Totals may not sum as a result of rounding.

### 3.4.4.3 Net Revenue by Basin and Crop

The losses in net revenue of irrigated land estimated for Alternative 4 are reported in Table 3-18. Net revenue declined by more than \$16 million per year, or 0.3 percent. Changes were greatest in the FFGO crop category, with a total reduction of approximately \$8.8 million per year across basins. The ORVIN category was estimated to decline by about \$6 million and VEGT by about \$1.5 million. Sacramento River and San Joaquin River Basins dominated the losses and accounted for almost 92 percent of total lost net revenue.

The percent loss in net revenue for both ORVIN and VEGT categories substantially exceeded their percent loss in acreage or value of production. This occurred because crops in those categories could more easily bear the extra costs imposed by Alternative 4, and so did not lose much acreage or value. However, the costs were subtracted from the production value and substantially cut the net revenue.



**Table 3-18. Alternative 4: Change in Net Revenue (\$000,000) by Crop Category and Basin from Alternative 1**

| Basin             | VEGT  | ORVIN | FFGO  | Total |
|-------------------|-------|-------|-------|-------|
| Sacramento River  | -0.6  | -1.7  | -3.1  | -5.5  |
| Percent Change    | -0.5% | -0.2% | -0.6% | -0.4% |
| San Joaquin River | -0.8  | -3.7  | -5.0  | -9.4  |
| Percent Change    | -0.5% | -0.3% | -1.6% | -1.0% |
| Tulare Lake       | -0.1  | -0.6  | -0.8  | -1.5  |
| Percent Change    | -0.1% | -0.0% | -0.1% | -0.1% |
| Total             | -1.5  | -6.0  | -8.8  | -16.3 |
| Percent Change    | -0.4% | -0.3% | -1.1% | -0.3% |

Totals may not sum as a result of rounding.

### 3.4.5 Alternative 5 – Change Relative to Alternative 1

Alternative 5 would represent a substantial increase in cost and in crop acres subject to many of the water quality control requirements. Compliance costs were estimated to increase by about \$20–50 per acre per year over the Alternative 1 level.

#### 3.4.5.1 Acreage by Basin and Crop

As seen in Table 3-19, acreage impacts were much greater and were spread more evenly among the three basins under Alternative 5. More than 10 percent of total reductions occurred in the Tulare Lake Basin, with more than 40 percent in each of the other basins. The total acreage out was larger in the Sacramento River Basin than in either of the other basins. Changes to crop categories were not minor as they were in Alternatives 2, 3, and 4. In total, more than 289 thousand acres, or more than 4.4 percent, were estimated to go out of production relative to Alternative 1.

**Table 3-19. Alternative 5: Change in Irrigated Acreage (000) by Crop Category and Basin from Alternative 1**

| Basin             | VEGT  | ORVIN | FFGO   | Total  |
|-------------------|-------|-------|--------|--------|
| Sacramento River  | -2.2  | -2.4  | -136.1 | -140.7 |
| Percent Change    | -1.2% | -0.5% | -11.3% | -7.4%  |
| San Joaquin River | -1.8  | -3.4  | -120.6 | -125.8 |
| Percent Change    | -1.0% | -0.5% | -14.1% | -7.5%  |
| Tulare Lake       | -1.2  | -3.7  | -26.3  | -31.1  |
| Percent Change    | -0.4% | -0.3% | -1.5%  | -1.0%  |
| Total             | -5.2  | -9.5  | -283.0 | -297.7 |
| Percent Change    | -0.8% | -0.4% | -7.5%  | -4.4%  |

Totals may not sum as a result of rounding.

### 3.4.5.2 Value of Production by Basin and Crop

The change in value of production by crop type between Alternative 5 and Alternative 1 is reported in Table 3-20. A total of \$269 million in crop value was estimated to go out under this alternative, with about 82 percent of that total coming from the FFGO category. The change in value of production in VEGT and ORVIN was considerably less but still important, at approximately \$15.9 and \$32.6 million, respectively. About 6.4 percent of the FFGO value was estimated to be lost, and the total loss was 2.1 percent.

**Table 3-20. Alternative 5: Change in Value of Production (\$000,000) by Crop Category and Basin from Alternative 1**

| Basin             | VEGT  | ORVIN | FFGO   | Total  |
|-------------------|-------|-------|--------|--------|
| Sacramento River  | -6.1  | -8.4  | -104.0 | -118.4 |
| Percent Change    | -1.2% | -0.5% | -10.4% | -3.6%  |
| San Joaquin River | -6.1  | -11.7 | -90.3  | -108.1 |
| Percent Change    | -1.0% | -0.6% | -13.3% | -3.2%  |
| Tulare Lake       | -3.7  | -12.5 | -26.0  | -42.2  |
| Percent Change    | -0.4% | -0.3% | -1.5%  | -0.7%  |
| Total             | -15.9 | -32.6 | -220.3 | -268.7 |
| Percent Change    | -0.8% | -0.4% | -6.4%  | -2.1%  |

Totals may not sum as a result of rounding.

### 3.4.5.3 Net Revenue by Basin and Crop

The change in net revenue between Alternative 5 and Alternative 1 is shown in Table 3-21. Total net revenue was estimated to decline by just over \$237 million per year, or more than 14 percent. That included a nearly 21 percent decline in net revenue to the FFGO category and 13.6 percent to VEGT. As described for Alternative 4, the percent impact on net revenue was much larger than either the acreage or the value of production percent change. The costs imposed by this alternative reduced net revenue substantially on lands remaining in production in addition to eliminating net revenue on lands going out of production.

**Table 3-21. Alternative 5: Change in Net Revenue (\$000,000) by Crop Category and Basin from Alternative 1**

| Basin             | VEGT   | ORVIN | FFGO   | Total  |
|-------------------|--------|-------|--------|--------|
| Sacramento River  | -13.6  | -36.0 | -80.9  | -130.6 |
| Percent Change    | -10.5% | -3.5% | -14.9% | -11.3% |
| San Joaquin River | -14.9  | -44.5 | -72.8  | -132.1 |
| Percent Change    | -9.3%  | -4.0% | -23.1% | -15.1% |
| Tulare Lake       | -6.7   | -5.8  | -13.3  | -25.8  |
| Percent Change    | -2.4%  | -0.3% | -1.4%  | -1.4%  |
| Total             | -21.8  | -74.7 | -140.4 | -236.9 |
| Percent Change    | -13.6% | -4.1% | -20.7% | -14.8% |

Totals may not sum as a result of rounding.

## 3.5 Summary and Discussion

This section provides a summary of the changes in acreage of irrigated agriculture and total production value estimated for each alternative. This section also provides an overview of effects on the livestock sector and identifies potential program funding mechanisms.

### 3.5.1 Summary Comparison of Alternatives 2–5 to Alternative 1

Tables 3-22 through 3-24 provide a summary comparison of analysis results for Alternatives 2 through 5, all compared to Alternative 1.

**Table 3-22. Summary of Changes in Total Irrigated Acreage (000) by Basin from Alternative 1**

| Basin             | Alternative 2 | Alternative 3 | Alternative 4 | Alternative 5 |
|-------------------|---------------|---------------|---------------|---------------|
| Sacramento River  | -1.9          | -23.8         | -0.3          | -140.7        |
| Percent Change    | -0.1%         | -1.3%         | -0.0%         | -7.4%         |
| San Joaquin River | -8.9          | -25.6         | -12.3         | -125.8        |
| Percent Change    | -0.5%         | -1.5%         | -0.7%         | -7.5%         |
| Tulare Lake       | -0.4          | -2.9          | -1.0          | -31.1         |
| Percent Change    | -0.0%         | -0.1%         | -0.0%         | -1.0%         |
| Total             | -11.2         | -52.3         | -13.6         | -297.7        |
| Percent Change    | -0.2%         | -0.8%         | -0.2%         | -4.4%         |

Totals may not sum as a result of rounding.

**Table 3-23. Summary of Changes in Total Value of Production (\$000,000) by Basin from Alternative 1**

| Basin             | Alternative 2 | Alternative 3 | Alternative 4 | Alternative 5 |
|-------------------|---------------|---------------|---------------|---------------|
| Sacramento River  | -1.3          | -18.3         | -4.5          | -118.4        |
| Percent Change    | -0.0%         | -0.6%         | -0.1%         | -3.6%         |
| San Joaquin River | -5.5          | -19.2         | -9.2          | -108.1        |
| Percent Change    | -0.2%         | -0.6%         | -0.3%         | -3.2%         |
| Tulare Lake       | -0.6          | -3.3          | -1.2          | -42.2         |
| Percent Change    | -0.0%         | -0.1%         | -0.0%         | -0.7%         |
| Total             | -7.4          | -40.9         | -14.9         | -268.7        |
| Percent Change    | -0.1%         | -0.3%         | -0.1%         | -2.1%         |

Totals may not sum as a result of rounding.

**Table 3-24. Summary of Changes in Total Net Revenue (\$000,000) by Basin from Alternative 1**

| Basin             | Alternative 2 | Alternative 3 | Alternative 4 | Alternative 5 |
|-------------------|---------------|---------------|---------------|---------------|
| Sacramento River  | -1.4          | -20.8         | -5.5          | -130.6        |
| Percent Change    | -0.1%         | -1.9%         | -0.4%         | -11.3%        |
| San Joaquin River | -4.2          | -22.5         | -9.4          | -132.1        |
| Percent Change    | -0.4%         | -2.7%         | -1.0%         | -15.1%        |
| Tulare Lake       | -0.7          | -4.4          | -1.5          | -25.8         |
| Percent Change    | 0.0%          | -0.2%         | -0.1%         | -1.4%         |
| Total             | -6.3          | -47.7         | -16.3         | -236.9        |
| Percent Change    | -0.1%         | -0.7%         | -0.3%         | -14.8%        |

Totals may not sum as a result of rounding.

A sensitivity analysis of grower implementation costs in Alternative 1 was described in Section 3.4.1.1 above. That analysis indicated that acreage revenue and net income changes were relatively sensitive to the implementation cost assumptions. The same general conclusion applies to the results for all alternatives. If growers can identify and implement more cost-effective methods to comply with ILRP requirements, impacts on production and income can be reduced substantially, especially for lower-value field and forage crops.

### 3.5.2 Potential Effects on the Livestock Sector

Alternatives summarized above showed a disproportionate effect on FFGO relative to the other crop categories. In the FFGO category, CVPM results indicated very large reductions in acreage that produces hay and forage for livestock. A detailed analysis of potential effects on livestock production and processing sectors was beyond the scope of this analysis, so a simpler approach was used that compared the value of forage and hay production in the study area to the value of beef and dairy cattle production. The study area was not divided into three basins.

Agricultural Commissioners of counties in the study area reported the value of irrigated hay and pasture was about \$1.33 billion on average for 2005–2007, and the value of beef and dairy cattle

was about \$1.85 billion (California County Agricultural Commissioners 2005–2007)<sup>1</sup>. According to the IMPLAN model database, described in the section below, 80 percent of the value of hay and forage produced in the study area counties is used in the study area, and 20 percent is exported to other counties or regions. The analysis also allowed 20 percent of any lost production within the study area to be replaced by increased imports of hay into the study area (or reduced exports out of the area). This last assumption represents a limited ability to replace local production with imported hay, and was made to illustrate the upper range of potential effects on livestock producers. Their actual ability to replace local forage and hay would depend on supply response in other regions, transportation costs, and other market conditions.

These estimates and assumptions, if reasonable, implied that for every dollar of lost value of forage and hay production, another 89 cents would be lost in value of livestock. Based on this estimate, Table 3-25 displays the loss in forage and hay value (which is already included in earlier tables as part of the loss to FFGO crop value) and the corresponding additional loss in value of livestock. The losses are order-of-magnitude estimates based on the assumptions described above.

**Table 3-25. Potential Changes in Value of Livestock Production in the Study Area Compared to Alternative 1**

|                                                           | <b>Alternative 2</b> | <b>Alternative 3</b> | <b>Alternative 4</b> | <b>Alternative 5</b> |
|-----------------------------------------------------------|----------------------|----------------------|----------------------|----------------------|
| Percent change in forage and hay value produced           | -0.063%              | -0.8%                | -0.3%                | -5.5%                |
| Percent change in livestock value produced                | -0.056%              | -0.7%                | -0.2%                | -4.9%                |
| Million \$ per year of change in livestock value produced | -\$1.0               | -\$13.3              | -\$4.5               | -\$90.6              |

Note: Livestock losses in this table are presented for illustrative purposes. They are not estimated at the same level of detail as the irrigated crop losses but provide a sense of the relative scale of impacts by Alternative.

### 3.5.3 Available Funding Programs

A number of existing or potential funding sources may be available to offset portions of the cost of implementing the ILRP. Depending on the funding source, the assistance may be provided to growers, local organizations and water suppliers, or implementing agencies. The programs described below are illustrative and are not intended to constitute a comprehensive list of funding sources.

#### 3.5.3.1 Federal Farm Bill

Title II of the 2008 Farm Bill (the Food, Conservation, and Energy Act of 2008, in effect through 2012) authorizes funding for conservation programs such as the Environmental Quality Incentives Program (EQIP) and the Conservation Stewardship Program. Both of these programs provide financial and technical assistance for activities that improve water quality on agricultural lands. For example, the NRCS provides financial and technical assistance to growers to improve water quality. The assistance is through the Agricultural Water Enhancement Program, an element of the NRCS

<sup>1</sup> This livestock value does not include the value of beef and dairy products and processing.



EQIP. The program is a voluntary conservation initiative in which NRCS develops partnership agreements with eligible growers.

Farm bills typically are in place for 4 to 5 years. Subsequent farm bills may expand, reduce, eliminate, or replace EQIP. Farm bills or other future legislation may authorize spending for direct grants, loans, or cost-sharing for irrigation practices that improve water quality.

### **3.5.3.2 State Water Resources Control Board**

The Division of Financial Assistance administers water quality improvement programs for the State Water Board. The programs provide grant and loan funding to reduce non-point-source pollution discharge to surface waters.

The Division of Financial Assistance currently administers two programs that improve water quality—the Agricultural Drainage Management Loan Program and the Agricultural Drainage Loan Program. Both of these programs were implemented to address the management of agricultural drainage into surface water. The Agricultural Water Quality Grant Program provides funding to reduce or eliminate the discharge of non-point-source pollution from agricultural lands into surface and groundwater. It is currently funded through bonds authorized by Proposition 84.

The State Water Pollution Control State Revolving Fund Program also has funding authorized through Proposition 84. It provides loan funds to a wide variety of point-source and non-point-source water quality control activities. The State Water Board also administers Clean Water Act funds that can be used for agricultural water quality improvements.

### **3.5.3.3 Potential Funding Provided by the Safe, Clean, and Reliable Drinking Water Supply Act of 2010**

This act was passed by the Legislature as SBX 7-2, and if approved by voters in November of 2010, would provide grant and loan funding for a wide range of water-related activities, including agricultural water quality improvement, watershed protection, and groundwater quality protection. The actual amount and timing of funding availability will depend on its passage, on the issuance of bonds and the release of funds, and on the kinds of programs and projects proposed and approved for funding.

### **3.5.3.4 Other Funding Programs**

Other state and federal funding programs have been available in recent years to address agricultural water quality improvements. Integrated Regional Water Management grants were authorized and funded by Proposition 50 and now by Proposition 84. These are being administered jointly by the State Water Board and DWR. Proposals can include agricultural water quality improvement projects. The Bureau of Reclamation also can provide assistance and cost-sharing for water conservation projects that help discharges.

For a list of recent activities funded from various sources for agricultural water quality improvements see Chapter 5 of the ILRP ECR.

### **Effect of External Funding on Economic Impacts**

Funding received from grants, cost-sharing, or low-interest loans would offset some of the local growers' expenditures for compliance and management practice implementation, and likely would

reduce the losses in irrigated acreage and value of production estimated and described above. Funding that is targeted toward lands, crops, or growers having the greatest potential for losses and economic hardship would be most effective at reducing the impact. Regional economic impacts (see Chapter 4) also would be reduced.

## 4.1 Introduction

This section describes the analysis of effects of the ILRP alternatives on regional economic conditions. The analysis considers effects of estimated changes in the value of agricultural production and spending to comply with program requirements and to implement management practices.

Three regional input/output (I/O) economics models were developed to assess economic impacts. The geographic areas of the models were delineated based on the counties either fully or partially within the Central Valley Water Board region. The counties in the 20-county Sacramento River Basin model, the 10-county San Joaquin River Basin model, and the four-county Tulare Lake Basin model are identified in Table 4-1. (Note that the models incorporate areas of some counties that are outside the regional boundaries.)

**Table 4-1. Counties in the Sacramento River, San Joaquin River, and Tulare Lake Basin Regions**

| <b>Sacramento River Basin Region</b> |            | <b>San Joaquin River Basin Region</b> | <b>Tulare Lake Basin Region</b> |
|--------------------------------------|------------|---------------------------------------|---------------------------------|
| Butte                                | Plumas     | Alpine                                | Fresno                          |
| Colusa                               | Sacramento | Amador                                | Kern                            |
| El Dorado                            | Shasta     | Calaveras                             | Kings                           |
| Glenn                                | Sierra     | Contra Costa                          | Tulare                          |
| Lake                                 | Siskiyou   | Madera                                |                                 |
| Lassen                               | Solano     | Mariposa                              |                                 |
| Modoc                                | Sutter     | Merced                                |                                 |
| Napa                                 | Tehama     | San Joaquin                           |                                 |
| Nevada                               | Yolo       | Stanislaus                            |                                 |
| Placer                               | Yuba       | Tuolumne                              |                                 |

## 4.2 Methodology and Model Description

The three regional economics I/O models were developed using IMPLAN software. The models were used to measure the indirect effects that changes in crop production and regional expenditures from implementing management practices and complying with regulations under the project alternatives would be expected to have on regional economies, in terms of changes in industry output, employment, and income. The models are based on 2007 IMPLAN data.

Originally developed by the U.S. Department of Agriculture Forest Service to assist with land and resource management planning, the IMPLAN I/O software is a widely used model employed to assess the regional economic impacts of private and public projects. I/O analysis is a means of examining relationships within an economy, both between businesses and final consumers. It captures all monetary market transactions for consumption in a given time period. I/O models, such

as the IMPLAN model, allow for assessing the effects of a change in one or several economic activities, such as changes in agricultural production and regulatory costs, on an entire economy.

In general terms, an I/O model is used to estimate the effects of changes in final demand on the regional economy. In the case of the ILRP, the direct effect is the change (decrease or increase) in overall agricultural output estimated by the farm income and production analysis (described in Chapter 3) and the change in expenditures to implement management practices and to comply with regulatory requirements (described in Chapter 2). Because businesses in a local economy are linked together through purchases and sales of goods and services produced in the region, an action that has a direct effect on one industry is likely to have an indirect effect on firms providing production inputs and support services, as the demand for their products also changes. As household income is affected by the changes in regional economic activity, additional induced effects are generated by increased household spending.

Three different economic measures typically are used to describe regional impacts. *Output* (also known as *total industry output*) represents the value of production of goods and services by businesses in the regional economy. This can serve as an overall measure of the local economy and is useful for comparing regions and considering impacts. The second measure is *personal income*, which is the sum of employee compensation, proprietor income, and other property income. Employee compensation represents total payroll costs, including wages and salaries paid to workers plus benefits such as health insurance, as well as retirement payments and non-cash compensation. Proprietor income includes payments received by self-employed individuals as income, such as income received by private business owners, doctors, or lawyers. This measure is useful to show how employees and proprietors of businesses producing the output benefit from those businesses. Other property income consists of payments to individuals in the form of rents received on property, royalties from contracts, dividends paid by corporations, and profits earned by corporations. The third measure is *employment*, which represents the annual average number of employees, whether full- or part-time, of the businesses producing the output.

The base period used to characterize regional economic conditions is 2007, matching the year of data in the IMPLAN databases of the counties making up the three economic regions. Crop production value data from county Agricultural Commissioners' Crop Reports were used to characterize the existing output for three aggregated crop sectors: FFGO, ORVIN, and VEGT. Industry-level output, personal income and employment data from the IMPLAN I/O model databases were used to characterize existing conditions for other industrial sectors in the three economic regions.

To assess the regional economic impacts of the project alternatives, direct effects on agricultural production value by aggregated crop sector and region, as estimated in the farm income and production analysis, were used. The estimates of farm income and production were used as inputs to appropriate agricultural sectors in the three regional I/O models. For each of the alternatives, the procedure was similar for estimating regional economic impacts. After changes in agricultural production value were input to the models, the models were simulated to estimate the indirect, induced, and total effects of the change in agricultural production on the three regional economies. This process was repeated for each of the five project alternatives.

A similar approach was used to estimate the regional economic effects of spending on compliance and management practice implementation. (Note that the regional economic effects generated by increased spending on compliance and management practice implementation, including increased

output, income, and employment, could be considered benefits to the regional economies, but are referred to as effects in this chapter.) Costs for each alternative, which were estimated as part of the compliance and management practice cost assessment, were grouped according to general cost category (e.g., administrative costs, management practice costs). Estimates of total regional compliance and management practice costs for each region and alternative were adjusted based on the predicted reduction in crop acreage in each region under each alternative. (Note that, as described in Chapter 2, compliance and management practice costs were developed on a per-acre basis for categories of costs as the starting point for estimating overall Program costs under each alternative. These per-acre costs then were multiplied by baseline acreages in each region, as represented by early 2000s existing conditions, to arrive at total Program costs for each region and alternative. As described in Chapter 3, the implementation of the alternatives would result in some of the baseline acreage going out of production. As a result, the overall Program costs estimated in Chapter 2 for each alternative would be lower because the per-acre costs would apply to fewer acres in each region than under the early 2000s baseline. For purposes of conducting the regional economic impact analysis, the compliance and management practice costs needed to be adjusted downward by the predicted acreage reductions under each alternative, which resulted in lower overall costs and lower regional economic effects.) Costs then were assigned to appropriate IMPLAN industrial sectors based on a sectoring scheme developed for each cost category. Costs, deflated to 2007 dollars, then were input to the model to estimate indirect, induced, and total effects of changes in compliance and management practice costs on the three regional economies.

In addition to addressing regional economic impacts resulting from changes in agricultural production levels and compliance costs, the analysis addressed an additional source of change in regional economic activity: the reduction in personal consumption and other spending that some growers could face as a result of lower profits. Loss in regional economic activity that results from land going out of production or from crop switching was included in the IMPLAN analysis of gross production value changes, but reduction in profit on lands that remain in production also reduces income that growers and landowners would have had available to spend on other consumption, capital investment, or saving. The actual effect that this loss would have on the regional economy would depend on how much of it would have been spent within the region and on what.

To assess the potential regional economic impacts of reduced grower profits, it was assumed that grower profits would be reduced by the amount growers would spend on compliance and management practice implementation in the three economic regions under each of the Program alternatives. Additionally, it was assumed that 80 percent of forgone profits (i.e., grower compliance costs) otherwise would have been spent within the region. Based on these assumptions, the adjusted grower compliance costs were entered into the IMPLAN household sectors of each regional model, with costs evenly divided among three household income sectors: \$75,000–\$100,000, \$100,000–\$150,000, and \$150,000+. (Note that the IMPLAN spending patterns for household sectors vary according to household income levels.) The models then were run to generate estimated direct, indirect, and induced output, personal income, and employment impacts for each alternative and region.

Alternative 1 represents a continuation of the current program. The regional economic analysis compared the effects of Alternative 1 to levels of output, personal income, and employment under the 2007 base period. Alternatives 2 through 5 were evaluated by comparing the effects of these alternatives to Alternative 1 output, personal income, and employment levels, which reflect the 2007 levels adjusted by the estimated changes under Alternative 1.



To address the potential magnitude of forward-linked effects of reduced livestock production, the order-of-magnitude results presented in Section 3.5.2 were carried forward into the regional economic impact analysis, as presented in Section 4.5.3, Potential Effects from Changes in Livestock Production. This limited assessment of livestock production effects was based on the results of the agricultural analysis presented Section 3.5.2. The potential forward-linked impacts on livestock producers was estimated by the regional IMPLAN models by inputting the estimated loss of livestock production value under each alternative, as shown in Table 3-25. To avoid double-counting the backward-linked impacts on the FFGO sector, which were already accounted for in the analysis of agricultural production impacts for each alternative, the regional purchase coefficients for the FFGO sectors of each regional model were set to zero before the models were run. (A regional purchase coefficient represents the proportion of local demand for a commodity, such as forage and feed, purchased from local producers.) The models then were run to generate estimated direct, indirect, and induced output, personal income, and employment impacts for each alternative and region.

## 4.3 Existing Regional Economic Conditions

As discussed previously, existing regional economic conditions are characterized by 2007 levels of industrial output, personal income, and employment.

### 4.3.1 Total Industry Output

In the Sacramento River Basin region, industrial output is dominated by the value of services and manufacturing. Of the region's \$232.4 billion in industrial output, the finance, insurance, and real estate (FIRE) sector accounted for 19 percent of regional output, with educational, health, social services (EHSS) and other services combining to account for 23 percent of output (Table 4-2). Manufacturing followed, accounting for 14 percent of the value of regional production. Agricultural sectors, though important to rural areas of the region, accounted for a small percentage of total regional industrial output in 2007. Combined, the three aggregated crop sectors (FFGO, VEGT, and ORVIN) directly accounted for about 2 percent of regional output, and the livestock, dairy, poultry, and agricultural support services sectors accounted for another 0.5 percent of regional output. Agricultural activities, however, directly and indirectly affect the value of the output of other sectors of the region's economy, such as the manufacturing (including food processing), retail and wholesale trade, and transportation and warehousing sectors.

**Table 4-2. Industrial Output by Sector in the Sacramento River Basin, 2007**

| <b>Sector</b>                               | <b>Industrial Output<sup>1</sup> (\$M)</b> | <b>Percent of Total</b> |
|---------------------------------------------|--------------------------------------------|-------------------------|
| Feed, forage, grain, and other crops        | 1,380.4                                    | 0.6%                    |
| Vegetable, truck crops                      | 625.2                                      | 0.3%                    |
| Orchard, vineyard crops                     | 1,943.7                                    | 0.8%                    |
| Livestock and poultry ranching and farming  | 748.5                                      | 0.3%                    |
| Forestry, fishing and hunting               | 524.6                                      | 0.2%                    |
| Agriculture and forestry support activities | 461.9                                      | 0.2%                    |
| Mining and utilities                        | 3,966.6                                    | 1.7%                    |
| Construction                                | 21,817.3                                   | 9.4%                    |
| Manufacturing                               | 32,522.1                                   | 14.0%                   |
| Wholesale and retail trade                  | 22,026.7                                   | 9.5%                    |
| Transportation and warehousing              | 5,688.9                                    | 2.4%                    |
| Information                                 | 9,422.4                                    | 4.1%                    |
| Finance, insurance, and real estate         | 44,680.8                                   | 19.2%                   |
| All other services                          | 36,411.3                                   | 15.7%                   |
| Educational, health, and social services    | 17,509.8                                   | 7.5%                    |
| Government                                  | 32,724.0                                   | 14.1%                   |
| Total                                       | 232,454.2                                  | 100.0%                  |

Sources: California County Agricultural Commissioners' Annual Crop Reports for counties in the Sacramento River Basin 2008; Minnesota IMPLAN Group 2008.

<sup>1</sup> 2007 U.S. dollars (\$).

Manufacturing was the dominant producer of industrial output in the San Joaquin River Basin in 2007, accounting for 36 percent of the region's \$228.6 billion in industrial output (Table 4-3). The services sectors, including the FIRE, EHSS, and other services sectors, also are important to the San Joaquin River Basin region, accounting for a combined 31 percent of regional output. Similar to the Sacramento River Basin region, the San Joaquin River Basin region's agricultural sector is important to local areas within the region, although agriculture directly plays a minor role in the overall value of industrial output in the region. Combined, the three crop sectors accounted for about 2 percent of regional output, with the livestock, dairy, poultry, and agricultural support services sectors accounting for another 2 percent of regional output. However, as in the Sacramento River Basin, agricultural activities in the San Joaquin River Basin directly and indirectly affect the value of the output of other sectors of the region's economy, such as the manufacturing (including food processing), retail and wholesale trade, and transportation and warehousing sectors.

**Table 4-3. Industrial Output by Sector in the San Joaquin River Basin, 2007**

| <b>Sector</b>                               | <b>Industrial Output<sup>1</sup> (\$M)</b> | <b>Percent of Total</b> |
|---------------------------------------------|--------------------------------------------|-------------------------|
| Feed, forage, grain, and other crops        | 849.8                                      | 0.4%                    |
| Vegetable, truck crops                      | 861.3                                      | 0.4%                    |
| Orchard, vineyard crops                     | 2,607.3                                    | 1.1%                    |
| Livestock and poultry ranching and farming  | 3,306.9                                    | 1.4%                    |
| Forestry, fishing and hunting               | 298.8                                      | 0.1%                    |
| Agriculture and forestry support activities | 759.5                                      | 0.3%                    |
| Mining and utilities                        | 6,584.4                                    | 2.9%                    |
| Construction                                | 15,399.3                                   | 6.7%                    |
| Manufacturing                               | 82,747.7                                   | 36.2%                   |
| Wholesale and retail trade                  | 15,763.0                                   | 6.9%                    |
| Transportation and warehousing              | 5,734.7                                    | 2.5%                    |
| Information                                 | 9,985.5                                    | 4.4%                    |
| Finance, insurance, and real estate         | 32,694.7                                   | 14.3%                   |
| All other services                          | 24,732.7                                   | 10.8%                   |
| Educational, health, and social services    | 13,244.5                                   | 5.8%                    |
| Government                                  | 12,998.7                                   | 5.7%                    |
| <b>Total</b>                                | <b>228,568.8</b>                           | <b>100.0%</b>           |

Sources: California County Agricultural Commissioners' Annual Crop Reports for counties in the Sacramento River Basin 2008; Minnesota IMPLAN Group 2008.

<sup>1</sup> 2007 U.S. dollars (\$).

In the Tulare Lake Basin region, agriculture contributes a larger share of output relative to overall regional industrial output. As Table 4-4 shows, the three crop sectors combined accounted for about 7 percent of regional output in 2007, with the livestock, dairy, poultry, and agricultural support services sectors accounting for another 5 percent of regional output. The region's agricultural industry also directly and indirectly affects the value of the output of other sectors of the region's economy, such as the manufacturing (including food processing), retail and wholesale trade, and transportation and warehousing sectors. The largest producers of regional industrial output were the services sectors—FIRE, EHSS, and other services—together accounting for 28 percent of regional output. Manufacturing accounted for another 21 percent of 2007 regional output.

**Table 4-4. Industrial Output by Sector in the Tulare Lake Basin, 2007**

| <b>Sector</b>                               | <b>Industrial Output<sup>1</sup> (\$M)</b> | <b>Percent of Total</b> |
|---------------------------------------------|--------------------------------------------|-------------------------|
| Feed, forage, grain, and other crops        | 1,886.7                                    | 1.4%                    |
| Vegetable, truck crops                      | 2,062.1                                    | 1.5%                    |
| Orchard, vineyard crops                     | 5,896.4                                    | 4.2%                    |
| Livestock and poultry ranching and farming  | 4,266.6                                    | 3.1%                    |
| Forestry, fishing and hunting               | 174.4                                      | 0.1%                    |
| Agriculture and forestry support activities | 2,380.8                                    | 1.7%                    |
| Mining and utilities                        | 9,889.1                                    | 7.1%                    |
| Construction                                | 9,763.8                                    | 7.0%                    |
| Manufacturing                               | 29,370.2                                   | 21.1%                   |
| Wholesale and retail trade                  | 12,150.0                                   | 8.7%                    |
| Transportation and warehousing              | 4,125.0                                    | 3.0%                    |
| Information                                 | 2,978.8                                    | 2.1%                    |
| Finance, insurance, and real estate         | 14,932.5                                   | 10.7%                   |
| All other services                          | 15,551.5                                   | 11.2%                   |
| Educational, health, and social services    | 8,127.2                                    | 5.8%                    |
| Government                                  | 15,470.8                                   | 11.1%                   |
| Total                                       | 139,025.9                                  | 100.0%                  |

Sources: California County Agricultural Commissioners' Annual Crop Reports for counties in the Sacramento River Basin 2008; Minnesota IMPLAN Group 2008.

<sup>1</sup> 2007 U.S. dollars (\$).

### 4.3.2 Personal Income

In 2007, personal income in the Sacramento River Basin region was distributed broadly across the region's economy, with services (FIRE, EHSS, and other services) generating 43 percent and with government producing 24 percent of total regional personal income (Table 4-5). The region's three crop-producing sectors directly accounted for about 1.5 percent of regional income, with the livestock, dairy, poultry, and agricultural support services sectors accounting for 0.5 percent of regional income.

**Table 4-5. Personal Income by Sector in the Sacramento River Basin, 2007**

| <b>Sector</b>                               | <b>Personal Income<sup>1</sup> (\$M)</b> | <b>Percent of Total</b> |
|---------------------------------------------|------------------------------------------|-------------------------|
| Feed, forage, grain, and other crops        | 422.4                                    | 0.3                     |
| Vegetable, truck crops                      | 437.7                                    | 0.3                     |
| Orchard, vineyard crops                     | 1,103.4                                  | 0.8                     |
| Livestock and poultry ranching and farming  | 190.7                                    | 0.2                     |
| Forestry, fishing and hunting               | 389.7                                    | 0.3                     |
| Agriculture and forestry support activities | 415.0                                    | 0.3                     |
| Mining and utilities                        | 1,946.4                                  | 1.5                     |
| Construction                                | 10,811.7                                 | 8.1                     |
| Manufacturing                               | 8,547.0                                  | 6.4                     |
| Wholesale and retail trade                  | 12,270.5                                 | 9.2                     |
| Transportation and warehousing              | 2,981.4                                  | 2.2                     |
| Information                                 | 4,139.0                                  | 3.1                     |
| Finance, insurance, and real estate         | 25,636.7                                 | 19.3                    |
| All other services                          | 20,618.7                                 | 15.5                    |
| Educational, health, and social services    | 11,699.6                                 | 8.8                     |
| Government                                  | 31,488.3                                 | 23.7                    |
| <b>Total</b>                                | <b>133,098.2</b>                         | <b>100.0</b>            |

Source: Minnesota IMPLAN Group 2008.

<sup>1</sup> Includes employee compensation, proprietor income, and other property income in 2007 U.S. dollars (\$).

Services, manufacturing, and government were the largest producers of personal income in the San Joaquin River Basin region in 2007, together accounting for more than two-thirds (69 percent) of total regional personal income (Table 4-6). Wholesale and retail trade, and construction, accounted for another 16 percent of the region's income. The three crop-producing sectors directly generated 3 percent of the region's income, with the livestock, dairy, poultry, and agricultural support services sectors accounting for 2 percent of regional income.



**Table 4-6. Personal Income by Sector in the San Joaquin River Basin, 2007**

| <b>Sector</b>                               | <b>Personal Income<sup>1</sup> (\$M)</b> | <b>Percent of Total</b> |
|---------------------------------------------|------------------------------------------|-------------------------|
| Feed, forage, grain, and other crops        | 233.2                                    | 0.2                     |
| Vegetable, truck crops                      | 739.1                                    | 0.8                     |
| Orchard, vineyard crops                     | 1,595.4                                  | 1.7                     |
| Livestock and poultry ranching and farming  | 1,094.7                                  | 1.1                     |
| Forestry, fishing and hunting               | 165.9                                    | 0.2                     |
| Agriculture and forestry support activities | 643.9                                    | 0.7                     |
| Mining and utilities                        | 2,578.3                                  | 2.7                     |
| Construction                                | 7,401.9                                  | 7.7                     |
| Manufacturing                               | 12,849.0                                 | 13.4                    |
| Wholesale and retail trade                  | 8,347.0                                  | 8.7                     |
| Transportation and warehousing              | 2,984.7                                  | 3.1                     |
| Information                                 | 4,218.8                                  | 4.4                     |
| Finance, insurance, and real estate         | 19,143.5                                 | 20.0                    |
| All other services                          | 13,477.1                                 | 14.1                    |
| Educational, health, and social services    | 8,409.9                                  | 8.8                     |
| Government                                  | 11,828.2                                 | 12.4                    |
| Total                                       | 95,710.6                                 | 100.0                   |

Source: Minnesota IMPLAN Group 2008.

<sup>1</sup> Includes employee compensation, proprietor income, and other property income in 2007 U.S. dollars (\$).

In the Tulare Lake Basin region, services and government were the largest producers of personal income in 2007. Services (FIRE, EHSS, and other services) accounted for 32 percent of total regional income (Table 4-7). Government followed, generating 22 percent of the region's income. Other important sectors included wholesale and regional trade (10 percent) and manufacturing (8 percent). The crop-producing sectors of the Tulare Lake Basin region's economy directly accounted for about 6 percent of the region's 2007 income. The livestock, dairy, poultry, and agricultural support services sectors accounted for additional 5 percent of regional income.

**Table 4-7. Personal Income by Sector in the Tulare Lake Basin, 2007**

| <b>Sector</b>                               | <b>Personal Income<sup>1</sup> (\$M)</b> | <b>Percent of Total</b> |
|---------------------------------------------|------------------------------------------|-------------------------|
| Feed, forage, grain, and other crops        | 547.5                                    | 0.8                     |
| Vegetable, truck crops                      | 1,087.7                                  | 1.6                     |
| Orchard, vineyard crops                     | 2,132.4                                  | 3.2                     |
| Livestock and poultry ranching and farming  | 1,435.0                                  | 2.2                     |
| Forestry, fishing and hunting               | 96.9                                     | 0.1                     |
| Agriculture and forestry support activities | 1,967.8                                  | 3.0                     |
| Mining and utilities                        | 4,297.1                                  | 6.5                     |
| Construction                                | 4,438.0                                  | 6.7                     |
| Manufacturing                               | 5,242.9                                  | 7.9                     |
| Wholesale and retail trade                  | 6,389.2                                  | 9.6                     |
| Transportation and warehousing              | 2,043.6                                  | 3.1                     |
| Information                                 | 1,067.9                                  | 1.6                     |
| Finance, insurance, and real estate         | 8,135.8                                  | 12.3                    |
| All other services                          | 8,087.4                                  | 12.2                    |
| Educational, health, and social services    | 4,981.5                                  | 7.5                     |
| Government                                  | 14,410.1                                 | 21.7                    |
| Total                                       | 66,360.8                                 | 100.0                   |

Source: Minnesota IMPLAN Group 2008.

<sup>1</sup> Includes employee compensation, proprietor income, and other property income in 2007 U.S. dollars (\$).

### 4.3.3 Employment

The services, government, and trade sectors are the dominant employment generators in the Sacramento River Basin region. In 2007, services, including FIRE, EHSS, and other services, generated 46 percent of the region's 1.9 million jobs (Table 4-8). Government and wholesale/retail trade produced 22 percent and 13 percent, respectively, of regional jobs. The agricultural sectors were directly responsible for a relatively small number of the region's jobs, with the three crop sectors accounting for just over 1 percent of the jobs, and the livestock, dairy, poultry, and agricultural support services sectors contributing another 1 percent of regional jobs.

**Table 4-8. Jobs by Sector in the Sacramento River Basin, 2007**

| <b>Sector</b>                               | <b>Jobs<sup>1</sup> (\$M)</b> | <b>Percent of Total</b> |
|---------------------------------------------|-------------------------------|-------------------------|
| Feed, forage, grain, and other crops        | 9,835                         | 0.5                     |
| Vegetable, truck crops                      | 2,675                         | 0.1                     |
| Orchard, vineyard crops                     | 12,859                        | 0.7                     |
| Livestock and poultry ranching and farming  | 4,421                         | 0.2                     |
| Forestry, fishing and hunting               | 2,316                         | 0.1                     |
| Agriculture and forestry support activities | 14,559                        | 0.8                     |
| Mining and utilities                        | 7,093                         | 0.4                     |
| Construction                                | 138,534                       | 7.5                     |
| Manufacturing                               | 80,251                        | 4.3                     |
| Wholesale and retail trade                  | 248,102                       | 13.4                    |
| Transportation and warehousing              | 45,738                        | 2.5                     |
| Information                                 | 29,404                        | 1.6                     |
| Finance, insurance, and real estate         | 171,788                       | 9.3                     |
| All other services                          | 473,489                       | 25.6                    |
| Educational, health, and social services    | 201,539                       | 10.9                    |
| Government                                  | 409,547                       | 22.1                    |
| Total                                       | 1,852,150                     | 100.0                   |

Source: Minnesota IMPLAN Group 2008.

<sup>1</sup> Includes part- and full-time employment.

Employment patterns are similar in the San Joaquin River Basin region. In 2007, 46 percent of the region's 1.2 million jobs were generated by the FIRE, EHSS, and other services sectors (Table 4-9). The government and wholesale/retail trade sectors each accounted for 14 percent of the region's jobs. The region's three crop-producing sectors together produced more than 21,000 jobs, which represented about 2 percent of the region's jobs, with the livestock, dairy, poultry, and agricultural support services sectors contributing nearly 3 percent of regional jobs.

**Table 4-9. Jobs by Sector in the San Joaquin River Basin, 2007**

| <b>Sector</b>                               | <b>Jobs<sup>1</sup> (\$M)</b> | <b>Percent of Total</b> |
|---------------------------------------------|-------------------------------|-------------------------|
| Feed, forage, grain, and other crops        | 3,446                         | 0.3                     |
| Vegetable, truck crops                      | 3,944                         | 0.3                     |
| Orchard, vineyard crops                     | 13,661                        | 1.1                     |
| Livestock and poultry ranching and farming  | 14,701                        | 1.2                     |
| Forestry, fishing and hunting               | 1,076                         | 0.1                     |
| Agriculture and forestry support activities | 27,408                        | 2.3                     |
| Mining and utilities                        | 6,994                         | 0.6                     |
| Construction                                | 91,207                        | 7.6                     |
| Manufacturing                               | 82,521                        | 6.8                     |
| Wholesale and retail trade                  | 168,044                       | 14.0                    |
| Transportation and warehousing              | 41,370                        | 3.4                     |
| Information                                 | 22,233                        | 1.8                     |
| Finance, insurance, and real estate         | 114,333                       | 9.5                     |
| All other services                          | 304,752                       | 25.3                    |
| Educational, health, and social services    | 139,337                       | 11.6                    |
| Government                                  | 169,362                       | 14.1                    |
| <b>Total</b>                                | <b>1,204,389</b>              | <b>100.0</b>            |

Source: Minnesota IMPLAN Group 2008.

<sup>1</sup> Includes part- and full-time employment.

As discussed previously, agriculture directly plays a greater role in the overall economy of the Tulare Lake Basin than it does in the other two economic regions. The three crop-producing sectors accounted for 4 percent of the region's 1.0 million jobs in 2007, but the livestock, dairy, poultry, and agricultural support services sectors produced an even greater share of regional employment, generating 12 percent of total jobs (Table 4-10). Apart from the region's agricultural sectors, services (FIRE, EHSS, and other services) were a large contributor to the region's employment base, accounting for 35 percent of all jobs. Government and wholesale/retail trade were also significant contributors to the regional economy, producing 19 percent and 13 percent, respectively, of the region's jobs.

**Table 4-10. Jobs by Sector in the Tulare Lake Basin, 2007**

| <b>Sector</b>                               | <b>Jobs<sup>1</sup> (\$M)</b> | <b>Percent of Total</b> |
|---------------------------------------------|-------------------------------|-------------------------|
| Feed, forage, grain, and other crops        | 8,348                         | 0.8                     |
| Vegetable, truck crops                      | 8,529                         | 0.8                     |
| Orchard, vineyard crops                     | 25,878                        | 2.5                     |
| Livestock and poultry ranching and farming  | 23,411                        | 2.3                     |
| Forestry, fishing and hunting               | 530                           | 0.1                     |
| Agriculture and forestry support activities | 99,643                        | 9.6                     |
| Mining and utilities                        | 15,836                        | 1.5                     |
| Construction                                | 62,938                        | 6.1                     |
| Manufacturing                               | 58,492                        | 5.6                     |
| Wholesale and retail trade                  | 131,773                       | 12.7                    |
| Transportation and warehousing              | 28,270                        | 2.7                     |
| Information                                 | 8,888                         | 0.9                     |
| Finance, insurance, and real estate         | 51,542                        | 5.0                     |
| All other services                          | 216,962                       | 20.9                    |
| Educational, health, and social services    | 99,328                        | 9.6                     |
| Government                                  | 196,150                       | 18.9                    |
| Total                                       | 1,036,518                     | 100.0                   |

Source: Minnesota IMPLAN Group 2008.

<sup>1</sup> Includes part- and full-time employment.

## 4.4 Regional Economic Impacts of the Program Alternatives

The results of the regional economic impact assessment are described for each of the Program alternatives in the following sections. The effects of Alternative 1 were compared to base period (2007) conditions, whereas the effects of Alternatives 2 through 5 were compared to Alternative 1 conditions.

### 4.4.1 Alternative 1 – Change Relative to 2007 Base Period Conditions

The effects of Alternative 1 reflect the continuation of the current Program, with changes in industrial output, personal income, and employment compared to 2007 base period levels.

#### 4.4.1.1 Total Industry Output

Under Alternative 1, reductions in annual industrial output directly and indirectly attributable to changes in irrigated agriculture and grower profitability would occur in all regions, largely because of reductions in the value of FFGO crops, particularly in the Sacramento River Basin and San Joaquin River Basin regions. Agriculture-related output reductions would range on an annual basis from \$137.4 million in the Tulare Lake Basin region to \$564.2 million in the Sacramento River Basin



region (Tables 4-11, 4-12, and 4-13). Output generated by spending to comply with Program regulations and to implement management practices would offset a portion of the loss of output associated with irrigated agriculture, with output increases ranging from \$91.0 million in the Tulare Lake Basin region to \$303.1 million in the San Joaquin River Basin region.

Considered together, the agriculture-related reductions in output would more than offset the gains generated by compliance spending, with net decreases in total output across all sectors ranging from 0.03 percent in the Tulare Lake Basin region to 0.13 percent in the Sacramento River Basin region relative to base-period levels (Table 4-11, 4-12, and 4-13). At the sector level, net output reductions would be large in the FFGO sectors of both the Sacramento River Basin and San Joaquin River Basin regions, with 9.5 percent and 13.0 percent reductions, respectively. Additionally, reductions in the production of FFGO crops, including hay and forage for livestock, could have adverse effects on the livestock production sector of the regional economies. A detailed analysis of potential effects on livestock production and other forward-linked sectors was beyond the scope of the analysis conducted for this chapter. The potential regional economic effects from reductions in livestock production, however, are discussed in Section 4.5.3, Potential Effects from Changes in Livestock Production.

**Table 4-11. Alternative 1: Change in Industrial Output, Personal Income, and Employment in the Sacramento River Basin Relative to Base Period (2007) Levels**

| <b>Sector</b>                                  | <b>Change Related to Agricultural Impacts</b> | <b>Change Related to Cost Impacts</b> | <b>Total Net Change</b> | <b>Percent Change</b> |
|------------------------------------------------|-----------------------------------------------|---------------------------------------|-------------------------|-----------------------|
| <b>Output<sup>1</sup> (\$M)</b>                |                                               |                                       |                         |                       |
| Feed, forage, grain, and other crops           | -146.14                                       | 14.95                                 | -131.19                 | -9.50%                |
| Vegetable, truck crops                         | -9.97                                         | 0.10                                  | -9.87                   | -1.58%                |
| Orchard, vineyard crops                        | -6.37                                         | 0.16                                  | -6.21                   | -0.32%                |
| Agriculture and forestry support activities    | -9.73                                         | 0.91                                  | -8.82                   | -1.91%                |
| All other sectors                              | -391.94                                       | 241.76                                | -150.18                 | -0.07%                |
| Total                                          | -564.15                                       | 257.88                                | -306.27                 | -0.13%                |
| <b>Personal Income<sup>1, 2</sup> (\$M)</b>    |                                               |                                       |                         |                       |
| Feed, forage, grain, and other crops           | -40.13                                        | 4.11                                  | -36.02                  | -8.53%                |
| Vegetable, truck crops                         | -5.58                                         | 0.06                                  | -5.52                   | -1.26%                |
| Orchard, vineyard crops                        | -3.38                                         | 0.08                                  | -3.30                   | -0.30%                |
| Agriculture and forestry support activities    | -8.45                                         | 0.80                                  | -7.65                   | -1.84%                |
| All other sectors                              | -217.32                                       | 139.93                                | -77.39                  | -0.06%                |
| Total                                          | -274.86                                       | 144.98                                | -129.88                 | -0.10%                |
| <b>Employment<sup>3</sup> (Number of jobs)</b> |                                               |                                       |                         |                       |
| Feed, forage, grain, and other crops           | -934.4                                        | 95.6                                  | -838.8                  | -8.53%                |
| Vegetable, truck crops                         | -34.1                                         | 0.4                                   | -33.7                   | -1.26%                |
| Orchard, vineyard crops                        | -39.4                                         | 1.0                                   | -38.4                   | -0.30%                |
| Agriculture and forestry support activities    | -296.8                                        | 27.9                                  | -268.9                  | -1.85%                |
| All other sectors                              | -3,060                                        | 1,897.6                               | -1,162.4                | -0.06%                |
| Total                                          | -4,364.7                                      | 2,022.5                               | -2,342.2                | -0.13%                |

Source: IMPLAN model output based on estimated agricultural and program cost impacts.

<sup>1</sup> Includes direct, indirect, and induced effects in 2007 U.S. dollars (\$).

<sup>2</sup> Personal income includes employee compensation, proprietor income, and other property income.

<sup>3</sup> Includes direct, indirect, and induced full- and part-time jobs.

**Table 4-12. Alternative 1: Change in Industrial Output, Personal Income, and Employment in the San Joaquin River Basin Relative to Base Period (2007) Levels**

| <b>Sector</b>                                  | <b>Change Related to Agricultural Impacts</b> | <b>Change Related to Cost Impacts</b> | <b>Total Net Change</b> | <b>Percent Change</b> |
|------------------------------------------------|-----------------------------------------------|---------------------------------------|-------------------------|-----------------------|
| <b>Output<sup>1</sup> (\$M)</b>                |                                               |                                       |                         |                       |
| Feed, forage, grain, and other crops           | -133.52                                       | 22.83                                 | -110.69                 | -13.03%               |
| Vegetable, truck crops                         | -9.51                                         | 0.19                                  | -9.32                   | -1.08%                |
| Orchard, vineyard crops                        | -6.93                                         | 0.22                                  | -6.71                   | -0.26%                |
| Agriculture and forestry support activities    | -11.74                                        | 1.80                                  | -9.94                   | -1.31%                |
| All other sectors                              | -373.70                                       | 278.02                                | -95.68                  | -0.04%                |
| Total                                          | -535.4                                        | 303.06                                | -232.34                 | -0.10%                |
| <b>Personal Income<sup>1, 2</sup> (\$M)</b>    |                                               |                                       |                         |                       |
| Feed, forage, grain, and other crops           | -37.95                                        | 6.49                                  | -31.46                  | -13.49%               |
| Vegetable, truck crops                         | -5.19                                         | 0.10                                  | -5.09                   | -0.69%                |
| Orchard, vineyard crops                        | -3.77                                         | 0.12                                  | -3.65                   | -0.23%                |
| Agriculture and forestry support activities    | -9.98                                         | 1.53                                  | -8.45                   | -1.31%                |
| All other sectors                              | -197.88                                       | 154.25                                | -43.63                  | -0.05%                |
| Total                                          | -254.77                                       | 162.49                                | -92.28                  | -0.10%                |
| <b>Employment<sup>3</sup> (Number of jobs)</b> |                                               |                                       |                         |                       |
| Feed, forage, grain, and other crops           | -560.8                                        | 95.9                                  | -464.9                  | -13.49%               |
| Vegetable, truck crops                         | -27.7                                         | 0.5                                   | -27.2                   | -0.69%                |
| Orchard, vineyard crops                        | -31.5                                         | 1.0                                   | -30.5                   | -0.22%                |
| Agriculture and forestry support activities    | -423.7                                        | 65.1                                  | -358.6                  | -1.31%                |
| All other sectors                              | -2,799.2                                      | 2,068.2                               | -731.0                  | -0.06%                |
| Total                                          | -3,842.9                                      | 2,230.7                               | -1,612.2                | -0.13%                |

Source: IMPLAN model output based on estimated agricultural and program cost impacts.

<sup>1</sup> Includes direct, indirect, and induced effects in 2007 U.S. dollars (\$).

<sup>2</sup> Personal income includes employee compensation, proprietor income, and other property income.

<sup>3</sup> Includes direct, indirect, and induced full- and part-time jobs.

**Table 4-13. Alternative 1: Change in Value of Industrial Output, Personal Income, and Employment in the Tulare Lake Basin from Base Period (2007) Levels**

| Sector                                         | Change Related to Agricultural Impacts | Change Related to Cost Impacts | Total Net Change | Percent Change |
|------------------------------------------------|----------------------------------------|--------------------------------|------------------|----------------|
| <b>Output<sup>1</sup> (\$M)</b>                |                                        |                                |                  |                |
| Feed, forage, grain, and other crops           | -30.44                                 | 5.72                           | -24.72           | -1.31%         |
| Vegetable, truck crops                         | -1.52                                  | 0.07                           | -1.45            | -0.07%         |
| Orchard, vineyard crops                        | -1.41                                  | 0.06                           | -1.35            | -0.02%         |
| Agriculture and forestry support activities    | -2.78                                  | 0.48                           | -2.30            | -0.10%         |
| All other sectors                              | -101.21                                | 84.70                          | -16.51           | -0.01%         |
| Total                                          | -137.36                                | 91.03                          | -46.33           | -0.03%         |
| <b>Personal Income<sup>1, 2</sup> (\$M)</b>    |                                        |                                |                  |                |
| Feed, forage, grain, and other crops           | -10.25                                 | 1.92                           | -8.33            | -1.52%         |
| Vegetable, truck crops                         | -0.81                                  | 0.04                           | -0.77            | -0.07%         |
| Orchard, vineyard crops                        | -0.75                                  | 0.03                           | -0.72            | -0.03%         |
| Agriculture and forestry support activities    | -2.30                                  | 0.40                           | -1.90            | -0.10%         |
| All other sectors                              | -53.22                                 | 47.50                          | -5.72            | -0.01%         |
| Total                                          | -67.33                                 | 49.89                          | -17.44           | -0.03%         |
| <b>Employment<sup>3</sup> (Number of jobs)</b> |                                        |                                |                  |                |
| Feed, forage, grain, and other crops           | -156.2                                 | 29.3                           | -126.9           | -1.52%         |
| Vegetable, truck crops                         | -6.4                                   | 0.3                            | -6.1             | -0.07%         |
| Orchard, vineyard crops                        | -9.0                                   | 0.4                            | -8.6             | -0.03%         |
| Agriculture and forestry support activities    | -116.2                                 | 20.1                           | -96.1            | -0.10%         |
| All other sectors                              | -823.4                                 | 706.9                          | -116.5           | -0.01%         |
| Total                                          | -1,111.2                               | 757.0                          | -354.2           | -0.03%         |

Source: IMPLAN model output based on estimated agricultural and program cost impacts.

<sup>1</sup> Includes direct, indirect, and induced effects in 2007 U.S. dollars (\$).

<sup>2</sup> Personal income includes employee compensation, proprietor income, and other property income.

<sup>3</sup> Includes direct, indirect, and induced full- and part-time jobs.

#### 4.4.1.2 Personal Income

Under Alternative 1, effects on personal income would be similar to those described for output effects, with decreases in personal income attributable to reduced agricultural production and reduced grower profitability offset to varying degrees by increases in personal income driven by compliance and management practice implementation spending (Tables 4-11, 4-12, and 4-13). On a sector basis, industries dependent on agricultural production, particularly on the production of FFGO crops, would experience reduced income. This is particularly true for the FFGO sector in the San Joaquin River Basin region, where personal income would fall by 13.5 percent, and in the Sacramento River Basin region, where income would decline by 8.5 percent, relative to base-period levels. Across all sectors, personal income generated by compliance and management practice implementation spending would partially offset the negative agricultural effects. Personal income would decrease by a net of \$17.4 million in the Tulare Lake Basin, \$92.3 million in the San Joaquin River Basin region, and \$129.9 million in the Sacramento River Basin region. These reductions

would be relatively small (0.03–0.10 percent) compared to total personal income levels in each region under base period conditions.

#### **4.4.1.3 Employment**

Under Alternative 1, reductions in agricultural production and grower profitability would directly and indirectly result in job losses in all three economic regions, with reductions ranging from 1,111 jobs in the Tulare Lake Basin to 4,365 jobs in the Sacramento River Basin region (Tables 4-11, 4-12, and 4-13). Most of the job losses would occur in the FFGO sector as a result of reductions in irrigated field crop acreage. These losses would be somewhat offset, primarily in other industrial sectors, by increased spending driven by program compliance and management practice implementation. Job growth related to this spending would range from 757 jobs in the Tulare Lake Basin region to 2,231 jobs in the San Joaquin River Basin region. When considered together, net employment would decrease by 354 jobs in the Tulare Lake Basin region, 1,612 jobs in the San Joaquin River Basin region, and 2,342 jobs in the Sacramento River Basin region. Compared to base-period employment levels, these changes would be relatively small, with a 0.03 percent decrease in the Tulare Lake Basin region and 0.13 percent decreases in the San Joaquin River Basin and Sacramento River Basin regions.

### **4.4.2 Alternative 2 – Change Relative to Alternative 1**

The annual changes in agricultural production, grower profitability, and compliance and management practice costs under Alternative 2 would be relatively small compared to Alternative 1 levels, resulting in relatively minor regional economic effects. The estimated gross value of agricultural production under Alternative 2 would fall by only 0.1 percent (\$7.4 million in 2007 dollars) across the three regions (see Table 3-10, Farm Income and Production Analysis section). Similarly, the increase in compliance and management practice implementation spending under Alternative 2, attributable primarily to added costs for groundwater monitoring and reporting, would not be substantially higher than under Alternative 1, with acreage-adjusted costs increasing by about \$2 million in each economic region. As described below, the net result of these changes on regional economies would be relatively minor compared to Alternative 1 conditions.

#### **4.4.2.1 Total Industry Output**

Relative to total industrial output levels under Alternative 1, the total net changes in annual output estimated to result from reduced agricultural output and grower profitability and increased compliance spending under Alternative 2 would be less than 0.005 percent for all three of the economic regions, with slight net decreases in the Sacramento River Basin and San Joaquin River Basin regions and a slight increase in the Tulare Lake Basin region (Tables 4-14, 4-15, and 4-16). (For the Tulare Lake River Basin region, this result is primarily because reductions in agricultural production values and grower profitability would be slightly smaller than the increase in compliance spending within the region, relative to Alternative 1 levels. In the Sacramento River Basin and San Joaquin River Basin regions, reductions in agricultural production value and grower profitability would be larger than the increase in compliance spending, leading to net reductions in output.) For the agricultural sectors, the output reductions would be largest in the FFGO sector, but the changes, compared to Alternative 1 levels, would be minor in all regions, ranging from 0.02 percent in the Tulare Lake Basin region to 0.39 percent in the San Joaquin River Basin region. Reductions in the production of FFGO crops, including hay and forage for livestock, could have



adverse effects on the livestock production sector of the regional economies. A detailed analysis of potential effects on livestock production and other forward-linked sectors was beyond the scope of the analysis conducted for this chapter. The potential regional economic effects from reductions in livestock production, however, are discussed in Section 4.5.3, Potential Effects from Changes in Livestock Production.

**Table 4-14. Alternative 2: Change in Industrial Output, Personal Income, and Employment in the Sacramento River Basin Relative to Alternative 1 Levels**

| Sector                                         | Change Related to Agricultural Impacts | Change Related to Cost Impacts | Total Net Change | Percent Change |
|------------------------------------------------|----------------------------------------|--------------------------------|------------------|----------------|
| <b>Output<sup>1</sup> (\$M)</b>                |                                        |                                |                  |                |
| Feed, forage, grain, and other crops           | -1.17                                  | 0.06                           | -1.11            | -0.089%        |
| Vegetable, truck crops                         | -0.004                                 | 0.002                          | -0.003           | 0.000%         |
| Orchard, vineyard crops                        | -0.06                                  | 0.002                          | -0.058           | -0.003%        |
| Agriculture and forestry support activities    | -0.08                                  | 0.004                          | -0.076           | -0.017%        |
| All other sectors                              | -4.03                                  | 4.49                           | 0.46             | 0.000%         |
| Total                                          | -5.34                                  | 4.56                           | -0.78            | 0.000%         |
| <b>Personal Income<sup>1, 2</sup> (\$M)</b>    |                                        |                                |                  |                |
| Feed, forage, grain, and other crops           | -0.32                                  | 0.02                           | -0.30            | -0.078%        |
| Vegetable, truck crops                         | -0.003                                 | 0.001                          | -0.002           | 0.000%         |
| Orchard, vineyard crops                        | -0.031                                 | 0.001                          | -0.03            | -0.003%        |
| Agriculture and forestry support activities    | -0.07                                  | 0.004                          | -0.066           | -0.016%        |
| All other sectors                              | -2.54                                  | 2.73                           | 0.19             | 0.000%         |
| Total                                          | -2.96                                  | 2.75                           | -0.21            | 0.000%         |
| <b>Employment<sup>3</sup> (Number of jobs)</b> |                                        |                                |                  |                |
| Feed, forage, grain, and other crops           | -7.5                                   | 0.4                            | -7.1             | -0.079%        |
| Vegetable, truck crops                         | 0.0                                    | 0.0                            | 0.0              | 0.000%         |
| Orchard, vineyard crops                        | -0.4                                   | 0.0                            | -0.4             | -0.003%        |
| Agriculture and forestry support activities    | -2.3                                   | 0.1                            | -2.2             | -0.015%        |
| All other sectors                              | -32.2                                  | 39.8                           | 7.6              | 0.000%         |
| Total                                          | -42.4                                  | 40.3                           | -2.1             | 0.000%         |

Source: IMPLAN model output based on estimated agricultural and program cost impacts.

<sup>1</sup> Includes direct, indirect, and induced effects in 2007 U.S. dollars (\$).

<sup>2</sup> Personal income includes employee compensation, proprietor income, and other property income.

<sup>3</sup> Includes direct, indirect, and induced full- and part-time jobs.

**Table 4-15. Alternative 2: Change in Industrial Output, Personal Income, and Employment in the San Joaquin River Basin Relative to Alternative 1 Levels**

| <b>Sector</b>                                  | <b>Change Related to Agricultural Impacts</b> | <b>Change Related to Cost Impacts</b> | <b>Total Net Change</b> | <b>Percent Change</b> |
|------------------------------------------------|-----------------------------------------------|---------------------------------------|-------------------------|-----------------------|
| <b>Output<sup>1</sup> (\$M)</b>                |                                               |                                       |                         |                       |
| Feed, forage, grain, and other crops           | -2.93                                         | 0.05                                  | -2.88                   | -0.390%               |
| Vegetable, truck crops                         | -0.26                                         | 0.003                                 | -0.257                  | -0.030%               |
| Orchard, vineyard crops                        | -2.46                                         | 0.003                                 | -2.457                  | -0.094%               |
| Agriculture and forestry support activities    | -0.54                                         | 0.005                                 | -0.535                  | -0.071%               |
| All other sectors                              | -7.28                                         | 4.55                                  | -2.73                   | -0.001%               |
| Total                                          | -13.47                                        | 4.61                                  | -8.86                   | -0.004%               |
| <b>Personal Income<sup>1, 2</sup> (\$M)</b>    |                                               |                                       |                         |                       |
| Feed, forage, grain, and other crops           | -0.83                                         | 0.01                                  | -0.82                   | -0.406%               |
| Vegetable, truck crops                         | -0.14                                         | 0.002                                 | -0.138                  | -0.019%               |
| Orchard, vineyard crops                        | -1.30                                         | 0.001                                 | -1.299                  | -0.082%               |
| Agriculture and forestry support activities    | -0.46                                         | 0.004                                 | -0.456                  | -0.072%               |
| All other sectors                              | -3.89                                         | 2.62                                  | -1.27                   | -0.001%               |
| Total                                          | -6.62                                         | 2.64                                  | -3.98                   | -0.004%               |
| <b>Employment<sup>3</sup> (Number of jobs)</b> |                                               |                                       |                         |                       |
| Feed, forage, grain, and other crops           | -12.3                                         | 0.2                                   | -12.1                   | -0.406%               |
| Vegetable, truck crops                         | -0.8                                          | 0.0                                   | -0.8                    | -0.020%               |
| Orchard, vineyard crops                        | -11.2                                         | 0.0                                   | -11.2                   | -0.082%               |
| Agriculture and forestry support activities    | -19.4                                         | 0.2                                   | -19.2                   | -0.071%               |
| All other sectors                              | -53.6                                         | 38.2                                  | -15.4                   | -0.001%               |
| Total                                          | -97.3                                         | 38.6                                  | -58.7                   | -0.005%               |

Source: IMPLAN model output based on estimated agricultural and program cost impacts.

<sup>1</sup> Includes direct, indirect, and induced effects in 2007 U.S. dollars (\$).

<sup>2</sup> Personal income includes employee compensation, proprietor income, and other property income.

<sup>3</sup> Includes direct, indirect, and induced full- and part-time jobs.

**Table 4-16. Alternative 2: Change in Value of Industrial Output, Personal Income, and Employment in the Tulare Lake Basin from Alternative 1 Levels**

| Sector                                         | Change Related to Agricultural Impacts | Change Related to Cost Impacts | Total Net Change | Percent Change |
|------------------------------------------------|----------------------------------------|--------------------------------|------------------|----------------|
| <b>Output<sup>1</sup> (\$M)</b>                |                                        |                                |                  |                |
| Feed, forage, grain, and other crops           | -0.42                                  | 0.007                          | -0.413           | -0.022%        |
| Vegetable, truck crops                         | -0.03                                  | 0.003                          | -0.027           | -0.001%        |
| Orchard, vineyard crops                        | -0.12                                  | 0.002                          | -0.118           | -0.002%        |
| Agriculture and forestry support activities    | -0.05                                  | 0.001                          | -0.049           | -0.002%        |
| All other sectors                              | -2.07                                  | 2.97                           | 0.90             | 0.001%         |
| Total                                          | -2.69                                  | 2.98                           | 0.29             | 0.000%         |
| <b>Personal Income<sup>1, 2</sup> (\$M)</b>    |                                        |                                |                  |                |
| Feed, forage, grain, and other crops           | -0.14                                  | 0.002                          | -0.138           | -0.026%        |
| Vegetable, truck crops                         | -0.02                                  | 0.001                          | -0.019           | -0.002%        |
| Orchard, vineyard crops                        | -0.06                                  | 0.001                          | -0.059           | -0.003%        |
| Agriculture and forestry support activities    | -0.04                                  | 0.001                          | -0.039           | -0.002%        |
| All other sectors                              | -1.09                                  | 1.75                           | 0.66             | 0.001%         |
| Total                                          | -1.35                                  | 1.76                           | 0.41             | 0.001%         |
| <b>Employment<sup>3</sup> (Number of jobs)</b> |                                        |                                |                  |                |
| Feed, forage, grain, and other crops           | -2.1                                   | 0.0                            | -2.1             | -0.026%        |
| Vegetable, truck crops                         | -0.1                                   | 0.0                            | -0.1             | -0.001%        |
| Orchard, vineyard crops                        | -0.8                                   | 0.0                            | -0.8             | -0.003%        |
| Agriculture and forestry support activities    | -2.2                                   | 0.1                            | -2.1             | -0.002%        |
| All other sectors                              | -17.1                                  | 29.5                           | 12.4             | 0.001%         |
| Total                                          | -22.3                                  | 29.6                           | 7.3              | 0.001%         |

Source: IMPLAN model output based on estimated agricultural and program cost impacts.

<sup>1</sup> Includes direct, indirect, and induced effects in 2007 U.S. dollars (\$).

<sup>2</sup> Personal income includes employee compensation, proprietor income, and other property income.

<sup>3</sup> Includes direct, indirect, and induced full- and part-time jobs.

#### 4.4.2.2 Personal Income

Under Alternative 2, annual changes in personal income would follow the trend in changes in industry output, with small (less than 0.005 percent) net decreases in income in the Sacramento River Basin and San Joaquin River Basin regions and a slight increase in the Tulare Lake Basin region (Tables 4-14, 4-15, and 4-16). As with output, net personal income changes would be greatest in the FFGO sectors of regional economies; however, the reductions would be relatively minor, ranging from 0.03 percent in the Tulare Lake Basin to 0.41 percent in the San Joaquin River Basin.

#### 4.4.2.3 Employment

As with output and personal income, changes in employment under Alternative 2 would be small relative to Alternative 1 levels of employment. Net changes in employment would include reductions of 59 jobs in the San Joaquin River Basin and two jobs in the Sacramento River Basin regions and an

increase of seven jobs in the Tulare Lake Basin region (Tables 4-14, 4-15, and 4-16). These changes would represent less than 0.01 percent of Alternative 1 employment levels in all regions. Job losses related to decreased agricultural production and grower profitability under Alternative 2 would be greatest in the San Joaquin River Basin, with an estimated 97 jobs lost. This change would be minor in the context of Alternative 1 employment levels.

#### **4.4.3 Alternative 3 – Change Relative to Alternative 1**

The annual changes in agricultural production and grower profitability under Alternative 3 would be larger than under Alternative 2 but still would be relatively small compared to Alternative 1 levels, resulting in relatively small regional economic effects. The reduction in the gross value of annual agricultural production under Alternative 3 would be only an estimated 0.3 percent (\$40.9 million in 2007 dollars) across the three regions compared to production value under Alternative 1 (see Table 3-13, Farm Income and Production Analysis section). The increase in annual compliance- and management practice-implementation spending under Alternative 3 would be higher than under Alternative 1, attributable primarily to increased costs to growers for preparing individual farm water quality management plans and for substantially higher costs for additional Water Board administrative staff. Relative to Alternative 1, acreage-adjusted costs under Alternative 3 would increase by 19 percent (\$84.3 million), ranging from an increase of \$16.3 million in the Tulare Lake Basin region to an increase of \$35.6 million in the San Joaquin River Basin region. As described below, the net result of these changes on regional economies would vary across the regions and impact indicators but would be positive for personal income and employment because of relatively large increases in compliance- and management practice-implementation spending, which would outweigh the adverse effects of reduced agricultural production and grower profitability. The net changes, however, would be relatively small compared to Alternative 1 conditions.

##### **4.4.3.1 Total Industry Output**

Under Alternative 3, annual industrial output losses related to reductions in agricultural production and grower profitability would offset output gains generated by Program compliance spending in two of the three economic regions. The net output reductions, however, would be small compared to Alternative 1 levels, falling by 0.002 percent in the San Joaquin River Basin region and by 0.003 percent in the Sacramento River Basin region (Tables 4-17 and 4-18). In the Tulare Lake Basin region, the net output change would be positive, but the change would represent an increase of only 0.006 percent over the Alternative 1 output level (Table 4-19). Among the agricultural sectors, output reductions would be greatest in the FFGO sectors of the regional economies, ranging from 0.15 percent in the Tulare Lake Basin region to 2.08 percent in the San Joaquin River Basin region. Additionally, reductions in the production of FFGO crops, including hay and forage for livestock, could have adverse effects on the livestock production sector of the regional economies. A detailed analysis of potential effects on livestock production and other forward-linked sectors was beyond the scope of the analysis conducted for this chapter. The potential regional economic effects from reductions in livestock production, however, are discussed in Section 4.5.3, Potential Effects from Changes in Livestock Production.

**Table 4-17. Alternative 3: Change in Industrial Output, Personal Income, and Employment in the Sacramento River Basin Relative to Alternative 1 Levels**

| <b>Sector</b>                                  | <b>Change Related to Agricultural Impacts</b> | <b>Change Related to Cost Impacts</b> | <b>Total Net Change</b> | <b>Percent Change</b> |
|------------------------------------------------|-----------------------------------------------|---------------------------------------|-------------------------|-----------------------|
| <b>Output<sup>1</sup> (\$M)</b>                |                                               |                                       |                         |                       |
| Feed, forage, grain, and other crops           | -16.81                                        | -0.09                                 | -16.90                  | -1.353%               |
| Vegetable, truck crops                         | -1.04                                         | 0.04                                  | -1.00                   | -0.163%               |
| Orchard, vineyard crops                        | -1.08                                         | 0.04                                  | -1.04                   | -0.054%               |
| Agriculture and forestry support activities    | -1.15                                         | 1.45                                  | 0.30                    | 0.066%                |
| All other sectors                              | -62.80                                        | 73.75                                 | 10.95                   | 0.005%                |
| Total                                          | -82.88                                        | 75.19                                 | -7.69                   | -0.003%               |
| <b>Personal Income<sup>1, 2</sup> (\$M)</b>    |                                               |                                       |                         |                       |
| Feed, forage, grain, and other crops           | -4.61                                         | -0.03                                 | -4.64                   | -1.201%               |
| Vegetable, truck crops                         | -0.57                                         | 0.02                                  | -0.55                   | -0.127%               |
| Orchard, vineyard crops                        | -0.57                                         | 0.02                                  | -0.55                   | -0.050%               |
| Agriculture and forestry support activities    | -1.00                                         | 1.26                                  | 0.26                    | 0.064%                |
| All other sectors                              | -34.55                                        | 51.24                                 | 16.69                   | 0.013%                |
| Total                                          | -41.30                                        | 52.51                                 | 11.21                   | 0.008%                |
| <b>Employment<sup>3</sup> (Number of jobs)</b> |                                               |                                       |                         |                       |
| Feed, forage, grain, and other crops           | -107.5                                        | -0.6                                  | -108.1                  | -1.202%               |
| Vegetable, truck crops                         | -3.4                                          | 0.1                                   | -3.3                    | -0.125%               |
| Orchard, vineyard crops                        | -6.7                                          | 0.3                                   | -6.4                    | -0.050%               |
| Agriculture and forestry support activities    | -34.9                                         | 44.3                                  | 9.4                     | 0.066%                |
| All other sectors                              | -495.2                                        | 714.5                                 | 219.3                   | 0.012%                |
| Total                                          | -647.7                                        | 758.6                                 | 110.9                   | 0.006%                |

Source: IMPLAN model output based on estimated agricultural and program cost impacts.

<sup>1</sup> Includes direct, indirect, and induced effects in 2007 U.S. dollars (\$).

<sup>2</sup> Personal income includes employee compensation, proprietor income, and other property income.

<sup>3</sup> Includes direct, indirect, and induced full- and part-time jobs.



**Table 4-18. Alternative 3: Change in Industrial Output, Personal Income, and Employment in the San Joaquin River Basin Relative to Alternative 1 Levels**

| Sector                                         | Change Related<br>to Agricultural<br>Impacts | Change<br>Related to<br>Cost Impacts | Total Net<br>Change | Percent<br>Change |
|------------------------------------------------|----------------------------------------------|--------------------------------------|---------------------|-------------------|
| <b>Output<sup>1</sup> (\$M)</b>                |                                              |                                      |                     |                   |
| Feed, forage, grain, and other crops           | -15.21                                       | -0.16                                | -15.37              | -2.080%           |
| Vegetable, truck crops                         | -1.17                                        | 0.06                                 | -1.11               | -0.130%           |
| Orchard, vineyard crops                        | -3.36                                        | 0.05                                 | -3.31               | -0.127%           |
| Agriculture and forestry support activities    | -1.65                                        | 1.23                                 | -0.42               | -0.056%           |
| All other sectors                              | -55.08                                       | 70.67                                | 15.59               | 0.007%            |
| Total                                          | -76.47                                       | 71.85                                | -4.62               | -0.002%           |
| <b>Personal Income<sup>1, 2</sup> (\$M)</b>    |                                              |                                      |                     |                   |
| Feed, forage, grain, and other crops           | -4.32                                        | -0.05                                | -4.37               | -2.166%           |
| Vegetable, truck crops                         | -0.64                                        | 0.04                                 | -0.60               | -0.082%           |
| Orchard, vineyard crops                        | -1.78                                        | 0.02                                 | -1.76               | -0.111%           |
| Agriculture and forestry support activities    | -1.41                                        | 1.04                                 | -0.37               | -0.058%           |
| All other sectors                              | -29.15                                       | 51.05                                | 21.90               | 0.024%            |
| Total                                          | -37.30                                       | 52.10                                | 14.80               | 0.015%            |
| <b>Employment<sup>3</sup> (Number of jobs)</b> |                                              |                                      |                     |                   |
| Feed, forage, grain, and other crops           | -63.9                                        | -0.7                                 | -64.6               | -2.167%           |
| Vegetable, truck crops                         | -3.4                                         | 0.2                                  | -3.2                | -0.082%           |
| Orchard, vineyard crops                        | -15.2                                        | 0.2                                  | -15.0               | -0.110%           |
| Agriculture and forestry support activities    | -59.7                                        | 44.2                                 | -15.5               | -0.057%           |
| All other sectors                              | -416.1                                       | 713.4                                | 297.3               | 0.026%            |
| Total                                          | -558.3                                       | 757.3                                | 199.0               | 0.017%            |

Source: IMPLAN model output based on estimated agricultural and program cost impacts.

<sup>1</sup> Includes direct, indirect, and induced effects in 2007 U.S. dollars (\$).

<sup>2</sup> Personal income includes employee compensation, proprietor income, and other property income.

<sup>3</sup> Includes direct, indirect, and induced full- and part-time jobs.

**Table 4-19. Alternative 3: Change in Value of Industrial Output, Personal Income, and Employment in the Tulare Lake Basin from Alternative 1 Levels**

| Sector                                         | Change Related to Agricultural Impacts | Change Related to Cost Impacts | Total Net Change | Percent Change |
|------------------------------------------------|----------------------------------------|--------------------------------|------------------|----------------|
| <b>Output<sup>1</sup> (\$M)</b>                |                                        |                                |                  |                |
| Feed, forage, grain, and other crops           | -2.85                                  | 0.01                           | -2.84            | -0.153%        |
| Vegetable, truck crops                         | -0.21                                  | 0.04                           | -0.17            | -0.008%        |
| Orchard, vineyard crops                        | -0.44                                  | 0.02                           | -0.42            | -0.007%        |
| Agriculture and forestry support activities    | -0.31                                  | 0.90                           | 0.59             | 0.025%         |
| All other sectors                              | -21.58                                 | 32.13                          | 10.55            | 0.008%         |
| Total                                          | -25.39                                 | 33.10                          | 7.71             | 0.006%         |
| <b>Personal Income<sup>1, 2</sup> (\$M)</b>    |                                        |                                |                  |                |
| Feed, forage, grain, and other crops           | -0.96                                  | 0.01                           | -0.95            | -0.176%        |
| Vegetable, truck crops                         | -0.11                                  | 0.02                           | -0.09            | -0.008%        |
| Orchard, vineyard crops                        | -0.23                                  | 0.01                           | -0.22            | -0.010%        |
| Agriculture and forestry support activities    | -0.26                                  | 0.75                           | 0.49             | 0.025%         |
| All other sectors                              | -11.25                                 | 17.71                          | 6.46             | 0.011%         |
| Total                                          | -12.81                                 | 18.50                          | 5.69             | 0.009%         |
| <b>Employment<sup>3</sup> (Number of jobs)</b> |                                        |                                |                  |                |
| Feed, forage, grain, and other crops           | -14.7                                  | 0.1                            | -14.6            | -0.178%        |
| Vegetable, truck crops                         | -0.9                                   | 0.2                            | -0.7             | -0.008%        |
| Orchard, vineyard crops                        | -2.8                                   | 0.1                            | -2.7             | -0.010%        |
| Agriculture and forestry support activities    | -13.0                                  | 37.8                           | 24.8             | 0.025%         |
| All other sectors                              | -179.3                                 | 339.7                          | 160.4            | 0.018%         |
| Total                                          | -210.70                                | 377.9                          | 167.2            | 0.016%         |

Source: IMPLAN model output based on estimated agricultural and program cost impacts.

<sup>1</sup> Includes direct, indirect, and induced effects in 2007 U.S. dollars (\$).

<sup>2</sup> Personal income includes employee compensation, proprietor income, and other property income.

<sup>3</sup> Includes direct, indirect, and induced full- and part-time jobs.

#### 4.4.3.2 Personal Income

Similar to output changes, net personal income changes under Alternative 3 would be relatively small compared to personal income levels under Alternative 1. Contrary to net changes in industrial output, however, which were negative for the Sacramento River Basin and San Joaquin River Basin regions under Alternative 3, net personal income changes under Alternative 3 would be positive for all regions. This counterintuitive result occurs because the adverse effects of output reductions in these two regions are concentrated in the FFGO sector, which has a relatively small number of jobs and personal income per million dollars of output compared to other economic sectors that would be positively affected by Program compliance spending.

Across all sectors and regions, annual net personal income gains would range from 0.008 percent in the Sacramento River Basin region to 0.015 percent in the San Joaquin River Basin region (Tables 4-17, 4-18, and 4-19). Reductions in personal income in agricultural sectors would be greatest in the

FFGO sectors, ranging from a 0.18 percent decrease in the Tulare Lake Basin region to a 2.17 percent reduction in the San Joaquin River Basin region.

#### **4.4.3.3 Employment**

Relative to Alternative 1 employment levels, net employment changes related to reduced agricultural production and increased compliance spending under Alternative 3 would be small compared total employment in each region. Compared to Alternative 1 employment levels, employment across all sectors would increase by 199 jobs (0.02 percent) in the San Joaquin River basin (Table 4-18), 167 jobs (0.02 percent) in the Tulare Lake Basin region (Table 4-19), and 111 jobs (0.01 percent) in the Sacramento River Basin region (Table 4-17). In the agricultural sectors, employment effects would be greatest in the FFGO sectors of the regional economies, with job losses in these sectors ranging from 0.18 percent in the Tulare Lake Basin region to 2.17 percent in the San Joaquin River Basin region, compared to employment levels under Alternative 1.

#### **4.4.4 Alternative 4 – Change Relative to Alternative 1**

Compared to Alternative 1, the annual reductions in agricultural production and grower profitability under Alternative 4 would be larger than under Alternative 2 but smaller than under Alternatives 3 and 5. Similarly, the annual increase in spending on Program compliance and management practice implementation under Alternative 4 would be greater than under Alternative 2 but lower than under Alternatives 3 and 5. The annual gross value of agricultural production under Alternative 4 is estimated to fall by 1.1 percent (\$14.9 million in 2007 dollars) across the three regions compared to production value under Alternative 1 (see Table 3-16, Farm Income and Production Analysis section). The annual increase in compliance and management practice implementation spending under Alternative 4, attributable primarily to increased costs for more intensive water quality monitoring and increased State Board administrative staffing costs, would be moderately higher than under Alternative 1, with acreage-adjusted costs increasing by 6.8 percent (\$30.6 million). Because the increase in compliance and management practice spending would be higher than the decrease in agricultural production value and grower profitability, the overall net regional effects of Alternative 4 are anticipated to be marginally positive compared to Alternative 1 conditions for two of the three economic regions, although effects would be mixed across the three regions, and agricultural sectors would experience relatively small adverse changes. The net regional economic effects of Alternative 4 are described below.

##### **4.4.4.1 Total Industry Output**

Under Alternative 4, annual industrial output changes related to reduced agricultural production and grower profitability would outweigh output gains generated by increased Program compliance spending in two of the three economic regions. The net output reductions, however, would be small compared to Alternative 1 levels, falling by 0.002 percent in the Sacramento River Basin region and by 0.005 percent in the San Joaquin River Basin region (Tables 4-20 and 4-21). In the Tulare Lake Basin region, the net output change would be positive, but the change would represent an increase of only 0.001 percent over the Alternative 1 output level (Table 4-22). Among the agricultural sectors, output would be reduced by a relatively small amount. Effects would be concentrated in the FFGO sectors in the San Joaquin River Basin and Sacramento River Basin regions, where FFGO-sector output would fall by 0.8 percent and 0.3 percent, respectively. Output reductions for the other agricultural sectors would be even smaller, at 0.1 percent or less, compared to Alternative 1 output

levels. Reductions in the production of FFGO crops, including hay and forage for livestock, could have adverse effects on the livestock production sector of the regional economies. A detailed analysis of potential effects on livestock production and other forward-linked sectors was beyond the scope of the analysis conducted for this chapter. The potential regional economic effects from reductions in livestock production, however, are discussed in Section 4.5.3, Potential Effects from Changes in Livestock Production.

**Table 4-20. Alternative 4: Change in Industrial Output, Personal Income, and Employment in the Sacramento River Basin Relative to Alternative 1 Levels**

| <b>Sector</b>                                  | <b>Change Related to Agricultural Impacts</b> | <b>Change Related to Cost Impacts</b> | <b>Total Net Change</b> | <b>Percent Change</b> |
|------------------------------------------------|-----------------------------------------------|---------------------------------------|-------------------------|-----------------------|
| <b>Output<sup>1</sup> (\$M)</b>                |                                               |                                       |                         |                       |
| Feed, forage, grain, and other crops           | -4.03                                         | 0.08                                  | -3.95                   | -0.316%               |
| Vegetable, truck crops                         | -0.28                                         | 0.01                                  | -0.27                   | -0.044%               |
| Orchard, vineyard crops                        | -0.30                                         | 0.01                                  | -0.29                   | -0.015%               |
| Agriculture and forestry support activities    | -0.28                                         | 1.50                                  | 1.22                    | 0.269%                |
| All other sectors                              | -18.88                                        | 18.41                                 | -0.47                   | -0.000%               |
| Total                                          | -23.77                                        | 20.01                                 | -3.76                   | -0.002%               |
| <b>Personal Income<sup>1, 2</sup> (\$M)</b>    |                                               |                                       |                         |                       |
| Feed, forage, grain, and other crops           | -1.11                                         | 0.02                                  | -1.09                   | -0.282%               |
| Vegetable, truck crops                         | -0.16                                         | 0.01                                  | -0.15                   | -0.035%               |
| Orchard, vineyard crops                        | -0.16                                         | 0.01                                  | -0.15                   | -0.014%               |
| Agriculture and forestry support activities    | -0.24                                         | 1.30                                  | 1.06                    | 0.260%                |
| All other sectors                              | -10.49                                        | 11.63                                 | 1.14                    | 0.001%                |
| Total                                          | -12.16                                        | 12.97                                 | 0.81                    | 0.001%                |
| <b>Employment<sup>3</sup> (Number of jobs)</b> |                                               |                                       |                         |                       |
| Feed, forage, grain, and other crops           | -25.8                                         | 0.5                                   | -25.3                   | -0.281%               |
| Vegetable, truck crops                         | -1.0                                          | 0.0                                   | -1.0                    | -0.038%               |
| Orchard, vineyard crops                        | -1.8                                          | 0.1                                   | -1.7                    | -0.013%               |
| Agriculture and forestry support activities    | -8.6                                          | 45.7                                  | 37.1                    | 0.260%                |
| All other sectors                              | -151.9                                        | 167.2                                 | 15.3                    | 0.001%                |
| Total                                          | -189.1                                        | 213.5                                 | 24.4                    | 0.001%                |

Source: IMPLAN model output based on estimated agricultural and program cost impacts.

<sup>1</sup> Includes direct, indirect, and induced effects in 2007 U.S. dollars (\$).

<sup>2</sup> Personal income includes employee compensation, proprietor income, and other property income.

<sup>3</sup> Includes direct, indirect, and induced full- and part-time jobs.

**Table 4-21. Alternative 4: Change in Industrial Output, Personal Income, and Employment in the San Joaquin River Basin Relative to Alternative 1 Levels**

| <b>Sector</b>                                  | <b>Change Related to Agricultural Impacts</b> | <b>Change Related to Cost Impacts</b> | <b>Total Net Change</b> | <b>Percent Change</b> |
|------------------------------------------------|-----------------------------------------------|---------------------------------------|-------------------------|-----------------------|
| <b>Output<sup>1</sup> (\$M)</b>                |                                               |                                       |                         |                       |
| Feed, forage, grain, and other crops           | -6.22                                         | 0.01                                  | -6.21                   | -0.840%               |
| Vegetable, truck crops                         | -0.51                                         | 0.02                                  | -0.49                   | -0.058%               |
| Orchard, vineyard crops                        | -2.72                                         | 0.01                                  | -2.71                   | -0.104%               |
| Agriculture and forestry support activities    | -0.84                                         | 1.24                                  | 0.40                    | 0.053%                |
| All other sectors                              | -20.69                                        | 19.42                                 | -1.27                   | -0.001%               |
| Total                                          | -30.98                                        | 20.70                                 | -10.28                  | -0.005%               |
| <b>Personal Income<sup>1, 2</sup> (\$M)</b>    |                                               |                                       |                         |                       |
| Feed, forage, grain, and other crops           | -1.77                                         | 0.002                                 | -1.768                  | -0.876%               |
| Vegetable, truck crops                         | -0.28                                         | 0.01                                  | -0.27                   | -0.037%               |
| Orchard, vineyard crops                        | -1.44                                         | 0.01                                  | -1.43                   | -0.090%               |
| Agriculture and forestry support activities    | -0.72                                         | 1.05                                  | 0.33                    | 0.052%                |
| All other sectors                              | -10.97                                        | 12.23                                 | 1.26                    | 0.001%                |
| Total                                          | -15.18                                        | 13.30                                 | -1.88                   | -0.002%               |
| <b>Employment<sup>3</sup> (Number of jobs)</b> |                                               |                                       |                         |                       |
| Feed, forage, grain, and other crops           | -26.1                                         | 0.0                                   | -26.1                   | -0.876%               |
| Vegetable, truck crops                         | -1.5                                          | 0.1                                   | -1.4                    | -0.036%               |
| Orchard, vineyard crops                        | -12.4                                         | 0.1                                   | -12.3                   | -0.090%               |
| Agriculture and forestry support activities    | -30.3                                         | 44.6                                  | 14.3                    | 0.053%                |
| All other sectors                              | -155.4                                        | 175.3                                 | 19.9                    | 0.002%                |
| Total                                          | -225.7                                        | 220.1                                 | -5.6                    | 0.000%                |

Source: IMPLAN model output based on estimated agricultural and program cost impacts.

<sup>1</sup> Includes direct, indirect, and induced effects in 2007 U.S. dollars (\$).

<sup>2</sup> Personal income includes employee compensation, proprietor income, and other property income.

<sup>3</sup> Includes direct, indirect, and induced full- and part-time jobs.



**Table 4-22. Alternative 4: Change in Value of Industrial Output, Personal Income, and Employment in the Tulare Lake Basin from Alternative 1 Levels**

| Sector                                         | Change Related to Agricultural Impacts | Change Related to Cost Impacts | Total Net Change | Percent Change |
|------------------------------------------------|----------------------------------------|--------------------------------|------------------|----------------|
| <b>Output<sup>1</sup> (\$M)</b>                |                                        |                                |                  |                |
| Feed, forage, grain, and other crops           | -0.95                                  | 0.01                           | -0.94            | -0.050%        |
| Vegetable, truck crops                         | -0.08                                  | 0.02                           | -0.06            | -0.003%        |
| Orchard, vineyard crops                        | -0.25                                  | 0.01                           | -0.24            | -0.004%        |
| Agriculture and forestry support activities    | -0.12                                  | 0.90                           | 0.78             | 0.033%         |
| All other sectors                              | -10.17                                 | 12.47                          | 2.30             | 0.002%         |
| Total                                          | -11.57                                 | 13.41                          | 1.84             | 0.001%         |
| <b>Personal Income<sup>1, 2</sup> (\$M)</b>    |                                        |                                |                  |                |
| Feed, forage, grain, and other crops           | -0.32                                  | 0.004                          | -0.316           | -0.059%        |
| Vegetable, truck crops                         | -0.04                                  | 0.01                           | -0.03            | -0.003%        |
| Orchard, vineyard crops                        | -0.14                                  | 0.005                          | -0.135           | -0.006%        |
| Agriculture and forestry support activities    | -0.14                                  | 0.74                           | 0.60             | 0.031%         |
| All other sectors                              | -5.25                                  | 7.64                           | 2.39             | 0.004%         |
| Total                                          | -5.89                                  | 8.40                           | 2.51             | 0.004%         |
| <b>Employment<sup>3</sup> (Number of jobs)</b> |                                        |                                |                  |                |
| Feed, forage, grain, and other crops           | -4.8                                   | 0.1                            | -4.7             | -0.057%        |
| Vegetable, truck crops                         | -0.1                                   | 0.1                            | -0.3             | -0.004%        |
| Orchard, vineyard crops                        | -1.6                                   | 0.1                            | -1.5             | -0.006%        |
| Agriculture and forestry support activities    | -5.0                                   | 37.6                           | 32.6             | 0.033%         |
| All other sectors                              | -85.3                                  | 124.1                          | 38.8             | 0.004%         |
| Total                                          | -96.8                                  | 162.0                          | 65.2             | 0.006%         |

Source: IMPLAN model output based on estimated agricultural and program cost impacts.

<sup>1</sup> Includes direct, indirect, and induced effects in 2007 U.S. dollars (\$).

<sup>2</sup> Personal income includes employee compensation, proprietor income, and other property income.

<sup>3</sup> Includes direct, indirect, and induced full- and part-time jobs.

#### 4.4.4.2 Personal Income

Under Alternative 4, annual net personal income changes would be positive for the Sacramento River Basin and Tulare Lake Basin regions but negative for the San Joaquin River Basin region. Net changes in all three regions, however, would be relatively minor compared to income levels under Alternative 1. In the Sacramento River Basin and Tulare Lake Basin regions, positive personal income changes generated by Program compliance spending would more than offset adverse changes caused by reduced agricultural production and grower profitability, with net income increasing by 0.004 percent in the Tulare Lake Basin region and by 0.001 percent in the Sacramento River Basin region (Tables 4-20 and 4-22). In the San Joaquin River Basin region, the net income change would be negative, with regional income falling by 0.002 percent (Table 4-21). In the agricultural production sectors of the regional economies, personal income reductions would be concentrated in the FFGO sectors of both the San Joaquin River Basin and Sacramento River Basin regions, where personal income would fall by 0.9 percent and 0.3 percent, respectively.

#### **4.4.4.3 Employment**

As with personal income effects, employment effects would vary across the three economic regions under Alternative 4, with small net employment gains in the Tulare Lake Basin and Sacramento River Basin regions and a small net employment reduction in the San Joaquin River Basin region. In the Tulare Lake Basin and Sacramento River Basin regions, the adverse employment effects of reduced agricultural production and grower profitability would be more than offset by the positive employment effects of compliance spending under Alternative 4. Net employment gains would be relatively small but would be largest in the Tulare Lake Basin region, where 65 jobs would be gained, a 0.006 percent increase over the Alternative 1 employment level (Table 4-22). In the Sacramento River Basin region, net employment would increase by 24 jobs (0.001 percent) (Table 4-20). Conversely, in the San Joaquin River Basin, net employment would fall by about six jobs, a decrease of less than 0.001 percent (Table 4-21). Among the sectors of the regional economies, small job losses would occur in the agricultural sectors, with losses concentrated in the FFGO sectors of the San Joaquin River Basin and the Sacramento River Basin regions, where 0.9 percent (26 jobs) and 0.3 percent (25 jobs) of the jobs, respectively, in these sectors would be lost relative to Alternative 1 levels.

#### **4.4.5 Alternative 5 – Change Relative to Alternative 1**

Compared to Alternative 1, the annual changes in agricultural production and grower profitability under Alternative 5 would be substantially larger than under the other Program alternatives, resulting in much larger output, personal income, and employment effects on the agricultural sectors of all three regional economies, particularly in the San Joaquin River Basin and Sacramento River Basin regions. The estimated annual gross value of agricultural production under Alternative 5 would fall by 2.1 percent (\$268.7 million in 2007 dollars) across the three regions compared to production value under Alternative 1 (see Table 3-19, Farm Income and Production Analysis section). The annual increase in compliance- and management practice-implementation spending under Alternative 5 also would be substantially higher than under Alternative 1, with acreage-adjusted costs increasing by 187 percent (\$841.7 million). As described below, the net result of these changes on the overall regional economies would be mixed, with the adverse effects of reduced agricultural production and grower profitability offsetting the beneficial effects of increased Program compliance spending in the Sacramento River Basin and San Joaquin River Basin regions, but with the beneficial effects of increased compliance spending outweighing the adverse effects of reduced agricultural production and grower profitability in the Tulare Lake Basin region. Adverse effects, however, would occur in the agricultural economies of all three regions.

##### **4.4.5.1 Total Industry Output**

As discussed above, net industrial output in the Sacramento River Basin and San Joaquin River Basin regions would decline under Alternative 5 compared to Alternative 1 levels because the effects of reductions in agricultural production and grower profitability would offset gains generated by Program compliance spending. In the context of regional economies, the changes would be small, with reductions of about 0.4 percent in both regions (Tables 4-23 and 4-24). In the Tulare Lake Basin region, the benefits of compliance spending would offset the adverse agricultural-related effects, with net output increasing by 0.1 percent (Table 4-25).

Percentage reductions in total output for agricultural sectors would be much larger in the San Joaquin River Basin and Sacramento River Basin regions than in the Tulare Lake Basin region, with

reductions concentrated in the FFGO sectors. Output in this sector would be reduced by about 12.0 percent in the San Joaquin River Basin region and by 8.0 percent in the Sacramento River Basin region compared to Alternative 1 output levels; in the Tulare Lake Basin region, the net output change would be about 0.8 percent (Tables 4-23, 4-24, and 4-25). Output also would fall by appreciable amounts in the other agricultural sectors, including the VEGT sector (reductions ranging from 0.2 to 1.0 percent across the three regions) and the ORVIN sector (reductions ranging from 0.2 to 0.5 percent). Reductions in the production of FFGO crops, including hay and forage for livestock, could have adverse effects on the livestock production sector of the regional economies. A detailed analysis of potential effects on livestock production and other forward-linked sectors was beyond the scope of the analysis conducted for this chapter. The potential regional economic effects from reductions in livestock production, however, are discussed in Section 4.5.3, Potential Effects from Changes in Livestock Production.

**Table 4-23. Alternative 5: Change in Industrial Output, Personal Income, and Employment in the Sacramento River Basin Relative to Alternative 1 Levels**

| Sector                                         | Change Related to Agricultural Impacts | Change Related to Cost Impacts | Total Net Change | Percent Change |
|------------------------------------------------|----------------------------------------|--------------------------------|------------------|----------------|
| <b>Output<sup>1</sup> (\$M)</b>                |                                        |                                |                  |                |
| Feed, forage, grain, and other crops           | -106.36                                | 6.92                           | -99.44           | -7.960%        |
| Vegetable, truck crops                         | -6.56                                  | 0.18                           | -6.38            | -1.037%        |
| Orchard, vineyard crops                        | -9.14                                  | 0.21                           | -8.93            | -0.461%        |
| Agriculture and forestry support activities    | -7.47                                  | 1.98                           | -5.49            | -1.212%        |
| All other sectors                              | -385.34                                | 402.03                         | 16.69            | 0.007%         |
| Total                                          | -514.87                                | 411.32                         | -103.55          | -0.045%        |
| <b>Personal Income<sup>1, 2</sup> (\$M)</b>    |                                        |                                |                  |                |
| Feed, forage, grain, and other crops           | -29.21                                 | 1.90                           | -27.31           | -7.068%        |
| Vegetable, truck crops                         | -3.68                                  | 0.10                           | -3.58            | -0.828%        |
| Orchard, vineyard crops                        | -4.83                                  | 0.11                           | -4.72            | -0.429%        |
| Agriculture and forestry support activities    | -6.49                                  | 1.72                           | -4.77            | -1.171%        |
| All other sectors                              | -215.47                                | 238.47                         | 23.00            | 0.018%         |
| Total                                          | -259.68                                | 242.30                         | -17.38           | -0.013%        |
| <b>Employment<sup>3</sup> (Number of jobs)</b> |                                        |                                |                  |                |
| Feed, forage, grain, and other crops           | -680.1                                 | 44.2                           | -635.9           | -7.069%        |
| Vegetable, truck crops                         | -22.5                                  | 0.6                            | -21.9            | -0.829%        |
| Orchard, vineyard crops                        | -56.4                                  | 1.3                            | -55.1            | -0.430%        |
| Agriculture and forestry support activities    | -227.8                                 | 60.4                           | -167.4           | -1.171%        |
| All other sectors                              | -3,084.3                               | 3,373.6                        | 289.3            | 0.016%         |
| Total                                          | -4,071.1                               | 3,480.1                        | -591.0           | -0.032%        |

Source: IMPLAN model output based on estimated agricultural and program cost impacts.

<sup>1</sup> Includes direct, indirect, and induced effects in 2007 U.S. dollars (\$).

<sup>2</sup> Personal income includes employee compensation, proprietor income, and other property income.

<sup>3</sup> Includes direct, indirect, and induced full- and part-time jobs.

**Table 4-24. Alternative 5: Change in Industrial Output, Personal Income, and Employment in the San Joaquin River Basin Relative to Alternative 1 Levels**

| <b>Sector</b>                                  | <b>Change Related to Agricultural Impacts</b> | <b>Change Related to Cost Impacts</b> | <b>Total Net Change</b> | <b>Percent Change</b> |
|------------------------------------------------|-----------------------------------------------|---------------------------------------|-------------------------|-----------------------|
| <b>Output<sup>1</sup> (\$M)</b>                |                                               |                                       |                         |                       |
| Feed, forage, grain, and other crops           | -91.62                                        | 3.23                                  | -88.39                  | -11.959%              |
| Vegetable, truck crops                         | -6.70                                         | 0.19                                  | -6.51                   | -0.764%               |
| Orchard, vineyard crops                        | -12.46                                        | 0.16                                  | -12.30                  | -0.473%               |
| Agriculture and forestry support activities    | -8.99                                         | 1.56                                  | -7.43                   | -0.991%               |
| All other sectors                              | -250.30                                       | 266.04                                | 15.74                   | 0.007%                |
| Total                                          | -370.07                                       | 271.18                                | -98.89                  | -0.043%               |
| <b>Personal Income<sup>1, 2</sup> (\$M)</b>    |                                               |                                       |                         |                       |
| Feed, forage, grain, and other crops           | -26.04                                        | 0.92                                  | -25.12                  | -12.452%              |
| Vegetable, truck crops                         | -3.66                                         | 0.10                                  | -3.56                   | -0.485%               |
| Orchard, vineyard crops                        | -6.61                                         | 0.08                                  | -6.53                   | -0.410%               |
| Agriculture and forestry support activities    | -7.63                                         | 1.33                                  | -6.30                   | -0.991%               |
| All other sectors                              | -132.70                                       | 156.33                                | 23.63                   | 0.026%                |
| Total                                          | -176.64                                       | 158.76                                | -17.88                  | -0.019%               |
| <b>Employment<sup>3</sup> (Number of jobs)</b> |                                               |                                       |                         |                       |
| Feed, forage, grain, and other crops           | -384.9                                        | 13.6                                  | -371.3                  | -12.455%              |
| Vegetable, truck crops                         | -19.5                                         | 0.5                                   | -19.0                   | -0.485%               |
| Orchard, vineyard crops                        | -56.5                                         | 0.7                                   | -55.8                   | -0.409%               |
| Agriculture and forestry support activities    | -324.5                                        | 56.4                                  | -268.1                  | -0.991%               |
| All other sectors                              | -1,871.0                                      | 2,195.2                               | 324.2                   | 0.028%                |
| Total                                          | -2,656.4                                      | 2,266.4                               | -390.0                  | -0.032%               |

Source: IMPLAN model output based on estimated agricultural and program cost impacts.

<sup>1</sup> Includes direct, indirect, and induced effects in 2007 U.S. dollars (\$).

<sup>2</sup> Personal income includes employee compensation, proprietor income, and other property income.

<sup>3</sup> Includes direct, indirect, and induced full- and part-time jobs.

**Table 4-25. Alternative 5: Change in Value of Industrial Output, Personal Income, and Employment in the Tulare Lake Basin from Alternative 1 Levels**

| Sector                                         | Change Related to Agricultural Impacts | Change Related to Cost Impacts | Total Net Change | Percent Change |
|------------------------------------------------|----------------------------------------|--------------------------------|------------------|----------------|
| <b>Output<sup>1</sup> (\$M)</b>                |                                        |                                |                  |                |
| Feed, forage, grain, and other crops           | -26.90                                 | 40.95                          | 14.05            | 0.755%         |
| Vegetable, truck crops                         | -5.21                                  | 0.67                           | -4.54            | -0.220%        |
| Orchard, vineyard crops                        | -13.52                                 | 0.51                           | -13.01           | -0.221%        |
| Agriculture and forestry support activities    | -4.56                                  | 4.48                           | -0.08            | -0.003%        |
| All other sectors                              | -593.38                                | 745.84                         | 152.46           | 0.120%         |
| Total                                          | -643.57                                | 792.45                         | 148.88           | 0.107%         |
| <b>Personal Income<sup>1, 2</sup> (\$M)</b>    |                                        |                                |                  |                |
| Feed, forage, grain, and other crops           | -9.05                                  | 13.78                          | 4.73             | 0.877%         |
| Vegetable, truck crops                         | -2.36                                  | 0.36                           | -2.00            | -0.184%        |
| Orchard, vineyard crops                        | -6.89                                  | 0.27                           | -6.62            | -0.311%        |
| Agriculture and forestry support activities    | -3.78                                  | 3.70                           | -0.08            | -0.004%        |
| All other sectors                              | -308.65                                | 422.07                         | 113.42           | 0.187%         |
| Total                                          | -330.73                                | 440.18                         | 109.45           | 0.165%         |
| <b>Employment<sup>3</sup> (Number of jobs)</b> |                                        |                                |                  |                |
| Feed, forage, grain, and other crops           | -138.0                                 | 210.1                          | 72.1             | 0.877%         |
| Vegetable, truck crops                         | -21.7                                  | 2.8                            | -18.9            | -0.222%        |
| Orchard, vineyard crops                        | -86.6                                  | 3.3                            | -83.3            | -0.322%        |
| Agriculture and forestry support activities    | -191.0                                 | 187.6                          | -3.4             | -0.003%        |
| All other sectors                              | -4,990.2                               | 6,410.7                        | 1,420.5          | 0.159%         |
| Total                                          | -5,427.5                               | 6,814.5                        | 1,387.0          | 0.134%         |

Source: IMPLAN model output based on estimated agricultural and program cost impacts.

<sup>1</sup> Includes direct, indirect, and induced effects in 2007 U.S. dollars (\$).

<sup>2</sup> Personal income includes employee compensation, proprietor income, and other property income.

<sup>3</sup> Includes direct, indirect, and induced full- and part-time jobs.

#### 4.4.5.2 Personal Income

Annual impacts on personal income from implementation of Alternative 5 would be similar to those for industrial output, with net income decreasing in the Sacramento River Basin and San Joaquin River Basin regions and increasing in the Tulare Lake Basin region relative to levels under Alternative 1. The net decrease in income would be largest in the San Joaquin River Basin region, where income would fall by \$17.9 million, or by about 0.02 percent of the regional level under Alternative 1 (Table 4-24). The reduction in net income would be similar (\$17.4 million) in the Sacramento River Basin region (Table 4-23). Net personal income would increase by an estimated \$109.5 (0.17 percent) million in the Tulare Lake Basin region because of large increases in spending on management practice implementation and Water Board staffing (Table 4-25).

In the agricultural economies of the three regions, personal income impacts would be adverse, particularly in the FFGO sectors of the San Joaquin River Basin and Sacramento River Basin regions.



In this sector, personal income would be reduced by 12.5 percent in the San Joaquin River Basin and by 7.1 percent in the Sacramento River Basin regions, compared to income levels under Alternative 1 (Tables 4-23, 4-24, and 4-25). Personal income also would fall in other agricultural sectors, including the VEGT sector, with reductions ranging from 0.18 percent to 0.82 percent, and the ORVIN sector, with reductions ranging from 0.31 percent to 0.43 percent.

#### **4.4.5.3 Employment**

Under Alternative 5, employment losses resulting from reduced agricultural output and grower profitability would outweigh employment gains generated by compliance spending in two of the three economic regions, with net losses of 591 jobs (0.03 percent) in the Sacramento River Basin region and 390 jobs (0.03 percent) in the San Joaquin River Basin region (Tables 4-23 and 4-24). In the Tulare Lake Basin region, net employment would increase by 1,387 jobs (0.13 percent) largely because of a substantial increase in spending on management practice implementation and Water Board staffing (Table 4-25).

Job losses in regional agricultural economies would be larger than under the other alternatives, with losses most severe in the FFGO sectors of the Sacramento River Basin and San Joaquin River Basin regions. Employment in this sector would fall by 636 jobs (7.1 percent of the Alternative 1 employment level) in the Sacramento River Basin region, and by 371 jobs (12.5 percent) in the San Joaquin River Basin region (Tables 4-23 and 4-24). While not as severely affected, other crop-producing sectors also would experience job losses. Net employment reductions in the VEGT sector would range from 19 jobs in the Tulare Lake Basin region (0.22 percent) to 22 jobs in the Sacramento River Basin region (0.83 percent). In the ORVIN sector, net employment losses would range from 55 jobs (0.43 percent) in the Sacramento River Basin region to 83 jobs (0.32 percent) in the Tulare Lake Basin region.

Under Alternative 5, net impacts on employment in the agriculture and forestry support activities sectors in the San Joaquin River Basin and Sacramento River Basin regions also would be larger than under the other alternatives. Although this sector would not be directly affected by changes in agricultural production, it would be indirectly affected as farm operators decrease their need for acquiring services from this sector, which provides soil preparation, planting, and harvesting services; post-harvest crop support (e.g., cleaning, drying, shelling, sorting, packing); farm labor through farm labor contractors; and contractual farm management services. Impacts on the agriculture and forestry support activities sector would include the net loss of 268 jobs in the San Joaquin River Basin region (1.0 percent of Alternative 1 employment levels) and 167 jobs in the Sacramento River Basin region (1.2 percent) (Tables 4-23 and 4-24). Job losses in this sector would be minor in the Tulare Lake Basin region (Table 4-25).

## **4.5 Summary and Conclusions**

This section provides a summary of the estimated net changes in industrial output, personal income, and employment for each alternative and discusses conclusions of the regional economic assessment of the Program alternatives.

### 4.5.1 Summary Comparison of Alternatives 2–5 to Alternative 1

Tables 4-26 through 4-28 provide a summary comparison of analysis results for Alternatives 2 through 5, all compared to Alternative 1. These results reflect the net changes generated by changes in agricultural production and changes in compliance cost spending under each alternative.

**Table 4-26. Summary of Net Changes in Industrial Output (\$M) by Basin from Alternative 1**

| Basin             | Alternative 2 | Alternative 3 | Alternative 4 | Alternative 5 |
|-------------------|---------------|---------------|---------------|---------------|
| Sacramento River  | -0.78         | -7.69         | -3.76         | -103.55       |
| Percent Change    | 0.000%        | -0.003%       | -0.002%       | -0.045%       |
| San Joaquin River | -8.86         | -4.62         | -10.28        | -98.89        |
| Percent Change    | -0.004%       | -0.002%       | -0.005%       | -0.043%       |
| Tulare Lake       | 0.29          | 7.71          | 1.84          | 148.88        |
| Percent Change    | 0.000%        | 0.006%        | 0.001%        | 0.107%        |

**Table 4-27. Summary of Net Changes in Personal Income (\$M) by Basin from Alternative 1**

| Basin             | Alternative 2 | Alternative 3 | Alternative 4 | Alternative 5 |
|-------------------|---------------|---------------|---------------|---------------|
| Sacramento River  | -0.21         | 11.21         | 0.81          | -17.38        |
| Percent Change    | 0.000%        | 0.008%        | 0.001%        | -0.013%       |
| San Joaquin River | -4.00         | 14.80         | -1.88         | -17.88        |
| Percent Change    | -0.004%       | 0.015%        | -0.002%       | -0.019%       |
| Tulare Lake       | 0.41          | 5.69          | 2.51          | 109.45        |
| Percent Change    | 0.001%        | 0.009%        | 0.004%        | 0.165%        |

**Table 4-28. Summary of Net Changes in Employment (Number of Jobs) by Basin from Alternative 1**

| Basin             | Alternative 2 | Alternative 3 | Alternative 4 | Alternative 5 |
|-------------------|---------------|---------------|---------------|---------------|
| Sacramento River  | -2.1          | 110.9         | 24.4          | -591.0        |
| Percent Change    | 0.000%        | 0.006%        | 0.001%        | -0.032%       |
| San Joaquin River | -58.7         | 199.0         | -5.6          | -390.0        |
| Percent Change    | -0.005%       | 0.017%        | 0.000%        | -0.032%       |
| Tulare Lake       | 7.3           | 167.2         | 65.2          | 1,387.0       |
| Percent Change    | 0.001%        | 0.016%        | 0.006%        | 0.134%        |

### 4.5.2 Conclusions

The results of the regional economic analysis show mixed results across Alternatives 2–5, particularly in the Sacramento River Basin and San Joaquin River Basin regions. In the Tulare Lake Basin Region, the beneficial net regional economic effects of increased spending on compliance and management practice implementation would more than offset the negative effects caused by reduced agricultural production and decreased grower profitability under all alternatives, although

the changes would not be large in the context of the overall regional economy. In the Sacramento River Basin and San Joaquin River Basin regions, however, net regional economic effects would be generally positive under Alternatives 3 and 4 and negative under Alternatives 2 and 5, although effects in the San Joaquin River Basin region would also be negative under Alternative 4.

The largest net regional economic effects of Program implementation would occur under Alternatives 3 and 5, with effects driven primarily by substantial changes in Water Board administrative staffing costs under both alternatives and by a large change in management practice costs under Alternative 5. As shown by Tables 4-26 through 4-28, these net changes, as well as those under Alternatives 2 and 4, would be minor in the context of the overall economies of each region, with adverse output, personal income, and employment changes in the Sacramento River Basin and San Joaquin River Basin regions generally below 0.05 percent of Alternative 1 levels and beneficial effects in all regions generally below 0.20 percent of Alternative 1 levels.

As discussed in Chapter 1, Analytical Objectives, Approach and Limitations, the results of the regional economic impact analysis may be biased by certain limitations of using the IMPLAN input-output model to estimate regional economic effects. These limitations likely result in underestimating adverse regional economic effects attributable to potential effects on forward-linked industries. The extent of the underestimation of adverse agriculture-related impacts, however, is not known, but the exclusion of these effects from the analysis underestimates the net adverse effects and overestimates the net beneficial effects of the alternatives. Including these forward-linked effects would be expected to result in more adverse regional economic effects across the alternatives and regions than those summarized in Tables 4-26 through 4-28. The potential implications of including the forward-linked impacts of the alternatives on the study area's livestock sector are discussed in the following section.

### 4.5.3 Potential Effects from Changes in Livestock Production

Implementation of the Program alternatives would result in disproportionate effects on FFGO crops relative to the other crop categories. As discussed in Chapter 3, Farm Income and Production Analysis, the assessment of net income effects indicates substantial reductions in acreage of lands that produce hay and forage for livestock. Although forward-linked effects are not quantitatively analyzed in this regional economics assessment, effects from Program implementation likely would be largest on the livestock production and processing sectors.

Potential forward-linked effects on the value of livestock production alone are addressed in Section 3.5.2, Potential Effects on the Livestock Sector. This simplified assessment of potential effects on the livestock sector, which was conducted at the study area level, concluded that that for every dollar of lost value of forage and hay production in the study area, another 89 cents would be lost in value of livestock. Based on this estimate, the loss in forage and hay value would result in a corresponding additional loss in the value of livestock production ranging from \$1.0 million under Alternative 2 to \$90.6 million under Alternative 5 (Table 3-25). (Note that these losses are order-of-magnitude estimates based on the assumptions described in Section 3.5.2).

To carry this simplified assessment of livestock sector effects into the regional impact assessment, estimated changes in livestock production were input to the IMPLAN input-output model for the study area, resulting in the regional economic effects (direct, indirect, and induced) displayed in Table 4-29. These order-of-magnitude results imply that forward-linked effects on the livestock sector could reduce or fully offset the beneficial regional economic effects of Alternatives 3 and 4

and worsen the adverse regional economic effects of Alternatives 2 and 5 summarized in Tables 4-26 through 4-28.

**Table 4-29. Potential Regional Economic Effects Resulting from Changes in Value of Livestock Production in the Study Area, Compared to Alternative 1**

|                                                                                                                                                                                                                                                                                                                                                          | Alternative 2 | Alternative 3 | Alternative 4 | Alternative 5 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------------|---------------|---------------|
| Change in the value of industrial output (\$M)                                                                                                                                                                                                                                                                                                           | -\$2.3        | -\$30.4       | -\$10.3       | -\$207.1      |
| Change in personal income (\$M)                                                                                                                                                                                                                                                                                                                          | -\$0.7        | -\$9.9        | -\$3.3        | -\$67.3       |
| Change in employment (jobs)                                                                                                                                                                                                                                                                                                                              | -15.6         | -207.8        | -70.3         | -1,415.6      |
| Note: Includes the direct, indirect, and induced effects of changes in the value of livestock production, compared to Alternative 1. Effects in this table are presented for illustrative purposes. They are not estimated at the same level of detail as the irrigated crop losses but provide a sense of the relative scale of impacts by alternative. |               |               |               |               |

This analysis was intended to illustrate the additional economic effects of the alternatives on a key linked industry, namely the livestock production industry. It was not intended to provide a comprehensive evaluation of forward-linked effects. First, the output of the livestock production industry is further linked to sectors such as meat processing and dairy products. This additional link was not included. Second, crops besides forage and feed also are used as inputs by other sectors within the study area, such as food processing. An assessment of effects on these other forward-linked sectors was not part of this study. Results of the farm income analysis indicated that other crops would not be as affected as those linked to the livestock sector, so the forward-linked effects would also be smaller. Nevertheless, the exclusion of these additional forward-linked effects understates the total regional economic impacts of the Program alternatives.

## **5.1 Introduction**

This section describes the effects of the ILRP alternatives on costs to government entities responsible for administering and participating in the Program. The fiscal assessment of direct Program costs is largely based on the cost evaluation described previously in the Compliance and Best Management Practices Costs section of this report. See Section 2.4, Cost Information, for a full discussion of how costs for administering the Program were estimated. All costs presented in this chapter are in 2005 dollars.

Additionally, potential effects of the Program on local agencies that provide water supply services are discussed. Concerns regarding the effects of the Program on nitrates in Central Valley groundwater have been brought forward by residents and environmental justice groups during public scoping meetings and by long-term ILRP Advisory Workgroup members (Central Valley Water Board 2008). The major thrust of these concerns regards costs faced by Central Valley small communities to provide high quality drinking water in the face of nitrate pollution. These concerns, which may be affected to varying extents by the ILRP alternatives, have potential fiscal implications for certain small communities in the Central Valley that provide or fund local water supplies.

## **5.2 Existing Fiscal Conditions**

Currently, all costs to administer the Program in the Central Valley are borne by the Central Valley Water Board. Over recent years, staff costs to administer the Program are estimated to total about \$2.8 million annually (17.75 person years of staff time). About 82 percent of these costs are for Central Valley Water Board personnel in Sacramento, 15 percent for personnel in Fresno, and 3 percent for personnel in Redding. Funding for the program is split between the State of California and the grower/operators who are part of the Program. Annual state funding, which comes from the State General Fund, is about \$1.8 million, or two-thirds of total Program costs; grower fees paid to the state provide the remaining \$954,000, or one-third of Program costs.

No other state or local agencies currently incur costs for administering elements of the existing Program (Laputz pers. comm.)

## **5.3 Fiscal Effects of the Program Alternatives**

### **5.3.1 Alternative 1 – Change Relative to Existing Conditions**

Under Alternative 1, public costs to administer the Program are anticipated to stay the same as under existing conditions. Thus, costs to the Central Valley Water Board that would be financed by state general funds would continue at about \$1.8 million per year (Table 5-1). Grower fees would continue to fund the remaining \$954,000 in costs. Although other agencies (e.g., counties, the federal



NRCS) may decide to participate in certain elements of the Program (e.g., collecting fees), the Program would not mandate participation by other agencies. As a result, no costs are anticipated for other agencies.

**Table 5-1. Estimated Costs to the Central Valley Regional Water Quality Control Board to Administer the Program Alternatives**

| <b>Alternative</b> | <b>Cost Funded by the State General Fund</b> | <b>Cost Funded by Growers/Operators</b> | <b>Total Cost</b> |
|--------------------|----------------------------------------------|-----------------------------------------|-------------------|
| Alternative 1      | \$1,798,530                                  | \$953,965 <sup>1</sup>                  | \$2,752,495       |
| Alternative 2      | \$1,798,530                                  | \$1,999,945 <sup>2</sup>                | \$3,798,475       |
| Alternative 3      | \$1,798,530                                  | \$63,891,490 <sup>3</sup>               | \$65,690,020      |
| Alternative 4      | \$1,798,530                                  | \$6,956,750 <sup>4</sup>                | \$8,755,280       |
| Alternative 5      | \$1,798,530                                  | \$61,161,110 <sup>5</sup>               | \$62,959,640      |

Source: Compliance and management practice cost assessment conducted for this study. Costs are shown in 2005 dollars.

Notes:

<sup>1</sup> Includes grower fees shown in Table 2-17.

<sup>2</sup> Includes grower fees and additional Central Valley Water Board costs for groundwater management and program analysis and reporting shown in Table 2-18.

<sup>3</sup> Includes grower fees, local administration costs, Water Board certification of practices costs, and other Central Valley Water Board administrative staff costs shown in Table 2-19.

<sup>4</sup> Includes grower fees, tier analysis and administration costs, inspection costs, and other Central Valley Water Board administrative staff costs shown in Table 2-20.

<sup>5</sup> Includes grower fees, local administration costs, tier analysis and administration costs, inspection costs, and other Central Valley Water Board administrative staff costs shown in Table 2-21.

### 5.3.2 Alternative 2 – Change Relative to Alternative 1

Under Alternative 2, total costs to the Central Valley Water Board are estimated at \$3.8 million, an increase of about \$1.0 million over Alternative 1 costs (Table 5-1). It is anticipated that state funding of the program would remain unchanged in the future under the Program alternatives. As a result, costs funded by the State General Fund would remain unchanged from Alternative 1, at about \$1.8 million per year. Costs to be funded by private grower/operator fees, however, would grow to about \$2.0 million per year, an increase of about \$1.0 million over Alternative 1 funding. As a result of private growers/operators absorbing the additional administrative costs, Alternative 2 would result in no fiscal impact on state fiscal conditions. Additionally, as with Alternative 1, no other agencies are mandated to participate in administering elements of the Program under Alternative 2; therefore, no costs are anticipated for other state or local agencies.

### 5.3.3 Alternative 3 – Change Relative to Alternative 1

Annual costs to the Central Valley Water Board to administer the Program are estimated to grow substantially under Alternative 3, to about \$65.7 million, representing an annual increase of \$62.9 million over Alternative 1 costs (Table 5-1). Much of this increase would result from the Central Valley Water Board needing to hire additional staff to administer the Program activities under Alternative 3 (Table 2-19). As discussed previously, costs funded by the state are anticipated to remain unchanged from existing funding levels (\$1.8 million). As a result, the additional \$62.9

million in annual costs would be funded by fees paid by growers/operators. Because private growers/operators would absorb the additional administrative costs, Alternative 3 would result in no fiscal impact on state fiscal conditions. Additionally, no other agencies are mandated to participate in administering elements of the Program under Alternative 3; therefore, no costs are anticipated for other state or local agencies.

### **5.3.4 Alternative 4 – Change Relative to Alternative 1**

Under Alternative 4, annual costs to the Central Valley Water Board to administer the Program are estimated to grow to about \$8.8 million, an annual increase of about \$6.0 million over Alternative 1 costs (Table 5-1). As discussed previously, costs funded by the state are anticipated to remain unchanged from existing Program funding levels (\$1.8 million). As a result, the additional \$6.0 million in annual costs would be funded by fees paid by growers/operators. Because private growers/operators would absorb the additional administrative costs, Alternative 4 would result in no fiscal impact on state fiscal conditions. Additionally, no other agencies are mandated to participate in administering elements of the Program under Alternative 4; therefore, no costs are anticipated for other state or local agencies.

### **5.3.5 Alternative 5 – Change Relative to Alternative 1**

Similar to Alternative 3, costs to the Central Valley Water Board to administer the Program are anticipated to increase substantially under Alternative 5, with costs rising to an estimated \$63.0 million per year, an annual increase of about \$60.2 million over Alternative 1 costs (Table 5-1). Much of this increase would result from the Central Valley Water Board needing to hire additional staff to administer the Program activities under Alternative 5 (Table 2-21). As discussed previously, costs funded by the state are anticipated to remain unchanged from existing Program funding levels (\$1.8 million). As a result, the additional \$60.2 million in annual costs would be funded by fees paid by growers/operators. Because private growers/operators would absorb the additional administrative costs, Alternative 5 would result in no fiscal impact on state fiscal conditions. Additionally, no other agencies are mandated to participate in administering elements of the Program under Alternative 5; therefore, no costs are anticipated for other state or local agencies.

## **5.4 Potential Effects of the ILRP on Nitrate-Related Water-Quality Costs of Small Communities**

High nitrate levels in public drinking water wells are an important concern for some small communities in the Central Valley, especially to those communities that provide water to residents from a single source such as a domestic drinking water well. (As defined by the California Department of Public Health (DPH), small community water systems include those serving a population of 12,600 persons or less, or that have 4,500 or fewer water connections and individual public schools.) In response to high nitrate levels, some Central Valley communities have drilled new or deeper wells, consolidated supplies with other communities, or installed nitrate treatment systems. All of these responses incur costs for small communities. (Larger community systems can blend water from multiple sources to meet water quality standards.)

One of the goals of the long-term ILRP is to “ensure that irrigated agricultural discharges do not impair Central Valley communities and residents access to safe and reliable drinking water.”

Because the program could affect nitrate levels in groundwater supplies, this assessment examines cost information related to approaches to address nitrate problems for potentially affected small communities in the Central Valley that provide water service.

Irrigated agricultural operations apply fertilizers containing nitrogen. Leaching of nitrate from fertilizer application is one of many potential sources of nitrate waste discharge to groundwater supplies in the Central Valley. Using information obtained from long-term ILRP Advisory Workgroup members (environmental justice groups; Balazs [2008]; and DPH [2009 third quarter nitrate exceedance report]), it is estimated that agriculture is a potential contaminating activity (PCA) for 45 small communities with systems that have high nitrate levels (Laputz pers. comm.). Of these communities, 19 of them are currently eligible for Proposition 84 and/or Proposition 50 grants and loans (Table 5-2).

**Table 5-2. Small Community Systems with High Nitrate Levels with Agricultural PCA**

|                                                                                                                        |    |
|------------------------------------------------------------------------------------------------------------------------|----|
| Systems with DPH source water assessment with agriculture identified as PCA                                            | 45 |
| Systems with DPH source water assessment with agriculture identified as PCA and receiving Proposition 84 or 50 funding | 19 |
| Source: Laputz pers. comm.                                                                                             |    |
| Notes:                                                                                                                 |    |
| PCA = potential contaminating activity.                                                                                |    |
| DPH = California Department of Public Health.                                                                          |    |

Once a nitrate maximum contaminant level (MCL) is exceeded, responding to the problem can be complicated and expensive for communities. Based on a review of the most recent list of projects being considered for funding under Proposition 84 and past Proposition 50 funding, small communities have proposed one or more of the following responses: drill new wells, consolidate water supplies, remove nitrates in existing water supplies, or conduct feasibility projects (DPH 2009).

One approach to addressing high nitrate levels is well replacement. Costs associated with well replacement include consideration of the geology of the water supply area, well design and depth, well drilling, well development and pumping rate, and wellhead protection (Harter 2003). General cost estimates for replacing a well are identified in Table 5-3, and estimates of ongoing costs to maintain a well and treat a domestic drinking water supply over time are identified in Table 5-4.

**Table 5-3. Well Replacement Costs**

| Well Size (gallons/minute)                                                        | General Cost Assumptions                 |
|-----------------------------------------------------------------------------------|------------------------------------------|
| 10 to 30 gpm                                                                      | \$25,000 to \$50,000 (\$37, 500 average) |
| 30 to 100 gpm                                                                     | \$100,000                                |
| 1000 gpm to 2000 gpm                                                              | Can be as high as \$1,000,000            |
| Sources: well size—Simmons 2010; general cost assumptions—Newkirk and Darby 2008. |                                          |
| Note: Actual costs should be verified by local drilling company.                  |                                          |

**Table 5-4. Operation and Maintenance Costs for Wells (Groundwater Source)**

| <b>Items</b>                                   | <b>Cost Ranges (Newkirk and Darby 2008)</b>             |
|------------------------------------------------|---------------------------------------------------------|
| Labor per person                               | \$30,000 to \$60,000 per year                           |
| Power for <100 gpm size                        | \$3,000 to \$5,000 (average \$4,000)                    |
| Administration/fees                            | \$2,000 per year                                        |
| Analytical Costs - Groundwater                 | \$2,000 per year with no treatment or compliance issues |
| Maintenance - Groundwater                      | \$1,000 per year if done by operator                    |
| Sources: Simmons 2010; Newkirk and Darby 2008. |                                                         |

Based on the information in Tables 5-3 and 5-4, estimated costs for well replacement and for 1 year of associated operation and maintenance range between \$76,500 and \$1.085 million. This cost range compares with average costs of \$60,000 to \$2.0 million estimated for 204 well replacement projects concerning small community infrastructure improvements for chemical and nitrate contaminants from Proposition 84. Projects identified by Proposition 50 (20 projects) specifically identified for nitrate exceedances ranged from \$324,000 to \$2,000,000. As suggested by these estimates, the actual costs of funded projects addressing nitrate contamination are generally consistent with the well replacement estimates.

Costs for other types of responses (besides well replacement) to nitrate problems appear to be higher (University of Minnesota 2006). Nitrate treatment projects listed for Proposition 84 funding identify costs ranging from \$75,000 to \$3.0 million. In the University of Minnesota assessment, well replacement was the preferred method for estimating costs to address nitrate problems. Determining costs for other methods requires the collection and evaluation of substantial area-specific information (e.g., consolidation may be a cost-effective solution where other supplies are nearby, and treatment may be cost-effective provided that communities can maintain the system).

For the 19 communities with nitrate exceedances and agriculture listed as a PCA and that are receiving Proposition 84/50 funding, total project funding is estimated at \$18.5 million. For the 26 communities that are not currently receiving funding, costs are estimated at \$2.0 to \$29.0 million based on the range given in Tables 5-3 and 5-4 for well replacement projects (\$76,500–\$1.085 million). Considered together, total costs for all 45 communities are estimated to range from \$20.5 to \$47.5 million. Although the extent to which the Program would affect (reduce) nitrate contamination levels is unknown, the Program likely would have some benefit in terms of reducing the costs to these communities for addressing high nitrate levels in their drinking water supplies.

It is important to note that fertilizer use by agricultural operations is only one of several potential sources of nitrate in groundwater. For this assessment, only systems that DPH considers vulnerable to agricultural operations were considered. Information is not available, however, to characterize whether current agricultural operations are contributing nitrate to these community water systems (e.g., past operations could have caused contamination), and if so to what extent agricultural operations may be responsible. The primary intent of providing this assessment is to demonstrate the Central Valley Water Board's awareness of nitrate-related problems to small Central Valley communities, and to provide background information for considering potential benefits of the Program that are difficult to quantify.

## Chapter 6

# References Cited

---

- Balazs, C. 2009. *Just Water? Social disparities in nitrate contaminated drinking water in California's Central Valley*. Doctoral Dissertation, University of California. Berkeley, CA.
- CALFED Bay-Delta Program. 2000. *Final Programmatic EIR/EIS*. CALFED Bay-Delta Program. Sacramento, CA.
- California Certified Organic. 2010. Welcome to CCOF Certification. Available: <<http://www.ccof.org/certification.php>>. Accessed: April 2010.
- California County Agricultural Commissioners. 2000–2004. Annual Crop Reports. Counties of Butte, Colusa, Contra Costa, Fresno, Glenn, Kern, Kings, Madera, Merced, Sacramento, San Benito, San Joaquin, Santa Clara, Shasta, Solano, Stanislaus, Sutter, Tehama, Tulare, Yolo.
- California Department of Pesticide Regulation. 2010. Ground Water Protection Program. Available: <<http://www.cdpr.ca.gov/docs/emon/grndwtr/index.htm>>. Accessed: April 2010.
- California Department of Public Health (DPH). 2009. Proposition 84 Section 75022—Second round project priority list small community infrastructure improvements for chemical and nitrate contaminants. January. Available: <<http://www.cdph.ca.gov/services/funding/Documents/Prop84/Prop84%20Section75022-Chem-PPL-01-30-09.pdf>>.
- California Department of Water Resources. 2005. California Water Plan Update 2005. Bulletin 160-05. Sacramento, CA.
- California Department of Water Resources. 2001. Land & Water Use Data Collections. 2001 Statewide irrigation methods survey. Available: <<http://www.water.ca.gov/landwateruse/lwudatacoll.cfm>>. Accessed: April 2010.
- Central Valley Regional Water Quality Control Board. 2008. Irrigated Lands Regulatory Program public workshop comments response summary. September 29, 2008. Sacramento, CA.
- Central Valley Regional Water Quality Control Board. 2009. *The Water Quality Control Plan (Basin Plan) for the California Regional Water Quality Control Board Central Valley Region*. Fourth Edition. Revised September 2009 (with Approved Amendments). The Sacramento River Basin and the San Joaquin River Basin. California Regional Water Quality Control Board Central Valley Region. Sacramento, CA. Available: <[http://www.swrcb.ca.gov/rwqcb5/water\\_issues/basin\\_plans/](http://www.swrcb.ca.gov/rwqcb5/water_issues/basin_plans/)>. Accessed: July 2010.
- Department of Natural Resources and Environment, Michigan. 2010. 50 State SWP Survey. Available: <[http://www.michigan.gov/deq/0,1607,7-135-3313\\_3675\\_3695-201296--,00.html](http://www.michigan.gov/deq/0,1607,7-135-3313_3675_3695-201296--,00.html)>. Accessed: April 2010.
- Footprint. 2010. Creating tools for pesticide risk assessment and management in Europe. Available: <<http://sitem.herts.ac.uk/aeru/footprint/en/index.htm>>. Accessed: April 2010.



- Harter, T. Water Well Design and Construction, 2003, PUBLICATION 8086 University of California, Division of Agriculture and Natural Resources. Available: <[http://groundwater.ucdavis.edu/Publications/Harter\\_FWQFS\\_8086.pdf](http://groundwater.ucdavis.edu/Publications/Harter_FWQFS_8086.pdf)>.
- Lewis, J. 2010. Abandoned well survey program, Sacramento County. Environmental Compliance Division Abandoned Wells Program. Environmental Management Department. Mather, CA.
- Lubell, M. and A. Fulton. 2007. Local diffusion networks act as pathways to sustainable agriculture in the Sacramento River Valley. Available: <<http://CaliforniaAgriculture.ucop.edu>>. Accessed: April 2010.
- Moss Landing Marine Laboratory, 2010. SWAMP monitoring cost and protocol information. Available: <<http://swamp.mpsl.mlml.calstate.edu/>>. Accessed: April 2010.
- Natural Resources Conservation Service, 2005. Environmental quality incentive program, water quality practices. Available: <<http://www.nrcs.usda.gov/programs/eqip/>>. Accessed: April 2010.
- Natural Resources Conservation Service, 2010. Electronic field services technical guides. Available: <<http://www.nrcs.usda.gov/technical/efotg/>>. Accessed: April 2010.
- Newkirk, D. and J. Darby. 2008. Evaluation and Design of Small Water Systems Cost Estimating and SWS Grants/Funding. University of California Davis Press. Davis, CA.
- PAN. 2010. Pesticides database – chemicals. Available: <[http://www.pesticideinfo.org/Search\\_Chemicals.jsp](http://www.pesticideinfo.org/Search_Chemicals.jsp)>. Accessed: April 2010.
- Tourte, L., and M. Buchanan. 2003a. Estimated costs and potential benefits for and annually planted cover crop. UC Cooperative Extension. Available: <<http://groups.ucanr.org/signup/Fact%5FSheets/>>. Accessed: April 2010.
- Tourte, L., and M. Buchanan. 2003b. Estimated costs and potential benefits for a annually planted grassed filter strip. UC Cooperative Extension, Available: <<http://groups.ucanr.org/signup/Fact%5FSheets/>>. Accessed: April 2010.
- Tourte, L. and M. Buchanan. 2003c. Estimated costs and potential benefits for a perennial hedgerow planting. UC Cooperative Extension, Available: <<http://groups.ucanr.org/signup/Fact%5FSheets/>>. Accessed: April 2010.
- Troiano, J., F. Spurlock and J. Marade. 1999. Update of the California Vulnerability Soil Analysis for the Movement of Pesticides to Groundwater: October 14, 1999. State of California Environmental Protection Agency Department of Pesticide Regulation Environmental Monitoring and Assessment Program Environmental Hazards Assessment Program, Available: <<http://www.cdpr.ca.gov/docs/emon/pubs/ehapreps/eh0005.pdf>>. Accessed: July 2010.
- U.S. Army Corps of Engineers (USACE). 2006. Hamilton army airfield wetland restoration feasibility study, Novato, Marin County California. San Francisco District. San Francisco, CA. Available: <<http://www.spn.usace.army.mil/hamilton/summary.pdf>>. Accessed: July 2010.
- U.S. Department of the Interior, Bureau of Reclamation and U.S. Fish and Wildlife Service. 1999. Central Valley Project Improvement Act Programmatic Environmental Impact Statement and Technical Appendices. Mid-Pacific Region. Sacramento, CA.

U.S. Department of the Interior, Bureau of Reclamation. 2008. Upper San Joaquin River Basin Storage Investigation. Plan Formulation Report. Mid-Pacific Region. Sacramento, CA.

University of California, Cooperative Extension Service. 2000–2004. Department of Agricultural and Resource Economics. Cost of Production Studies. Various Crops and Dates. Davis, California. Available: <<http://coststudies.ucdavis.edu>>. Accessed: April 2010.

University of Minnesota. 2006. Drinking Water Protection Series, Nitrate Contamination—What is the Cost? May. Minnesota Department of Agriculture. St. Paul, MN. Available: <<http://www.mda.state.mn.us/en/protecting/waterprotection/drinkingwater.aspx>>. Accessed: July 2010.

## 6.1 Personal Communications

Blackman, K. Orchard crop agronomic crop consultant. Dellavalle Laboratories, Fresno, CA. 2010— Personal communication.

Challendar, B. Water quality, Natural Resources Conservation Service. Davis, CA. 2010— Personal communication.

Chilcotte, J. Senior Environmental Scientist. Surface Water Ambient Monitoring Program, Central Valley Water Board. Sacramento, CA. 2010— Personal communication.

Cone, D. Deputy General Manager. Regional groundwater monitoring, Kings River Coalition District, Fresno, CA. January 4, 2010—email communication to Adam Laputz, Engineer, Central Valley Water Board, Sacramento, CA.

Dickey, J. Principal Soil Scientist and Agronomist. CVSALT model preparation costs. Newfields, LLC, Sacramento CA., 2010— Personal communication.

Fry, B. Nutrient management and farm management planning, Natural Resources Conservation Service. Davis, CA. Date, 2010— Personal communication.

Huggins, D. Water Resource Control Engineer. Surface Water Ambient Monitoring Program, Central Valley Water Board. Davis, CA. 2010— Personal communication.

Kasapligil, D. Vineyard and vegetable crop agronomic crop consultant. Davis, CA. 2010— Personal communication.

Kreggen, A. Regional groundwater monitoring, California Department of Water Resources. Sacramento, CA. 2010— Personal communication.

Laputz, Adam. Engineer. Central Valley Water Board, Sacramento, CA. Transmitting small-community nitrate cost analysis. April 29, 2010—email communication to Megan Smith, ICF International, Sacramento, CA.

Marcus, Barry. 2010. Abandoned wells Sacramento County. Sacramento County Environmental Management Dept., Environmental Compliance Division, Sacramento CA.

Phillips, S. Hydrologist & Groundwater Specialist. Cost estimate for regional groundwater monitoring, U.S. Geological Service, Sacramento, CA. March 1, 2010— email communication to Adam Laputz, Engineer, Central Valley Water Board, Sacramento, CA.

- Simmons, H. Provost & Pritchard Consulting. Telephone communication with Central Valley Water Board staff. March 10, 2010.
- Quagliaroli, L. Senior Environmental Scientist, Pesticide Programs Division. Annual DPR well network program costs. Department of Pesticide Regulation, Sacramento, CA. February 18, 2010— email communication to Adam Laputz, Engineer, Central Valley Water Board, Sacramento, CA.
- Rathburn, H. Row crop agronomic crop consultant, Dellavalle Laboratories. Hanford, CA. 2010— Personal communication.
- Reid, C. Policy/Program Director, California Certified Organic Farmers (CCOF) 2010— Communication regarding organic certification, Available: <<http://www.ccof.org>>. Sacramento, CA.
- Schroeter, A. Farm planning and grower education, Central Coast Regional Water Quality Control Board. San Luis Obispo, CA. February 11, 2010— email communication to Adam Laputz, Engineer, Central Valley Water Board, Sacramento, CA.
- Troiano, J. Supervising Pesticide Use Specialist. Department of Pesticide Regulation, Abandoned wells. Sacramento, CA February 17, 2010—email communication to Mark Roberson, Sacramento, CA.

## Appendix A

# Variables Affecting Cost Analysis

---

This appendix reviews variables used in the analysis that, if changed, would affect the compliance and management costs estimates, and in turn would affect the farm income and production analysis, regional economic impacts, and fiscal effects.

### A.1 Land Use Information

The land use coverage for this analysis was based on California Department of Water Resources (DWR) land use survey results for the years 1999–2004. Updating this information to current day likely would show a reduction in low value–crop acreage and conversely an increase in higher value–crop acreage. Because there are more high-value acres in production, there would be less of an economic impact.

### A.2 Implemented Management Practices Baseline

Analogous to the land use information issue is the lack of information on the status of implemented management practices. A data set that provides this type of information would improve the accuracy of the analysis. Obviously if data show that there are more practices implemented than what have been accounted for in this analysis, the management practice costs would be reduced. The converse is true.

### A.3 Farming Units and Operations

From a land use perspective, agricultural operations of a single operator may be a contiguous operation that includes multiple fields, or an operator may have several fields spread out over multiple locations. If an operation is consolidated, the number of management practices could be reduced. The analysis as presented did not account such a configuration; it was conducted on a per-acre basis.

### A.4 Management Practice Cost Allocation and Net Benefit

Typically management practice costs used in this analysis originated from other agronomic objectives. For example, a grower may implement water management practices for conservation or cost reduction purposes, or nutrient management may be used to reduce the cost of an input. As another example, pressurized irrigation may be installed for multiple reasons, including labor savings, water scarcity, or because the grower needs to manipulate soil water content for yield purposes. Other benefits of management practice implementation, such as water and fertilizer savings, were considered in the economic analysis, although there may be additional benefits that

were not included. If additional benefits were considered, management practice costs likely would be reduced.

## A.5 Management Practice Implementation

This analysis was prepared to provide a sample of the sensitivity of the costs associated with implementing tailwater recovery systems on pasture lands. Tailwater recovery systems are designed to capture runoff and prevent it from entering downstream water bodies. Tailwater recovery systems are required when high- or very high-priority pesticides (Table 2-5) have been identified as constituents of concern (COC). Table A-1 gives the management practice costs for pasture with and without tailwater recovery systems. Overall, there is a 61% percent reduction in management practice costs when the tailwater recovery systems are removed.

**Table A-1. Total Management Practice Costs (2007\$) for Pasture Lands with and without the Implementation of Tailwater Recovery Systems**

| <b>Watershed</b>         | <b>Analysis with Tailwater Recovery Systems</b> | <b>Analysis without Tailwater Recovery Systems</b> |
|--------------------------|-------------------------------------------------|----------------------------------------------------|
| Ahwahnee                 | 2,196                                           | 2,196                                              |
| American River           | 2,162,052                                       | 837,404                                            |
| Butte-Sutter-Yuba        | 3,548,104                                       | 1,374,249                                          |
| Coast Range              | 0                                               | 0                                                  |
| Colusa Basin             | 5,065,174                                       | 1,975,453                                          |
| Cosumnes River           | 51,807                                          | 51,807                                             |
| Delta-Carbona            | 8,212,285                                       | 3,143,676                                          |
| Delta-Mendota Canal      | 11,292,128                                      | 4,365,874                                          |
| Grapevine                | 8,050                                           | 8,050                                              |
| Kaweah                   | 39                                              | 39                                                 |
| Kern River               | 10,034                                          | 10,034                                             |
| Kings                    | 86                                              | 86                                                 |
| Lake-Napa                | 540,505                                         | 209,204                                            |
| Mariposa                 | 0                                               | 0                                                  |
| Merced                   | 8,425                                           | 8,425                                              |
| North Valley Floor       | 5,155,611                                       | 1,993,313                                          |
| Pit River                | 518,551                                         | 518,551                                            |
| San Joaquin River        | 0                                               | 0                                                  |
| San Joaquin Valley Floor | 26,627,914                                      | 10,306,397                                         |
| Shasta-Tehama            | 5,807,443                                       | 2,247,784                                          |
| Solano-Yolo              | 10,876,944                                      | 4,209,946                                          |
| South Valley Floor       | 6,840,286                                       | 2,644,659                                          |
| Southern Sierra          | 3,102                                           | 3,102                                              |
| Stanislaus               | 1,398                                           | 1,398                                              |
| Sunflower Valley         | 1,559                                           | 1,559                                              |
| Tremblor                 | 0                                               | 0                                                  |



| <b>Watershed</b>         | <b>Analysis with Tailwater Recovery Systems</b> | <b>Analysis without Tailwater Recovery Systems</b> |
|--------------------------|-------------------------------------------------|----------------------------------------------------|
| Tuolumne                 | 2,516                                           | 2,516                                              |
| Upper Feather–Upper Yuba | 307,198                                         | 118,902                                            |
| Upper Mokelumne          | 0                                               | 0                                                  |
| <b>Total</b>             | <b>87,043,403</b>                               | <b>34,034,620</b>                                  |

This analysis shows that if a particular land use type does not use high- or very high–priority pesticides, there is the potential for a significant reduction in management practice costs. For example, if no high- or very high–priority pesticides were used on cherries, those acres would not be required to implement pressurized irrigation in watersheds where there are high- or very high–priority COC.