



CENTRAL VALLEY REGIONAL  
WATER QUALITY CONTROL BOARD

Amendments to the Water Quality Control  
Plan For the Sacramento River and  
San Joaquin River Basins

For

The Control of Diazinon and Chlorpyrifos  
Runoff into the Sacramento-San Joaquin  
Delta

*June 2006 Final Staff Report*



CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY



State of California  
*Arnold Schwarzenegger, Governor*

California Environmental Protection Agency  
*Linda S. Adams, Secretary*

**REGIONAL WATER QUALITY CONTROL BOARD  
CENTRAL VALLEY REGION**

*Robert Schneider, Chair  
Karl Longley, Vice Chair*

*Paul Betancourt, Member  
Alson Brizard, Member  
Christopher Cabaldon, Member  
Kate Hart, Member  
Sopac Mulholland, Member  
Dan Odenweller, Member*

*Pamela C. Creedon, Executive Officer*

11020 Sun Center Drive #200  
Rancho Cordova, CA 95670

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 adoption of an amendment to the Water Quality Control Plan for the Sacramento and San Joaquin River Basins (Resolution No R5-2006-0061). Mention of specific products does not represent endorsement of those products by the Regional Water Board.*

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY  
REGIONAL WATER QUALITY CONTROL BOARD  
CENTRAL VALLEY REGION

Amendments to the Water Quality Control  
Plan For the Sacramento River and  
San Joaquin River Basins

For

The Control of Diazinon and Chlorpyrifos  
Runoff into the Sacramento-San Joaquin  
Delta

*June 2006 Final Staff Report*

Report Prepared by:  
Daniel McClure, Water Resources Control Engineer  
Gene Davis, Engineering Geologist  
Joe Karkoski, Senior Water Resources Control Engineer  
Petra Lee, Environmental Scientist

## LIST OF ACRONYMS AND ABBREVIATIONS

|                      |  |
|----------------------|--|
| §                    | Section  |
| µg/L                 | micrograms/liter (0.10 µg/L = 100 ng/L)  |
| ACR                  | acute to chronic ratio   |
| avg                  | average  |
| Basin Plan           | Water Quality Control Plan for the Sacramento River and San Joaquin River Basins |
| BPTCP                | Bay Protection and Toxic Cleanup Program   |
| CCC                  | Criterion Continuous Concentration   |
| CDFG                 | California Department of Fish and Game   |
| CEQA                 | California Environmental Quality Act   |
| CFR                  | Code of Federal Regulations  |
| CMC                  | Criterion Maximum Concentration  |
| CRWQCB-CVR           | California Regional Water Quality Control Board – Central Valley Region          |
| CWA                  | Federal Clean Water Act  |
| CWC                  | California Water Code  |
| Delta                | Sacramento-San Joaquin Delta   |
| Delta Waterways      | Sacramento-San Joaquin Delta Waterways   |
| ds                   | downstream of  |
| DPR                  | California Department of Pesticide Regulation                                    |
| DWR                  | California Department of Water Resources   |
| ESA                  | Endangered Species Act   |
| g/day                | grams/day  |
| LA                   | Load Allocation  |
| lbs                  | pounds   |
| LC                   | Loading Capacity   |
| LOEC                 | lowest observed effect concentration   |
| MAA                  | Management Agency Agreement  |
| ng/L                 | nanograms/liter (100 ng/L = 0.10 µg/L)   |
| NOEC                 | no observed effect concentration   |
| NPDES                | National Pollution Discharge Elimination System                                  |
| NPS                  | nonpoint source  |
| nr                   | near   |
| OP                   | organophosphorous  |
| ppm                  | parts per million  |
| ppt                  | parts per thousand   |
| PERA                 | Probabilistic Ecological Risk Assessment   |
| Porter-Cologne       | Porter-Cologne Water Quality Control Act   |
| QA                   | quality assurance  |
| QC                   | quality control  |
| PUR                  | Pesticide Use Report   |
| Regional Water Board | California Regional Water Quality Control Board – Central Valley Region          |
| RPF                  | relative potency factor  |
| Sac R                | Sacramento River   |
| SJR                  | San Joaquin River  |
| SNARL                | Suggested No Adverse Response Level  |

|                      |   |
|----------------------|---|
| State Board or SWRCB | State Water Resources Control Board           |
| TAF                  | thousand acre-feet                            |
| TEQ                  | toxic equivalents                             |
| TIE                  | toxicity identification evaluation            |
| TMDL                 | Total Maximum Daily Load                      |
| USDA                 | United States Department of Agriculture       |
| USEPA                | United States Environmental Protection Agency |
| USGS                 | United States Geological Survey               |
| Water Code           | California Water Code                         |
| WDR                  | Waste Discharge Requirements                  |
| WLA                  | Waste Load Allocation                         |
| WQC                  | Water Quality Criteria                        |
| WQO                  | Water Quality Objective                       |

## TABLE OF CONTENTS

|          |  |            |
|----------|--|------------|
| <b>1</b> | <b><i>Executive Summary</i></b> .....  | <b>6</b>   |
| <b>2</b> | <b><i>Background</i></b> .....   | <b>9</b>   |
| 2.1      | <b>Watershed Areas to Be Considered</b> .....  | <b>9</b>   |
| 2.2      | <b>Sources, Transport and Effects of Diazinon and Chlorpyrifos in Surface Water</b><br>..... | <b>13</b>  |
| 2.3      | <b>Diazinon and Chlorpyrifos in the Delta and its Tributaries</b> .....                      | <b>16</b>  |
| 2.4      | <b>Need for an Amendment to the Basin Plan</b> .....   | <b>37</b>  |
| <b>3</b> | <b><i>Proposed Amendments to the Basin Plan</i></b> .....                                    | <b>38</b>  |
| 3.1      | <b>Additions to Chapter III, Water Quality Objectives</b> .....                              | <b>38</b>  |
| 3.2      | <b>Additions to Chapter IV, Implementation</b> .....   | <b>38</b>  |
| 3.3      | <b>Additions to Chapter 5, Surveillance and Monitoring</b> .....                             | <b>42</b>  |
| 3.4      | <b>Additions to Appendices</b> .....   | <b>43</b>  |
| <b>4</b> | <b><i>Beneficial Uses</i></b> .....  | <b>44</b>  |
| 4.1      | <b>Evaluation of Designated Uses</b> .....   | <b>44</b>  |
| 4.2      | <b>Alternatives Considered</b> .....   | <b>45</b>  |
| 4.3      | <b>Recommended Alternative for Beneficial Uses</b> .....                                     | <b>46</b>  |
| <b>5</b> | <b><i>Water Quality Objectives for Diazinon and Chlorpyrifos</i></b> .....                   | <b>48</b>  |
| 5.1      | <b>Alternatives Considered for Deriving Water Quality Objectives</b> .....                   | <b>52</b>  |
| 5.2      | <b>Evaluation of Alternate Methods for Deriving Water Quality Objectives</b> .....           | <b>66</b>  |
| <b>6</b> | <b><i>Program of Implementation</i></b> .....  | <b>76</b>  |
| 6.1      | <b>TMDL Loading Capacity and Allocations</b> .....   | <b>76</b>  |
| 6.2      | <b>Allocations</b> .....   | <b>80</b>  |
| 6.3      | <b>Margin of Safety and Seasonal Variations</b> .....  | <b>82</b>  |
| 6.4      | <b>Comparison of Proposed Load Allocations to Current Concentrations</b> .....               | <b>82</b>  |
| 6.5      | <b>Available Practices and Technology</b> .....  | <b>84</b>  |
| 6.6      | <b>Implementation Framework Alternatives</b> .....   | <b>85</b>  |
| 6.7      | <b>Other Implementation Provisions</b> .....   | <b>88</b>  |
| <b>7</b> | <b><i>Policies</i></b> .....   | <b>91</b>  |
| 7.1      | <b>Existing Policies</b> .....   | <b>91</b>  |
| 7.2      | <b>Need For New Policies</b> .....   | <b>104</b> |
| <b>8</b> | <b><i>Surveillance and Monitoring</i></b> .....  | <b>106</b> |
| <b>9</b> | <b><i>Estimated Costs and Potential Sources of Financing</i></b> .....                       | <b>112</b> |
| 9.1      | <b>Estimated Costs for Agricultural Management Practices</b> .....                           | <b>112</b> |

|      |   |            |
|------|---|------------|
| 9.2  | Estimated Monitoring, Planning, and Evaluation Costs .....      | 114        |
| 9.3  | Estimated Costs to NPDES Permittees .....                       | 116        |
| 9.4  | Potential Sources of Financing.....                             | 116        |
| 10   | <i>California Environmental Quality Act (CEQA) Review .....</i> | <i>118</i> |
| 10.1 | Environmental Checklist Form.....                               | 118        |
| 10.2 | Thresholds Of Significance.....                                 | 130        |
| 10.3 | Discussion of Environmental Impacts .....                       | 130        |
| 11   | <i>Public Participation and Agency Consultation .....</i>       | <i>137</i> |
| 12   | <i>References .....</i>   | <i>138</i> |

## APPENDICES

|            |  |
|------------|--|
| Appendix A | List of Delta Waterways  |
| Appendix B | Summary of Monitoring Programs and Studies Used as Sources of Delta and Delta Tributary Diazinon and Chlorpyrifos Concentration Data |
| Appendix C | Comparison of Existing Concentrations to the Proposed Loading Capacity   |
| Appendix D | Cost Calculations  |
| Appendix E | Detailed Background Information for Seven Geographic Subareas Within the Delta Watershed   |
| Appendix F | Maps of Total Annual Agricultural Diazinon and Chlorpyrifos Applications in the Delta Watershed 1999-2003, by Year                   |
| Appendix G | Criteria Calculations for Diazinon and Chlorpyrifos  |
| Appendix H | Response to Scientific Peer Review Comments  |
| Appendix I | Suggested Format for Comment Letters   |

## LIST OF TABLES

|            |   |    |
|------------|---|----|
| Table 2.1. | Key Delta Features (DWR, 1995).....   | 10 |
| Table 2.2. | Average Annual Delta Inflows 1980-1991 (DWR, 1995) .....                                    | 12 |
| Table 2.3. | Average Annual Delta Outflows and Diversions 1980-1991 (DWR, 1995).....                     | 13 |
| Table 2.4. | Highest Reported Diazinon Uses In the Delta Watershed.....                                  | 19 |
| Table 2.5. | Seasonal Agricultural Diazinon Applications in the Delta Watershed (1999-2003 Average)..... | 21 |

|   |     |
|---|-----|
| Table 2.6. Highest Reported Chlorpyrifos Uses in the Delta Watershed 1999-2003.....   | 22  |
| Table 2.7. Seasonal Agricultural Chlorpyrifos Applications in the Delta Watershed (1999-2003 Average).....                              | 23  |
| Table 2.8. Diazinon Concentrations in Key Delta Watershed Sites, January, 1991 – March, 2005 .....                                      | 28  |
| Table 2.9. Chlorpyrifos Concentrations In Key Delta Watershed Sites, March, 1988 – March, 2005 .....                                    | 29  |
| Table 2.10. Combined Criteria-Normalized Diazinon and Chlorpyrifos Concentrations In Key Delta Watershed Sites, 1991 – March, 2005..... | 30  |
| Table 2.11. Diazinon Concentrations By Waterbody Category .....   | 32  |
| Table 2.12. Chlorpyrifos Concentrations by Waterbody Category.....  | 32  |
| Table 2.13. Combined Normalized Diazinon and Chlorpyrifos Concentrations by Waterbody Category .....                                    | 33  |
| Table 2.14. Diazinon Concentration Trends at Key Delta Watershed Sites .....  | 36  |
| Table 2.15. Chlorpyrifos Concentration Trends at Key Delta Watershed Sites .....  | 36  |
| Table 4.1. Designated Beneficial Uses of the Delta .....  | 44  |
| Table 5.1. Water Quality Criteria for Diazinon .....  | 51  |
| Table 5.2. Water Quality Criteria for Chlorpyrifos.....   | 51  |
| Table 5.3. Summary of Potential Freshwater Water Quality Objectives Derived by Alternative Methods.....                                 | 60  |
| Table 5.4. Freshwater and Saltwater Criteria Developed Using the USEPA Methodology ....   | 61  |
| Table 5.5. Comparison of Available Data (Oct, 2000- March, 2005) to Alternate Diazinon Acute Water Quality Objectives.....              | 64  |
| Table 5.6. Comparison of Available Data (Oct, 2000 – March, 2005) to Alternate Chlorpyrifos Acute Water Quality Objectives.....         | 65  |
| Table 5.7. Assessment of Diazinon Alternatives for Consistency with Porter Cologne and other State and Federal Requirements .....       | 67  |
| Table 5.8. Assessment of Chlorpyrifos Alternatives for Consistency with Porter Cologne and other State and Federal Requirements .....   | 68  |
| Table 5.9. Diazinon and Chlorpyrifos Water Quality Objectives for the Sacramento and San Joaquin Rivers Upstream of the Delta.....      | 71  |
| Table 9.1. Ag Practice Cost Estimates from Beaulaurier et al., 2005 .....   | 113 |



# 1 EXECUTIVE SUMMARY

This report provides the technical and policy foundation for a proposed amendment to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins (Basin Plan). The proposed Amendment addresses impairments to the Sacramento-San Joaquin Delta Waterways (Delta Waterways) caused by the organophosphorous (OP) insecticides diazinon and chlorpyrifos. For each of the major provisions of the proposed Amendment, alternatives are analyzed and recommendations are made based on the technical and policy analysis described. The proposed amendment includes new numeric Water Quality Objectives and Total Maximum Daily Loads (TMDLs) for both diazinon and chlorpyrifos. Diazinon and chlorpyrifos Waste Load Allocations for point sources and Load Allocations for non-point sources are included, and have been designed to meet existing and proposed Water Quality Objectives for diazinon and chlorpyrifos in the Delta Waterways. The proposed Basin Plan amendments are largely based upon the technical and policy framework established in recently adopted Basin Plan amendments addressing diazinon and chlorpyrifos in the two largest tributaries to the Delta, the Sacramento and San Joaquin Rivers, (CRWQCB-CVR Resolutions R5-2003-0148 and R5-2005-0138, respectively). Some of the language in this report was taken directly from the staff reports supporting those two Basin Plan amendments (Karkoski et al., 2003) (Beaulaurier et al., 2005). In all cases when they were used, the analysis, language, and technical and policy framework from those two Basin Plan amendments were reviewed for applicability to addressing diazinon and chlorpyrifos in the Delta Waterways.

Monitoring since the early 1990s by State and federal agencies and other groups has confirmed the presence of diazinon and chlorpyrifos at levels of concern in the Delta Waterways. The Delta Waterways were placed on the Clean Water Act Section 303(d) List for aquatic toxicity due to diazinon and chlorpyrifos (SWRCB, 2002). The sources of these compounds are agricultural and urban runoff. Agriculture will be the dominant source in the near future, since the United States Environmental Protection Agency (USEPA) has banned the sale of all non-agricultural uses of diazinon and most non-agricultural uses of chlorpyrifos.

**Designated Uses** - This Amendment recommends that no changes be made to existing designated uses for the Delta Waterways. The use that is most sensitive to diazinon and chlorpyrifos (freshwater habitat beneficial use designation) has already been designated, and was reviewed and found to be appropriate in this case.

**Water quality objectives** - For both diazinon and chlorpyrifos, this Amendment recommends adoption of Water Quality Objectives derived using the USEPA method and applied to datasets screened by the California Department of Fish and Game (CDFG).

**TMDL Elements** - The Amendment establishes the Loading Capacity, Waste Load Allocations, and Load Allocations for diazinon and chlorpyrifos discharges to Delta Waterways. The Loading Capacity and allocations are established at levels necessary to attain the applicable numeric and narrative Water Quality Objectives within each of the Delta Waterways. A combined additive toxicity formula, found in the Basin Plan, is used to set a loading capacity that accounts for the combined toxicity of diazinon and chlorpyrifos. Equating the allocations to the Loading Capacity provides an implicit margin of safety, since no dilution

credit is given. Since the Loading Capacity, Load Allocations and Wasteload Allocations are not dependant on a particular flow regime, they would not be changed by changes in flows, water diversions or flow routing within the Delta.

**Implementation and Time Schedule** - This Amendment recommends that, if neither Waste Discharge Requirements (WDRs) nor a Waiver of WDRs apply to diazinon and chlorpyrifos discharges, then a prohibition of discharge would apply when the objectives or loading capacity are not met. The prohibition is constructed to address the two seasons of use. A five-year time schedule for compliance with diazinon and chlorpyrifos Water Quality Objectives, allocations and Loading Capacity is recommended. Approximately five years from California Regional Water Quality Control Board, Central Valley Region (Regional Water Board) adoption of the Basin Plan Amendment should provide sufficient time to attain the objectives and allocations, and should be sufficient to get a comprehensive system for control of pesticide runoff into place.

**Submission of Management Plans** - Dischargers must submit a management plan that describes the actions that the discharger will take to reduce diazinon and chlorpyrifos discharges during the dormant season and the irrigation season, and to meet the applicable allocations by the required compliance dates.

**Surveillance and Monitoring** - Surveillance and monitoring required of dischargers will include water quality monitoring, evaluation of changes in pesticide use, surveys of adoption of management practices to reduce diazinon and chlorpyrifos in runoff, and evaluation of the effectiveness of the management practices in reducing pesticide runoff.

**Consideration of Economics and the California Environmental Quality Act (CEQA)** - A discussion of the potential economic effects of the proposed Amendment, as well as a CEQA checklist, are provided in this staff report. This proposed Basin Plan Amendment is designed to reduce diazinon and chlorpyrifos concentrations in the Delta Waterways, and to ensure that increased use of alternatives to those pesticides will not degrade water quality. The Water Quality Objectives and TMDLs established by this amendment are designed to eliminate the impacts of diazinon and chlorpyrifos to aquatic life in the Delta Waterways. This Basin Plan Amendment does not require or allow any changes in pesticide application practices that could degrade the quality of the environment, or have environmental effects that could cause substantial indirect or direct adverse effects on human beings.

**Public Participation and Comments** – Two public workshops have been held in the preparation of this proposed Basin Plan Amendment and Staff Report. A public workshop was held on January 19, 2005 in Stockton to obtain comments on the proposed scope of the Basin Plan Amendment. No comments on changing the scope of this proposed Basin Plan Amendment were received at that meeting or at any other time during the scoping period for this Amendment. The peer review draft of this Staff Report was made publicly available in February 2006. Another public workshop was held on April 27, 2006 in Sacramento to provide information and obtain comments related to this draft Staff Report and the proposed Basin Plan Amendment. The proposed Basin Plan Amendment was acted on by the Central Valley Regional Water Board during a public hearing at the Board's June 22/23 meeting.

The Public Review Draft of this Staff Report (April 2006) included the following instructions to the public regarding submittal of comments:

Both written and verbal comments can be provided up to and during the Regional Water Board hearing. Written comments on this Staff Report and proposed Basin Plan Amendment submitted by June 7, 2006 will be responded to in writing. To assist staff in identifying and responding to comments, comments should be submitted (hard copy and electronic) in the format suggested in Appendix I. The suggested format is to number the comment, state in one sentence the topic of the comment, followed by supporting discussion, and a specific recommendation. If you have any questions concerning this staff report or the proposed Basin Plan Amendment please contact Danny McClure at (916) 464-4751 or by email at [dmcclure@waterboards.ca.gov](mailto:dmcclure@waterboards.ca.gov).

## **2 BACKGROUND**

### **2.1 Watershed Areas to Be Considered**

The Delta, along with the San Francisco Bay, forms the largest estuary on the North American western coast. The Delta encompasses a maze of river channels and diked islands encompassing roughly 738,000 acres (1,153 square miles) in Alameda, Contra Costa, Sacramento, San Joaquin, Solano and Yolo counties. The Delta forms the lowest part of the Central Valley, lying between the Sacramento and San Joaquin Rivers and extending from the confluence of the two rivers inland as far as Sacramento and Stockton. Many of the waterways follow natural courses while others have been constructed to provide deep-water navigation channels, to improve water circulation, or to obtain material for levee construction (DWR, 1995).

The Delta supports communities, agriculture, and recreation, and provides essential habitat for fish and wildlife (DWR, 1995). Over five hundred species of wildlife inhabit the Delta, making it one of the State's most important wildlife habitats (DWR, 1995). The Delta is the major source of freshwater to the San Francisco Bay and supplies over half of the drinking water for the State. The Sacramento, San Joaquin, Mokelumne, Cosumnes, and Calaveras rivers all flow into the Delta, carrying approximately 47% of the State's total runoff (DWR, 1995). Table 2.1 describes additional features of the Delta.

Over the past three decades, a decline in zooplankton abundance, as well as significant changes in the makeup of the invertebrate community have been observed in the Delta. The Interagency Ecological Program has monitored zooplankton abundance in the upper San Francisco Estuary, including the Delta since 1972. All of the native zooplankton of the upper estuary have decreased in abundance since they were first monitored (Mencum, 2005). Among other factors such as habitat and flow regime alteration and invasive species, toxic substances (including pesticides) may be contributing to the decline in the plankton community in the Delta (CALFED, 1999). The deterioration of the zooplankton community in key habitat areas of the Delta is a serious problem because striped bass, Delta smelt, Chinook salmon, and other species that use the Delta as a nursery area feed exclusively on zooplankton during early life. Several pelagic (living in open water) fish species that spawn and rear in the upper estuary have undergone severe declines in recent years (Hieb et al., 2005).

**Table 2.1. Key Delta Features (DWR, 1995)**

|  |   |   |   |                                    |
|--|---|---|---|------------------------------------|
| Population:  | 410,000 (1990)  | Area (acres):                             | Agriculture:  | 538,000                            |
| Incorporated cities entirely within the Delta:   | Antioch, Brentwood, Isleton, Pittsburg, Tracy   |   | Cities & towns:   | 64,000                             |
| Major cities partly within the Delta:  | Sacramento, Stockton, West Sacramento   |   | Water surface:  | 61,000                             |
|  |   |   | Undeveloped:  | 75,000                             |
|  |   |   | <i>Total:</i>   | <i>738,000</i>                     |
| # of unincorporated towns and villages:  | 14  | Total length of all channels with levees: | 1,100 miles (1987)  |                                    |
| Main crops:  | Alfalfa<br>asparagus<br>corn<br>fruit<br>grain & hay<br>pasture<br>safflower<br>sugar beets<br>tomatoes | Diversions from the Delta:                | Central Valley Project<br>State Water Project<br>Contra Costa Canal<br>City of Vallejo<br>Western Delta Industry<br>1,800+ Agricultural Users |                                    |
|  |   | Rivers flowing into the Delta:            | Calaveras<br>Cosumnes<br>Sacramento   | San Joaquin<br>Mokelumne           |
| Fish and wildlife  |   |   | <u># of Federal &amp; State Species of Concern (a)</u>  | <u># of Non-Native Species (b)</u> |
|  | <u># of Species</u>   |   |   |                                    |
|  | Birds:  | 230                                       | 10  | 3                                  |
|  | Mammals:  | 45  | 9   | 7                                  |
|  | Fish:   | 52  | 8   | 30                                 |
|  | Reptiles & amphibians:  | 25  | 6   | 1                                  |
|  | Flowering plants:   | 150                                       | 54  | 70                                 |
|  | Invertebrates:  | na  | 21  | 13                                 |
|  | Major anadromous fish: American shad, salmon, steelhead trout, striped bass, sturgeon                   |   |   |                                    |
| (a) Endangered, threatened, rare, and candidate species per the federal listing effective January 31, 1992, and the State listing effective April 9, 1992. |   |   |   |                                    |
| (b) Introduced species in the Sacramento – San Joaquin Delta.  |   |   |   |                                    |

For the purposes of this report, the term “Delta watershed” refers to the area outlined in Figure 2.1 which includes the Legal Delta, as defined in Section 12220 of the California Water Code, as well as the areas that drain directly to the Legal Delta. Not included in the Delta watershed are the areas that drain to upland reservoirs or the areas that drain to the Sacramento or San Joaquin Rivers upstream of the Legal Delta Boundaries. Diazinon and chlorpyrifos sources that discharge to the Sacramento and San Joaquin Rivers upstream of the Legal Delta are addressed in separate Basin Plan Amendments for those waterbodies (CRWQCB-CVR Resolutions R5-2003-0148 and R5-2005-0138). The Western extent of the Delta watershed corresponds to the boundary between Regional Water Boards 2 and 5. The extent of the Delta watershed was defined using Calwater v. 2.2.1 (CIWMC, 1999) watershed boundaries.

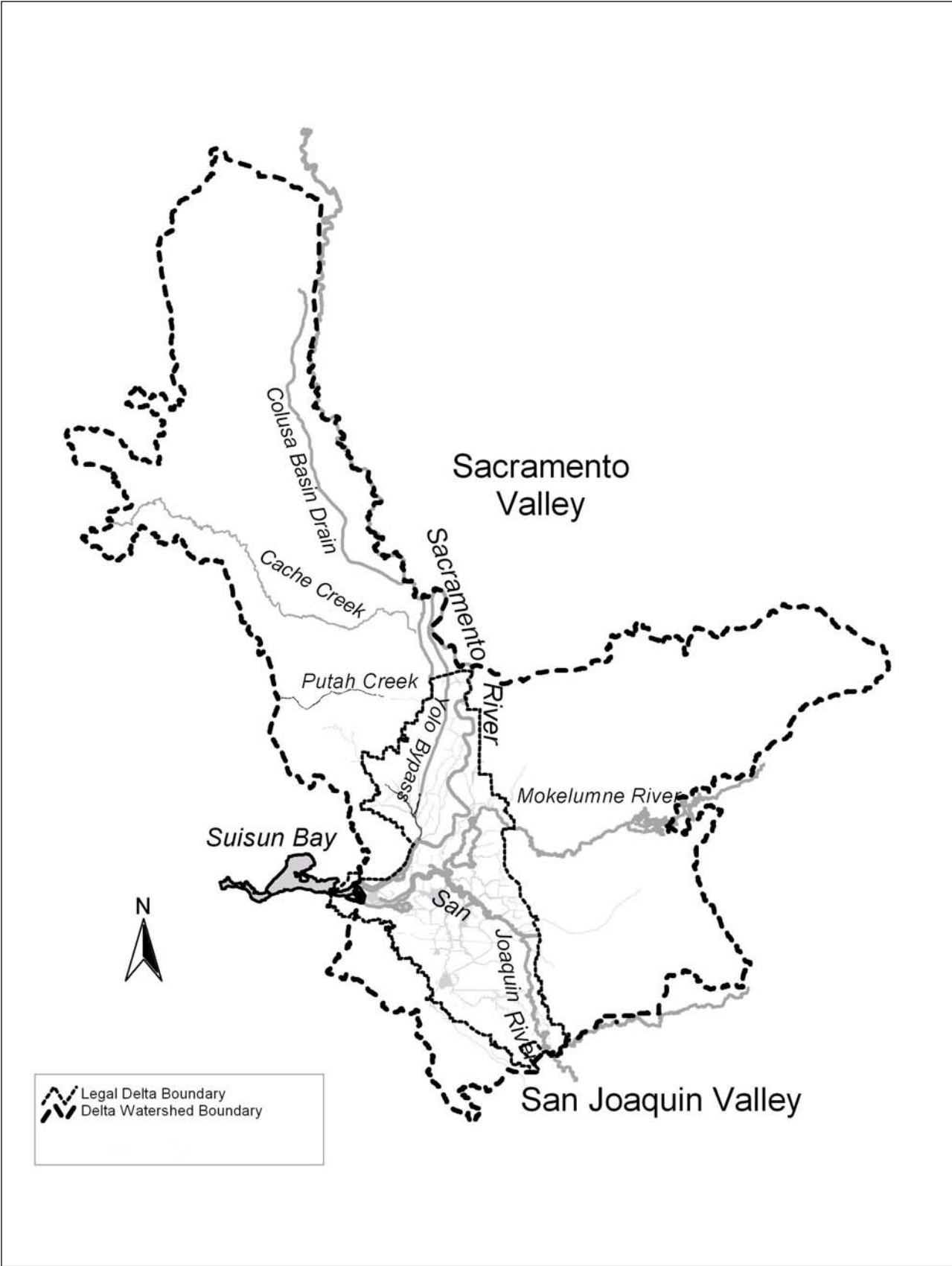


Figure 2.1. The Delta Watershed

This proposed Basin Plan amendment addresses the diazinon and chlorpyrifos concentrations within the Delta Waterways, and the sources of diazinon and chlorpyrifos within the Delta watershed. The Delta Waterways, listed in Appendix A, include all the distinct, readily identifiable waterbodies within the boundaries of the “Legal” Delta that are hydrologically connected by surface water flows (not including pumping) to the Sacramento and/or San Joaquin rivers. Identification of the specific waterways clarifies application of the water quality objectives and loading capacity. It is not the intent of this Amendment to establish water quality objectives in canals or drains that are not hydrologically connected by surface water flows or distinct and readily identifiable.

### 2.1.1 Delta Hydrology

The average annual inflows and outflows of the Delta are shown in Tables 2.2 and 2.3. The average annual inflow to the Delta during the 1980 to 1991 period was 27,840 thousand acre-feet (TAF); the Sacramento River contributed an average annual inflow of 17,220 TAF, approximately 62% of the total inflow (DWR, 1995). The Delta is at sea level. Water levels vary greatly during each tidal cycle, and during the tidal cycle, flows can vary in direction and amount. The tidal flows into and out of the Delta are much greater than the “net” Delta outflow. The average tidal flow (ebb or flood) at Chipps Island is 170,000 cfs, while the average winter outflow is 32,000 cfs and the average summer outflow is 6,000 cfs (DWR, 1995). Flows in Delta Waterways are also greatly affected by the export of water from the Delta by the two major pumping facilities located in the south Delta; the Harvey O Banks Pumping Plant of the State Water Project and the Tracy Pumping Plant of the Central Valley Project.

**Table 2.2. Average Annual Delta Inflows 1980-1991 (DWR, 1995)**

| Source                   | Avg. Inflow (TAF) |
|--------------------------|-------------------|
| Sacramento River         | 17,220            |
| East Side Sierra Streams | 1,360             |
| San Joaquin River        | 4,300             |
| Delta Precipitation      | 990               |
| Yolo Bypass              | 3,970             |
| Total Inflows            | 27,840            |

**Table 2.3. Average Annual Delta Outflows and Diversions 1980-1991 (DWR, 1995)**

| <b>Outflow or Diversion</b>           | <b>Avg. Outflow (TAF)</b> |
|---------------------------------------|---------------------------|
| Delta Outflow to Bay                  | 21,020                    |
| Consumptive Use and Channel Depletion | 1,690                     |
| Tracy Pumping Plant                   | 2,530                     |
| Banks Pumping Plant                   | 2,490                     |
| Contra Costa Pumping Plant            | 110                       |
| Total Outflows                        | 27,840                    |

Much of the land in and around the Delta is below sea level, and is dependant on hundreds of miles of levees to prevent flooding. Because most agricultural areas in the Delta are at or below sea level, agricultural drainage water from these low-lying areas has to be pumped over levees into nearby channels` (DWR, 1995).

## **2.2 Sources, Transport and Effects of Diazinon and Chlorpyrifos in Surface Water**

Diazinon and chlorpyrifos are man-made pesticides. The sources of the diazinon and chlorpyrifos found in Delta Waterways are urban and agricultural applications. In the Central Valley, diazinon and chlorpyrifos are used to exterminate destructive pests and insects such as aphids, spider mites, fleas, ants, roaches, and boring insects. A fraction of urban and agricultural diazinon and chlorpyrifos applications can reach surface water during rainfall or irrigation events, when residual diazinon and chlorpyrifos can migrate with stormwater runoff, irrigation return water, or rainwater, and enters the Delta or its tributaries.

Diazinon is moderately mobile and persistent in the environment. Due to its mobility and widespread use, diazinon has been detected in air, rain, fog, soil, surface water, and groundwater (USEPA 2000a). Diazinon has a moderately low vapor pressure (ranging from 6.4 to 18.7 milliPascals (mPa) at 20 degrees C (USDA, 1995a)) and Henry's law constant (estimated at 0.072 Pa-m<sup>3</sup>/mol (USDA, 1995a)), indicating that a small fraction of applied diazinon is expected to volatilize from soil, crops, surface water or other surfaces into the atmosphere. Atmospheric diazinon can exist in particulate and vapor forms, as well as a solute dissolved in fog (Seiber et al., 1993). Atmospheric vapor-phase diazinon is degraded by reacting with photochemically-produced hydroxyl radicals, and the estimated half life for this reaction is 4 hours (NLM, 2002). Particulate-phase diazinon may be removed from the air by wet and dry deposition (NLM, 2002). Diazinon also absorbs light in the environmental spectrum and has the potential for direct photolysis in the atmosphere (NLM, 2002). Once in the atmosphere, diazinon can be transported by bulk movement of air and is subject to deposition processes (Larkin and Tjeerdema, 2000). Atmospheric transport of diazinon from the Central Valley to the Sierra Nevada Mountains has been found to occur, although diazinon levels decreased significantly with distance and elevation (Zabik and Seiber, 1993). Both dry and wet deposition processes can deposit atmospheric diazinon onto the ground surface, onto vegetation, or directly into surface waters.



Diazinon has a low to moderate tendency to adsorb to soil, with reported organic carbon adsorption coefficient (K<sub>oc</sub>) values of 1,007 to 1,842 (USDA, 1995a). In soils, diazinon can be degraded by hydrolysis, microbial degradation and photolysis, lost to surface and/or groundwater via runoff and/or leaching, and lost to the atmosphere via volatilization. Diazinon degrades more rapidly in acidic soils than neutral or alkaline soils, and degrades more rapidly in nonsterilized soils than sterilized soils (Larkin and Tjeerdeema, 2000). Field dissipation half-life is a measure of the overall rate of disappearance of a pesticide from soil by leaching, runoff, hydrolysis, photolysis and microbial degradation. Reported diazinon field dissipation half-life values range from 3 to 54 days, with the range of 3 to 13 days considered to be the most representative of actual field conditions (USDA, 1995a). As a rule of thumb, the time needed for about 90 percent of the pesticide residue to dissipate is 4 times the field dissipation half-life (USDA, 1995a). Reported values for diazinon's half-life on vegetation range between 2 and 14 days (Sheplaine, 1993).

Diazinon is moderately soluble in water with reported solubility values ranging from 40 to 60 parts per million (ppm) at 20 to 30 degrees C (USDA, 1995a). The solubility of diazinon is relatively high for a pesticide (Larkin and Tjeerdema, 2000) and diazinon's solubility values indicate that solubility is probably not limiting the movement of diazinon into solution for transport in moving water. Due to diazinon's moderate solubility and low to moderate tendency to adsorb to soil, it can move off of crops, soil and other surfaces and into surface water in runoff from rainfall and irrigation runoff. Atmospheric deposition has the potential to directly contribute to surface water diazinon concentrations. Sediment associated diazinon can also be mobilized by sediment runoff and transport of sediments in surface waters, but this may not be as important a mechanism of transport for diazinon, as approximately 98% of the diazinon in San Francisco Bay is reported to occur in the dissolved phase (Domagalski and Kuivila, 1993). In water, diazinon can be degraded by hydrolysis, photolysis, and microbial degradation, and lost via volatilization. All of these processes are strongly influenced by the pH, temperature, salinity and purity of water. The rate of hydrolysis of aqueous diazinon increases with high or low pH. Reported values for diazinon's hydrolysis half-life in water have been reported at 12 days (pH 5), 138 days (pH 7), and 77 days (pH 9) (Giddings et al., 2000). Reported values for diazinon's photolysis half-life in water range from and 15 to 25 days (Giddings et al., 2000). Estimates of diazinon's half-life in water in incubated bottles range from 14 to 99 days, and from 5 to 25 days in larger, open, outdoor experimental systems (Giddings et al., 2000).

Diazinon has a low to moderate potential to bioconcentrate in aquatic organisms with reported bioconcentration factors ranging from 4.9 to 152 (NLM, 2002). Depuration of accumulated diazinon is rapid, with experimental results showing 96 to 97 percent of accumulated diazinon residues eliminated from fish tissues within seven days (USEPA, 2000a).

Chlorpyrifos can contaminate surface water via spray drift at the time of application or as runoff up to several months after application (USEPA, 2000b). Degradation of chlorpyrifos in soil, water and air may occur by hydrolysis, photolysis and microbial degradation. Chlorpyrifos has a moderately low volatility, with reported vapor pressures ranging from 2.3 to 12 milliPascals (mPa) at 20 to 35 degrees C (USDA, 1995b), and a moderately low Henry's law constant of 0.743 Pa-m<sup>3</sup>/mol at 25 degrees C (USDA, 1995b), indicating that a small fraction of applied chlorpyrifos is expected to volatilize from soil, crops, surface water or other surfaces

into the atmosphere. When released into the atmosphere, the half-life of the vapor phase of chlorpyrifos is 6.43 hours when reacting with photochemically produced hydroxyls (Linde, 1994).

Reported values for the field dissipation half-life of chlorpyrifos in soil range from 4 to 139 days (USDA, 1995b), with an average half-life in soil of 30 days (USEPA, 2000b). Chlorpyrifos has a greater tendency than diazinon to adsorb to soil and sediment, with reported organic carbon adsorption coefficient (K<sub>oc</sub>) values of 6,070 to 14,000 (USDA, 1995b). Chlorpyrifos is moderately soluble in water for a pesticide, with reported solubility values ranging from 0.45 to 1.18 parts per million at temperatures between 10 and 30 degrees C (USDA, 1995b). Available data indicate that most chlorpyrifos runoff is generally via adsorption to eroding soil rather than by dissolution in runoff water. However, under some conditions, dissolution in runoff water may be significant (USEPA, 2000b).

The relatively low to moderate susceptibility of chlorpyrifos to hydrolysis (half-lives of 72 days at pHs 5 and 7 and 16 days at pH 9), direct aqueous photolysis (half-life of 30 days in sunlight), and low volatilization, and degradation under aerobic conditions indicate that chlorpyrifos will be somewhat persistent in the water columns of some aqueous systems that have relatively long hydrological residence times (USEPA, 2000b). However, volatilization and/or adsorption to sediment may substantially reduce the persistence of dissolved chlorpyrifos in shallow waters and in waters receiving influxes of uncontaminated sediment, respectively (USEPA, 2000b). The relatively low to moderate susceptibility of chlorpyrifos to degradation under anaerobic conditions indicates that it will also be somewhat persistent in anaerobic bottom sediment (USEPA, 2000b). Chlorpyrifos half-lives in pond sediment typically range from 14 to 64 days, with some longer times observed (Poletika and Robb, 1998).

Atmospheric transport and deposition of diazinon and chlorpyrifos can significantly affect surface water concentrations in the Central Valley (Majewski et al. 2005). Atmospheric deposition tends to be correlated to proximity to application areas as well as the timing and amount of pesticide used (Majewski et al., 2005). In the Central Valley, wet deposition appears to be the more important mechanism of diazinon deposition, while dry deposition appears to be the more important mechanism of chlorpyrifos deposition (Majewski et al., 2005).

Diazinon and chlorpyrifos can be acutely toxic to aquatic life, wildlife, and humans. Aquatic invertebrates appear to be the aquatic organisms most sensitive to chlorpyrifos and diazinon exposure (Giddings et al., 2000). When ingested by an organism, diazinon and chlorpyrifos cause toxicity through inactivation of the enzyme acetylcholinesterase (AChE) that is involved in nerve impulse transmission. This inactivation of the AChE enzyme results in a variety of lethal and sub-lethal toxic effects (Larkin and Tjeerdema, 2000). When present in a mixture, diazinon and chlorpyrifos display additive toxicity (Bailey et al., 1997). After uptake, aquatic organisms remove diazinon and chlorpyrifos from the body relatively rapidly (Giddings et al., 2000). Partly due to these rapid depuration rates, diazinon and chlorpyrifos have only a moderate tendency to bioconcentrate in aquatic organisms (Giddings et al., 2000), and are not expected to biomagnify in aquatic food webs.

## 2.3 Diazinon and Chlorpyrifos in the Delta and its Tributaries

### 2.3.1 Introduction

This section describes the available information about the sources of diazinon and chlorpyrifos to the Delta, and the magnitude, timing and seasonality of diazinon and chlorpyrifos concentrations and loads in surface waters within the Delta watershed. When appropriate, additional information, results and observations from previous studies are also included. In Appendix E, the Delta watershed is also broken down geographically, and the waterbodies and available pesticide use and concentration data are discussed for each geographic subarea.

Diazinon and chlorpyrifos use data were obtained from the Pesticide Use Report (PUR) database (DPR, 2005a) and summed for each cartographic section (an area of roughly one square mile) within the Delta watershed for the period of study 1993-2003. Geographic Information Systems (GIS) and database software was then used to prepare maps showing the locations of the applications and other data summaries.

Diazinon and chlorpyrifos concentration data were obtained from numerous studies and programs funded and conducted by several agencies and institutions that sampled surface water in the Delta Waterways and their tributaries within the Delta watershed from 1988 through February 2005. The titles of these studies, as well as the sites, timing and frequency of sampling are summarized in Appendix B.

### 2.3.2 Diazinon and Chlorpyrifos Use in the Delta Watershed

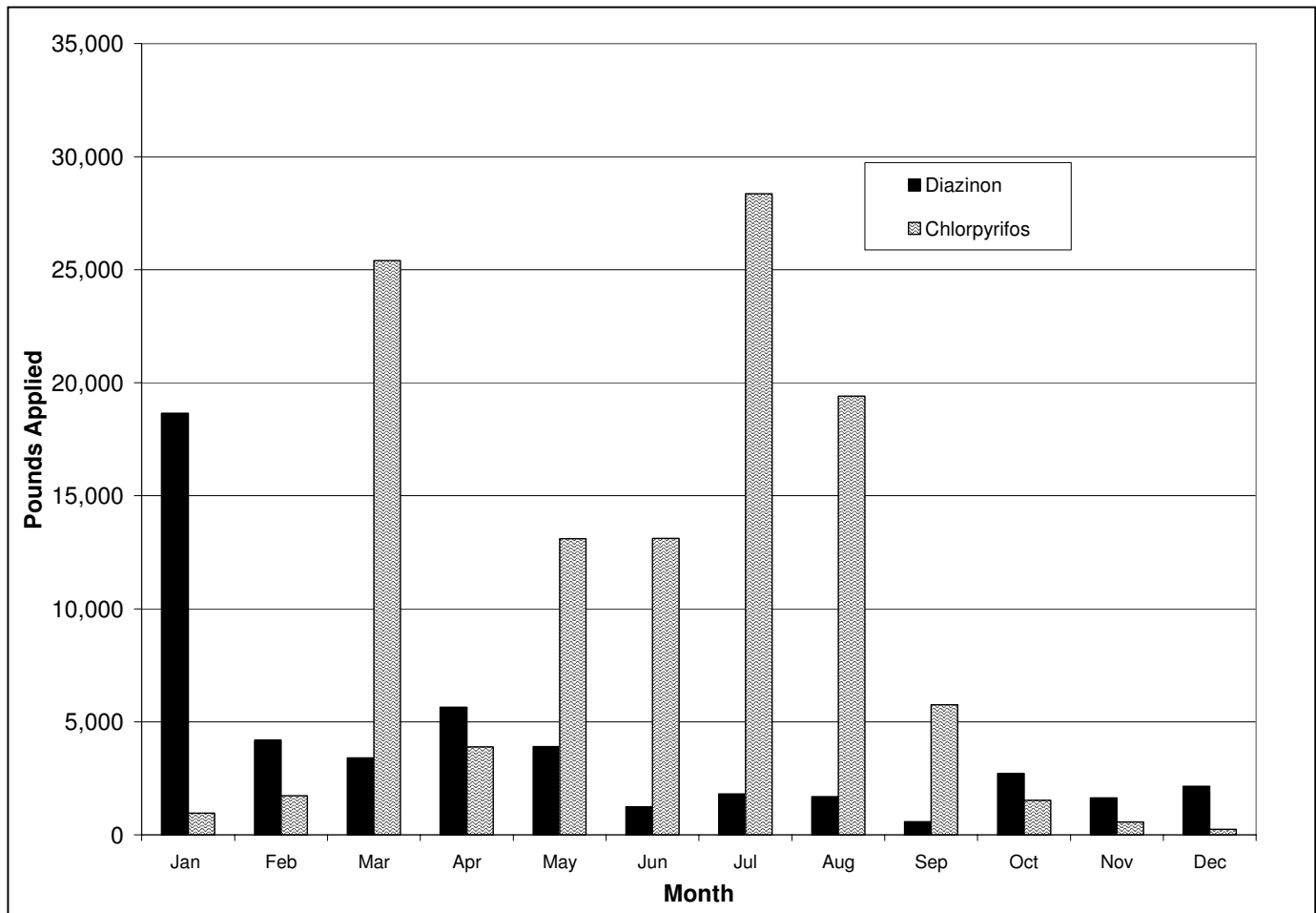
Agricultural uses of diazinon and chlorpyrifos<sup>1</sup> in the Delta watershed average 47,652 and 114,100 lbs/year, respectively, using data from 1999 through 2003. These averages are comparable to the agricultural uses in the Central Valley upstream of the Delta watershed. Uses of diazinon and chlorpyrifos over the same period in the Sacramento Valley average 81,389 and 104,357 lbs/year, respectively. Use of diazinon and chlorpyrifos over the same period in the San Joaquin Valley average 50,746 and 239,049, respectively. Uses in the Sacramento and San Joaquin Valleys are discussed further in Karkoski et al., 2003 and Beaulaurier et al., 2005.

Figure 2.1 shows the average agricultural use of diazinon and chlorpyrifos by month in the Delta watershed, using the most recent five years of available data, 1999 through 2003. Use of diazinon and chlorpyrifos during the year can be grouped into two main seasons; the dormant season; December through February, and the irrigation season; March through November. During the dormant season, dormant orchards of nuts and stone fruits and other tree crops are sprayed to limit damage from several potential pests. Diazinon is heavily used in the dormant spray season (25,000 lbs, 52% of annual agricultural diazinon use), while

---

<sup>1</sup> As discussed below, since most non-agricultural uses of chlorpyrifos and diazinon have been cancelled recently, most of the tables, figures and discussion in this section focuses on agricultural uses.

chlorpyrifos use is relatively light (2,900 lbs, 3 % of annual agricultural chlorpyrifos use). The “irrigation season” includes the month of November, when irrigation typically does not occur, but diazinon and chlorpyrifos are still applied to some crops. During the irrigation season, agricultural chlorpyrifos use averages 111,200 lbs, which is much higher than diazinon, but significant quantities of diazinon are also used. Agricultural diazinon use averages approximately 22,700 lbs for the irrigation season.



**Figure 2.1. Monthly Agricultural Diazinon and Chlorpyrifos Applications in the Delta Watershed (1999-2003 Average)**

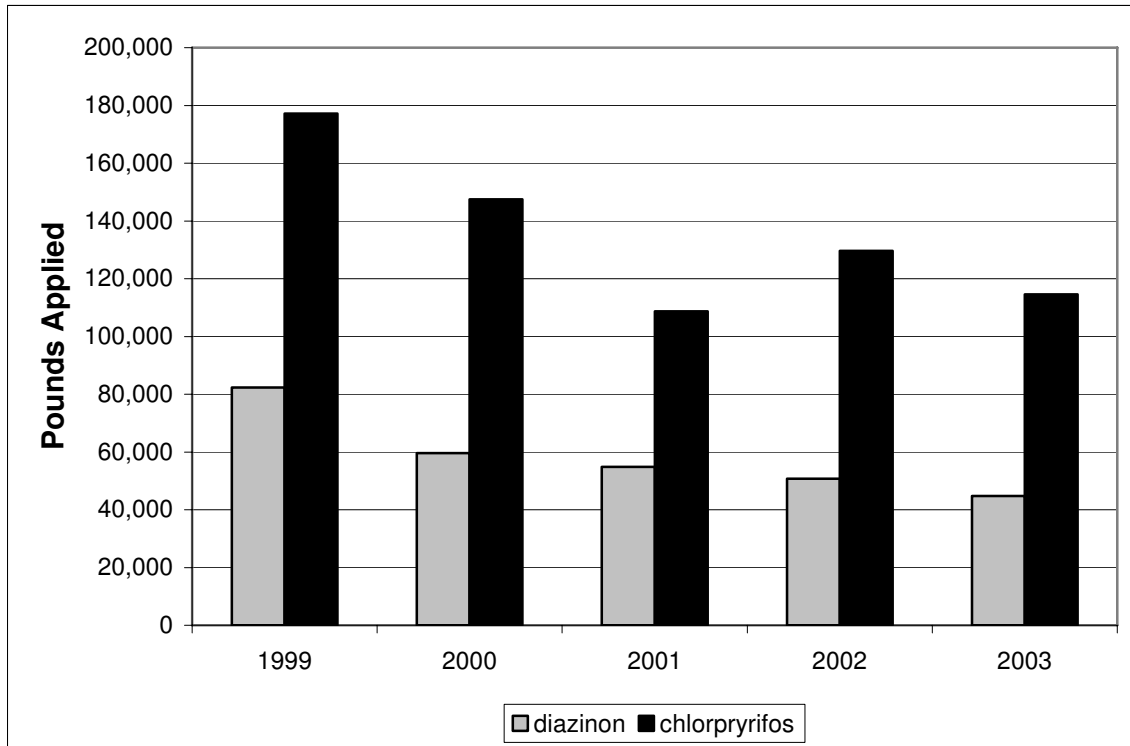
Table 2.4 shows total (using data from January 1999 through December 2003) diazinon application amounts during each year for the most significant reported uses within the Delta watershed. These uses account for over 99% of the reported uses during 1999 through 2003. All other reported uses were less than 1% of the total use for this period. Based on this data, the predominant sites of diazinon use are, in decreasing total annual amounts, almonds, tomatoes, prunes, cherries, pears, apples, and walnuts. Although they were significant in 1999-2003, structural and landscaping uses have been canceled by USEPA, as have all non-agricultural uses, so most of the diazinon use tables and figures below focus on agricultural uses of diazinon. The data for total reported uses indicate that there has been a steady decline in reported agricultural diazinon use within the Delta watershed from 1999 through 2003, as shown in Figure 2.2.



**Table 2.4. Highest Reported Diazinon Uses In the Delta Watershed**

| Crop / Use                    | 1999   |      | 2000   |      | 2001   |      | 2002   |      | 2003   |      | Average |      |
|-------------------------------|--------|------|--------|------|--------|------|--------|------|--------|------|---------|------|
|                               | Lbs    | %    | Lbs    | %    | Lbs    | %    | Lbs    | %    | Lbs    | %    | Lbs     | %    |
| Almonds                       | 27,703 | 34%  | 6,232  | 10%  | 12,423 | 23%  | 12,204 | 24%  | 13,304 | 30%  | 14,373  | 25%  |
| Structural*                   | 8,104  | 10%  | 17,362 | 29%  | 15,591 | 28%  | 3,917  | 8%   | 2,345  | 5%   | 9,464   | 16%  |
| Tomatoes                      | 10,296 | 13%  | 7,752  | 13%  | 5,450  | 10%  | 7,157  | 14%  | 4,659  | 10%  | 7,063   | 12%  |
| Plums                         | 7,518  | 9%   | 4,963  | 8%   | 5,107  | 9%   | 8,965  | 18%  | 6,499  | 15%  | 6,610   | 11%  |
| Cherries                      | 8,724  | 11%  | 6,558  | 11%  | 3,260  | 6%   | 4,975  | 10%  | 6,183  | 14%  | 5,940   | 10%  |
| Pears                         | 2,794  | 3%   | 4,292  | 7%   | 3,841  | 7%   | 6,017  | 12%  | 4,639  | 10%  | 4,317   | 7%   |
| Apples                        | 5,560  | 7%   | 3,161  | 5%   | 2,025  | 4%   | 989    | 2%   | 1,650  | 4%   | 2,677   | 5%   |
| Walnuts                       | 2,557  | 3%   | 1,455  | 2%   | 1,365  | 2%   | 2,377  | 5%   | 1,588  | 4%   | 1,868   | 3%   |
| Landscaping                   | 1,171  | 1%   | 1,444  | 2%   | 2,063  | 4%   | 1,536  | 3%   | 556    | 1%   | 1,354   | 2%   |
| Melons                        | 1,712  | 2%   | 1,842  | 3%   | 1,209  | 2%   | 43     | 0%   | 3      | 0%   | 962     | 2%   |
| Peaches                       | 909    | 1%   | 966    | 2%   | 563    | 1%   | 243    | 0%   | 718    | 2%   | 680     | 1%   |
| Watermelons                   | 589    | 1%   | 294    | 0%   | 248    | 0%   | 1,021  | 2%   | 1,234  | 3%   | 677     | 1%   |
| Outdoor Nursery Plants        | 348    | 0%   | 691    | 1%   | 671    | 1%   | 770    | 2%   | 509    | 1%   | 598     | 1%   |
| Apricots                      | 1,223  | 1%   | 611    | 1%   | 313    | 1%   | 126    | 0%   | 212    | 0%   | 497     | 1%   |
| Grapes                        | 161    | 0%   | 241    | 0%   | 191    | 0%   | 182    | 0%   | 492    | 1%   | 253     | 0%   |
| Onions                        | 787    | 1%   | 220    | 0%   | 96     | 0%   | 53     | 0%   | 72     | 0%   | 246     | 0%   |
| Sugarbeets                    | 552    | 1%   | 460    | 1%   | 0      | 0%   | 0      | 0%   | 0      | 0%   | 202     | 0%   |
| Cucumbers                     | 299    | 0%   | 351    | 1%   | 71     | 0%   | 0      | 0%   | 1      | 0%   | 144     | 0%   |
| Total Reported for Uses Shown | 81,006 | 98%  | 58,894 | 99%  | 54,486 | 99%  | 50,576 | 100% | 44,666 | 100% | 57,926  | 99%  |
| Total Of Reported Uses        | 82,301 | 100% | 59,654 | 100% | 54,888 | 100% | 50,724 | 100% | 44,782 | 100% | 58,470  | 100% |

\* All non-agricultural uses of diazinon have been canceled



**Figure 2.2 Yearly Agricultural Use of Diazinon and Chlorpyrifos in the Delta Watershed (1999-2003)**

Table 2.5 summarizes the major diazinon uses (averaging approximately 1,000 lbs or 5% of seasonal use or greater) for the dormant and irrigation seasons. During the dormant spray season, dormant orchards of almonds, prunes, cherries, apples and other tree crops are sprayed with a mixture of pesticides and dormant oils to limit crop and tree damage from several potential pests. Dormant orchard sprays are typically applied via a tractor-pulled airblast sprayer.

During the irrigation season most of the agricultural diazinon uses are on (in descending order of amount used) tomatoes, pears, cherries, walnuts, prunes and apples. The main use of diazinon during March, April and May is application to tomatoes. The main uses of diazinon during June, July and August are applications to walnut and cherry orchards. During October and November the most significant use of diazinon is application to pear orchards following harvest.

**Table 2.5. Seasonal Agricultural Diazinon Applications in the Delta Watershed (1999-2003 Average)**

| Dormant Season (Dec-Feb) |             |                         | Irrigation Season (Mar-Nov) |             |                            |
|--------------------------|-------------|-------------------------|-----------------------------|-------------|----------------------------|
| Crop                     | lbs applied | % of dormant season use | Crop                        | lbs applied | % of irrigation season use |
| Almonds                  | 14,194      | 57%                     | Tomatoes                    | 6,655       | 29%                        |
| Prunes and Plums         | 5,118       | 20%                     | Pears                       | 4,272       | 19%                        |
| Cherries                 | 3,055       | 12%                     | Cherries                    | 2,885       | 13%                        |
| Apples                   | 1,246       | 5%                      | Walnuts                     | 1,857       | 8%                         |
|                          |             |                         | Plums                       | 1,492       | 7%                         |
|                          |             |                         | Apples                      | 1,431       | 6%                         |
|                          |             |                         | Melons                      | 962         | 4%                         |
| Total of Uses Shown      | 23,613      | 95%                     | Total of Uses Shown         | 19,554      | 86%                        |
| Dormant Season Use       | 24,983 lbs  |                         | Irrigation Season Use       | 22,669 lbs  |                            |
| % of Annual Use          | 52%         |                         | % of Annual Use             | 48%         |                            |

Table 2.6 shows total (using data from January 1999 through December 2003) chlorpyrifos application amounts during each year for the most significant reported uses within the Delta watershed. These uses account for over 90% of the reported chlorpyrifos uses during 1999 through 2003. All other reported uses were less than 5% of the total use for any year in this period. Based on this data, the predominant sites of chlorpyrifos use are, in decreasing total annual amounts, walnuts, alfalfa, almonds, and corn. Use of chlorpyrifos for tomatoes, apples, landscape maintenance, and most structural applications has been canceled by USEPA. Since most non-agricultural uses of chlorpyrifos have been cancelled, most of the chlorpyrifos use tables and figures below focus on the agricultural uses. Although sugarbeets were a significant use in 1999 and 2000, sugarbeets have not been a major chlorpyrifos use in the Delta watershed since 2000. The data indicate that there has been a general decline in reported agricultural chlorpyrifos use within the Delta watershed from 1999 through 2003, as shown in Figure 2.2.



**Table 2.6. Highest Reported Chlorpyrifos Uses in the Delta Watershed 1999-2003**

| Crop / Use                    | 1999    |     | 2000    |     | 2001    |     | 2002    |     | 2003    |     | Average |     |
|-------------------------------|---------|-----|---------|-----|---------|-----|---------|-----|---------|-----|---------|-----|
|                               | Lbs     | %   | Lbs     | %   | Lbs     | %   | Lbs     | %   | Lbs     | %   | Lbs     | %   |
| Walnuts                       | 36,422  | 21% | 39,070  | 26% | 35,361  | 33% | 45,334  | 35% | 47,623  | 42% | 40,762  | 30% |
| Alfalfa                       | 49,160  | 28% | 36,500  | 25% | 19,499  | 18% | 44,300  | 34% | 29,307  | 26% | 35,753  | 26% |
| Structural*                   | 42,839  | 24% | 23,782  | 16% | 25,838  | 24% | 10,178  | 8%  | 1,679   | 1%  | 20,863  | 15% |
| Almonds                       | 12,881  | 7%  | 17,438  | 12% | 11,056  | 10% | 14,067  | 11% | 17,661  | 15% | 14,621  | 11% |
| Corn                          | 8,601   | 5%  | 5,756   | 4%  | 3,473   | 3%  | 3,597   | 3%  | 3,563   | 3%  | 4,998   | 4%  |
| Sugarbeets**                  | 10,027  | 6%  | 9,444   | 6%  | 0       | 0%  | 0       | 0%  | 427     | 0%  | 3,979   | 3%  |
| Apples***                     | 3,332   | 2%  | 4,097   | 3%  | 1,081   | 1%  | 3,627   | 3%  | 5,859   | 5%  | 3,599   | 3%  |
| Asparagus                     | 4,418   | 2%  | 4,280   | 3%  | 2,404   | 2%  | 3,311   | 3%  | 1,704   | 1%  | 3,223   | 2%  |
| Cotton                        | 2,062   | 1%  | 2,776   | 2%  | 4,486   | 4%  | 199     | 0%  | 548     | 0%  | 2,014   | 1%  |
| Grapes                        | 150     | 0%  | 31      | 0%  | 64      | 0%  | 1,064   | 1%  | 4,405   | 4%  | 1,143   | 1%  |
| Sunflowers                    | 3,307   | 2%  | 482     | 0%  | 361     | 0%  | 615     | 0%  | 308     | 0%  | 1,015   | 1%  |
| Outdoor Nursery Plants        | 669     | 0%  | 819     | 1%  | 1,600   | 1%  | 1,044   | 1%  | 488     | 0%  | 924     | 1%  |
| Landscaping                   | 1,056   | 1%  | 650     | 0%  | 649     | 1%  | 230     | 0%  | 139     | 0%  | 545     | 0%  |
| Sorghum                       | 575     | 0%  | 421     | 0%  | 514     | 0%  | 640     | 0%  | 71      | 0%  | 444     | 0%  |
| Pears                         | 0       | 0%  | 100     | 0%  | 986     | 1%  | 0       | 0%  | 465     | 0%  | 310     | 0%  |
| Oranges                       | 484     | 0%  | 234     | 0%  | 233     | 0%  | 380     | 0%  | 70      | 0%  | 280     | 0%  |
| Grasses                       | 261     | 0%  | 48      | 0%  | 705     | 1%  | 0       | 0%  | 0       | 0%  | 203     | 0%  |
| Total Reported For Uses Shown | 176,243 | 99  | 145,928 | 99  | 108,311 | 100 | 128,587 | 99  | 114,317 | 100 | 134,677 | 99% |
| Total Reported Uses           | 177,176 | 100 | 147,514 | 100 | 108,647 | 100 | 129,601 | 100 | 114,604 | 100 | 135,508 | 100 |

\* Most structural uses of chlorpyrifos have been canceled , \*\* Sugarbeets are no longer grown in significant quantities in or around the Delta., \*\*\* Use of chlorpyrifos for apples has been canceled.

Table 2.7 summarizes the major chlorpyrifos uses (greater than 500 lbs or 5% of seasonal use) for the dormant and irrigation seasons. During the dormant season, when approximately 3% of the annual chlorpyrifos use occurs, the main chlorpyrifos uses are alfalfa, almonds, outdoor nursery plants, and grapes (use on apples has now been canceled). During the

irrigation season most of the agricultural use of chlorpyrifos is on (in order of descending amount applied) walnuts, alfalfa, almonds, and corn. During March, the predominant use of chlorpyrifos is alfalfa. During May, June, July and August the main use of chlorpyrifos is on walnuts, but almonds and alfalfa also receive significant applications in those months.

**Table 2.7. Seasonal Agricultural Chlorpyrifos Applications in the Delta Watershed (1999-2003 Average)**

| Dormant Season (Dec-Feb)   |             |                         | Irrigation Season (Mar-Nov) |             |                            |
|--|-------------|-------------------------|-----------------------------|-------------|----------------------------|
| Crop   | lbs Applied | % of Dormant Season Use | Crop                        | lbs Applied | % of Irrigation Season Use |
| Apples*  | 823         | 28%                     | Walnuts                     | 40,725      | 37%                        |
| Alfalfa  | 771         | 26%                     | Alfalfa                     | 34,982      | 31%                        |
| Almonds  | 462         | 16%                     | Almonds                     | 14,159      | 13%                        |
| Outdoor Nursery Plants   | 245         | 8%                      | Corn                        | 4,994       | 4%                         |
|  |             |                         | Sugarbeets**                | 3,959       | 4%                         |
|  |             |                         | Asparagus                   | 3,153       | 3%                         |
|  |             |                         | Apples                      | 2,776       | 2%                         |
|  |             |                         | Cotton                      | 2,014       | 2%                         |
|  |             |                         | Grapes                      | 1,020       | 1%                         |
|  |             |                         | Sunflowers                  | 1,015       | 1%                         |
| Total Of Uses Shown  | 2,302       | 78%                     | Total Of Uses Shown         | 107,781     | 97%                        |
| Total Dormant Season Use   | 2,944       |                         | Total Irrigation Season Use | 111,157     |                            |
| % Of Annual Average  | 3%          |                         | % Of Annual Average         | 97%         |                            |
| * Use of chlorpyrifos on apples has been canceled                        |             |                         |                             |             |                            |
| ** sugarbeets are no longer grown in significant quantities in the Delta |             |                         |                             |             |                            |

Unlike agricultural pesticide use, which must be reported to the DPR in pesticide use reports, pesticides used in the urban environment include both reported and unreported uses. Only professional urban applications must be reported to DPR. Professional applications include structural and landscape pest control, and restaurant and commercial building pest control. Residential pesticide use, such as animal-care products, and home and garden pest control are not reported, but previous to their phase-out, their use was very common in urban areas.

Sale of both diazinon and chlorpyrifos for use in indoor and outdoor areas where children could be exposed (schools, playgrounds, parks) was cancelled by recent USEPA regulations. Sales of chlorpyrifos and diazinon for indoor uses were cancelled effective December 31, 2001 and December 31, 2002, respectively. Manufacturers of diazinon were required to stop the sale of diazinon formulations for outdoor non-agricultural uses by August 2003. Retailers were required to stop the sale of diazinon for outdoor non-agricultural uses after December

2004. Consumers will be able to use their remaining supplies until depleted. A few “low risk” structural uses of chlorpyrifos, where children are not exposed, are still permitted. These uses include ship holds, railroad boxcars, industrial plants, manufacturing plants, food processing plants, golf courses, road medians, treatment of utility poles and other outdoor wood products, fire ant mounds and mosquito control. The ban on residential urban use of chlorpyrifos and diazinon should eventually reduce the potential for water quality impacts from these pesticides in urban areas. Pyrethroids and carbamates are being used as replacements for many urban (and agricultural) uses, and these may also cause aquatic toxicity impacts (TDC Environmental, 2003).

### **2.3.3 Diazinon and Chlorpyrifos in Surface Water in the Delta Watershed**

Over the past 17 years (1988 to 2005), a considerable amount of pesticide sampling has taken place in the Delta and the Delta watershed. Multiple studies, summarized in Appendix B, conducted by the United States Geological Survey, California Regional Water Quality Control Board-Central Valley Region, and others have detected diazinon and chlorpyrifos concentrations at levels of concern in the Delta and many of its tributaries. Beneficial uses potentially affected by the concentrations of diazinon and chlorpyrifos in the Delta Waterways are Warm (WARM) and Cold (COLD) Freshwater Habitat (CRWQCB-CVR, 1998).

Some of the Delta’s tributaries and waterbodies, such as the Sacramento and San Joaquin Rivers, have a large amount of pesticide data available, while others have little or no pesticide data available. When evaluating the available data, it is important to keep in mind the following key factors:

- 1) Monitoring in this large area has been highly variable and the available data are a result of the monitoring studies and programs implemented at a particular period and location.
- 2) Many of the data have analytical detection limits (particularly for chlorpyrifos) that are above levels of concern.
- 3) The sites and time periods with more frequent data collection (especially during key runoff events) and lower analytical detection limits are better characterized than the sites and time periods with few data and/or higher detection limits.
- 4) The dynamics of pesticide use patterns and changes in the registered uses of these pesticides have affected and will continue to affect the presence of these pesticides in the surface waters.

Samples collected from the Sacramento River at Rio Vista and from the San Joaquin River at Vernalis in February 1993 were found to be toxic (100% mortality) to the water flea *Ceriodaphnia dubia* (an invertebrate organism (zooplankton) used in USEPA toxicity tests of water samples) for three and twelve consecutive days, respectively. Diazinon concentrations detected in these samples appear high enough to account for most of the toxicity (Kuivila and Foe, 1995). Ambient water samples were collected from the Sacramento-San Joaquin Delta as part of the Bay Protection and Toxic Cleanup Program (BPTCP) between May 1993 and May 1994 and tested for toxicity (Deanovic *et al.*, 1996). Samples that exhibited significant toxicity were then tested to determine the constituent or constituents causing toxicity. *Ceriodaphnia* mortality was reported in samples collected from the Sacramento River at Greene’s Landing and from the San Joaquin River at Vernalis following rain events in January

and February 1994. Toxicity Identification Evaluation (TIE) tests indicated that the toxicity in these samples was due primarily to metabolically activated OP pesticides, including diazinon and chlorpyrifos.

One hundred seventy-two ambient water samples were collected from the Sacramento-San Joaquin Delta as part of the BPTCP during routine monitoring between June 1994 and July 1995 and tested for toxicity using *Ceriodaphnia dubia* (Deanovic *et al.*, 1998). Samples that exhibited significant toxicity were then further tested to determine the constituent or constituents causing toxicity. Acute mortality (statistically significant difference in mortality between a sample and the laboratory control at 96 hours) in *Ceriodaphnia* was reported in 12 (7%) of the 172 samples collected from Mosher Slough, Ulatis Creek, Paradise Cut, Haas Slough, Ryer Island Drain, French Camp Slough, and Duck Slough. Ambient water samples were also collected during six rain events at select Delta locations. One hundred percent mortality was observed within 96 hours in samples collected from Ulatis Creek, Paradise Cut, and Mosher Slough on March 9, 1995. One hundred percent mortality was observed within 24 hours in samples collected from Duck Slough on March 25, 1995 and Mosher Slough on March 24, 1995. TIE tests suggest that diazinon caused or contributed to observed *Ceriodaphnia* toxicity in eight of these samples. Toxicity (100% *Ceriodaphnia dubia* mortality within 5 days) was found in monthly samples collected during the 1997 irrigation season from the Calaveras River and French Camp Slough within the legal boundaries of the Delta in May and August 1997, respectively. TIE tests indicated that the toxicity in these samples was due primarily to chlorpyrifos (Reyes *et al.*, 2000).

Figure 2.3 shows “Key” Delta watershed sampling locations that are useful in understanding the transport and presence of diazinon and chlorpyrifos into and within the Delta Waterways due to their location, hydrology and data availability. Tables 2.8 and 2.9 summarize diazinon and chlorpyrifos data for these sites (data for additional sampling sites are summarized in the discussions of each of the subareas in Appendix E). For the purpose of assessing the levels of impairment, Tables 2.8 and 2.9 also summarize exceedances of the proposed acute Water Quality Objective concentrations. As discussed in the Water Quality Objectives section of this report, the proposed Water Quality Objectives are based on criteria developed for the protection of aquatic life from toxic effects of diazinon or chlorpyrifos. Exceedance of these proposed Water Quality Objectives, therefore, represents a potential impact to aquatic life, and an exceedance of the Basin Plan’s narrative toxicity Water Quality Objective. Under the proposed Water Quality Objectives, the maximum allowable hourly concentrations would be 160 ng/L for diazinon and 25 ng/L for chlorpyrifos<sup>2</sup>, not to be exceeded more than once every three years. Diazinon and chlorpyrifos have been shown to exhibit additive toxicity when present together (Bailey *et al.*, 1997). Therefore, when both diazinon and chlorpyrifos concentration data were available for the same time and location, the potential toxic effects of the combined diazinon and chlorpyrifos concentrations are also evaluated in table 2.10 using the equation provided from the Basin Plan (CRWQCB-CVR, 1998):

---

<sup>2</sup> For ease of discussion, this report uses the units of nanograms per liter (n/L), or parts per trillion, when discussing diazinon and chlorpyrifos concentrations. The actual proposed Basin Plan amendment language expresses the diazinon and chlorpyrifos Water Quality Objectives in units of micrograms per liter (µg/L), or parts per billion, for consistency with the Basin Plan. Concentrations expressed in nanograms per liter can be converted to micrograms per liter by dividing by one thousand.

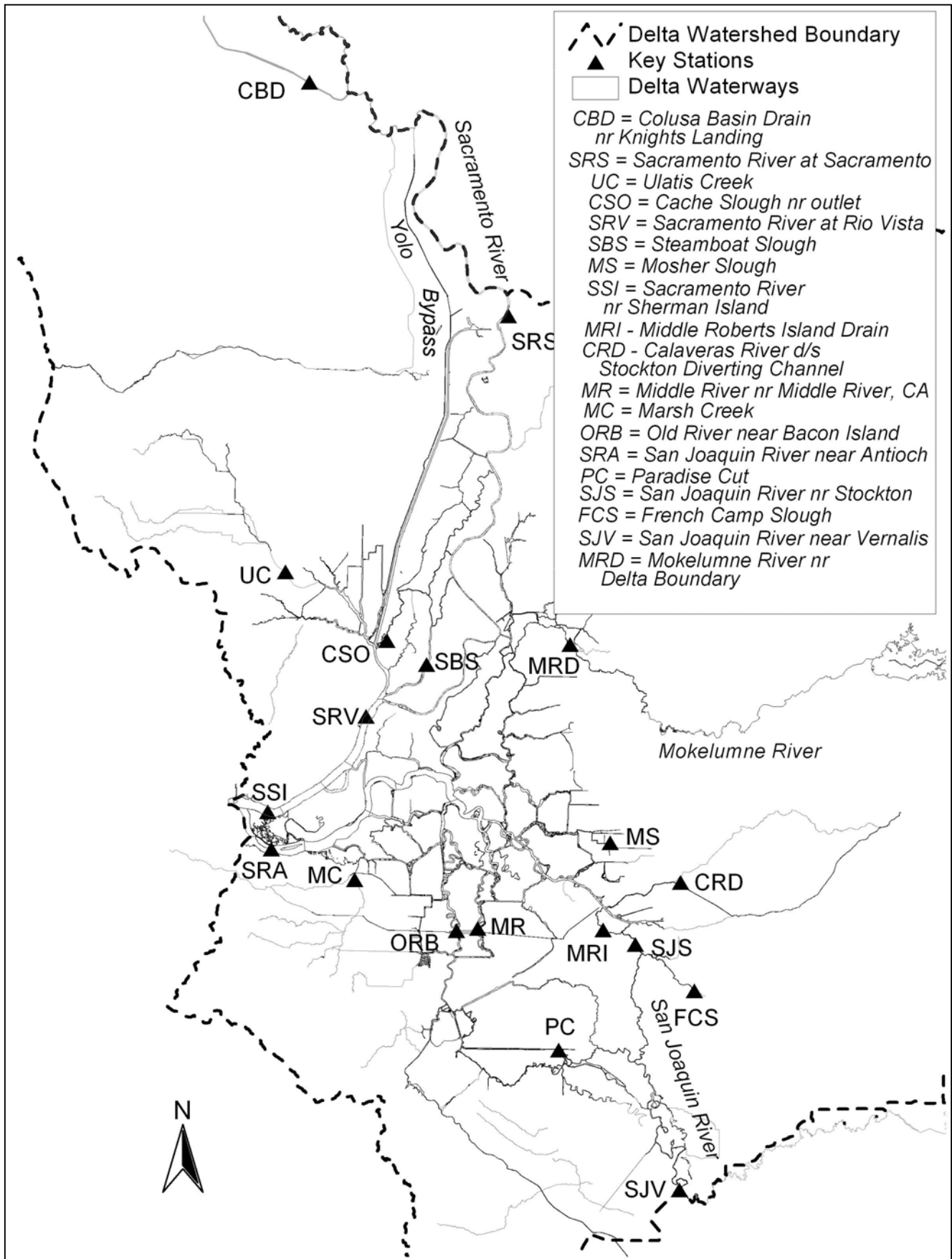
$$\frac{C_1}{O_1} + \frac{C_2}{O_2} = S \quad \text{[Equation 1]}$$

Where:

C = The concentration of each pesticide.

O = The proposed acute toxicity Water Quality Objective for diazinon to protect invertebrates (0.16 µg/L, or 160 ng/L) and the proposed acute Water Quality Objective for chlorpyrifos (0.025 µg/L or 25 ng/L).

S = The sum. A sum equal to, or exceeding, one (1.0) indicates that the beneficial use may be impacted.



**Figure 2.3. Key Delta Watershed Monitoring Sites**

**Table 2.8. Diazinon Concentrations in Key Delta Watershed Sites, January, 1991 – March, 2005**

| <b>Location</b>                               | <b># of Samples</b> | <b>Median Concentration (ng/L)</b> | <b>90th Percentile Concentration (ng/L)</b> | <b>Maximum Concentration (ng/L)</b> | <b># of Samples &gt;160 ng/L</b> | <b>% of Samples &gt; 160 ng/L</b> |
|---|---------------------|------------------------------------|---|-------------------------------------|----------------------------------|-----------------------------------|
| Colusa Basin Drain nr Knights Landing         | 170                 | 20                                 | 120   | 420                                 | 13                               | 8%                                |
| Sac R at Sacramento                           | 551                 | 0                                  | 41  | 307                                 | 8                                | 1%                                |
| Steamboat Slough                              | 35                  | 0                                  | 10  | 12                                  | 0                                | 0%                                |
| Ulatis Creek                                  | 73                  | 9                                  | 100   | 380                                 | 5                                | 7%                                |
| Cache Slough nr Outlet                        | 49                  | 9                                  | 37  | 96                                  | 0                                | 0%                                |
| Sac R at Rio Vista                            | 88                  | 22                                 | 111   | 310                                 | 4                                | 5%                                |
| Sac R nr Sherman Island                       | 16                  | 3                                  | 18  | 38                                  | 0                                | 0%                                |
| Mokelumne River near Delta Boundary           | 44                  | 0                                  | 19  | 230                                 | 1                                | 2%                                |
| Mosher Slough                                 | 77                  | 130                                | 547   | 1,400                               | 31                               | 40%                               |
| Calaveras River ds Stockton Diverting Channel | 43                  | 43                                 | 308   | 1,700                               | 10                               | 23%                               |
| SJR nr Stockton                               | 50                  | 80                                 | 258   | 797                                 | 15                               | 30%                               |
| Middle Roberts Island Drain                   | 45                  | 0                                  | 15  | 82                                  | 0                                | 0%                                |
| Paradise Cut                                  | 36                  | 0                                  | 25  | 125                                 | 0                                | 0%                                |
| French Camp Slough                            | 59                  | 9                                  | 202   | 1,110                               | 7                                | 12%                               |
| SJR nr Vernalis                               | 1,237               | 4                                  | 93  | 1,216                               | 72                               | 6%                                |
| Old River nr Bacon Island                     | 35                  | 38                                 | 93  | 121                                 | 0                                | 0%                                |
| Middle River near Middle River                | 57                  | 56                                 | 129   | 149                                 | 0                                | 0%                                |
| Marsh Creek                                   | 52                  | 19                                 | 99  | 380                                 | 3                                | 6%                                |
| SJR at Antioch                                | 18                  | 2                                  | 27  | 35                                  | 0                                | 0%                                |

**Table 2.9. Chlorpyrifos Concentrations In Key Delta Watershed Sites, March, 1988 – March, 2005**

| Location                                      | # of Samples | Median Concentration (ng/L) | 90th Percentile Concentration (ng/L) | Maximum Concentration (ng/L) | # of Samples > 25 ng/L | % of Samples > 25 ng/L |
|---|--------------|-----------------------------|--------------------------------------|------------------------------|------------------------|------------------------|
| Colusa Basin Drain nr Knights Landing         | 87           | 0                           | 0                                    | 700                          | 1                      | 1%                     |
| Sac R at Sacramento                           | 520          | 0                           | 0                                    | 30                           | 1                      | 0%                     |
| Steamboat Slough                              | 35           | 0                           | 0                                    | 33                           | 1                      | 3%                     |
| Ulatis Creek                                  | 73           | 8                           | 91                                   | 137                          | 28                     | 38%                    |
| Cache Slough nr Outlet                        | 49           | 0                           | 4                                    | 36                           | 1                      | 2%                     |
| Sac R at Rio Vista                            | 89           | 0                           | 0                                    | 36                           | 2                      | 2%                     |
| Sac R nr Sherman Island                       | 28           | 0                           | 0                                    | 1                            | 0                      | 0%                     |
| Mokelumne River near Delta Boundary           | 42           | 0                           | 0                                    | 43                           | 2                      | 5%                     |
| Mosher Slough                                 | 72           | 7                           | 107                                  | 210                          | 23                     | 32%                    |
| Calaveras River ds Stockton Diverting Channel | 43           | 0                           | 53                                   | 110                          | 6                      | 14%                    |
| SJR nr Stockton                               | 50           | 0                           | 0                                    | 16                           | 0                      | 0%                     |
| Middle Roberts Island Drain                   | 45           | 9                           | 56                                   | 360                          | 11                     | 24%                    |
| Paradise Cut                                  | 39           | 0                           | 93                                   | 550                          | 6                      | 15%                    |
| French Camp Slough                            | 60           | 5                           | 65                                   | 520                          | 9                      | 15%                    |
| SJR nr Vernalis                               | 1,185        | 0                           | 9                                    | 110                          | 19                     | 2%                     |
| Old River nr Bacon Island                     | 47           | 0                           | 0                                    | 3                            | 0                      | 0%                     |
| Middle River near Middle River                | 57           | 0                           | 0                                    | 4                            | 0                      | 0%                     |
| Marsh Creek                                   | 52           | 0                           | 8                                    | 24                           | 0                      | 0%                     |
| SJR at Antioch                                | 29           | 0                           | 0                                    | 1                            | 0                      | 0%                     |

As the tables 2.11 and 2.12 indicate, several sites have diazinon and chlorpyrifos concentrations that are occasionally above the proposed Water Quality Objective concentrations. The Sacramento, San Joaquin, Mokelumne and Calaveras Rivers all occasionally contain concentrations of diazinon and chlorpyrifos above the proposed target concentration as they flow into the Delta contributing significant loads of diazinon and chlorpyrifos to the Delta Waterways from the north, south and east. In addition, smaller tributaries to the main Delta Waterways also have diazinon concentrations that are occasionally above the proposed Water Quality Objective concentrations. As the table 2.13 indicates, many sites also have concentrations that exceed the proposed Loading Capacity for combined diazinon and chlorpyrifos concentrations, as described using Equation 1 and the proposed individual diazinon and chlorpyrifos concentrations.



**Table 2.10. Combined Criteria-Normalized Diazinon and Chlorpyrifos Concentrations In Key Delta Watershed Sites, 1991 – March, 2005**

| Location                                      | # of Samples | Median S* Value | 90th Percentile S Value | Maximum S value | # of Samples S > 1 | % of samples S > 1 |
|---|--------------|-----------------|-------------------------|-----------------|--------------------|--------------------|
| Colusa Basin Drain nr Knights Landing         | 74           | 0.1             | 0.6                     | 28.0            | 4                  | 5%                 |
| Sac R at Sacramento                           | 521          | 0.0             | 0.3                     | 1.9             | 9                  | 2%                 |
| Steamboat Slough                              | 35           | 0.0             | 0.1                     | 1.3             | 1                  | 3%                 |
| Ulatis Creek                                  | 72           | 0.7             | 3.9                     | 7.3             | 32                 | 44%                |
| Cache Slough nr Outlet                        | 49           | 0.1             | 0.5                     | 1.4             | 1                  | 2%                 |
| Sac R at Rio Vista                            | 88           | 0.1             | 0.8                     | 1.9             | 6                  | 7%                 |
| Sac R nr Sherman Island                       | 15           | 0.0             | 0.1                     | 0.2             | 0                  | 0%                 |
| Mokelumne River near Delta Boundary           | 42           | 0.0             | 0.1                     | 2.1             | 2                  | 5%                 |
| Mosher Slough                                 | 63           | 0.9             | 7.3                     | 17.1            | 31                 | 49%                |
| Calaveras River ds Stockton Diverting Channel | 43           | 0.6             | 2.7                     | 14.6            | 15                 | 35%                |
| SJR nr Stockton                               | 50           | 0.6             | 1.6                     | 5.0             | 15                 | 30%                |
| Middle Roberts Island Drain                   | 45           | 0.4             | 2.2                     | 14.4            | 11                 | 24%                |
| Paradise Cut                                  | 36           | 0.1             | 4.9                     | 22.3            | 6                  | 17%                |
| French Camp Slough                            | 58           | 0.5             | 3.4                     | 21.0            | 17                 | 29%                |
| SJR nr Vernalis                               | 1089         | 0.1             | 1.0                     | 9.1             | 105                | 10%                |
| Old River nr Bacon Island                     | 35           | 0.2             | 0.6                     | 0.8             | 0                  | 0%                 |
| Middle River near Middle River                | 65           | 0.4             | 0.8                     | 0.9             | 0                  | 0%                 |
| Marsh Creek                                   | 52           | 0.1             | 1.0                     | 2.7             | 4                  | 8%                 |
| SJR at Antioch                                | 16           | 0.0             | 0.2                     | 0.2             | 0                  | 0%                 |

Table 2.11, 2.12 and 2.13 summarize the concentrations of diazinon and chlorpyrifos for different categories of waterbodies within the Delta watershed. Previous studies of the Delta have indicated that toxicity to *Ceriodaphnia dubia* occurred most frequently in back sloughs and small upland drainages of the Delta, and this toxicity was often due to elevated

\* S = the sum of criteria normalized diazinon and chlorpyrifos concentrations, as defined by Equation 1.

chlorpyrifos and/or diazinon concentrations (Deanovic et al., 1996). As shown in table 2.11, the available data indicate that diazinon concentrations tend to be highest in back sloughs and small upland drainages, and lower in Delta island drains, the main river inputs to the Delta, and the main channels of the Delta. As shown in table 2.12, chlorpyrifos concentrations tend to be highest in back sloughs, Delta island drains, and small upland drainages and lower in the main river inputs to the Delta or the main channels of the Delta. In the Delta island drains where data are available, chlorpyrifos concentrations appear to be higher and exceed criteria more frequently than diazinon concentrations. The relatively lower diazinon and chlorpyrifos concentration in main river inputs to the Delta and main channels of the Delta are likely due to the dilution available in these waterways due to upstream and/or tidal flows.

**Table 2.11. Diazinon Concentrations By Waterbody Category**

| <b>Water Body Type</b>                | <b># of Samples</b> | <b>Median Concentration (ng/L)</b> | <b>90th Percentile Concentration (ng/L)</b> | <b>Maximum Concentration (ng/L)</b> | <b># of Samples &gt; 160 ng/L</b> | <b>% of Samples &gt;160 ng/L</b> |
|---------------------------------------|---------------------|------------------------------------|---|-------------------------------------|-----------------------------------|----------------------------------|
| Delta Back Sloughs                    | 352                 | 13                                 | 300   | 1,400                               | 56                                | 16%                              |
| Delta Island Drains                   | 57                  | 0                                  | 17  | 82                                  | 0                                 | 0%                               |
| Delta Rivers and Main Delta Waterways | 774                 | 0                                  | 97  | 797                                 | 31                                | 4%                               |
| Major Delta Tributaries               | 2,056               | 0                                  | 80  | 1,700                               | 106                               | 5%                               |
| Small Upland Drainages                | 146                 | 16                                 | 150   | 2,790                               | 13                                | 9%                               |

**Table 2.12. Chlorpyrifos Concentrations by Waterbody Category**

| <b>Water Body Type</b>                | <b># of Samples</b> | <b>Median Concentration (ng/L)</b> | <b>90th Percentile concentration (ng/L)</b> | <b>Maximum Concentration (ng/L)</b> | <b># of Samples &gt; 25</b> | <b>% of Samples &gt; 25</b> |
|---------------------------------------|---------------------|------------------------------------|---|-------------------------------------|-----------------------------|-----------------------------|
| Delta Back Sloughs                    | 373                 | 0                                  | 68  | 677                                 | 62                          | 17%                         |
| Delta Island Drains                   | 57                  | 5                                  | 46  | 360                                 | 11                          | 19%                         |
| Delta Rivers and Main Delta Waterways | 722                 | 0                                  | 0   | 76                                  | 7                           | 1%                          |
| Major Delta Tributaries               | 1,887               | 0                                  | 7   | 700                                 | 32                          | 2%                          |
| Small Upland Drainages                | 148                 | 0                                  | 87  | 180                                 | 35                          | 24%                         |

**Table 2.13. Combined Normalized Diazinon and Chlorpyrifos Concentrations by Waterbody Category**

| <b>Water Body Type</b>               | <b># of Samples</b> | <b>Median S value</b> | <b>90th Percentile S Value</b> | <b>Maximum S Value</b> | <b># of Samples with S &gt; 1</b> | <b>% of Samples with S &gt;1</b> |
|--------------------------------------|---------------------|-----------------------|--------------------------------|------------------------|-----------------------------------|----------------------------------|
| Delta Back Sloughs                   | 326                 | 0                     | 4                              | 27                     | 84                                | 26%                              |
| Delta Island Drains                  | 56                  | 0                     | 2                              | 14                     | 11                                | 20%                              |
| Delta Rivers and Main Delta Channels | 596                 | 0                     | 1                              | 5                      | 35                                | 6%                               |
| Major Delta Tributaries              | 1,779               | 0                     | 1                              | 28                     | 139                               | 8%                               |
| Small Upland Drainages               | 145                 | 0                     | 4                              | 17                     | 46                                | 32%                              |

### 2.3.3.1 Diazinon and Chlorpyrifos in the Delta Following Winter Storms

Following storm events in January and February, diazinon concentrations in the Sacramento River within the Delta and diazinon and chlorpyrifos in the San Joaquin River within the Delta exceeded the proposed acute Water Quality Objective concentrations for the protection of aquatic life (160 ng/l for diazinon and 25 ng/L for chlorpyrifos). As discussed above, samples collected from the Sacramento River at Rio Vista and the San Joaquin River at Vernalis in February 1993 were toxic (causing 100% mortality) to the water flea *Ceriodaphnia dubia*, and diazinon concentrations were high enough to account for most of the observed toxicity (Kuivila and Foe, 1995). The diazinon concentrations in the Sacramento River are eventually diluted by tidal flows as they flow out towards San Francisco Bay. Pulses of diazinon from the Sacramento River have been traced across the Delta as far west as Chipps Island (Kuivila and Foe, 1995). Water in the Sacramento River can also be diverted through the Mokelumne River towards the pumping plants in the southern Delta via the Delta cross channel. Water from the San Joaquin River can flow through the Old and Middle Rivers as it is pulled towards the pumping plants in the southern Delta. Therefore, the diazinon loads due to elevated diazinon concentrations and high winter storm flows in the Sacramento and San Joaquin Rivers have the potential to increase the diazinon concentrations in the major river channels within the Delta (the Sacramento, Mokelumne, San Joaquin, Old and Middle Rivers), and the Delta Waterways to which they are hydrologically connected. Also, the chlorpyrifos in the San Joaquin River following winter storms has the potential to increase the chlorpyrifos concentrations in the main river channels in the Southern Delta (the San Joaquin, Old and Middle Rivers), and in the Delta Waterways in the Southern Delta to which they are hydrologically connected.

### 2.3.3.2 Diazinon and Chlorpyrifos in the Delta During the Irrigation Season

During the irrigation season (March through September) elevated diazinon and chlorpyrifos concentrations can be found within smaller watercourses that receive runoff from urban and

agricultural areas. During years when there is a wet spring, elevated concentrations of chlorpyrifos and diazinon can also occur in rivers within the Delta (Foe, 1995). In the Sacramento River as it flows through the Delta, the winter storm season is the only time that diazinon has been found at concentrations greater than the proposed Water Quality Objectives.

### **2.3.3.3 Diazinon and Chlorpyrifos in Urban Waterways Within the Delta**

Historically, samples collected from streams, sumps and sloughs in the cities of Sacramento and Stockton during storm runoff events indicate that urban waterways in these areas have routinely contained concentrations of diazinon and chlorpyrifos that exceed the proposed Water Quality Objectives for these pesticides, and cause toxicity to sensitive invertebrates (Bailey, et al., 2000). Samples were collected from streams, sumps and sloughs in the cities of Sacramento and Stockton during 1994 and 1995. The majority of the sampling sites were located within the legal Delta boundary. Most of these samples were collected between October and May, during or after precipitation events. Of the two hundred thirty-one samples analyzed for diazinon, more than half exceeded the proposed diazinon acute Water Quality Objective (160 ng/L), and diazinon concentrations ranged from below detection to 1,500 ng/L, with a median of 210 ng/L. Of the ninety samples analyzed for chlorpyrifos, more than half exceeded the proposed acute chlorpyrifos Water Quality Objective (25 ng/L), and chlorpyrifos concentrations ranged from below the detection limit to 190 ng/L with a median of 50 ng/L (Bailey et al., 2000). Diazinon and chlorpyrifos from urban sources are primarily introduced into surface water through storm runoff and irrigation runoff. In addition, agricultural pesticides that have entered the atmosphere can drift into urban areas and fall out there during storms (USGS, 2003).

The phase-outs of the non-agricultural uses of diazinon and of most non-agricultural uses of chlorpyrifos are expected to result in significantly lower diazinon and chlorpyrifos concentrations in urban runoff and wastewater treatment plant effluent. The Delta tributaries and reaches of waterways within the Delta that receive a significant amount of urban runoff or wastewater treatment plant effluent are therefore expected to have lower diazinon and chlorpyrifos concentrations in the next few years, as the cancellations take effect and residents use up their remaining stored diazinon and chlorpyrifos products. There still may be some chlorpyrifos present in urban runoff from the remaining allowed non-agricultural uses.

Before the ban on urban uses of diazinon and chlorpyrifos, these uses likely contributed significantly to the diazinon and chlorpyrifos concentrations in the Delta Waterways. Urban waterways in both the Sacramento and Stockton areas had diazinon and or chlorpyrifos concentrations high enough that several of these waterbodies were placed on the Clean Water Act Section 303(d) list of impaired waterways for the Central Valley Region (SWRCB, 2003). Based on the widespread presence of these pesticides in urban waterways where data were available, waterbodies receiving runoff from other urban areas in the Delta watershed also likely had high concentrations of diazinon and chlorpyrifos.

### **2.3.3.4 Trends in Diazinon and Chlorpyrifos Concentrations in the Delta Waterways and Their Tributaries**

Tables 2.14 and 2.15 compare diazinon and chlorpyrifos concentration data from the early nineties (1990 through 1995 water years), with data from recent years (2000 through 2005 water years) for all sampling locations at which there were 10 or more data points available in

each time period. The observed maximum and 90th percentile diazinon concentrations, and the number of exceedances of the proposed diazinon Water Quality Objectives are less in 2000-2005 for all the sites listed in Table 2.14. With the exception of the Sacramento River sites, the observed maximum and 90th percentile chlorpyrifos concentrations and the number of exceedances of the proposed chlorpyrifos Water Quality Objectives are less for 2000 through 2005 for all sites listed in Table 2.15. There is an apparent increase in chlorpyrifos concentrations Sacramento River at Sacramento and at Rio Vista. This apparent increase may be due to improvements in detection limits since the early nineties and the more frequent filtering of samples in the early nineties<sup>3</sup>.

In general, concentrations of diazinon and chlorpyrifos in the Delta Waterways and their tributaries in the Delta watershed appear to have declined since the early nineties, when widespread diazinon and chlorpyrifos concentrations of concern were first observed in the Delta. Part of this apparent decline may be explained by the reductions in diazinon and chlorpyrifos use in the Delta watershed, as discussed above, and by reduced diazinon and chlorpyrifos loading to the Delta from the Sacramento and San Joaquin River basins.

---

<sup>3</sup> In the early nineties detection limits were above 40 ng/L (MacCoy et al., 1995) and most of the data from the early nineties was for filtered samples (MacCoy et al., 1995). More of the recent data are for unfiltered samples, with detection limits less than 10 ng/L (Calanchini et al., 2004, Calanchini et al., 2005a, 2005b). Due to the tendency of chlorpyrifos to sorb to suspended sediment, filtering larger particles may remove a fraction of the total chlorpyrifos present in a raw water sample.

**Table 2.14. Diazinon Concentration Trends at Key Delta Watershed Sites**

| Location<br>(as shown in<br>Figure 2.3)   | Water<br>Years | # of<br>Samples | Median<br>Concentration<br>(ng/L) | 90th Percentile<br>Concentration<br>(ng/L) | Maximum<br>Concentration<br>(ng/L) | % of<br>Samples<br>> 160 ng/L |
|---|----------------|-----------------|-----------------------------------|--|------------------------------------|-------------------------------|
| Colusa Basin Drain<br>nr. Knights Landing | 1990-1995      | 60              | 42                                | 304  | 420                                | 18%                           |
|   | 2000-2005      | 75              | 17                                | 68   | 180                                | 3%                            |
| Sac R.<br>at Sacramento                   | 1990-1995      | 448             | 0                                 | 41   | 307                                | 2%                            |
|   | 2000-2005      | 103             | 10                                | 39   | 96                                 | 0%                            |
| Ulatis Creek                              | 1990-1995      | 20              | 9                                 | 240  | 293                                | 15%                           |
|   | 2000-2005      | 53              | 9                                 | 95   | 380                                | 4%                            |
| Sac R. at Rio Vista                       | 1990-1995      | 39              | 37                                | 157  | 310                                | 10%                           |
|   | 2000-2005      | 49              | 9                                 | 36   | 86                                 | 0%                            |
| Mosher Slough                             | 1990-1995      | 14              | 420                               | 647  | 1,090                              | 86%                           |
|   | 2000-2005      | 53              | 85                                | 196  | 480                                | 17%                           |
| Paradise Cut                              | 1990-1995      | 10              | 5                                 | 51   | 125                                | 0%                            |
|   | 2000-2005      | 26              | 0                                 | 15   | 45                                 | 0%                            |
| French Camp<br>Slough                     | 1990-1995      | 11              | 17                                | 460  | 1,110                              | 36%                           |
|   | 2000-2005      | 46              | 8                                 | 145  | 440                                | 7%                            |
| SJR nr Vernalis                           | 1990-1995      | 780             | 11                                | 110  | 1,216                              | 7%                            |
|   | 2000-2005      | 300             | 0                                 | 49   | 235                                | 3%                            |

**Table 2.15. Chlorpyrifos Concentration Trends at Key Delta Watershed Sites**

| Location<br>(as shown in<br>Figure 2.3) | Water<br>years | # of<br>Samples | Median<br>Concentration<br>(ng/L) | 90th Percentile<br>Concentration<br>(ng/L) | Maximum<br>Concentration<br>(ng/L) | % of Samples ><br>25 ng/L |
|---|----------------|-----------------|-----------------------------------|--|------------------------------------|---------------------------|
| Sac R. at<br>Sacramento                 | 1990-1995      | 418             | 0                                 | 0  | 0                                  | 0%                        |
|   | 2000-2005      | 102             | 0                                 | 3  | 30                                 | 1%                        |
| Ulatis Creek                            | 1990-1995      | 19              | 28                                | 92   | 137                                | 53%                       |
|   | 2000-2005      | 54              | 7                                 | 91   | 120                                | 33%                       |
| Sac R. at Rio Vista                     | 1990-1995      | 40              | 0                                 | 0  | 0                                  | 0%                        |
|   | 2000-2005      | 49              | 0                                 | 6  | 36                                 | 4%                        |
| Mosher Slough                           | 1990-1995      | 11              | 73                                | 116  | 119                                | 64%                       |
|   | 2000-2005      | 53              | 5                                 | 38   | 100                                | 17%                       |
| Paradise Cut                            | 1990-1995      | 13              | 0                                 | 384  | 550                                | 46%                       |
|   | 2000-2005      | 26              | 0                                 | 7  | 20                                 | 0%                        |
| French Camp<br>Slough                   | 1990-1995      | 11              | 12                                | 130  | 520                                | 36%                       |
|   | 2000-2005      | 46              | 5                                 | 16   | 230                                | 7%                        |
| SJR nr Vernalis                         | 1990-1995      | 758             | 0                                 | 10   | 110                                | 2%                        |
|   | 2000-2005      | 302             | 0                                 | 10   | 32                                 | 1%                        |

## **2.4 Need for an Amendment to the Basin Plan**

Currently, the Basin Plan does not include a specific program of implementation to address diazinon and chlorpyrifos runoff from orchards and fields into the Delta. In addition, there are no numeric Water Quality Objectives for diazinon or chlorpyrifos for the Delta Waterway in the Basin Plan.

The Pesticide Management Plan established under the Management Agency Agreement (MAA) between the State Water Resources Control Board and the Department of Pesticide Regulation, and existing Regional Water Board Basin Plan pesticide policies outline approaches that could result in the establishment of an implementation program and performance measures to assess attainment of Water Quality Objectives. Each of those plans or policies suggests that the Regional Water Board should take action if an implementation program has not been established and water quality is not protected.

The Bay Protection Toxic Hot Spots Cleanup Plan (Cleanup Plan; State Board Resolution No. 2004-0002) requires the adoption of a Basin Plan Amendment to control diazinon and chlorpyrifos in the Delta. The Cleanup Plan states that the Amendment will include Water Quality Objectives for diazinon and chlorpyrifos, an implementation program and framework, a compliance time schedule; a monitoring program, and other required TMDL elements.

Federal law requires the establishment of TMDLs for waters not attaining water quality standards (CWA § 303(d)(1)(C)). Federal regulations require the incorporation of approved TMDLs into the State's water quality management plan (40 CFR § 130.7(d)(2)). Every region's Basin Plan and any statewide plans or policies constitute California's water quality management plan. Based on the federal and State requirements and policies discussed above, the Regional Water Board must develop a control program to address diazinon and chlorpyrifos discharges into the Delta Waterways.

The approach proposed in this Basin Plan Amendment is to establish an agricultural runoff control program that is focused on protecting the Delta Waterways from the impacts of diazinon and chlorpyrifos. The proposed control program is year-round, since both pesticides have been detected and criteria have been exceeded throughout the year. Adoption of the Basin Plan Amendment will result in the establishment of Water Quality Objectives for diazinon and chlorpyrifos, a specific time frame for compliance with applicable objectives and allocations; the establishment of the necessary elements of a TMDL, and an implementation framework for ensuring compliance, including monitoring requirements.



### 3 PROPOSED AMENDMENTS TO THE BASIN PLAN

The proposed Basin Plan Amendment consists of additions and modifications to several sections of the current Water Quality Control Plan for the Sacramento River and San Joaquin River Basins (Basin Plan). This section contains the proposed changes to the Basin Plan. Deletions are shown in strikeout, and additions are shown by underline.

#### 3.1 Additions to Chapter III, Water Quality Objectives

Add the following text to table III-2A:

TABLE III-2A  
SPECIFIC PESTICIDE OBJECTIVES

| PESTICIDE    | MAXIMUM CONCENTRATION AND AVERAGING PERIOD   | APPLICABLE WATER BODIES  |
|--------------|--|--|
| Chlorpyrifos | 0.025 µg/L ; 1-hour average (acute)<br><br>0.015 µg/L ; 4-day average (chronic)<br><br>Not to be exceeded more than once in a three year period. | San Joaquin River from Mendota Dam to Vernalis (Reaches include Mendota Dam to Sack Dam (70), Sack Dam to Mouth of Merced River (71), Mouth of Merced River to Vernalis (83))<br><u>, Delta Waterways listed in Appendix -.)</u> |
| Diazinon     | 0.16 µg/L ; 1-hour average (acute)<br><br>0.10 µ µg/L ; 4-day average (chronic)<br><br>Not to be exceeded more than once in a three year period. | San Joaquin River from Mendota Dam to Vernalis (Reaches include Mendota Dam to Sack Dam (70), Sack Dam to Mouth of Merced River (71), Mouth of Merced River to Vernalis (83))<br><u>, Delta Waterways listed in Appendix -.)</u> |

#### 3.2 Additions to Chapter IV, Implementation

To the “Regional Water Board Prohibitions” section, after 8. Control of Diazinon and Chlorpyrifos Runoff into the San Joaquin River, add:

9. Control of Diazinon and Chlorpyrifos Runoff into Delta Waterways (as identified in Appendix -.)

Beginning December 1, 2011, the direct or indirect discharge of diazinon or chlorpyrifos into Delta Waterways is prohibited during the dormant season (1 December through 1 March) if any exceedance of the chlorpyrifos or diazinon water quality objectives, or diazinon and chlorpyrifos loading capacity occurred during the previous dormant season.

Beginning March 2, 2012, the direct or indirect discharge of diazinon or chlorpyrifos into Delta Waterways is prohibited during the irrigation season (2 March through 30 November) if any exceedance of the chlorpyrifos or diazinon water quality objectives, or diazinon and chlorpyrifos loading capacity occurred during the previous irrigation season.

These prohibitions do not apply if the discharge of diazinon or chlorpyrifos is subject to a waiver of waste discharge requirements implementing the diazinon and chlorpyrifos water quality objectives and load allocations for diazinon and chlorpyrifos for the Delta Waterways, or governed by individual or general waste discharge requirements.

These prohibitions apply only to dischargers causing or contributing to the exceedance of the water quality objective or loading capacity.

These prohibitions do not apply to direct or indirect discharges to the Sacramento or San Joaquin Rivers upstream of the legal boundary of the Delta (as defined in Section 12220 of the Water Code).

## **To the Pesticide Discharges from Nonpoint Sources Add**

### **Diazinon and Chlorpyrifos Runoff into the Sacramento-San Joaquin Delta Waterways (as identified in Appendix -)**

1. The pesticide runoff control program shall:
  - a. Ensure compliance with water quality objectives applicable to diazinon and chlorpyrifos in the Sacramento-San Joaquin Delta Waterways through the implementation of management practices.
  - b. Ensure that measures that are implemented to reduce discharges of diazinon and chlorpyrifos do not lead to an increase in the discharge of other pesticides to levels that cause or contribute to violations of applicable water quality objectives and Regional Water Board plans and policies, and
  - c. Ensure that discharges of pesticides to surface waters are controlled so that pesticide concentrations are at the lowest levels that are technically and economically achievable.
2. Dischargers must consider whether any proposed alternative to the use of diazinon or chlorpyrifos has the potential to degrade ground or surface water. If the alternative has the potential to degrade groundwater, alternative pest control methods must be considered. If the alternative has the potential to degrade surface water, control measures must be implemented to ensure that applicable water quality objectives and Regional Water Board plans and policies are not violated, including State Water Resources Control Board Resolution 68-16.

3. Compliance with applicable water quality objectives, load allocations, and waste load allocations for diazinon and chlorpyrifos in the Delta Waterways is required by December 1, 2011.

The water quality objectives and allocations will be implemented through one or a combination of the following: the adoption of one or more waivers of waste discharge requirements, and general or individual waste discharge requirements. To the extent not already in place, the Regional Water Board expects to adopt or revise the appropriate waiver(s) or waste discharge requirements by December 31, 2009.

4. The Regional Water Board intends to review the diazinon and chlorpyrifos allocations and the implementation provisions in the Basin Plan at least once every five years, beginning no later than December 31, 2010.
5. Regional Water Board staff will meet at least annually with staff from the Department of Pesticide Regulation and representatives from the California Agricultural Commissioners and Sealers Association to review pesticide use and instream pesticide concentrations during the dormant spray and irrigation application seasons and to consider the effectiveness of management measures in meeting water quality objectives and load allocations.
6. The waste load allocations (WLA) for all NPDES-permitted dischargers, load allocations (LA) for nonpoint source discharges, and the loading capacity (LC) of each of the Sacramento-San Joaquin Delta Waterways defined in Appendix - shall not exceed the sum (S) of one (1) as defined below.

$$S = \frac{C_D}{WQO_D} + \frac{C_C}{WQO_C} \leq 1.0$$

where

$C_D$  = diazinon concentration in  $\mu\text{g/L}$  of point source discharge for the WLA; nonpoint source discharge for the LA; or a Delta Waterway for the LC.

$C_C$  = chlorpyrifos concentration in  $\mu\text{g/L}$  of point source discharge for the WLA; nonpoint source discharge for the LA; or a Delta Waterway for the LC.

$WQO_D$  = acute or chronic diazinon water quality objective in  $\mu\text{g/L}$ .

$WQO_C$  = acute or chronic chlorpyrifos water quality objective in  $\mu\text{g/L}$ .

Available samples collected within the applicable averaging period for the water quality objective will be used to determine compliance with the allocations and loading capacity. For purposes of calculating the sum (S) above, analytical results that are reported as "non-detectable" concentrations are considered to be zero.

7. The established waste load and load allocations for diazinon and chlorpyrifos, and the water quality objectives for chlorpyrifos and diazinon in the Delta Waterways represent a maximum allowable level. The Regional Water Board shall require any additional

reductions in diazinon and chlorpyrifos levels necessary to account for additional additive or synergistic toxicity effects or to protect beneficial uses in tributary waters.

8. Pursuant to CWC Section 13267, the Executive Officer will require dischargers to submit a management plan that describes the actions that the discharger will take to reduce diazinon and chlorpyrifos discharges and meet the applicable allocations by the required compliance date. The management plan may include actions required by State and Federal pesticide regulations. The Executive Officer will require the discharger to document the relationship between the actions to be taken and the expected reductions in diazinon and chlorpyrifos discharges. The Executive Officer will allow individual dischargers or a discharger group or coalition to submit management plans. The management plan must comply with the provisions of any applicable waiver of waste discharge requirements or waste discharge requirements. The Executive Officer may require revisions to the management plan if compliance with applicable allocations is not attained or the management plan is not reasonably likely to attain compliance.
9. If the loading capacity in one or more Delta Waterways is not being met by the compliance date, direct or indirect dischargers to the those waterways whose discharge exceeds their load allocation will be required to revise their management plans and implement an improved complement of management measures to meet the loading capacity.
10. Any waiver of waste discharge requirements or waste discharge requirements that govern the control of pesticide runoff that is discharged directly or indirectly into the Delta Waterways must be consistent with the policies and actions described in paragraphs 1 – 9.
11. In determining compliance with the waste load allocations, the Regional Water Board will consider any data or information submitted by the discharger regarding diazinon and chlorpyrifos inputs from sources outside of the jurisdiction of the permitted discharger, including any diazinon and chlorpyrifos present in precipitation and other available relevant information; and any applicable provisions in the discharger's NPDES permit requiring the discharger to reduce the discharge of pollutants to the maximum extent possible.
12. The above provisions for control of diazinon and chlorpyrifos discharges to the Delta Waterways do not apply to dischargers to the Sacramento and San Joaquin Rivers upstream of the Delta.

**To the “Estimated Costs of Agricultural Water Quality Control Programs and Potential Sources of Financing” section, add:**

The total estimated costs for management practices to meet the diazinon and chlorpyrifos objectives for the Delta Waterways range from \$5.9 to \$12.7 million. The estimated costs for discharger compliance monitoring, planning and evaluation range from \$500,000 to \$1.8 million. The estimated total annual costs range from \$6.4 to \$14.4 million (2005 dollars).

Potential funding sources include:

1. Those identified in the San Joaquin River Subsurface Agricultural Drainage Control Program and the Pesticide Control Program.

### **3.3 Additions to Chapter 5, Surveillance and Monitoring**

The Regional Water Board requires a focused monitoring effort of pesticide runoff from orchards and fields discharging to the Sacramento-San Joaquin Delta Waterways (as identified in Appendix -).

The monitoring and reporting program for any waste discharge requirements or waiver of waste discharge requirements that addresses pesticide runoff into the Delta Waterways must be designed to collect the information necessary to:

1. Determine compliance with established water quality objectives and loading capacity, applicable to diazinon and chlorpyrifos in the Delta Waterways.
2. Determine compliance with the load allocations applicable to discharges of diazinon and chlorpyrifos into the Delta Waterways.
3. Determine the degree of implementation of management practices to reduce off-site movement of diazinon and chlorpyrifos.
4. Determine the effectiveness of management practices and strategies to reduce off-site migration of diazinon and chlorpyrifos.
5. Determine whether alternatives to diazinon and chlorpyrifos are causing surface water quality impacts.
6. Determine whether the discharge causes or contributes to a toxicity impairment due to additive or synergistic effects of multiple pollutants.
7. Demonstrate that management practices are achieving the lowest pesticide levels technically and economically achievable.

Dischargers are responsible for providing the necessary information. The information may come from the dischargers' monitoring efforts; monitoring programs conducted by State or federal agencies or collaborative watershed efforts; or from special studies that evaluate the effectiveness of management practices.

With Regional Water Board Executive Officer approval, monitoring can be performed in a subset of the Delta Waterways listed in Appendix -, and the tributaries of those waterways, to determine compliance with the water quality objectives, loading capacity and load allocations.

### **3.4 Additions to Appendices**

Add a new Appendix titled "Sacramento-San Joaquin Delta Waterways". The proposed language is in Appendix A of this report.

## 4 BENEFICIAL USES

Porter-Cologne requires that the “Past, present, and probable future beneficial uses of water” be considered in establishing Water Quality Objectives. The Basin Plan defines 21 categories of uses that could be applied to surface waters in the Central Valley. Beneficial uses designated in the Basin Plan for the Sacramento-San Joaquin Delta are summarized in Table 4.1. This section will consider what use designations are necessary in order to establish appropriate diazinon and chlorpyrifos Water Quality Objectives in the Delta Waterways.

**Table 4.1. Designated Beneficial Uses of the Delta**

| Beneficial Use* (CRWQCB -CVR, 1998)   | Status   |
|---|----------|
| Municipal and domestic supply (MUN)   | Existing |
| Agriculture – irrigation and stock watering (AGR)   | Existing |
| Industry – process (PROC) and service supply (IND)  | Existing |
| Contact recreation (REC-1)  | Existing |
| Non-contact recreation (REC-2)  | Existing |
| Freshwater habitat for warm water species (WARM)  | Existing |
| Freshwater habitat for cold water species (COLD)  | Existing |
| Migration of aquatic organisms (MIGR) (warm and cold water species)   | Existing |
| Spawning, reproduction and/or early development of fish (SPWN) (warm water species)   | Existing |
| Wildlife habitat (WILD)   | Existing |
| Navigation (NAV)  | Existing |
| * In the Basin Plan, the table of beneficial uses for surface water bodies has the following footnote for the Delta: “Beneficial uses vary throughout the Delta and will be evaluated on a case-by-case basis.” |          |

### 4.1 Evaluation of Designated Uses

As discussed in the Water Quality Objectives section of this report, aquatic invertebrates have been identified as the most sensitive aquatic organisms to diazinon and chlorpyrifos. The Warm Freshwater Habitat and Cold Freshwater Habitat beneficial uses, WARM and COLD are defined as follows: “Uses of water that support warm [cold] water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.”

The Delta Waterways listed in Appendix A include flowing rivers, creeks and other upland tributaries, as well as sloughs, backwaters and constructed channels. Fresh emergent wetlands occur as narrow fragmented bands along levees, channel islands, shorelines, and levee blowout ponds within the Delta, while tidal perennial aquatic habitats, such as mudflats,

link these wetlands to open-water habitats (CALFED, 1999). Phytoplankton species are the dominant source of primary productivity in the Delta, and substantial in situ production of phytoplankton occurs in the Delta (Herbold and Moyle, 1989). The distribution of smaller zooplankton in the Delta closely parallels the distribution of phytoplankton. Due to their longer residence times, Delta channels with slower flow rates, such as the San Joaquin River and dead end sloughs in the Delta, tend to have higher primary productivity and greater phytoplankton densities than the Delta waterbodies with faster velocities, such as the Sacramento River and the Delta channels that pass water to the Clifton Court Forebay (Herbold and Moyle, 1989).

Riverine aquatic habitat in the Delta provides spawning substrate, rearing and escape cover, feeding sites, and refuge from turbulent storm flows for fish and other aquatic organisms (CALFED, 1999). Delta sloughs provide warmer, highly productive habitat for seasonal spawning, rearing and foraging for many aquatic organisms, as well as important organic carbon productivity for all habitats of the Bay-Delta (CALFED, 1999). Freshwater emergent wetland habitats are important habitat areas for fish and wildlife dependent on marshes and tidal shallows, and contribute to the aquatic foodweb by supporting nutrient transformation (CALFED, 1999). Tidal perennial aquatic habitat is used by resident and migratory fish for spawning, rearing, foraging and escape cover. Young salmon forage in the productive waters of tidal perennial aquatic habitat in the Delta to put on critical weight before entering the Delta. Striped bass, Delta smelt, splittail and many native resident Delta fish use tidal perennial aquatic habitat in the Delta, especially as rearing areas (CALFED, 1999).

The Delta Waterways are all interconnected and support an abundance of aquatic life, as described above. Therefore, the freshwater habitat beneficial uses (WARM and/or COLD) are appropriate designations for all of the Delta Waterways identified in Appendix A.

## **4.2 Alternatives Considered**

The alternatives considered are to designate new uses, modify existing designated uses, or make no change to current use designations. The primary factor used in choosing the appropriate alternative is whether new or modified use designations are necessary to establish the appropriate diazinon and chlorpyrifos Water Quality Objectives.

### **4.2.1 No Changes in Uses for the Delta Waterways**

This alternative would consider no changes in the already existing uses for the Delta Waterways identified in the list of Delta Waterways in Appendix A. The WARM/COLD (freshwater habitat) beneficial uses have been examined and all available information indicates that these uses exist within the Delta Waterways.



#### **4.2.2 Modification of Uses Affected by Diazinon or Chlorpyrifos for the Delta Waterways**

This alternative would result in creating a sub-category of the designated WARM and COLD uses to account for factors that would make attainment of the WARM and COLD uses infeasible. The factors that could be considered in establishing a sub-category of the WARM and COLD uses include (from 40 CFR § 131.10(g)): 1) natural pollutant concentrations prevent attainment of the use; 2) flow conditions prevent attainment of the use; 3) human caused pollution prevents attainment of the use and remediation would cause more damage than to leave in place; 4) hydrologic modification prevents attainment of the use; 5) natural features of the water body preclude attainment of the aquatic life protection uses; and 6) controls more stringent than those required by sections 301(b) and 306 of the Clean Water Act would result in substantial and widespread economic and social impact.

None of those factors is expected to make attainment of designated uses infeasible with respect to diazinon or chlorpyrifos. Diazinon and chlorpyrifos are not natural pollutants (Factor 1). Flow conditions in the Delta Waterways would not prevent attainment of the use (Factor 2). It is not expected that environmental damage would result from reducing diazinon and chlorpyrifos discharges (Factor 3). Although there is hydromodification within the Delta, discharges of diazinon and chlorpyrifos are not impacted by those modifications (Factor 4). The natural features of the Delta Waterways do not prevent attainment of the uses (Factor 5). As discussed elsewhere in this report (Sections 9), Regional Water Board staff has estimated the costs for compliance with the proposed Amendment. These costs are relatively modest relative to the size of the Delta watershed, and therefore would not result in substantial and widespread economic and social impact (Factor 6).

#### **4.2.3 Addition of Uses for the Delta Waterways**

There are a number of defined uses in the Basin Plan that likely apply to the Delta Waterways. Those uses include: Commercial and Sport Fishing; Preservation of Biological Habitats of Special Significance; Rare, Threatened, or Endangered Species; Shellfish Harvesting; and Estuarine Habitat. None of these uses is more sensitive to diazinon or chlorpyrifos than the WARM and COLD uses. Any potential effects of diazinon or chlorpyrifos on salmon or other threatened or endangered fish species (see Section 5.2.7.3) can be addressed by ensuring that existing designated uses are protected.

### **4.3 Recommended Alternative for Beneficial Uses**

It is recommended that no change be made to existing designated uses for the Sacramento-San Joaquin Delta Waterways. The existing information about the Delta indicates that warmwater and/or coldwater aquatic habitat uses are existing beneficial uses for all the Delta Waterways described above. Therefore, the uses most sensitive to diazinon and chlorpyrifos has already been designated, and had been determined to be appropriate in this case (addressing the presence of diazinon and chlorpyrifos in Delta Waterways). Therefore additional use designations are not necessary at this time, and the beneficial uses currently designated in the Basin Plan support the establishment of appropriate diazinon and

chlorpyrifos Water Quality Objectives for the Delta Waterways listed in Appendix A.

## 5 WATER QUALITY OBJECTIVES FOR DIAZINON AND CHLORPYRIFOS

Section 303(c) of the Federal Clean Water Act requires States to adopt water quality standards to protect public health and enhance water quality. Water quality standards consist of the beneficial uses of a water body and the water quality criteria designed to protect those uses. Individual states are responsible for reviewing, establishing, and revising water quality standards, and these water quality standards are then submitted to the USEPA for approval. In California, the State Water Resources Control Board (SWRCB) and the Regional Water Quality Control Boards (Regional Water Boards) are responsible for developing these standards. Upon approval by the Regional Water Board, State Board, State Office of Administrative Law and USEPA, these criteria are included in the appropriate Water Quality Control Plan (Basin Plan) as Water Quality Objectives.

Water quality objectives can be either numeric or narrative. The Basin Plan currently contains the following narrative Water Quality Objectives for pesticides and for toxicity:

- No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses.
- Discharges shall not result in pesticide concentrations in bottom sediments or aquatic life that adversely affect beneficial uses.
- Pesticide concentrations shall not exceed those allowable by applicable antidegradation policies.
- Pesticide concentrations shall not exceed the lowest levels technically and economically achievable.

The Basin Plan defines pesticides as: "...any substance, or mixture of substances which is intended to be used for defoliating plants, regulating plant growth, or for preventing, destroying, repelling, or mitigating any pest,...or, any spray adjuvant; or, any breakdown products of these materials that threaten beneficial uses. Note that discharges of 'inert' ingredients included in pesticide formulations must comply with all applicable Water Quality Objectives."

The Basin Plan's narrative Water Quality Objective for toxicity specifies "...all waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life. This objective applies regardless of whether the toxicity is caused by a single substance or the interactive effect of multiple substances. Compliance with this objective will be determined by analyses of indicator organisms, species diversity, population density, growth anomalies, and biotoxicity tests of appropriate duration or other methods as specified by the Regional Water Board." This narrative objective applies to toxicity caused by pesticides.

The Implementation chapter of the Basin Plan includes the following policies for evaluating pesticides relative to narrative Water Quality Objectives:

“For most pesticides, numerical Water Quality Objectives have not been adopted. USEPA criteria and other guidance are also extremely limited. Since this situation is not likely to change in the near future, the Board will use the best available technical information to evaluate compliance with the narrative objectives. Where valid testing has developed 96 hour LC50 values for aquatic organisms (the concentration that kills one half of the test organisms in 96 hours), the Board will consider one tenth of this value for the most sensitive species tested as the upper limit (daily maximum) for the protection of aquatic life. Other available technical information on the pesticide (such as Lowest Observed Effect Concentrations and No Observed Effect Levels), the water bodies and the organisms involved will be evaluated to determine if lower concentrations are required to meet the narrative objectives.”

The Basin Plan also includes a policy for considering the additive toxicity of pesticides:

“In conducting a review of pesticide monitoring data, the Board will consider the cumulative impact if more than one pesticide is present in the water body. This will be done by initially assuming that the toxicities of pesticides are additive. This will be evaluated separately for each beneficial use, using the following formula:

$$\frac{C_1}{O_1} + \frac{C_2}{O_2} + \dots + \frac{C_i}{O_i} = S$$

Where:

- C = The concentration of each pesticide.
- O = The Water Quality Objective or criterion for the specific beneficial use for each pesticide present, based on the best available information. Note that the numbers must be acceptable to the Board and performance goals are not to be used in this equation.
- S = The sum. A sum exceeding one (1.0) indicates that the beneficial use may be impacted.”

The Basin Plan also includes a more general policy for considering the additive toxicity of pollutants that is consistent with the pesticide-specific policy (see pages IV-17.00 & IV-18.00 of the Basin Plan).

In addition to the Basin Plan’s narrative Water Quality Objectives for pesticides and toxicity and associated policies for implementing those objectives, the State Board’s policy for maintaining high quality waters (Resolution 68-16) requires the maintenance of existing water quality, unless a change in water quality would provide maximum benefit to the people of the state and will not adversely affect beneficial uses.

The Basin Plan does not currently contain numeric Water Quality Objectives for diazinon or chlorpyrifos in the Delta Waterways. This section examines and evaluates alternatives for establishing numeric Water Quality Objectives and describes the basis for the recommended alternative. The alternative water quality standards methodologies reviewed for the Sacramento, Feather and San Joaquin Rivers in Karkoski et al., 2003 and Beaulaurier et al., 2005 are reviewed in this report for the Delta Waterways. The detailed description of those methodologies that was provided previously (Karkoski, et al., 2003) is not repeated.

The Probabilistic Ecological Risk Assessment (PERA) approach conducted by Novartis (1997) is not evaluated for the Delta Waterways. The evaluation for the Sacramento and Feather Rivers (Karkoski, et al., 2003) found that the PERA methodology applied by Novartis is inconsistent with the Clean Water Act and would allow toxic conditions to exist. Since the Regional Water Board is not required to evaluate alternatives that are clearly contrary to State and federal clean water laws, the PERA method as applied by Novartis is not reviewed for the Delta Waterways.

Tables 5.1 and 5.2 present diazinon and chlorpyrifos water quality criteria used in the United States, Canada, and Australia and New Zealand. Criteria for other beneficial uses listed in Section 4 are not available. The available criteria show that the freshwater habitat beneficial uses are the most sensitive to diazinon and chlorpyrifos in the Delta Waterways.

**Table 5.1. Water Quality Criteria for Diazinon**

| <b>Aquatic Life Criteria for Surface Water</b>   | <b>ng/L</b> |
|--|-------------|
| CDFG Aquatic Life Criteria for freshwater – 4 day average concentration  | 50          |
| CDFG Aquatic Life Criteria for freshwater – 1 hour maximum concentration   | 80          |
| Recalculated CDFG Aquatic Life Criteria for freshwater – 4 day average concentration                                 | 100         |
| Recalculated CDFG Aquatic Life Criteria for freshwater – 1 hour maximum concentration                                | 160         |
| EPA Aquatic Life Criteria for freshwater – 4 day average concentration   | 170         |
| EPA Aquatic Life Criteria for freshwater – 1 hour maximum concentration  | 170         |
| Australian and New Zealand trigger values (95% protection- based on NOEC)  | 10          |
| Australian and New Zealand trigger values (99% protection – based on NOEC)   | 0.03        |
| 1/10 <sup>th</sup> Most sensitive species mean average value ( <i>Ceriodaphnia dubia</i> ) <sup>4</sup> (Basin Plan) | 44          |
| <b>Human Health Criteria for Drinking Water</b>  |             |
| USEPA Suggested No Adverse Response Levels (SNARL) for non-cancer toxicity   | 600         |
| California Department of Health Services State Action Level for Toxicity   | 6,000       |
| National Academy of Sciences SNARL for non-cancer toxicity   | 14,000      |
| Canadian Environmental Quality Guidelines  | 20,000      |

**Table 5.2. Water Quality Criteria for Chlorpyrifos**

| <b>Aquatic Life Criteria for Surface Water</b>   | <b>ng/L</b> |
|--|-------------|
| CDFG Aquatic Life Criteria for freshwater – 4 day average concentration  | 14          |
| CDFG Aquatic Life Criteria for freshwater – 1 hour maximum concentration   | 20          |
| Recalculated CDFG Aquatic Life Criteria for freshwater – 4 day average concentration                                 | 15          |
| Recalculated CDFG Aquatic Life Criteria for freshwater – 1 hour maximum concentration                                | 25          |
| EPA Aquatic Life Criteria for freshwater – 4 day average concentration   | 41          |
| EPA Aquatic Life Criteria for freshwater – 1 hour maximum concentration  | 83          |
| Canadian Environmental Quality Guidelines  | 3.5         |
| Australian and New Zealand trigger values (95% protection based on NOEC)   | 10          |
| Australian and New Zealand trigger values (99% protection based on NOEC)   | 0.04        |
| 1/10 <sup>th</sup> most sensitive species mean average value ( <i>Ceriodaphnia dubia</i> ) <sup>5</sup> (Basin Plan) | 6           |
| <b>Human Health Criteria for Drinking Water</b>  |             |
| USEPA Suggested No Adverse Response Levels (SNARL) for non-cancer toxicity   | 20,000      |
| Canadian Environmental Quality Guidelines  | 90,000      |
| <b>Agriculture-Livestock</b>   |             |
| Canadian Environmental Quality Guidelines  | 24,000      |

Sources: Marshack, 2003; Canadian Council of Ministers of the Environment, 2002; USEPA 2006; USEPA 1986; Siepmann and Finlayson, 2000; Finlayson, 2004a; Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, 2000.

<sup>4</sup> The species mean average value reported by Siepmann and Finlayson, 2000 is 440 ng/L for diazinon acute toxicity tests accepted by CDFG. *Ceriodaphnia dubia* is the most sensitive species when the reported results for *Gammarus fasciatus* are not considered (see discussion in Section 1.2.1 below).

<sup>5</sup> The species mean average value reported by Siepmann and Finlayson, 2000 is 60 ng/L for chlorpyrifos acute toxicity tests. Of the freshwater species tested, *Ceriodaphnia dubia* is the most sensitive to chlorpyrifos.

## **5.1 Alternatives Considered for Deriving Water Quality Objectives**

Water quality objectives adopted by the Regional Water Board must protect the beneficial uses designated for the applicable water bodies, be consistent with State and Federal regulations, and be approved by the SWRCB, the USEPA, and the Office of Administrative Law. Alternate methods for deriving Water Quality Objectives are discussed below, followed by an evaluation of the methods and their suitability for use in deriving a Water Quality Objective.

Invertebrates are specifically mentioned in the definition of freshwater habitat uses contained in the Basin Plan (page II-2.00): “Uses of water that support warm (cold) water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.” Any methodology used to derive Water Quality Objectives must protect the beneficial uses (40 CFR §131.11(a)), which for this use specifically includes invertebrates.

The alternatives considered for deriving Water Quality Objectives for diazinon and chlorpyrifos are:

- No change in Water Quality Objectives
- No detectable levels of diazinon or chlorpyrifos
- USEPA Water Quality Criteria methodology
- Canadian methodology
- Australian and New Zealand methodology

After each methodology is described, a preliminary evaluation is made. The evaluation is based on the scientific merits of the method, and policy and data considerations. If no significant issues are associated with the methodology after the preliminary evaluation, a more detailed evaluation is performed relative to Porter-Cologne considerations and other applicable laws and policies in Section 5.2.

### **5.1.1 No Change in Water Quality Objectives**

As discussed above, the Basin Plan currently contains narrative Water Quality Objectives regarding pesticides and toxicity. The Regional Water Board uses available guidelines and criteria to interpret existing narrative Water Quality Objectives. Since 2000, the Regional Water Board has been using the California Department of Fish and Game (CDFG) criteria for diazinon and chlorpyrifos (Siepmann and Finlayson, 2000) to interpret compliance with its narrative toxicity and pesticide Water Quality Objectives.

The manufacturer of diazinon (Makhteshim Agan of North America, Inc. or MANA) has provided information that suggests that the results from one of the toxicity tests used to derive the CDFG diazinon criteria were reported incorrectly (Weinberg, 2004a, b). The toxicity test in

question used the species *Gammarus fasciatus*, which had the lowest acceptable acute toxicity test result identified by CDFG or USEPA. The toxicity test data sheets MANA provided came from the microfiche archives of the USGS laboratory that conducted the toxicity tests. The USGS researcher who obtained the data sheets concluded that the toxicity value for *Gammarus fasciatus* was an order of magnitude higher than originally reported (Ingersoll, 2004). Regional Water Board staff concluded that the toxicity test data sheets were inconsistent in how test results were reported, and the toxicity test results reported in the literature could neither be definitively confirmed nor changed to a value an order of magnitude higher, as suggested by MANA (CRWQCB-CVR, 2004). CDFG also concluded it was impossible to discern the correct toxicity test results for the questionable *Gammarmus fasciatus* study from the toxicity test data sheets (Finlayson 2004b). CDFG has recalculated their diazinon criteria without the toxicity test results in question (Finlayson, 2004a). The recalculated CDFG acute criterion is 160 ng/L and the chronic criterion is 100 ng/L.

The Basin Plan states that the Regional Water Board will consider 1/10<sup>th</sup> of the 96-hour LC50 of the most sensitive organism as the daily maximum for protection of aquatic life. Other available information, such as the Lowest Observed Effect Concentrations and No Observed Effect Levels, is to be evaluated to determine whether lower concentrations are required to interpret narrative objectives when numeric Water Quality Objectives or appropriate criteria are not available. Since diazinon and chlorpyrifos criteria have been calculated based on the CDFG dataset, it would not be necessary to interpret narrative objectives using 1/10<sup>th</sup> of the 96-hour LC50 of the most sensitive organism.

Basin Plan policy also requires consideration of other available information when interpreting narrative objectives (e.g. no observed effect levels or lowest observed effect levels). As discussed below under Endangered Species Act, effects of diazinon on salmon behavior have been observed at levels as low as 100 ng/L, although the effects at this concentration were not statistically significant when compared to controls (Scholz, et al., 2000). These effects are not currently well understood enough to provide a basis for interpretation of narrative objectives, but may need to be considered in the future.

Under the “no change” alternative for diazinon, the Regional Water Board would not rely on any criteria that include the questionable *Gammarus fasciatus* toxicity test results. Based on existing Regional Water Board policies, compliance with narrative pesticide and toxicity objectives would be determined by using the recalculated California Department of Fish and Game criteria (160 ng/L one-hour average; 100 ng/L 4-day average)<sup>6</sup>.

The “no change” alternative will be considered for both diazinon and chlorpyrifos, since it would apply if new Water Quality Objectives were not established. For the “no change” alternative for chlorpyrifos, the Regional Water Board’s recalculation of the CDFG chlorpyrifos criteria would be used to interpret compliance with narrative objectives<sup>7</sup>. For the “no change”

---

<sup>6</sup> Note that the recalculation of the CDFG diazinon criteria (Finlayson, 2004) did not include a comprehensive review of data and information available since the Siepmann and Finlayson (2000) report was published. The recalculation only considered the effect of removing the *Gammarus fasciatus* results from the data set, but did not consider the possible effect on the criteria of any other recently available data or information.

<sup>7</sup> The Regional Water Board used the suggested significant figures for criteria calculations found in the USEPA (1985) guidelines, which resulted in slightly higher acute and chronic chlorpyrifos criteria.



alternative for diazinon, the recalculated CDFG diazinon criteria should protect aquatic invertebrates from acute and chronic effects of diazinon. The majority of the most sensitive invertebrates used in the development of the CDFG criteria were freshwater zooplankton, which are typically abundant in healthy freshwater ecosystems. When additive toxicity is considered in determining compliance, the recalculated CDFG diazinon criteria, along with the recalculated CDFG chlorpyrifos criteria, would be used.

### **5.1.2 Numeric Water Quality Objectives Based on No Diazinon or Chlorpyrifos**

The Regional Water Board could adopt Water Quality Objectives that would maintain “natural” water quality conditions. Water quality objectives based on these conditions would mean no detected concentrations of diazinon or chlorpyrifos. State and federal anti-degradation policies would allow for the presence of diazinon and chlorpyrifos if the presence of those pollutants were consistent with maximum benefit to the people of the State, would not unreasonably affect present and anticipated beneficial uses, and would not result in water quality less than that prescribed in existing policies. (See SWRCB Resolution 68-16 and 40 CFR 131.12.)

The Regional Water Board could make a determination that the presence of any diazinon or chlorpyrifos in surface waters is not to the maximum benefit of the people of the State, which would serve as the basis for a no diazinon or chlorpyrifos objective. Alternatively, the Regional Water Board could determine that the presence of some diazinon or chlorpyrifos is consistent with the maximum benefit to the people of the State, but the level that is consistent with the maximum benefit is less than the highest level that would still be protective of beneficial uses.

The no diazinon or chlorpyrifos alternative will be further considered, since anti-degradation policies suggest that the Regional Water Board could determine that the presence of any diazinon or chlorpyrifos in the Delta Waterways is not to the maximum benefit of the people of the State.

### **5.1.3 Numeric Water Quality Objectives Based on the USEPA Method for Deriving Numeric Water Quality Criteria**

Most states and the USEPA use the USEPA methodology to establish aquatic life water quality criteria and standards. USEPA guidelines (USEPA, 1985) for deriving numeric water quality criteria (WQC) for aquatic organisms provide a method to review available toxicity data for a water quality constituent and to derive two values—the criterion maximum concentration (CMC), an acute criterion, and the criterion continuous concentration (CCC), a chronic criterion. According to the guidelines, restricting concentrations to levels at or below these criteria should provide aquatic organisms with a “reasonable level” of protection and prevent “unacceptable” impacts.

USEPA WQC are intended to protect all species for which acceptable toxicity data exist, and species for which those in the data set serve as surrogates. The criteria are met if the one-hour average concentration of the constituent does not exceed the acute criterion (CMC) and the four-day average concentration does not exceed the chronic criterion (CCC) more than once every three years, on average, at a given location.

The USEPA guidelines also suggest that data that may not have been used in the standard criteria derivation method should be used "...if the data were obtained with an important species, the test concentrations were measured, and the endpoint was biologically important." In cases in which such data show that a lower value than that suggested by the Final Chronic Value, the Final Plant Value, or the Final Residue Value should be used, that lower value should be applied as the Criterion Continuous Concentration (CCC) or chronic criterion (USEPA, 1985).

#### **5.1.3.1 USEPA Final Criteria for Diazinon and Chlorpyrifos**

For diazinon, USEPA recently published final aquatic life ambient water quality criteria (USEPA, 2005). These criteria were derived using the USEPA methodology described above. Acceptable freshwater acute toxicity data for thirteen invertebrate, ten fish, and one amphibian species were used in calculating the USEPA criteria. In response to the concerns about the questionable toxicity values reported for *Gammarus fasciatus* discussed above, the data set used by USEPA included *Gammarus fasciatus* acute toxicity values that were changed to a value an order of magnitude higher than originally reported, as suggested by MANA (USEPA, 2006)(MANA, 2004 a,b,c). Also in response to the concerns about the questionable *Gammarus fasciatus* toxicity values discussed above, the toxicity value for a less sensitive *Gammarus* species, *Gammarus pseudolimnaeus*, was added to the USEPA data set, as suggested by MANA (USEPA, 2006)(MANA, 2004 a,b,c). The acute freshwater criterion was calculated to be 170 ng/L. Chronic toxicity values for two species were used in calculating the USEPA chronic criteria. The chronic freshwater criterion was also calculated to be 170 ng/L, or equivalent to the acute criterion. As shown in Appendix G, Regional Water Board staff calculated the acute and chronic freshwater diazinon criteria using the USEPA data set, both with and without the changed *Gammarus fasciatus* acute toxicity values. The results of the Regional Water Board calculations using the USEPA data set were the same as the USEPA criteria. The inclusion of the changed *Gammarus fasciatus* acute toxicity values did not affect the final freshwater diazinon criteria. Acceptable saltwater acute diazinon toxicity data were available for seven invertebrate, and two fish species. The acute saltwater criterion was calculated to be 820 ng/L. The chronic saltwater criterion was also calculated to be 820 ng/L, or equivalent to the acute saltwater criterion.

The USEPA published national water quality criteria for chlorpyrifos in 1986 (USEPA, 1986). Acceptable freshwater acute toxicity data were available for seven fish species and eleven invertebrate species. Acceptable saltwater acute toxicity data were available for ten species of fish and five species of invertebrates. Acceptable chronic toxicity data were available for one freshwater and seven saltwater species. The calculated freshwater acute criterion was 83 ng/L and the chronic criterion was 41 ng/L. The calculated saltwater acute criterion was 11 ng/L and the chronic criterion was 5.6 ng/L.

#### **5.1.3.2 CDFG Criteria for Diazinon and Chlorpyrifos**

In 2000 CDFG published freshwater WQC for diazinon (Siepmann and Finlayson, 2000), using the USEPA methodology described above (USEPA, 1985). Forty acceptable acute toxicity values were available to calculate freshwater criteria for diazinon. Acceptable acute toxicity tests were available for nine invertebrate and nine fish species. Five acute to chronic ratios for four species were available to calculate a chronic criterion for diazinon. CDFG calculated

an acute criterion for diazinon of 80 ng/L and a chronic criterion of 50 ng/L. Insufficient data were available to calculate acute or chronic saltwater WQC for diazinon.

The CDFG diazinon criteria in Siepmann and Finlayson (2000) were calculated using the questionable *Gammarus fasciatus* toxicity test results discussed above. CDFG has recalculated the diazinon criteria to exclude the questionable toxicity test values for *Gammarus fasciatus*, but has also noted that the recalculation assumes no new information has been collected that would affect the criteria (Finlayson, 2004a). CDFG believed that it was impossible to discern the correct toxicity test results for the questionable *Gammarus fasciatus* study (Finlayson 2004a). The data set that CDFG used in recalculating the diazinon criteria also did not include the toxicity values for *Gammarus pseudolimnaeus* test that USEPA used in their criteria. CDFG found the *Gammarus pseudolimnaeus* study used by USEPA unacceptable for use in calculating water quality criteria because it did not meet American Society for Testing and Materials (ASTM) standards for acute toxicity tests (Finlayson, 2004b). The recalculated CDFG values are an acute criterion for diazinon of 160 ng/L and a chronic criterion of 100 ng/L. Regional Water Board staff confirmed these recalculated values. The Regional Water Board's diazinon criteria calculations are contained in Appendix G.

Forty-three acceptable acute toxicity values were available to calculate freshwater criteria for chlorpyrifos. Acceptable acute toxicity tests were available for thirteen invertebrate and seven fish species. Eight acute to chronic ratios for seven species (both freshwater and saltwater) were available to calculate a chronic criterion for chlorpyrifos. CDFG calculated an acute criterion for chlorpyrifos of 20 ng/L and a chronic freshwater criterion of 14 ng/L. The calculations that are part of the USEPA methodology (1985) can include interim calculations before the final criterion is calculated. The methodology states that interim calculations should be rounded to four significant figures and the final criterion should be rounded to two significant figures. When the freshwater chlorpyrifos criteria are rounded to two significant figures using the data set that CDFG found acceptable, the acute criterion is 25 ng/L, rather than 20 ng/L, and the chronic criterion is 15 ng/L, rather than 14 ng/L. The Regional Water Board's chlorpyrifos criteria calculations are contained in Appendix G.

Forty acceptable acute toxicity values were available to calculate saltwater criteria for chlorpyrifos. Acceptable acute toxicity tests were available for six invertebrate and ten fish species. CDFG calculated an acute saltwater criterion for chlorpyrifos of 20 ng/L and a chronic saltwater criterion for chlorpyrifos of 9 ng/L. When the saltwater chlorpyrifos criteria are rounded to two significant figures, as recommended in the USEPA methodology (USEPA, 1985), using the data set that CDFG found acceptable, the acute saltwater chlorpyrifos criterion is 15 ng/L, rather than 20 ng/L, and the chronic saltwater chlorpyrifos criterion is 8.3 ng/L, rather than 9 ng/L.

### **5.1.3.3 Comparison of Diazinon and Chlorpyrifos Criteria Derived Using the USEPA Methodology**

For the freshwater diazinon criteria, the use of different data sets resulted in a small (6%) difference between the recalculated CDFG acute criterion and the USEPA acute criterion, 160 vs. 170 ng/L, respectively. The USEPA methodology uses only toxicity data from the four most sensitive genera directly in the criteria derivation. If the toxicity values for the four lowest genera are not changed, adding data for additional genera makes the criteria higher by lowering the percentile rankings of the four lowest genera. The four lowest toxicity values

used by USEPA and CDFG were very similar. The associated percentile ranks were different because USEPA's data set included additional, less sensitive genera. The inclusion of data for a greater number of genera in the USEPA data set resulted in USEPA's acute criterion being slightly higher than CDFG's recalculated acute criterion.

The difference between the recalculated CDFG and the USEPA chronic freshwater diazinon criterion (100 vs. 170 ng/L, respectively) is due to the use of different acute to chronic ratios (ACRs) – an ACR of 2 was used by USEPA and an ACR of 3 was used by CDFG. The ACR calculated by CDFG appears to be more appropriate, since CDFG included three sensitive species in their calculation of the ACR (versus two by USEPA) and CDFG calculated ACRs based on toxicity test results from the same studies or at least the same laboratory. Because the CDFG criteria calculations used a more appropriate ACR and did not use the results from the two questionable *Gammarus* studies discussed above, the recalculated CDFG criteria presented by Finlayson (2004a) and confirmed by Regional Board staff calculations, are used to represent the application of the USEPA methodology for deriving freshwater diazinon criteria (see Appendix G).

For chlorpyrifos, the criteria derived by CDFG (Siepmann and Finlayson, 2000), and recalculated by Regional Board staff to correct the number of significant figures, as described in Appendix G, are more appropriate than the criteria derived by USEPA (1986). The CDFG data set included toxicity studies for a greater number of sensitive organisms and included more recent toxicity study results.

#### **5.1.4 Canadian Guidelines**

The Canadian protocol for deriving water quality guidelines depends on the available data. For guidelines derived from chronic studies, the most sensitive lowest-observable-effect level (LOEL) for a given pollutant is multiplied by a safety factor of 0.1 (CCME, 1999a).

Guidelines can also be derived from acute studies. One approach is to calculate acute to chronic ratios (ACRs-expressed as the LC50/NOEL (no-observed-effect level)). The guideline value is then derived by dividing the most sensitive LC50 or EC50 by the most appropriate ACR (CCME, 1999a).

If ACRs are not available, the alternate method is to derive the guideline value by multiplying the most sensitive LC50 or EC50 by a universal application factor. The application factor for non-persistent pollutants is 0.05 and for persistent pollutants is 0.01 (CCME, 1999a).

The guideline values are expressed as a single maximum concentration that is not to be exceeded. The maximum concentration represents a long term no effects concentration.

The Canadian guideline for protection of freshwater aquatic life for chlorpyrifos (CCME, 1999b) is found by multiplying the lowest acceptable primary effects concentration (70 ng/L–the 96-hour LC50 for *G. pulex*) by the application factor for non-persistent pollutants (0.05). The guideline value is 3.5 ng/L.

The Canadian protocol provides a simple and easy to apply approach for assessing pollutant levels. The application factors used should provide a margin of safety to ensure protection of aquatic life, since the factors are applied to test results for the most sensitive organisms and the most sensitive endpoint. The Canadian protocol does not take into account the number of toxicity studies available or the variability between study results. This can lead to the guideline being unnecessarily high or low, since the application factor is the same, whether much or very little is known about the pollutant. In contrast, the USEPA methodology takes into account the number of valid study results and the variability between studies (at least for the four most sensitive genera).

Although the Canadian protocol is relatively simple, it requires an evaluation and review of available toxicity study results to determine the most appropriate approach for deriving the guideline value. Such an evaluation and review has not been conducted for diazinon and is beyond the scope of this report.

Due to the lack of an available guideline value for diazinon, an alternative diazinon Water Quality Objective based on the Canadian protocol will not be evaluated further. An alternative Water Quality Objective for chlorpyrifos based on the Canadian protocol will not be evaluated further because chlorpyrifos criteria based on other methods (e.g. the USEPA method) are available that take into consideration the number of studies and variability of study results.

### **5.1.5 Australian and New Zealand Guidelines**

Australia and New Zealand have developed a multi-pronged approach to developing guidelines (or “trigger values”) (ANZECC, 2000 – Figure 8.3.2). The approach defines “High”, “Moderate”, and “Low” reliability trigger values.

High reliability trigger values are based on no-observed effect concentration (NOEC) values (either for multiple species tests or single species tests). If NOEC values are available for more than five species, a statistical distribution method is applied to the data. Protection levels for 95% and 99% of the species at a 50% certainty level are found. In other words, the trigger value should be at or above the NOEC for all but 5% or 1% of the species, depending on the level of protection chosen. If the statistical distribution requirements are not satisfied, then the lowest NOEC is divided by 10.

Moderate reliability trigger values are derived from EC/LC50 data available for greater than or equal to 5 species. If the data satisfy the statistical distribution requirements, the 95% or 99% protection level is divided by 10 or by a calculated acute to chronic ratio. If the data do not satisfy the statistical distribution requirements, then the lowest LC50 is divided by 100 or by 10 times the acute to chronic ratio.

Low reliability trigger values are derived based on the type of data available and the type of pollutant. In general, the approach is to divide the lowest NOEC or EC/LC50 value by an application factor. Application factors can range from 20 to 1,000, depending on the type of data available and the type of pollutant.

The Australian and New Zealand (ANZ) guidelines are meant to protect ambient waters from sustained exposures to toxicants. No specific averaging period or allowed frequency of exceedance is associated with the trigger values. The guidelines suggest that a number of samples be collected and that the median value be compared to the trigger value. The ANZ guidelines also suggest that transient exposure should be incorporated in the decision process to determine whether there is a problem. The ANZ guidelines suggest that some chemicals can cause delayed toxic effects after a brief exposure. For this reason, the ANZ guidelines do not include trigger values for brief exposures based solely on acute toxicity. The lack of acute toxicity guidelines is based on the concern that concentration levels that may protect organisms from acute toxicity may not protect organisms from transient exposures.

For chlorpyrifos, a high reliability trigger value of 10 ng/L was derived using the statistical distribution method with 95% protection. The 99% protection level trigger value was found to be 0.04ng/L.

For diazinon, a moderate reliability trigger value of 10 ng/L was derived using the statistical distribution method with a 95% protection level and an ACR of 17.5.

The chlorpyrifos trigger value was, therefore, based on NOEC data and the diazinon trigger value was derived from acute toxicity test results.

The ANZ guidelines provide a robust framework for deriving water quality criteria that are protective of aquatic life. The guidelines allow the derivation of trigger values whether very little or a great deal of toxicity test results for species are available. Such an approach allows water quality managers to take initial management steps, if necessary, rather than allowing degradation to continue while studies are being performed. In Australia and New Zealand, the trigger values are meant to indicate a potential environmental problem and “trigger” a management response. The response can lead to development of a site-specific guideline or the development of Water Quality Objectives.

The focus on NOEC data and protecting aquatic systems from chronic effects should generally result in the derivation of guidelines that are protective of aquatic life. Two issues not addressed by the guidelines are the appropriate averaging period associated with the trigger values and guidelines for protecting aquatic systems from acute toxic events.

As discussed above, the ANZ guidelines suggest that the median concentration of monitoring data collected should be compared to the trigger value. Comparison of the trigger value to the median concentration could mask significant water quality problems that may occur seasonally or episodically, since it is not clear if the median is evaluated over a day, week, month, year, or several year time frame. The lack of a criterion to protect aquatic life from acute effects could mean that significant, short duration pollution exposure events are not addressed.

The ANZ guidelines have potential application for the derivation of Water Quality Objectives in California. Further refinement of those guidelines for application to diazinon and chlorpyrifos is beyond the scope of this report. Therefore, an alternative Water Quality Objective for diazinon or chlorpyrifos based on the ANZ guidelines will not be evaluated further.

### 5.1.6 Summary of Potential Water Quality Objectives Derived by Alternate Methods

The alternative potential Water Quality Objectives are summarized in Table 5.3. The three alternatives for diazinon and chlorpyrifos are evaluated below with respect to Porter-Cologne requirements and other applicable laws and policies. Water quality objectives for diazinon and chlorpyrifos do not necessarily have to be selected from the same alternative.

The “No change” alternative would not establish Water Quality Objectives for diazinon or chlorpyrifos, but would likely result in the use of the criteria developed from the CDFG data set to interpret the narrative objectives.

The “No diazinon or chlorpyrifos” alternative would establish no detectable concentrations of either pesticide as Water Quality Objectives.

The “CDFG/USEPA method” alternative would establish Water Quality Objectives for diazinon and chlorpyrifos based upon criteria calculated using the CDFG data set and the USEPA methodology.

**Table 5.3. Summary of Potential Freshwater Water Quality Objectives Derived by Alternative Methods**

| ALTERNATIVE                    | Diazinon         |                  | Chlorpyrifos    |                 |
|--------------------------------|------------------|------------------|-----------------|-----------------|
|                                | Acute (ng/L)     | Chronic (ng/L)   | Acute (ng/L)    | Chronic (ng/L)  |
| 1. No Change                   | 160 <sup>1</sup> | 100 <sup>1</sup> | 25 <sup>2</sup> | 15 <sup>2</sup> |
| 2. No diazinon or chlorpyrifos | 0 or non detect  | 0 or non detect  | 0 or non detect | 0 or non detect |
| 3. CDFG/USEPA Method           | 160 <sup>1</sup> | 100 <sup>1</sup> | 25 <sup>2</sup> | 15 <sup>2</sup> |

1) Regional Water Board staff calculations based on the CDFG data set, using the USEPA method. The acute criterion is a one-hour average and the chronic criterion is a four-day average—neither to be exceeded more than once every three years on the average.

2) CDFG (Siepmann and Finlayson, 2000) acute criterion recalculated by Regional Water Board staff to two significant figures per the USEPA methodology (1985).

### 5.1.7 Use of Freshwater Criteria

With the exception of the “no diazinon or chlorpyrifos” alternative, all of the alternative Water Quality Objectives examined above are based on freshwater diazinon and chlorpyrifos criteria. Since salinity at the outlet of the Delta into Suisun Bay averages just under 2 parts per thousand (Fox et al., 1991), western parts of the Delta do not meet the definition of

“freshwater” used in Federal water quality standards<sup>8</sup>, but are also clearly not saltwater. In federal standards (USEPA 2000a), when waters that do not fit under one of these definitions for freshwater and saltwater, the more stringent of the two criteria is applied to ensure protection of beneficial uses. Table 5.4 shows available freshwater and saltwater criteria developed using the USEPA Method.

**Table 5.4. Freshwater and Saltwater Criteria Developed Using the USEPA Methodology**

| Source   | Pesticide    | Freshwater Criteria (ng/L) |         | Saltwater Criteria (ng/L) |         |
|--|--------------|----------------------------|---------|---------------------------|---------|
|  |              | Acute                      | Chronic | Acute                     | Chronic |
| CDFG (Siepmann and Finlayson, 2000)  | diazinon     | 160 (1)                    | 100 (1) | NA                        | NA      |
| CDFG (Siepmann and Finlayson, 2000)  | chlorpyrifos | 25 (2)                     | 15 (2)  | 15 (2)                    | 8.6(2)  |
| USEPA (2005)   | diazinon     | 170                        | 170     | 820                       | 820     |
| USEPA (1986)   | chlorpyrifos | 83                         | 41      | 11                        | 5.6     |
| (1) Regional Water Board staff calculations based on CDFG data set, using USEPA methodology                                    |              |                            |         |                           |         |
| (2) CDFG acute criteria recalculated by Regional Water Board staff to two significant figures per the USEPA methodology (1985) |              |                            |         |                           |         |

As indicated in Table 5.4, the freshwater criteria for diazinon are more stringent than the saltwater criteria. For chlorpyrifos, however, the saltwater criteria are more stringent than the freshwater criteria. Looking at the CDFG criteria, the freshwater chlorpyrifos criteria concentrations are 67% and 74% higher, respectively, than the acute and chronic saltwater criteria concentrations. Therefore it might be appropriate to apply the more stringent saltwater criteria to the western portions of the Delta where the salinity levels exceed some definitions of freshwater. In evaluating the toxicity tests used to calculate the saltwater and freshwater criteria, however, the conditions of the toxicity tests used to determine the freshwater criteria are more representative of the salinity in even the most saline parts of the Delta. In the toxicity tests that were used by Siepmann and Finlayson (2000) in calculating the saltwater chlorpyrifos criteria<sup>9</sup>, the salinity ranged from 20 to 27 parts per thousand (ppt), and averaged 25 ppt—a salinity over ten times greater than the salinity of the western Delta.

In addition, as shown in section 4, the observed chlorpyrifos concentrations are all 1 ng/L or less in the main Delta channels within the western Delta. The observed chlorpyrifos concentrations further west in the Estuary, at Grizzly Bay (in the San Francisco Bay Region), are all less than 0.5 ng/L (SFEI, 2005), so tidal flows entering the Delta from the west are

<sup>8</sup> Under the California Toxics Rule (USEPA, 2000c), for waters in which the salinity is equal to or less than 1 part per thousand 95% or more of the time, the applicable criteria are the freshwater criteria. For waters in which the salinity is equal to or greater than 10 parts per thousand 95% or more of the time, the applicable criteria are the saltwater criteria. For waters that do not fit under one of these definitions, the more stringent of the two criteria apply.

<sup>9</sup> Following the USEPA methodology (USEPA, 1985), the toxicity tests for the four genera with the lowest toxicity values drive the criteria.



expected to have negligible chlorpyrifos concentrations. Large tidal flows of water, with negligible chlorpyrifos concentrations in the western Delta, contribute significant tidal dilution to the western parts of the Delta. Therefore if the freshwater chlorpyrifos criteria are met upstream, where nearly all the sources of chlorpyrifos are, the saltwater criteria could easily be met in the downstream portions of the Delta where the saltwater criteria might be applied. For this reason, setting a different objective based on the saltwater criteria for the more saline parts of the Delta would make no difference in terms of needed load reductions.

Setting Water Quality Objectives based on the saltwater criteria would add significantly to the level of complexity of this Basin Plan Amendment, since it would require delineating the geographic extent to which each of the different criteria would apply, and adjustment of the Load and Wasteload Allocations to ensure that the lower, downstream saltwater criteria would be met.

For the reasons described above, saltwater criteria-based Water Quality Objectives are not proposed or examined in further detail in this report. If future information indicates that saltwater criteria-based objectives are necessary to protect the beneficial uses in any of the Delta Waterways, modified objectives will be considered when the objectives and allocations are re-visited.

### 5.1.8 Additive Toxicity

Diazinon and chlorpyrifos have the same mechanism of toxic action, and have been shown to exhibit additive toxicity to aquatic invertebrates when they co-occur (Bailey et al. 1997; Siepmann and Finlayson, 2000). Studies of mixtures of compounds acting through the same mechanism suggest there is no concentration below which a compound will no longer contribute to the overall toxicity of the mixture (Deener et al., 1988). Therefore, the total potential toxicity of co-occurring diazinon and chlorpyrifos needs to be assessed, even when one or both of their individual concentrations would otherwise be below thresholds of concern. As discussed above, existing Regional Water Board Water Quality Objectives require that additive toxicity effects be considered when evaluating compliance with the applicable narrative objectives. The Basin Plan (in Chapter IV, "Pesticide Discharges from Nonpoint Sources) provides an additivity formula that applies to diazinon and chlorpyrifos when they co-occur.

$$\frac{C_D}{WQO_D} + \frac{C_C}{WQO_C} \leq 1.0$$

where

$C_D$  = Diazinon concentration in the receiving water.

$C_C$  = Chlorpyrifos concentration in the receiving water.

$WQO_D$  = Acute or chronic diazinon Water Quality Objective or criterion.

$WQO_C$  = Acute or chronic chlorpyrifos Water Quality Objective or criterion.

The diazinon and chlorpyrifos Water Quality Objectives adopted by the Regional Water Board would be applied to the above formula when both diazinon and chlorpyrifos are present. In the

absence of an established Water Quality Objective for either diazinon or chlorpyrifos, the best available information would be used to identify an appropriate criterion for the formula.

It should be noted that when applying the additive toxicity formula, care must be taken in choosing the criteria to ensure that the additive effects being assessed are comparable. For example, if one criterion was driven by fish toxicity test results and the other by aquatic invertebrate test results, it may not be appropriate to use those criteria together to determine whether there is an additive effect.

Another method that can be used to evaluate the additive toxicity of similar toxicants is the Toxic Equivalents (TEQ) method suggested by Felsot (2005). This method was used by USEPA to calculate the cumulative human health risk of OP pesticides (USEPA, 2002). In this case the ratio of the relative potency of chlorpyrifos to diazinon (the Relative Potency Factor or RPF) is multiplied by the diazinon concentration to express the diazinon concentration in terms of chlorpyrifos toxicity. This transforms the diazinon concentration into an equivalent chlorpyrifos concentration based on the relative toxicity of these two chemicals. The transformed diazinon concentration is then added to the measured chlorpyrifos concentration, and the sum is compared to the chlorpyrifos objective.

This can be expressed as:

$$\text{ChlorTEQ} = C(\text{diaz}) \times \text{RPF}(\text{chlor/diaz}) + C(\text{chlors}) \leq \text{WQO}(\text{chlor})$$

WHERE:

ChlorTEQ = Chlorpyrifos toxic equivalents.

C (diazinon) = Diazinon concentration.

C (chlorpyrifos) = Chlorpyrifos concentration.

RPF (Chlor/Diaz) = Relative potency factor—the ratio of chlorpyrifos to diazinon toxicity.

WQO (Chlor) = Acute or chronic chlorpyrifos Water Quality Objective

As detailed in Appendix G, the TEQ method as suggested by Felsot (2005) is mathematically the same as the Basin Plan formula for additive toxic effects of pesticides.

### 5.1.9 Comparison of Water Quality Data to Alternative Objectives

Tables 5.5 and 5.6 compare historical data to the alternate Water Quality Objectives. The studies evaluated used different sampling frequencies (either event-based or a specified frequency) and different analytical methods, which had different detection limits. Therefore, caution should be used in drawing any conclusions regarding trends or differences between sites. For the “no diazinon” and “no chlorpyrifos” method, any detection of diazinon or chlorpyrifos would be counted as an exceedance.

**Table 5.5. Comparison of Available Data (Oct, 2000- March, 2005) to Alternate Diazinon Acute Water Quality Objectives**

| Location                                      | # Of Samples | % > 0 ng/L | % > 42 ng/L | Avg. % Reduction Needed To Meet 42 ng/L During Exceedances | Max % Reduction Needed To Meet 42 ng/L During Exceedances | % > 160 ng/L | Avg. % Reduction Needed To Meet 160 ng/L During Exceedances | Max % Reduction Needed To Meet 160 ng/L During Exceedances |
|---|--------------|------------|-------------|--|---|--------------|---|--|
| Sac R at Sacramento                           | 103          | 1          | 9%          | 31%  | 56%   | 0%           | -   | 0%   |
| Steamboat Slough                              | 35           | 0          | 0%          | -  | 0%  | 0%           | -   | 0%   |
| Ulatis Creek                                  | 53           | 1          | 23%         | 50%  | 89%   | 4%           | 56%   | 58%  |
| Cache Slough nr Outlet                        | 49           | 1          | 6%          | 41%  | 56%   | 0%           | -   | 0%   |
| Sac R at Rio Vista                            | 49           | 1          | 4%          | 44%  | 51%   | 0%           | -   | 0%   |
| Mokelumne River near Delta Boundary           | 41           | 0          | 5%          | 36%  | 42%   | 0%           | -   | 0%   |
| Mosher Slough                                 | 53           | 1          | 66%         | 61%  | 91%   | 17%          | 37%   | 67%  |
| Calaveras River ds Stockton Diverting Channel | 36           | 1          | 53%         | 59%  | 92%   | 22%          | 32%   | 69%  |
| SJR nr Stockton                               | 4            | 1          | 0%          | -  | 0%  | 0%           | -   | 0%   |
| Middle Roberts Island Drain                   | 43           | 0          | 5%          | 41%  | 49%   | 0%           | -   | 0%   |
| Paradise Cut                                  | 26           | 0          | 4%          | 7%   | 7%  | 0%           | -   | 0%   |
| French Camp Slough                            | 46           | 1          | 30%         | 48%  | 90%   | 7%           | 43%   | 64%  |
| SJR nr Vernalis                               | 300          | 0          | 12%         | 43%  | 82%   | 3%           | 20%   | 32%  |
| Old River at Tracy Rd                         | 31           | 0          | 0%          | -  | 0%  | 0%           | -   | 0%   |
| Middle River near Middle River                | 7            | 0          | 0%          | -  | 0%  | 0%           | -   | 0%   |
| Marsh Creek                                   | 51           | 1          | 31%         | 44%  | 89%   | 4%           | 37%   | 58%  |
| SJR at Antioch                                | 5            | 0          | 0%          | -  | 0%  | 0%           | -   | 0%   |

**Table 5.6. Comparison of Available Data (Oct, 2000 – March, 2005) to Alternate  
Chlorpyrifos  
Acute Water Quality Objectives**

| Location                                      | # Of Samples | % > 0 ng/L | % > 25 ng/L | Avg. % Reduction Needed To Meet 25 ng/L During Exceedances | Max % Reduction Needed To Meet 25 ng/L During Exceedances |
|---|--------------|------------|-------------|--|---|
| Sac R at Sacramento                           | 102          | 12%        | 1%          | 17%  | 17%   |
| Steamboat Slough                              | 35           | 6%         | 3%          | 24%  | 24%   |
| Ulatis Creek                                  | 54           | 63%        | 33%         | 61%  | 79%   |
| Cache Slough nr Outlet                        | 49           | 14%        | 2%          | 31%  | 31%   |
| Sac R at Rio Vista                            | 49           | 16%        | 4%          | 24%  | 31%   |
| Mokelumne River near Delta Boundary           | 40           | 10%        | 5%          | 31%  | 42%   |
| Mosher Slough                                 | 53           | 55%        | 17%         | 35%  | 75%   |
| Calaveras River ds Stockton Diverting Channel | 36           | 47%        | 6%          | 35%  | 63%   |
| SJR nr Stockton                               | 4            | 75%        | 0%          | -  | -   |
| Middle Roberts Island Drain                   | 43           | 63%        | 23%         | 54%  | 93%   |
| Paradise Cut                                  | 26           | 15%        | 0%          | -  | -   |
| French Camp Slough                            | 46           | 65%        | 7%          | 78%  | 89%   |
| SJR nr Vernalis                               | 302          | 40%        | 1%          | 14%  | 22%   |
| Old River at Tracy Rd                         | 31           | 35%        | 3%          | 32%  | 32%   |
| Middle River near Middle River                | 7            | 0%         | 0%          | -  | -   |
| Marsh Creek                                   | 51           | 18%        | 0%          | -  | -   |
| SJR at Antioch                                | 5            | 20%        | 0%          | -  | -   |

## **5.2 Evaluation of Alternate Methods for Deriving Water Quality Objectives**

This section evaluates the alternate methods for deriving Water Quality Objectives presented above, with respect to Porter-Cologne and other applicable state and federal laws and policies. Section §13241 of Porter-Cologne specifies the following considerations in establishing Water Quality Objectives:

- Past, present, and probable future beneficial uses of water.
- Environmental characteristics of hydrographic unit, including quality of water available to it.
- Water quality conditions reasonably achievable through coordinated control of all factors that affect water quality in the area.
- Economic considerations.
- The need for developing housing within the region.
- The need to develop and use recycled water.

Tables 5.7 and 5.8 present qualitative assessments of the alternate methods for their consistency with Porter-Cologne and other state and federal requirements. The rationale for the assessment of each method follows the tables.

**Table 5.7. Assessment of Diazinon Alternatives for Consistency with Porter Cologne and other State and Federal Requirements**

| <b>Porter-Cologne Requirements</b>         | <b>No Change</b> | <b>No Diazinon</b> | <b>CDFG/ USEPA</b> |
|--|------------------|--------------------|--------------------|
| Beneficial Uses                            | +                | +                  | +                  |
| Environmental Characteristics              | 0                | 0                  | 0                  |
| Conditions Reasonably Achievable           | +                | -                  | +                  |
| Economic Considerations                    | +                | -                  | +                  |
| Need for Housing                           | 0                | 0                  | 0                  |
| Need to Recycle Water                      | 0                | 0                  | 0                  |
| <b>State and Federal Laws and Policies</b> | <b>No Change</b> | <b>No Diazinon</b> | <b>CDFG/USEPA</b>  |
| Anti-degradation                           | C                | C                  | C                  |
| Clean Water Act                            | C                | C                  | C                  |
| ESA  | C                | C                  | C                  |

Scores indicate relative degree of protection; attainability; achievability; impact or consistency with policy, as applicable, with 0 indicating neutral:

- Beneficial Uses:** Not protective of beneficial uses: - Fully protective: +
- Environmental Characteristics:** Not attainable: - Fully attainable: +
- Achievability:** Difficult to achieve - Readily achievable: +
- Economic Considerations:** Potentially significant impact: - Modest or no negative impact: +
- Housing:** Significant housing impact: - Little or no impact: +
- Recycling Water:** Significant impact on recycling water: - Little or no impact: +
- C = Consistent**

**Table 5.8. Assessment of Chlorpyrifos Alternatives for Consistency with Porter Cologne and other State and Federal Requirements**

| <b>Porter-Cologne Requirements</b>         | <b>No Change</b> | <b>No Chlorpyrifos</b> | <b>CDFG/USEPA</b> |
|--|------------------|------------------------|-------------------|
| Beneficial Uses                            | +                | +                      | +                 |
| Environmental Characteristics              | 0                | 0                      | 0                 |
| Conditions Reasonably Achievable           | +                | -                      | +                 |
| Economic Considerations                    | +                | -                      | +                 |
| Need for Housing                           | 0                | 0                      | 0                 |
| Need to Recycle Water                      | 0                | 0                      | 0                 |
| <b>State and Federal Laws and Policies</b> | <b>No Change</b> | <b>No Chlorpyrifos</b> | <b>CDFG/USEPA</b> |
| Anti-degradation                           | C                | C                      | C                 |
| Clean Water Act                            | C                | C                      | C                 |
| ESA  | C                | C                      | C                 |

Scores indicate relative degree of protection; attainability; achievability; impact or consistency with policy, as applicable, with 0 indicating neutral:

**Beneficial Uses:** Not protective of beneficial uses: - Fully protective: +

**Environmental Characteristics:** Not attainable: - Fully attainable: +

**Achievability:** Difficult to achieve - Readily achievable: +

**Economic Considerations:** Potentially significant impact: - Modest or no negative impact: +

**Housing:** Significant housing impact: - Little or no impact: +

**Recycling Water:** Significant impact on recycling water: - Little or no impact: +

**C** = Consistent

## **5.2.1 Beneficial Uses**

This section evaluates each potential objective with the requirement to protect beneficial uses. Federal law requires that states adopt criteria that protect the beneficial uses and that the most sensitive use is protected (40 CFR § 131.11(a)). State law requires the reasonable protection of beneficial uses and that those beneficial uses of water be considered in establishing Water Quality Objectives (CWC § 13241, et seq.).

### **5.2.1.1 No Change in Water Quality Objectives**

The Basin Plan's narrative Water Quality Objectives for pesticides and toxicity provide direction in terms of protecting beneficial uses, i.e., toxicity is not allowed. However, the practical application of the narratives is problematic in that toxicity has to be demonstrated by actually testing surface water samples with living organisms, or by using available numeric criteria to determine whether beneficial uses are impacted. In addition, a narrative objective cannot be used directly to establish total maximum daily loads (TMDLs) or for other quantitative applications that require numeric criteria.

Existing numeric criteria, such as the CDFG water quality criteria, have been used for specific water bodies to determine if beneficial uses are being protected. The CDFG criteria have been used to determine if waters should be identified as not attaining standards as required by Section 303(d) of the Clean Water Act. Criteria calculations applying the USEPA methodology to the CDFG datasets were considered the most appropriate. The datasets were evaluated by a California state agency charged with protecting fish and wildlife and the USEPA methodology is used specifically to derive numeric criteria that should protect aquatic life beneficial uses.

The recalculated CDFG criteria for chlorpyrifos are at a level that should be protective of freshwater habitat uses. Other beneficial uses are less sensitive to chlorpyrifos than the freshwater habitat uses. With no change in the Water Quality Objectives, the recalculated CDFG criteria for chlorpyrifos would be used.

The recalculated diazinon criteria using the USEPA methodology and CDFG dataset provide the best available information on protection of aquatic invertebrates from diazinon. A lower acute value (0.10 µg/L) for the protection of salmon from diazinon effects was also considered (see Endangered Species Section 5.2.6.3). Other beneficial uses are less sensitive to diazinon than the freshwater habitat uses. With no change in the Water Quality Objectives, the recalculated CDFG criteria would be used to interpret the narrative objective.

### **5.2.1.2 Numeric Water Quality Objectives Based on No Diazinon or No Chlorpyrifos**

Water quality objectives based on no diazinon or no chlorpyrifos would be highly protective of beneficial uses, since there would be no potential risk to beneficial uses from these chemicals.

### **5.2.1.3 Numeric Water Quality Objectives Based on the USEPA Method**

The USEPA criteria method, as applied by CDFG (and recalculated by the Regional Water Board), uses acute and chronic toxicity data for a wide range of species. The criteria are designed to be protective of the most sensitive aquatic organisms and the acute and chronic criteria are designed to avoid detrimental physiologic responses. The method has been used by the USEPA for almost twenty years to establish water quality criteria, and has been used by



the CDFG since the late 1980s to assess hazards to aquatic organisms in the Sacramento-San Joaquin Rivers and Delta Waterways. All available information indicates that the recalculated CDFG diazinon criteria and the recalculated CDFG chlorpyrifos criteria (both recalculated by Regional Water Board staff using the USEPA method of calculating significant figures-see Appendix G) should be protective of all freshwater habitat uses in the Delta Waterways.

### **5.2.2 Environmental Characteristics and Quality of Water Available**

Diazinon and chlorpyrifos enter the Delta Waterways system primarily from applications to a variety of crops in the Delta watershed, and from the San Joaquin and Sacramento Valleys upstream of the Delta. None of the alternate methods of deriving Water Quality Objectives are dependent on any natural environmental characteristic. Diazinon and chlorpyrifos are not natural pollutants, so background levels of these pesticides would not be expected in absence of their use. All of the potential criteria are, therefore, equally consistent with the environmental characteristics of the watershed.

Since the San Joaquin and Sacramento rivers (and the Yolo Bypass, which also sometimes carries Sacramento River Water into the Delta) flow into the Delta watershed, the Water Quality Objectives for the Delta should be achievable given the water quality expected in these inflows. The concentrations of diazinon and chlorpyrifos in the Sacramento and San Joaquin rivers are expected to have concentrations of diazinon and chlorpyrifos no higher than those allowed by current Basin Plan requirements for those waterbodies, shown in table 5.9. Therefore, the water flowing into the Delta from outside the Delta watershed should be at or below the objectives shown in Table 5.4, and the quality of available water should not interfere with the achievability of any Water Quality Objective greater than or equal to those shown in table 5.9. Water quality objectives for the Delta significantly lower than those in Table 5.9 could require further upstream reductions in the Sacramento and San Joaquin Rivers upstream of the Delta.

**Table 5.9. Diazinon and Chlorpyrifos Water Quality Objectives for the Sacramento and San Joaquin Rivers Upstream of the Delta.**

| Delta Tributary  | Diazinon Water Quality Objectives (ng/L) |             | Chlorpyrifos Water Quality Objectives (ng/L) |         |
|--|--|-------------|--|---------|
|  | Acute (1)                                | Chronic (2) | Acute  | Chronic |
| Lower Sacramento River   | 80                                       | 50          | NA (3)                                       | NA (3)  |
| Lower San Joaquin River  | 160                                      | 100         | 25   | 15      |
| <p>(1) Hourly maximum concentration not to be exceeded more than once every three years.</p> <p>(2) 4-day average maximum concentration not to be exceeded more than once every three years</p> <p>(3) Chlorpyrifos levels in the Sacramento River upstream of the Delta are generally below levels of concern (Karkoski et al., 2003), but recent levels of chlorpyrifos detected in the Lower Sacramento River (Calanchini et al., 2004) may necessitate adoption of chlorpyrifos objectives for the Lower Sacramento River.</p> |  |             |  |         |

### 5.2.3 Water Quality Conditions Reasonably Achievable

Diazinon and chlorpyrifos concentrations detected in the Delta Waterways are the result of current-year applications of these pesticides. Unlike DDT or certain other chlorinated pesticides, diazinon and chlorpyrifos break down relatively rapidly in the aqueous environment, and are not sequestered in sediments to an appreciable extent. Unlike some naturally occurring compounds such as selenium, there are no natural sources of diazinon or chlorpyrifos, and there are no natural, or “background” concentrations. If these pesticides were prevented from entering surface waters, then concentrations of diazinon and chlorpyrifos in the Delta Waterways system would decline rapidly. Tables 5.5 and 5.6 compare historical data to the alternate Water Quality Objectives evaluated in this section. Much of this data was collected before the significant declines in diazinon and chlorpyrifos use and concentrations in the Delta Watershed (discussed in sections 2) and in the Sacramento and San Joaquin Valleys (Karkoski et al, 2003 and Beaulaurier et al., 2005)

The difficulty and cost of preventing diazinon and chlorpyrifos from entering surface waters is the key element in achieving the Water Quality Objectives for these pesticides. Options for reducing the amount of pesticides entering the Delta Waterways systems are discussed in Beaulaurier et al. (2005) and Reyes and Menconi (2002). It is reasonable to assume that the lower the Water Quality Objective, the more difficult it will be to achieve, and the more cost and effort will be required to meet it. Some options discussed in Section 9 and by Reyes and Menconi (2002) are more likely to be effective than others, and it is currently unknown which options will deliver the greatest reductions for the least cost and effort. Given the suite of options available to agricultural dischargers, as well as the recent declines in use and concentrations in Central Valley waterways, the numeric criteria developed using the USEPA

methodology appear to be reasonably achievable. More significant changes would likely be needed to meet the no detectable levels of diazinon or chlorpyrifos alternative (e.g. additional controls to completely prevent diazinon and chlorpyrifos runoff).

#### **5.2.4 Economic Considerations**

It is likely that changes agricultural practices will be necessary to reduce diazinon and chlorpyrifos concentrations in the Delta Waterways. These practices and their potential costs are discussed in greater detail in Sections 6.5 and 9 of this report. Alternative pesticides and practices have been identified by the University of California Integrated Pest Management Program (Zalom et al., 1999) and described in Beaulaurier et al. (2005) and in Reyes and Menconi (2002). For those growers that must change their current management practices to meet the new Water Quality Objectives, providing mitigation for or preventing diazinon or chlorpyrifos runoff could increase total production cost by approximately 0% to 10% (see Section 9). The same costs would be incurred with no change in Water Quality Objectives, because growers would still need to meet the applicable narrative objectives. The criteria being considered for the new numeric objectives provide the best available information to interpret the narrative objectives. As described in Section 9.1 of this report, new federal label requirement on the use of diazinon (MANA, 2004d) and draft DPR dormant spray regulations (DPR, 2005b) have recently been issued. It is likely that by meeting the existing federal label requirements for diazinon dormant season application and the pending DPR dormant spray regulations that growers using diazinon and chlorpyrifos in the dormant season will not need to implement additional management practices in the dormant season to meet the proposed objectives.

For the “no diazinon” or “no chlorpyrifos” alternative, all growers would either need to use a different pesticide product or implement measures to prevent surface water runoff. Using an alternative to diazinon or chlorpyrifos would not necessarily lead to a significant increase in cost to the grower, since the cost of the actual pesticides is not a significant part of overall production costs (see Section 9), but in some cases it could increase potential pest damage by limiting pest control options available to address insecticide resistance in pests. Preventing all off-site movement of diazinon or chlorpyrifos into the Delta Waterways would be more costly since both runoff and aerial drift would need to be controlled. NPDES dischargers would likely be able to meet the criteria with no additional cost, given enough time for the ban on the sale of non-agricultural uses of diazinon and chlorpyrifos to take full effect, including the depletion of existing homeowner supplies.

#### **5.2.5 The Need to Develop Housing**

The discharge of diazinon and chlorpyrifos is not necessary for the development of new housing or to maintain existing housing supply or values. Therefore, none of the alternate methods for establishing Water Quality Objectives for diazinon or chlorpyrifos in the Delta Waterways is expected to affect housing.

## **5.2.6 The Need To Develop And Use Recycled Water**

Diazinon or chlorpyrifos is not known to be a limiting factor for the development or use of recycled water. Therefore, none of the alternate methods for establishing Water Quality Objectives in the Delta Waterways is expected to affect the development or use of recycled water.

## **5.2.7 Consistency of Alternate Methods with State and Federal Laws and Policies**

### **5.2.7.1 Anti-degradation Policy**

Establishing a Water Quality Objective based on “no diazinon/chlorpyrifos” would be consistent with the anti-degradation policy, since water quality would improve in the absence of diazinon and chlorpyrifos.

The “no change” alternative is protective of beneficial uses, since the existing narrative objectives are consistent with the anti-degradation policy.

Chlorpyrifos and diazinon Water Quality Objectives based on the USEPA methodology should be protective of beneficial uses and would not cause degradation of the existing quality of the Delta Waterways.

### **5.2.7.2 Clean Water Act**

The Clean Water Act requires that numerical criteria be based on “... (i) 304(a) Guidance; or (ii) 304(a) Guidance modified to reflect site-specific conditions; or (iii) other scientifically defensible methods” (40 CFR § 131.11 (b) et seq.).

Making no change in the current narrative Water Quality Objectives would be consistent with the Clean Water Act. The Regional Water Board would need to interpret the existing narrative objectives to adopt TMDLs. Numeric Water Quality Objectives based on the no diazinon or chlorpyrifos alternative would be consistent with the Clean Water Act, since States may adopt water quality standards that are more stringent than those necessary to protect beneficial uses. Criteria based on the USEPA methodology would be consistent with the Clean Water Act, since the methodology is part of the 304(a) Guidance.

### **5.2.7.3 Endangered Species Act**

There are a number of aquatic species within the Delta that are listed as threatened, endangered, or species of concern under the Endangered Species Act (CALFED, 1999). These include the Delta smelt, Sacramento splittail, green sturgeon, steelhead trout, and multiple runs of Chinook salmon. Water quality objectives must protect the aquatic life in the Delta Waterways, particularly endangered, threatened and endangered species and the food web on which they depend. Indirect effects of diazinon and chlorpyrifos on endangered Delta fishes could occur if populations of sensitive arthropods were reduced at critical periods when they are needed as food by juvenile fish. Water quality objectives based on the no diazinon and no chlorpyrifos alternative would provide the greatest protection. Diazinon and chlorpyrifos Water Quality Objectives derived by the USEPA methodology would still be

protective, although the methodology is based on data from tested species, and these species are surrogates for resident or endangered species.

A study conducted on Chinook salmon indicated that diazinon significantly inhibited olfactory-mediated avoidance response to predators at concentrations as low as 1,000 ng/L. An effect, although not statistically significant, was also found at 100 ng/L. The authors conclude that this inhibition could have negative consequences for survival and reproduction (Scholz, et al., 2000). Since these effects were observed after short-term (2-hour) exposure of the fish to diazinon, longer-term exposure to diazinon may have a more pronounced effect. Felsot, (2005) suggested that the Scholz, et al (2000) study could not be used as the basis for deriving criteria due to the large differences in concentrations tested, poor quantitative separation of observed responses, and ambiguity about the ecological relevance of the observed responses. Regional Water Board staff agrees that the results of the Scholz study cannot be used directly for diazinon criteria derivation, although the study does raise concerns regarding sublethal effects of diazinon on endangered salmonids.

### **5.2.8 Recommended Alternative for Diazinon Water Quality Objectives in the Delta Waterways**

The recalculated CDFG criteria using the USEPA methodology (Finlayson, 2004a) are the recommended Water Quality Objectives. The recommended diazinon Water Quality Objectives are 160 ng/L as a 1-hour average (acute) maximum concentration and 100 ng/L as a 4-day average (chronic) maximum concentration, not to be exceeded more than once in three years. The CDFG criteria are driven by toxicity studies for aquatic invertebrates. The criteria would, therefore, be appropriate to use when assessing the additive toxicity of diazinon and chlorpyrifos. The Scholz (2000) study indicated that effects on salmon behavior from short-term exposure to diazinon begin to occur at a concentration somewhere between 100 ng/L and 1000 ng/L, however, additional study is needed in order to determine a concentration that would be appropriate to apply as a water quality criterion. If the proposed diazinon criteria are adopted as Water Quality Objectives and new information suggested the numeric objectives were not protective enough, the Regional Water Board could still apply the narrative objectives to ensure protection of beneficial uses while it went through the process of amending the numeric objective. A number of alternative management practices are available to reduce the amount of diazinon introduced into the Delta Waterways. Available data indicate that the proposed objectives are often attained in the Delta Waterways.

The “No Diazinon” alternative is not recommended at this time. It may not be feasible to completely prevent off-site movement of diazinon given current allowed uses, seasons of use, and application methods.

The “No Change” alternative is not recommended. There is sufficient information available to establish a diazinon objective, which will provide a clear goal for dischargers of diazinon.

### **5.2.9 Recommended Alternative for Chlorpyrifos Water Quality Objectives in the Delta Waterways**

The recalculated CDFG criteria for chlorpyrifos are the recommended Water Quality Objectives. The recommended chlorpyrifos Water Quality Objectives are 25 ng/L as a 1-hour average (acute) maximum concentration and 15 ng/L as a 4-day average (chronic) maximum concentration, not to be exceeded more than once in three years. A number of alternative management practices are available to reduce the amount of chlorpyrifos introduced into the Delta Waterways. Available data indicate that the proposed objectives are often attained in the Delta Waterways.

The “No Chlorpyrifos” alternative is not recommended at this time. It may not be feasible to completely prevent off-site movement of chlorpyrifos given current allowed uses, seasons of use, and application methods.

The “No Change” alternative is not recommended. There is sufficient information available to establish a chlorpyrifos objective, which will provide a clear goal for dischargers of chlorpyrifos.

## **6 PROGRAM OF IMPLEMENTATION**

Porter-Cologne (§ 13242) requires the identification of a program of implementation for achieving Water Quality Objectives "...that shall include, but not be limited to:

- (a) A description of the nature of actions which are necessary to achieve the objectives, including recommendations for appropriate action by any entity, public or private.
- (b) A time schedule for actions to be taken.
- (c) A description of the surveillance to be undertaken to determine compliance with objectives."

This section proposes options for how the Regional Water Board can ensure compliance with the proposed Water Quality Objectives and TMDLs for diazinon and chlorpyrifos in the Delta Waterways. The first part of this section proposes definitions for the Loading Capacity and allocations that make up the TMDL, including consideration of the additive toxicity of the two pesticides. The rest of this section contains a discussion of the alternative regulatory tools available to control discharge of diazinon and chlorpyrifos runoff, and proposes a time schedule for specific actions to ensure compliance with the Water Quality Objectives.

### **6.1 TMDL Loading Capacity and Allocations**

Section 303(d)(1)(C) of the Clean Water Act requires the establishment of a Total Maximum Daily Load (TMDL) for waters identified on the 303(d) list, if the USEPA Administrator has determined that the pollutant is suitable for a TMDL calculation. The TMDL must be "...established at a level necessary to implement the applicable water quality standards with seasonal variations and a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality."

Federal regulations provide further definition of the structure and content of TMDLs. TMDLs shall "... take into account critical conditions for stream flow, loading, and water quality parameters" (40 CFR § 130.7(c)(1)).

TMDLs are defined as the sum of the individual waste load allocations (WLAs) and load allocations (LAs). TMDLs can be expressed in terms of "... mass per time, toxicity, or other appropriate measure." WLAs are the portion of the receiving water's loading capacity allocated to existing or future point sources and LAs are the portion of the receiving water's loading capacity allocated to existing or future nonpoint sources of pollution or to natural background sources. The loading capacity is the greatest amount of a pollutant a water can receive without violating water quality standards (40 CFR § 130.2 (f), (g), (h), (i)). Although the term "load" often refers to "mass", the federal regulations do not restrict the expression of a TMDL to units of mass. In this section, the discussion of load allocations, waste load allocations, and loading capacity include consideration of mass per time or other appropriate measures (e.g. concentration or toxic unit calculations).

This section provides an overview of the alternatives considered, the factors considered in selecting a recommended alternative, and a description of the recommended alternatives for defining the Loading Capacity, the Wasteload Allocations, and the Load Allocations for diazinon and chlorpyrifos in the Delta Waterways.

### **6.1.1 Factors Considered in Selecting the Recommended Alternative**

The following factors were considered in selecting the recommended method for determining the loading capacity and allocation method:

1. The ability of the method to adequately assess the loading capacity.
2. The availability of adequate data to apply to the method.
3. The ability of the method to account for seasonal variations.
4. The degree of uncertainty associated with the method.
5. The ease of determining compliance.
6. Equity of the methodology.

### **6.1.2 Loading Capacity**

The Loading Capacity of the Delta Waterways for diazinon and chlorpyrifos is the amount of diazinon and chlorpyrifos that can be assimilated by the Delta Waterways without exceeding the proposed Water Quality Objectives. Since diazinon and chlorpyrifos can both be present at levels of concern in the Delta Waterways, additive toxicity must also be considered in determining the Loading Capacity.

Appendix A lists the Delta Waterways (and reaches of Delta Waterways) for which the Loading Capacity needs to be defined. The list in Appendix A includes all the distinct, readily identifiable waterbodies within the boundaries of the “Legal” Delta that are hydrologically connected by surface water flows (not including pumping) to the Sacramento and/or San Joaquin rivers.

Small agricultural drains on Delta islands or uplands were not considered “Delta Waterways” and are therefore not included in the list in Appendix A. As with all the other tributaries to Delta Waterways, the discharges into Delta Waterways from these drains and streams would still need to be addressed via allocations to ensure the Loading Capacities for the Delta Waterways into which they drain are not exceeded.

### **6.1.3 Concentration-Based Loading Capacity**

The Loading Capacity for the Delta Waterways could be defined in terms of maximum allowable concentrations. Loading Capacity for Delta Waterways based on attaining the diazinon and chlorpyrifos Water Quality Objective concentrations was considered in developing this Basin Plan Amendment. Under this scenario, diazinon or chlorpyrifos concentrations must not exceed the Water Quality Objectives in order to meet the TMDL. Since diazinon and chlorpyrifos can and do co-occur in Delta Waterways, the joint toxicity of



these chemicals must be considered (see Basin Plan; pages IV-18.00 and IV-35.00). To address the joint toxicity of these chemicals, the Loading Capacity can be expressed using either of the equations for additive toxicity discussed in Section 5.1.8.

#### 6.1.4 Mass-Based Loading Capacity

A Mass-based loading capacity would be defined in terms of a mass per unit time, such as grams per day. Determination of a mass-based loading capacity for a river or stream requires an estimate of the volume of water or the amount of flow available to assimilate the pollutant load. For a pollutant in a typical stream or river site, where flow is only in one direction, the loading capacity, or allowable loading over a given time interval, can be determined by calculating the product of flow rate and the Water Quality Objective concentration.

For many of the hydrologically complex Delta Waterways, such as the sloughs, rivers, and constructed channels, flow is in more than one direction due to effects of tides and/or water diversions. In these cases, the method described above cannot be used since there is not one-directional flow. The water in a hydrologically complex Delta waterway, or a reach of that waterway, may already contain pesticides from other Delta Waterways, or from its tributary watershed. If a hydrologically complex Delta Waterway, or a reach of that waterway, is not assumed to have any available loading capacity (e.g. the concentrations within the waterbody are already approaching the water quality objectives) the loading capacity can be conservatively estimated as the sum of the tributary inflows (excluding flows from other Delta Waterways) times the target concentration.

A fixed loading capacity would be a constant maximum allowable load based on design flows from historical data. Fixed loading capacities were considered in previous Central Valley Water Board staff reports for the Sacramento and San Joaquin Rivers (Karkoski et al., 2003, Beaulaurier et al., 2005), but were not considered for the Delta Waterways due to the hydrologic complexity, lack of available data, and the fact that historic or current flow data may not be representative of future conditions in this highly managed system.

A variable loading capacity would be a maximum allowable load that varies with the flow within, and/or into a waterbody. Variable loading capacities would directly assess the actual available assimilative capacities. Since a variable loading capacity varies with flow, seasonal variations are explicitly considered. There is no uncertainty in the calculation of the loading capacity. There is uncertainty associated with the measurement of flow under this option, which would need to be taken into consideration in determining the Margin of Safety under this scenario.

The joint toxicity of diazinon and chlorpyrifos must also be considered when determining a mass-based loading capacity. The mass-based loading capacities are found by converting the equation for combined toxicity from section 5.3.8 to express the loading capacity in terms of mass loads instead of concentrations and becomes:

$$(L_d / LC_d) + (L_c / LC_c) \leq 1 \quad \text{Equation 2}$$

where

- $L_D$  = Diazinon Load (g/day)
- $LC_D$  = Diazinon Loading Capacity (g/day)
- $L_C$  = Chlorpyrifos Load (g/day)
- $LC_C$  = Chlorpyrifos Loading Capacity (g/day)

There are a number of potential ways to split the total allowable mass load between diazinon and chlorpyrifos to determine the allowable mass loads for the individual pesticides. The allowable loads of each pesticide could be based on a reduction of the existing loads of each pesticide. This would require either assuming that the existing loads are currently well characterized, or implementing extensive monitoring to characterize the current loads. Such an approach could penalize those who are already implementing effective runoff control.

The allowable loads of each pesticide could be set according to the acreage in the watershed directly tributary to the Delta Waterway that is planted in crops for which each pesticide is registered or commonly used. This could be difficult to define, since not all growers of the commodities for which diazinon or chlorpyrifos are registered use diazinon or chlorpyrifos on those crops. This alternative would also be somewhat complicated and cumbersome to implement, since it would require frequent, extensive land-use data collection since crops planted, especially field crops, can vary extensively from year to year.

Another method of splitting the total allowable mass load between diazinon and chlorpyrifos would be to make the allowable load of each pesticide proportional to the use of each pesticide in the watershed directly tributary to the Delta Waterway. This alternative would be complicated and cumbersome to implement, however, due to the temporal and spatial variability of the use patterns in the Delta watershed, the hydrologic complexity of the Delta, and the delay in the availability of the pesticide use data (e.g. compliance could not be evaluated for up to a year after any violations occurred, pesticide use data typically takes from 1 to 2 years after use is reported to become available).

### 6.1.5 Recommended Loading Capacities

The recommended Delta Waterways Loading Capacity is a concentration-based loading capacity that addresses the additive toxicity of diazinon and chlorpyrifos. The equation used in the Basin Plan to assess the additive toxicity is recommended. The recommended Delta Waterways Loading Capacity is therefore based on equation 1:

$$\frac{C_{\text{diaz}}}{O_{\text{diaz}}} + \frac{C_{\text{chlor}}}{O_{\text{chlor}}} = S, S \leq 1$$

Where:

- $C_D$  = Diazinon concentration in the receiving water.
- $C_C$  = Chlorpyrifos concentration in the receiving water.
- $WQO_D$  = Acute or chronic diazinon Water Quality Objective or criterion.
- $WQO_C$  = Acute or chronic chlorpyrifos Water Quality Objective or criterion

The recommended Delta Waterways Loading Capacity is consistent with the narrative toxicity Water Quality Objective which states, in part "...This objective applies regardless of whether the toxicity is caused by a single substance or the interactive effect of multiple substances..." The recommended Delta Waterways Loading Capacity is also consistent with the narrative pesticide objective that states, in part "No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses" (see Basin Plan; pages III-6.00 and III-8.00).

The recommendation for this method of defining the loading capacity was made after considering all the factors listed in section 6.1.1. The recommended method of defining the loading capacity is more straightforward than any of the mass-based methods in terms of defining and assessing compliance with the allowable amounts of diazinon and chlorpyrifos in the Delta Waterways. Since the recommended Delta Waterways Loading Capacity is not dependant on a particular flow regime, it would not be changed by changes in flows, withdrawals, or flow routing within the Delta. Because the recommended method of determining the loading capacity is so straightforward, there is no error involved in applying this method to adequately assess the loading capacity. Similarly there are no data gaps that need to be filled in order to use the recommended method. Since the Delta Waterways Loading Capacity is based on an hourly and 4-day basis, all seasonal variations are taken into account. For these reasons, there is minimal uncertainty associated with this method of defining the loading capacity. Determining the Delta Waterways Loading Capacity is relatively straightforward, since it only requires measuring concentrations in the Delta Waterways and does not require the extensive discharge measurements and loading calculations involved in the other scenarios.

## **6.2 Allocations**

This section of the report identifies scenarios for defining the load allocations for nonpoint sources, and wasteload allocations for point sources of the diazinon and chlorpyrifos in the Delta Waterways. These allocations are defined so that when the allocations are combined, along with a margin of safety, they will be equal to the Delta Waterways Loading Capacity.

### **6.2.1 Wasteload Allocations**

The point sources with potential to discharge diazinon and chlorpyrifos into the Delta Waterways are the municipal wastewater treatment plants and the municipal stormwater discharges in the Delta watershed. Since sales of all non-agricultural uses of diazinon have been banned since December 31, 2004 (USEPA, 2001), diazinon levels in municipal wastewater treatment plant discharges and stormwater discharges are expected to decline rapidly. Since the majority of the non-agricultural uses of chlorpyrifos were banned after December 2001 by USEPA, a significant reduction in the concentrations of chlorpyrifos in urban runoff and wastewater treatment plant effluent is also expected.

Infrequent outdoor applications of diazinon may occur for several years after the phase-out and some fraction of the diazinon applied may be discharged in storm water. A few minor non-agricultural uses of chlorpyrifos will still be allowed. Some fraction of these chlorpyrifos

applications may be discharged in storm water or wastewater treatment plant effluent. For these reasons a waste load allocation should be established for chlorpyrifos and diazinon in urban stormwater discharges and wastewater treatment plant discharges. The proposed diazinon and chlorpyrifos Waste Load Allocations for these point sources are equivalent to the Delta Waterways Loading Capacity defined above. Since the proposed Waste Load Allocations are not dependant on a particular flow regime, they would not be changed by changes in flows, withdrawals or flow routing within the Delta. Since chlorpyrifos and diazinon from agricultural sources may still be present in rainfall in urban areas, these “background” concentrations may need to be considered in assessing compliance with the waste Load Allocations. Based on the phase out of urban uses of diazinon and the ban in 2001 of the majority of non-agricultural chlorpyrifos uses, the presence of diazinon and chlorpyrifos in urban runoff is expected to be infrequent and below the waste Load Allocations.

### **6.2.2 Load Allocations**

There are several load allocation scenarios that can be used to allocate the available loading capacity to agricultural sources in the Delta Watershed. Methods used to allocate loads can be based upon a geographic split, crop or land-use patterns, pesticide use patterns, present loading rates, or a mix of these methods. Scenarios based on current loading rates were not considered because this would disadvantage dischargers and areas that have already effectively minimized offsite movement of pesticides through implementation of management practices. In addition, insufficient information is available to characterize current loading rates. Scenarios based on pesticide use rates were also not considered since this may disadvantage areas and dischargers that try to minimize offsite movement of pesticide through reduced use.

Previous Central Valley Water Board reports (Karkoski et al., 2003, Beaulaurier et al., 2005) evaluated calculating the loading capacity at downstream points in the riverine watersheds, and setting Load allocations for the discharges upstream of those points. Due to the hydrologic complexity of the Delta, it cannot be split into geographic subwatersheds that drain to unique downstream points. The subareas discussed in the background information have water quality that is representative of the water quality in the flows from differing combinations of sources areas, but the same source areas affect the water quality in multiple Delta subareas. For this reason, options considered for the rivers upstream of the Delta that would base the load allocations on various attributes of tributary subareas, such as their size or the areas within the subareas that are being used to grow certain crops, would not present a clear rationale for setting load allocations for the Delta Waterways.

The Load Allocations for the discharges to each Delta Waterway could be set at the proposed Delta Waterways Loading Capacity. Under this scenario, the concentrations of diazinon and chlorpyrifos coming into the each of the Delta Waterways would be required to be no greater than the concentrations which would be allowable in the each Delta Waterway, as defined by proposed Delta Waterways Loading Capacity. For Delta Waterways that flow into the Legal Delta from outside, the Load Allocations for discharges to each waterbody upstream of the Legal Delta would be defined at the point where the waterway enters the legal Delta (essentially treating the reaches of the waterways upstream of the Legal Delta as tributaries).

The latter scenario for defining the load allocations is the recommended methodology for determining the allowable nonpoint source loads. The recommendation for this method of

defining the load allocations was made after considering all the factors listed in section 6.1.1. This recommended allocation methodology would provide a very straightforward definition of the load allocations, with no inherent error involved in the methodology, and no data gaps that would have to be filled. Since the proposed Load Allocations are not dependant on a particular flow regime, they would not be changed by changes in flows, withdrawals, or flow routing within the Delta. Also, since the Load Allocations would be defined on an hourly and 4-day basis, seasonal variations are taken into account. For these reasons, there is minimal uncertainty associated with this method of defining the load allocations. Assessment of compliance would be relatively straightforward. The only data that would be necessary to assess compliance with the proposed Load Allocations would be diazinon and chlorpyrifos concentration data at points of discharge to the Delta Waterways. Since the Delta Waterways are so numerous, and the points of discharge to the Delta Waterways are even more numerous, representative monitoring in key Delta Waterways and representative tributaries could be used to estimate conditions in remaining Delta Waterways and their tributaries, as discussed in the monitoring section of this report.

### **6.3 Margin of Safety and Seasonal Variations**

The recommended alternative Load Allocations and Wasteload Allocations have an implicit margin of safety, as described below, and therefore no explicit margin of safety is required. Since all the Load Allocations are set at the Delta Waterways Loading Capacity, no dilution is assumed—all tributaries and Delta Waterways are assumed to be discharging at concentrations approaching the Loading Capacity. Since all tributaries and Delta Waterways are not expected to be discharging diazinon and chlorpyrifos at concentrations approaching the Loading Capacity, there will be extra dilution in the Delta Waterways to provide a sufficient margin of safety.

The recommended methodology for allocating the Delta Waterways Loading Capacity also assumes no significant reductions in diazinon or chlorpyrifos loading due to removal from the water column by degradation and adsorption to sediment particles and subsequent sediment deposition. Since these processes are likely to take place, this assumption further contributes to the implicit margin of safety in the recommended allocation alternative. Since the Load Allocations and Loading Capacity are all defined using hourly and 4-day concentrations, all seasonal variations and critical conditions are explicitly considered in the recommended method for determining of the Delta Waterways Loading Capacity and Allocations.

### **6.4 Comparison of Proposed Load Allocations to Current Concentrations**

A review of recent diazinon and chlorpyrifos concentrations gives an indication of the additional effort that will be required to consistently meet the proposed Delta Waterways Loading Capacity and Load Allocations for tributaries to Delta Waterways. The tables in Appendix C can be used to compare the current concentrations of diazinon and chlorpyrifos, based on data from recent years, to those that would be allowable under the proposed Delta Waterways Loading Capacity and Load Allocations.

In making these comparisons, it is important to consider both the overall decline in total use of these pesticides in recent years, which makes the concentrations in recent years more representative of current conditions, and the variability of precipitation and flow patterns from year to year, which makes it necessary to consider multiple years to fully characterize current and potential near future conditions.

The recent diazinon and chlorpyrifos concentration data for the Delta Waterways indicate that there are still occasions where the Delta Waterways Loading Capacity and the Allocations for their tributaries are exceeded. The limited number of exceedances indicates that in many cases excess loading capacity is available in the days immediately preceding the exceedance. The magnitude and frequency of the exceedances tend to be greater in smaller streams, sloughs, and drains that are dominated by agricultural and/or urban runoff. Meeting the proposed Load Allocations in the smaller agriculturally dominated tributaries will likely require more effort than in areas where more dilution flows are present. Meeting the proposed allocations in the tributaries dominated by urban runoff is not expected to require much additional effort due to the cancellations of non-agricultural uses of these pesticides, discussed above.

The recent loading data suggest that one or a combination of three general approaches could be used to address those days on which the Loading Capacity is exceeded: (1) reduce diazinon and chlorpyrifos use further, (2) reduce the runoff of diazinon and chlorpyrifos, (3) delay the runoff of diazinon and chlorpyrifos.

As discussed in Section 6.5 of this report there are a number of alternative management practices available to growers that would result in reduction in the amount of diazinon and chlorpyrifos present in the Delta Waterways and their tributaries. An approach focused solely on reduction of diazinon and chlorpyrifos use could be applied incrementally until the Loading Capacity is no longer exceeded. The amount of use reduction necessary would depend on the focus of the effort. If the effort was focused on areas that are likely to result in greater diazinon and/or chlorpyrifos runoff (e.g. based on slope, soil type, crop type, and proximity to waterways), diazinon and chlorpyrifos use could be maximized. Simple adjustments in timing of application (e.g. applying dormant sprays in December when soils are not saturated or avoiding applications before storms) may require little or no reduction in overall use to provide further reductions of diazinon and chlorpyrifos concentrations.

The reduction in the amount of diazinon and chlorpyrifos that runs off fields and orchards would also result in reductions in peak concentrations. As discussed in previous Regional Water Board reports (Reyes and Menconi, 2002; Karkoski et al, 2003), substantial reductions of pesticide runoff can occur when buffer strips or cover crops are used. Another approach, that has not been thoroughly evaluated, is to delay diazinon and/or chlorpyrifos storm or irrigation runoff, so that peaks are attenuated. In many cases, if a portion of the diazinon and/or chlorpyrifos loading could be shifted to at least a day or two after the peak, the Delta Waterways Loading Capacity would not be exceeded. Techniques used in rice farming and to flood irrigate orchards during the irrigation season could possibly be employed to temporarily retain some pesticide-bearing runoff during rainfall events and to allow that runoff to be discharged over a period of days. Irrigation and drainage management practices could also be employed to reduce or eliminate pesticide-bearing tail water runoff in the irrigation season.

## 6.5 Available Practices and Technology

The information in this section is a summary of information described in greater detail by Reyes and Menconi (2002) and Azimi-Gaylon et al. (2002), and is similar to the discussion of available practices and technology for the reduction of concentrations of diazinon and chlorpyrifos in the San Joaquin River (Beaulaurier et al., 2005). Many viable agricultural management practices exist that are likely to be effective in reducing offsite movement of diazinon and chlorpyrifos into surface water. Information is available on trends in pesticide use through the pesticide use reporting system, but information on the extent of implementation of runoff mitigation practices is not currently available. The major types of management practices available for reducing diazinon and chlorpyrifos agricultural discharges are:

- Pest management practices.
- Pesticide application practices.
- Vegetation management practices.
- Water management practices.

As discussed in Beaulaurier et al. (2005) and Reyes and Menconi (2002), viable pest control alternatives to diazinon and chlorpyrifos are available. Regional Water Board staff assessed strategies that should be viable for both pest management and water quality protection (including mitigating potential effects of replacement products) in Section 9.

Changes in application practices could include improved sprayer technologies, more frequent calibration of sprayer equipment, use of aerial drift retardants, improved mixing and loading procedures, and other practices that would result in reduced application rates or mitigation of off-site pesticide movement.

Vegetation management practices could be used to increase infiltration and/or decrease runoff. Examples of these types of practices include planting cover crops, buffer strips or allowing native vegetation to grow where they would reduce runoff rates. In addition to reducing runoff, vegetative cover would also reduce runoff of sediment and excess nutrients, as well as recharge groundwater through increased infiltration<sup>10</sup>.

Water management practices that could include improvements in water infiltration and runoff control include better irrigation efficiency and distribution uniformity, increased use of soil moisture monitoring tools, increased use of tailwater return systems, and vegetated drainage ditches.

The appropriate actions for individual growers to take will vary, depending on the specific crops grown, field conditions and pest pressures. The Regional Water Board will not require implementation of specific practices or technologies, but may review proposed actions based

---

<sup>10</sup> In many areas of the Delta with high groundwater levels, increased infiltration would not have the benefit of increasing groundwater recharge.

upon the likelihood that the growers' collective actions will be protective of water quality in the Delta Waterways.

In summary, growers have available a variety of management practices to control pests and to control diazinon and chlorpyrifos runoff. Some growers have already implemented these practices (e.g. irrigation runoff management; use of alternatives to diazinon and chlorpyrifos). Based on the variety of management practices available to growers, it is technically and economically feasible to meet the proposed diazinon and chlorpyrifos Water Quality Objectives, Loading Capacity and Load Allocations.

## **6.6 Implementation Framework Alternatives**

The framework adopted by the Regional Water Board for addressing diazinon discharges to the Sacramento and Feather Rivers (Karkoski et al., 2003) and diazinon and chlorpyrifos discharges to the San Joaquin River (Beaulaurier et al., 2005) is also recommended for addressing diazinon and chlorpyrifos discharges to the Delta Waterways. The following discussion is, therefore, very similar to the implementation framework discussions included in those Basin Plan Amendment Staff Reports.

Porter-Cologne provides four basic tools for the regulation of discharges of waste (including runoff) into surface waters:

1. Not allowing discharge of waste in certain areas or under certain conditions (i.e. a prohibition under Water Code Section 13243).
2. Issuing Waste Discharge Requirements or WDRs (Water Code Section 13263).
3. Conditionally waiving WDRs (Water Code Section 13269).
4. Issuing cleanup and abatement orders (Water Code Section 13304).

Cleanup and abatement orders are generally applied to localized pollution problems and not to watershed-wide issues addressed in the Basin Plan, so they are not reviewed any further.

Any alternative that is selected to implement this Basin Plan Amendment must clearly address the attainment of the Water Quality Objectives, and must be protective of the aquatic life beneficial use. Alternatives considered included (1) no specific implementation framework or mechanism defined, (2) specific definition of the implementation framework or mechanism (e.g. waivers of waste discharge requirements; waste discharge requirements; or a prohibition of discharge), and (3) a flexible implementation framework with a clear backstop.

The primary factors considered in evaluating the alternatives include (1) flexibility, (2) certainty in meeting Water Quality Objectives, and (3) consistency with State and Federal laws and policies.

### **6.6.1 Alternative 1. No Specific Implementation Framework or Mechanism**

The Regional Water Board could establish the program of implementation without defining the specific implementation framework or mechanism. As applicable waivers of waste discharge



requirements or waste discharge requirements are renewed, it would be assumed that the provisions in this Basin Plan Amendment would be incorporated.

This alternative would provide flexibility, since no particular implementation mechanism would be defined. There would be less certainty that Water Quality Objectives would be met, since there would be no description as to how the Regional Water Board planned to implement the provisions of this Basin Plan Amendment. This alternative would not be consistent with the Bay Protection and Toxic Hot Spot Cleanup Program Plan (Bay Protection Plan) (CRWQCB-CVR, 2003) or the Policy for Implementation and Enforcement of The Nonpoint Source Pollution Control Program (Nonpoint Source Policy) (SWRCB, 2004). The Bay Protection Plan (CRWQCB-CVR, 2003) states that the implementation framework would be defined for this Amendment. The Nonpoint Source Policy states that the Regional Water Board will address nonpoint source discharges through waivers of waste discharge requirements, waste discharge requirements, or prohibitions.

### **6.6.2 Alternative 2. Specific Definition of the Implementation Framework or Mechanism**

The Basin Plan Amendment could define a specific implementation framework or mechanism. For point sources of diazinon and chlorpyrifos, the implementation mechanism is defined by federal law. Those sources are regulated through the NPDES permit program<sup>11</sup>. For nonpoint source discharge of pesticides, a variety of approaches could be identified through the use of waivers of waste discharge requirements, waste discharge requirements or prohibitions of discharge (see Karkoski, et al., 2003 for a detailed description of these options).

This alternative would limit the flexibility of the Regional Water Board, since it would identify a specific regulatory mechanism for nonpoint source pesticide discharges. The degree of certainty in attaining Water Quality Objectives would depend on which mechanism was chosen. If the WDRs or waivers of WDRs depend to some extent on the actions of a third party not directly regulated by the Regional Water Board (e.g. another agency or association of dischargers), there would be less certainty that objectives would be met. Identifying a specific implementation framework would be consistent with both the Bay Protection and Toxic Hot Spot Cleanup Program Plan and the Nonpoint Source Policy.

### **6.6.3 Alternative 3. Flexible Implementation Framework with a Clear Backstop**

Under this alternative, either waivers of WDRs or WDRs could be effectively used to control nonpoint source discharges of diazinon and chlorpyrifos to the Delta Waterways. However, if neither is being used to control these discharges from nonpoint sources, then a prohibition would automatically be in effect to ensure that objectives and allocations are met within the required time frame. The prohibition would not need to apply to those areas that are attaining the applicable objectives and allocations. The prohibition also would not apply to point source discharges regulated under WDRs and NPDES permits.

---

<sup>11</sup> The permits issued for point sources in California are both NPDES permits and Waste Discharge Requirements.

This alternative would provide the highest degree of flexibility to the Regional Water Board. The Regional Water Board could use waivers of WDRs or individual or general WDRs for different categories of nonpoint source dischargers. There would be a high degree of certainty of attaining the Water Quality Objectives, since a prohibition would apply if the necessary waiver or WDR was not in place and objectives and allocation were not being attained. Identification of an implementation framework that includes WDRs, waivers of WDRs, and a prohibition of discharges would be consistent with both the Bay Protection Program Cleanup Plan and the Nonpoint Source Policy.

#### **6.6.4 Recommended Alternative**

Alternative 3 is recommended. At this time, it provides the greatest flexibility, the highest degree of certainty of attaining objectives and allocations, and is consistent with applicable laws and policies. The most effective regulatory alternative for management of diazinon and chlorpyrifos runoff cannot be determined until the Regional Water Board establishes its overall regulatory approach for agricultural discharges. Either WDRs or a conditional waiver of WDRs could be used to control diazinon and chlorpyrifos discharges. Any future implementation program that is developed to control agricultural discharges should provide the flexibility to take advantage of DPR, EPA or County Agricultural Commissioner regulatory activities, and any efficiencies offered by coalition groups in representing the dischargers. If neither of these regulatory tools is constructed to implement this Basin Plan Amendment, then a default (i.e. prohibition of discharge) is needed to ensure that Water Quality Objectives and Load Allocations are met in the required timeframe.

There are two recommended types of conditional prohibitions recommended for the two seasons of use.

##### **6.6.4.1 Dormant Season Conditional Prohibition of Discharge**

The recommended alternative is a conditional prohibition of discharge (Porter-Cologne Section 13243). The prohibition will take effect beginning December 1, 2010 if, during the previous year between 1 December and 1 March, the Water Quality Objectives and/or the Loading Capacity are not being met, and these discharges are not being controlled through waste discharge requirements, or a waiver of waste discharge requirements. The previous year provision is necessary to ensure that unregulated discharges are not impairing water quality.

##### **6.6.4.2 Irrigation Season Conditional Prohibition of Discharge**

The recommended alternative for the irrigation season is a conditional prohibition of discharge (Porter Cologne Section 13243). The prohibition will take effect beginning March 2, 2011 if, during the previous year between 2 March and 30 November, the Water Quality Objectives and/or the Loading Capacity are not being met, and these discharges are not being controlled through waste discharge requirements, or a waiver of waste discharge requirements. The previous year provision is necessary to ensure that unregulated discharges are not impairing water quality in the Delta Waterways.

## **6.7 Other Implementation Provisions**

### **6.7.1 Submission of Management Plans**

The Nonpoint Source Policy requires nonpoint source dischargers to describe the management practices that will be implemented to attain Water Quality Objectives. The Regional Water Board will require the submission of a management plan by a coalition of dischargers or by individual dischargers. By identifying the actions that the discharger will take to reduce diazinon and chlorpyrifos discharges, the Regional Water Board and the dischargers will be able to determine which practices are most effective at reducing pesticide runoff. The Regional Water Board will also be able to determine whether adequate effort is being made to reduce diazinon and chlorpyrifos discharges to the Delta Waterways.

### **6.7.2 Time Schedule for Actions to be Taken**

Porter-Cologne requires the Regional Water Board to include a time schedule for actions to be taken as part of the program of implementation. Timelines are identified for Regional Water Board issuance or revision of WDRs or waivers of WDRs to address diazinon and chlorpyrifos runoff. A timeline for the expected establishment of diazinon Water Quality Objectives is identified, as well as the frequency for review of the implementation program.

### **6.7.3 Time Schedule for Compliance**

This section will discuss the alternative time schedules for compliance with Water Quality Objectives and the TMDL. The primary considerations were feasibility of complying in the specified time frame, minimizing the time period in which potential beneficial use impacts could occur, and cost. Note that much of the discussion from the Sacramento and Feather River diazinon Staff Report (Karkoski, et al., 2003) and the San Joaquin River diazinon and chlorpyrifos Staff Report (Beaulaurier et al., 2005) is also applicable to this Amendment. Short term (by 2008-2010), medium term (by 2011-2013), and long term (by 2013- 2016) time frames for compliance were evaluated. It is assumed that establishing requirements in less than two years would not be feasible, since State Board, USEPA and Office of Administrative Law approval of the Water Quality Objectives and the Basin Plan Amendment may take 18 months or more after Regional Water Board action. The time schedule will focus on compliance with the Loading Capacity. Areas where the Load Allocations are not being met will be targeted for additional management efforts if the Loading Capacity is exceeded after the compliance date. As discussed previously, a number of practices could be implemented in a short time-frame (i.e. within the next two years) to produce the required changes. Since the agricultural management practices generally do not require large capital investments, a long time-frame should not be needed.

Factors that may make compliance more difficult and require more time to achieve compliance include, (1) increased diazinon or chlorpyrifos use, (2) unfavorable weather conditions, and (3) difficulty in reducing peak concentrations. Diazinon and chlorpyrifos use may increase if pests develop resistance to alternatives being used. Diazinon and chlorpyrifos use may also increase if commodity prices increase and growers are more willing to increase production

costs to ensure yields are maximized. If heavy rainfall were to occur soon after applications were made, receiving water concentrations may increase, even if total yearly use does not. Careful management of the timing of pesticide application (i.e. so that applications are not made immediately prior to storm or irrigation events) may be required to make significant reductions in peak concentrations.

#### **6.7.3.1 Short-Term (2008-2010) Time Schedule for Compliance**

Compliance with the proposed objectives and Loading Capacity is feasible in the short term. As discussed previously, a number of agricultural management practices could be implemented in a short time frame (i.e. within the next two years) to produce the required changes. Since the management practices generally do not require large capital investments, a long time-frame should not be needed. In most of the Delta Waterways, only small reductions in diazinon and chlorpyrifos runoff are required. In some of the smaller Delta Waterways, such as the back sloughs and small upland drainages, greater reductions will be required. A short-term compliance schedule would likely provide the greatest benefit to the environment, since exposure of aquatic life to diazinon and chlorpyrifos would be quickly reduced. A short-term time schedule may not give the majority of growers sufficient time to implement improved agricultural management practices if weather conditions or pest pressure conditions prove unfavorable to reducing diazinon and chlorpyrifos runoff. In addition, compliance with allocations in the short-term would be difficult without making significant changes in pesticide use and management practices. Growers who continue to use diazinon and chlorpyrifos may require several seasons to fully implement practices that will reduce chlorpyrifos and diazinon runoff, such as establishing buffer strips, implementing improved application techniques or implementing improved irrigation practices.

A short-term compliance schedule should be readily attained by NPDES dischargers. It is expected that the vast majority of the diazinon and chlorpyrifos stock held by non-agricultural users will have been applied within a short-term timeframe.. This should result in very few detections of diazinon or chlorpyrifos in NPDES effluent that originates within the jurisdiction of NPDES permittees.

#### **6.7.3.2 Medium-Term (2011-2013) Time Schedule for Compliance**

Compliance with the proposed objectives and Loading Capacity is feasible to obtain in the medium term (see Short-Term discussion). A medium-term time schedule would accommodate any additional time that might be needed to respond to changing pest pressures or economic conditions. The Load Allocations would be more difficult to achieve in all tributaries than the Loading Capacity. Growers would likely be able to implement an effective system to reduce pesticide runoff by 2009/ 2010. Establishing buffer strips, improved application techniques, or improved water management could be feasibly accomplished in three to four years. If growers had an effective overall system of management practices for minimizing pesticide runoff, then any necessary changes in use of pest control products would not be as likely to result in significant discharge of pesticides to surface water. A medium-term compliance schedule should be readily attained by NPDES dischargers for the same reasons described above for a short-term compliance schedule.

A medium term compliance schedule would potentially result in aquatic life being exposed to elevated diazinon and chlorpyrifos levels for a longer period of time. If growers implement

practices to reduce overall pesticide runoff, the exposure of aquatic life to all potentially toxic pesticides would be reduced.

### **6.7.3.3 Long-Term (2014-2016) Time Schedule for Compliance**

Compliance with the proposed objectives is feasible to obtain in the long term (see Short Term discussion). A long-term compliance time schedule would have similar benefits to a medium term time schedule. A long-term time schedule for tributaries requiring significant reductions in peak concentrations would make compliance within the time schedule more likely. A longer compliance schedule would provide growers with greater flexibility to adopt those management practices that are most cost effective at minimizing pesticide runoff. There are not likely to be any NPDES permitted sources of diazinon or chlorpyrifos, since the sale of non-agricultural diazinon products would have been banned for over ten years and most non-agricultural chlorpyrifos products would have been banned for thirteen years.

### **6.7.3.4 Recommendation for Time Schedule for Compliance**

A five-year time schedule, requiring compliance with the proposed diazinon and chlorpyrifos Water Quality Objectives, Allocations, and Loading Capacity by 2012 is recommended. A period of five years from Regional Water Board adoption of the Basin Plan Amendment should provide sufficient time to attain the objectives and allocations, and should be sufficient to get a comprehensive system for control of pesticide runoff into place. Although attainment of the objectives is likely feasible in the short term, focusing exclusively on diazinon and chlorpyrifos could result in use of alternative pesticides that may also impact surface water. A five-year compliance time schedule provides sufficient time to implement a more comprehensive program focused on an overall reduction of pesticide runoff through implementation of appropriate agricultural management practices. Since point sources will likely not be significant dischargers of diazinon and chlorpyrifos to the Delta Waterways within a medium-term schedule for compliance, compliance monitoring should be more straightforward under a five-year time schedule. A compliance time schedule greater than five years is not recommended, since there is no clear environmental or economic benefit to extending compliance beyond five years. A five-year compliance schedule should also result in diazinon and chlorpyrifos levels from NPDES discharges being reduced to negligible levels due to the ban on sale of non-agricultural diazinon and chlorpyrifos products.

A five-year compliance schedule is consistent with the time frame for the Sacramento and Feather River diazinon Basin Plan amendment and the San Joaquin River diazinon and chlorpyrifos Basin Plan amendment.

Compliance with numeric Water Quality Objectives and Loading Capacity will be required no later than December 1, 2011 during the dormant season (December through February of the following year) and no later than March 2, 2012, for the irrigation season (March through November).

## 7 POLICIES

Both the State Board and the Central Valley Regional Water Board have a number of existing policies and Management Agency Agreements (MAA's) that are potentially applicable to the control of diazinon and chlorpyrifos in the Delta Waterways. The Basin Plan Amendment should be consistent with those policies. In addition, the Basin Plan Amendment will need to include new policies specific to the control of diazinon and chlorpyrifos in the Delta Waterways. The new policies will either address the mitigation of a potential impact or will specify how the program of implementation will be carried out. This section summarizes existing State and Regional Water Board policies and MAAs that are relevant to the changes proposed in this Basin Plan amendment, and describes the needed policies specific to the control of diazinon and chlorpyrifos discharges to the Delta Waterways. In the sections below, the language from the State and Regional Water Board policies or MAA's are shown in italics within quotes.

### 7.1 Existing Policies

#### 7.1.1 CRWQCB-CVR's Water Quality Limited Segments Policy

*“Additional treatment beyond minimum federal requirements will be imposed on dischargers to Water Quality Limited Segments. Dischargers will be assigned or allocated a maximum allowable load of pollutant so that Water Quality Objectives can be met in the segment.”*

The proposed Basin Plan amendment establishes a TMDL for the Delta Waterways, which are included in the CWA section 303(d) list of Water Quality Limited Segments, and allocates the allowable loads to nonpoint source dischargers and to NPDES dischargers. Therefore, the proposed Basin Plan amendment is consistent with the implementation of this policy.

#### 7.1.2 CRWQCB-CVR's Controllable Factors Policy

*“Controllable water quality factors are not allowed to cause further degradation of water quality in instances where other factors have already resulted in Water Quality Objectives being exceeded. Controllable water quality factors are those actions, conditions, or circumstances resulting from human activities that may influence the quality of waters of the State, that are subject to the authority of the State Water Board or Regional Water Board, and that may be reasonably controlled.”*

The evaluation of management practices in Section 6 shows that a variety of methods to control the runoff of diazinon and chlorpyrifos are available. Implementation of these control measures is expected to result in attainment of the proposed Water Quality Objectives within a reasonable period of time. There are no other factors that would cause these Water Quality Objectives to be exceeded.

### 7.1.2.1 SWRCB and CRWQCB-CVR's Anti-degradation Policies

The SWRCB's Statement of Policy with Respect to Maintaining High Quality of Water in California (Anti-degradation Policy) (State Water Board Resolution No. 68-16)<sup>12</sup> includes the following statements:

*"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 increase 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."*

In addition, the CRWQCB-CVR's Anti-degradation Implementation Policy states:

*"...Implementation of this policy [State Water Board Resolution No. 68-16] to prevent or minimize surface and ground water degradation is a high priority for the Board.... The prevention of degradation is, therefore, an important strategy to meet the policy's objectives.*

*"The Regional Water Board will apply 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 discharge, existing discharge, or material change therein, 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."*

No degradation of ground or surface water is expected as a result of this Basin Plan Amendment. The establishment of Water Quality Objectives and a program of implementation for diazinon and chlorpyrifos will result in an improvement in water quality in the Delta Waterways, as well as their tributaries within the Delta watershed, as diazinon and chlorpyrifos loadings are reduced to meet Water Quality Objectives. The proposed Basin Plan Amendment is not allowing degradation in the existing quality of Delta Waterways or their tributaries.

The Anti-degradation policies discussed above also apply to potential degradation of ground water, and potential degradation of the ground or surface water due to the use and introduction of new chemicals. As discussed in Section 9.1, there are a number of alternative

---

<sup>12</sup> Resolution No. 68-16 incorporates the federal anti-degradation standards for surface waters. (see 40 CFR § 131.12)

practices available to growers that could lead to further reduction of diazinon and chlorpyrifos levels in the Delta Waterways. Some of these alternatives could result in increased infiltration of water, changes in timing of application of diazinon and/or chlorpyrifos, or the increased use of other chemicals that could degrade ground or surface water.

The proposed Basin Plan Amendment, therefore, includes new policies requiring that dischargers using an alternative to diazinon or chlorpyrifos prevent groundwater contamination and ensure compliance with existing Regional Water Board Water Quality Objectives and policies. In addition, any monitoring and reporting program will require the discharger to demonstrate that the lowest pesticide levels in surface water that are technically and economically achievable are being attained. Also, practices that result in increased infiltration of surface runoff are not expected to degrade ground water due to the relatively short half-life of diazinon and chlorpyrifos in soil (see Section 2). The proposed Basin Plan Amendment is, therefore, consistent with the SWRCB and Regional Water Board's Anti-degradation Policy and Regional Water Board's Anti-degradation Implementation Policy.

### **7.1.3 CRWQCB-CVR's Watershed Policy**

*"The Regional Water Board supports implementing a watershed based approach to addressing water quality problems. The benefits to implementing a watershed based approach would include gaining participation of stakeholders and focusing efforts on the most important problems and those sources contributing most significantly to those problems."*

The Regional Water Board conducted outreach to the stakeholders in the area covered by this Amendment, as discussed in the Executive Summary and in Section 11.. These outreach activities were conducted to gain participation stakeholders as part of implementation of the watershed policy. This Report also focused on identifying and addressing the uses of diazinon and chlorpyrifos that are likely contributing most significantly to their presence in the Delta Waterways. For these reasons, the proposed Amendment is consistent with the watershed policy.

### **7.1.4 CRWQCB-CVR's Policy for Application of Water Quality Objectives**

Excerpts from this policy are presented below. The full text can be found on page IV-16.00 of the Basin Plan.

*"Water quality objectives are defined as 'the limits or levels of water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water, or the prevention of nuisance within a specific area.' Water quality objectives may be stated in either numerical or narrative form. Water quality objectives apply to all waters within a surface or ground water resource for which beneficial uses have been designated. The numerical and narrative Water Quality Objectives define the least stringent standards that the Regional Water Boards will apply to regional waters in order to protect beneficial uses. Where compliance with narrative objectives is required, the Regional Water Board will, on a case-by-case basis, adopt numerical limitations in orders which will implement the narrative objectives."*



Where multiple toxic pollutants exist together in water, the potential for toxicological interactions exists. On a case-by-case basis, the Regional Water Board will evaluate data to determine whether there is a reasonable potential for interactive toxicity. Pollutants which are carcinogenic or which manifest their toxic effects on the same organ systems or through similar mechanisms will generally be considered to have potentially additive toxicity. The following formula will be used to assist the Regional Water Board in making determinations:

$$\sum_{i=1}^n \frac{[\text{Concentration of Toxic Substance}]_i}{[\text{Toxicologic Limit for Substance in Water}]_i} < 1.0$$

*The concentration of each toxic substance is divided by its toxicologic limit. The resulting ratios are added for substances having similar toxicologic effects. If such a sum of ratios is less than one, an additive toxicity problem is assumed not to exist. If the summation is equal to or greater than one, the combination of chemicals is assumed to present an unacceptable level of toxicologic risk.”*

This Amendment proposes establishment of acute and chronic numeric objectives for diazinon and chlorpyrifos in the Delta Waterways. Since diazinon and chlorpyrifos have the same toxicological effect, this amendment also requires compliance based upon the additive toxicity of these two pesticides when present together. The loading capacity and allocations for diazinon and chlorpyrifos explicitly account for the additive effects of these pesticides.

### **7.1.5 Pesticide Discharges from Nonpoint Sources**

The Regional Board’s policy on Pesticide Discharges from Nonpoint Sources (Pesticide Policy) was adopted to implement the water quality objectives for Pesticides. The Pesticide Policy includes a number of provisions that should be evaluated with respect to this Basin Plan Amendment.

1. *“The control of pesticide discharges to surface waters from nonpoint sources will be achieved primarily by the development and implementation of management practices that minimize or eliminate the amount discharged.”*

The evaluation of available practices for the control of diazinon and chlorpyrifos (Section 6.5) includes both management practices that should minimize the off-site movement of diazinon and chlorpyrifos, as well as practices (i.e. use of other pest control methods) that would eliminate the amount discharged. The proposed Basin Plan Amendment requires dischargers to submit a management plan to describe the actions they will take to meet the applicable allocations. The Basin Plan Amendment has, therefore, been prepared in a manner consistent with this provision of the Pesticide Policy.

2. *“The Board will use water quality monitoring results to evaluate the effectiveness of control efforts and to help prioritize control efforts.”*

The proposed Basin Plan Amendment includes provisions that address the evaluation of water quality monitoring results to evaluate the effectiveness of control efforts (see Sections 3 and

8). Prioritization of which control efforts to pursue will be conducted primarily by growers or their representatives and will be identified in the management plan submitted. The Basin Plan Amendment has, therefore, been prepared in a manner consistent with this provision of the Pesticide Policy.

3. *“Regional Board monitoring will consist primarily of chemical analysis and biotoxicity testing of major water bodies receiving irrigation return flows. The focus will be on pesticides with use patterns and chemical characteristics that indicate a high probability of entering surface waters at levels that may impact beneficial uses. Board staff will advise other agencies that conduct water quality and aquatic biota monitoring of high priority chemicals, and will review monitoring data developed by these agencies. Review of the impacts of “inert” ingredients contained in pesticide formulations will be integrated into the Board’s pesticide monitoring program.*

*When a pesticide is detected more than once in surface waters, investigations will be conducted to identify sources. Priority for investigation will be determined through consideration of the following factors: toxicity of the compound, use patterns and the number of detections. These investigations may be limited to specific watersheds where the pesticide is heavily used or local practices result in unusually high discharges. Special studies will also be conducted to determine pesticide content of sediment and aquatic life when conditions warrant. Other agencies will be consulted regarding prioritization of monitoring projects, protocol, and interpretation of results.”*

These provisions focus on the general approach the Regional Board will use in determining whether a water quality problem related to pesticides exist. This procedure was generally followed in the investigation of water quality problems related to diazinon and chlorpyrifos. The Regional Board will need to continue following this procedure to determine if shifts in pesticides use patterns or use of alternatives to diazinon or chlorpyrifos require investigation or special studies. The proposed Basin Plan Amendment includes provisions that address continued sampling and evaluation of pesticides in the major waterbodies (see Sections 3 and 8). The Basin Plan Amendment has, therefore, been prepared in a manner consistent with this provision of the Pesticide Policy.

4. *“To ensure that new pesticides do not create a threat to water quality, the Board, either directly or through the State Water Resources Control Board, will review the pesticides that are processed through the Department of Food and Agriculture’s (DFA) registration program. Where use of the pesticide may result in a discharge to surface waters, the Board staff will make efforts to ensure that label instructions or use restrictions require management practices that will result in compliance with water quality objectives. When the Board determines that despite any actions taken by DFA, use of the pesticide may result in discharge to surface waters in violation of the objectives, the Board will take regulatory action, such as adoption of a prohibition of discharge or issuance of waste discharge requirements to control discharges of the pesticide. Monitoring may be required to verify that management practices are effective in protecting water quality.”*

This provision of the Pesticide Policy describes a procedure to be applied during the registration process for new pesticides, and is, therefore, not directly related to the control of diazinon or chlorpyrifos runoff and does not apply to this Basin Plan Amendment.

5. *“The Board will notify pesticide dischargers through public notices, educational programs and the Department of Food and Agriculture's pesticide regulatory program of the water quality objectives related to pesticide discharges. Dischargers will be advised to implement management practices that result in full compliance with these objectives by 1 January 1993, unless required to do so earlier. (Dischargers of carbofuran, malathion, methyl parathion, molinate and thiobencarb must meet the requirements detailed in the Prohibitions section.) During this time period, dischargers will remain legally responsible for the impacts caused by their discharges.”*

This provision of the Pesticide Policy refers to the pesticide water quality objectives adopted at the time of the policy. The provision, therefore, does not apply to the establishment of site-specific water quality objectives for diazinon contained in this Basin Plan Amendment.

6. *“The Board will conduct reviews of the management practices being followed to verify that they produce discharges that comply with water quality objectives. It is anticipated that practices associated with one or two pesticides can be reviewed each year. Since criteria, control methods and other factors are subject to change, it is also anticipated that allowable management practices will change over time, and control practices for individual pesticides will have to be reevaluated periodically.”*

The proposed Basin Plan Amendment (see Section 3) describes a role for the Central Valley Water Board in reviewing management practices and provides for periodic review of those practices. Dischargers of diazinon and chlorpyrifos will be responsible for providing that information to the Central Valley Water Board. The Basin Plan Amendment has, therefore, been prepared in a manner consistent with this provision of the Pesticide Policy.

7. *“Public hearings will be held at least once every two years to review the progress of the pesticide control program. At these hearings, the Board will*

- review monitoring results and identify pesticides of greatest concern,*
- review changes or trends in pesticide use that may impact water quality,*
- consider approval of proposed management practices for the control of pesticide discharges,*
- set the schedule for reviewing management practices for specific pesticides, and*
- consider enforcement action.*

*“After reviewing the testimony, the Board will place the pesticides into one of the following three classifications. When compliance with water quality objectives and performance goals is not obtained within the timeframes allowed, the Board will consider alternate control options, such as prohibition of discharge or issuance of waste discharge requirements.*

*“1. Where the Board finds that pesticide discharges pose a significant threat to drinking water supplies or other beneficial uses, it will request DFA to act to prevent further impacts. If DFA does not proceed with such action(s) within six months of the Board's request, the Board will act within a reasonable time period to place restrictions on the discharges.*

*“2. Where the Board finds that currently used discharge management practices are resulting in violations of water quality objectives, but the impacts of the discharge are not so severe as to*

*require immediate changes, dischargers will be given three years, with a possibility of three one year time extensions depending on the circumstances involved, to develop and implement practices that will meet the objectives. During this period of time, dischargers may be required to take interim steps, such as meeting Board established performance goals to reduce impacts of the discharges. Monitoring will be required to show that the interim steps and proposed management practices are effective.*

*“3. The Board may approve the management practices as adequate to meet water quality objectives. After the Board has approved specific management practices for the use and discharge of a pesticide, no other management practice may be used until it has been reviewed by the Board and found to be equivalent to or better than previously approved practices. Waste discharge requirements will be waived for irrigation return water per Resolution No. 82-036 if the Board determines that the management practices are adequate to meet water quality objectives and meet the conditions of the waiver policy. Enforcement action may be taken against those who do not follow management practices approved by the Board.”*

The Regional Board, through the Clean Water Act Section 303(d) listing process, has reviewed available monitoring results for pesticides and has identified diazinon and chlorpyrifos as two of the pesticides of greatest concern, which is consistent with this provision of the Pesticide Policy.

In preparing this Basin Plan Amendment, the Regional Board has reviewed changes and trends in use of diazinon and chlorpyrifos and potential replacement products, which is consistent with this provision of the Pesticide Policy.

As part of the review procedure identified in this Basin Plan Amendment (see Section 3), the Regional Board will consider enforcement action, which is consistent with this provision of the Pesticide Policy.

By adopting this Basin Plan Amendment, the Regional Board is effectively considering diazinon and chlorpyrifos to fall within classification two identified by this provision of the Pesticide Policy. A conditional prohibition of discharge of diazinon and chlorpyrifos are proposed unless such discharges are regulated either by a waiver of waste discharge requirements or waste discharge requirements or the diazinon and chlorpyrifos water quality objectives and loading capacity are met. This Basin Plan Amendment requires monitoring to demonstrate that interim steps and proposed management practices are effective. The Basin Plan Amendment is, therefore, consistent with this provision of the Pesticide Policy.

8. *“To ensure the best possible program, the Board will coordinate its pesticide control efforts with other agencies and organizations. Wherever possible, the burdens on pesticide dischargers will be reduced by working through the DFA or other appropriate regulatory processes. The Board may also designate another agency or organization as the responsible party for the development and/or implementation of management practices, but it will retain overall review and control authority. The Board will work with water agencies and others whose activities may influence pesticide levels to minimize concentrations in surface waters.”*

The Regional Board has worked with the Department of Pesticide Regulation (DPR)<sup>13</sup> to identify possible ways of reducing the burden on pesticide dischargers. Management practices for controlling diazinon have been added to the diazinon use label requirements (MANA, 2004d), which are implemented by the County Agricultural Commissioners under DPR's supervision. Management practices for controlling diazinon and chlorpyrifos are also expected to be incorporated into upcoming revisions to the chlorpyrifos use labels requirements (DPR 2004), as well as DPR's pending dormant spray regulations (DPR 2005b). The proposed amendment contains provisions for continuing to work with DPR and the County Agricultural Commissioners to assess the success of the management practices being implemented. The program of implementation established by this Basin Plan Amendment also still retains the Regional Board's role in reviewing management practices and monitoring data, as well as determining what further control actions might be required. The Basin Plan Amendment has, therefore, been prepared in a manner consistent with this provision of the Pesticide Policy.

9. *"Since the discharge of pesticides into surface waters will be allowed under certain conditions, the Board will take steps to ensure that this control program is conducted in compliance with the federal and state antidegradation policies. This will primarily be done as pesticide discharges are evaluated on a case by case basis."*

Anti-degradation policies have been explicitly considered in a number of sections of this staff report. The Basin Plan Amendment has, therefore, been prepared in a manner consistent with this provision of the Pesticide Policy.

#### **7.1.6 SWRCB's Water Quality Control Policy for Addressing Impaired Waters**

The SWRCB adopted to the Water Quality Control Policy for Addressing Impaired Waters (SWRCB, 2005) to describe the requirements for how the State and Regional Boards must correct impairments to the waters of the State.

*"A. If the water body is neither impaired nor threatened, the appropriate regulatory response is to delist the water body."*

As discussed in the Background section of this staff report, diazinon and chlorpyrifos are still found at levels exceeding water quality standards in the Delta Waterways, therefore this impairment still needs to be corrected through a Regional Board action.

*"B. If the failure to attain standards is due to the fact that the applicable standards are not appropriate to natural conditions, an appropriate regulatory response is to correct the standards."*

As discussed in the section of this report Beneficial Uses (section 4) the beneficial uses that are most sensitive to diazinon and chlorpyrifos warm and cold freshwater habitat, have been reviewed and are appropriate for the delta waterways

---

<sup>13</sup> DPR was part of the California Department of Food and Agriculture at the time the Pesticide Policy was adopted.

*“C. The State Board and Regional Boards are responsible for the quality of all waters of the state, irrespective of the cause of the impairment. In addition, a TMDL must be calculated for impairments caused by certain EPA designated pollutants.”*

Pesticides fit under the definition of pollutants, and diazinon and chlorpyrifos are technically suitable for TMDL calculation in the Delta Waterways. Therefore a TMDL must be calculated. The proposed amendment contains all of the necessary elements of a TMDL; the Loading Capacity, allocations, and consideration of seasonal variations and a margin of safety.

*“D. Whether or not a TMDL calculation is required as described above, impaired waters will be corrected (and implementation plans crafted) using existing regulatory tools”*

The proposed Amendment uses existing regulatory tools, including prohibitions of discharge, waste discharge requirements and, possibly, waivers of waste discharge requirements, to correct the diazinon and chlorpyrifos impairment in the Delta Waterways.

*“D1. If the solution to an impairment will require multiple actions of the regional board that affect multiple persons, the solution must be implemented through a basin plan amendment or other regulation.”*

Correcting the diazinon and chlorpyrifos impairment in the Delta will likely require multiple actions of the Regional Board to gain compliance from all of the dischargers to the Delta Waterways, therefore a Basin Plan amendment or other regulation is necessary in this case.

*“D2. If the solution to an impairment can be implemented with a single vote of the Regional Board, it may be implemented by that vote.”*

As discussed under D1, the solution to this impairment will likely require multiple votes of the Regional Board, therefore a regulation, such as a Basin Plan Amendment, is required.

*“D3. If a solution to an impairment is being implemented by a regulatory action of another state, regional, local, or federal agency, and the Regional Board finds that the solution will actually correct the impairment, the Regional Board may certify that the regulatory action will correct the impairment and if applicable, implement the assumptions of the TMDL, in lieu of adopting a redundant program.”*

Recent and anticipated changes in pesticide use requirements by regulatory agencies such as DPR and USEPA are expected to reduce diazinon and chlorpyrifos discharges. However, some of those changes have not yet been implemented, so there is no guarantee that these actions will result in attainment of water quality objectives. Therefore the adoption of a Basin Plan Amendment is appropriate. In addition, this provision of the Policy provides an option for the Regional Water Boards and not a requirement to certify a regulatory action by another agency.

*“D 4. If a solution to an impairment is being implemented by a non-regulatory action of another entity, and the regional board finds that the solution will actually correct the impairment, the regional board may certify that the non-regulatory action will correct the impairment and if applicable, implement the assumptions of the TMDL, in lieu of adopting a redundant program.”*

A solution to the impairment is not being implemented through a non-regulatory action by another entity, so this provision could not be applied.

## *“II. Process for adopting TMDLs”*

For the reasons stated above, a Basin Plan Amendment is the appropriate means for the adoption of a TMDL for diazinon and chlorpyrifos in the Delta Waterways. The adoption of this TMDL will follow the process outlined in this policy.

The proposed Basin Plan Amendment contains all the necessary elements of a TMDL, and an implementation plan that uses existing regulatory tools, prohibitions, waivers and WDRs to correct the impairment caused by diazinon and chlorpyrifos in the Delta Waterways. This Basin Plan Amendment has, therefore, been prepared in a manner consistent with this provision of the SWRCB’s Water Quality Control Policy for Addressing Impaired Waters.

### **7.1.7 SWRCB’s Policy for Implementation and Enforcement of the Nonpoint Source Pollution Program**

The Nonpoint Source Pollution Program Policy (Policy) (SWRCB, 2004) clarifies the applicability of Porter-Cologne to nonpoint sources. The Policy also describes the key elements that must be included in a nonpoint source implementation program.

The Policy makes it clear that all nonpoint source (NPS) discharges must be regulated under waste discharge requirements, waivers of waste discharge requirements, a Basin Plan prohibition, or some combination of those administrative tools. An implementation program developed by the Regional Water Board, State Board, discharger, or third party must include the following key elements:

*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 anti-degradation requirements.*

*KEY ELEMENT 2: An NPS control implementation program shall 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(s), 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.*

*KEY ELEMENT 3: Where a 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.*

*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 management practices or other actions are required.*

*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.*

The proposed Amendment is consistent with the NPS Program Policy. A prohibition of discharge applies if the discharge is not addressed by a WDR or waiver of WDRs and objectives are not attained. The proposed Amendment includes requirements to: meet Water Quality Objectives (Key Element 1); submit management plans and evaluate management practices (Key Element 2); comply with objectives and allocations within a specified time frame (Key Element 3); and conduct monitoring on the success of management practices (Key Element 4). The conditional prohibition of discharge provides a clear consequence for failure to attain objectives and obtain a waiver of WDRs or WDR (Key Element 5).

### **7.1.8 SWRCB's Water Quality Control Policy for the Enclosed Bays and Estuaries of California (SWRCB, 1974)**

This policy was adopted by the State Board in 1974 and provides water quality principles and guidelines for the prevention of water quality degradation in enclosed bays and estuaries to protect the beneficial uses of such waters. The Regional Water Board must enforce the policy and take actions consistent with its provisions. Sections of the policy relevant to this Basin Plan Amendment are discussed below.

*"This policy does not apply to wastes from vessels or land runoff except as specifically indicated for siltation (Chapter III 4.) and combined sewer flows (Chapter III 7)."*

Many of the sources of diazinon and chlorpyrifos to the Delta Waterways are from direct runoff. This policy is not relevant to those sources that discharge to Delta Waterways via land runoff, unless the runoff is associated with siltation/sedimentation, as discussed below.

*" There is a considerable body of scientific evidence and opinion which suggests the existence of biological degradation due to long-term exposure to toxicants which have been discharged to the San Francisco Bay-Delta system. Therefore, implementation of a program which controls toxic effects through a combination of source control for toxic materials, upgraded wastewater treatment, and improved dilution of wastewaters, shall proceed as rapidly as is practicable with the objective of providing full protection to the biota and the beneficial uses of Bay-Delta waters in a cost-effective manner."*

*"Nonpoint sources of pollution shall be controlled to the maximum practicable extent"*

The proposed Basin Plan Amendment would require source controls for toxic materials (diazinon and chlorpyrifos) that currently discharge to the Delta Waterways, and provide requirements for controlling nonpoint source pollution. Thus, the proposed Basin Plan Amendment would be consistent with implementing this policy.



### **7.1.9 SWRCB Bay Protection Toxic Hot Spots Cleanup Program**

In 1989 the California Legislature established the Bay Protection and Toxic Cleanup Program (Bay Protection Program). The State and Regional Water Boards have adopted cleanup plans for diazinon and chlorpyrifos in the Delta (CRWQCB-CVR, 2003) as part of the Consolidated Toxic Hot Spots Cleanup Plan (Cleanup Plan) under the Bay Protection Program (CRWQCB-CVR Resolution R5-2003-0034, SWRCB Resolution 2004-0002). The Cleanup Plan identified the entire Delta as a toxic hot spot due to diazinon from dormant spray runoff. The Cleanup Plan also identified Morrison Creek in the City of Sacramento, and Mosher Slough, 5 Mile Slough, the Calaveras River, and Mormon Slough in the City of Stockton, as toxic hot spots due to diazinon and chlorpyrifos from urban runoff. In addition, the Cleanup Plan identified French Camp Slough, Duck Slough, Paradise Cut, and Ulatis Creek as toxic hot spots due to chlorpyrifos in irrigation return flows.

The Cleanup Plan requires the development of a Basin Plan Amendment for the Delta Waterways that addresses both diazinon and chlorpyrifos. The Amendment is required to include Water Quality Objectives for diazinon and chlorpyrifos, an implementation program and framework, a compliance time schedule, a monitoring program, and other required TMDL elements.

The proposed Amendment includes all of the elements identified in the Cleanup Plan.

### **7.1.10 Management Agency Agreement (MAA) with the California Department of Pesticide Regulation (DPR)**

The State Board and DPR have a Management Agency Agreement (MAA) (SWRCB, DPR 1997) to ensure that pesticides registered for use in California are used in a manner that protects water quality and the beneficial uses of water, while recognizing the need for pest control. The State and Regional Water Boards are responsible for protecting the beneficial uses of water in California, and for controlling all discharges of waste into waters of the State. DPR is the lead agency for pesticide regulation in California.

The MAA describes a four-stage process for DPR and the Regional Water Boards to address potential water quality problems related to pesticides. Stage one is general outreach and education to prevent surface water contamination. Stage two is a self-regulating response based on sponsors leading implementation efforts. Stage three is a regulatory approach based on the authorities of DPR and the Agricultural Commissioners. Stage four is a regulatory approach based on Regional Water Board authorities.

Stage two and stage three include the development of numerical values (referred to as "Quantitative Response Limits"-QRLs) to assess success of mitigation efforts when no numerical Water Quality Objectives are available. DPR is to develop QRLs after repeated valid detections of pesticides in surface water. The stage four process under the MAA, regulation by the Regional Water Board, is to be considered when there is an actual or threatened violation of water quality standards; when the Regional or State Board finds that the stage two or three efforts are not protecting water quality; or when the Regional Water

Board believes it is necessary to take action to protect water quality and meet its statutory obligations.

A stage two process described in the MAA has not been put into effect for diazinon or chlorpyrifos in the Delta. A QRL or QRLs for diazinon or chlorpyrifos have not been developed and no sponsor has been identified. DPR began the stage 3 process in February 2003 (DPR, 2003a) by placing diazinon into the reevaluation process, and later placed chlorpyrifos into reevaluation (DPR, 2004). On June 15, 2005 the DPR released a Notice of Proposed Regulatory Action for the control of dormant spray applications and opened the public comment period for the proposed action. The proposed action would restrict ground and aerial applications of dormant season insecticides to areas 100 feet or more from any irrigation or drainage ditch, canal, or any other body of water in which the presence of dormant season insecticides could adversely impact any of the beneficial uses of the waters of the state. The proposed action would also specify wind speeds in which dormant insecticides may be applied. The proposed action would allow aerial application only if soil conditions do not allow field entry or approaching bloom conditions require aerial applications. The proposed action would prohibit all dormant insecticide applications when soil moisture is at field capacity and a storm event is forecast to occur within 48 hours following application, or when a storm event that is likely to produce runoff from the treated area is forecast to occur within 48 hours following application.

Since the diazinon and chlorpyrifos concentrations in the Delta Waterways have been found to exceed Water Quality Objectives, the Regional Water Board is obligated by both Federal and State law to develop a program to address the discharge of diazinon and chlorpyrifos, so the stage four process applies. This amendment allows DPR requirements to be taken into account as a component of management plans that are submitted by dischargers. DPR's regulatory authorities can still be used in conjunction with this Amendment to address the control of diazinon and chlorpyrifos discharges.

#### **7.1.11 CALFED Bay-Delta Program**

CALFED includes a goal to:

*“Improve and/or maintain water quality conditions that fully support healthy and diverse aquatic ecosystems in the Bay-Delta estuary and watershed, and eliminate to the extent possible, toxic impacts to aquatic organisms, wildlife and people.”*

An improvement in water quality by limiting diazinon and chlorpyrifos concentrations in the Delta Waterways, as proposed by this Amendment, is consistent with CALFED program goals.

## **7.2 Need For New Policies**

### **7.2.1 Compliance Policy**

The proposed Basin Plan Amendment identifies Water Quality Objectives and a TMDL (with Load Allocations and Waste Load Allocations) for diazinon and chlorpyrifos. There is no existing policy that describes how the Regional Water Board would determine compliance when evaluating the combination of water column concentration data and pollutant loading information.

The Regional Water Board's compliance policy for control of diazinon and chlorpyrifos in the Delta Waterways requires compliance with both the allocations and the Water Quality Objectives. The allocations are established to assign responsibility for meeting the Water Quality Objectives. If all allocations are met, the Water Quality Objectives should be met.

Although the Basin Plan Amendment establishes diazinon and chlorpyrifos Water Quality Objectives and allocations, the Basin Plan's general pesticide objectives and policies still apply to diazinon and chlorpyrifos discharges. Based on current information, reduction of diazinon and chlorpyrifos levels to meet the allocations and Water Quality Objectives should be sufficient to protect the Delta Waterways from diazinon and chlorpyrifos discharges. If it is later found that diazinon and chlorpyrifos discharges are contributing to a violation of other Basin Plan Water Quality Objectives (e.g. due to additive or synergistic toxicity impacts), additional Regional Water Board action to reduce diazinon and chlorpyrifos discharges may be necessary.

Given the potential for the need for further reductions of diazinon and chlorpyrifos in the Delta Waterways, either due to toxicity issues (discussed above) or to protect tributary waters, the Basin Plan Amendment clarifies that the diazinon and chlorpyrifos objectives and allocations are maximum allowable levels. In addition, the Basin Plan Amendment states that the Regional Water Board shall require any necessary reductions in diazinon and chlorpyrifos levels to account for additive or synergistic effects or protect beneficial uses in tributary waters. Depending on the nature of the needed reductions, the Regional Water Board may further regulate diazinon and chlorpyrifos through waste discharge requirements, waiver of waste discharge requirements, or by additional Basin Plan Amendments.

### **7.2.2 Pesticide Runoff Management Policy**

The Regional Water Board must follow federal, State, and Regional Water Board anti-degradation policies when taking specific actions (see discussion in Sections 7). In the case of the control of diazinon and chlorpyrifos, potential responses by growers could result in the use of other products that may runoff and degrade water quality. In addition, the Regional Water Board has an existing pesticide Water Quality Objective that states “[p]esticide concentrations shall not exceed the lowest levels technically and economically achievable.”

Based on the existing anti-degradation policy and the current pesticide Water Quality Objective, the Regional Water Board should encourage the adoption of practices to control

pesticide runoff to surface waters. In addition, the Regional Water Board recognizes that practices that retain surface runoff may in some instances increase infiltration. It is, therefore, important that the solution for one problem (surface water contamination) does not create another problem (groundwater contamination). The Department of Pesticide Regulation and the County Agricultural Commissioners currently have programs to address groundwater contamination and are familiar with those pesticides that are most likely to cause groundwater contamination problems.

It is ultimately the responsibility of the dischargers to ensure that their pest control practices are not contaminating ground water and not causing violations of applicable Regional Water Board policies and Water Quality Objectives. The proposed Basin Plan Amendment includes a policy that requires dischargers to consider potential impacts to ground or surface waters of alternatives to diazinon and chlorpyrifos.

### **7.2.3 Review and Planning Policies**

The Regional Water Board will periodically review the provisions that have been included in this Basin Plan Amendment. New scientific or technical information may be developed that could suggest revisions to the Water Quality Objectives, TMDL, or implementation policies. The Regional Water Board will also determine whether the implementation framework established by this Basin Plan Amendment is effective. The Regional Water Board may act on new information at any time, but a comprehensive, periodic review of the overall control program will help ensure that Water Quality Objectives are being attained.

The proposed Basin Plan Amendment includes a policy to periodically review the implementation program. The first review is proposed to take place prior to the compliance date to allow for potential adjustments to the implementation program.

## 8 SURVEILLANCE AND MONITORING

Porter-Cologne requires that the Basin Plan Amendment describe the type of surveillance and monitoring that will be required to determine compliance with the Water Quality Objectives, Loading Capacity and Load Allocations. In general, responsibility for monitoring and surveillance will fall to three main groups: the Regional Water Board, the entity or entities and individuals directly overseeing the implementation program (i.e. watershed coalition groups and/or individual dischargers), and those responsible for adopting new management practices.

Three main alternatives for surveillance and monitoring were considered: (1) Do not include a description of the type of monitoring and surveillance required, (2) Provide general direction on the required monitoring and surveillance, and (3) Identify specific monitoring requirements, including methods, sites, and constituents.

A description of the monitoring and surveillance to be conducted would not be required (Alternative 1), if the required monitoring were already being conducted as part of an existing monitoring program. The Regional Water Board is currently conducting some monitoring of diazinon and chlorpyrifos in the Delta Waterways and their tributaries within the Delta watershed, but the monitoring program may not be adequate to determine compliance for all the Delta Waterways. In addition, the Regional Water Board's funding for monitoring in the Delta Waterways is not certain for the long term and does not include tracking and evaluating management practices. Two agricultural coalition groups, the Sacramento Valley Water Quality Coalition and the San Joaquin River and Delta Water Quality Coalition are also conducting water quality monitoring within the Delta Waterways and their tributaries in the Delta Watershed. The monitoring and reporting being performed by these Water Quality Coalitions may need to be augmented in order to ensure that adequate information is generated to determine compliance for all the Delta Waterways.

Alternative 2 would provide general requirements for the monitoring and surveillance to be conducted, but allow flexibility in terms of the precise requirements and who would conduct the monitoring. The general requirements would be structured to provide enough data to allow evaluation of compliance with this Basin Plan Amendment.

Alternative 3 would identify specific requirements for monitoring and surveillance, including specific sites to be monitored, the frequency of monitoring, and constituents to be monitored. This alternative would provide the greatest certainty as to expectations of the monitoring effort, but would provide the least flexibility.

Alternative 2 is recommended. Specific expectations with respect to the information to be collected are needed to ensure the Regional Water Board can determine progress in implementing this Amendment. The specific methods and number of monitoring sites required to meet those expectations should remain flexible to take advantage of the efforts of different groups and agencies conducting monitoring and evaluating management practices. The use of monitoring and reporting programs (e.g. through a waiver of waste discharge requirements or waste discharge requirements) should provide the assurance that the necessary information

is collected and submitted to the Regional Water Board. Alternative 2 would only apply to agricultural discharge, since diazinon and chlorpyrifos discharge from NPDES sources is not expected and any monitoring required as part of the NPDES permit process should be sufficient. The general monitoring and surveillance needs are described below.

The surveillance and monitoring program should be designed to collect the information necessary to:

1. Determine compliance with established Water Quality Objectives and Loading Capacities applicable to diazinon and chlorpyrifos in the Delta Waterways.
2. Determine compliance with the Load Allocations applicable to discharges of diazinon and chlorpyrifos into the Delta Waterways
3. Determine the degree of implementation of management practices to reduce off-site movement of diazinon and chlorpyrifos
4. Determine the effectiveness of management practices and strategies to reduce off-site migration of diazinon and chlorpyrifos
5. Determine whether alternatives to diazinon and chlorpyrifos are causing surface water quality impacts
6. Determine whether the discharge causes or contributes to a toxicity impairment due to additive or synergistic effects of multiple pollutants
7. Demonstrate that management practices are achieving the lowest pesticide levels technically and economically achievable.

The types of activities required to meet the monitoring goals are described in more detail below. The descriptions below assume that a collective monitoring effort would be implemented by the agricultural dischargers. If individual agricultural dischargers choose to implement their own monitoring, the requirements would consist of monitoring their own discharges to meet the goals stated above.

1: Determine compliance with established Water Quality Objectives and Loading Capacities applicable to diazinon and chlorpyrifos in the Delta Waterways and their tributaries.

To determine compliance with Water Quality Objectives and Loading Capacities, monitoring will need to occur at a number of sites within the Delta Waterways and their tributaries in the Delta watershed. A number of sites along the main course of water flow through the Delta would need to be monitored to track the presence and transport of diazinon and chlorpyrifos in the major courses of flow through the Delta. Therefore monitoring should be conducted within the Delta at sites along the Sacramento, San Joaquin, Mokelumne, Old and Middle Rivers, and in Cache Slough.

In addition, there are hundreds of other Delta Waterways. To determine compliance with the Water Quality Objectives, Loading Capacity and Load Allocations in these other Delta Waterways, monitoring could be done A) in each unique Delta Waterway that receives agricultural discharges or B) in a representative number of Delta Waterways within Delta. Monitoring in each unique Delta Waterway (option A) would be the more expensive option, but would provide a higher level of certainty that the Water Quality Objectives and TMDL were being met in all the Delta Waterways. Monitoring in a representative number of Delta

Waterways (option B) would be less expensive, but would provide less assurance that the Water Quality Objectives were being met. Monitoring programs would need to be carefully designed so that the stations monitored were representative of the water quality conditions that result from the wide range of discharges and hydrologic conditions likely to occur in the Delta. These should include sites within back sloughs, upland drainages, and waterbodies receiving discharges from the all of the crops upon which the greatest amount of diazinon and chlorpyrifos are used (such as those highlighted in Tables 2.9 and 2.10).

A number of ways to choose representative monitoring sites could be used. As an example, a representative number of main Delta Waterways, smaller back sloughs and upland drainages could be sampled in each of the Delta subareas described in Appendix E. The Delta Waterways determined by the Bay Protection program to be “hot spots” due to diazinon or chlorpyrifos should be included among the locations sampled to assess progress in meeting the Water Quality Objectives, since there have been documented OP pesticide toxicity problems in these Delta Waterways in the past (Deanovic et al., 1996, Deanovic et al., 1998). The recommended monitoring requirement is option B, provided that an adequate plan or plans can be developed. The proposed Basin Plan Amendment language states that it may not be necessary to monitor in all the Delta Waterways to determine compliance with the Water Quality Objectives, Waste Load Allocations and Load Allocations.

The frequency of monitoring should be based on the primary processes leading to diazinon and chlorpyrifos runoff. During the dormant season, storm water runoff will account for most diazinon and chlorpyrifos found in the Delta Waterways. Monitoring should, therefore, take place concurrent with and for a number of days after storms of sufficient magnitude to produce runoff in the Delta watershed, Sacramento Valley, or the San Joaquin Valley. Stormwater runoff during March should also be monitored, since this is the period of intense chlorpyrifos applications on alfalfa.

During the dry periods between storm and following the winter storm season, interval sampling should be implemented to monitor diazinon and chlorpyrifos transported into the Delta Waterways via irrigation runoff and possibly aerial drift. Since irrigation and pesticide use will take place at different times, monitoring at the sites discussed above can take place at a frequency that depends on use patterns and frequency of irrigation.

## 2: Determine compliance with the Load Allocations applicable to discharges of diazinon and chlorpyrifos into the Delta Waterways

To determine compliance with the Load Allocations, monitoring should be done at each of the major Delta tributaries near where they flow into the Delta. Therefore the Mokelumne River and the Yolo Bypass should be monitored near where they enter the Delta. The Sacramento and San Joaquin Rivers already have monitoring requirements under their respective TMDLS (Karkoski et al., 2003, Beaulaurier et al., 2005). In addition compliance must be determined for dozens of smaller waterbodies flowing into the Delta and hundreds of direct discharges to the Delta Waterways. To determine compliance with the Load Allocations in these other Delta Waterways, monitoring could be done either (A) at each point of discharge to a Delta Waterway, and at every point where a waterbody flows into the Delta or (B) at the major tributaries to the Delta Waterways, and at a representative number of minor tributaries flowing into the Delta. Monitoring at every point of discharge to a Delta Waterway would provide the

highest level of certainty that the Load Allocations were being met, but would be the most expensive option, since there are hundreds of discharges to the Delta Waterways, and dozens of waterbodies that flow into the Legal Delta. Monitoring at the major tributaries to the Delta, plus a representative number of minor tributaries would be less expensive, but would provide less certainty that the Load Allocations were being met. Monitoring programs would need to be carefully designed so that the samples collected would be representative of the water quality conditions likely to result from the wide range of discharges and hydrologic conditions likely to occur in the Delta watershed. These sites should include sites that represent discharges from the major diazinon and chlorpyrifos using crops. For smaller Delta Waterways, where there is little dilution available, monitoring within the Delta Waterway could be used to estimate compliance with the Load Allocations for discharges to that Delta Waterway, and upstream monitoring could be used to follow-up on exceedances.

### 3: Determine the degree of implementation of management practices to reduce off-site movement of diazinon and chlorpyrifos.

Information must be collected from growers on the types of practices being used and how those practices are being applied, while considering the following factors:

- Minimize the paperwork burden on growers.
- Use existing reporting systems.
- Create a repository for the data that will allow for ease of data entry and analysis.

Data should be collected in the four broad areas:

- Pesticide application, mixing, and loading practices.
- Pest management practices.
- Water management practices.
- Cultural practices.

Experts in each of those broad fields should be consulted in designing the survey or reporting requirements to ensure relevant data is collected.

A focused effort should be made to receive complete reporting from growers whose lands drain to the monitoring sites. This should allow the Regional Water Board to relate the implementation of specific diazinon and chlorpyrifos runoff mitigation approaches to changes in diazinon and chlorpyrifos loading.

### 4: Determine the effectiveness of management practices and strategies to reduce off-site migration of diazinon and chlorpyrifos.

To assess the effectiveness of specific management practices or strategies, field level evaluations will need to be conducted. The field evaluations should quantify the amount of load reduction, or reduction in off-site migration of diazinon and chlorpyrifos (in the case of practices to reduce aerial drift) that could be expected with implementation of a new management practice or strategy.



5: Determine whether alternatives to diazinon and chlorpyrifos are causing surface water quality impacts.

Replacement of diazinon and chlorpyrifos with other OP insecticides, carbamate insecticides or pyrethroids may result in water column or sediment toxicity. First, an evaluation of pesticide use patterns would need to be performed in order to determine whether any alternative pesticides pose a threat to water quality. Monitoring of the water column and sediment would need to include analyses for these insecticides to ensure that aquatic toxicity does not continue, or does not simply move from the water column to sediment.

The monitoring locations should generally be the same as those used to monitor diazinon and chlorpyrifos levels and the monitoring could be done concurrently. As discussed under Monitoring Goal #1, monitoring could be done at a representative number of Delta Waterways if monitoring programs were carefully designed so that the stations monitored were representative of the water quality conditions likely to occur in the Delta. Sediment monitoring should be done at sites where sediments are likely to be deposited. Sediment sampling could be performed concurrently with surface water monitoring, but may not need to be performed as frequently (e.g. monthly during the dormant season rather than daily storm event sampling).

6: Determine whether the discharge causes or contributes to a toxicity impairment due to additive or synergistic effects of multiple pollutants.

The toxicity and pesticide Water Quality Objectives that apply to diazinon and chlorpyrifos include provisions for considering additive or synergistic effects. The Amendment is based on the current understanding of the additive effects of diazinon and chlorpyrifos. Diazinon and chlorpyrifos may also have additive, synergistic or antagonistic effects in combination with other pollutants. To determine if such effects are occurring, monitoring for toxicity and monitoring for pollutants suspected of acting in an additive or synergistic manner with diazinon and chlorpyrifos will be required. When toxicity is detected, toxicity identification evaluations will be required to determine the compounds contributing to the toxicity. Such monitoring can be conducted in conjunction with monitoring for diazinon and chlorpyrifos.

As discussed under Monitoring Goal #1, monitoring could be done at a representative number of Delta Waterways if monitoring programs were carefully designed so that the stations monitored were representative of the water quality conditions likely to occur in the Delta. Toxicity monitoring should be done at sites and times of year when toxicity would be most likely to occur. Delta Waterways receiving orchard runoff should be monitored for toxicity following winter storms. During the irrigation season, Delta Waterways receiving irrigation runoff, including back sloughs and small upland drainages should be monitored for toxicity. The stations monitored should include stations at which toxicity was previously detected in the Delta (Kuivila and Foe, 1995, Deanovic et al., 1996, Deanovic et al., 1998).

7: Demonstrate that management practices are achieving the lowest pesticide levels technically and economically achievable.

Goal 7 can be met by assessing the information collected to meet goals 3 and 4. Evaluation of the effectiveness of management practices should help identify which ones (or combinations) achieve the lowest pesticide levels in discharge and are economically

achievable. Tracking the degree of implementation of these practices should help the Regional Water Board determine whether the practices are wide spread enough to achieve the lowest pesticide levels possible in the Delta Waterways.

## 9 ESTIMATED COSTS AND POTENTIAL SOURCES OF FINANCING

The Porter-Cologne Water Quality Control Act requires consideration of economics when Water Quality Objectives are established, and 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.” This section presents the information needed to meet those requirements. The costs to meet the proposed Water Quality Objectives and Allocations are estimated below.

It should be noted that without the proposed Basin Plan Amendment, the discharges of diazinon and chlorpyrifos would still need to be addressed under existing laws and regulations. These include the existing Water Quality Objectives for toxicity and pesticides discussed in the Water Quality Objectives section of this report, SWRCB’s Nonpoint Source Pollution Program Policy (SWRCB, 2004), Bay Protection, existing federal pesticide label requirements, and DPR’s dormant spray regulations. (New diazinon label requirements and DPR dormant spray regulations are discussed below.) Therefore, the costs to agriculture for implementing management practices to meet the Water Quality Objectives and Allocations proposed in this Amendment, should be considered high-end cost estimates, since reductions in diazinon and chlorpyrifos discharges to the Delta Waterways are required by current laws and regulations.

### 9.1 Estimated Costs for Agricultural Management Practices

Previous Regional Water Board Staff Reports (Karkoski et al., 2003), (Beaulaurier et al., 2005<sup>14</sup>) have examined the costs to agriculture of implementing management practices to reduce or eliminate agricultural discharges of diazinon and chlorpyrifos. The results of the most recent analyses are used in this report to estimate the costs to agriculture of implementing practices to reduce or eliminate diazinon and chlorpyrifos discharges to meet the proposed Load Allocations. Karkoski et al. (2003) and Beaulaurier et al. (2005) examined the costs of management practices for dormant sprays on almonds, peaches and apples, and management practices for irrigation season discharges from alfalfa and almonds. A base case scenario for each crop, the use of diazinon or chlorpyrifos, was compared with alternative scenarios that reduced risk to water quality while still providing adequate pest control. The management practices for the irrigation season included water management, since irrigation runoff is the main mechanism of transport of chlorpyrifos and diazinon from agricultural lands into surface waters during the irrigation season. The resulting cost estimates are summarized in Table 9.1.

---

<sup>14</sup> With cost corrections as described in Landau, 2006.

**Table 9.1. Ag Practice Cost Estimates from Beaulaurier et al., 2005<sup>15</sup>**

| Crop  | Cost of Implementing Practices (\$/acre) | Change in Per-Acre Production Cost (percent) |
|---|--|--|
| Dormant Season <sup>16</sup> (December-March) |  |  |
| Almonds                                       | \$0 to \$163                             | 0% to 6%                                     |
| Peaches                                       | \$0 to \$146                             | 0% to 3%                                     |
| Apples  | \$-15 to \$159                           | 0% to 1%                                     |
| Non – Dormant Season (April-November)         |  |  |
| Alfalfa                                       | \$60 to \$100                            | 6% to 10%                                    |
| Almonds                                       | \$90 to \$118                            | 3% to 4%                                     |

From a review of the Staff Reports discussed above, it is evident that management practices are available that will result in the reduction or elimination of diazinon and chlorpyrifos in agricultural discharges. The range of overall costs for implementing dormant season or irrigation season practices did not vary greatly between commodities during either the dormant or irrigation season. For all of the commodities examined, alternative products are available that are effective in controlling pests. The price of the pesticide is a small fraction of overall production costs. Therefore, the use of alternative pesticides generally did not represent a significant cost increase, unless the use of alternative pesticides made it more likely that multiple applications would be necessary to adequately control pests (Karkoski et. al., 2003). Some or all of the water management practices examined in Beaulaurier et al.(2005) for alfalfa and almonds are applicable to the other orchard and field/row crops grown in the Delta watershed. Therefore, the other orchard and field/row crops upon which diazinon and chlorpyrifos are used in the Delta are expected to have similar costs to implement practices to meet the proposed Load Allocations.

To estimate the costs of implementing management practices to agricultural dischargers in the Delta watershed, the high- and low-end per-acre cost estimates for orchard crops and field/row crops from Beaulaurier et al.(2005)<sup>13</sup> are multiplied by the number of acres treated (using 2003 pesticide use data (DPR, 2005a)) for the major dormant season and irrigation season uses in the Delta watershed. Since the new diazinon label requirements described below are expected to adequately control dormant season diazinon discharges, costs of management practices for diazinon used during the dormant season were not included in these calculations. The per acre costs to some agricultural dischargers may be less than the low end cost estimates, since they may already be implementing practices that adequately control pesticide runoff to surface water. The per-acre cost of implementation also did not include any cost savings from reduced water use or reduced soil loss. Tables D-2 and D-3 in Appendix D summarize the estimates of the cost of implementing agricultural management practices for the dormant and irrigation seasons, respectively. The crops included in these calculations constitute approximately 70% of dormant season agricultural use of chlorpyrifos and constitute

<sup>15</sup> With cost corrections as described in Landau, 2006.

<sup>16</sup> The dormant season cost range estimates shown used treatment with chlorpyrifos as a base case scenario in order to be consistent with how the total dormant season cost range was estimated.

86% and 97% of the irrigation season agricultural use of diazinon and chlorpyrifos, respectively. Uses in the Delta watershed are described in Section 2.3 of this report. The estimated total costs of implementing orchard dormant season management practices throughout the Delta watershed range from a minor cost savings to a cost of 175,000 dollars for dormant season orchard practices. The estimated total costs of implementing irrigation season practices throughout the Delta watershed range from 5.9 to 12.5 million dollars.

### **9.1.1 Recent Changes in Dormant Season Use Regulations for Diazinon and Chlorpyrifos**

In 2004, supplemental Federal label requirements for diazinon were issued by the manufacturer of diazinon to reduce impacts of diazinon used for dormant sprays in the Sacramento and San Joaquin Valleys (MANA, 2004d). In 2005, DPR issued draft dormant spray regulations (DPR, 2005b) to address the impacts of the use of diazinon and chlorpyrifos as dormant spray pesticides in the Central Valley. It is likely that by meeting the existing federal label requirements for diazinon dormant season applications and implementing the pending DPR dormant spray regulations that growers will not need to implement additional management practices in the dormant season to meet the requirements of this proposed Amendment (i.e. there should be little or no additional increase in cost).

## **9.2 Estimated Monitoring, Planning, and Evaluation Costs**

Monitoring and planning costs were estimated for two different approaches that growers could take in responding to this Basin Plan Amendment. Growers could participate in a watershed group to meet the Basin Plan Amendment requirements, or growers could work individually with the Regional Water Board to meet the Basin Plan Amendment requirements.

Approximately 900 growers reported applications diazinon or chlorpyrifos in the Delta watershed in 2003 (DPR 2005a), with approximately 3,500 individual applications reported. For the purposes of this analysis, it is assumed that all of those growers would need to respond to this Basin Plan Amendment. The total cost for monitoring, planning, and evaluation would be approximately 0.5 to 1.8 million dollars for a waiver-based program, depending on whether growers used a watershed approach or an individual approach, respectively. The cost calculations are detailed in Appendix D. These costs also represent a high-end estimate, since they do not take into account other monitoring, planning, and management practice evaluation programs and requirements relevant to OP pesticides in the Delta.

### **9.2.1 Watershed Approach**

For a watershed group, the estimated annual monitoring, planning, and evaluation cost is approximately 0.5 million dollars per year, or 500 dollars per grower. These costs estimates are detailed in Table D-4 in Appendix D. The total monitoring cost would be approximately 380,000 dollars annually. These costs may be lower if a portion of the monitoring is already being performed under the Agricultural Waiver Monitoring Program or other monitoring

programs. The monitoring costs are associated with determining compliance with Water Quality Objectives, Loading Capacities, and Load Allocations. The costs for planning and evaluation by watershed groups include development of annual monitoring and implementation plans, annual reporting of monitoring and implementation results (including the effectiveness of management practices), and coordination of implementation activities. The total cost for these activities is approximately 120,000 dollars annually. The planning and evaluation costs are associated with ensuring management practices are implemented, determining the degree of implementation, and reporting on the effectiveness of the implementation efforts in meeting water quality goals.

### **9.2.2 Individual Grower Approach**

The estimated per-grower costs for monitoring, planning and evaluation using the individual grower approach are similar to those estimated for the San Joaquin River Basin (Beaulaurier et al., 2005<sup>17</sup>). If growers report directly to the Regional Water Board, the estimated monitoring, planning, and evaluation cost is approximately 2,000 dollars per grower and the total monitoring planning and evaluation cost to growers within the Delta watershed would be approximately 1.8 million dollars. These costs are detailed in Table D-5 in Appendix D

It is assumed that monitoring (flow and water quality) would need to take place at 900 discharge points-one for each grower. Each site would be monitored up to 2 times during the season(s) during which the pesticides are applied or runoff is expected to occur. The total monitoring cost would be approximately 620,000 dollars annually. These costs may be lower if a portion of the monitoring is already being performed under the Agricultural Waiver Monitoring Program. The monitoring costs could be substantially greater if the sample collection and flow monitoring were contracted out instead of conducted by the grower. The monitoring costs are associated with determining compliance with Load Allocations. The cost for planning and evaluation by the grower would primarily consist of filling out standard forms developed by Regional Water Board staff for reporting and monitoring purposes. The cost to the grower for his/her time to prepare forms detailing management practice implementation and effectiveness is estimated to be 320 dollars annually, for a total annual cost within the Delta watershed of approximately 290,000 dollars.

### **9.2.3 Summary of Potential Grower Cost**

The estimated annual cost of dormant season alternative pest management practices ranges from a minor cost savings to a maximum cost of approximately 175,000 dollars. The estimated annual cost of irrigation season alternative pest and water management costs range from 5.9 million dollars to 12.5 million dollars. The estimated annual cost of monitoring, planning and management practice evaluation ranged from approximately 0.5 million dollars to 1.8 million dollars. The Delta watershed-wide combined costs of alternative pest management practices, alternative water management practices, and monitoring and compliance activities for the major crops that use diazinon and chlorpyrifos are estimated to range from 6.4 million dollars to \$14.4 million dollars. These total costs are shown in Table D-1 in Appendix D.

---

<sup>17</sup> With cost corrections as described in Landau, 2006.

The estimated costs for practices represent a high-end estimate. It is likely that by meeting the existing federal requirements for diazinon dormant season application and the pending DPR regulations (DPR, 2003b), growers will not need to implement additional management practices in the dormant season to meet the requirements of this proposed Amendment (i.e. there should be little or no additional increase in cost). The irrigation season cost estimates also provide a high-end estimate since the cost estimates assume that all growers currently using diazinon or chlorpyrifos in the irrigation season (except for orchard growers using drip irrigation or microsprinklers) would need to change management practices. The monitoring, planning and evaluation costs also represent a high end estimate, since they did not take into account other monitoring planning and management practice evaluation programs and requirements relevant to OP pesticides in the Delta watershed.

### **9.3 Estimated Costs to NPDES Permittees**

As discussed previously, all urban uses of diazinon and almost all urban uses of chlorpyrifos are being phased out. Therefore, it is not anticipated that NPDES permittees (municipal storm water permittees or publicly owned treatment works) will be required to implement additional management measures or treatment technologies to control diazinon or chlorpyrifos.

Additionally, any diazinon or chlorpyrifos monitoring that is currently part of an NPDES permit is not expected to increase or change as a result of adoption of this Basin Plan Amendment. Therefore, no change in control costs or monitoring costs is projected to occur for NPDES permit holders with adoption of this Basin Plan Amendment.

### **9.4 Potential Sources of Financing**

In general, the potential sources of funding for agricultural water quality programs do not change significantly by crop type. The sources of funding identified in the Basin Plan for the agricultural subsurface drainage program and rice pesticide program are also potential funding sources for this program. These sources include:

1. Private financing by individual sources.
2. Bonded indebtedness or loans from government institutions.
3. Surcharge on water deliveries to lands contributing to the water quality problem.
4. Ad Valorem tax on lands contributing to the water quality problem.
5. Taxes and fees levied by a district created for the purpose of drainage management.
6. State or federal grants or low-interest loan programs.
7. Single purpose appropriations from federal or State legislative bodies (including land retirement programs).

Specific state and federal grant and loan programs include:

1. USDA Environmental Quality Incentive Program (EQIP) grants, administered by the Natural Resources Conservation Service (NRCS)

2. Consolidated grant program administered by the State Water Resources Control Board, including Proposition 40 grants, 319 NPS Implementation Program grants, and Proposition 50 CalFed Watershed Program grants
3. State Revolving Fund Loan program for NPS pollution



## 10 CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA) REVIEW

The proposed Basin Plan Amendment does not prescribe any particular changes in land use or require any specific changes in pesticide use. The analysis of potential environmental impacts is, therefore, based on the possible changes in pest management methods or possible approaches to controlling diazinon and chlorpyrifos runoff. This CEQA review is based on the potential alternative strategies that agricultural users of diazinon and chlorpyrifos could employ in response to the proposed Basin Plan Amendment.

Urban users of diazinon and chlorpyrifos are not considered in detail in this analysis, since those uses are being phased out in the time-frame for compliance with the proposed Basin Plan Amendment.

### 10.1 Environmental Checklist Form

#### 1. Project title

Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Diazinon and Chlorpyrifos Runoff into the Sacramento-San Joaquin Delta

#### 2. Lead agency name and address

California Regional Water Quality Control Board, Central Valley Region  
11020 Sun Center Drive #200  
Rancho Cordova, CA 95670

#### 3. Contact person and phone number

Daniel McClure, Water Resources Control Engineer  
(916) 464-4751

#### 4. Project location

Sacramento-San Joaquin Delta (Delta) as defined in section 12220 of the California Water Code, as well as the areas that drain to the Legal Delta, with the exception of the areas that drain to reservoirs or to the Sacramento or San Joaquin Rivers upstream of the Legal Delta boundaries

#### 5. Project sponsor's name and address

California Regional Water Quality Control Board, Central Valley Region  
11020 Sun Center Drive #200  
Rancho Cordova, CA 95670

#### 6. General plan designation

Not applicable

#### 7. Zoning

Not applicable

## **8. Description of project**

The Regional Water Board is proposing to amend the Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins. The purposes of the proposed amendment are to adopt Water Quality Objectives for the Delta and to adopt an implementation strategy to bring dischargers of diazinon and chlorpyrifos into compliance with the Water Quality Objectives. The proposed amendment also establishes the maximum diazinon and chlorpyrifos Loading Capacity, Waste Load Allocations, and Load Allocations for the Delta Waterways as required by the Clean Water Act § 303(d)(1)(C).

## **9. Surrounding land uses and setting**

The areas affected by this Basin Plan amendment include the Sacramento-San Joaquin Delta and its surrounding watershed. The land uses in the area include agriculture, urban, open space, and wildlife habitat.

## **10. Other public agencies whose approval is required**

State Water Resources Control Board  
Office of Administrative Law  
U.S. Environmental Protection Agency

**ENVIRONMENTAL FACTORS POTENTIALLY AFFECTED:**

The environmental resource categories identified below are analyzed herein to determine whether the Proposed Project would result in adverse impacts to any of these resources. None of the categories below are checked because the Proposed Project is not expected to result in “significant or potentially significant impacts” to any of these resources.

- |                               |                                    |
|-------------------------------|------------------------------------|
| Aesthetics                    | Biological Resources               |
| Hazards & Hazardous Materials | Mineral Resources                  |
| Public Services               | Utilities/Service Systems          |
| Agriculture Resources         | Cultural Resources                 |
| Hydrology/Water Quality       | Noise                              |
| Recreation                    | Mandatory Findings of Significance |
| Air Quality                   | Geology/Soils                      |
| Land Use Planning             | Transportation/Traffic             |

On the basis of this initial evaluation:

- I find that the proposed Basin Plan Amendment could not have a significant effect on the environment.
- I find that although the proposed Basin Plan Amendment could have a significant effect on the environment, there will not be a significant effect in this case because feasible alternatives and/or feasible mitigation measures exist that would substantially lessen any significant impact. These alternatives are discussed in the attached written report.
- I find that the proposed Basin Plan Amendment may have a significant effect on the environment. There are no feasible alternatives and/or mitigation measures available which would substantially lessen any significant adverse impacts. See attached written report for a discussion of this determination.

original signed by  
PAMELA C. CREEDON  
Executive Officer  
California Regional Water Quality Control Board,  
Central Valley Region

23 June 2006  
Date

## EVALUATION OF ENVIRONMENTAL IMPACTS

This Environmental Checklist has been prepared in compliance with the requirements of CEQA relating to certified regulatory programs.

| IMPACT   | POTENTIALLY SIGNIFICANT IMPACT | POTENTIALLY SIGNIFICANT UNLESS MITIGATION INCORPORATION | LESS THAN SIGNIFICANT IMPACT | NO IMPACT                           |
|--|--------------------------------|---|------------------------------|-------------------------------------|
| <b>I. AESTHETICS Would the Project:</b>  |                                |   |                              |                                     |
| a) Have a substantial adverse effect on a scenic vista?  | <input type="checkbox"/>       | <input type="checkbox"/>                                | <input type="checkbox"/>     | <input checked="" type="checkbox"/> |
| b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?   | <input type="checkbox"/>       | <input type="checkbox"/>                                | <input type="checkbox"/>     | <input checked="" type="checkbox"/> |
| c) Substantially degrade the existing visual character or quality of the site and its surroundings?  | <input type="checkbox"/>       | <input type="checkbox"/>                                | <input type="checkbox"/>     | <input checked="" type="checkbox"/> |
| d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?  | <input type="checkbox"/>       | <input type="checkbox"/>                                | <input type="checkbox"/>     | <input checked="" type="checkbox"/> |
| <b>II. AGRICULTURE RESOURCES: In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Department of Conservation as an optional model to use in assessing impacts on agriculture and farmland. Would the Project:</b> |                                |   |                              |                                     |
| a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?   | <input type="checkbox"/>       | <input type="checkbox"/>                                | <input type="checkbox"/>     | <input checked="" type="checkbox"/> |
| b) Conflict with existing zoning for agricultural use, or a Williamson Act contract?   | <input type="checkbox"/>       | <input type="checkbox"/>                                | <input type="checkbox"/>     | <input checked="" type="checkbox"/> |
| c) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use?  | <input type="checkbox"/>       | <input type="checkbox"/>                                | <input type="checkbox"/>     | <input checked="" type="checkbox"/> |
| <b>III. AIR QUALITY – Where available, the significance criteria established by the applicable air quality management or air pollution control the District may be relied upon to make the following determinations. Would the Project:</b>  |                                |   |                              |                                     |
| a) Conflict with or obstruct implementation of the applicable air quality plan?  | <input type="checkbox"/>       | <input type="checkbox"/>                                | <input type="checkbox"/>     | <input checked="" type="checkbox"/> |

| IMPACT  | POTENTIALLY SIGNIFICANT IMPACT | POTENTIALLY SIGNIFICANT UNLESS MITIGATION INCORPORATION | LESS THAN SIGNIFICANT IMPACT | NO IMPACT                           |
|---|--------------------------------|---|------------------------------|-------------------------------------|
| b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation?  | <input type="checkbox"/>       | <input type="checkbox"/>                                | <input type="checkbox"/>     | <input checked="" type="checkbox"/> |
| c) Result in a cumulatively considerable net increase of any criteria pollutant for which the Project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)? | <input type="checkbox"/>       | <input type="checkbox"/>                                | <input type="checkbox"/>     | <input checked="" type="checkbox"/> |
| d) Expose sensitive receptors to substantial pollutant concentrations?  | <input type="checkbox"/>       | <input type="checkbox"/>                                | <input type="checkbox"/>     | <input checked="" type="checkbox"/> |
| e) Create objectionable odors affecting a substantial number of people?   | <input type="checkbox"/>       | <input type="checkbox"/>                                | <input type="checkbox"/>     | <input checked="" type="checkbox"/> |

**IV. BIOLOGICAL RESOURCES – Would the Project:**

|  |                          |                          |                          |                                     |
|--|--------------------------|--------------------------|--------------------------|-------------------------------------|
| a) Have 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 regulators, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the California Department of Fish and Game or US fish and Wildlife Service?   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |

| IMPACT   | POTENTIALLY SIGNIFICANT IMPACT | POTENTIALLY SIGNIFICANT UNLESS MITIGATION INCORPORATION | LESS THAN SIGNIFICANT IMPACT | NO IMPACT                           |
|--|--------------------------------|---|------------------------------|-------------------------------------|
| e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?  | <input type="checkbox"/>       | <input type="checkbox"/>                                | <input type="checkbox"/>     | <input checked="" type="checkbox"/> |
| f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan? | <input type="checkbox"/>       | <input type="checkbox"/>                                | <input type="checkbox"/>     | <input checked="" type="checkbox"/> |

**V. CULTURAL RESOURCES – Would the Project:**

|   |                          |                          |                          |                                     |
|---|--------------------------|--------------------------|--------------------------|-------------------------------------|
| a) Cause a substantial adverse change in the significance of a historical resource as defined in §15064.5?    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| c) Directly or indirectly destroy a unique paleontological resource of site or unique geological feature?     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| d) Disturb any human remains, including those interred outside of formal cemeteries?                          | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |

**VI. GEOLOGY AND SOILS – Would the Project:**

|  |                          |                          |                          |                                     |
|--|--------------------------|--------------------------|--------------------------|-------------------------------------|
| a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| ii) Strong seismic ground shaking?   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| iii) Seismic-related ground failure,, including liquefaction?  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| iv) Landslides?  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| b) Result in substantial soil erosion or the loss of topsoil?  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the Project, and potentially   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |

| IMPACT   | POTENTIALLY SIGNIFICANT IMPACT | POTENTIALLY UNLESS MITIGATION INCORPORATION | LESS THAN SIGNIFICANT IMPACT | NO IMPACT                           |
|--|--------------------------------|---|------------------------------|-------------------------------------|
| result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?  |                                |   |                              |                                     |
| d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform building Code (1994), creating substantial risks to life or property? | <input type="checkbox"/>       | <input type="checkbox"/>                    | <input type="checkbox"/>     | <input checked="" type="checkbox"/> |

**VII. HAZARDS AND HAZARDOUS MATERIALS – Would the Project:**

|  |                          |                          |                          |                                     |
|--|--------------------------|--------------------------|--------------------------|-------------------------------------|
| a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?                                   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| e) For a Project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the Project result in a safety hazard for people residing or working in the Project area? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| f) For a Project within the vicinity of a private airstrip, would the Project result in a safety hazard for people residing or working in the Project area?  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| h) Expose people or structures to a  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |

| IMPACT   | POTENTIALLY SIGNIFICANT IMPACT | POTENTIALLY UNLESS MITIGATION INCORPORATION | LESS THAN SIGNIFICANT IMPACT | NO IMPACT |
|--|--------------------------------|---|------------------------------|-----------|
| significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands? |                                |   |                              |           |

**VIII. HYDROLOGY AND WATER QUALITY – Would the Project:**

|  |                          |                          |                          |                                     |
|--|--------------------------|--------------------------|--------------------------|-------------------------------------|
| a) Violate any water quality standards or waste discharge requirements?  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of preexisting nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which results in flooding on- or off-site?   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| e) Create or contribute runoff water which exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| f) Otherwise substantially degrade water quality?  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| g) Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| h) Place within a 100-year flood hazard  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |



| IMPACT  | POTENTIALLY<br>SIGNIFICANT<br>IMPACT | POTENTIALLY<br>SIGNIFICANT<br>UNLESS<br>MITIGATION<br>INCORPORATION | LESS THAN<br>SIGNIFICANT<br>IMPACT | NO IMPACT                           |
|---|--------------------------------------|---|------------------------------------|-------------------------------------|
| area structures which would impede or redirect flood flows?   |                                      |   |                                    |                                     |
| i) Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam?  | <input type="checkbox"/>             | <input type="checkbox"/>  | <input type="checkbox"/>           | <input checked="" type="checkbox"/> |
| j) Inundation by seiche, tsunami, or mudflow?   | <input type="checkbox"/>             | <input type="checkbox"/>  | <input type="checkbox"/>           | <input checked="" type="checkbox"/> |
| <b>IX. LAND USE AND PLANNING – Would the Project:</b>   |                                      |   |                                    |                                     |
| a) Physically divide an established community?  | <input type="checkbox"/>             | <input type="checkbox"/>  | <input type="checkbox"/>           | <input checked="" type="checkbox"/> |
| b) Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the Project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect? | <input type="checkbox"/>             | <input type="checkbox"/>  | <input type="checkbox"/>           | <input checked="" type="checkbox"/> |
| c) Conflict with any applicable habitat conservation plan or natural community conservation plan?   | <input type="checkbox"/>             | <input type="checkbox"/>  | <input type="checkbox"/>           | <input checked="" type="checkbox"/> |
| <b>X. MINERAL RESOURCES – Would the Project:</b>  |                                      |   |                                    |                                     |
| a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?  | <input type="checkbox"/>             | <input type="checkbox"/>  | <input type="checkbox"/>           | <input checked="" type="checkbox"/> |
| b) Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?   | <input type="checkbox"/>             | <input type="checkbox"/>  | <input type="checkbox"/>           | <input checked="" type="checkbox"/> |
| <b>XI. NOISE – Would the Project result in:</b>   |                                      |   |                                    |                                     |
| a) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?   | <input type="checkbox"/>             | <input type="checkbox"/>  | <input type="checkbox"/>           | <input checked="" type="checkbox"/> |
| b) Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?   | <input type="checkbox"/>             | <input type="checkbox"/>  | <input type="checkbox"/>           | <input checked="" type="checkbox"/> |
| c) A substantial permanent increase in ambient noise levels in the Project vicinity   | <input type="checkbox"/>             | <input type="checkbox"/>  | <input type="checkbox"/>           | <input checked="" type="checkbox"/> |

| IMPACT  | POTENTIALLY<br>SIGNIFICANT<br>IMPACT | POTENTIALLY<br>SIGNIFICANT<br>UNLESS<br>MITIGATION<br>INCORPORATION | LESS THAN<br>SIGNIFICANT<br>IMPACT | NO IMPACT                           |
|---|--------------------------------------|---|------------------------------------|-------------------------------------|
| above levels existing without the Project?  |                                      |   |                                    |                                     |
| d) A substantial temporary or periodic increase in ambient noise levels in the Project vicinity above levels existing without the Project?  | <input type="checkbox"/>             | <input type="checkbox"/>  | <input type="checkbox"/>           | <input checked="" type="checkbox"/> |
| e) For a Project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the Project expose people residing or working in the Project area to excessive noise levels? | <input type="checkbox"/>             | <input type="checkbox"/>  | <input type="checkbox"/>           | <input checked="" type="checkbox"/> |
| f) For a Project within the vicinity of a private airstrip, would the Project expose people residing or working in the Project area to excessive noise levels?  | <input type="checkbox"/>             | <input type="checkbox"/>  | <input type="checkbox"/>           | <input checked="" type="checkbox"/> |

**XII. POPULATION AND HOUSING – Would the Project?**

|   |                          |                          |                          |                                     |
|---|--------------------------|--------------------------|--------------------------|-------------------------------------|
| a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| b) Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| c) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |

**XIII. PUBLIC SERVICES**

|  |                          |                          |                          |                                     |
|--|--------------------------|--------------------------|--------------------------|-------------------------------------|
| a) Would the Project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services: |                          |                          |                          |                                     |
| Fire protection?   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| Police protection?   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| Schools?   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |

|                          | POTENTIALLY<br>SIGNIFICANT<br>IMPACT | POTENTIALLY<br>UNLESS<br>MITIGATION<br>INCORPORATION | POTENTIALLY<br>SIGNIFICANT<br>LESS THAN<br>SIGNIFICANT<br>IMPACT | NO IMPACT                           |
|--------------------------|--------------------------------------|--|--|-------------------------------------|
| Parks?                   | <input type="checkbox"/>             | <input type="checkbox"/>                             | <input type="checkbox"/>   | <input checked="" type="checkbox"/> |
| Other public facilities? | <input type="checkbox"/>             | <input type="checkbox"/>                             | <input type="checkbox"/>   | <input checked="" type="checkbox"/> |

**XIV. RECREATION**

a) Would the Project increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?

b) Does the Project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?

**XV. TRANSPORTATION/TRAFFIC – Would the Project:**

a) Cause an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume to capacity ratio to roads, or congestion at intersections?

b) Exceed, either individually or cumulatively, a level of service standard established by the county congestion/management agency for designated roads or highways?

c) Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks?

d) Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?

e) Result in inadequate emergency access?

f) Result in inadequate parking capacity?

g) Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks)?

**XVI. UTILITIES AND SERVICE SYSTEMS – Would the Project?**

| IMPACT  | POTENTIALLY<br>SIGNIFICANT<br>IMPACT | POTENTIALLY<br>SIGNIFICANT<br>UNLESS<br>MITIGATION<br>INCORPORATION | LESS THAN<br>SIGNIFICANT<br>IMPACT | NO IMPACT                           |
|---|--------------------------------------|---|------------------------------------|-------------------------------------|
| a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?   | <input type="checkbox"/>             | <input type="checkbox"/>  | <input type="checkbox"/>           | <input checked="" type="checkbox"/> |
| b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?                            | <input type="checkbox"/>             | <input type="checkbox"/>  | <input type="checkbox"/>           | <input checked="" type="checkbox"/> |
| c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?                                     | <input type="checkbox"/>             | <input type="checkbox"/>  | <input type="checkbox"/>           | <input checked="" type="checkbox"/> |
| d) Have sufficient water supplies available to serve the Project from existing entitlements and resources, or are new or expanded entitlements needed?  | <input type="checkbox"/>             | <input type="checkbox"/>  | <input type="checkbox"/>           | <input checked="" type="checkbox"/> |
| e) Result in a determination by the wastewater treatment provider which serves or may serve the Project that it has adequate capacity to serve the Project's projected demand in addition to the provider's existing commitments? | <input type="checkbox"/>             | <input type="checkbox"/>  | <input type="checkbox"/>           | <input checked="" type="checkbox"/> |
| f) Be served by a landfill with sufficient permitted capacity to accommodate the Project's solid waste disposal needs?  | <input type="checkbox"/>             | <input type="checkbox"/>  | <input type="checkbox"/>           | <input checked="" type="checkbox"/> |
| g) Comply with federal, state, and local statutes and regulations related to solid waste?   | <input type="checkbox"/>             | <input type="checkbox"/>  | <input type="checkbox"/>           | <input checked="" type="checkbox"/> |

**XVII. MANDATORY FINDINGS OF SIGNIFICANCE**

|  |                          |                          |                          |                                     |
|--|--------------------------|--------------------------|--------------------------|-------------------------------------|
| a) Does the Project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number of restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
|--|--------------------------|--------------------------|--------------------------|-------------------------------------|

| IMPACT   | POTENTIALLY SIGNIFICANT IMPACT | POTENTIALLY UNLESS MITIGATION INCORPORATION | LESS THAN SIGNIFICANT IMPACT | NO IMPACT                           |
|--|--------------------------------|---|------------------------------|-------------------------------------|
| b) Does the Project have impacts that are individually limited, but cumulatively considerable? (“Cumulatively considerable” means 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 probably future projects)? | <input type="checkbox"/>       | <input type="checkbox"/>                    | <input type="checkbox"/>     | <input checked="" type="checkbox"/> |
| c) Does the Project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?  | <input type="checkbox"/>       | <input type="checkbox"/>                    | <input type="checkbox"/>     | <input checked="" type="checkbox"/> |

## 10.2 Thresholds Of Significance

For the purposes of making impact determinations, potential impacts were determined to be significant if the Proposed Project or its alternatives would result in changes in environmental condition that would, either directly or indirectly, cause a substantial loss of habitat or substantial degradation of water quality or other resources.

## 10.3 Discussion of Environmental Impacts

The analysis of potential environmental impacts is based on the possible changes in pest management methods or possible approaches to controlling runoff of diazinon and chlorpyrifos in response to the proposed Basin Plan Amendment. The evaluation is based on the alternative strategies described in Section 6.5 of this report, in Karkoski et al. (2003) and in Beaulaurier et al. (2005).

### 10.3.1 Aesthetics

The proposed Basin Plan Amendment will likely result in changes in pest management practices on crops. Potential practices are described in Section 6.5 of this report, in Karkoski et al. (2003), and in Beaulaurier et al. (2005). None of those practices would alter any scenic vistas, damage scenic resources, degrade the visual character of any site, or adversely affect day or nighttime views.

### 10.3.2 Agricultural Resources

The alternative strategies described in Section 6.5 of this report, Karkoski and others (2003) and Beaulaurier and others (2005), or other potential strategies that could be pursued by

growers, are unlikely to lead to a conversion of agricultural land to other uses. Conservation buffers, which may be installed to reduce runoff containing pesticides, are considered to be agricultural land.

Regional Water Board staff has reviewed the potential range of costs of the proposed implementation program, as well as the potential range of costs of alternative pest management strategies and water management practices that might be employed by growers. This review has shown that growers have a wide range of alternatives to diazinon and chlorpyrifos available to both maintain control of pests and to minimize or eliminate water quality impacts. Based on the wide range of options available, growers should be able to choose an approach appropriate to their crop and field that will minimize costs, allow them to continue farming, and meet Water Quality Objectives and Load Allocations.

The review has also shown the availability of alternative irrigation methods that could be implemented to reduce diazinon and chlorpyrifos in irrigation runoff. As with alternative pest control methods, there is a range of irrigation options available, and growers should be able to choose an approach appropriate to their crop and field that will minimize costs, allow them to continue farming, and meet Water Quality Objectives.

The availability of Federal and State government funds for environmental conservation (e.g. EQIP, Proposition 13, and other funds) should allow growers to offset some of their costs, if they choose an approach that requires a large capital investment

### **10.3.3 Air Quality**

Implementation of some of the alternative pest management strategies and pesticide application technologies, especially those that result in a reduction in diazinon and chlorpyrifos use rates, could lead to a reduction in aerial drift, and therefore an improvement in air quality.

Some of the alternative pest management practices could lead growers to switch from diazinon and chlorpyrifos to other pesticides. In response to a Regional Water Board request, the DPR has evaluated those alternative pesticides to determine whether air quality could be impacted by use of the alternatives. It is DPR's opinion that a reduction in the use of diazinon and chlorpyrifos would result in an improvement in air quality, even if an increase in the use of alternative pesticides, such as carbaryl or pyrethroids, occurs (Segawa, 2004).

Under the Toxic Air Contaminant Program, DPR prioritizes pesticides for air monitoring based on human toxicity, use patterns, and volatility. The DPR and the California Air Resources Board monitor for a number of pesticides. In addition to the Toxic Air Contaminant Program, DPR tracks emissions of volatile organic compounds (VOCs) from pesticide products because they are precursors to ozone. It is unlikely that changes in use patterns due to regulatory action on diazinon and chlorpyrifos will cause DPR's goals for reduction of VOC emissions from pesticides to be exceeded (Segawa, 2004).

Changes to water management practices should result in improved water conservation. This will not have any affect on air quality.

#### **10.3.4 Biological Resources**

The proposed Basin Plan amendment is designed to reduce diazinon and chlorpyrifos in runoff to levels that are not toxic to organisms in the Delta Waterways. Therefore, effects of this Amendment on biological communities should be positive. Growers also currently use other pesticides, including pyrethroid and carbamate insecticides that, when present in runoff or in aquatic sediments, could have a negative effect on biological resources. These insecticides are commonly used on a variety of crops and under a wide range of conditions. Growers who currently use diazinon and chlorpyrifos may choose to switch to these or to other products to control pests in response to this Basin Plan Amendment, causing a further increase in the use of other pesticides.

In order to prevent the substitution of other potential biologically damaging pesticides for diazinon and chlorpyrifos, this Amendment includes monitoring requirements that will allow the Regional Water Board to identify potential impacts of pesticides in runoff. The Amendment also requires agricultural pesticide dischargers to implement control measures to insure compliance with Water Quality Objectives when alternatives to diazinon and chlorpyrifos have the potential to contaminate surface water or groundwater. The Basin Plan currently contains Water Quality Objectives that do not allow pesticides to impact beneficial uses, including aquatic life use. This Amendment does not change in any way, the applicability of these objectives. This Amendment also reinforces existing Central Valley Water Board policies regarding additive toxicity by explicitly addressing the additivity of diazinon and chlorpyrifos and alternatives to diazinon and chlorpyrifos.

Changes to water management practices should result in improved water conservation. Conserved water is potentially available to enhance in-stream flows and for other uses. This should not have any negative effect on biological resources.

#### **10.3.5 Cultural Resources**

Implementation of the proposed Basin Plan amendment is unlikely to affect cultural resources. None of the potential practices that growers might implement are likely to change the significance of any historical or archaeological resource, destroy a unique paleontological resource or geologic feature, or disturb any human remains.

#### **10.3.6 Geology and Soils**

Implementation of the Basin Plan amendment will not affect the geology of the region and will not expose people to additional geologic hazards. Growers may plant cover crops or buffer strips to increase soil infiltration and reduce runoff, which will likely reduce soil erosion. Changes to water management practices should result in improved water conservation, and will not result in increased erosion or siltation.

### **10.3.7 Hazards and Hazardous Materials**

During its regulatory process, DPR examines hazards posed by pesticides to workers and the public. Each product is evaluated for potential hazards, and any conditions necessary for the safe use of the material are required on the label or in specific regulations. Some of these requirements include use of protective clothing and respirators, use of a closed system for mixing and loading, or special training requirements for workers applying the pesticide.

Some of the pesticides that growers may use as alternatives to diazinon and chlorpyrifos, such as azinphos methyl, methidathion, and carbaryl, are restricted use pesticides. Restricted use pesticides require permits to purchase and apply, and usually require special handling procedures. Propargite is on DPR's Minimal Exposure Pesticide list, and requires special protection for workers due to its toxicity. Implementation of this Basin Plan amendment should not result in any increased exposure to hazards or hazardous material.

### **10.3.8 Hydrology and Water Quality**

None of the potential options to reduce diazinon and chlorpyrifos in runoff are likely to result in changes in drainage patterns that would increase erosion or siltation, increase the rate or amount of surface runoff, increase the risk of flooding, contribute to increases in storm water runoff that would exceed the capacity of stormwater drainage systems, or increase the chance of inundation by seiche, tsunami, or mudflow.

One of the approaches to reducing diazinon and chlorpyrifos in runoff is to increase the infiltration of stormwater into soil, rather than allowing it to run off the end of the orchard or field. Increasing infiltration is not likely to result in groundwater contamination with pesticides, especially in soils with moderate to high clay and organic matter content. Pyrethroids, and some of the alternatives to diazinon and chlorpyrifos have very high soil adsorption coefficients that cause them to bind tightly to soils, and therefore these pesticides would not be carried more than a few inches below the soil surface. Other pesticides break down quickly through microbial decomposition and, therefore, do not persist long enough to be carried to groundwater.

The amendment includes a policy that requires growers to evaluate whether an alternative pesticide could potentially result in groundwater contamination or violation of surface Water Quality Objectives. The policy states that growers should use an alternative that will not result in groundwater contamination or violation of surface Water Quality Objectives.

Changes to water management practices should result in improved water conservation. Conserved water is potentially available to enhance in-stream flows and for other uses. Reducing runoff of diazinon and chlorpyrifos may also result in the reduction of other contaminants (e.g. nutrients and sediment), which would enhance water quality. This Amendment is not expected to have any negative effect on hydrology and water quality.



### **10.3.9 Land Use and Planning**

Implementation of the proposed Basin Plan amendment should not result in any changes in land use or planning. See discussion of Agricultural Resources above.

### **10.3.10 Mineral Resources**

The effect of the proposed Basin Plan amendment should be limited to land currently under agricultural production, and there should be no impact to mineral resources.

### **10.3.11 Noise**

The proposed Basin Plan amendment could lead to changes in the way in which diazinon and chlorpyrifos are applied. The alternative practices should not lead to any increase in exposure to noise. The proposed Basin Plan amendment should have no impact on noise in the project area.

### **10.3.12 Population and Housing**

The proposed Basin Plan amendment will likely result in changes in pest management practices on orchards and certain field crops. Those changes in pest management practices would not directly or indirectly induce population growth in the area, displace existing housing, or displace people. The proposed Basin Plan amendment should not have an impact on population and housing.

### **10.3.13 Public Services**

The proposed Basin Plan amendment will not have an impact on public services. If the implementation program for the Basin Plan amendment is administered at the county level, CACs may need to add as many as two additional staff, depending on the county. These potential staff increases should not require new or altered government facilities.

### **10.3.14 Recreation**

There should be no increase in use of parks or recreational facilities or the need for new or expanded recreational facilities as a result of this proposed Basin Plan amendment.

### **10.3.15 Transportation/Traffic**

The proposed Basin Plan amendment will not have an impact on transportation/traffic. None of the potential alternative practices should result in changes in traffic or require changes in traffic infrastructure.

### **10.3.16 Utilities and Service Systems**

The proposed Basin Plan amendment will likely result in changes in pest management practices on orchards and some field crops. No wastewater treatment requirements for diazinon and chlorpyrifos in agricultural runoff have been established by the Regional Water Boards. No wastewater treatment requirements have been established for diazinon and chlorpyrifos from other potential sources, such as urban runoff or municipal treatment plants in the project area, due to the phase-out of the use of these pesticides in urban settings. The proposed Basin Plan amendment should not result in changes in wastewater treatment requirements.

None of the potential alternative practices would cause the construction of new water or wastewater treatment plants or the expansion of existing plants for control of diazinon and chlorpyrifos in runoff from agricultural fields. The phase-out of the residential use of diazinon and chlorpyrifos makes it highly unlikely that these pesticides would be present in the effluent of municipal wastewater treatment plants at levels requiring additional wastewater treatment controls.

The proposed Basin Plan amendment does not require and should not result in the construction or expansion of new storm water drainage facilities. The most feasible practices for the control of diazinon and chlorpyrifos in agricultural runoff are changes in on-field practices, including changes in pest management and water management practices.

The proposed Basin Plan amendment should not result in significant changes in water supply. One of the potential alternative practices that could be used by growers would be the use of cover crops to increase infiltration and reduce surface runoff of water, which may contain diazinon, chlorpyrifos and other contaminants. The use of cover crops may or may not require additional irrigation water, but it should also result in reduced evaporation from soil surfaces, with little net change in irrigation water needs. Changes to water management practices should result in improved water conservation.

The proposed Basin Plan amendment should not require any changes in wastewater treatment services. The potential practices that could be applied by growers should not result in any changes in the generation of solid waste and therefore should not impact landfill capacity. The potential practices that could be applied by growers should not result in any changes in the generation of solid waste and therefore should not affect compliance with federal, state, or local statutes and regulations related to solid waste.

### **10.3.17 Mandatory Findings of Significance**

The Basin Plan amendment is designed to reduce diazinon and chlorpyrifos concentrations in the Delta Waterways, and to ensure that increased use of the alternatives to these pesticides will not degrade water quality. The Water Quality Objectives and Allocations established by this amendment are designed to eliminate the impacts of diazinon and chlorpyrifos to aquatic life in the Delta Waterways. This Basin Plan amendment does not require or allow any changes in pesticide application practices that could degrade the quality of the environment or

have environmental effects that could cause substantial indirect or direct adverse effects on human beings.

The proposed Basin Plan amendment will likely result in changes in pest management and water management practices on orchards and on some field crops. Growers may use other pesticides instead of diazinon and chlorpyrifos, and they may apply pesticides less frequently. The Regional Water Board's Basin Plan amendment, therefore, addresses the identified water quality impacts from diazinon and chlorpyrifos in runoff, as well as the potential impact of other pesticides applied to orchards and fields.

There are no probable future changes in Regional Water Board programs that would lead to cumulatively significant impacts when combined with likely impacts from the proposed Basin Plan amendment.

## **11 PUBLIC PARTICIPATION AND AGENCY CONSULTATION**

Two public workshops have been held in the preparation of this proposed Basin Plan Amendment. A public workshop was held on January 19, 2005 in Stockton to obtain comments on the proposed scope of the Basin Plan Amendment. No comments on changing the scope of this proposed Basin Plan Amendment were received at that meeting or at any other time during the scoping period for this Amendment. The peer review draft of this Staff Report was made publicly available in February 2006, and the public review draft was made available in April 2006. Another public workshop was held on April 27, 2006 in Sacramento to provide information and obtain comments related to this draft Staff Report and the proposed Basin Plan Amendment. Staff has also contacted representatives of municipalities, agricultural and environmental groups to see if they have any questions or concerns regarding the amendment to discuss before the June Board hearing.

The following agencies participated in the development of this draft amendment, through receipt of mailings pertaining to development of the amendment, attendance at public workshops, and submission of comments on the amendment: California Department of Pesticide Regulation; California Department of Fish and Game; National Oceanic and Atmospheric Administration – Fisheries; U.S. Fish and Wildlife Service; and U.S. Environmental Protection Agency.

## 12 REFERENCES

- ANZECC (Australian and New Zealand Environment and Conservation Council). 2000. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Vol. 1. Ch. 1-7.
- Azimi-Gaylon, S., D. Beaulaurier, L.F. Grober, E.L. Reyes, M.J. McCarthy and T. Tadlock. 2002 draft. *Implementation Framework Report for the Control of Diazinon and Chlorpyrifos in the San Joaquin River*. Staff Report, California Regional Water Quality Control Board, Central Valley Region. Sacramento, California. September 2002.
- Bailey, H. C., J. L. Miller, M. J. Miller, L.C.Wiborg, L. Deanovic and T. Shed. 1997. Joint Acute Toxicity of Diazinon and Chlorpyrifos to Ceriodaphnia Dubia. *Environmental Toxicology and Chemistry* Vol. 16, No.11, pp. 2304-2308.
- Bailey, B.C., L. Deanovic, E. Reyes, T. Kimball, K. Larson, K. Cortright, V. Connor, and D.E. Hinton. 2000. Diazinon and Chlorpyrifos in Urban Waterways in Northern California, USA. *Environmental Toxicology and Chemistry* 19:82-87.
- Beaulaurier, D., G. Davis, J. Karkoski, M. McCarthy, D. McClure, M. Menconi. 2005. Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Diazinon and Chlorpyrifos Runoff into the Lower San Joaquin River. California Regional Water Quality Control Board, Central Valley Region. Sacramento, CA.
- Calanchini, H.J., M. Johnson and A. Wehrmann. 2004. A Brief Summary of the 2004 TMDL monitoring for Diazinon in California's Sacramento Valley Waterways, January-March 2004. John Muir Institute of the Environment, University of California, Davis. Davis, CA.
- CALFED. 1999. Ecosystem Restoration Program Plan Vol. 1 – Ecological Attributes of the San Francisco Bay-Delta Watershed. CALFED. Sacramento CA.
- CCME. 1999a. Canadian Council of Ministers of the Environment. 1991. Appendix IX - A Protocol for the Derivation of Water Quality Guidelines for the Protection of Aquatic Life (April 1991). In: Canadian Water Quality Guidelines, Canadian Council of Resource and Environment Ministers, 1987. Prepared by the Task Force on Water Quality Guidelines. [Updated and reprinted with minor revisions and editorial changes in Canadian environmental quality guidelines, Chapter 4, Canadian Council of Ministers of the Environment, 1999, Winnipeg.
- CCME. 1999b. Canadian Water Quality Guidelines for the Protection of Aquatic Life: Chlorpyrifos. In: Canadian environmental guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

- CCME. 2002. Summary of Existing Canadian Environmental Quality Guidelines. Canadian Environmental Quality Guidelines (CCME). [http://www.ccme.ca/assets/pdf/e1\\_06.pdf](http://www.ccme.ca/assets/pdf/e1_06.pdf)
- CIWMC. 1999. California Interagency Watershed Map of 1999 (CalWater 2.2.1). California Interagency Watershed Mapping Committee (<http://cain.nbii.gov/calwater/>).
- California Regional Water Quality Control Board, Central Valley Region. (CRWQCB-CVR) 1998. The Water Quality Control Plan (Basin Plan) for the California Regional Water Quality Control Board, Central Valley Region — The Sacramento River Basin and The San Joaquin River Basin. Fourth Edition.
- CRWQCB-CVR, 2003. Bay Protection Program Toxic Hot Spot Cleanup Plans for Diazinon in Orchard Dormant Spray, Diazinon and Chlorpyrifos in Urban Stormwater, Chlorpyrifos in Irrigation Return Flow. CRWQCB-CVR Resolution No. R5-2003-0034. Sacramento, CA.
- CRWQCB-CVR. 2004. Response to Petition for Expedited Action to Correct Diazinon Water Quality Objectives. Letter from Thomas Pinkos (CRWQCB-CVR) to David B. Weinberg (Howrey, Simon, Arnold & White). Sacramento, California. 11 August 2004
- Deanovic, L., H. Bailey, T.W. Shed, and D.E. Hinton. 1996. Sacramento-San Joaquin Delta Bioassay Monitoring Report: 1993-1994. First annual report to the California Regional Water Quality Control Board-Central Valley Region. May 1996. Aquatic Toxicology Laboratory, UC Davis.
- Deanovic, L., C. Cortright, K. Larsen, E. Reyes, H. Bailey, and D.E. Hinton. 1998. Sacramento-San Joaquin Delta Bioassay Monitoring Report: 1994-1995. Second annual report to the California Regional Water Quality Control Board-Central Valley Region. Aquatic Toxicology Laboratory, UC Davis.
- Deener, J.W., T.L. Sinnige, W. Seinen and J.L.M. Hermens. 1988. The Joint Acute Toxicity to *Daphnia Magna* of Industrial Organic Chemicals at Low Concentrations. Aquatic Toxicology, Vol 12 p. 33-38.
- Domagalski, J.L., and K.M. Kuivila. 1993. Distributions of Pesticides and Organic Contaminants Between Water and Suspended Sediments, San Francisco Bay, California. Estuaries, Vol. 16 No. 3A, p. 416-426.
- DPR. 2003. Notice of Decision to Begin Reevaluation of Pesticide Products Containing Diazinon. California Department of Pesticide Regulation (DPR). Signed by Barry Cortez, Chief, Pesticide Registration Branch, Department of Pesticide Regulation. February 19, 2003. California Notice 2003-2.
- DPR. 2004. Notice of Decision to Begin Reevaluation of Pesticide Products Containing Chlorpyrifos. California Department of Pesticide Regulation (DPR). Signed by Barry Cortez, Chief, Pesticide Registration Branch, Department of Pesticide Regulation. March 11, 2004. California Notice 2004-4.

- DPR. 2005a. Pesticide Use Report Database. California Department of Pesticide Regulations (DPR). Sacramento, CA. ([http:// http://www.cdpr.ca.gov/docs/pur/purmain.htm](http://www.cdpr.ca.gov/docs/pur/purmain.htm), accessed July 2005)
- DPR. 2005b. Notice of Proposed Regulatory Action, Dormant Insecticide Contamination Prevention. California Department of Pesticide Regulations (DPR). Sacramento, CA
- DWR. 1995. Sacramento-San Joaquin Delta Atlas. California Department of Water Resources (DWR). Sacramento, CA .
- Foe, C. 1995. Evaluation of the Potential Impact of Contaminants on Aquatic Resources in the Central Valley and Sacramento-San Joaquin Delta Estuary. California Regional Water Quality Control Board, Central Valley Region. Sacramento, CA.
- Felsot, A. 2005. A Critical Analysis of the Draft Report, "Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Diazinon and Chlorpyrifos Runoff into the Lower San Joaquin River" (Karkoski et al. 2004)
- Finlayson, B. 2004a. Memo from Brian Finlayson, Chief, Pesticide Investigations Unit, California Department of Fish and Game to Joe Karkoski (CRWQCB-CVR).Re: Water Quality for Diazinon. July 30, 2004.
- Finlayson, B. 2004b. Letter from Brian Finlayson, Chief, Pesticide Investigations Unit, California Department of Fish and Game to Lenwood Hall, University of Maryland Agricultural Experiment Station. Re: Toxicity of Diazinon to the Amphipod *Gammarus pseudolimnaeus*. May 17, 2004.
- Fox, J. P., T. R. Mongan and W. J. Miller.1991. Long-term annual and seasonal trends in surface salinity of San Francisco Bay. *Journal of Hydrology* 122 (1991) 93-117.
- Giddings, J.M., L.W. Hall Jr., and K.R. Solomon. 2000. Ecological Risks of Diazinon from Agricultural Use in the Sacramento-San Joaquin River Basins, California. *Risk Analysis Journal. Society for Risk Analysis*. Vol. 20, No. 5., p. 545-572.
- Herbold, B. and P. Moyle. 1989. *The Ecology of the Sacramento-San Joaquin Delta: a Community Profile*. US Fish and Wildlife Service. Washington, DC.
- Hieb, K., M. Bryant, M. Dege, T. Greiner, K. Souza, and S. Slater. 2005. Fishes in the San Francisco Estuary, 2004 Status and Trends. *Interagency Ecological Program Newsletter*. Volume 18, Number 2, Spring 2004: 19-36. Interagency Ecological Program for the San Francisco Estuary. Sacramento, CA.
- Ingersoll, C. 2004. Letter from Chris Ingersoll, USGS Columbia Environmental Research Center, to Lenwood Hall, University of Maryland Agricultural Experiment Station. Re: Diazinon toxicity data for *Gammarus fasciatus* reported in Johnson and Finley (1980) and in Mayer and Ellersieck (1986). May 19, 2004.

- Karkoski, J., G. Davis, J. Dyke, D. McClure, and M. Menconi. 2003. Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Orchard Pesticide Runoff and Diazinon Runoff into the Sacramento and Feather Rivers. California Regional Water Quality Control Board, Central Valley Region. Sacramento, CA.
- Kuivila, K.M., and Foe, C. 1995. Concentrations, transport and biological effects of dormant spray pesticides in the San Francisco estuary, California. *Environmental Toxicology and Chemistry*, vol. 14, No.7, pp. 1141-1150.
- Landau, K. 2006. Corrections To Basin Plan Amendment for the Control of Diazinon and Chlorpyrifos Runoff into the San Joaquin River. Memo from Ken Landau (Acting Executive Officer, California Regional Water Quality Control Board, Central Valley Region) to Celeste Cantu (Executive Director, State Water Resources Control Board) dated January 26, 2006.
- Larkin, D.J., and R.S. Tjeerdema. 2000. Fate and Effects of Diazinon. *Reviews of Environmental Contamination and Toxicology* 166: 49-82
- Linde, C. D. 1994. Physico-Chemical Properties and Environmental Fate of Pesticides. California Department of Pesticide Regulations. Sacramento, CA.
- MacCoy, D., K. Crepeau, and K. Kuivila. 1995. Dissolved pesticide data for the San Joaquin River at Vernalis and the Sacramento River at Sacramento, California, 1991-1994. Open-File Report 95-110. U.S. Geological Survey, Denver, CO.
- Majewski, M. S., C. Zamora, W. Foreman, and C. Kratzer. 2005. Contribution of Atmospheric Deposition to Pesticide Loads in Surface Water Runoff. USGS Open File Report 2005-1307. US Geological Survey. Sacramento, CA.
- MANA. 2004a, 2004b and 2004c. Letters from Andy Eimanis, Regulatory Affairs Manager, to USEPA regarding Draft Diazinon Aquatic Life Ambient Water Quality Criteria dated March 29, April 12 and June 23, 2004. Makhteshim Agan of North America (MANA). New York, NY.
- MANA. 2004d. Supplemental Label, Diazinon 50W Insecticide, EPA Registration Number 66222-10. Makhteshim Agan of North America (MANA). New York, NY.
- Marshack, J.B. 2003. *A Compilation of Water Quality Goals*. California Regional Water Quality Control Board, Central Valley Region (CRWQCB-CVR). Sacramento, CA.
- Mencum, W.L. 2005. Zooplankton Monitoring. Interagency Ecological Program Newsletter. Volume 18, Number 2, Spring 2004: 10-16. Interagency Ecological Program for the San Francisco Estuary. Sacramento, CA.



- Novartis Crop Protection, Inc. 1997. Ecological Risk Assessment of Diazinon in the Sacramento-San Joaquin Basins. Technical Report 11/97. Environmental and Public Affairs Department. Greensboro, NC.
- NLM. 2002. Hazardous Substances Data Bank. Results of an online (<http://www.toxnet.nlm.nih.gov/>) query for diazinon conducted on 8/5/2003 National Library of Medicine (NLM). Bethesda, MD.
- Poletika, N.N. and C.K. Robb. 1998. A Monitoring Study to Characterize Chlorpyrifos Concentration Patterns and Ecological Risk in an Agricultural Dominated Tributary of San Joaquin River. Dow AgroSciences.
- Reyes, E., L. Deanovic, D. Hinton, and C. Foe. 2000. Orchard In-Season Spray Toxicity Monitoring Results: 1997. UC Davis Aquatic Toxicology Laboratory. Davis, CA.
- Reyes, E. and M. Menconi. 2002. Agricultural Practices and Technologies Report. Staff report of the California Regional Water Quality Control Board, Central Valley Region (May 2002 Draft Report)  
[http://www.waterboards.ca.gov/centralvalley/programs/tmdl/sjrop/ag\\_practices\\_report.pdf](http://www.waterboards.ca.gov/centralvalley/programs/tmdl/sjrop/ag_practices_report.pdf)
- Scholz, N. L. et al. 2000. Diazinon Disrupts Antipredator and Homing Behaviors in Chinook Salmon (*Oncorhynchus tshawytscha*). *Canadian Journal of Fisheries and Aquatic Sciences*. 57:1911-1918.
- Segawa, R. 2004. Electronic mail from Randy Segawa (California Department of Pesticide Regulations) to Mary Menconi (CRWQCB-CVR), on November 12, 2002, regarding CEQA checklist on possible environmental impacts from attached list of pesticides. Telephone conversation in 2004 with Diane Beaulaurier to confirm contents of email were still applicable.
- Seiber, J.N., B.W. Wilson, M. McChesney. 1993. Air and Fog Deposition Residues of Four Organophosphate Insecticides Used on Dormant Orchards in the San Joaquin Valley, California. *Environmental Science and Technology*, Vol 27, No 10, pp 2236-2243 1993.
- SFEI. 2005. Regional Monitoring Program, Total Pesticide Concentrations in Water Samples. Accessed online at <http://www.sfei.org>. San Francisco Estuary Institute. Oakland, CA.
- Sheipline, R. 1993. Background Information on Nine Selected Pesticides. Staff Report of the California Regional Water Quality Control Board, Central Valley Region. Sacramento, CA.
- Siepmann, S. and B.J. Finlayson. 2000. Water quality criteria for diazinon and chlorpyrifos. California Department of Fish and Game. Office of Spill Prevention and Response Administrative Report 00-3. Sacramento, CA.

- SWRCB. 1974. Water Quality Control Policy for the Enclosed Bays and Estuaries of California. State Water Resources Control Board. Sacramento, CA.
- SWRCB. 2003. Final 2002 Clean Water Act Section 303(d) List of Water Quality Limited Segments (Region 5). State Water Resources Control Board (SWRCB). Sacramento, California. Available: <http://www.waterboards.ca.gov/tmdl/docs/2002reg5303dlist.pdf>.
- SWRCB 2004 Policy For Implementation And Enforcement Of The Nonpoint Source Pollution Control Program. State Water Resources Control Board. Sacramento, CA.
- SWRCB 2005. Water Quality Control Policy of Addressing Impaired Waters. State Water Resources Control Board Resolution No. 2005-0050. Sacramento, CA.
- SWRCB and DPR 1997. State Water Resources Control Board and California Department of Pesticide Regulation Managing Agency Agreement. Sacramento, CA.
- TDC Environmental. 2003. Insecticide Market Trends and Potential Water Quality Implications. Available: [www.tdcenvironmental.com](http://www.tdcenvironmental.com). April 2003.
- USDA. 1995a. Agricultural Research Service Pesticide Properties Database. United States Department of Agriculture (USDA). Updated May 1995.  
<http://wizard.arsusda.gov/acsl/textfiles/DIAZINON> accessed April 3, 2002.
- USDA. 1995b. Agricultural Research Service Pesticide Properties Database. United States Department of Agriculture (USDA). Updated May 1995.  
<http://www.arsusda.gov/acsl/services/ppdb/textfiles/CHLORPYRIFOS> accessed April 11, 2006.
- USEPA. 1985. Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses. United States Environmental Protection Agency (USEPA). Washington, D.C.
- USEPA. 1986. Ambient water quality criteria for chlorpyrifos – 1986. United States Environmental Protection Agency (USEPA). Office of Water Document 440/5005. Washington, DC.
- USEPA. 2000a. Environmental Risk Assessment for Diazinon. Environmental Fate and Effects Division Revised Science Chapter for the Diazinon Reregistration Eligibility Decision Document. United States Environmental Protection Agency (USEPA). Washington, DC.
- USEPA. 2000b. Reregistration Eligibility Science Chapter for Chlorpyrifos, Fate and Environmental Risk Assessment Chapter. United States Environmental Protection Agency (USEPA). Washington, DC.

- USEPA. 2000c. Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California (California Toxic Rule). United States Environmental Protection Agency (USEPA). Washington, DC.
- USEPA. 2001. Fact sheet entitled "Diazinon Revised Risk Assessment and Agreement with Registrants." United States Environmental Protection Agency (USEPA). Washington, D.C.
- US EPA. 2002. Relative Potency Factors, EPA's Points of Departure and Revised Relative Potency Factors for the Cumulative Risk Assessment of the Organophosphate Pesticides. United States Environmental Protection Agency (USEPA). Washington, D.C.
- USEPA. 2005. Final Diazinon Aquatic Life Ambient Water Quality Criteria. United States Environmental Protection Agency (USEPA). Washington, DC.
- USEPA. 2006. Notice of Availability of Final Recommended Aquatic Life Ambient Water Quality Criteria for Diazinon. United States Environmental Protection Agency (USEPA). Washington, DC.
- USGS. 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. United States Geological Survey. Sacramento, CA.
- Weinberg, D.B. 2004a. Letter from David B. Weinberg (Howery, Simon, Arnold & White, Representing Makhteshim Agan of North America, Inc.) to Thomas Pinkos (California Regional Water Quality Control Board, Central Valley Region, CRWQCB-CVR) on June 18, 2004, regarding "Petition for Expedited Action to Correct Diazinon Water Quality Objectives".
- Weinberg, D.B. 2004b Letter from David B. Weinberg (Howery, Simon, Arnold & White, Representing Makhteshim Agan of North America, Inc.) to Thomas Pinkos (California Regional Water Quality Control Board, Central Valley Region, CRWQCB-CVR) on July 7, 2004 regarding "Petition for Expedited Action to Correct Diazinon Water Quality Objectives".
- Zabik, J.N. and J.N. Seiber. 1993. Atmospheric Transport of Organophosphate Pesticides from California's Central Valley to the Sierra Nevada Mountains. J. Environ. Qual. Vol. 22, pp 80-90.
- Zalom, F.G., M.N. Oliver, D.E. Hinton. 1999. Alternatives to Chlorpyrifos and Diazinon Dormant Sprays. Statewide IPM Project, Water Resources Center, and Exotoxicology Program, University of California, Davis. Davis, CA. Final Report. September, 1999.