Sacramento River Watershed Evaluation Report

Prepared for

Sacramento Valley Water Quality Coalition

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April 1, 2004

Acknowledgements.

More than two years ago, farmers throughout the Central Valley of California recognized the efficiencies to be gained by advancing a regional, scientific water quality management program to address discharges from irrigated lands. This regional approach is consistent with the federal Clean Water Act (CWA, 2002) and meets the challenges associated with managing nonpoint source pollution. The program provides the capacity for state regulatory authorities to work together with the regulated community to ensure implementation of management practices in an iterative fashion, not via a punitive process.

The membership of the Sacramento Valley Water Quality Coalition (Coalition) recognizes that implementation of such an iterative program is a long-term educational process that will help growers, and wetland managers understand impacts to water quality and, in response, modify their cultural practices to reduce those impacts. While this shift might come at a price, the farmers understand the need to remain true to their stewardship principles by minimizing impacts on the resources vital to their continued production and economic success.

The Coalition could not have prepared the Watershed Evaluation Report (WER) and the Monitoring and Reporting Program Plan (MRP) without the commitment and dedication of hundreds of individuals and organizations throughout the Sacramento River watershed. Representatives with particular agricultural expertise and a unique understanding of the geographic, hydrologic and agronomic features of their watershed have compiled the reports in each of the ten subwatersheds. Particular thanks must be given to the following individuals who provided input and guidance during the development of the reports.

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Mike Hardesty, Reclamation District No. 2068
Meda Benefield, Maine Prairie Water District

The Coalition would like to give special thanks the County Agricultural Commissioners, U.C. Cooperative Extension Advisors/Specialists, County Farm Bureaus, Natural Resources Conservation Service, Resource Conservation Districts, local Watershed Groups and local Water, Reclamation and Drainage Districts, who continue to be key partners in this effort. Their willingness to play a significant role in providing technical, educational and outreach support to farmers is invaluable. Their continued commitment will be critical to long-term management of the program.

The water quality regulations before California's Central Valley agricultural community are unprecedented in their scope and complexity. Without the tireless efforts of individuals and entities representing agricultural interests in the legislative, regulatory and judicial arenas, the rational "Coalition Group" alternative to managing this pressing water quality challenge would not have seen the light of day and individual farmers would almost certainly be subject to individual waste discharge requirements by this time.

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Introduction.

On July 2003, the Central Valley Regional Water Quality Control Board (Regional Board) adopted *a Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands* (Conditional Waiver for Irrigated Lands) Resolution No. R5-2003-0105. In January 2004, The State Water Resource Control Board (SWRCB) amended Resolution No. R5-2003-0105 and provided important guidance for the Coalition to move forward. The regulations provide for a watershed approach focused on a regional monitoring program and relies on a locally-driven outreach program to enhance and improve water quality.

The Sacramento River watershed (Sacramento River Basin, Central Valley Regional Water Quality Control Board, Region 5a) is the northern most hydrologic basin included in the Central Valley Conditional Waiver for Irrigated Lands Program and is represented by the Sacramento Valley Water Quality Coalition (Coalition). The Coalition was formed in 2002 to enhance and improve water quality in the Sacramento River watershed, while sustaining the economic viability of agriculture, associated values of managed wetlands and sources of safe drinking water. The Coalition is comprised of more than 200 agricultural and wetlands interests that have joined with local governments throughout the region to improve water quality for Northern California farms, cities and the environment.

The Coalition is dedicated to working with the Regional Board in developing a comprehensive approach to managing water quality on irrigated lands at the watershed level. This regional effort provides the framework necessary to meet water quality goals, help local subwatersheds meet regulatory requirements, and ensure that watershed management practices are broadly implemented through sustainable economic management measures.

In June 2003, the Coalition submitted a Regional Plan for Action (Plan) to the State Water Resources Control Board and the Central Valley Regional Water Quality Control Board. The Plan was resubmitted in October 2003 as the General Report for the Coalition with a Notice of Intent (NOI) to meet the newly adopted water quality regulations and obtain coverage under the Conditional Waiver for Irrigated Lands. More than 200 organizations throughout the Sacramento River watershed support the Plan and are committed to implementing a regional strategy to address water quality. The Coalition will evaluate a range of water quality parameters for the entire watershed rather than focusing only on specific water quality constituents, and will manage the region to meet the objectives in the Porter-Cologne Water Quality Control Act (Water Code 13000 et seq.).

On February 10, 2004, the Regional Board issued a Notice of Applicability (NOA) to the Coalition verifying the NOI was complete and approved with conditions. The NOA requires the Coalition to submit a watershed evaluation report and a monitoring and reporting program plan for the Sacramento River watershed by April 1, 2004. To implement the Plan and to meet the Conditional Waiver for Agricultural Lands requirements, the Coalition has prepared and is submitting the following documents that will serve as the foundation for a rational, phased water quality management program: (1) *Sacramento River Watershed Evaluation Report* (WER); and, (2) *Sacramento River Watershed Monitoring and Reporting Plan* (MRP).

The quantitative data and analysis presented in the above-mentioned reports is designed to provide a consistent and comprehensive approach to watershed management. This approach will support farmers and wetland managers in meeting water quality goals and regulatory requirements.

The following is a brief description of the WER and the MRP. Together these plans satisfy the requirements of the Conditional Waiver for Irrigated Lands.

Sacramento River Watershed Evaluation Report (WER)

The WER is a comprehensive and technical watershed assessment for irrigated agriculture in the twenty-one county region that comprises the Sacramento River watershed. The WER is organized into ten subwatersheds. Each subwatershed represents a unique geographic region delineated by hydrologic features as well as political boundaries. The WER delineates major drainages in each subwatershed. These drainages have been prioritized according to the presence of irrigated agriculture, major crop types, pesticide use, the presence of impaired waterbodies and other factors. Drainage prioritization in the WER provides subwatershed groups the ability to assess risk and efficiently utilize resources.

The WER components provide the foundation to establish monitoring priorities in the region and include the following features associated with each subwatershed:

- *Geography*
- *Climate*
- *Hydrology and Drainage Patterns*
- *Land Use*
- *Irrigated Lands/Managed Wetlands*
- *Aquatic Resources*
- *Crop Types*
- *Production Practices*
- *Pesticide Use/Chemical Use/Application/Timing of Application*
- *Known Water Quality Improvement Programs and Techniques Associated with Discharges from Irrigated Lands*
- *Inventory of Management Practices*
- *Water Quality Data and Information*
- *Management Practices Implementation Plan*
- *Subwatershed Drainage Priorities*

Sacramento River Watershed Monitoring and Reporting Program Plan (MRP)

The Coalition's regional water quality monitoring and reporting program is designed to evaluate the causes or contributions of toxicity in receiving waters. This information will provide the basis to determine the effectiveness of selected management practices that are most effective in

reducing waste discharges from irrigated lands to surface waters and provide an important tool to adaptively manage a change in those practices.

A monitoring plan has been developed for each subwatershed in the WER that is tailored to the unique circumstances in each area. The MRP builds upon historical monitoring and recommends a list of candidate drainages in the Sacramento River watershed. The Coalition will recommend sites selected from these candidate drainages to be monitored for toxicity during the irrigation and winter storm-season. The science-based monitoring sites, when pursued in an economically feasible manner, will help the Coalition understand the potential water quality impacts agricultural and managed wetland operations have upon surface waters in the Sacramento River watershed. Additionally, the monitoring will help the Coalition and the Regional Board:

- *Assess the impacts of waste discharges from irrigated lands to surface waters;*
- *Determine the degree of implementation of management practices to reduce discharge of specific waste that impact water quality;*
- *Determine the effectiveness of management practices and strategies to reduce discharges of waste that impacts water quality;*
- *Determine concentration and load of wastes in discharges;*
- *Comply with narrative and/or numeric water quality objectives.*

Management Program

In crafting the MRP, the Coalition takes a phased approach to both monitoring and addressing water quality problems. If monitoring results show a significant toxicity trend, the MRP proposes follow-up monitoring to understand the duration of the water quality impairment. If the magnitude and duration of the toxicity is sufficient to warrant implementation of management practices, the Coalition will mobilize its partners at the subwatershed level to work with growers to implement practices intended to improve water quality.

Section 1.0 Sacramento River Watershed Setting

1.1 General Characteristics

Map. Please refer to Figure 1: Sacramento River Watershed Land Use Map.

Geography. The Sacramento River watershed drains the northern part of California's prominent Central Valley into the middle and lower reaches of the Sacramento River. This 327-mi river drains over 27,000 square miles of land. The upper watershed of the Sacramento River region includes the drainages above Lake Shasta and Lake Oroville. The valley drainages include the upper Colusa and Cache Creek watershed on the west side of the valley, and the Feather River and American River watersheds on the east side of the valley. It is geographically continuous with the San Joaquin Valley to the south, but is defined by its distinct drainage basin. Beginning near the town of Red Bluff at its northern terminus, the valley stretches about 150 mi to the southeast where it merges into the broad expanse of the Sacramento-San Joaquin River Delta south of the Sacramento metropolitan area. The valley is 30 to 45 mi wide in the southern to central parts, but narrows to about 5 mi near Red Bluff. Its elevation decreases almost imperceptibly from 300 ft (feet) at its northern end to near sea level in the delta (Olmstead and Davis, 1961).

The geologic provinces composing the Sacramento River Watershed include the Klamath Mountains, the Coast Ranges, the Cascade Range/Modoc Plateau, the Sierra Nevada, and the Central Valley. Land cover within the Sierra Nevada and Cascades Ranges is principally forest. Forest and range land are mixed throughout the Coast Ranges and Modoc Plateau.

Climate. Sacramento Valley winters are cool and moist with fogs that may last for a week or more; summers are clear, hot, and dry. Summer hot spells that drive daytime temperatures into triple digits are relieved by cooling "Delta breezes" that carry moist air from San Francisco Bay eastward through the Delta and into the Sacramento area.

Rainfall is frequent in the winter, but snowfall is unusual because temperatures, particularly in the daytime, normally remain well above freezing. Average temperatures in July and January in Sacramento are 75ºF and 45ºF, respectively. Annual precipitation in Sacramento averages 17.2 inches; whereas, annual precipitation in Redding in the northern part of the Sacramento Valley averages 40.9 inches. In the high mountainous areas of the Sierra Nevada, precipitation averages 80 to 90 in. each year, primarily from heavy snowfall during the winter.

Soils. The Sacramento River Watershed contains four major landform types (each with its own characteristic soils): (1) floodplain, (2) basin rim/basin floor, (3) terraces, and (4) foothills and mountains. Floodplain alluvial soils make up some of the best agricultural land in the state. Basin landforms consist of poorly drained soils, and saline and alkali soils in the valley trough and on the basin rims. These soils are used mainly for pasture, rice, and cotton. Areas above

the valley floor have terrace and foothill soils, which are primarily used for grazing and timberland.

The upper watersheds of the Sacramento Valley mainly drain foothill soils. These soils are found on the hilly to mountainous terrain surrounding the Sacramento Valley and are formed in place through the decomposition and disintegration of the underlying parent material. The most prevalent foothill soil groups are those with a deep depth (>40 inches), shallow depth (<20 inches), and very shallow depth (<12 inches) to bedrock. Deep soils occur in the high rainfall zones at the higher elevations in the mountains surrounding the Sacramento Valley.

Shallow soils occur in the medium-to-low rainfall zones at lower elevations. The soils range from calcareous brown stony clay (for example, Lassen soils) to noncalcareous brown loam (for example, Vallecitos soils) and are used principally for grazing.

Very shallow soils are found on steep slopes, often at high elevations. They consist of stony clay loam or stony loam and are not useful for agriculture or timber because of their very shallow depth, steep slopes, and stony texture. As such, they also are rated very low for grazing purposes.

Hydrology-Drainage Patterns. On average, over 22 million acre-ft (acre-feet) of water flow through the Sacramento River watershed each year making it the largest river in California. This is approximately one-third of the total runoff in the State. The most intensive runoff occurs in the upper watershed of the Sacramento River above Lake Shasta and on the rivers originating on the west slope of the Sierra Nevada. These watersheds produce an annual average of 1,000-2,000 acre-feet of runoff per square mile.

The Sacramento River flow annually averages 19,000 cubic feet per second (cfs). The Sacramento River's hydrology has been profoundly altered by reservoir construction. At Red Bluff, the average annual flood flow was 121,000 cfs before construction of Shasta Dam (1879-1944), and 79,000 cfs after (1945-93). The 10-year flood has been reduced from 218,000 to 134,000 cfs.

The two major tributaries to the Sacramento River along its lower reach are the Feather River (which also includes flows from the Yuba River) and the American River. The Feather River, the largest natural tributary of the Sacramento River, originates in the Sierra Nevada and drains much of the eastern area of the Sacramento River watershed. The combined flows of the Feather River and Sutter Bypass enter the river near Verona. The American River joins the Sacramento River north of downtown Sacramento. Smaller contributions are made by the Natomas Cross Canal, draining the area between the Bear River and American River drainages, and the Colusa Basin Drain, which drains the west side of the Sacramento Valley from about Willows south to Knights Landing. Many smaller tributaries originate in the coastal mountains and in the Sierra Nevada.

The flows of the Sacramento River are controlled mainly by Shasta Dam and, to a lesser extent, by dams on the Feather, Yuba, and American Rivers. Part of the runoff from winter rains and spring snowmelt is stored in reservoirs and released during the normally dry summer months. Winter flow in the watershed is affected by reservoir releases, storm runoff, and diversions to bypass channels used for flood control.

The Sacramento River watershed is comprised of 244 drainages hydrologically linked to the following major tributaries to the Sacramento River by subwatershed area. Drainage level maps are provided for each subwatershed highlighted in Section 4. The regional subwatersheds contain the following major drainages:

Pit River Subwatershed: Fall River, Burney Creek, Pit River
Shasta-Tehama Subwatershed: Clear Creek, Cow Creek, Anderson Creek, Battle Creek, Antelope Creek, Mill Creek, Deer Creek, Cottonwood Creek, Reeds Creek, Elder Creek, Thomes Creek, Burch Creek, Capay Creek.
Colusa Basin: Colusa Basin Drain, Stony Creek
Lake-Napa Subwatershed: Upper Cache Creek, Upper Putah Creek
Solano-Southern Yolo Subwatershed: Cache Slough, Lower Cache Creek, Lower Putah Creek, Willow Slough
Upper Feather – Upper Yuba Subwatershed: North Fork Feather River, Middle Fork Feather River, Lower Yuba River, Upper Bear River
Butte-Sutter-Yuba Subwatershed: Big Chico Creek, Butte Creek, Sutter Bypass, Lower Yuba River, Lower Bear River
Placer – No. Sacramento Subwatershed: Natomas East Main Drain, Natomas Cross Canal, American River
El Dorado Subwatershed: South Fork American River; North & Middle Fork Cosumnes River
Sacramento – Amador Subwatershed: Cosumnes River, Mokelumne River, Dry Creek, Elder Creek, Morrison Creek

Land Use. Land uses in the Sacramento River Basin are principally agricultural, silvicultural, and open space, with urban development focused around the City of Sacramento. More than half the region's population lives in the greater metropolitan Sacramento area. Other fast-growing communities include Vacaville, Dixon, Redding, Chico, Yuba City and various Sierra Nevada foothill towns. Urban development has occurred along major highway corridors in Placer, El Dorado, Yolo, Solano, and Sutter Counties, and has taken some irrigated agricultural land out of production. The suburban ranchette homes on relatively large parcels that surround many of the urban areas often include irrigated pastures or small orchards.

Agriculture is the dominant land use on the valley floor followed by urban development. About 2,300 mi² in the watershed are devoted to agricultural use. Land use on the valley floor is shown in Figure 1. Land once occupied by flood basins on either side of the Sacramento River is affected by shallow ground water and silty, poorly draining soils. Much of that area is planted in rice. Historically, rice was the most prominent crop in the Sacramento River watershed, accounting for 30% of the total irrigated agricultural acres. The next most prominent crops in the

Sacramento River Basin are irrigated pasture and orchards, each accounting for 20% of the total irrigated acres. Row crops and orchards requiring well-drained land are grown on soil derived from alluvial fans and the coarser soils associated with stream channels and elevated natural deposits that built up around the larger rivers and streams. Stone fruit and almond orchards occupy about 290 mi², mostly in the northern and central parts of the valley. (California Department of Water Resources (DWR), 1990, 1994a,b, 1995a,b,c,d, 2000).

Between 1944 and 1964, the number of farms in the Sacramento River watershed increased from 9,948 in 1944 to 11,538 in 1954, then declined to 9,255 in 1964. This was mainly due to the accumulation of irrigated land into fewer and larger farms. As a result, the average farm size in the region increased from 64 acres in 1944 to 138 acres in 1964. The number of farms in the Sacramento River watershed decreased from 11,916 in 1987 to 11,507 in 1992, primarily due to loss of farmland (193,000 acres) to industrial and urban uses. The average farm size remained about the same during this period. About 70% of farms are operated by owner/operators.

Irrigated Lands. The region supports about 2,145,000 acres of irrigated agriculture. About 1,847,000 acres are irrigated on the valley floor; the surrounding mountain valleys in the region add about 298,000 irrigated acres (primarily pasture and alfalfa) to the region's total. Each subwatershed highlighted in Section 4.0 has a unique drainage-level map depicting irrigated lands. These maps can be found at the end of each subwatershed report in Section 4.0.

Managed Wetlands. Wetland resources in the Sacramento Valley can be separated into three main categories: unmanaged wetlands, seasonally managed and permanently managed. The unmanaged wetlands are naturally flooded areas along lakes, rivers and streams that fill during rain events or high water flows. The DWR Land Use Survey by county (DWR 98-2002) represents these areas with the Riparian General, Marshlands, Meadow High Water Table, and Trees and Shrubs classifications. Since these areas are not irrigated, they are not part of the Conditional Waiver for Irrigated Lands. The waiver refers directly to irrigated lands and includes both seasonal and permanent duck marshes for a total of approximately 65,104 acres. The majority of the managed wetlands in the watershed are seasonal with flood-up occurring in late September or October with draw-down in February or March. However, some managed wetlands are flooded permanently or semi-permanently and may hold water all year or may be drained in late summer for vegetation management.

Table 1. DWR Land Survey Wetlands		
Riparian Type	**Irrigation**	**Acres**
Seasonal Duck Marsh	Yes	49,230
Permanent Duck Marsh	Yes	15,874
General	*No*	*7,142*
Marshlands	*No*	*15,050*
Meadow High Water Table	*No*	*33,330*
Trees and Shrubs	*No*	*49,525*

Wetlands usually occur in a habitat mosaic of marshy lands and associated uplands. These upland areas are composed of seasonal grasses and shrubs. Since these are not irrigated, they are not covered under the agricultural waiver. In some of the large federal refuges in the Sacramento Valley, associated grasslands may contain up to half of the acreage in the refuge.

Unlike most areas of the country, the wetland base in the Sacramento River Watershed has increased over the last decade due to restoration efforts led by the Central Valley Habitat Joint Venture. Since the majority of the DWR mapping occurred in the mid-1990's, the current DWR layer of managed wetlands does not include recently restored and irrigated wetland areas. The largest omission from the current DWR Land Survey data is the creation of the Vic Fazio Yolo Wildlife Area. This area includes approximately 3,000 acres of irrigated wetlands. The long-term management plans of the Yolo Bypass may include the eventual restoration of 10,000 or more acres to wetlands.

Valuable Aquatic Resources. The Sacramento River Basin contains a number of species, subspecies, and genetically distinct populations of fish that are presently listed as Federal or State threatened/endangered species or species that appear to be approaching that status and are considered valuable aquatic resources within the watershed. The winter-run race of Chinook salmon (*Oncorhynchus tschawytscha*) that spawns below Keswick Dam in the mainstem Sacramento River is on the Federal list of endangered species. The spring-run Chinook salmon (*Oncorhyncus tshawytscha*) that spend the summer in deep, cool pools of streams tributary to the Sacramento river before spawning in the early fall are presently a species of special concern, and efforts are being made to increase its population before the species becomes endangered. The Sacramento splittail (*Pogonichthys macrolepidotus*) a large minnow native to the Sacramento-San Joaquin drainage and the only remaining representative of the genus in the world, has been officially proposed as a threatened species by the U.S. Fish and Wildlife Service.

Section 1.2 Agricultural Characteristics

This section presents inclusive information that applies to all of the subwatersheds regarding crop types, production practices, chemical use, chemical application methods and timing and management practices, as well as known water quality improvement programs and techniques

associated with discharges from irrigated lands. The WER is thereby framed in a consistent manner and provides the essential data to meet the requirements for the companion document to this report, the Monitoring and Reporting Program Plan. Where applicable, this information has been referenced in the individual subwatershed reports.

Crop Types. In the Sacramento Valley, there are approximately 60 commercial crops that exceed a minimum total acreage of 600 acres per crop. The 60 commercial crops have been combined into 10 categories described in the legend on the Figure 1. In general, the lowlands of Sacramento Valley are primarily planted to rice, rotated into winter cereal grains or are permanent wetlands. Orchards are generally grown on alluvial soils near the major rivers and tributaries and tend to be concentrated on the eastern or far western areas of the Sacramento Valley. Irrigated and non-irrigated pasture dominates the northern areas of the Sacramento Valley. Vegetable and cereal crops are also grown in the alluvial areas near waterways as well as the medium elevation lands.

Rice is the number one crop in the Sacramento River Region, accounting for 26% of the region's total harvested acres. The next most prominent group of crops in the region includes field crops (19%), orchards (15%), pasture (11%), and grains (10%). Between 1986 and 1995, orchards and tomatoes together accounted for less than 25% of the total harvested acreage in this region but produced about 50% of the total production value, reflecting high crop values per acre. Pasture, alfalfa, grains, and field crops produced less than 20% of total production value with more than 50% of total harvested acres, indicating lower crop values per acre.

Production Practices. Production practices can vary based on crop type, soils, climate and other factors. In this report, Crop Production Calendars (Appendix A) have been developed for eight major crops in the Coalition area, including almonds, prunes, walnuts, alfalfa olives, tomatoes, peaches and irrigated pasture to illustrate when specific best management practices (BMPs) are performed throughout the year. In general, practices outlined in the timelines do not change from year to year. Calendars for crops planted on fewer acres in the Coalition area are under development by Coalition members and will be included in the first annual report.

Historical monitoring results show that production practices impact surface water primarily through winter storm runoff and irrigation return flows. Winter storm runoff can transport: pesticides applied to dormant orchards; sediment, which may contain dissolved nutrients or pesticides; and nutrients from pasture and confined animal facilities. Irrigation return flows can transport pesticides applied before irrigation; sediment (with pesticides/nutrients also) from tilled fields (row/field crops); or dissolved salts.

Chemical Use. Chemicals used on irrigated farmland vary by crop, pest, weather and other factors. As reported by the 2002 California Department of Pesticide Regulation (DPR) Pesticide Use Report (PUR) Database, a total of 1,329 different insecticides, herbicides and fungicides were in used crop production in the Coalition region. The potential threat to surface water quality posed by each of these pesticides can vary widely and is based on physical characteristics of the pesticide, application method, time of year applied, and weather conditions during

application, among other factors. Please refer to Appendix B: Compilation of Best Management Practices to Protect Surface Water from Farm Runoff, that provides a description of the primary pesticides used on major crops grown in the Coalition area along with management practices that have the potential to prevent movement into surface water.

The pesticide label on many products is another source of information on practices to prevent movement of products into surface water. The registrants of diazinon, an insecticide listed as impairing water quality in several waterways in the Coalition region, have recently enacted new California label changes that require use of management practices when applying the product during dormant season. The registrants for Lorsban (chlorpyrifos), are in the process of revising the U.S. Environmental Protection Agency (EPA) product label to include practices for protecting water quality that are expected to be in place by 2005. Label restrictions for all insecticides applied to orchards during dormant season are in development by DPR and could be in effect by 2006.

Chemical Application Methods / Timing of Application. The majority of pesticides in the Coalition area are applied either by ground equipment or aerial applicators. Only a select number of pesticides have product labels that allow application through irrigation systems (Appendix A). Fertilizers are either applied to the soil using a variety of soil banding methods, applications through irrigation systems, or in fewer instances, using soil broadcast methods. Fertilizer applications to the soil are often applied in multiple applications at low rates during the growing season to increase the efficiency of crop uptake and minimize the likelihood of nutrients leaching from the root zone.

General Pesticide Application Methods

Pesticide applicators are licensed through the County Agricultural Commissioners and maintain a valid license through a continuing education program. Sprayer or applicator (also applicable to fertilizers) calibration is a precursor to any chemical application. After calibration, proper loading and mixing of the chemical is conducted. Many agricultural pesticides are pre-packaged in formulations and quantities designed specifically for common spray equipment. This minimizes the need for handling and measurement of pesticides, thereby, lessening the risk of exposure. Adjuvants, spreaders, and stickers are often mixed with the water and pesticide to improve the level of control and lessen the runoff of a chemical in the event that a rain event follows a pesticide application. Weather conditions are considered prior to pesticide applications; precautions are taken to avoid windy conditions and temperature inversions.

Pesticide applications are only part of an integrated approach to manage pests in orchard crops. Awareness of pesticide applications and their effect on water quality along with awareness that pests develop resistance to chemical control measures when relied upon too extensively, and the need to farm cost-effectively, all give incentive to an integrated approach to pest management. Removal and destruction of residual crop left in the orchard after harvest to reduce winter survival of some pests and mowing are just two simple examples of alternatives to chemical applications. There are numerous other examples found in Appendix B. An integrated approach

balancing pesticide applications and alternatives will most likely be successful in protecting the crop and protecting water quality.

Orchard Methods

The choice to apply pesticides is likely to be based upon the following few decision-making tools: historic recordkeeping, current season pest monitoring, and tracking real-time weather conditions. Review of crop quality reports by field help prioritize orchards from high to low pest pressure and help anticipate where significant pest pressure is more likely to occur the next season. Insect traps and disease monitoring techniques help identify the beginning of an insect or disease infestation and the specific stage in the insect or disease life cycle. Use of real-time weather information in various insect and disease models assist with forecasting the various phases of pest development and with planning the pesticide application for greatest efficacy. When application timing is most effective, the need for subsequent applications is lessened. Proper identification of the weed species and proper recognition of the most susceptible stage of weed development are fundamental to effective weed control with minimal use of herbicide.

Orchard air blast sprayers that deliver larger volumes of water (about 50 –100 gallons per sprayed acre) along with the dilute chemical are commonly used to spray for insects and diseases in the large tree canopy. "Smart" sprayers are becoming more readily available to help reduce the quantity of pesticide applied by improving the precision of the spray application. Light sensors on the sprayer detect the presence or absence of a target tree limb. When a tree limb or tree is absent, the smart sprayer deactivates specific spray nozzles or all nozzles and the chemical is not dispensed until another target limb or tree is detected. Herbicides are applied in orchards using ground application equipment. "Smart" sprayers are more commonly available for herbicide applications. Herbicides are typically applied in strips aligned with the tree row using 5 to 10 gallons of water with the dilute herbicide per sprayed acre. The purpose of the weed control is to prevent weeds from blocking the sprinkler patterns of microsprinkler and sprinkler irrigation systems and to facilitate harvest. Only about ¼ to ½ of the total planted acreage is actually treated with herbicide. Vegetation in the orchard middles between the tree rows are usually left untreated to help sustain higher soil intake rates and reduce runoff. At times, spot treatment with backpack sprayers is also practiced. Plant tissue testing is commonly used to guide fertilizer application needs and timings.

Row/Field Crop Methods

Row and field crops are not treated with pesticide applications until an economic threshold for a specific pest is approached. Specific thresholds are established based upon field research for the known economic pests for each crop. Sweeping with an insect net, presence/absence sampling methods, and insect trapping are examples of common techniques of monitoring known insect pests, tracking populations, and guiding pesticide application decisions in row and field crops. Plant breeding and development of disease and insect resistant crop varieties are important in reducing the need for pesticides. Cultivation also reduces the need for herbicides. Soil and crop tissue testing is frequently used to determine fertilizer needs and timings.

Row and field crops are often treated by ground equipment with nozzles directed at the crop canopy or soil. Hydrostatic ground sprayers are sometime used to electrically charge the spray droplets thereby improving the coverage of the crop canopy with the treatment and treatment penetration. Sometime this results in improved control with fewer applications and with less pesticide per application. Applications by fixed wing aircraft or helicopters are sometimes made to both row and field crops.

Irrigated Pasture

Pesticide and fertilizer use in irrigated pasture is generally of lower intensity. The likelihood of an economic insect pest occurring is rare, if at all. Disease control is not a concern. Weeds are the primary pest concern in pasture systems and generally of greatest concern during the first year of establishing a newly seeded pasture. Herbicides are primarily applied with ground applicators in irrigated pastures. Berry control along fences and small drainages can be of concern and are generally treated with a ground sprayer and hand-gun to precisely direct the sprays. Fertilizers are generally applied using ground broadcast applicators. Both soil and plant tissue testing are used to determine fertilizer needs and timings.

Inventory of Management Practices. The Coalition and cooperating entities have compiled a comprehensive suite of options for the major crops in the Coalition area that includes many pesticide, nutrient and sediment management practices currently in use or with potential to protect surface water (Appendix B). There are numerous entities that provide information regarding management practices including, but not limited to, those described in the following section of this report. The Coalition's Management Practices Compilation is a summary of management practices familiar to growers, crop advisors, commodity groups and farm advisors. The Coalition will continually update the suite of options as new information is generated.

Depending on the constituent impacting water quality and existing field and crop management practices, a landowner may need to adopt a combination of management practices to reduce or eliminate impacts to water quality. With assistance from agricultural experts from public private firms, landowners will select and implement effective management practices.

Over the next two years, Coalition members will conduct research projects expected to generate data for use in determining management practice effectiveness. The following is a list of projects that have been awarded funding through the Pesticide Research and Investigation of Source and Mitigation Grant (PRISM):

- Coalition for Urban/ Rural Environmental Stewardship (CURES): Research on management practices such as buffer strips, Smart sprayer technology, sprayer calibration.

- CURES/UC Davis: Research on improving orchard sprayer deposition.
- Yolo County Resource Conservation District: Research on vegetated ditches.
- Glenn County Surface Water Stewardship Program: Effectiveness of buffer strips.

Known Water Quality Improvement Programs and Techniques Associated with Discharges From Irrigated Lands.

There are numerous programs examining the effectiveness of management practices and programs that provide assistance to landowners in the selection and installation of known management practices that reduce impacts to water quality.

Natural Resource Conservation Service

Environmental Quality Incentives Program (EQIP). The EQIP provides technical, educational, and financial assistance to eligible farmers and ranchers to address soil, water, and related natural resource concerns on their land in an environmentally beneficial and cost-effective manner. The program provides assistance to farmers and ranchers in complying with Federal, State, and tribal environmental laws, and encourages environmental enhancement.

The purposes of the program are achieved through implementation of a conservation plan that includes structural, vegetative, and land management practices on eligible land. Five-to-ten-year contracts are made with eligible producers. Cost-share payments may be made to implement one or more eligible structural or vegetative practices such as irrigation improvements, filter strips, cover crops, and permanent wildlife habitat. Incentive payments can be made to implement one or more land management practices, such as nutrient management, integrated pest management, and grazing land management. Currently, fifty percent of the funding available for the program will be targeted for livestock production related natural resource concerns. The program is carried out in priority areas that may be watersheds, regions, or multi-state areas, and for significant statewide natural resource concerns that are outside of geographic priority areas.

Wetlands Reserve Program (WRP). The WRP is a voluntary program to restore wetlands. Participating landowners have the opportunity establish conservation easements in perpetuity or for a 30-year duration. Landowners also have the option to enter into restoration cost-share agreements where no easement is involved. In exchange for establishing a permanent easement, the landowner receives payment up to the agricultural value of the land and 100 percent of the restoration costs for restoring the wetlands. The 30-year easement payment is 75 percent of what would be provided for a permanent easement on the same site and 75 percent of the restoration cost. The voluntary agreements are for a minimum of 10-year duration and provides 75 percent of the cost of restoring the involved wetlands. Easements and restoration cost-share agreements establish wetland protection and restoration as the primary land use for the duration of the easement agreement. In all instances, landowners continue to control access to their land.

Wildlife Habitat Incentives Program (WHIP). The WHIP is a voluntary program that encourages creation of high quality wildlife habitats that support wildlife populations of National, State, Tribal and local significance. Through WHIP, NRCS provides technical and financial assistance to landowners and others to develop upland, wetland, riparian, and aquatic habitat areas on their property. Cost-share is available to landowners for various wildlife habitat enhancing practices.

Commodity Research and Marketing Boards

Each of the major crops identified within the Coalition area, except irrigated pasture, have commodity research and marketing boards that manage direct annual research programs. These programs are funded through grower assessments and usually linked with processors of the specific crops. Substantial funds are invested in research and development of efficient and environmentally-sound farming practices. The following general categories of research and development are typically funded on an annual basis:

- General understanding of crop growth and development;
- Crop breeding programs for pest resistance and reduced need for pesticides;
- Water management technology (e.g., improved application and timing methods);
- Integrated pest management (understanding the biology of economic pests, improved monitoring methods, non-chemical methods of control, etc.).

References to these research and development activities are listed below:

Pesticide Environmental Stewardship Program Participants
www.epa.gov/appbppdl/PESP

- Almond Board of California
- California Dried Plum Board
- California Walnut Marketing Board

California Alfalfa and Forage Association	http://www.calhay.org
California Tomato Research Institute	http://www.wrpmc.ucdavis.edu
California Cling Peach Board	http://www.calclingpeach.com
California Olive Committee	http://www.calolive.org

Natural Resources Conservation Service

Information regarding management practices related to land management, sediment transport, habitat protection, and water quality can be found in the following resource documents:

Publications: The NRCS "Index of Conservation Practices and Specifications" (Appendix C) lists hundreds of practices and information on installation;

NRCS Performance & Results Measurement System Reports Total Conservation Buffers (Acres) by County (Appendix D);

NRCS Performance & Results Measurement System Reports Pest Management Systems Applied (595A) (Acres) (Appendix E);

NRCS - National and State Resources Concerns and Quality Criteria (Appendix F).

Outreach: NRCS organizes field days and workshops to promote adoption of management practices.

Funding: Landowners are eligible for grants and other financial assistance through the Environmental Quality Incentive Program (EQIP).

University of California Cooperative Extension

Conducts research and works directly with growers to implement pest management, irrigation management, pesticide safety practices and also performs research on various production practices.

Publications: The U.C Agriculture and Natural Resources (UCANR) Publications department has developed "Production Manuals" for six major crops and "Integrated Pest Management (IPM) Guidelines" for 29 crops grown in the Central Valley. These publications include information on low risk pest and nutrient management practices that would often be components of an overall farm plan to protect surface water. For more information, please see the University of California Agriculture and Natural Resources for Ag Management Practices – February 9, 2004 in Appendix G.

Outreach: UC Farm Advisors organize regular grower update meetings on various crop and pest management issues. To maintain pesticide use permits, growers attend continuing education courses provided by UC Cooperative Extension.

County Agricultural Commissioners

County regulatory enforcement agency for pesticide use and handling.

Publications: Each county has a manual or handbook that outlines local and state regulations regarding pesticide handling and application. Growers review these manuals in advance of taking tests to receive a Pesticide Applicator Permit, a license needed to purchase and apply pesticides.

Outreach: CAC hold periodic continuing education meetings for growers and Pest Control Advisors (PCAs). During these meetings, growers review regulations, production practices and issues related to proper pesticide use and handling.

Coalition for Urban/ Rural Environmental Stewardship (CURES)

A non-profit organization that promotes pesticide and nutrient management practices and develops and coordinates management practice research projects.

Publications: CURES produces booklets on management practices for orchard, row crops and other pesticide uses.

Outreach: CURES organizes and develops grower presentations and PCA meetings that cover water regulations and management practices to protect surface water quality.

Resource Conservation Districts (RCDs)

Formed as independent local liaisons between the federal government and landowners, conservation districts have always worked closely with the USDA Natural Resources Conservation Service. RCDs address a wide variety of conservation issues such as forest fuel management, water and air quality, wildlife habitat restoration, soil erosion control, conservation education, and much more. Each district has a locally elected or appointed volunteer board of directors made up of landowners in that district.

Publications: RCD staff work closely with NRCS staff to prepare Soil Surveys.

Outreach: RCDs organize periodic educational workshops and meetings on subjects related to resource conservation.

Farm Input Suppliers

Private firms that sell nutrients and pesticides and provide information through licensed Pest Control Advisors (PCAs).

Publications: Farm input suppliers distribute product specific information including product labels, Material Safety Data Sheets (MSDS) and other publications related to proper use of pesticides and nutrients.

Outreach: PCAs have frequent personal contact with landowners to provide pesticide use recommendations

Coalition participating entities who will communicate with landowners regarding management practices include:

- County Agricultural Commissioners
- County Farm Bureaus
- Resource Conservation Districts
- University of California Farm Advisors and Specialists
- Natural Resource Conservation Service
- Farm input suppliers
- Crop consultants and Pest Control Advisors
- Coalition for Urban/Rural Environmental Stewardship (CURES)
- Irrigation and drainage districts
- California Association of Pest Control Advisors (CAPCA)
- Pesticide Applicators Professional Associations
- California Plant Health Association
- Commodity Groups (California Dried Plum Board, Almond Board of California, California Cling Peach Advisory Board, etc.)

Section 1.3 Water Quality

This section of the WER presents information applicable to the entire Sacramento River watershed regarding historical water quality data, known water quality issues, water quality limited waterbodies and potential water quality problems. This link ensures consistency for the purpose of prioritizing drainages at the subwatershed level and for the development of a comprehensive water quality monitoring and reporting program.

Historical Water Quality Data.

Historical Pesticide Data

The DPR Surface Water Database was used to investigate pesticide concentrations in the Sacramento River watershed. This database was created in 1997 by DPR under agreement with the State Water Resources Control Board. This database contains the results from approximately 48,000 samples collected from 71 different sites in the Sacramento River Watershed from August 1990 through September 2003.

In an effort to prioritize monitoring locations in the Sacramento Valley this report looked at four individual or groups of pesticides: diazinon, chlorpyrifos, copper compounds, and sediment binding pesticides (pyrethroids). Diazinon was chosen because of its documented impairment of several streams on the 303(d) list, proposed basin plan amendment and Total Maximum Daily Load (TMDL) monitoring program. Chlorpyrifos was included due to its leading cause of water column toxicity in the Regional Board's Phase I testing of agricultural drains in the summer of 2003. Copper compounds included in the rankings were copper hydroxide, copper sulfate (basic), copper sulfate (pentahydrate), copper oxide and copper oxychloride. These copper compounds are the largest non-fumigant pesticide load (in pounds) on non-rice crops in the Sacramento Valley. The final group of pesticides examined were the sediment binding

pesticides identified in the Regional Board's Phase I monitoring program. This group included pyrethroids (esfenvalerate, permethrin, cypermethrin and lamba-cyhalothrin). The DPR Surface Water Database was searched for records in the four target pesticide categories.

Diazinon samples were collected at 63 sites in the database. Please refer to Table 2. Diazinon Maximum Concentrations by Site from DPR Surface Water Database, 2004. Of the total 2,022 individual samples tested, 456 samples contained concentrations greater than 80 ng/l, which is the California guideline for short-term exposure (criteria maximum concentration). The 456 samples with concentrations greater than the guideline occurred at 39 sites as shown in Table 2. Some of these sites from the mid-1990's contain positive bias due to the use of Enzyme Linked Immunosorbant Assay (ELISA) field assay rather than the more standard Gas Chromatography Mass Spectrometry (GCMS) methods. A more relevant baseline for current water quality impacts would be the focused analysis of the samples collected in the last five years. Since January 1999, 12 sites have shown exceedences with a total of 97 samples collected with concentrations above the acute criteria. The recent exceedences all occurred in the Butte-Sutter-Yuba subwatershed with the exception of one sample from the Colusa Drain. This five-year summary is presented in Table 3. Diazinon Acute Criteria Exceedences in 1999 - 2003 from the DPR Surface Water Database.

Chlorpyrifos was monitored at 48 sites in the watershed. Please refer to Table 4. Chlorpyrifos Maximum Concentrations by Site from DPR Surface Water Database. A total of 1455 samples were collected and 33 samples had concentrations over 20 ng/l, which is the guideline for acute exposure. The 33 samples with concentrations that exceeded the guideline occurred at 6 different sites. The number of exceedences drops to only three occurrences when the analysis only looks at the past five years. Two of these three exceedences were on Arcade Creek, an urban dominated stream in the Sacramento area. The remaining exceedence was at the Colusa Basin Drain above Knights Landing in June 2001.

Copper concentrations are not recorded in the Surface Water Database. No readily accessible records exist that describe agriculturally applied copper compounds affecting water quality in the Sacramento Valley Watershed.

Lamda-cyhalothrin was tested for in 18 samples in the Surface Water Database with all results below the limit of quantification (LOQ) of 10 ng/l. Permethrin was monitored for in 112 samples collected from 5 sites with all results yielding non-detects with a LOQ of 50 ng/l at one site and 0.5 ng/l at the remaining 4 sites. Esfenvalerate was tested in 100 samples collected from 5 sites with all readings listed as non-detects with a LOQ of 50 ng/l at one site and 19 ng/l at the remaining 4 sites. The final pesticide in this class, Cypermethrin, was not monitored and no data was collected in the Surface Water Database. Although this chemical is used in other areas of the state, the Sacramento River Watershed had only one recorded use of this chemical in the DPR PUR database.

Due to the lack of water solubility of the sediment binding chemicals, it is not surprising that the four pesticides mentioned above had no measurable concentration in the water column. The

Conditional Waiver for Irrigated Lands Monitoring Program includes a section on testing for sediment toxicity. These techniques have little precedent in the Sacramento Valley and no centralized database exists to examine past trends. As of March 2004, the Regional Board has not released the full test results of their initial screening of sediment-bound pesticides from their Summer 2003 Phase I monitoring. Additional historic data for the Sacramento River watershed can be referred to in Table 5. Sacramento River Watershed Historic Sampling Sites: A Compilation. This information was compiled by the Regional Board and the Coalition.

Ongoing Monitoring Activities

In the Sacramento River watershed, there are several ongoing surface water quality monitoring programs. These programs and sites are summarized in Table 5. Sacramento River Watershed Historic Sampling Sites. This information is spatially depicted on the Sacramento River watershed On-going Monitoring Sites Map - Figure 2. In addition to the programs listed, the Regional Board plans to monitor 30-50 sites in the Central Valley during the summer of 2004. Details on these sites have not been released. In total, the monitoring results from these Regional Board sites and the following programs will provide the coalition and the regional board a more thorough understanding of the impacts on the water quality in the region.

The Pit River Alliance currently has a comprehensive program that collects information on ambient conditions, nutrients and pathogens in the main stem of the Pit River and many tributaries. This program includes monthly irrigation season monitoring and one winter storm event. Due to the 303(d) listing of Pit River and Fall River, this program focuses on 303(d) identified constituents such as sediment, nutrients, and water temperature.

The California Rice Commission currently monitors five sites in on the valley floor from spring to mid-summer. This program is focused on five major rice pesticides and collects samples twice weekly during a 12-week period.

The U.S. Geological Survey (USGS) has three ongoing sites in the watershed that monitor pesticides, nutrients and ambient water quality parameters. Their site at Sacramento Slough is directly relevant to agricultural run off. The USGS also monitors urban dominated discharges at Arcade Creek and Sacramento River main stem water quality at Freeport.

The DWR Municipal Water Quality Investigation focuses on four sites around Sacramento. Three sites are mainstem sites on the Sacramento and American Rivers. The fourth site on the Natomas East Main Drain is mostly urban dominated with some agricultural run off. This site is sampled weekly during rain events.

DWR monitors 41 sites in the watershed for metals, nutrients, and ambient conditions. This monitoring is done quarterly with two samples collected during the irrigation season and one sample gathered in February. The majority of these sites are in the upper half of the Sacramento River Watershed.

The Sacramento River Watershed Program will monitor 13 sites in the watershed with 11 of those sites including toxicity. The majority of these sites sample the main stem of the Sacramento River. The sites most relevant to Coalition efforts include the sites at Colusa Basin and Sacramento Slough.

The Regional Board will be continuing their monitoring of diazinon during two storm events in the winter of 2004. Their list of sites includes daily sampling at Sacramento Slough and Colusa Basin Drain during rain events. An in-depth monitoring regime is planned for Wadsworth Canal with sampling three times a day during storm events.

Known Water Quality Issues / Potential Water Quality Problems.

- *Abandoned mines*—A number of abandoned mines, especially those near Lake Shasta have been identified by the United States Geological Survey as having elevated concentrations of trace metals, and have the potential to degrade the quality of much of the Sacramento River (USGS).

- *Pesticide contamination of surface water and potential contamination of ground water* – Pesticide use within the Sacramento Valley is high and application occurs during as much as 75 percent of the year. Pesticides can be transported from the fields to surface water by irrigation and winter storm runoff or to ground water by percolation of rain or irrigation water (USGS)

- *Sediment-binding Pesticides* - Group A Pesticides are the Organochlorine pesticides. These are DDT, endrin, methoxychlor, dieldrin and sometimes it may include PCBs. Results of some of the sediment samples showed endrin and methoxychlor at toxic levels. (CVRWQCB, 2003)

- *Nitrate contamination of ground water*—Ground water basins below highly permeable soils are susceptible to contamination by nitrate from fertilizers and other sources (USGS).

- *Urban runoff*—Urban runoff is a potential source of contaminants in the Sacramento River watershed (USGS).

- *Aquatic Resources*—Issues considered important for aquatic species include the operation of dams and diversions of all sizes and their effects on streamflow, aquatic habitat, fish migration, and stream temperature. Other issues affecting aquatic species include acidic mine discharge, agricultural return flows, reductions in fish populations by commercial and sport fishing, and introduction of non-native species (USGS).

- *Drinking Water Constituents of Concern.* Drinking water suppliers that divert from the Sacramento River and water exporters that divert from the Sacramento-San Joaquin River Delta for provision to urban communities have a direct interest in the quality of source

waters. At times, these waters contain elevated concentrations of dissolved organic carbon and bromide, and exceeds the U.S. Environmental Protection Agency's maximum contaminant level for trihalomethanes of 0.100 milligrams per liter if chlorinated for drinking water (USGS). The California Bay-Delta Authority Drinking Water Subcommittee is sponsoring a long-term research project to determine source loads of drinking water constituents of concern that would initiate a Basin Plan amendment for numeric and/or narrative water quality objectives for these constituents. There is current debate over the natural background concentrations of "total organic carbon" (TOC) and the persistence of TOC as it travels downstream.

Water Quality Limited Water Bodies.

The Federal Clean Water Act requires states to identify impaired waterbodies and implement Total Maximum Daily Load (TMDL) programs to remediate the impairment. The State Water Quality Control Board (SWRCB) has identified 40 waterbody segments in the Sacramento Valley as impaired based upon constituent loads from Urban, Resource Extraction, Agricultural, and Unknown sources. Impairing agents for these water bodies include: diazinon, chlorpyrifos, Group A pesticides, PCBs, mercury, copper, lead, cadmium, zinc, nickel, acid mine drainage, pesticides (azinphos-methyl, carbofuran/furadan, malathion, methyl parathion, and molinate/odram), nutrients, organic enrichment, temperature, arsenic, fecal coliform, sediment siltation, and unknown caused of toxicity. Each of these segments and their general location, together with a list of the waterbody segments and their respective impairing agents are identified in Table 6. Impaired 303(d) Waterbodies in the Sacramento River Watershed: Possible Agriculture Sources and Unknown Source and Figure 3. General Location of 303(d) listed waterbodies in the Sacramento River Watershed.

Also, a complete list of each of these waterbody segments and their respective impairing agents is listed in Table 7. Impaired 303(d) Waterbodies in the Sacramento River Watershed with Constituents.

For further reference, please refer to Table 8. Impaired 303(d) Waterbodies in the Sacramento River Watershed with Agricultural or Unknown Constituents.

The SWRCB assigns either a "High," "Medium" or "Low" priority to each waterbody impairment. Only "High" priority impairments have been assigned a TMDL completion date. Water bodies on the 303(d) list due to the agriculturally related chemicals are: Pitt River, Fall River, Lower Bear River, Sacramento River above Colusa, Colusa Drain, Lower Feather River, Butte Slough, Sutter Bypass, Sacramento Slough, Natomas East Main Drain, Elder Creek, Butte Slough, Chicken Ranch Slough, Morrison Creek, Strong Ranch Slough and Jack Slough.

Section 2.0 Sacramento River Watershed Priorities

The prioritization of the subwatersheds and drainages in the Sacramento River watershed include the input from three main data sources: drainage mapping, land use and pesticide use. The following section reviews each of these datasets in more detail and their role in the prioritization process.

The prioritization was performed at two levels in this report. First, the prioritization is conducted at the Coalition level. Ten subwatersheds are prioritized in the General Report according to their potential relative impact on water quality. Second, this ranking process was mirrored at the individual subwatershed level to choose a list of candidate monitoring drainages. (For a detailed description of the subwatershed prioritization, please refer to Section 4.0).

The initial boundaries of the ten subwatersheds were created primarily based on hydrologic features (Figure 4. Sacramento Valley Water Quality Coalition Subwatershed Map). The pesticide use and land use layers were spatially linked to the subwatershed and drainage layers. This link enabled the creation of the following tables: Table 9. Sacramento River Watershed Major Crop Types by Subwatershed; Table 10. Sacramento River Watershed Pesticide Ranking by Subwatershed. These two input tables were summarized in Table 11. Sacramento River Watershed - Priority Ranking by Subwatershed. A detailed description of these tables is found in Section 2.2 of this report.

2.1 Prioritization Methodology

Drainage. CalWater 2.2 dataset was used as a starting point to map drainages in the Sacramento River Watershed. This spatial layer was originally created by the California Department of Forestry and Fire Protection and later updated by DWR. CalWater 2.2 is recognized as the best available data for statewide watershed boundaries and has very detailed drainages in the foothills and mountains. In areas of little topographic relief, the CalWater coverage lacks adequate delineation with some valley floor drainages over half a million acres in size. In total, CalWater separates the Sacramento Valley floor into fewer than 25 units. For an area with approximately 2 million acres of irrigated land, this resolution was too coarse to help the Coalition in prioritize monitoring locations. The Coalition responded by gathering local drainage information from the subwatershed steering committees to better define drainages in the subwatershed areas. This new information was integrated with CalWater at the Hydrologic Sub-Areas (HAS) level to create new drainage coverage for the Sacramento River Watershed.

Each subwatershed group was given an opportunity to review the new drainages during a series of subwatershed meetings held in December 2003 and January 2004. In these meetings, the new boundaries were informally reviewed by the agricultural commissioners, local landowners and others. Due to the April 1 deadline associated with the Conditional Waiver for Irrigated Lands, a more formal review process was not pursued at this time.

The WER presents a drainage coverage that contains a total of 244 drainages. The level of detail in the valley floor increased from 25 areas in CalWater 2.2 to approximately 120 new drainages. The Coalition will conduct a more thorough review of the drainage delineations during Phase 1 of the program.

Land Use. Acres of irrigated farmland were estimated primarily using the DWR Land Use Survey (DWR 98-2002) GIS datasets. This DWR data is collected at the county level with large agricultural counties being surveyed every five to seven years. All counties in the Sacramento River Watershed were included in the Land Surveys areas except for Modoc, Napa, Sierra, Nevada, and El Dorado Counties. The agricultural acres for this select set of counties was included by using the Agricultural Commissioner reports and then distributing the acres on the landscape into drainages based on the "General Agriculture" designation in the California Department of Forestry Land Cover Monitoring and Mapping Program (LMMCP) coverages. The DWR dataset may over predict the amount of irrigated land due to the existence of dry land farming of some grain crops in the valley or the dry land orchard practices in the Coast Range or the Sierra foothills.

Pesticide Use. In an effort to prioritize monitoring locations in the Sacramento Valley, the WER analyzes four individual or groups of pesticides: diazinon, Chlorpyrifos, copper compounds, and sediment binding pesticides (phyrethroids). Diazinon was chosen because of its documented impairment of several streams on the 303(d) list, proposed basin plan amendment and TMDL monitoring program. Chlorpyrifos was included due to its cause of water column toxicity in the Regional Board's Phase I testing of agricultural drains in the summer of 2003. Copper compounds included in the rankings were copper hydroxide, copper sulfate (basic), copper sulfate (pentahydrate), copper oxide and copper oxychloride. These copper compounds are the largest non-fumigant pesticide load (in pounds) on non-rice crops in the Sacramento Valley. The final group of pesticides examined were the sediment binding pesticides (phrethroids) identified in the Regional Board's Phase I monitoring program. This group included esfenvalerate, permethrin, cypermethrin and lamba-cyhalothrin.

The California Department of Pesticide Regulation (DPR) Pesticide Use Report Database (PUR) for 2002 was queried for records in the four target pesticide categories. The PUR dataset for Region 5 was initially used. In this area, PUR contained over 1.75 million records of pesticide applications in 2002. Of these records, approximately 182,000 records were from the Sacramento River Watershed and were applied to non-rice ground. All records with flagged errors from PUR were excluded from the analysis.

2.2 Analysis of Prioritization Effort

An initial drainage prioritization based upon crop-type and pesticide use provided a watershed wide ranking of subwatersheds. A more detailed analysis of each subwatershed is described in Sections 4.1-4.10 leading to a list of candidate drainages. The major crops in each subwatershed are spatially depicted in Figure 5. Sacramento River Watershed Major Crops by Subwatershed and calculated in Table 9.

Pesticide use from the DPR 2002 Pesticide Use Reporting Database and subsequent rankings are displayed in Table 10. This table ranks the Butte-Sutter-Yuba Subwatershed as the largest user of the focus pesticides followed by the Colusa Basin and Solano-Yolo subwatersheds. The pesticide ranking only prioritizes the top six subwatersheds. Due to the low use of the target pesticides in the remaining four subwatersheds, they were excluded from the ranking. A better indicator of potential water quality impact in these four subwatersheds is the agricultural acreages.

The overall ranking is presented in Table 11. This table summarizes the crop types data and pesticide use data along with other information to prioritize the subwatersheds for reporting purposes. Those drainages showing a high level of orchard or annual crop acreage (Crop-Weighted Index below), high pesticide use ranking, and 303(d) listed streams were ranked as high. Only 303(d) listed streams that cited agriculture as a possible source are included in Table 11.

Crop-Weighted Index Methodology: A crop-weighted index was developed for each subwatershed in order to better understand the complexities associated with intensive agriculture and potential discharges of water quality constituents of concern. The index assumes that there is a gradation of water quality issues from the more intensive agriculture to the less intensive agriculture. For the purposes of the index, the major crop acreage data for each drainage was segregated into three major crop categories: orchard crops, annual crops and pasture/other. A factor representative of the water quality issues gradation was then assigned to each crop category and multiplied by the crop category acreage. The factor used for the index were as follows: for orchard crops (3.0), for annual crops (2.0), and, for pasture/other crops (1.0). The product of the crop category acreage times the factor yielded the final index number. A low/medium/high ranking was then assigned to the index numbers. An index number of 50,000 and above ranked high, an index number of 20,000 to 50,000 ranked medium and an index number below 20,000 ranked low.

The Sacramento River Watershed contained three subwatersheds with a high ranking and four subwatersheds with a medium ranking. The balance of the 10 subwatersheds were ranked as low. The subwatersheds with low values were all foothill or mountain areas with small agricultural areas.

A similar analysis was mirrored for each of the ten subwatersheds at the drainage level. Each of these analyses is detailed in the individual subwatershed chapters in Section 4.1-4.10 of this report. Of the 244 drainages that were evaluated in the subwatershed chapters, a total of 42 drainages received a medium or high ranking. These sites and their priority levels are summarized in Table 12. Sacramento River Watershed Drainage Candidates List. Additional local information including information on water flows and timing will be considered before identifying specific drainages and monitoring locations. This step of obtaining local input is vital in the final selection of appropriate monitoring locations.

Section 3.1

Implementation Plan

This Implementation Plan has been prepared to illustrate how the Coalition and its subwatersheds will develop, coordinate and disseminate information on water quality requirements in a flexible and adaptive manner.

Initially, outreach and management practice implementation efforts will include communication with landowners and operators in the Sacramento River watershed regarding the requirements mandated in the Conditional Waiver for Irrigated Lands, organizational efforts of the Coalition and subwatershed groups and the status and reporting of regional monitoring program development and implementation. Outreach to landowners and operators will be performed through various activities including grower meetings and workshops, newsletter articles and trade publications, Coalition website postings and direct mail.

To ensure a consistent approach, the Coalition will utilize a template for the subwatershed general outreach program. Each subwatershed group will tailor the template to meet their individual needs. To initiate the outreach program, an orientation meeting will be convened to discuss the template and implementation methods. The template will be framed around the watershed setting, hydrology, crops, pesticides, sources of information, contacts and monitoring plans for applicable management practices. Where available, many of the organizations listed in the "Known Water Quality Improvement Programs and Techniques Associated with Discharges from Irrigated Lands" in Section 1 will be recruited to accomplish this task.

The Implementation Plan will utilize GIS capabilities to spatially map and track the progress and implementation of water quality management practices. In addition, information regarding water quality issues related to irrigation return flow discharges and storm water discharges will be compiled and evaluated by utilizing "On-Farm Practices" information sheets filed by landowners or operators at the county agricultural commissioner's office. With the technical assistance of local RCDs, NRCS, UC Cooperative Extension, commodity groups and farm input suppliers, the Coalition will conduct informational workshops regarding on-farm conservation planning. To broaden the outreach capability of the Coalition, plans are underway to develop a website to facilitate farmer accessibility, provide basin-wide dissemination and to collect information.

After results from the initial round of water quality monitoring are available, the Coalition will begin communicating with subwatershed group members about those results. Should monitoring indicate toxicity in the water or sediment sampling at a specific site, the Coalition will notify the subwatershed group who will then initiate outreach with landowners and operators within the subwatershed to solve the problem. The Coalition will work with the subwatershed groups to implement a Response Plan framed around a three-tiered approach that is consistent with the MRP.

Three-Tiered Approach

Tier 1 - Pesticides

(1) Contact landowners in the impacted subwatershed or drainage via email or mailed correspondence. The following information will be provided:

- Identification of the constituent detected (pesticide, nutrient, sediment, etc.);
- Identification of the potential lands in the subwatershed that may be contributing to runoff;
- Identification of the potential crops where the constituent could have been applied (or could have originated);
- A Plan for Action, developed by Coalition members and cooperating entities includes a list of potential BMPs, time frames for implementation and information on agencies or resources to assist in adopting management practices. A template implementation plan for the specific constituent causing toxicity will be developed by the Coalition Technical Steering Committee and, when appropriate, revised to meet the individual needs of subwatershed groups.
- A description of potential enforcement actions by local or state regulators if subsequent monitoring does not show mitigation of the toxicity.

(2) Organize Outreach meetings in the affected subwatershed or drainage.

Landowners and operators will be informed of the monitoring results through outreach meetings held in the subwatershed or drainage areas organized by the respective subwatershed group and cooperating entities. The same information described in part 1 will be covered in presentations and handout materials.

Tier II – Pesticides

If successive monitoring results show persistent toxicity or no improvement in discharge levels for constituents of concern, the Coalition will implement Tier II of the plan. Tier II includes continued landowner outreach describing monitoring results and promotion of management practices to mitigate the water quality problem as described in Tier 1.

In addition, the Coalition or subwatershed groups may request the implementation of a mandatory Product Stewardship Program. This program, lead by the County Agricultural Commissioners, the California DPR and pesticide registrants and suppliers, consists of working with landowners and operators on management practices that are product specific.

Tier III - Pesticides

If additional monitoring results show no improvement in toxicity, a recommendation may be made to the County Agricultural Commissioners that actions such as localized permit conditions be developed and implemented to prevent movement of the pesticide into local waterways. The Coalition may also recommend to DPR that the product be considered for a formal Product Reevaluation

Tier I – Other Constituents or Parameters of Concern

(1) Contact landowners in the impacted Subwatershed or drainage via email or mailed correspondence. The following information will be provided:

- Identification of the constituent detected (pesticide, nutrient, sediment, etc.);
- Identification of the potential lands in the subwatersheds that may be contributing to runoff;
- Identification of the potential crops where the constituent could have been applied (or could have originated);
- A Plan for Action, developed by the Coalition and subwatershed groups that includes a list of potential management practices, time frames for implementation and information on agencies or resources to assist in adopting management practices. A template implementation plan for the specific constituent causing toxicity will be developed by the Coalition Technical Steering Committee and, if necessary, revised to meet the individual needs of subwatersheds.
- A description of potential enforcement actions by local or state regulators if subsequent monitoring does not show mitigation of the toxicity.

(2) Organize Outreach meetings in the effected Subwatershed or drainage

Landowners and operators will also be informed of the monitoring results through outreach meetings or presentations held in the subwatershed or drainage areas and organized by the subwatershed group and cooperating entities. The same information described in section (1) will be covered in presentations and handout materials.

Tier II – Other Constituents or Parameters of Concern

Example. If successive monitoring shows no improvement at a particular monitoring site, then Tier II will be implemented. Tier II may include a focused outreach program utilizing entities with expertise on management practices such as NRCS, UC Extension, RCDs and CURES. This outreach and management practice implementation will concentrate on areas identified or other source areas and will involve working with landowners and operators to implement programs to address those concerns.

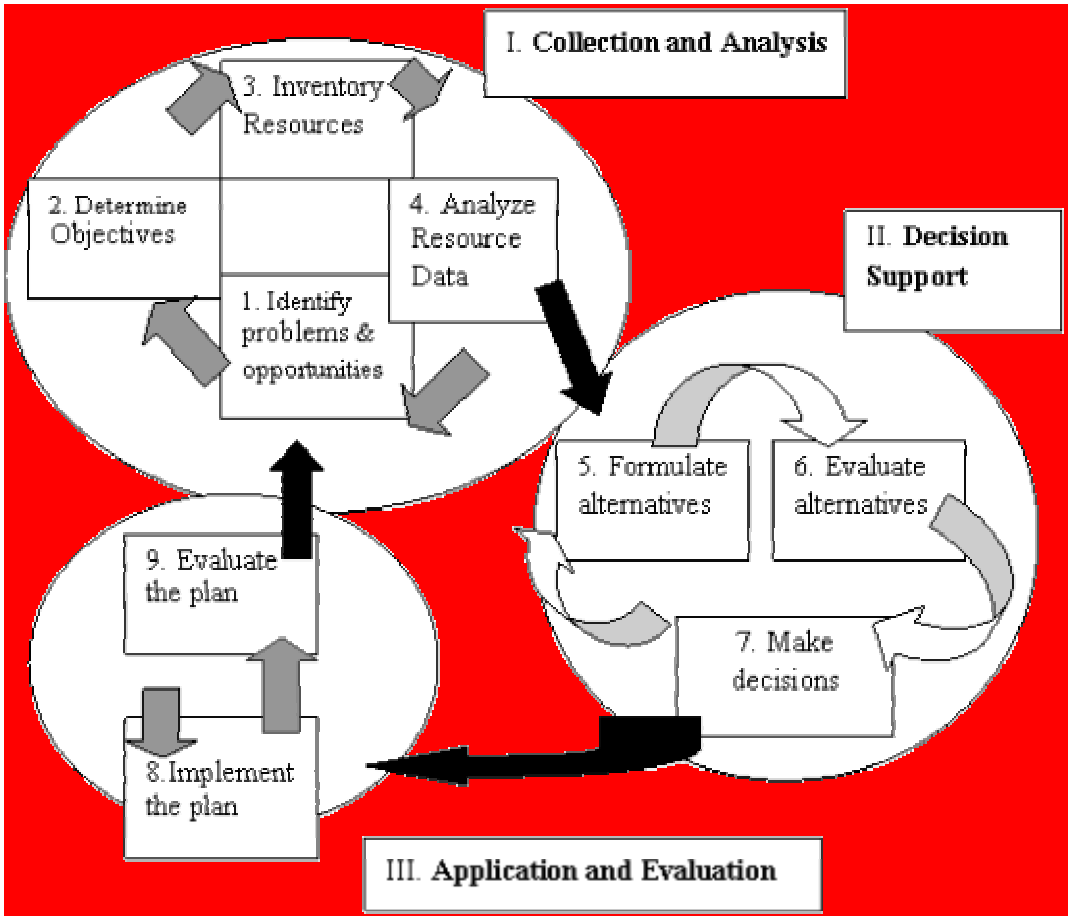
As an example of technical support in each subwatershed, NRCS assists people, including groups and units of government, through local RCDs, to help with nonpoint source control

efforts. NRCS advocates the wise use of California's soil and water resources on both public and private lands. NRCS encourages the use and treatment of these natural resources within their capability and according to their needs.

NRCS recognizes that no single practice will solve a water quality problem; rather, a combination of practices working together (resource management system, or RMS) will be required. For example, the soils found in an identified area should be investigated to see if they have high leaching and runoff indices. There may be other factors besides soils that contribute to constituents of concern, such as slope, a higher rainfall area, etc. In order to make an accurate evaluation, a good natural resources inventory should be conducted as one of the first phases of the conservation planning process.

NRCS assists with training people to conduct conservation planning, installation, maintenance, and assessment of RMSs; and in, providing cost-share funds such as the Environmental Quality Incentives Program (EQIP) helps install conservation practices. The following figure represents steps of the NRCS conservation planning process:

Figure 6. NRCS Conservation Planning Process



Tier III – Other Constituents or Parameters of Concern

If additional monitoring results show no improvement in problem discharges, then Tier III will be implemented. Tier III will recommend that landowners perform a Mandatory Farm Conservation Plan or similar plan designed to address the specific constituent. (For more detail see NRCS Planning Assessments - Appendix H) The affected landowners will be encouraged to work with NRCS and associated entities to develop and implement a plan.

Pilot Projects.

Known pilot projects have been identified at the subwatershed level with each subwatershed group reporting these projects within their areas (See Section 4.1 – 4.10 for lists and Section 2.0 for priority subwatersheds). In addition, the PRISM Projects are reported in Section 1.2 under Inventory of Management Practices. Recently, many pilot projects were submitted for consideration under a Consolidated RFP Program. These additional pilot projects will be reported as part of the first Annual Report once the final selection is made and the State Board Water Resources Control Board approves the projects. Although pilot projects are listed for implementation of management practices in priority subwatersheds, data from each of these priority subwatershed pilot projects will be used to bolster management practices implementation throughout Coalition area.

Section 3.2

Communications Report

The Porter-Cologne Water Quality Control Act defines water quality objectives 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 Code Section 13050h). Water quality objectives may be either numerical (i.e., mg/L limit for copper) or narrative (i.e., no toxics in toxic amounts). The definition of water quality objectives is critical for both the WER and the MRP as the following two key points in the above definition apply: (1) since the trigger for the Phase 1 monitoring in the MRP is toxicity to test species, the narrative objective and not the numeric objective (levels of constituents) will dictate the need for management practices and determine success; and (2) reasonable protection of beneficial uses implies that 100% protection for all species all the time is not the intent of the Porter Cologne Act.

The Conditional Waiver for Irrigated Lands states that a Communications Report must be submitted as part of the WER. The Communications Report must outline a Response Plan by the watershed group if monitoring results show that significant toxicity is reported in surface waters of the watershed group area (i.e., Sacramento River watershed). The communication strategy that will be adopted by the Coalition is an eight step process described below and also presented in flow-chart form in Figure 7. A Communications Report will be submitted as described in the Monitoring and Reporting Program (Resolution No. R5-2003-0105, Section III – Reporting Requirements) to the Regional Board seasonally (at a minimum) when monitoring results

indicate that implementation of management practices is needed to control toxicity (Steps 5-8 below). The three phases listed with the eight steps are explained in detail in the MRP.

Step 1 (Phase 1) – If the results for either the water column toxicity tests or sediment toxicity test demonstrate any degree of toxicity at a monitoring site then Step 2 will apply.

Step 2 (Phase 1) – The significance of toxicity reported at a site will be determined by repeating the toxicity test(s) that showed initial toxicity to determine if the toxicity is persistent. If persistent toxicity is reported then Step 3 will apply. If persistent toxicity is not reported no further action is needed.

Step 3 (Phase 1) – Toxicity Identification Evaluations (TIEs) and pesticide monitoring (i.e., may apply to pyrethroids in sediment) will be conducted to determine the cause of toxicity.

Step 4 (Phase 1) – This step applies if Step 3 is successful in determining the cause of toxicity. If the cause of toxicity (i.e., a specific pesticide) is not identified then further work will be needed to determine the cause. Non-pesticide stressors are a potential cause of toxicity.

Step 5 (Phase 2) – If the cause of toxicity is identified then appropriate management practices will be instituted in the drainage to reduce toxicity at the monitoring site.

Step 6 (Phase 3) – Continued toxicity testing and COC (constituent of concern) monitoring will be conducted at the site to determine the effectiveness of management practices in reducing the toxicity and COC concentrations. It is anticipated that multiple years of effort may be needed to determine the effectiveness of management practices.

Step 7 (Phase 3) – An evaluation of the success of the management practices in reducing toxicity and COC concentrations will be determined and, if the toxicity is reduced, then Step 8 applies (no additional action). If the initial management practice (or practices) do not reduce toxicity then other management practices will be used. If these additional management practices reduce toxicity then Step 8 applies. If these additional management practices are not successful, then the Department of Pesticide Regulation will be contacted and other measures such as label changes for pesticides will be considered.

Step 8 – No additional action is needed because toxicity has been removed from the monitoring site.

Section 4.0 Sacramento Valley Subwatershed Reports

As stated in the Introduction of the WER, the Coalition is organized on a watershed scale. To successfully manage and implement a water quality program, the Coalition has divided the Sacramento River watershed into ten subwatersheds. Common agricultural practices exist in each subwatershed, however, operations vary according to geographic, hydrologic and agricultural features. The reports presented in Sections 4.1 - 4.10 will help to provide an understanding of this diversity.

Sections 4.1 – 4.10 provide a description of conditions in each of the subwatersheds, including geography, hydrology, existing land use, existing water quality conditions and drainage prioritization. The information compiled from each subwatershed was used to support the final prioritization strategy described in Section 2.0. This background information is fundamental to the design of the Monitoring and Report Plan (MRP) and the recommendation for potential monitoring sites within each subwatershed. This monitoring strategy is being developed to provide important data and analysis to quickly mobilize management measures that will adapt to water quality impacts. It will also provide important data for the Coalition to evaluate the success of selected management measures as described in the Implementation Plan in Section 3.0.

The boundaries of the subwatersheds represent hydrologic units for the purpose of analyzing drainage and flow regimes of major rivers and streams in the Sacramento River watershed. Where appropriate, and not to compromise the accurate description of runoff potential, the subwatersheds have also been delineated by county boundaries in an effort to facilitate long-term local water quality management. In the future, the subwatershed boundaries may be modified to support an effective water quality management program.

The subwatershed reports will change as new information is developed during the interim program and throughout the 10-year implementation program proposed for the *Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands.* This long-term planning horizon supports an "adaptive management" approach at the local level, by allowing the time to evaluate options in order to make optimal decisions with limited resources to achieve desired results.