CALIFORNIA
STATE WATER
PROJECT

Sanitary Survey Update Report 1996

This Survey was conducted by:

California Department of Water Resources
Division of Local Assistance
Water Quality Assessment Branch

Under the direction of:

State Water Contractors

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Background

The requirement for a sanitary survey of watersheds used as sources of drinking water results from the California Department of Health Services (DHS) Surface Water Treatment Regulation, which was put into effect on June 1, 1991. This rule requires that all water purveyors of drinking water perform a sanitary survey of their source water watersheds by January 1, 1996. It is intended to implement the federal Surface Water Treatment Rule (SWTR), which was promulgated on June 29, 1989, and became effective on December 31, 1990.

The intent of a sanitary survey is to identify actual or potential sources of contamination in a watershed, along with a variety of other related factors which are capable of producing adverse impacts on the quality of water used for domestic drinking water purposes. For many regional and local water agencies that use the State Water Project (SWP) as a source of drinking water, the requirements mandated by SWTR required some interpretation regarding how the rule would be applied to agencies using SWP water.

Both DHS and the SWP State Water Contractors (SWC) were in agreement that the most practical approach to meeting the requirements of SWTR for a system as large and complex as SWP was to conduct a single sanitary survey of the entire water collection, storage, and distribution system. A major advantage for the water agencies of conducting a unified sanitary survey for SWP was that individual surveys would not be required of them for either new or amended water supply permits when SWP was the water source.

The Initial 1990 Sanitary Survey of the State Water Project

The initial 1990 Sanitary Survey of the State Water Project resulted from a request by DHS in early 1988. The consulting firm of Brown and Caldwell Engineers conducted the initial 1990 Sanitary Survey under the direction of the SWC. The report, Sanitary Survey of the State Water Project, was transmitted to DHS on October 26, 1990.

The State Water Project Sanitary Survey Review Committee was formed to follow up on the recommendations contained in the 1990 Sanitary Survey Report. The work of the Review Committee resulted in the State Water Project Sanitary Survey Action Plan, which addressed many of the recommendations resulting from the initial Sanitary Survey Report.

Since the recommended actions may affect both the staffing and the budgets of various agencies, the plan was written with the understanding that the agencies would utilize available resources to address actions recommended in both the report and the action plan.

The 1996 Sanitary Survey Update of the State Water Project

The 1996 Sanitary Survey of the State Water Project focuses on the recommendations resulting from the 1990 effort and any major changes in the watersheds or water quality occurring during the preceding five year period.

Since the initial sanitary survey was conducted, the American Water Works Association, California-Nevada Section, Source Water Quality Committee has prepared the Watershed Sanitary Survey Guidance Manual. This guidance manual and the checklist it contains were followed as closely as possible in conducting the 1996 Sanitary Survey Update of the State Water Project. While the manual was found to be a very useful and comprehensive guide, and the checklist a very useful tool, some interpretation and adaptation were required to adjust for the scale of SWP.

In addition to the actions taken and discussed in SWP Sanitary Survey Action Plan, the 1996 Sanitary Survey Update of the State Water Project had several additional areas of focus. DHS requested that greater attention be given to several specific components of SWP. A more detailed investigation of the major reservoir watersheds, which include Del Valle, San Luis, Pyramid, Castaic, Silverwood, and Perris, along with the Barker Slough/NBA watershed, and the open channel section of the Coastal Aqueduct, was requested. An emphasis was also placed on the occurrence of coliforms and the pathogens *Giardia lamblia* and *Cryptosporidium parvum* in the water supply, and any related monitoring efforts. The 1996 Sanitary Survey Update of the State Water Project also covered actual and potential contaminant sources in the watersheds, emergency action plans, and water quality conditions at representative points throughout SWP.

Water quality data were reviewed and reported for several important monitoring locations both in the Sacramento-San Joaquin Delta and at various selected points along the California Aqueduct itself. The monitoring stations at Greene's Landing on the Sacramento River and Vernalis on the San Joaquin River are intended to provide an indication of the quality of water flowing into the Delta from these two major sources. The majority of these data were obtained from DWR's Municipal Water Quality Investigations Program and from the State Water Project Water Quality Monitoring Program, with other external sources used as necessary. Any significant trends in constituent levels are noted and discussed where appropriate.

The high turbidity in SWP resulting from the March 1995 storm events, which introduced large amounts of sediment-laden storm water into the California Aqueduct, has become an issue for several reasons. These high sediment loads have caused concerns from both drinking water treatment and groundwater recharge/storage perspectives.

Included in this update was a questionnaire sent out to the municipal contractors of the State Water Project, inquiring about their projected ability to meet new and proposed drinking water rules. The questionnaire asked for water quality or treatment-related information, which included any difficulties the contractors may be experiencing treating SWP water for drinking water purposes. It also invited discussion of the agencies' success in handling any problems encountered, and how they adapted the treatment system to handle each situation. The contractors were also asked to identify any known or potential threats to SWP water quality. Agricultural runoff to source waters, algae and other aquatic plant blooms, taste and odor problems, sediment and turbidity in the Aqueduct, asbestos, transportation accidents, and petroleum product pipeline spills were among the responses.

The 1996 Sanitary Survey Update of the State Water Project briefly discusses the major revised or proposed drinking water regulations. The current drinking water regulations are also provided for reference.

Water Supply System, Watersheds, and Potential Contaminants

The 1996 Sanitary Survey Update of the State Water Project includes eight study areas which were selected for more detailed investigation based on data evaluated from the initial 1990 Sanitary Survey of the State Water Project. They are: Barker Slough, Lake Del Valle, San Luis Reservoir Complex, the open segment of the Coastal Aqueduct Branch, Pyramid Lake, Castaic Lake, Silverwood Lake, and Lake Perris. Also included is an overview of the water supply system of each study area and of the State Water Project.

The watersheds for each study area contain a variety of potential sources of contamination. The contaminant sources were identified through the use of field surveys, data base searches, existing literature, and interviews. Environmental data bases were searched to identify certain environmental concerns arising from activities in the watersheds and adjacent areas. Checklists of potential contamination sources were prepared and forwarded to DHS during research and preparation of the 1996 Sanitary Survey Update of the State Water Project, in accordance with AWWA guidelines.

Several important characteristics of each watershed related to land use, population center data, agriculture, grazing, hydrology, surface geology and hydrology, soils, and vegetation are described. The watershed boundaries for each study area were defined using both 7.5 and 15 minute United States Geological Survey (USGS) topographical maps and DWR Hydrologic maps (DWR 1987). In addition, the area of each watershed was measured using these maps and a planimeter.

Barker Slough

Barker Slough is the source of water for the North Bay Aqueduct (NBA). Water is pumped from the slough via NBA pipeline and supporting structures to many San Francisco Bay area users.

The northwest portion of the watershed produces significant amounts of several agricultural crops which include safflower, corn, alfalfa, tomatoes, and other field crops. Potential contaminants to the waters of the NBA from agricultural crop production include pesticides, nutrients, increases of total organic carbon (TOC), and suspended solids.

Grazing of both cattle and sheep in the watershed may produce contaminants in the form of nutrients, increased erosion of stream banks where animals have direct access to the water leading to increases in turbidity, and possible introduction of the pathogens *Giardia lamblia* and *Cryptosporidium* to the water supply.

The environmental database search identified two solid waste landfills (B&J Landfill and Aqua Clear Farms) and several additional underground storage tank (UST) sites. There are also two permitted underground storage tanks at the Campbell Ranch site, and one underground storage tank at Cripps Ranch located on Hay Road.

Easterly Waste Water Treatment Plant

The Easterly Waste Water Treatment Plant for the city of Vacaville is the nearest treatment plant to Barker Slough, and discharges treated effluent to Alamo Creek. This discharge is approximately 15 river miles from the Barker Slough intake for the NBA.

A dye test was performed on the Easterly Plant discharge by Montgomery Consulting in 1991. The results indicated that measured dye concentrations were less than the method detection limit of 0.1 ppb at the North Bay Pumping Plant on Barker Slough. The study concluded that these were essentially background concentrations and that the dye did not reach the NBA intake at Barker Slough during any of the test periods.

Argyll Park

The Argyll Park motocross race track facility is 1.5 miles to the west of NBA pump house on Cook Lane. Currently this site is proposing an expansion of recreational activities under the project name Campbell Ranch. These recreational activities could possibly impact surface water quality in Barker Slough.

In July 1994, a formal response was prepared and submitted by DWR to the Solano County Department of Environmental Management on the Campbell Ranch project Environmental Impact Report (EIR) (Letter from Keith Barrett, Chief, Division of Operations and Maintenance, 1994). DWR response focused on the contribution of pollutants from the project to Barker Slough and the ability for runoff to be controlled when the site is operational.

DWR was not satisfied that runoff safeguards would be extended on a "permanent operational basis" at the site. There was concern about inadequate capacity of waste water handling procedures at the site to accommodate as many as 2,500 visitors to the proposed project area, as well as for an adequate contingency plan for untreated water entering Barker Slough. This EIR is scheduled for review by Solano County in early 1996 and DWR intends to closely follow the process.

The city of Benicia has submitted comments concerning the findings of both the initial 1990 Sanitary Survey and the 1996 Sanitary Survey Update with regard to the quality of the North Bay Aqueduct source waters. A number of these findings have been incorporated as recommendations in this report. It is anticipated that the recommendations in this report will be addressed by a Sanitary Survey Action Committee in much the same manner as the recommendations resulting from the 1990 Sanitary Survey were addressed by the original Sanitary Survey Action Committee, and can be considered as work in progress.

Lake Del Valle

Land use in the watershed is limited to recreation associated with Lake Del Valle and cattle grazing in the Arroyo Valle drainage. The N-3 Cattle Company is located in the Arroyo Valle drainage. The land is privately owned and several hundred cattle graze in this area year round, with grazing heavier in the winter compared with the summer. This ranch also has various cattle pens present.

The Patterson Ranch is located in the northwest part of the watershed, and is also a cattle operation. Accurate estimates of the number of cattle present in the watershed are difficult to determine since private land is involved.

Crop production in the watershed is limited, with alfalfa, truck crops, and wine grapes being grown in the Livermore Valley northwest of the lake.

San Luis Reservoir Complex

The watershed of O'Neill Forebay is undeveloped except for the recreational facilities. Cattle grazing is limited on the privately-owned hills surrounding the lake. There are extensive recreational developments and three wildlife areas around the reservoir.

Sites identified within the Environmental Database Records Search area consist predominantly of UST sites.

Coastal Branch

Currently no domestic water turnouts are along this portion of the Coastal Aqueduct. However, SWP is being extended to the central coast between the end of the existing open canal at Check 5 and Santa Barbara. The aqueduct extension will be an enclosed pipeline.

Cattle grazing does occur in the watershed area on a year-round basis. During the field survey, sheep were observed on both sides of the aqueduct. Oil wells, gas wells, and petroleum pipelines are located in the watershed. Various agricultural crops are produced on both sides of the aqueduct.

The environmental database search identified several spills on Highway 33 and on Barker Road. Other identified spilled material events in the watershed appear to be related to oil and gas operations in the area.

Pyramid Lake

The watershed areas nearest the reservoir are used primarily for recreational purposes associated with both the lake, and the Hungry Valley State Vehicular Recreation area.

Cattle and sheep grazing occurs in the watershed on a seasonal and non-irrigated basis from mid-May to mid-October. Grazing in the Piru Allotment involves a total of 47,580 acres, but only 16,187 acres are actually grazed by approximately 250 cattle.

Seven emergency response notifications were recorded for the Environmental Database Records Search area. These notifications represent transportation spills that occurred on Interstate 5 or Highway 138. None of the spills were documented as reaching a surface water body, such as the reservoir.

In October 1992, an underground storage tank at the Emigrant Landing area of the lake was reported to have leaked and contaminated soils with petroleum hydrocarbons. The tank has been removed and the site is currently being monitored quarterly. Other sites in the watershed include 12 mines, with eleven being active gold mines. These mines are not listed as either actively discharging to surface water or using chemicals for mining purposes.

Quail Lake

The major activities in the Quail Lake area are recreation (consisting mostly of fishing) and cattle grazing in areas around the northern part of the lake. Highway 138 passes near the lake to the south; one underground storage tank is in the watershed.

Castaic Lake

Sheep grazing occurs in the watershed on a seasonal and non-irrigated basis for the purpose of fire hazard reduction in the northwest arm of Castaic Lake. Approximately 750 sheep graze a total of 2,560 acres, of which 135 acres are owned by DWR and the remaining acreage is owned by the Bureau of Land Management. Runoff from the surrounding grazing areas would enter the reservoir from creeks draining these areas.

Castaic lagoon is operated as a recreational area and is an afterbay of Castaic Lake. It is not a part of either the State Water Project or Castaic Lake.

Hazardous waste is generated in the vicinity of the lake through various DWR maintenance activities. However, these DWR maintenance facilities are below the lake and pose little or no threat to SWP water quality. Since 1989, hazardous waste has been generated in the following waste streams: asbestos, waste oil, oil containing waste, organic liquid mixture, and organic solids.

Other possible sources of contaminants in the watershed include drainage from mines and runoff from Hughes Road.

Silverwood Lake

Two leaking USTs were found in the watershed of the lake. Both were located at the Cedar Springs Dam, and DWR was identified as the responsible party. However, the DWR facility is located below the dam and poses little or no threat to SWP water quality. The removal of a 10,000 gallon gasoline UST and a 10,000 gallon diesel UST occurred in 1994. All removal activities were in conjunction with San Bernardino County and Regional Water Quality Control Board recommendations. No further action has been taken at the dam site.

Grazing has not occurred in the watershed area since 1990.

Crestline Sanitation District

The waste water handling facilities consist of four waste WTPs, which include the Cleghorn, Seeley Creek, Pilot Rock, and Huston Creek plants. All plants provide secondary treatment of effluent (0.8 million gallons per day average dry weather flow, combined), and all are located above Lake Silverwood. Effluent is discharged by a single 11-mile long outfall pipe to Summit Valley and the Las Flores Ranch, where it is applied to irrigate pasture land or is directed to percolation ponds.

Between January 16, 1993, and January 25, 1993, a failure resulted from construction-related damage to the outfall pipeline when a fence post was driven through the outfall pipe. Approximately 11 million gallons of treated and disinfected effluent was lost to the East Fork of the West Fork of the Mojave River. The spill was to the ground approximately 100 yards north of Highway 173 on Las Flores Ranch property, and eventually flowed 1.5 miles into the West Fork of the Mojave River. The location of the spill was below the Lake Silverwood watershed.

Repairs to the outfall pipe were completed on January 25, 1993. Due to the nature of the spill, clean up was not possible. As a result of the failure, modifications were made to the outfall and a fine was assessed by the Lahontan Regional Water Quality Control Board. A low flow alarm and a holding vault have been installed since the event.

Lake Arrowhead Sanitation District

The waste water handling facilities consist of two waste WTPs (Willow Creek and Grass Valley), with an average flow of 1.7 million gallons per day. The treated effluent is conveyed by pipeline to a 380 acre farm located in Hesperia, where it is used to irrigate pasture land.

Any system failures would involve Grass Valley Creek or the Lake Arrowhead drainage basin, but not the Silverwood Lake watershed. Lake Arrowhead is a source of drinking water for the district.

Lake Perris

Lake Perris State Recreation Area is operated by the Department of Parks and Recreation. Activities at the lake are predominately associated with recreation.

An underground storage tank leak was located at the Lake Perris Marina. This tank was reported to have leaked 5,000 gallons of gasoline in July 1994 which did reach surface water. According to the Regional Water Quality Control Board, the tank was removed in February 1995, with the excavation observed by the Riverside County Health Department. A vapor extraction system and monitoring wells have been installed as part of the remediation effort.

As reported in the initial Sanitary Survey of the State Water Project, the swimming beaches, particularly at the north end of the lake, have had problems with high total and fecal coliform contamination in 1985 and 1986. The contamination resulted in the beaches being closed for short periods of time. Since that time, a visitor education program has been in effect. The beaches have not been closed since the institution of the program.

Sanitary Survey Update Questionnaire

The questionnaire was sent to various water agencies in the State of California that contract for SWP water. It was intended to provide supplemental information in support of the 1996 Sanitary Survey Update of the State Water Project. While some of the agencies did not report any problems using SWP water, other agencies did experience difficulties treating water supplied by SWP. A total of 16 out of 18 (89 percent) questionnaires were returned.

Turbidity was a major concern for many of the 16 agencies responding, as were water quality parameters such as temperature variations, pH, and alkalinity. The pH variations ranged from low to high concern depending on the agency. Changes in pH, particularly high alkalinity, creates problems with the coagulants resulting in the need to adjust the coagulant application rate.

Taste and odor were other concerns expressed by many agencies, and appeared to be closely related to algae blooms and subsequent decay in the California Aqueduct and reservoirs. Other responses related to taste and odor were methylisoborneol/geosmin, pondweed blooms, and high nutrient loading. Fresh water shrimp were also a concern.

Total organic carbon (TOC) and bromide created many treatment challenges for some agencies. These two constituents have been shown to be related to elevated levels of trihalomethanes (THMs). Many of the agencies responding rated this problem to be of high concern.

For the agencies that currently use ozone, upon treating SWP source water, bromate production was reported to be a problem. The agencies have reported that the increase in THMs are due to several factors, which include high organic matter content, decaying organic matter, and seawater intrusion in the Delta causing elevated levels of bromide.

Metal constituents in the water have created treatment problems for a few water agencies. High metal concentrations can be treated by increased use of pre-chlorination and by flushing out the distribution system more frequently. Iron and aluminum have created problems in treating water from the State Water Project. Iron is a problem for treatment facilities using ozone, since iron precipitates on the ozone diffusers. Aluminum is managed by adjusting the amount of alum used to treat the water. Other infrequent problems are asbestos and heavy metals.

The questionnaire also asked water agencies if they are anticipating difficulties complying with the proposed Disinfectants/Disinfection By-Products Rule, Phase 1. Of the 12 respondents to this question (66 percent), four of the agencies were currently operating under the Phase 1 specifications and were not anticipating compliance problems.

Agencies were questioned about monitoring of either source and/or finished waters for *Giardia*, *Cryptosporidium*, or coliforms. The number of agencies performing pathogen monitoring was 11 of 18 (61 percent).

The questionnaire asked water agencies if they were aware of any sources of contamination, events, or situations that could adversely impact the quality of SWP source water. Agricultural runoff to source waters, algae and other aquatic plant blooms, taste and odor, sediment and turbidity in the California Aqueduct, asbestos, transportation accidents, and petroleum product pipeline spills were among the responses.

DWR Groundwater Pump-in Policy

Based on drought emergency conditions, DWR instituted several interim one-year policies (1990, 1991, 1992, and 1994) for accepting groundwater pumped into the State Water Project from water contractors. The policy was last amended in 1994. Acceptance of non-project water was allowed on an emergency basis during drought conditions provided it did not result in significant degradation of SWP water quality, toxicity to fish and wildlife, or adverse changes in the suitability of the water for its beneficial uses, including municipal, industrial, agricultural, or recreational purposes. As part of its pump-in policy, DWR established water quality criteria based on DHS Drinking Water Standards to determine whether or not to accept water into the California Aqueduct. Fifteen water quality constituents were monitored, including arsenic, selenium, nitrate, chloride, sulfate, total dissolved solids, and specific conductance.

Water quality monitoring for the pump-ins to the California Aqueduct was conducted by DWR Division of Operations and Maintenance (O&M) and U.S. Bureau of Reclamation (USBR). The data indicate that there was much variation between the quality of pumped-in groundwater, when compared to aqueduct water quality. However, for most aqueduct reaches, downstream water quality changes in the California Aqueduct were not observed.

Currently there is no policy which provides for pump-ins on a drought emergency basis. Future non-drought programs may be allowed and will be governed by a long-term policy that is currently being developed by DWR and the State Water Contractors.

DWR State Water Project Emergency Action Plan

The main purpose of an Emergency Action Plan (EAP) is to provide comprehensive, easy-to-follow, and up-to-date information to people responding to emergencies. It also serves as a reference for pre-emergency training.

The EAPs for each of the five Field Divisions of SWP follow essentially the same format. The EAP format is designed to provide logical pre-emergency training and to provide quick reference in emergencies. It is based upon the format recommended in Analysis of Emergency Plans of Agencies Operating State Water Project Facilities (G. Laverty 1990), which was included in the initial 1990 Sanitary Survey of the State Water Project.

Water Quality of the State Water Project System

Pathogen and Coliform Water Quality Data

Total coliform bacteria measurements are intended to indicate the general level of urban and animal contamination of a water supply. Coliform bacteria are generally not harmful to humans; however, they could be indicators that other pathogenic organisms may be present.

Pathogen data were requested from member water agencies by the State Water Contractors organization. Only raw water pathogen data were compiled. Where isolation of SWP water was possible, this was done, realizing that many agencies blend water of different sources. Pathogen data from other sources or blends were identified as such. Respondents were also asked to estimate what percentage of their source water came from SWP.

Coliform Water Quality Data

Raw water coliform values were reported. These values are higher than treated water values and, therefore, should not be compared to regulatory standards. However, raw water coliform values are valuable in the selection of treatment processes to provide pathogen-free finished water.

North Bay Area

NBA water had a higher median total coliform concentration than Cordelia Forebay or Lake Herman. The North Bay Aqueduct had a median total coliform concentration of 110 MPN/100 ml. Cordelia Forebay, which stores NBA water had a median total coliform concentration of 52-70 MPN/100 ml. Lake Herman, a reservoir for excess NBA water that also drains a small watershed, had the lowest total coliform concentration of 23 MPN/100 ml. Examination of NBA coliform data over time showed peaks in coliform concentration in the winter months.

South Bay Area

The range of total coliform concentrations was lower in the South Bay area than the North Bay area. The highest median total coliform concentration observed was at the bayside terminal of the South Bay Aqueduct (median = 240 MPN/100 ml). The lowest median coliform value was in the Santa Teresa WTP intake (median = 8 MPN/100 ml). Patterson Pass, Del Valle, and Penitencia WTP intakes had median total coliform values ranging from 17 to 30 MPN/100 ml.

San Joaquin Valley Area

In the San Joaquin Valley area, the median total coliform value was 8 MPN/100 ml based on data reported by the Kern County Water Agency for SWP water; the median total coliform value was 12 MPN/100 ml in water that was aSWP/Kern Water Bank water blend; and the median total coliform value was 8 MPN/100 ml at the Kern River Intertie with SWP. It appears from the data that the coliform concentration in SWP is increased when blended with Kern Water Bank water by the Kern County Water Agency and remains approximately the same when blended with Kern River water.

Southern California Area

The median total coliform values for Quartz Hill and Eastside WTPs were 11 and 18 MPN/100 ml, respectively. Data for the Palmdale WTP intake which receives water farther south on the East Branch of the California Aqueduct have a median total coliform value of 30 MPN/100 ml, slightly higher than the intakes for the Antelope Valley/East Kern Water Agency WTPs.

Summary of Coliform Water Quality Data

In general, the highest total coliform counts were seen in the NBA. The median total coliform value in the NBA was 110 MPN/100 ml. Other areas of elevated coliform concentrations were the South Bay Aqueduct terminus with a median total coliform value 240 MPN/100 ml, and Palmdale WTP which receives water from the East Branch of the California Aqueduct with a median total coliform 30 MPN/100 ml.

Fecal Coliform Water Quality Data

North Bay Area

Fecal coliform concentration trends were similar to total coliform concentrations in the North Bay Area. Higher fecal coliform concentrations were seen in the NBA and the Cordelia Forebay water. Lower fecal coliform concentrations were seen in Lake Herman.

South Bay Area

Santa Clara Valley Water District's Penitencia WTP receives influent from the South Bay Aqueduct, and had the highest median fecal coliform concentration of 11 MPN/100 ml. Rinconada and Santa Teresa WTPs, which receive blends of San Luis and SBA water, had lower median fecal coliform concentrations.

Southern California Area

Quartz Hill and Eastside WTPs had relatively low median fecal coliform concentrations of 2 and 4 MPN/100 ml, respectively while Palmdale had a higher median fecal coliform concentration of 11 MPN/100 ml.

Summary of Fecal Coliform Water Quality Data

The highest median fecal coliform value of the data evaluated was in Cordelia Forebay (median = 63 MPN/100 ml) in the North Bay Area. In the South Bay Area, the sample of one hundred percent South Bay Aqueduct water had a higher median fecal coliform value than that of water blended with San Luis water. In the Southern California area, the Palmdale WTP intake had higher fecal coliform values than that of the Antelope Valley/East Kern Water Agency WTP.

Giardia lamblia Water Quality Data

Delta/San Luis/San Joaquin Areas

Giardia lamblia data for this area were supplied by DWR's O&M and the Metropolitan Water District of Southern California (MWD). The only positive results were seen at the Delta-Mendota Canal at O'Neill Forebay and at Greenes Landing on the Sacramento River, which were sampled by MWD in 1992-93. The average *Giardia lamblia* concentrations at Greenes Landing and the Delta-Mendota Canal were 37 and 6 cysts/100 L, respectively.

DWR sampling in the Delta-Mendota Canal near O'Neill Forebay, Banks Pumping Plant, and Arroyo Valle inlet to Lake Del Valle in 1995 did not result in any positive results. Average reporting limits for the 1995 DWR sampling ranged from approximately 5 to 30 cysts/100 L.

South Bay Area

The only positive *Giardia lamblia* samples were detected in Rinconada WTP intake water (Santa Clara Valley Water District) and in one South Bay Aqueduct bayside takeoff sample (Alameda County Water District). The one positive *Giardia lamblia* concentration for the Rinconada WTP was 4.4 cysts/100 L, which was for one out of 21 samples analyzed. The one SBA bayside takeoff sample, which was 75 percent Delta/25 percent Del Valle water, had a *Giardia lamblia* concentration of 2.1 cysts/100 L. Average reporting limits ranged from

0.2 cysts/100 L (at Rinconada) to 39 cysts/100 L at Patterson Pass WTP (Alameda County Flood Control and Conservation District, Zone 7).

Southern California Area

Positive *Giardia lamblia* samples were obtained by MWD at the treatment plant intakes (Diemer, Jensen, Mills, Skinner, Weymouth) at the outlet tower to Lake Perris and at the Foothill Pressure Control Structure. Average concentrations ranged from 1.5 cysts/100 L at the Skinner WTP and Lake Perris, to 7 cysts/100 L at Weymouth WTP. Reporting limits for all reported data ranged from 1 to 21 cysts/100 L.

Cryptosporidium Water Quality Data

Delta/San Luis Areas

Cryptosporidium data in the Delta area were obtained from DWR O&M sampling in 1995 and from MWD sampling in 1992-93. Positive *Cryptosporidium* samples were detected at Greenes Landing, Banks Pumping Plant, the Delta-Mendota Canal, and the California Aqueduct (Check 29) in 1992-93 by MWD. Average concentrations ranged from 17 oocysts/100 L at Check 29, to 54 oocysts/100 L at Banks Pumping Plant.

Sampling by DWR in 1995 at Banks Pumping Plant, Delta-Mendota Canal, and the Arroyo Intake to Lake Del Valle did not result in positive *Cryptosporidium* samples. However, presumptive results of sampling at Banks Pumping Plant showed positive samples with concentrations of less than 10 oocysts/100 L. However, internal bodies of the oocysts were not identified (i.e., confirmed) with these presumptive results. Average reporting limits ranged from about 2 oocysts/100 L at the Arroyo Intake to Lake Del Valle to about 11 oocysts/100 L at Delta-Mendota Canal.

South Bay Area

Cryptosporidium results for the South Bay area include data from DWR, Alameda County Flood Control District - Zone 7, Alameda County Water District, and Santa Clara Valley Water District (SCVWD). Positive samples were only seen in the one hundred percent San Luis water taken into SCVWD treatment plants, and intake water to Penitencia, Rinconada and Santa Teresa WTPs. Rinconada, and Santa Teresa WTPs blend water from SBA and San Luis.

Average *Cryptosporidium* concentrations measured by Santa Clara Valley Water District ranged from 0.1 oocysts/100 L at Penitencia to 3.4 oocysts/100 L of one hundred percent San Luis water. Other water agencies with different reporting limits did not detect *Cryptosporidium*.

Southern California Area

Cryptosporidium concentrations for the Southern California area include data from the Palmdale Water District and MWD. Positive concentrations were seen at MWD treatment plants. Average concentrations ranged from 1.1 oocysts/100 L at Mills WTP to 3.7 oocysts/100 L at Weymouth WTP. Average reporting limits for Palmdale WTP and the East Branch of the California Aqueduct measured by Palmdale Water District were 20 oocysts/100 L.

Summary of *Giardia* and *Cryptosporidium* Water Quality Data

Due to variations in the reporting limits and analytical laboratory performance, it was difficult to compare the results of *Giardia lamblia* and *Cryptosporidium* analyses between sites. However, available data show high positive concentrations of *Giardia lamblia* and *Cryptosporidium* in the Delta, as measured by MWD.

Giardia lamblia was only detected in a few samples in the South Bay area. One sample at the South Bay Aqueduct (SBA) bayside takeoff (75 percent Delta water, 25 percent Del Valle water) and several samples at the Rinconada WTP (SBA water) were positive for *Giardia lamblia*. *Cryptosporidium* was detected at the Santa Clara Valley Water District plants at median values ranging from 0.1 to 3.4 oocysts/100 L. All other samples taken in the South Bay Area were below reporting limits.

In the Southern California area, *Giardia lamblia* and *Cryptosporidium* were seen in almost all the intakes to MWD WTPs. Palmdale Water District samples did not obtain positive *Giardia lamblia* and *Cryptosporidium* results with their reporting limits.

DWR Division of Local Assistance

Water quality data for the Sacramento-San Joaquin Delta and major inputs to the Delta were obtained from the Municipal Water Quality Investigations (MWQI) Program. The Program's major goal is to assist water agencies in protecting and improving Delta drinking water supplies and to guide water treatment research.

DWR Division of Operations and Maintenance

Water quality data for major stations along SWP south of the Delta were obtained from DWR's O&M Water Quality Monitoring Program. The Program's goals include monitoring SWP water quality, documenting temporal and spatial changes in SWP water quality, providing SWP contractors with water quality data to assess WTP operational needs, and conducting studies as needed to characterize the effect of specific activities on SWP water quality.

Water Quality Data

The period of record varies for each location and constituent. In general, the data presented in this section were collected between 1990 and 1995.

Disinfection By-Products

Since untreated water does not generally contain significant quantities of THMs, waters of the Delta and its tributaries are analyzed for total trihalomethane formation potential (TTHMFP), which is a test of the maximum capacity of a water source to form THMs upon chlorination. THMFP values obtained in this assay <u>do</u> <u>not</u> reflect trihalomethane concentrations actually produced in drinking water treatment facilities.

Although TTHMFP results are not directly comparable to the actual amount of trihalomethanes formed at a treatment plant after disinfection, TTHMFP values do indicate an increased likelihood of formation of THMs after treatment plant disinfection of water. The greatest enrichment of SWP water with THM formation material occurs in the

Delta and in the NBA at Barker Slough watershed. This enrichment is on the order of 100-300 µg/L TTHMFP. TTHMFP decreases as the water moves from north to south in the Aqueduct, with values at Southern California export sites being about 50 µg/L lower.

Organic Carbon

The high TTHMFP levels in Delta waters are likely due to the relatively high organic carbon content of Delta waters. Organic carbon and chlorine are the basic and essential precursors in the formation of THMs during water treatment. Waters high in organic carbon may be highly colored and usually contain substantial quantities of humic and fulvic acids that produce DBPs upon chlorination. Dissolved organic carbon (DOC) and total organic carbon (TOC) concentrations of water supplies are a rough indication of the potential for THM formation since TOC and DOC measurements include the organic THM precursors. The median DOC concentrations in the Delta increase as the water flows through the Delta.

The NBA at Barker Slough had the highest median TOC concentration of all SWP sites monitored by DWR's O&M Division. The next highest median TOC concentrations were at DMC and Check 13 (O'Neill Forebay) with TOC concentrations of 4.3 mg/L and 4.4 mg/L, respectively. TOC concentrations decreased as water moved along the Aqueduct, ranging 3.0 to 3.8 mg/L at the terminal reservoirs of the east and west branches of the Aqueduct.

The proposed Disinfectants/Disinfection By-Products Rule will most likely include an MCL or removal requirement for TOC in source water. The elevated TOC concentrations in Delta waters (approximately 3.5-4.0 mg/L) represent a cost for WTPs to remove.

Bromide

Bromides are of concern because formation of disinfection by-products increases in the presence of bromides. Brominated methanes are also generally more difficult to control and remove than chloroform using current treatment processes. An additional concern is that bromide is converted to bromate (a carcinogen) in WTPs during the ozonation process. Bromate may be regulated under the proposed Disinfectants/Disinfection By-Products Rule at a level of 0.010 mg/L after water treatment.

Median bromide values in the Delta ranged from 0.02 mg/L at the American River and the Sacramento River, to 0.37 mg/L at the San Joaquin River at Vernalis. The NBA at Barker Slough had a relatively low median concentration of bromide of 0.05 mg/L. The median concentration of bromide at Banks and the Delta-Mendota Canal was 0.3 mg/L. The stations along the California Aqueduct showed median bromide values of 0.22 mg/L at Banks Pumping Plant, to concentrations of 0.35 to 0.50 mg/L at the reservoirs (Silverwood, Perris, Pyramid and Castaic).

There is no regulatory water quality criterion for bromide; however, these bromide concentrations contribute to the formation of THMs and other potentially more harmful chemicals upon water treatment.

Total Dissolved Solids

Total dissolved solids concentrations were greater south of the Delta than in the Delta. The NBA had a TDS concentration of 176 mg/L and California Aqueduct stations had TDS concentrations that ranged from 315-390 mg/L due, in part, to TDS contributions from the San Joaquin River. There do not appear to be significant increases in TDS concentrations along the California Aqueduct as a result of discharges into the Aqueduct.

Electrical Conductivity

MWQI monitoring of electrical conductivity (specific conductance), another indirect measure of salinity, in the Delta region shows low EC values for the American and Sacramento rivers (median EC values of 65 and 170 micromhos/cm, respectively). San Joaquin River water introduces high concentrations of salts into the Delta as seen by the median EC value of 855 micromhos/cm at Vernalis.

Turbidity

Turbidity median values ranged from 16 NTU (DWR O&M data) to 20 NTU (DWR MWQI data) in the NBA. Turbidity was generally higher during the winter months of January through March. The highest turbidity value (180 NTU) was observed in March 1995, a time of unusually heavy precipitation.

Chloride

Chloride concentrations are also an indicator of salinity in source water. Median chloride concentrations in SWP ranged from 26 mg/L at the NBA at Barker Slough to approximately 120 mg/L at Lake Perris and San Luis Reservoir. The South Bay Aqueduct median chloride concentration was 76 mg/L, which was lower than other stations along the Aqueduct that had median chloride values of 80 to 100 mg/L. All the chloride concentrations measured along the Aqueduct were well below the Secondary MCL of 250 mg/L.

Algae and Nutrients

In the Delta and SWP, nitrogen is often a limiting nutrient for algal growth. As such, it is important to monitor. Excessive algal growth can lead to taste and odor problems and filter clogging in WTPs, as well as creating nuisance conditions in reservoirs.

All of the nitrate median values are less than the State MCL of 45 mg/L. Median nitrate values range from 0.10 mg/L at Lake Perris to 3.9 mg/L at the Delta-Mendota Canal O'Neill Forebay.

Nitrate is probably introduced to the source waters of the California Aqueduct primarily from agricultural drainage in the San Joaquin and Sacramento rivers and in the Delta, and from waste WTP discharges. However, nitrate concentrations in the SWP are generally less than 5 mg/L, which is much less than the State MCL of 45 mg/L.

Metals and Other Constituents of Concern

Median arsenic, barium, chromium, selenium, and silver concentrations were less than the federal and State MCL. All cadmium concentrations measured along the Aqueduct were less than the reporting limit of 0.005 mg/L except for one sample at Pyramid Lake which was measured at the reporting limit.

All lead concentrations at SWP stations were less than the federal action level for treatment for lead which is 0.015 mg/L.

All mercury concentrations measured along the Aqueduct were less than the reporting limit of 0.001 mg/L, except for one concentration measured on February 19, 1992. This apparently anomalous value was from one of fifty-seven samples and had a concentration of 0.006 mg/L.

When pesticides have been found in SWP, they are usually at very low concentrations and widely distributed. In general, these chemicals have also been present in the Sacramento and San Joaquin rivers when they are found in SWP. Pesticide applications by DWR are too small and localized to account for the distribution found in SWP.

National Pollutant Discharge Elimination System Stormwater Monitoring Data

Storm water data from the County of Sacramento were included in the survey because storm water from the urban area of Sacramento drains into the watershed of the Sacramento-San Joaquin Delta through the Sacramento and American rivers. It would be similar to data obtained from other cities, except for variations due to industries or activities specific to any particular city.

The dissolved organic carbon concentrations ranged from 3.1 to 8.9 mg/L, while the total trihalomethane formation potential concentrations ranged from 200 to 850 µg/L. In all samples, chloroform was the primary trihalomethane analyte measured from the runoff samples, indicating bromide was not present in significant concentrations.

The results of the Sacramento storm water monitoring suggest that storm water runoff may be a significant source of organic carbon for the Sacramento River watershed, but the impact on the watershed has not been fully assessed.

San Luis Canal Segment of the California Aqueduct – Turbidity Data

Storm water inflows from drain inlets, and both portable and permanent pump emplacements are allowed into the Aqueduct (San Luis Canal segment) at times. Most of these storm water inflows occur over a 30-mile segment of the Aqueduct between Milepost 130 and Milepost 160. During the period of 1973 to 1993, these floodwater inflow volumes ranged from 0 to 41,938 acre-feet annually, and occurred on an average of 14 out of every 100 months. Such flood waters normally make up less than 10 percent of the San Luis Canal volume.

Cantua and Salt creeks have accounted for 88 percent of the total inflow volumes over the past seven years. Prior to this period, the Arroyo Pasajero was the single largest source of floodwater to this segment of the Aqueduct. These flood waters are very turbid and generally introduce increased levels of sediment into the Aqueduct. Iron, aluminum, selenium, magnesium, asbestos, TOC (total organic carbon), and nitrate concentrations were found at high levels in the flood waters, but have not been found to influence water quality in the Aqueduct in general.

The Storm Event of March 1995

On March 11, 1995, an embankment at the Arroyo Pasajero impoundment area failed at Milepost 157.4 on the Aqueduct. Floodwaters from Cantua and Salt creeks also came over the Aqueduct embankments at Mileposts 134.93, 136.96, and 138.96. The failure occurred in the presence of heavy storm-related floodwaters. An improperly constructed private landowner encroachment through the embankment may have contributed to the failure. The flooding event caused an oil pipeline to rupture, releasing oil to Arroyo Pasajero, some of which was ultimately carried into the Aqueduct through the damaged dike.

The breach of the embankment allowed floodwater to flow into the Aqueduct at the rate of approximately 600 cfs, while displacing a number of concrete panels which line the Aqueduct. Large amounts of sediment were carried into the Aqueduct by these floodwaters. The depth of silt in the Aqueduct was surveyed by DWR's San Luis Field Division at various points along the affected segment.

Turbidity remained high in water deliveries south of Cantua and Salt creeks well after the event. The elevated turbidity resulted from the residual sediment/silt introduced into the Aqueduct from the March floodwater flows. The turbidity increased again beginning about June 1995, and is believed to be related to increased flows in the Aqueduct coinciding with agricultural crop production irrigation deliveries. Turbidity measurements were performed by DWR O&M from April 1995 to September 1995. Various methods of removing the sediment from the Aqueduct are currently being evaluated by DWR.

On the morning of March 10, 1995, storm-related flooding conditions occurred in this segment of the Aqueduct, with turbidities as high as 2,900 NTU reported at the Avenal WTP. The cities of Coalinga and Huron also experienced similar sediment-related problems. The city of Huron did have to shut down its plant for several days to avoid having to treat highly turbid water. Operators of the smaller WTPs indicated that operational problems related to the high raw water turbidity were experienced until late August 1995. The cities in Fresno and Kings counties that were directly impacted by the floodwater and emergencies in the California Aqueduct are USBR water contractors and not SWP contractors.

In summary, increased turbidities were experienced in the San Luis Reach of the California Aqueduct during the spring of 1995. These turbidities were the result of storm events and the breach of a dike in the Arroyo Pasajero and floodwaters flowing over the embankment into the Aqueduct from Cantua and Salt creeks. The water quality events related to the spring storms are still being evaluated.

Conclusions and Recommendations

SWP Sanitary Survey Review and Action Plan Committee

Conclusion: This report is the five-year update of the initial 1990 Sanitary Survey of SWP. This survey update was designed and conducted to focus on the recommendations resulting from the initial survey, and to identify and evaluate water quality of SWP during the past five years since the initial survey was conducted.

Recommendation: To formulate an action plan for the recommendations made in this report, a SWP Sanitary Survey Review and Action Plan Committee should be created to prioritize the recommendations, and to determine the necessary actions for follow-up to these recommendations. In addition, the committee should review the status of all actions taken in response to the 1990 Sanitary Survey recommendations.

Table ES-1
Potential Sources of Pathogenic Organisms in Watersheds

Watershed	Livestock Grazing	Wastewater Treatment	Recreational Use/Facilities	Wildlife Areas
Barker Slough/North Bay Aqueduct	✘	✘	✘	
Lake Del Valle/South Bay Aqueduct	✘	✘	✘	
San Luis Reservoir/O'Neill Forebay	✘	✘	✘	✘
Coastal Branch		✘		
Pyramid Lake	✘	✘	✘	
Quail Lake	✘		✘	
Castaic Lake	✘		✘	
Silverwood Lake	✘	✘	✘	
Lake Perris			✘	

Pathogens

Conclusion: The *Giardia lamblia* and *Cryptosporidium* data from raw water sources now available vary in quantity and quality from treatment plant to treatment plant. The data are not adequate to observe trends in *Giardia lamblia* and *Cryptosporidium* concentrations over time, and it is difficult to compare results of *Giardia lamblia* and *Cryptosporidium* data between raw water sources of treatment plants due to difficulties with the current analytical techniques. The limited information on *Giardia lamblia* and *Cryptosporidium* suggest that raw water concentrations of these pathogenic organisms from SWP water are very low, with average concentrations of *Giardia* cysts and *Cryptosporidium* oocysts approximately five times lower than nationwide averages reported by M.W. LeChevallier, et. al. (September 1995, AWWA Journal).

The potential sources of pathogenic organisms in the watersheds are livestock grazing, recreational use and facilities, waste WTP failures, and wildlife areas. The potential sources of pathogens in the watersheds are in Table ES-1. Total and fecal coliform data from raw water sources now available are difficult to evaluate for comparisons due to differences in analytical techniques used by the water agencies. However, in general raw water coliform values reported by the water agencies were highest for those agencies receiving water from the NBA and the South Bay Aqueduct.

Recommendation: *Giardia lamblia* and *Cryptosporidium* sampling should continue, and total and fecal coliform sampling should be implemented at selected locations on SWP. When problems with recoveries and precision of the analytical method for *Giardia lamblia* and

Cryptosporidium are solved, monitoring for these pathogens should be implemented at more locations.

Further investigation of each watershed should be conducted to further evaluate the potential sources of microbial contaminants identified. In addition, the microbiological safety of SWP source waters should be comprehensively evaluated on an ongoing basis, and should include implementation of the following elements:

- Institute total and fecal coliform monitoring of SWP source water at key locations.
- Work with municipal SWP contractors to coordinate monitoring in such a manner as to make data collected by the contracting agencies comparable to data collected from within the SWP system.
- On an ongoing basis, monitoring data from contracting agencies should be accumulated, along with data collected from within the SWP.
- Results of the data analyses and evaluations should be shared on an ongoing basis among municipal contractors and DWR staff.

Delta Enrichment of Trihalomethane Formation Potential and Organic Carbon in SWP Water

Conclusion: Water is enriched substantially in trihalomethane formation potential (THMFP) and organic carbon as it passes through the Sacramento-San Joaquin Delta.

Recommendation: Studies should be implemented to investigate means of reducing total and dissolved organic carbon levels in the Delta and in the NBA at Barker Slough.

Current studies of the Municipal Water Quality Investigations Program of DWR include treatment of Delta island drainage to reduce total organic loads, characterization of dissolved organic carbon from Delta island soils, mass loading of Delta island water use, and organic carbon drain-age from rice fields.

Dissolved Solids and Turbidity in the Aqueduct

Conclusion: Elevated dissolved solids and turbidity measurements were found in the California Aqueduct, south of the Delta. The elevated dissolved solids and turbidity appear to be primarily a result of salts and sediment in the Delta estuary and the San Joaquin River, and of flood water inflows to the California Aqueduct from Cantua and Salt creeks.

Recommendation: The efficacy of measures to reduce turbidity in the Aqueduct should be investigated. This could include the implementation of measures to reduce the silt load in agricultural drainage, greater restrictions on the dissolved constituent content of any groundwater pump-ins to the Aqueduct, and preventative measures to reduce the possibility of breaches to the Aqueduct, such as the Arroyo Pasajero incident which is currently undergoing extensive study.

In response to flooding problems in Arroyo Pasajero, an Arroyo Pasajero Multi-Agency Forum was created. Among other water related problems in the area, the Forum will be reviewing and commenting on the development and implementation of a feasibility study created jointly by the U.S. Army Corps of Engineers and DWR on corrective actions to prevent similar incidents from reoccurring. The progress of this feasibility study and of the implementation of corrective actions should be monitored. In addition, the SWP Sanitary Survey Review and Action Plan Committee should monitor all activities in Arroyo Pasajero.

Two draft Environmental Impact Reports (EIRs), submitted by Westlands Water District, for proposed groundwater pump-ins to SWP are currently under review. The progress of these proposals should be monitored to prevent the degradation of drinking water quality in SWP by the proposed pump-ins. In addition, the Inflow Committee of DWR is currently in the process of developing a revised policy for pump-ins. The activities and decisions of this committee should also be monitored to ensure that the adopted policy is adequate to prevent the degradation of drinking water quality in SWP.

Bromide

Conclusion: Elevated bromide concentrations were found in the export sites of the Delta, the San Joaquin River at Vernalis, and at some of the reservoirs in the east and west branches of the California Aqueduct. These concentrations, which ranged from 0.30 to 0.50 mg/L, complicateachievement of the bromate and trihalomethane levels required by the Disinfectants/ Disinfection By-Products Rule.

Recommendation: Monitoring should be continued for bromide in the Delta, in the San Joaquin River, and in the terminal reservoirs of SWP. The primary source of bromide to SWP is from

Table ES-2
Hazardous Waste Facilities/Hazardous Materials Releases

Watershed	Hazardous Waste Facility within Watershed	Hazardous Waste Facility in Adjacent Watershed	Emergency Responses to Hazardous Materials Releases within Watershed	Emergency Responses to Hazardous Materials Releases in Adjacent Watershed
Barker Slough/ North Bay Aqueduct	4	12	0	1
Lake Del Valle/ South Bay Aqueduct	0	2	0	0
San Luis Reservoir/ O'Neill Forebay	3	5	0	3
Coastal Branch	2	3	4	1
Pyramid Lake	0	1	0	6
Quail Lake	0	3*	0	2
Castaic Lake	1	1	1	1
Silverwood Lake	1	2	2	1
Lake Perris	0	4	1	2

* Two of these sites are also listed on the CERCLIS list

the intrusion of sea water into the Delta. The possibility of controlling bromide concentrations in source waters should be investigated.

Hazardous Waste Facilities/Hazardous Materials Releases

Conclusion: Of the nine watersheds surveyed, five watersheds were identified as having facilities which generate, transport, treat, store, or dispose of hazardous waste, existing within the watershed. In addition, a total of 25 emergency responses to hazardous materials releases, both within the watersheds and in adjacent watersheds, were identified. The total number of hazardous waste facilities and emergency responses to hazardous materials releases are summarized in Table ES-2.

Recommendation: Although the majority of hazardous waste facilities exists and the majority of incidences of hazardous materials releases occurs outside of the immediate watershed area, potential contamination in the watershed could occur if contaminants are transported through the watershed area. To further evaluate the potential for contamination from all of the hazardous waste facilities, both within the watersheds and in adjacent watersheds, an inventory of hazardous materials, business plan, and emergency response plan of each facility should be obtained and reviewed.

Incidences of emergency responses to hazardous materials releases should be reviewed in detail to determine the types and amounts of materials released and the potential for contamination in the watershed from the release.

Urban Runoff

Conclusion: Storm water runoff from the city of Sacramento contributes total and dissolved organic carbon to the rivers that flow into the Delta. This runoff may be a significant source of organic carbon to the Delta.

Recommendation: Storm water sampling for the city of Sacramento should be continued and expanded to include analysis of parameters of drinking water concern. The MWQI Program will monitor the results of the samples collected under this program.

In addition, storm water monitoring in other cities and urbanized areas should be monitored and reviewed to determine the extent of discharge of contaminants of drinking water concern into the watersheds.

Barker Slough

Conclusion: Approximately 80 percent of the entire watershed is used for grazing by cattle and sheep. Coliform concentrations at drinking water supply intakes of the NBA sug gest that significant microbial contamination may exist in the watershed.

In July 1994, DWR responded to the draft Environmental Impact Report (EIR) for the proposed expansion of the Argyll Park/Campbell Ranch project, a motocross race track facility located 1.5 miles to the west of the NBA pump house. Potential water quality impacts resulting from both the construction of expanded recreational facilities and their subsequent use were identified by the DWR response.

Organic carbon concentrations are highest in the NBA watershed. Potential sources of organic carbon in this watershed include agricultural and urban runoff, and upstream releases of stagnant waters.

While most of the metals measured along the Aqueduct were below reporting limits and below State and federal MCLs, aluminum, iron, and manganese were above the secondary MCLs at the NBA.

The NBA was found to have more water quality problems when compared to other components of SWP.

Recommendation: To assess the potential and extent of microbial contamination in Barker Slough, total and fecal coliform sampling should be implemented at and around the NBA Pumping Plant, as part of implementing Recommendation #2. Raw water monitoring data collected by NBA contractors should be gathered and comprehensively assessed on an on-going basis.

The progress on the development of the Argyll Park/Campbell Ranch project should be monitored to determine if the recommendations made by DWR are being followed.

Studies should be conducted to identify and characterize organic carbon inputs into the NBA watershed.

A system should be developed to alert NBA contractors when significant degradation of water quality has occurred.

The source(s) for the levels of the metals aluminum, iron, and manganese above the secondary MCLs at the NBA should be characterized.

It is anticipated that the recommendations in this report will be addressed by a Sanitary Survey Action Committee in much the same manner as the recommendations resulting from the 1990 Sanitary Survey were addressed by the orignial Sanitiary Survey Action Committee, and can be considered as work in progress.

Lake Del Valle and the South Bay Aqueduct

Conclusion: Significant microbial contamination of the Lake Del Valle watershed may occur as a result of two potential significant sources: 1) cattle grazing in the Arroyo Valle drainage, and 2) recreational facilities and activities in the lake.

Limited information on *Giardia lamblia* and *Cryptosporidium* in raw water sources provided by DWR's Operations and Maintenance; Alameda County Water District; Alameda County Flood Control and Water Conservation District, Zone 7; and Santa Clara Valley Water District suggest that concentrations of these pathogenic organisms from Lake Del Valle and the South Bay Aqueduct are not significant.

Recommendation: To assess the potential and extent of microbial contamination in Lake Del Valle and the South Bay Aqueduct, total and fecal coliform sampling should be implemented at several locations along the Aqueduct and Lake Del Valle, as part of implementing Recommendation #2.

Solid Waste Landfills

Conclusion: Of the nine watersheds surveyed, four watersheds were identified as having solid waste landfills existing either within the watershed or in adjacent watersheds. A total of 8 landfill sites were identified within these four watersheds. (Table ES-3) Solid Waste Landfill Sites summarizes the locations of the identified sites. The majority of identified solid waste landfill sites exist in adjacent watersheds. The Barker Slough watershed had the most number of landfill sites, two of which are within the watershed and two in adjacent watersheds. Potential contamination in the watershed from the solid waste land fill sites and operations would include runoff from the landfill sites, accidental releases of solid waste during transportation through the watershed, and failure of the leachate collection systems. Contaminants released from the landfill sites and operations could include nutrients, organic carbon, coliforms, and pathogenic organisms.

Table ES-3
Solid Waste Landfill Sites

Watershed	Within Watershed	In Adjacent Watershed
Barker Slough/North Bay Aqueduct	2	2
Lake Del Valle/South Bay Aqueduct	0	0
San Luis Reservoir/O'Neill Forebay	0	2
Coastal Branch	0	1
Pyramid Lake	0	0
Quail Lake	0	0
Castaic Lake	0	0
Silverwood Lake	0	0

Recommendation: To further evaluate the potential for contamination from all of the solid waste landfill sites, a review of each landfill site should be conducted to determine the types and volume of solid waste which exists at each site, the topography of the landfill site, any records of accidental releases, the design of the landfill sites, and the standard operating and emergency response procedures. Incidences of accidental releases should be reviewed to determine the frequency and potential for contamination in the watershed from the release. Any monitoring data of surface runoff from the landfill should be reviewed to determine the types of contaminants which may be released from the landfill operation.

Underground Storage Tanks

Conclusion: Leaking underground storage tanks typically result in subsurface contamination to soil and groundwater, which may impact surface water. All of the watersheds contain underground storage tanks (USTs) for diesel fuel or gasoline storage. In five of the watersheds, leaking underground storage tanks (LUSTs) were identified. The location of the leaking tanks were determined, and the status of each tank was reported when data on the tank was available. These five tanks were associated with operation of equipment or recreation activities at the lakes, and were within 1,000 feet of a surface water body.

Recommendation: Further evaluation of the status of underground storage tanks within the watersheds should be performed, particularly those known to have leaked. Records from regulatory agencies should be reviewed, and progress of any remedial activities should be closely followed.

Emergency Action Plan

Conclusion: An emergency action plan has been developed by DWR to provide comprehensive, easy to follow, and up-to-date information to persons responding to emergencies, and to serve as a reference for pre-emergency training. The emergency action plan for each of the five Field Divisions of SWP follow the same format. The format was designed to provide logical pre-emergency training, to provide quicker reference in emergencies, and to reduce obsolescence by making updating easier.

Recommendation: The SWP Sanitary Survey Review and Action Plan Committee should review the information and organization of the emergency action plan to ensure that the document is up to date and functionally adequate.

Drinking Water Standards

Conclusion: A recommendation was made in the 1990 Sanitary Survey Report that DWR should stay abreast of drinking water standards of the U.S. Environmental Protection Agency and the California Department of Health Services, and that DWR should review and revise SWP monitoring programs in response to changes to drinking water standards.

Recommendation: DWR's water quality monitoring program should continue to be updated to reflect the current water quality regulations.

This has already been initiated in the MWQI Program under the New Parameters Plan, which started in June 1995. The New Parameters Plan consists of quarterly monitoring of parameters that have been newly regulated, or are anticipated to be regulated. These new parameters include chemical compounds newly regulated under the Phase II Rule and the Phase V Rule, and chemical compounds soon to be regulated under the proposed Phase VIB Rule.

Since O&M operates five DHS licensed WTPs, it is necessary to follow developments in the drinking water industry and modify monitoring to respond to regulatory changes. A one-year Phase II/Phase V monitoring effort is now underway at these plants in response to DHS requirements.

Petroleum Product Pipelines

Conclusion: Several oil pipelines exist within close proximity of SWP facilities. During the March 1995 storm, a Chevron oil pipeline ruptured, releasing oil to Arroyo Pasajero, some of which was ultimately carried into the Aqueduct. Other incidences of oil pipeline breaks near SWP facilities include the April 1993 failure of ARCO's Line 63 which released 147,000 gallons, and the failure of ARCO's Line 1 during the January 17, 1994 Northridge earthquake.

Recommendation: The incidence of pipeline failures resulting in releases of petroleum products to the environment should be reviewed to determine the potential for SWP water quality contamination.

Introduction

Since June 1, 1996 the California Department of Health Services (DHS) Surface Water Treatment Regulation has required a sanitary survey of watersheds used as sources of drinking water. This rule requires that all water purveyors perform a sanitary survey of their source water watersheds by January 1, 1996. It is intended to implement the federal Surface Water Treatment Rule (SWTR), which was promulgated on June 29, 1989, and became effective on December 31, 1990. The purpose of a sanitary survey is to identify actual or potential sources of contamination in a watershed, along with a variety of other related factors which are capable of producing adverse impacts on the quality of water used for domestic drinking water purposes.

For public water systems using surface water supplies, or groundwater supplies influenced by surface water, the SWTR also requires filtration and disinfection to protect against exposure to pathogens, which include viruses, heterotrophic bacteria, Legionella, and the protozoan *Giardia lamblia*. An additional protozoan, *Cryptosporidium parvum*, is currently not regulated by this rule, but may be in the future. The Total Coliform Rule of June 1989 is also intended to control pathogens in public water systems.

DHS Surface Water Treatment Regulation, while very similar to the federal rule, does not contain exactly the same requirements. For example, DHS Surface Water Treatment Regulation requires that a sanitary survey be updated regularly at five-year intervals, a requirement that this report is intended to address. A sanitary survey may also be required in advance of January 1, 1996. This requirement was imposed in 1988 when DHS requested that a sanitary survey be performed on the State Water Project. The initial sanitary survey of SWP was completed in October 1990.

For many regional and local water agencies that use SWP as a source of drinking water, the requirements mandated by SWTR required some interpretation regarding how the rule would be applied to agencies using SWP water. These agencies, for the most part, do not have control over either the watersheds from which their raw water is derived, or over the storage and distribution system by which water is delivered to them. Both DHS and the State Water Contractors (SWC) were in agreement that the most practical approach to meeting the requirements of SWTR for a system as large and complex as SWP was to conduct a single sanitary survey of the entire water collection, storage, and distribution system. A major advantage for the water agencies of conducting a unified sanitary survey for SWP was that individual surveys would not be required of them for either new or amended water supply permits when SWP was the water source. Water agencies that have their own reservoirs and/or watersheds distinct from SWP are still required to meet the requirements of DHS Surface Water Treatment Regulation for a sanitary survey.

The Initial 1990 Sanitary Survey of the State Water Project

The initial Sanitary Survey of SWP resulted from a request by DHS in early 1988. The initial Sanitary Survey of SWP was accomplished under the direction of, and under contract to, SWCs by the consulting firm of Brown and Caldwell Engineers, and the report, *Sanitary Survey of the State Water Project,* was transmitted to DHS on October 26, 1990. To direct this task, SWC formed an Advisory Committee (see Appendix A) composed of representatives of SWC, along with the participation of several local, State, and federal agencies. The Advisory Committee helped write the report's conclusions and recommendations.

The initial sanitary survey effort used field surveys of the aqueducts, reservoirs, and other major facilities associated with SWP, along with a review of relevant literature, available studies, contaminant sources, and previous concerns related to sanitary conditions affecting water supplied by SWP. Since this was an initial sanitary survey of SWP, a great deal of background and baseline information was provided on the many physical features and facilities which comprise SWP. Other details, such as flows, entitlements, and operational characteristics were also documented, as was selected water quality data at various points in the SWP system.

The State Water Project Sanitary Survey Action Plan

The State Water Project Sanitary Survey Review Committee was formed to follow up on the recommendations contained in the initial Sanitary Survey of SWP. The work of the Review Committee resulted in the State Water Project Sanitary Survey Action Plan, which addressed many of the recommendations resulting from the initial Sanitary Survey of SWP. Since many of the agencies represented on the Review Committee participated at the staff level, the recommendations contained in the action plan did not represent the official position or policy of those agencies. The recommended actions may affect both the staffing and the budgets of various agencies. Therefore, the plan was written with the understanding that the agencies would use available resources to address actions recommended in both the report and the action plan.

Each recommendation in the Action Plan was assigned a priority as follows:

Priority A – Actions that are important to address current high-profile water quality concerns. Agencies should manage their staff and funds to accomplish these actions within the identified schedule.

Priority B – Actions that are designed to address current water quality concerns of a non-critical nature. These actions should be integrated into the agencies' ongoing work schedules to accomplish the work within the identified schedules as staff and funds permit.

Priority C – Actions that should be done as staff and funds are available.

No Action Required – In some cases, the Review Committee believed that the Sanitary Survey recommendation was either addressed in another recommendation or that the recommendation was beyond the scope of the sanitary survey.

In addition to the recommendations resulting from the 1990 Sanitary Survey Report, the Review Committee provided additional ones where appropriate. The Action Plan identified costs, the agencies responsible for the work, and the time schedule to complete the various tasks involved. SWC coordinated with the involved agencies in the attempt to ensure that the identified actions were completed within the time schedules. However, it was understood that, due to staff and budget considerations discussed above, actions required by the agencies were not under the control of SWC.

Summary of SWP Sanitary Survey Action Plan Activities

Priority A and B recommendations and the actions taken to address them are summarized below. The Sanitary Survey Action Plan and the summary below identify the actions taken by the Review Committee to address the recommendations, and also any actions or responses requested of either DWR or other agencies or entities to which the recommendation was directed. Where action was taken based on the request of the Review Committee, it is noted and summarized; however, not all requests resulted in activities to address the recommendation. The complete action plan, including all recommendations and supporting material, is included in Appendix A.

Priority A

Recommendations 2 & 8 Combined

Recommendations 2 : Source waters - Sacramento Basin Upstream of Greene's Landing - M&I

Recommendations 8 : Source waters - San Joaquin River Upstream of Vernalis - M&I Dischargers

Recommendation: Monitoring requirements for National Pollutant Discharge Elimination System (NPDES) discharges, such as municipal waste WTPs, should be increased to cover *Giardia lamblia, Cryptosporidium sp*., and viruses. The State Water Project Sanitary Survey Review Committee should encourage CVRWQCB to include these constituents in discharge compliance monitoring programs.

Solution: The extent of the problem should be determined by sampling for one year in the Delta and northern areas of SWP California Aqueduct. If significant numbers of pathogens are found, a workplan should be developed for municipal waste water dischargers to begin a one-year, bimonthly monitoring program for *Giardia lamblia, Cryptosporidium sp*., and viruses. Samples of the plant effluent and upstream receiving water should be collected and analyzed. Once compiled, this information would allow an assessment of the impacts of these discharges on SWP.

Benefits: If pathogens are not controlled to low levels in the source water, SWP M&I contractors could be required to provide additional filtration and/or disinfection capacity and use higher disinfectant dosages. For MWD alone, the additional annual operating cost of achieving 4 logs of *Giardia lamblia* removal, rather than the minimum 3 logs, is estimated to cost $2 million per year. This assumes that the ozone dosage would have to be increased by 0.5 mg/L to achieve the higher *Giardia lamblia* removal. The additional capital cost of providing this capacity is estimated to be over $17 million for MWD alone.

Action: All recommended actions completed. Pathogen monitoring data from around SWP is included and discussed in Chapter 4.

Recommendation 4: Source Waters - Sacramento Basin Upstream of Greene's Landing - Agricultural Drainage

Recommendation: None

Review Committee Recommendation: Determine if the current assessment, which is the impact of agricultural drainage at Greene's Landing is negligible, is correct. If it is not, implement necessary actions to correct problem.

Solution: Determine if agricultural drainage upstream of Greene's Landing is a threat to SWP drinking water supplies.

Benefits: Improved drinking water supplies at Greene's Landing.

Action: Sacramento River agricultural drainage upstream of Greene's Landing was reviewed, and a summary report was prepared and transmitted to SWC on May 15, 1992. A letter was sent to CVRWQCB transmitting recommendations on July 13, 1992, and July 20, 1992 (see Appendix A).

Recommendation 6: Source Waters - San Joaquin Basin Upstream of Vernalis.

Recommendation: The San Joaquin River at Vernalis is not designated as having an existing beneficial use of municipal water supply. This water is exported at the south Delta pumps and used for drinking water purposes. The Regional Board should recognize this use and adopt standards that protect the municipal water supply beneficial use classification of the San Joaquin River at Vernalis.

Solution: In 1989, SWRCB established a "Sources of Drinking Water Policy" which, in effect, declares all waters of the State to be drinking water, with specific exceptions such as waste water discharges and groundwater of high salinity. With the current Basin Plan 5b and the "Sources of Drinking Water Policy," municipal and domestic beneficial uses of the lower San Joaquin River enjoy a degree of protection at the present time. However, as part of the normal update of Basin Plan 5b, the beneficial use designation of "Municipal and Domestic Supply" should be changed from "Potential" to "Existing," because San Joaquin River water is included in water exported from the Delta for municipal supply.

Benefits: If the lower San Joaquin River carries an "existing" municipal water supply designation, the State and Regional Water Quality Control Boards will be fully obligated to protect this beneficial use in their decision making concerning discharges into the river.

Action: A letter sent on July 13, 1992, to the Central Valley Regional Water Quality Control Board requesting an M&I beneficial use designation for the lower San Joaquin River. A letter was sent on November 30, 1993, to the Central Valley Regional Water Quality Control Board providing comment and requesting that an M&I beneficial use designation for the San Joaquin River at Vernalis be considered as a basin plan amendment.

Recommendation 7: San Joaquin Basin Upstream of Vernalis

Recommendation: A mass loading estimate of key contaminants from discharges to the San Joaquin Basin should be developed by the Regional Board.

Solution: SWRCB's Inland Surface Waters Plan requires implementation of performance goals for agricultural drainage with a phased program which establishes a monitoring program of agricultural discharges and begins implementation of Best Management Plans (BMPs). The monitoring program did not begin until October 1993 so meaningful key contaminant data was not available until after 1995. CVRWQCB is required to establish an accelerated schedule for agricultural dischargers to implement BMPs and controls to reduce levels of known problem constituents. CVRWQCB is also required to immediately pursue regulatory-based encouragement of BMPs or issuance of waste discharge requirements if agricultural dischargers do not cooperate.

Benefits: Implementation of a program to regulate agricultural drainage to reduce key contaminants will result in the improvement of water quality at Vernalis.

Action: A letter was sent on July 13, 1992, to CVRWQCB requesting that the monitoring program for the San Joaquin River not be delayed. A letter was sent on November 30, 1993, to CVRWQCB providing comment and requesting that an M&I beneficial use designation for the San Joaquin River at Vernalis be considered as a basin plan amendment. SWRCB's Inland Surface Water Plan was overturned in court during the past year, and work is in progress at the current time to again implement it.

Recommendation 10: Source Waters - San Joaquin Basin Upstream of Vernalis: Agricultural Drainage

Recommendation: Because the west side subsurface agricultural discharges into the San Joaquin River are the single largest cause of the poor water quality of the San Joaquin River at Vernalis, the efforts of CVRWQCB and USBR to find solutions for these discharges should be supported and monitored by the Review Committee.

Solution: Programs to control subsurface and surface agricultural discharges to the San Joaquin River are in their early stages. These control programs should be evaluated, as more intense efforts may be required. Agricultural management practices to control agricultural drainage in the San Joaquin Basin are being investigated by CVRWQCB. Management alternatives being evaluated include water conservation methods such as more efficient use and recycling of water, sediment control, retirement of farmed land, and changing crops grown in some areas.

CVRWQCB's Plan identifies "out of basin" export and discharge to saline, less sensitive waters to be the best long-term technical solution to the problems caused by agricultural drainage.

The San Joaquin Valley Inter-Agency Drainage Program produced detailed recommendations regarding agricultural drainage management throughout the San Joaquin Valley. Development of an implementation program for these recommendations is being coordinated under the direction of DWR. Continued support of these efforts is essential to properly address this issue.

Benefits: Development and implementation of an agricultural drainage management plan for the San Joaquin Basin will improve the water quality of the San Joaquin River at Vernalis.

Action: The Review Committee has reviewed the San Joaquin Valley Agricultural Drainage Program reports titled Management Plan for Agricultural Subsurface Drainage and Related Problems on the Westside San Joaquin Valley, September 1990 and A Strategy for Implementation of the Management Plan for Agricultural Subsurface Drainage and Related Problems on the Westside San Joaquin Valley, December 1991 for impacts on domestic water quality in the SWP. The results of the review were transmitted to SWC in an October 5, 1995 memo, and to the San Joaquin Valley Drainage Implementation Program's Public Health Workgroup by SWC in a January 28, 1995 letter; the program continues to be monitored.

<u>Recommendation 12: Source Waters - The Tulare Basin</u>

Recommendation: None

Review Committee Recommendation: Develop an appropriate monitoring program to be implemented during future flood events when Kings River water is flowing north through the James Bypass, and also when water is being pumped north from the Tulare Basin via the James Bypass.

Solution: Although no recommended action is presented in this report, the Review Committee believes that appropriate sampling and analyses should be performed during appropriate flood events.

Benefits: Possible improvement of water quality in San Joaquin River at Vernalis.

Action: Data must be collected to determine if the flows entering the San Joaquin River from the Kings River and Tulare Basin via the James Bypass present a water quality problem. This can be done by collecting water samples during flood events when the James Bypass is in operation. The sampling would cover periods when just Kings River water is flowing, and also when water from the Tule, Kaweah, and Kern rivers is being pumped north from the Tulare Lake Basin as occurred in 1983. Sampling would start at the beginning of the flood event and include Title 22 constituents plus *Giardia lamblia* and *Cryptosporidium sp.* DWR staff would collect the data.

Recommendation 15: Source Waters - Agricultural Drainage

Recommendation: The Delta Islands Drainage Investigation project is critically important to understanding the degradation of Delta water and the impact of agricultural drainage on SWP drinking water quality. This project should be supported and, if possible, accelerated.

Solution: Since publication of the initial Sanitary Survey of the State Water Project, the Delta Islands Drainage Investigations Program has merged with the Delta Health Aspects Monitoring Program to become the Municipal Water Quality Investigations (MWQI) Program. SWC supported accelerating the agricultural drainage investigation in July 1991.

Benefits: The MWQI Program will improve our understanding of the effects of Delta island drainage on drinking water quality.

Action: Intensive investigation of Delta island drainage and the means of managing drainage quality are being intensively studied under the MWQI Program.

Recommendation 17: Source Waters - The Delta

Recommendation: Seismic vulnerability of Delta levees must be reduced and SWP water supplies must be protected from catastrophic sea water intrusion to assure high-quality drinking water.

Solution: SWC should support activities to enhance the Delta levees.

Benefits: Stabilizing the Delta levees could avoid a catastrophic interruption in SWP water supply.

Action: SWC sent letters to USBR and DWR, with a copy to CVRWQCB, on February 7, 1994, highlighting the need for reducing the seismic vulnerability of the Delta levees to protect SWP water quality (see Appendix A).

Recommendation 19: Operation of the State Water Project - O'Neill Forebay

Recommendation: DWR is currently expanding its monitoring program at O'Neill Forebay. The Review Committee should monitor DWR's new program for its effectiveness in determining the impact of Delta-Mendota Canal (DMC) water on the drinking water quality of SWP.

Review Committee Recommendation: In addition to the Sanitary Survey recommendation, the Review Committee should also review CVP's Delta Mendota Canal monitoring program.

Solution: The Review Committee should review USBR and DWR monitoring programs and recommend changes as necessary.

Benefits: If DMC water is causing a drinking water supply problem, preventing the degradation may be easier than treating the degraded water.

Action: The Review Committee has reviewed USBR and DWR monitoring plans for the O'Neill intake channel, and all water quality data for waters entering O'Neill Forebay via the O'Neill Pumping Plant. DWR is continuing to monitor DMC inflow at McCabe Road for Title 22 constituents, specific herbicides and pesticides, and total and fecal coliform. USBR continues to monitor monthly in the O'Neill intake channel. Data for various water quality parameters are contained in Chapter 4 of this report.

Recommendation 21 : Field Survey of State Water Project Facilities - Coastal Drainage

Recommendation: Existing monitoring programs should be modified to determine the impact on SWP drinking water quality of the Coast Range Drainage.

Review Committee Recommendation: The Review Committee should review the existing monitoring program and data to determine if the current monitoring program is adequate. If it is not, the Review Committee should recommend an appropriate monitoring program.

Solution: The Review Committee should review the existing monitoring program to determine if it is adequate.

Benefits: Data will help identify the impact of Coast Range Drainage entering the San Luis Reach of the California Aqueduct.

Action: DWR has provided the Review Committee with the existing monitoring program and data. The Review Committee has reviewed the monitoring information in order to determine its adequacy. DWR has implemented the Review Committee's recommendations (see letters dated October 20, 1992, and October 19, 1995, in Appendix A).

Recommendation 22 : Field Survey of State Water Project Facilities - Agricultural Drainage

Recommendation: Existing monitoring programs should be modified to determine the impact on SWP drinking water quality from agricultural discharges (particularly in the San Luis Reach of the California Aqueduct).

Review Committee Recommendation: Existing monitoring programs and data should be reviewed to determine if storm water inflows into the San Luis Reach of the California Aqueduct have any impacts on SWP drinking water supplies.

Solution: The Review Committee should review the existing monitoring program and data to determine if they are adequate. If they are not, necessary changes should be recommended.

Benefits: Data will help identify the severity of the problem of storm water entering the California and South Bay Aqueducts, and the San Luis Reach of the California Aqueduct.

Action: The Review Committee has reviewed the monitoring programs and data, and has recommended appropriate modifications in memorandums dated October 2, 1992, and October 20, 1992 (see Recommendation 21). These modifications have been implemented by DWR.

Recommendation 24 & 25 Combined

Recommendation 24 : Field Survey of State Water Project Facilities - Highway drainage

Recommendation 25 : Field Survey of State Water Project Facilities - Other Potential Sources of Contamination to Open Canal Sections

Recommendation (24): DWR should consider the recommendations of the initial Sanitary Survey of SWP in updating and standardizing its Emergency Response Plans. The value of developing a Geographical Information System which identifies potential drains that could allow tanker truck spillage to reach SWP should be evaluated. Such information may speed the identification of which drainage inlets to block during spills. DWR should also consider constructing containment structures at vulnerable points.

Recommendation (25): As priorities permit, the Review Committee should consider the potential for contamination of SWP from canal roadside drainage, over crossings, under crossings, bridges, water service turnouts, and fishing areas.

Solution: DWR is currently updating its Emergency Action Plan for the SWP. SWC should review the updated Emergency Response Plan and provide recommendations, if required. A Geographical Information System is not considered appropriate for this type of problem because of the complexity of the Project Facilities and the short times required to respond to this type of emergency.

Benefits: The updated Emergency Action Plan should increase the protection of SWP water supplies.

Action: Based upon the review of the updated Emergency Action Plan, SWC should make recommendations as required to insure the aqueduct is protected against contamination from highway drainage and all other sources.

<u>Recommendation 26 : Other Potential Sources of Contamination in Open Canal Segments - Body Contact</u>

Recommendation: The Review Committee should consider the potential for contamination of SWP from these sources as priorities permit.

Solution: DHS should review existing domestic water supply reservoir regulations, the implementation of the regulations, and water treatment requirements in regard to their adequacy for protecting public health.

Benefits: A review will identify any problems.

Action: The Review Committee has reviewed existing domestic water supply reservoir regulations as they relate to body contact on both SWP and non-SWP reservoirs (see memorandum dated October 2, 1995). The Review Committee determined that the permit process controlling recreation, in concert with the surface water treatment regulations, enable adequate protection of surface water supplies.

<u>Recommendation 30 : Water quality - Drinking Water Standards</u>

Recommendation: DWR should stay abreast of USEPA and DHS drinking water standards programs. As drinking water standards are proposed for new constituents and lowered for existing constituents, DWR should review and revise SWP monitoring programs to collect data on these constituents.

Review Committee Recommendation: DWR should stay abreast of USEPA and DHS drinking water standards. As drinking water standards are proposed for new constituents and lowered for existing constituents, DWR, in consultation with DHS, should review and revise SWP monitoring programs to collect necessary data.

Solution: To ensure the necessary water quality data are efficiently collected, DWR water quality monitoring programs should be jointly reviewed by DWR, DHS, and SWC's SWP Water Quality Technical Committee. This review should be repeated annually.

Benefits: The benefit of maintaining a current monitoring program is an accurate and cost-effective definition of the water quality throughout SWP. This information will make assessments of potential improvements possible, so that the cost of improvements can be compared to the expected water quality enhancement. As drinking water regulations become more stringent, source water protection may be the most cost effective way to meet new regulations.

Action: DWR is staying abreast of new USEPA and DHS regulations; in consultation with the SWC, DWR reviews and revises existing monitoring programs to respond to changing needs. In 1995, DWR monitors for new parameters under an MWQI study element.

Recommendation 31: Water Quality - Water Quality Monitoring Programs

Recommendation: DWR has begun and should continue to elevate the drinking water monitoring of the SWP system. DWR should consider the centralization and coordination of ecological, operational, and drinking water monitoring programs, and special water quality investigations under the supervision of a water quality program manager responsible for coordination of water monitoring programs, identification of needed studies, implementation of the studies, and management of the data in a centralized data bank.

Review Committee Recommendation: SWC should write a letter to DWR expressing Review Committee support of the recommendation.

Solution: SWC should write a letter conveying support of the recommendation.

Benefits: The centralization of DWR's water quality programs will provide a more efficient approach to meeting the SWP's water quality needs.

Action: No action has been taken on this issue.

Priority B

Recommendation 1: Source Waters - Sacramento Basin Upstream of Greene's Landing - General

Recommendation: The Central Valley Regional Water Quality Control Board's (CVRWQCB's) efforts to develop a mass loading estimate of key contaminants for the Sacramento Basin should be supported and expanded. The contributions of key contaminants from Municipal & Industrial discharges, urban runoff, agricultural drainage, and mine discharges can then be better determined.

Solution: The Action Plan established a program for compliance with water quality objectives including a wasteload allocation process. CVRWQCB needs to vigorously pursue monitoring programs for all major sources of pollution and implement wasteload allocation programs as necessary.

Benefits: Implementation of this program, including the wasteload allocation, will result in improved water quality of the Sacramento River at Greene's Landing.

Action: A letter was sent to CVRWQCB on February 14, 1994, transmitting recommendations contained in the Action Plan (see Appendix A).

<u>Recommendation 3: Source Waters - Upstream of Greene's Landing - Urban Runoff Discharges</u>

Recommendation: As the Sacramento area urban runoff water quality data become available, the Sanitary Survey Review Committee should reevaluate the impacts of urban runoff discharges into the Sacramento Basin.

Solution: Existing regulatory programs can include collection of data necessary to assess the impact of urban runoff on drinking water quality. The Review Committee should review the storm water NPDES permit monitoring requirements to ensure that constituents that impact drinking water quality are being analyzed.

Benefits: This program will generate data that can be used in the wasteload allocation process and more stringent regulation of urban runoff, if required.

Action: The current monitoring program was reviewed, and a letter was sent to applicable agencies on June 24, 1992. Recommendations for a monitoring program are detailed in a December 22, 1993, memo (see Appendix A). Evaluation of monitoring results is ongoing.

<u>Recommendation 23: Field Survey of the State Water Project Facilities - Urban Runoff</u>

Recommendation: Existing monitoring programs should be modified to determine the impact on SWP drinking water quality of these urban run off discharges.

Solution: Storm water inflows should be monitored to determine if they are impacting the downstream water quality.

Benefits: Characterization of the quality of storm water entering the East Branch Aqueduct would help to quantify any impacts of these discharges on water quality. The costs of these impacts, including downstream treatment costs, could then be compared to other physical solutions, such as installing detention ponds, or rerouting the drainages across the Aqueduct.

Action: DWR has met with the Lahontan Regional Water Quality Control Board staff to discuss the storm water runoff into the California Aqueduct (see memorandum dated March 10, 1994, in Appendix A). DWR has designed and implemented a monitoring program to determine if the storm water inflow is impacting the downstream water quality. If a problem is detected, DWR will work with the city of Hesperia, LRWQCB, and the downstream SWP M&I contractors to determine the most feasible solution.

The 1996 Sanitary Survey Update of the State Water Project

The current five-year update of the initial Sanitary Survey of SWP was required by DHS in compliance with the California Surface Water Treatment Regulation. The 1996 Sanitary Survey Update of SWP was designed and conducted to focus on the recommendations resulting from the 1990 effort, and to identify and evaluate water quality of SWP during the preceding five-year period.

Since the initial sanitary survey was conducted, a guidance manual has been developed for use in conducting such studies. The *Watershed Sanitary Survey Guidance Manual* prepared by the American Water Works Association, California-Nevada Section, Source Water Quality Committee, December 1993, and the checklist contained within, were followed as closely as possible where practical in conducting the 1996 Sanitary Survey Update. While the manual was found to be a very useful and comprehensive guide, and the checklist a very useful tool, some interpretation and adaptation were required to adjust for the scale of SWP.

Scope of Study

In addition to the actions taken and discussed in the SWP Sanitary Survey Action Plan, the 1996 Sanitary Survey had several additional areas of focus. DHS requested that greater attention be given to several specific components of SWP. A more detailed investigation of the major reservoir watersheds, which include Del Valle, San Luis, Pyramid, Castaic, Silverwood, and Perris, along with the Barker Slough/NBA watershed, and the open channel section of the Coastal Aqueduct, was requested. An emphasis was also placed on the occurrence of coliforms, the pathogens *Giardia lamblia* and *Cryptosporidium* in the water supply, and any related monitoring efforts. The 1996 Sanitary Survey Update of SWP also covers, to the extent possible, actual, and potential contaminant sources in the watersheds, emergency action plans, and water quality conditions at representative points throughout SWP.

Watershed Investigations

Detailed investigations were undertaken for each of the eight previously listed watershed study areas. Contacts were made with appropriate federal, State, and local agencies and personnel in each study area. Computer record searches were also conducted as a means of determining the presence of toxic or hazardous materials or situations in the watersheds. Field surveys were performed by staff of DWR's Division of Local Assistance to document any new or changed conditions in each study area.

Water Quality

Water quality data were reviewed and reported for several important monitoring locations in the Sacramento-San Joaquin Delta and at various selected points along the Aqueduct. The monitoring stations at Greene's Landing on the Sacramento River and Vernalis on the San Joaquin River provide an indication of the quality of water flowing into the Delta from these two major sources. The majority of these data were obtained from DWR's MWQI Program and from SWP's Water Quality Monitoring

Program, with other external sources used as necessary. Water quality constituent levels are summarized for each watershed study area of SWP.

Coliforms and Pathogens

Coliforms and the pathogens *Giardia lamblia* and *Cryptosporidium* receive greater attention in this update, particularly as they relate to recreational use in SWP reservoirs, and livestock operations in SWP watersheds. Coliform and pathogen data were obtained from selected water agencies at various points along SWP. Limited pathogen data were also available from DWR's own monitoring program. Wherever possible, these data are intended to describe the status of SWP source waters only, and are not intended to reflect the status of the finished drinking waters produced by water contractors and their member agencies.

The high turbidity in SWP resulting from the March 1995 storm events, which introduced large amounts of sediment-laden storm water into the Aqueduct, has become an issue for several reasons. These high sediment loads have caused concerns from both drinking water treatment and groundwater recharge/storage perspectives. The groundwater recharge aspect of this issue is important with respect to water supply, and activities are currently underway to define both the magnitude of the problem and possible methods of resolution.

High turbidity is also of concern from the perspective of drinking water treatment. Such high turbidity can complicate the treatment process with regard to chemical usage, increased sludge volume, shortened filter runs, increased cost, and most importantly, treatment adequacy. A primary concern is the effect of high turbidity on the effectiveness of the treatment process in removing both coliforms and pathogens, which include *Giardia lamblia* and *Cryptosporidium*.

This survey briefly discusses the major revised or proposed drinking water regulations and provides the current drinking water regulations for reference.

Questionnaire

This update includes a questionnaire that was sent out to the municipal contractors of SWP, inquiring about their projected ability to meet some of the new and proposed drinking water rules. The questionnaire asked for water quality or treatment-related information, which included any difficulties the contractors may be experiencing treating SWP water for drinking water purposes. The questionnaire also asked agencies for information on successes in handling problems and for information on how the treatment system was adapted to handle each situation. In addition, the contractors were asked to identify any known or potential threats to SWP water quality.

Conclusions and Recommendations

This sanitary survey contains conclusions and recommendations concerning the degree to which earlier recommendations were satisfactorily addressed, and provides new recommendations for further action where appropriate.

As was done after completion of the initial Sanitary Survey of SWP, a Sanitary Survey Action Committee will be formed to address the recommendations of this 1996 Sanitary Survey Update of SWP.

The 1996 Sanitary Survey Update of SWP includes eight study areas which were selected for more detailed investigation based on data evaluated from the initial 1990 Sanitary Survey of SWP. They are Barker Slough, Lake Del Valle, San Luis Reservoir Complex, the open segment of the Coastal Aqueduct Branch, Pyramid Lake, Castaic Lake, Silverwood Lake, and Lake Perris. All of these received greater attention in this 1996 Sanitary Survey Update. This chapter adds detail to the watershed descriptions and contaminant sources contained in the initial sanitary survey. Also included is an overview of the water supply system of each study area and of SWP.

Water Supply System, Watersheds, and Potential Contaminants

Water Supply

SWP's major facilities (Figure 2-1) include the multipurpose Oroville Dam and Reservoir on the Feather River, California Aqueduct, South Bay Aqueduct, NBA, a portion of San Luis Reservoir, and four Southern California reservoirs. In its entirety, the SWP presently includes 23 reservoirs and lakes, 20 pumping plants, 4 pumping-generating plants, 8 hydroelectric power plants, and about 660 miles of aqueducts and pipelines.

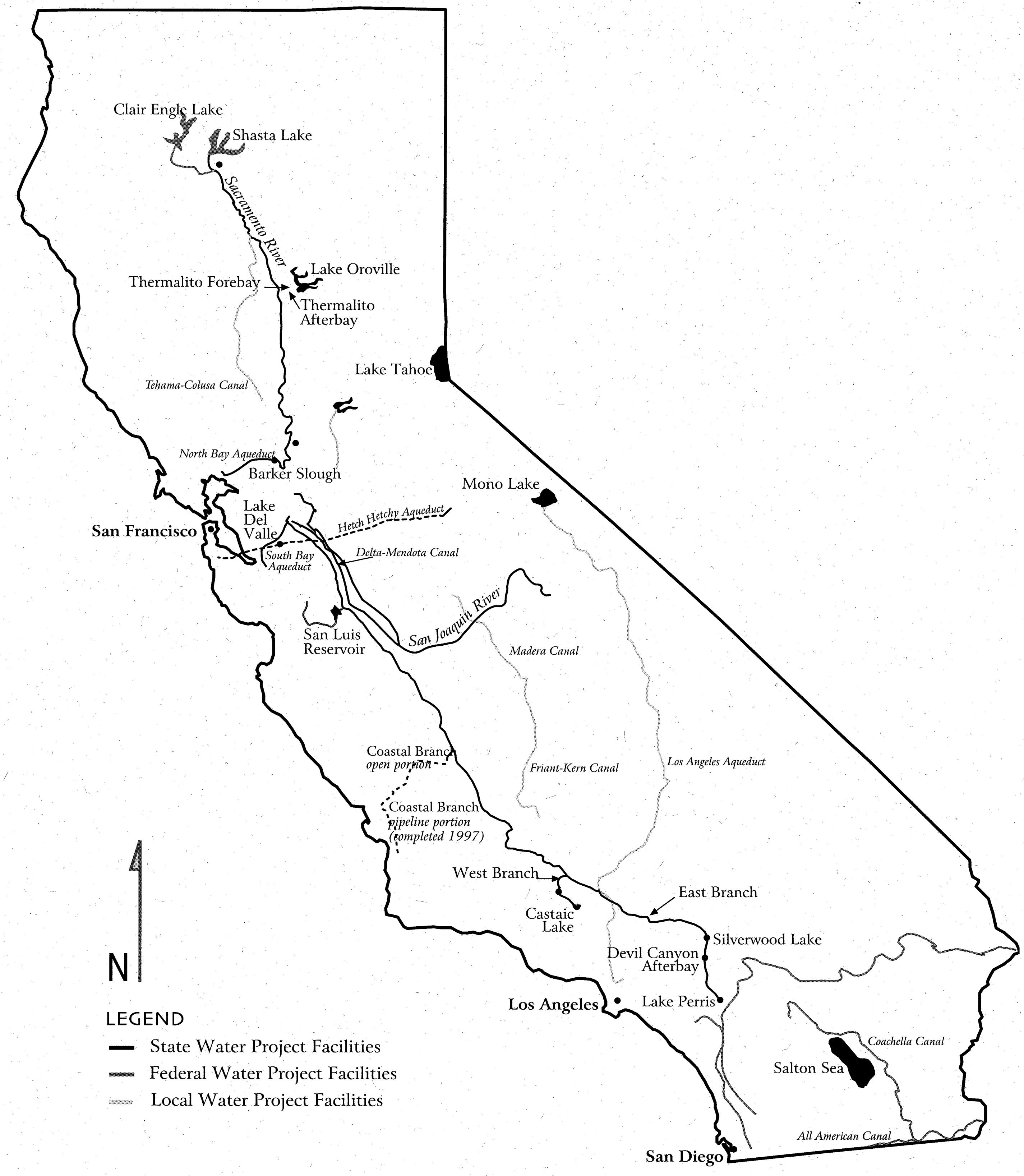
The California Aqueduct is the State's largest and longest water conveyance system. The Aqueduct begins in the Sacramento-San Joaquin Delta at the Banks Pumping Plant and extends to Lake Perris south of Riverside in Southern California. SWP provides water to two-thirds of California's population, provides water for irrigating about 1 million acres of farmland, and is maintained and operated by DWR. SWP also maintains water quality in the Delta, controls Feather River flood waters, provides recreation, and enhances fish and wildlife.

Runoff from the Feather River is stored behind Oroville Dam in Butte County, which can hold a maximum of 3.5 million acre-feet with 800,000 AF of reserve capacity reserved as flood control space. The water then flows down natural channels to the Sacramento-San Joaquin Delta where some water is pumped from Barker Slough through the NBA to Napa and Solano counties. In the southern Delta, water is pumped by the Harvey O. Banks Delta Pumping Plant into the 444-mile California Aqueduct. The South Bay Aqueduct begins just a few miles south of the Banks Pumping Plant and conveys water to Alameda and Santa Clara counties.

Water in the California Aqueduct travels 63 miles along the west side of the San Joaquin Valley to San Luis Reservoir, which is jointly owned by DWR and CVP. The reservoir can store a maximum of 2.04 MAF, of which 971,000 AF is federal and 1.06 MAF is State. The Aqueduct then continues to flow southward from San Luis Reservoir to the southern San Joaquin Valley. The Coastal Branch Aqueduct, which stems from the California Aqueduct 10 miles south of the city of Avenal, is currently being extended to carry water to San Luis Obispo and Santa Barbara counties.

Water in the California Aqueduct then flows south to the foot of the Tehachapi Mountains where the A.D. Edmonston Pumping Plant raises the water 1,926 feet before pumping it through 10 miles of tunnels and siphons which traverse the Tehachapi Mountains. After crossing the Tehachapi Mountains, the Aqueduct divides into two branches. The West Branch Aqueduct stores water in Pyramid and Castaic reservoirs to serve Los Angeles and other coastal cities. The East Branch Aqueduct flows through the Antelope Valley, storing water in Silverwood Lake. Water flows from Silverwood Lake to Devil Canyon Afterbay, from which it is sent to San Bernardino and Riverside and other counties. Lake Perris is the terminal reservoir of the East Branch.

 Figure 2-1 Major State Water Project Facilities



Survey Methods

The watersheds for each study area contain a variety of potential sources of contamination. The contaminant sources were identified through the use of field surveys, database searches, existing literature, and interviews. Checklists (see Appendix H) of potential contamination sources were prepared according to AWWA guidelines and forwarded to DHS during research and preparation of the 1996 Sanitary Survey Update of SWP to obtain any available additional information on contaminant sources.

Environmental Databases Searched

Environmental databases were searched to identify certain environmental concerns arising from activities in the watersheds and adjacent areas. Activities or practices that may contaminate SWP water are of most concern. A records search produces listings of situations in the search area from multiple sources related to the actual or potential contaminant sources present.

Impacts to the watershed related to these facilities could be associated with an unauthorized release of the hazardous materials via spills during transportation or leakage from storage facilities. Hazardous waste generators typically have waste transported offsite to a licensed treatment or disposal facility, with limited treatment of their wastes performed onsite.

Leaking underground storage tanks are the most common finding, as are relatively small industrial operations which generate and/or store small quantities of hazardous materials. Waste oils and related materials are commonly associated with service stations or similar industries which are located in the watersheds.

U.S. Environmental Protection Agency Lists

Various USEPA databases contain information related to hazardous substances, situations or events related to the generation, transport, storage, and accidents involving listed materials or events. The databases are briefly discussed, and the type of material listed in each database is explained.

National Priorities List (NPL) lists uncontrolled or abandoned hazardous waste sites identified for priority remedial action under the Superfund Program. Due to the nature of the sites included on NPL, the potential for releases into surface water bodies and into groundwater can be considered relatively high.

Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) lists facilities evaluated for possible inclusion in the Superfund program. CERCLIS records indicate that the facilities are in various stages of investigation and cleanup. As of February 1995, CERCLIS sites designated "No Further Remedial Action Planned (NFRAP)." These sites have been removed from CERCLIS listing and may be sites where, following an initial investigation, no contamination was found, or contamination was removed quickly without the site being placed on the National Priority List NPL, or contamination was not serious enough to require Federal Superfund action or NPL consideration. USEPA has removed these NFRAP sites from CERCLIS to lift unintended barriers to the redevelopment of these properties.

The Polychlorinated Biphenyls (PCB's) database is maintained by the USEPA and tracks generators, transporters, commercial storage sites, brokers, and disposal operations of PCB's in accordance with the Toxic Substance Control Act (TSCA).

The USEPA Airs Facility System (AFS) database tracks point sources of air pollution and monitors emissions and compliance data from sources.

The USEPA Facility Index System (FINDS) is a database which lists facilities that have been assigned a USEPA identification number for tracking purposes.

Federal Insecticide, Fungicide and Rodenticide Control Act (FIFRA) lists sites that handle materials which are regulated under this act.

Resource Conservation and Recovery Act (RCRA) lists facilities that treat, store, or dispose of hazardous waste, and also lists facilities that generate hazardous waste.

Emergency Response Notification System (ERNS). lists facilities with reported releases of oil and hazardous substances.

California State and Regional Lists

Hazardous Waste Information System (HWIS), A database maintained by California Department of Toxic Substance Control, which keeps track of the movement and disposal of hazardous waste.

The Annual Work Plan (AWP) of the Hazardous Substances Cleanup Bond Expenditure Plan (State Superfund) lists facilities designated for remediation using USEPA, State, or responsible-party funds.

Hazardous Waste and Substance Site (Cortese) lists facilities with known or potential hazardous waste or substance releases.

Leaking Underground Storage Tank (LUST). lists underground storage tanks (USTs) with known releases.

Solid Waste Assessment Test (SWAT) lists facilities disposing of greater than 50,000 cubic yards of solid waste.

Solid Waste Information System (SWIS) lists active and inactive landfills and transfer stations.

Toxic Pit Cleanup (TPC) Act lists surface impoundments, pits, lagoons, and ponds that have received hazardous wastes.

Underground Storage Tank (UST) lists USTs registered with the State between 1984 and 1987.

Other Sources

The California Department of Conservation, Division of Mines and Geology, and the U.S. Bureau of Mines were researched for active and abandoned mine sites. The California Department of Conservation, Division of Oil, Gas, and Geothermal Resources, were used to locate active and abandoned oil wells, gas wells, and oil field locations.

County planning agencies were contacted for existing land use information and for new development in the planning stage. County Agricultural Commissioners were contacted for current agricultural practices in the watershed. Other local, State, and federal agencies were contacted as required, including county health departments, planning agencies, the State Water Resources Control Board, the Regional Water Quality Control Boards, DHS, United States Forest Service, and the various concessionaires at the reservoirs.

Watersheds

Several important characteristics of each watershed (Figure 2-2) related to land use, population center data, agriculture, grazing, hydrology, surface geology and hydrology, soils, and vegetation are described. The watershed boundaries for each study area were defined using both 7.5 and 15 minute United States Geological Survey topographical maps and DWR Hydrologic maps (DWR 1987). In addition, the area of each watershed was measured using these maps and a planimeter.

Natural or anthropogenic events that occur in the watersheds on a periodic and unpredictable basis, such as earthquakes, fires, floods, landslides, and other emergencies or disasters, are documented where significant impacts or threats to water quality are likely or are known to have occurred. Depending on their magnitude, such events are capable of causing either the direct or indirect release of contaminants to source waters, or may produce effects or conditions. An example is increased turbidity, which may degrade water quality. The adverse effects associated with these events are generally episodic and transient in nature, and by necessity are addressed on case by case basis as they occur through emergency response or other contingency plans, which may include notification of source water users of degraded conditions. Problems that tend to occur at the same location associated with the same event or events are best addressed through a more formal planning process leading to more permanent solutions.

Recreational use, and the various facilities that support these activities are the major potential contamination sources in several of the watersheds; by necessity they are often located in areas that are very close or even on the water body. Potential sources of contamination from recreational use in the watersheds include bacterial and other pathogen contamination of the water by sanitary waste water facilities problems or failures, or the improper use or nonuse of these facilities by visitors. Petroleum product spills (e.g., gasoline, diesel, or oil) associated with the use of powered watercraft and the facilities that launch, recover, refuel, service, and dock such watercraft are also potential sources of contamination. Other solid and liquid waste generated by recreational activities in the watershed can be a concern if they are not controlled and disposed of properly.

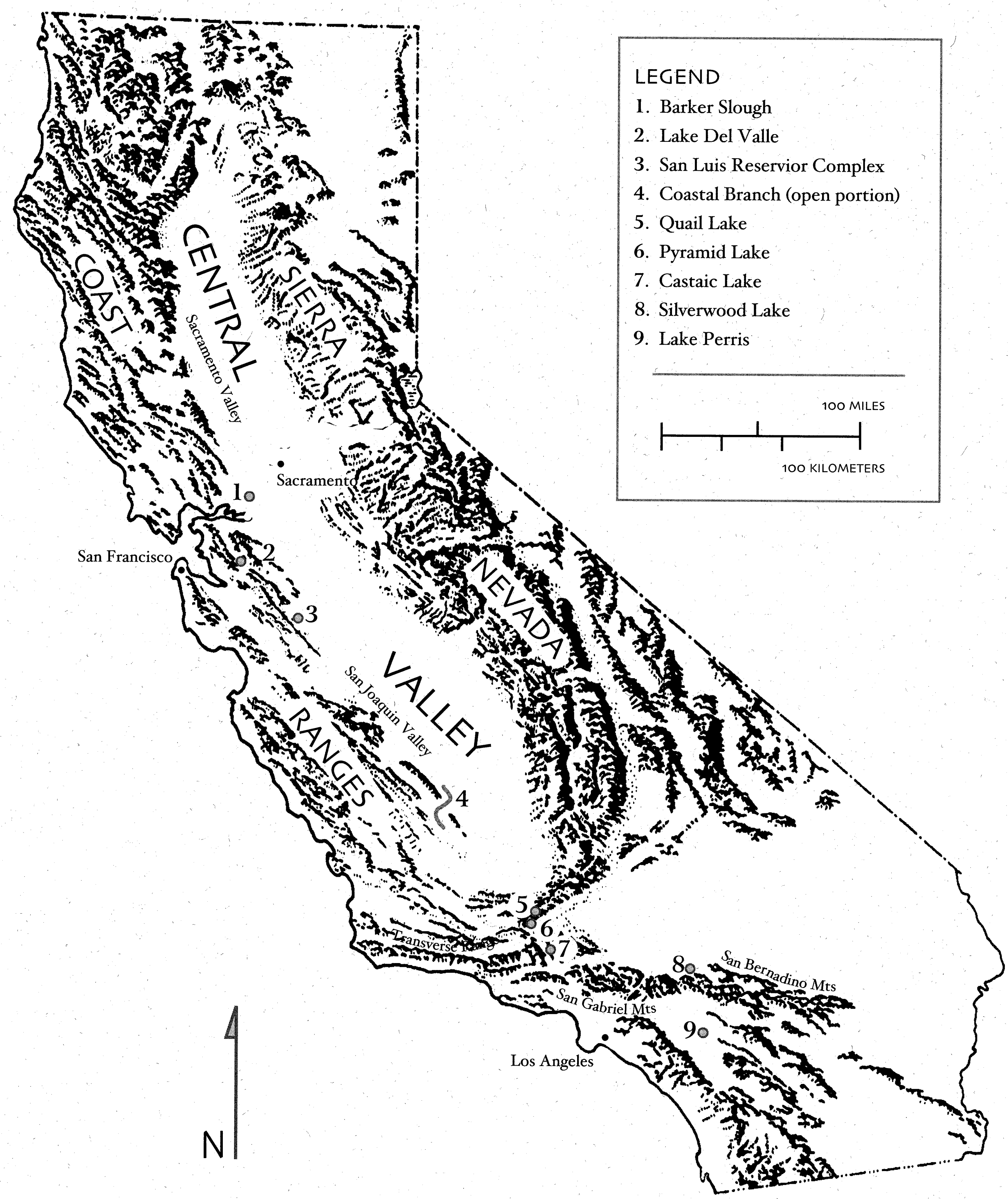
Barker Slough

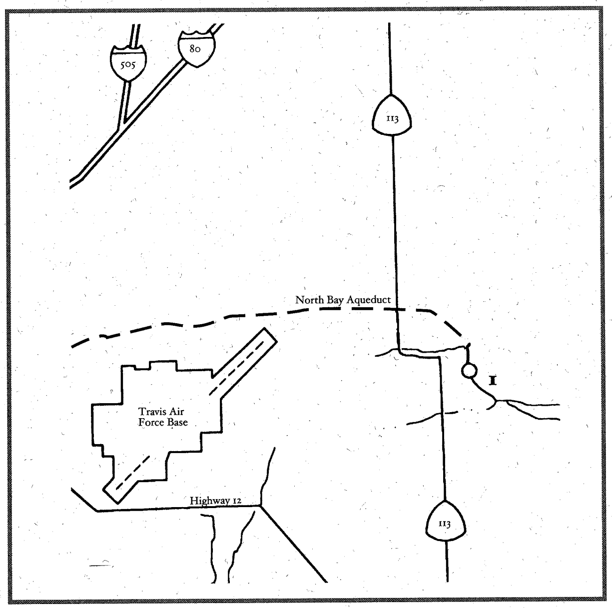
The Barker Slough watershed (Figure 2-3) is located in the larger Sacramento River watershed and is approximately 30 square miles (19,513 acres) in area. The watershed is positioned at the southern edge of the Sacramento Valley having a Mediterranean climate, and producing an average annual precipitation of 16 inches. Barker Slough is the source of water for the North Bay Aqueduct (NBA). Water is pumped from the slough via the NBA pipeline and supporting structures to many north San Francisco Bay area users.

Land Use

Two general types of agricultural land use were encountered in the Barker Slough watershed in surveys conducted during spring 1995, and consist of agricultural crop production and the grazing of both

Figure 2-2 Map of Watershed Study Areas



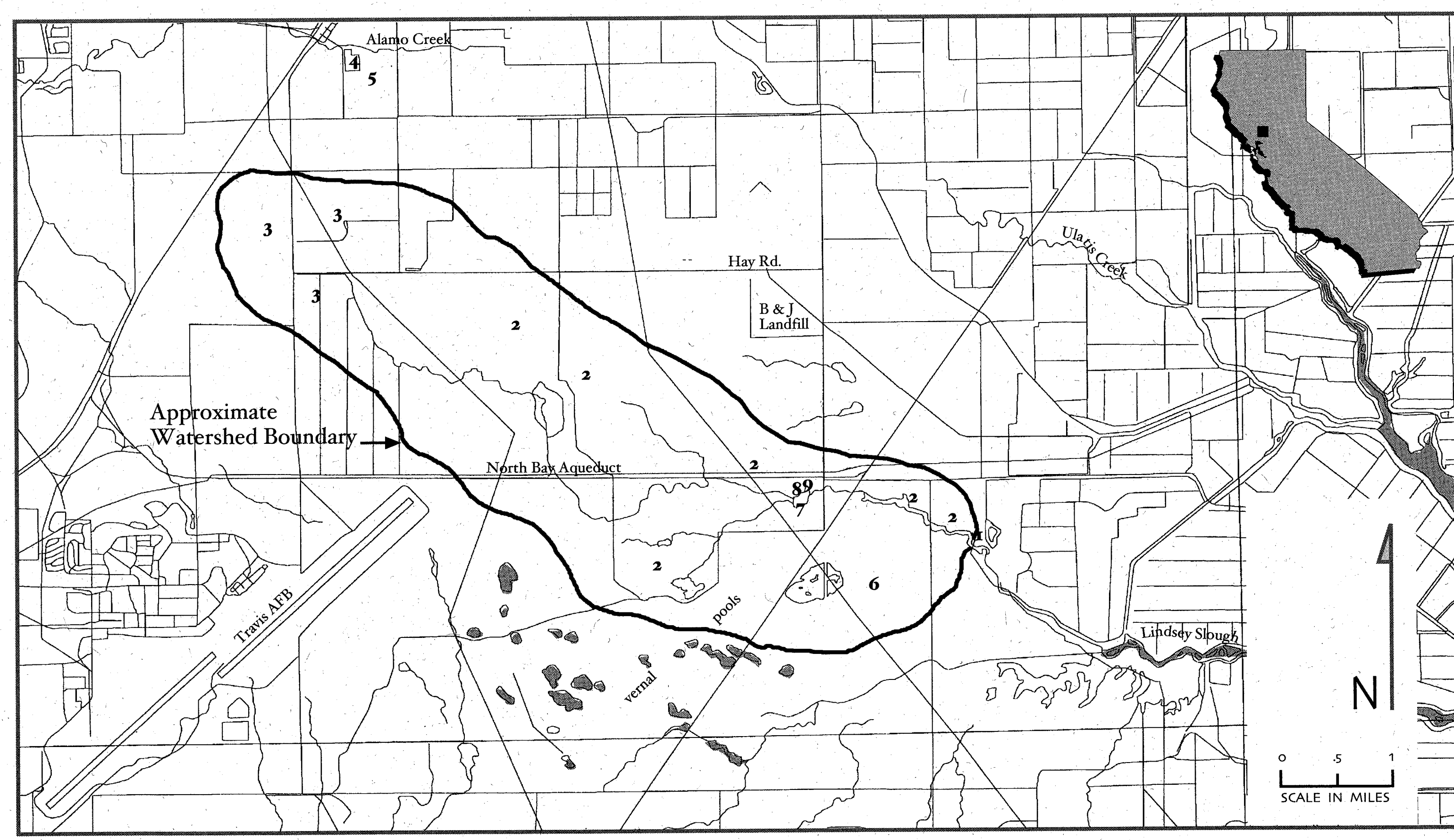


Barker Slough

LEGEND

1 Barker Slough Pump House
2 cattle & sheep grazing
3 corn, safflower, alfalfa, barley
4 Easterly Wastewater Treatment Plant
5 land application of sludge
6 Jepson Preserve
7 Campbell Ranch/ Argyll Park
8 UST
9 recreation activities

Approximate area of watershed: 30 sq. mi. / 19,153 acres



cattle and sheep. The northwest portion of the watershed produces significant amounts of several agricultural crops which include safflower, corn, alfalfa, tomatoes, and other field crops.

Barker Slough follows a generally northwest to southeast course through the watershed, with grazing occurring predominately in the southern region where soils are less suitable for agricultural crop production. This area is generally located south of Hay Road. The grazing season is heaviest between the months of November and June, and normally ends in July when the cattle and sheep are moved to the coast.

An estimated 15,610 acres of the watershed are grazed by cattle and sheep. In 1994, 52,000 cattle and calves, and 50,000 sheep, were estimated within Solano County (Solano County Department of Agriculture 1994). Approximately 80 percent of the entire watershed is estimated to be used for grazing by cattle and sheep.

Livestock has had free access to the areas immediately surrounding the Barker Slough Pumping Plant in the past. Since the initial Sanitary Survey of SWP was conducted, a chain-link fence was installed by DWR during summer 1994. The fence completely encloses the Barker Slough Pumping Plant in order to keep livestock away from the NBA intake. However, beyond that DWR can not control land use in the area or the access of livestock to Barker Slough.

Geology

The watershed of Barker Slough is in the Great Valley Province and is fairly uniform in surface geology. In general, the Sacramento Valley is a trough partially filled with clay, silt, sand, and gravel deposited through millions of years of flooding. Approximately 80 percent of the watershed is comprised of alluvium, lake, playa, and terrace deposits, which are both consolidated and semi-consolidated (Jennings 1977). The rock types of the watershed can be categorized as mostly nonmarine sedimentary rocks. Near the coast are marine deposits which also contain some nonmarine sedimentary rocks, such as loosely consolidated sandstones, shales, and gravels.

Although groundwater is found in all of the younger sediments, only the more permeable sand and gravel aquifers provide enough water to make the installation of wells feasible. Throughout the valley, these younger sediments overlie older marine sediments containing brackish or saline water. Marine formations which would produce more mineralized runoff are nearly absent.

Soils

Nearly 70 percent of the watershed is of the San Ysidoro-Antioch association, which is described as level to moderately sloping, moderately well-drained sandy loams and loams on terraces (USDA 1977*b*). In the Campbell Ranch area of the watershed (approximately 1.5 miles west of the Barker Slough Pumping Plant), the Solano-Pescadero soil association occurs, and is nearly level with somewhat poorly drained loams to clays. These soils are found on both the terraces and in the basins of the watershed.

In the extreme northwest region of the watershed, the Caypay-Clear Lake soil association is found. This association is characterized by nearly level to gently sloping, moderately well-drained to poorly-drained, silty clay loams to clays, which are found both on the rims and within the basins.

Vegetation

Where agricultural land uses are absent, the native vegetation has been classified as Valley Grassland, which includes dense to somewhat open bunch grass communities with forbes (Schoenherr 1992). Native perennial grasslands and vernal pools are examples of natural habitats native to California found in the watershed, which can also be found in the Jepson Prairie Preserve in the southeastern portion of the watershed. The Jepson Prairie Preserve is owned by the Nature Conservancy and is part of the University of California reserve system.

Vernal pools occur in the southern portion of the watershed in the Jepson Prairie Preserve area, an area which contains the highest density of vernal pools in Solano County (Barbor & Major 1977). Department of Fish and Game has designated these vernal pool communities as significant natural communities and monitors their status through the Natural Heritage Program (Sawyer & Keeler-Wolf 1995).

Barker Slough – Potential Contaminants in the Watershed

The NBA Pumping Plant is situated on the north shore of Barker Slough approximately 0.5 miles east of State Highway 113. The initial 1990 Sanitary Survey determined that water quality at Barker Slough could be affected by various possible contaminant sources located in the watershed and in the delta, including municipal and industrial waste discharges, urban runoff, agricultural drainage, and possible mine drainage. These sources were documented as being present in the watershed.

Potential contaminants to the waters of the NBA from agricultural crop production include pesticides, nutrients, increases of total organic carbon (TOC), and suspended solids.

Grazing of both cattle and sheep in the watershed may produce contaminants in the form of nutrients, increased erosion of stream banks where animals have direct access to the water leading to increases in turbidity, and possible introduction of the pathogens *Giardia lamblia* and *Cryptosporidium* to the water supply.

Environmental Database Records Search

For the Barker Slough watershed, environmental database searches were conducted for the area defined by Fry Road and Midway Road on the north; Liberty Island Road and the southern extension of the Solano County-Yolo County line on the east; Scandia Road, Creed Road, and Highway 12 on the south; and Goose Haven Road, Walters Road, Peabody Road, and Robben Road on the west.

The findings of the database search are found in Appendix G. Of the sites identified within the search area, Travis Air Force Base accounts for 129 of the 138 records found. Based on DWR hydrological maps (DWR 1987), Travis AFB does not appear to be in the surface watershed of Barker Slough. The groundwater flow from the contaminated sites on the base was determined to be toward the south and Montezuma Slough. Ninety-nine of the Travis Air

Force Base records are for underground storage tank (UST) sites within the base boundary. The site is also listed on the National Priorities List.

Other sites listed include two solid waste landfills (B&J Landfill and Aqua Clear Farms) and several additional UST sites. In addition, two permitted underground storage tanks are at the Campbell Ranch site, and one underground storage tank is at Cripps Ranch located on Hay Road.

The database records also indicate that surface spills of predominantly jet fuel occur with some degree of frequency and have entered both waterways and storm drains. Other sites identified in the database search are generally limited to known generators and storers of hazardous materials.

Several sites, which include Travis AFB, the Naval Radio Transmitting Facility, and Robbins Myers, Inc., are listed in the CERCLIS database of potential Superfund sites. Most of the remaining sites are storers or generators of various hazardous materials.

Easterly Waste Water Treatment Plant

The Easterly Waste WTP for the city of Vacaville, the nearest treatment Plant to Barker Slough, discharges treated effluent to Alamo Creek. The Easterly Plant dry weather discharge is approximately 6.2 million gallons per day of a secondary, disinfected, and dechlorinated effluent. This effluent is discharged to Alamo Creek, which then drains into Cache Slough. This effluent discharge is approximately 15 river miles from the Barker Slough intake for the NBA.

Approximately one-third of the sludge produced at the Easterly Plant is applied to adjacent agricultural land as a soil amendment. This agricultural land is located in the Alamo Creek watershed. The remaining sludge is disposed of at the B & J landfill.

A dye test was performed on the Easterly Plant discharge by Montgomery Consulting (Montgomery Consulting Engineers 1992). The results indicated that measured dye concentrations were less than the method detection limit of 0.1 ppb at the North Bay Pumping Plant on Barker Slough. The study concluded that these were essentially background concentrations, and that the dye did not reach the NBA intake at Barker Slough during any of the test periods.

Other

Solano County Environmental Health Department files on septic systems date back to 1975, with permit requirements for septic systems starting in 1976. Residential septic systems exist on Cook Lane, Salem Road, Rio-Dixon Road (Highway 113), Hasting Island Road, and in several rural homes on Cook Lane. The systems on Cook Lane are closest to Barker Slough and the NBA.

Argyll Park is also located on Cook Lane (Campbell Ranch Site) and uses chemical toilets for sanitary waste disposal. Solano County Environmental Health Services has reported no septic systems failures in the watershed (personal communication, September 1995, Melissa Saint John, Solano County Environmental Management).

Sediment was removed from the Napa Terminal Tank during October 1994, and from the Travis Surge Tank during February 1995. The sediment was removed from both tanks in response to a 1993 joint

Summary Of Existing and Potential Contamination Sources for Barker Slough

- *Recreational use in watershed*
- *Highway/road runoff*
- *Leaking underground storage tanks*
- *Hazardous material spills*
- *Wastewater treatment system spills/failures*
- *Livestock grazing*
- *Landfill runoff*
- *Agricultural runoff to source waters*

DWR, DHS, and water treatment representatives inspection of the NBA. Two to six feet of sediment was found in the Travis Surge Tank. The sediments were assessed, and elevated levels of contaminants were not found. All sediment removal and remedial activities associated with the joint inspection have been completed. Cleaning of the Travis Surge Tank and the Napa Terminal Facility has not been needed previously, and has not been a routine activity. If necessary, a routine maintenance program will be developed.

Table 2-1
Existing and Proposed Uses at Argyll Park (Campbell Ranch)

EXISTING / PROPOSED USE	EXISTING	PROPOSED IN CAMPBELL RANCH EIR
Motocross Track	Yes	Yes
Smooth TT Track	Yes	No
Go-Kart Track	Yes	No
Go-Kart Track Expansion	No	No
Mini-bike Track	Yes	No
Models	Yes	No
Parking(plus event parking)	Yes	Portion
RV Event Camping	Some	No
Concessions	Yes	Yes
Picnicking	Portion	No
Seating	Yes	Assessory Uses
Bird Dog Trails	Yes	No
Cattle/Sheep Grazing	Yes	No
Two Residences	Yes	Yes
Paintball Recreation Games	No	No

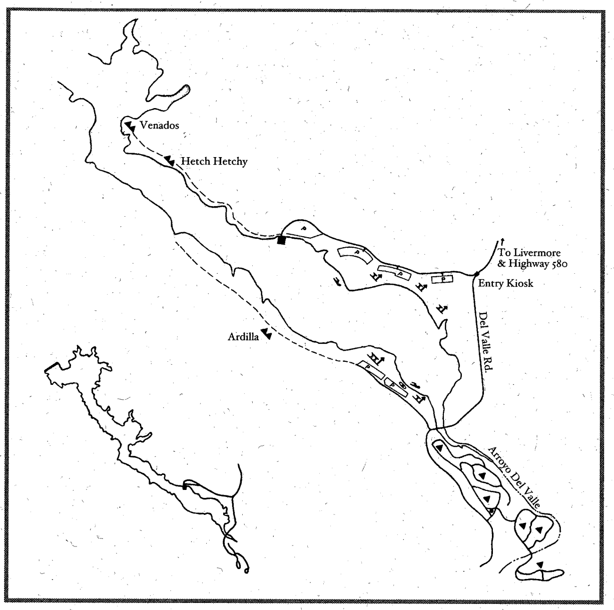
Argyll Park

The Argyll Park motocross race track facility is 1.5 miles to the west of the NBA pump house on Cook Lane. Currently this site is proposing an expansion of recreational activities under the project name Campbell Ranch (Table 2-1). Any of these activities could possibly impact surface water quality in Barker Slough.

The planned construction activities at the site are subject to the provisions of the National Pollutant Discharge Elimination System (NPDES) permit process, which controls waste discharges to waters under the Clean Water Act (CWA). The site is also required to prepare a Storm Water Pollution Prevention Plan (SWPPP). The SWPPP would establish both physical and management controls of storm water runoff for construction at the site, and for after construction when the recreational site is in operation. Erosion at the site during construction would be controlled through practices outlined in a grading permit required by Solano County.

In July 1994, a formal response was prepared and submitted by DWR to the Solano County Department of Environmental Management on the Campbell Ranch project Environmental Impact Report (Letter from Keith Barrett, Chief, Division of Operations and Maintenance, 1994). The DWR response focused on the contribution of pollutants from the project to Barker Slough, and the ability for runoff to be controlled when the site is operational.

DWR was not satisfied that runoff safeguards would be extended on a "permanent operational basis" at the site. DWR was concerned about inadequate capacity of waste water facilities at the site where as many as 2,500 visitors were expected, as well as for inadequate contingency plans for un-

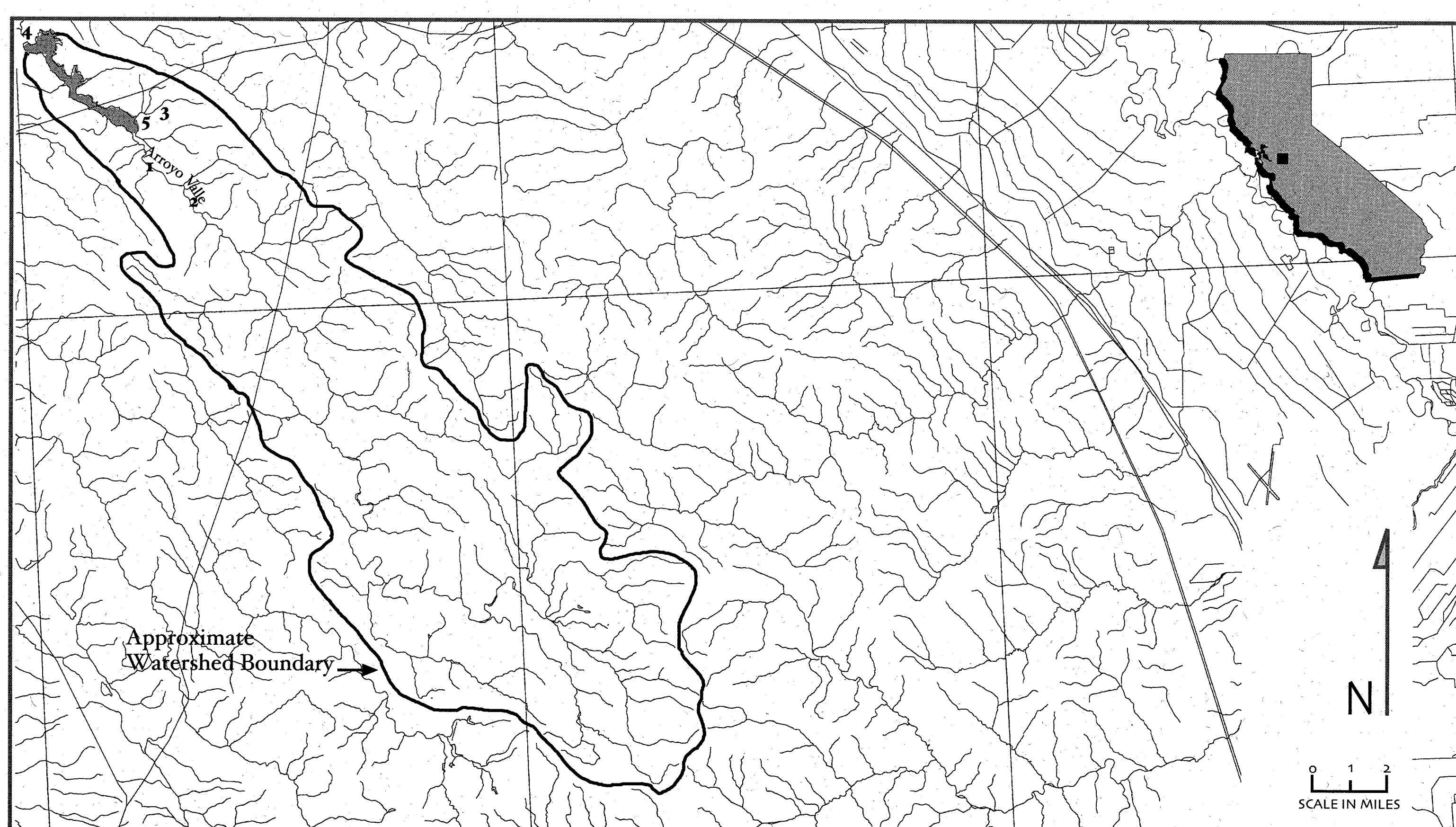


Lake Del Valle

LEGEND

- campground
- group campground
- swim beach
- picnic
- RV dump site
- group picnic
- vista point
- P parking
- 1 N-3 Cattle Ranch
- 2 cattle grazing
- 3 evaporation ponds
- 4 V.A. Hospital
- 5 UST

Approximate size of watershed: 130 sq. mi. / 83,165 acres



treated water entering Barker Slough.

The draft EIR was also found to contain no specific workable plan for either the construction of a permanent waste water collection and treatment system, or spill containment measures as required by the Solano County Environmental Health Division. This EIR is scheduled for review by Solano County in early 1996, and DWR intends to closely follow the process.

Lake Del Valle

Lake Del Valle and Del Valle Dam (Figure 2-4) are located in Arroyo Valle just south of Livermore Valley, approximately 11 miles from Livermore, which has a population of 62,800 as of 1995 (California Department of Finance 1995). Lake Del Valle was created in 1968 as a SWP facility to provide recreation, fish and wildlife enhancement, flood control for Alameda Creek, and regulatory storage for the South Bay Aqueduct. Lake Del Valle recreational facilities are operated by the East Bay Regional Park District, and offer camping, picnicking, horseback riding, swimming, hiking, wind surfing, boating, and fishing. Total visitor use between April 1990 and April 1995 was 2,436,591 (California Department of Parks and Recreation 1995).

Arroyo Del Valle Creek flows from October through July in normal rainfall years. Water is usually released into the South Bay Aqueduct from September through November to prepare for the winter runoff. In the initial Sanitary Survey, it was estimated that the creek had deposited some 20,000 cubic yards of silt in the lake since the dam was built. Several minor creeks are around the lake draining small, almost totally undeveloped, watersheds that ultimately drain into Lake Del Valle.

Most of the precipitation occurs between the months of October and May. Since most of the moisture occurs in the winter, surface water flow is seasonal and is mostly nonexistent during the dry season of June through September. This area of the county is prone to higher summer temperatures and moderately low winter temperatures typical of a Mediterranean climate. According to data collected at Livermore, the lowest temperatures can fall well below freezing between December and March (USDA 1966), with the highest temperatures approaching 100° F between May and October.

The surface hydrology of the watershed is typical of the central coast of California, where the arroyos, creeks and streams of the watershed are influenced by the climate of the region. In general, the watershed has a mild climate, but is more variable than western portions of Alameda County due to the neighboring mountains and its distance from the San Francisco Bay.

Land Use

Land use in the 130 square mile (83,165 acres) watershed is limited to recreation associated with Lake Del Valle and cattle grazing in the Arroyo Valle drainage. The N-3 Cattle Company is located in the Arroyo Valle drainage. Several hundred cattle graze on this privately-owned land year round, with grazing heavier in the winter compared with the summer. This ranch also has various cattle pens. DWR monitoring data for the Arroyo Valle drainage is discussed in Chapter 4 of this report.

The Patterson Ranch is located in the northwest part of the watershed, and is also a cattle operation. Reasonably accurate estimates of the number of cattle present in the watershed are difficult to determine since private land is involved.

The East Bay Regional Parks District allows grazing on the park land adjacent to the reservoir as a cost-effective fire suppression measure.

Geology

The watershed of Lake Del Valle encompasses several rock types in both the Great Valley Province and the California Central Coast Range. Lake Del Valle is within a well-defined topographic feature known as the Diablo Range, which extends southeast 130 miles from the Carquinez Strait at Benicia, and along the west side of the San Joaquin Valley almost to Coalinga (Norris and Webb 1990).

On the northern shore of the lake (Arroyo Mocho Area), the surface geology is comprised of terrace deposits from various sources of the Great Valley Syncline which are both consolidated and semi-consolidated. This rock type could be categorized as mostly non-marine sedimentary rock, but it may also include marine deposits. The watershed also contains non-marine sedimentary rocks including loosely consolidated sandstones, shales, and gravels. Marine sediments and metasedimentary rocks are found on the southeastern shore, and consist of sandstone, shale, and conglomerates.

The geology in the Arroyo Valle drainage is similar to that found in the reservoir area. South along the Arroyo Valle drainage, plutonic rock is encountered consisting of mostly serpentine, but can include peridotite, gabbro, and diabase. A mélange of fragmented sheared Franciscan Complex rocks may also be present. The nearest active earthquake faults to the lake include the Las Positas Fault, 4 miles north; the Greenville Fault, 6 miles east; the Calavares Fault, 8 miles west; the Vallecitos Fault, 5 miles west; the Hayward Fault, 20 miles west; and the San Andres Fault, 55 miles west (Jennings 1977).

Soils

Soils in the Del Valle watershed are primarily of the Millsholm-Los Gatos-Los Osos and Vallecitos-Parrish associations (USDA 1966). The soil surrounding the lake is characterized by brownish soils within moderately hard sedimentary rocks. These soil types are associated with moderately sloping to very steep terrain. The Arroyo Valle drainage soils are characterized by moderately sloping to very steep, brownish and reddish-brown soils on metasedimentary and basic igneous rocks.

Vegetation

The vegetation of the watershed is dominated by foothill woodlands and grasses (Schoenherr 1992). Tree species that occur in the watershed are blue oaks (*Quercus douglasii*), interior live oaks (*Quercus wislizenii*), and valley oaks (*Quercus lobata*). Digger pines (*Pinus sabiniana*) are found on slopes in the watershed. Cottonwoods (*Populus fremontii*) and Sycamores (*Platanus racemosa*) are found along portions of Arroyo Valle drainage. Native needle grass (*Stipa/Nasella sp.*) and speargrass (*Stipa/Nasella sp.*) occupy open areas between trees (Schoenherr 1992).

Lake Del Valle – Potential Contaminants in the Watershed

Summary of Existing and Potential Contamination Sources for Lake Del Valle

- *Recreational use in watershed*
- *Highway/road runoff*
- *Leaking underground storage tanks*
- *Wastewater treatment system spills/failures*
- *Hazardous material spills*
- *Livestock grazing*

Environmental Database Records Search

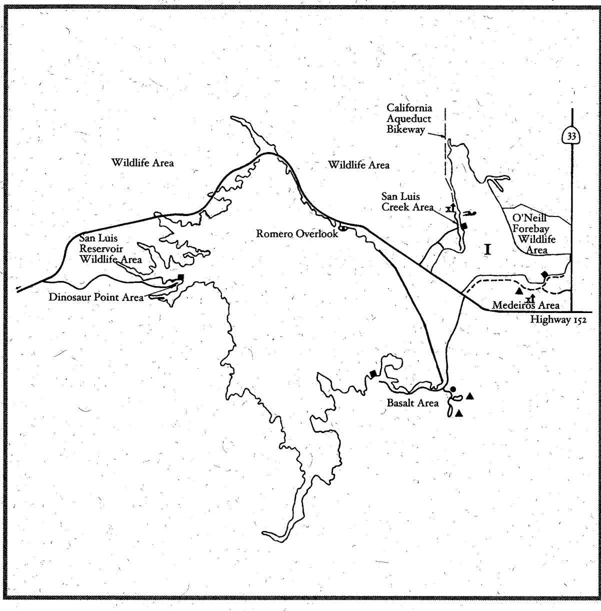
The search of the environmental databases was conducted for the area within a one-mile radius of the reservoir and within a one-half mile radius of Arroyo Del Valle. The search area was continued five miles upstream in Arroyo Valle Creek drainage.

The findings of the database search are summarized in Appendix G. The search did identify several sites based on information included in the regulatory agency database files that could not be precisely located in the search area. Most of these sites are identified based on known sites that either generate or store hazardous materials. One leaking underground petroleum hydrocarbon (fuel) storage tank is located at Del Valle Regional Park. This tank was removed along with two others which were not leaking. Removal occurred in October 1992. The tanks were located in the maintenance yard area east of Del Valle Road. The San Francisco Regional Water Quality Control Board was contacted to determine if contamination entered the lake. Contamination had not reached the lake and only minor soil removal was required. The Regional Board has not required any further action by East Bay Regional Parks at the maintenance yard. The tanks were replaced with above-ground storage tanks.

Other

The recreational facilities at the lake are managed by the East Bay Regional Park District. During the site visit in 1995, the sanitary waste handling facilities appeared to be adequately maintained. The waste water collection and treatment system consists of lift stations to collect waste water from various points around the lake, with oxidation ponds used for waste disposal. No failures were reported since the initial Sanitary Survey of SWP according to the San Francisco Regional Water Quality Control Board. Portable chemical toilets are used at various points around the lake to supplement permanent facilities. The entire system is inspected and maintained at regular intervals. An abandoned solid waste landfill and a former U.S. Veterans Administration medical center site were identified in the database search, but these sites are not in the watershed. The watershed area has not changed significantly since the initial Sanitary Survey was conducted, when the major facilities at the lake were identified. The potential contaminant sources remain the same. Agricultural crop production, cattle grazing, body contact recreation, and the potential for spills related to the sanitary waste handling facilities remain as the major sources of contaminants in the watershed.

The city of Benicia has submitted comments (Appendix I) concerning the findings of both the initial 1990 Sanitary Survey and the 1996 Sanitary Survey Update with regard to the quality of the NBA source waters. A number of these findings have been incorporated as recommendations in this report. It is anticipated that the recommendations in this report will be addressed by a Sanitary Survey Review and Action Plan Committee in much the same manner as the recommendations resulting from the 1990 Sanitary Survey were addressed by the original Sanitary Survey Action Committee, and can be considered as work in progress.

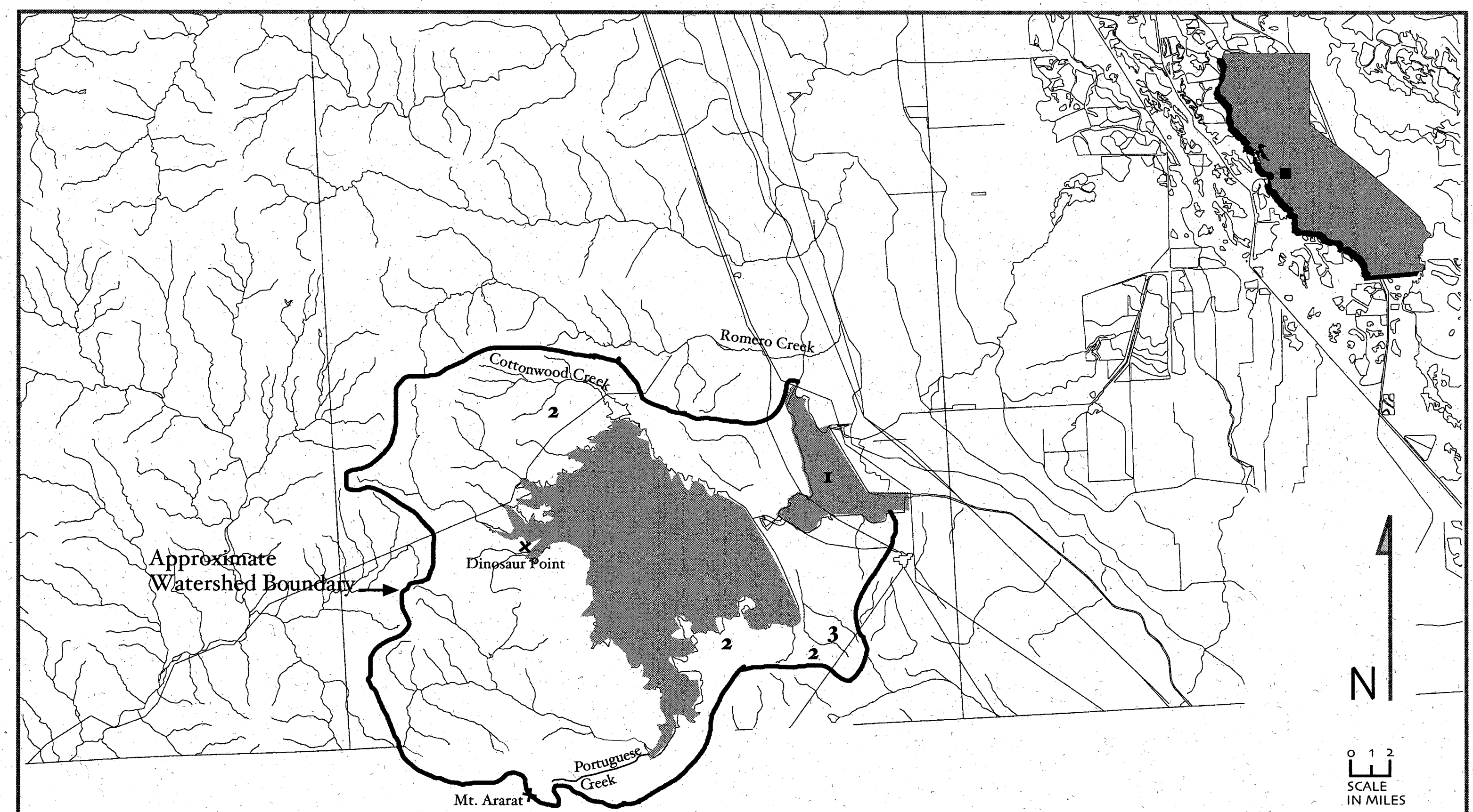


San Luis Reservoir Complex

LEGEND

- ▲ camp ground
- swim beach
- picnic area
- ● RV dump site
- vista point
- ■ boat ramp
- 1 O'Neill Forebay
- 2 cattle grazing
- 3 evaporation ponds

Approximate area of watershed: 141 sq. mi. / 90,458 acres



San Luis Reservoir Complex

The San Luis Reservoir and Dam (Figure 2-5) are located on San Luis Creek in the foothills of the west side of the San Joaquin Valley in Merced County, 12 miles west of the city of Los Banos (population 19,900, California Department of Finance 1995). The climate of the study area is similar to the Del Valle Lake watershed. San Luis Reservoir is part of the San Luis Joint-Use Facilities which serve SWP and federal Central Valley Project. The San Luis Joint-Use Facilities were completed in 1967 and provide storage for water diverted from the Sacramento-San Joaquin Delta for later delivery to the San Joaquin Valley, Santa Clara Valley, and Southern California.

Land Use

San Luis Reservoir State Recreation Area is operated by the California Department of Parks and Recreation (DPR). Extensive recreational developments and three wildlife areas are around the Reservoir. O'Neill Forebay offers camping, picnicking, boating (sail and power), water-skiing, wind surfing, fishing, swimming, hiking, bicycling, and waterfowl hunting. San Luis Reservoir and O'Neill Forebay averaged 512,391 visitors between 1967 and 1995 (DPR 1995). The recreational areas appeared to be in good condition and well maintained at the time of the site visit in May 1995.

The watershed of O'Neill Forebay is undeveloped except for the recreational facilities. A few cattle graze on the hills surrounding the lake, which are privately owned. While the initial Sanitary Survey noted the presence of approximately 1,000 head of sheep using the watershed of O'Neill Forebay for grazing, no sheep were present during the site visit in May 1995. Grazing, however, still occurs in the watershed of the San Luis Reservoir.

Geology

The watershed of the San Luis Reservoir Complex, located within the Diablo Range, encompasses 141 square miles (90,458 acres) with several rock types. This range extends southeast 130 miles almost to Coalinga, and from the Carquinez Strait at Benicia along the west side of the San Joaquin Valley (Norris and Webb 1990).

The northwestern portion of the lake is comprised of a mélange of sheared fragmented Franciscan Complex rocks (Jennings and others 1977). The dam area and the O'Neill Forebay area east of the Reservoir are primarily non-marine sedimentary rock, and include loosely consolidated sandstones, shales, and gravels. A small portion of the northern shore of the O'Neill Forebay contains terrace deposits from various sources from the Great Valley Syncline. These deposits are both consolidated and semi-consolidated, and may be categorized as mostly non-marine sedimentary rock, possibly including some marine deposits.

The surface geology of the watershed for the remainder of the reservoir complex is very similar to that of Lake Del Valle, with the exception of a small pluton encountered along the Ortigalita Fault north of the lake. This plutonic rock is mostly serpentine but may include peridotite, gabbro, and diabase. Additionally, a melange of sheared fragmented Franciscan Complex rocks also occurs in the region. Some volcanic rocks occur on both the west and south shores of the Reservoir, which include flows and minor pyroclastic deposits (Jennings and others 1977).

Soils

Five general soil types are in the watershed of the San Luis Reservoir Complex, and include the Damluis-Bapos-Los Banos, O'Neil-Apollo, Franciscan-Quinto-Rock Outcrop, Millsholm-Fifeld-Honaker, and Peckhem-Ararat-Laveaga (USDA 1990). Well-drained clay loam soils are located on slopes and flat areas. Soils found in foothill areas are moderately deep silt and clay loams with moderately high organic matter.

In the mountainous areas of the Coast Range are found well-drained sandy clay loams and sandy loams located on steep slopes. Also located in mountainous areas of the western portion of the watershed are various types of loam on moderately steep to very steep mountainous slopes. The soils found in the western portion of the watershed in gently sloping to very steep mountainous areas are well-drained cobbly, bouldery loams.

The surface hydrology of the watershed is typical of the central coast of California, where the arroyos, creeks, and streams of the watershed are influenced by the climate of the region.

Vegetation

The vegetation of the watershed is primarily Valley Grasslands, with Valley Oak Woodlands in drainage areas. Native grassland species in the watershed have almost been totally eliminated in areas that have been intensely grazed. Needle grass *(Stipa/Nasella sp.)* and speargrass(*Stipa/Nasella sp.*) are the dominant native grasses (Schoenherr 1992).

Oak woodlands dominate foothill slopes with blue oaks (*Quercus douglasii*), interior live oaks(*Quercus wislizenii*), and valley oak (*Quercus lobata*) present. Cottonwood-sycamore riparian communities are found in seasonally wet drainage areas. Stands of California sycamores(*Platanus racemosa*) occur in the Portuguese Bay drainage (Schoenherr 1992).

San Luis Reservoir Complex – Potential Contaminants in the Watershed

Environmental Database Records Search

The records search of the environmental databases was conducted for the area within a two-mile radius of the reservoir and forebay (Appendix G). Sites identified within the search area consist predominantly of underground storage tank (UST) sites. However, two RCRA generators and an emergency response site were also identified. One leaking underground storage tank was located at the DWR mobile equipment building and the other was located at the boat ramp for O'Neill Forebay. The tank at the mobile equipment building was a 200-gallon waste oil tank and was removed in 1987. The tank at the boat ramp was a 500-gallon gasoline tank and was removed in 1989. Both tanks had minor leaks, but contamination did not enter the reservoir or forebay.

The search also identified several sites that could not be precisely located in the search area based on information included in the regulatory agency database files. These sites are generally linked to known small-scale hazardous substance generators

Summary of Existing and Potential Contamination Sources for the San Luis Reservoir Complex

- *Recreational use in watershed*
- *Highway/road runoff*
- *Leaking underground storage tanks*
- *Hazardous material spills*
- *Waste WTP spills/failures*
- *Livestock grazing*

and storage facilities, which often include fuel service stations, small industries, and other similar activities. Two solid waste landfills are identified adjacent to the search area: the Billy Wright Disposal Site and the city of Los Banos Disposal Site. However, both of these sites are located outside of the watershed boundary (DWR 1989). Licensed solid waste landfills are required to maintain surface water runoff controls and typically to maintain some form of leachate collection systems. Landfills are also required to undergo an assessment to ascertain the potential for, and magnitude of, groundwater contamination as a result of the landfill activity.

Other

In addition to the potential contaminant sources identified through the environmental database searches and site visit, the initial Sanitary Survey identified roadside drainage of oil, metals, and grease, as well as hazardous materials accidents from Highway 152, as the major potential sources of contamination to O'Neill Forebay and San Luis Reservoir.

Coastal Branch

The Coastal Branch Aqueduct (Figure 2-6) is located in the Kettleman Hills area of western Kings County in a rural farm/range setting. It is approximately 9 miles south of Highway 41, and 15 miles south of the city of Avenal, which had a 1995 population of 12,100 (California Department of Finance 1995). Currently no domestic water turnouts are along this portion of the Coastal Aqueduct. However, SWP is being extended to the central coast from the end of the existing open canal at Check 5 into Santa Barbara County. The Aqueduct extension will be an enclosed pipeline.

The climate of Kings County is a drier variation of the Mediterranean climate of the San Joaquin Valley. Less precipitation occurs in this portion of the valley, and an average of 8.5 inches annually occurs in Hanford, 30 miles northeast of the study area (USDA 1977).

Land Use

Year-round cattle grazing occurs in the watershed area on an open-range, non-irrigated pasture. During the field survey, sheep were observed on both sides of the Aqueduct.

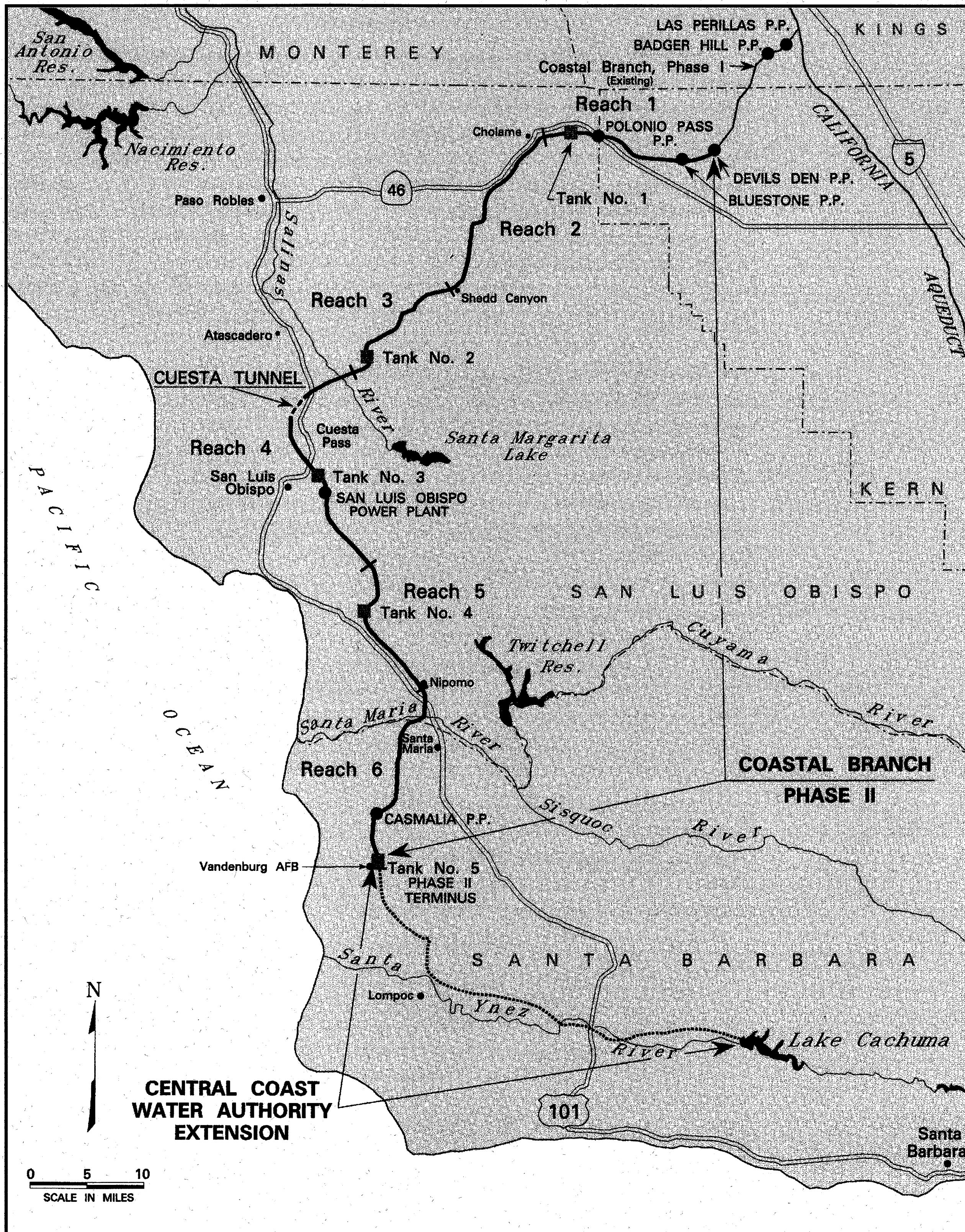
Oil wells, gas wells, and petroleum pipelines are located in the watershed. Various agricultural crops are grown on both sides of the Aqueduct.

Geology

The Coastal Branch area is predominately non-marine sedimentary rocks. The geology of the watershed from the eastern portion to the southwestern portion where it intersects the California Aqueduct consists of mostly non-marine sedimentary rocks of various composition. At the eastern side of the watershed are non-marine sedimentary rocks consisting of unconsolidated and semi-consolidated alluvium, lake, playa, and terrace deposits. The Kettleman Hills are just west of the Aqueduct, and are made up of mostly moderately consolidated sandstone, shale, siltstone, conglomerate, and breccia, with fault tracings throughout (Jennings and others 1977).

The base of the Kettleman Hills contains loosely

 Figure 2-6 Coastal Branch



Summary of Existing and Potential Contamination Sources for the Coastal Branch

- *Highway/Road runoff*
- *Hazardous material spills*
- *Livestock grazing*
- *Agricultural runoff*

consolidated sandstone, shale, and gravel deposits. On the west side of the Kettleman Hills, the watershed crosses a synclinal fold that is concealed by the alluvium of sedimentary rocks at the 500 foot elevation. Highway 33 intersects the watershed approximately 2 miles west of the folds in a formation known as Devil's Den.

About 2 miles southwest of Devil's Den, the watershed reaches an area of moderately consolidated marine sandstone, shale, siltstone, conglomerate, and breccia. The watershed terminates in a region of mostly well-consolidated marine shale, sandstone, conglomerate, and minor limestone formations. The San Andres Fault is the closest major active fault and is located 10 miles to the southwest (Jennings and others 1977).

Soils

The two general soil types found in the study area are Lehent silty clay and Panoche clay loam (USDA 1977). Lehent silty clay soils are well-drained saline-alkali soils on basin rims. These soils are formed in alluvium derived dominantly from igneous and sedimentary rock. Panoche clay loam is a very deep well-drained soil on alluvial fans, and is formed in alluvium derived primarily from sedimentary rock.

Vegetation

Native vegetation of the study area has been classified as Valley Grassland, which includes dense to somewhat open bunch grass and valley saltbush scrub communities. Needle grass (*Stipa/Nasella sp.*) and speargrass (*Stipa/Nasella sp.*) are the dominant native grasses (Schoenherr 1992).

Coastal Branch – Potential Contaminants in the Watershed

Environmental Database Records Search

The search of environmental databases was conducted for the area within a three-mile radius of the open channel portion of the Coastal Branch Aqueduct between the California Aqueduct on the north and the small reservoir (Berrenda Mesa) near Kecks Road on the south. The findings of the database search are presented in Appendix G.

Several small generators of hazardous materials are in areas adjacent to the Aqueduct. Several spills were reported to have occurred on Highway 33 and on Barker Road. Other spilled materials in the watershed appear to be related to oil and gas operations in the area. The Coastal Branch was not impacted by any of these spills.

Other

Damaged aqueduct lining panels were at mile marker 1.75, and a groundwater pump-in point was noted at mile marker 4.22. At mile marker 5.65, sand bags were stacked at the top of the concrete channel to control storm water runoff.

The access roads along both sides of the Aqueduct are drained through pipes into the Aqueduct at regular intervals. Both the access roads and the drains are designed to direct only water from the access roads into the Aqueduct, with storm water flows from the surrounding area directed either over or under the Aqueduct. At mile markers 7.26 and 7.13, access road drains appeared to have the potential of also directing runoff from the surrounding hillsides into the Aqueduct. Most of the project is designed not to accept storm water or flood water except for the San Luis reach of the California Aqueduct.

At the junction of the main Aqueduct and the Coastal Branch is a station where copper sulfate is added to the Coastal Branch for control of algae. Under normal conditions, sufficient copper sulfate is added to obtain a concentration of approximately 1 part per million in the Aqueduct. Due to the turbidity in the Aqueduct resulting from the March 1995 storms, the copper sulfate application schedule was reduced during spring and early summer 1995.

The field survey found both pesticide and vehicle maintenance waste at the location of the Devil's Den temporary agricultural water takeout point (mile marker 10.50). Lead-acid vehicle batteries, oil filters, spilled oil, a storage tank, and a partially full container of pesticides (brand name is Goal; active ingredient is oxyfluorfen) was present. The small amounts of materials present appear to pose little or no threat to SWP water quality. The take-out pipe had a metering device, but no device controlling flow back into the Aqueduct was apparent. The opening of the pipe was approximately 18 inches above the ground, which should prevent ground materials from entering both the pipe and the Aqueduct. A cap on the end of this pipe would provide greater assurance that these materials would not reach the Aqueduct when it is not being used to deliver water.

Pyramid Lake

Pyramid Lake and dam (Figure 2-7) are within the Angeles and Los Padres National Forests located on Piru Creek, about 14 miles north of the city of Castaic. Pyramid facilities were completed in 1973 and provide regulatory storage for the Castaic Power Plant, normal regulatory storage for water deliveries from SWP's West Branch, emergency storage in the event of a shut-down of SWP to the north, recreational opportunities, and incidental flood protection. The east/west dimension of the watershed is approximately 24 miles in length, which yields an approximate area of 250 square miles.

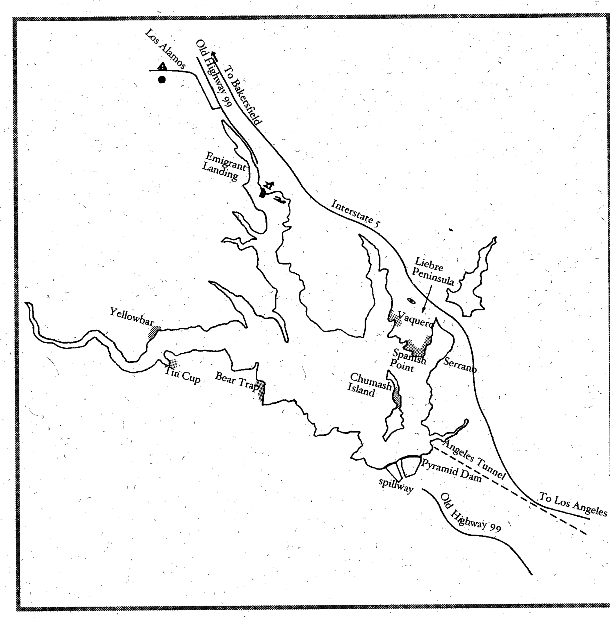
Land Use

The watershed areas nearest the reservoir are used primarily for recreational purposes associated with both the lake and the Hungry Valley State Vehicular Recreation area.

Pyramid Lake facilities are operated by the U.S. Forest Service and offer camping, picnicking, boating, water-skiing, fishing, and swimming. Total visitor use between 1990 and 1994 was 1,183,216. Grazing occurs in the watershed on a seasonal and non-irrigated basis from mid-May to mid-October. Grazing in the Piru Allotment involves 47,580 acres, but only 16,187 acres are actually grazed by approximately 250 cattle (personal communication, Lisa Kruger, USFS, 1995).

Geology

The watershed of Pyramid Lake is located in a matrix of rocks of several origins in a geologically active area consisting of many faults and folds. The lithology of the Pyramid Lake watershed is nearly equally distributed over several rock types which include marine sedimentary rocks, non-marine sedimentary rocks, and plutonic rocks of the Sierra Nevada Batholith. San Guillermo Mountain is lo-

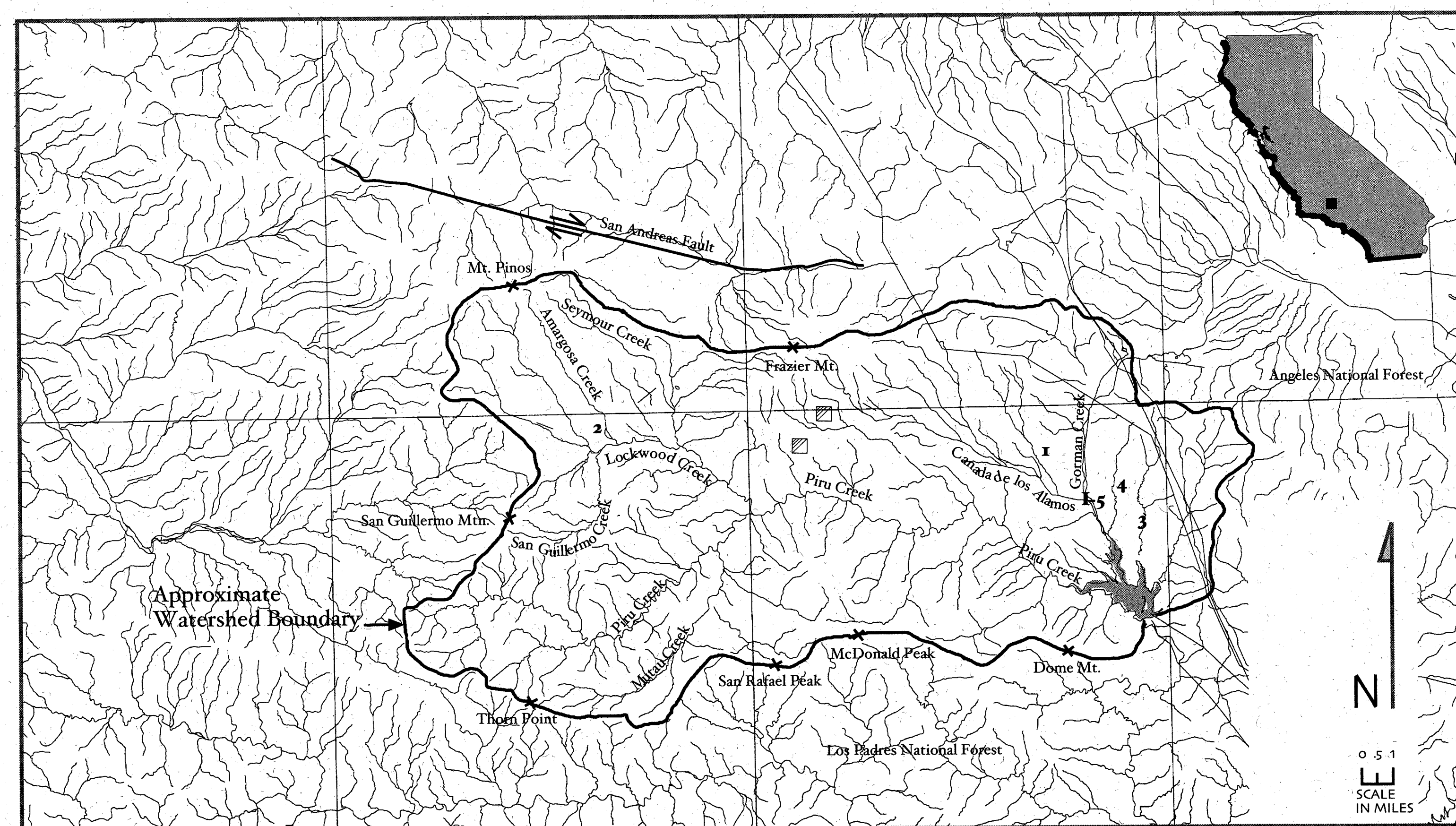


Pyramid Lake

LEGEND

- camp ground
- swim beach
- picnic area
- RV dump site
- vista point
- boat ramp
- mine shaft
- 1 Hungry Valley State Vehicle Recreation Area
- 2 Lockwood Valley
- 3 Libre Gulch
- 4 Apple Canyon

Approximate area of watershed: 250 sq. mi. / 160,000 acres



cated approximately 3 miles from the western perimeter of the watershed and is bounded by all three rock types mentioned above, but is found in a region of sandstone, shale, conglomerate, breccia, and ancient lake deposits (Jennings 1977).

The northern portion of the watershed also contains small areas of non-marine sedimentary rocks and volcanic flow rocks (minor pyroclastic deposits). The watershed is in a region with well-defined fault traces and thrust faults located both within and around it.

The perimeter of the watershed is bounded by 3 major faults, which include the Pine Mountain Fault on the south, the Big Pine Fault on the northwest, and the San Andreas Fault on the north. Many smaller faults are within the perimeter typically located at rock type boundaries where folds occur within the same rock type.

The Coast Range, which contains Mount Pinos, enters the watershed to the northwest. Several mountain ranges converge with Mount Pinos in the northwestern area which is part of the Franciscan Complex. The San Gabriel Mountains boarder the watershed to the east and the Santa Ynez mountains to the south and west (Jennings 1977).

Soils

Soils in the watershed consist primarily of sediments from the parent rock of the surrounding area. USDA has not conducted soil surveys of the area. Soils in the Lockwood Valley area support grasses for cattle grazing, along with some pasture crops (e.g. alfalfa) which are grown on a small scale.

Vegetation

In general, the scrub vegetation encompassing the lake is known as Chaparral, with variations occurring in the type of Chaparral found in the watershed. Changes in vegetation occur in the lower and upper riparian areas of the larger creeks, such as Piru Creek. California sagebrush (*Artemisia californica*) and Yellow Pine forest are found in the Lockwood Valley area (Schoenherr 1992).

Lockwood Creek flow is supported by runoff of seasonal rains and snow from the south slope of Mount Pinos and the east slope of Mount San Guillermo. Several ephemeral creeks converge to form Lockwood Creek in the Lockwood Valley, including Seymour Creek, Amargosa Creek, Middle Fork, South Fork, and San Guillermo Creek. Vegetation in this area of the watershed is mostly sagebrush scrub and yellow pine forest on mountain slopes.

Piru Creek is the largest creek entering the lake, and flows generally from west to east. The major tributaries of this creek are Lockwood, Mutau, Frazier, and Snowy creeks. Piru Creek flow is seasonal, in conjunction with winter precipitation. Extreme flow in the creek was observed on May 23, 1995, when the creek was approximately 3 feet above its normal flood plain. At the time of the site visit in May 1995, the creek flow was observed to be turbid with sediments. Areas around Hardluck Campground (Piru Creek) exhibited signs of heavy erosion, such as deep cut banks.

Hungry Valley State Vehicular Recreation Area (SVRA) occupies 19,000 acres of the watershed, and is used by off-road vehicles year-round. Hungry Valley is directly north of Pyramid Lake. Lower Hungry

Summary of Existing and Potential Contamination Sources for Pyramid Lake

- *Recreational use in watershed*
- *Highway/Road runoff*
- *Leaking underground storage tanks*
- *Hazardous material spills*
- *Livestock grazing*

Valley drains into Canada de Los Alamos when supplied by enough precipitation, which then flows into Gorman Creek. Gorman Creek flows annually from the city of Gorman, following Interstate 5 south to Pyramid Lake. This flow is mostly underground and not noticeable in the dry season. Approximately half of the SVRA is drained by the Canada de Los Alamos drainage system. An unnamed creek, south and east of Gorman Creek, enters the lake via a drain under Interstate 5. The Apple Canyon creek is seasonal in flow. All of these creeks entering the lake have the potential to introduce sediments.

Pyramid Lake – Potential Contaminants in the Watershed

Environmental Database Records Search

The database search for Pyramid Lake and other adjacent areas included sites within an area approximately 1.5 miles wide beginning at Schmidt Ranch and extending to Gorman Creek. Sites within an area approximately 1 mile wide from the reservoir on either side of Interstate 5 to the junction of Highway 138 were also included, as were sites within an area approximately 1 mile wide and extending from the northwest tip of the reservoir along Piru Creek for 5 miles. An area approximately 1 mile wide and extending up Buck Creek for 5 miles (0.5 miles on either side), and up Snowy Creek from the confluence with Piru Creek for 5 miles (0.5 miles on either side) was also included in the area searched. Sites within the specified search range are listed in Appendix G.

Seven emergency response notifications were recorded for the search area. These notifications represent transportation spills that occurred on Interstate 5 or Highway 138. These spills were cleaned up and do not reach any surface water bodies of the watershed. However, such spills do indicate the potential for accidental discharges from transportation incidents which may occur in the watershed.

In October 1992, an underground storage tank at the Emigrant Landing area of the lake was reported to have leaked and contaminated soils with petroleum hydrocarbons. A remediation plan was submitted to Los Angeles County and to the Los Angeles Regional Water Quality Control Board. The tanks were removed and a vapor extraction system and monitoring wells were installed by the U.S. Forest Service (Angles National Forest, Saugus, CA). Currently, the vapor extraction system is not in operation but the wells are being monitored quarterly for petroleum hydrocarbons. The former tank location is within one hundred yards of the lake.

Other sites in the watersheds include 12 mines, with eleven being active gold mines. These mines are not listed as either actively discharging to surface water or using chemicals for mining purposes, and are considered to be placer mines that use milling methods for gold extraction. One uranium mine also uses a milling method for ore extraction.

One site was identified on the Hazardous Waste Information System as accepting waste for disposal. The site is a USDA facility in Castaic, and is located approximately 15 miles southeast of Pyramid Lake, which is outside of the watershed boundary.

Other

Cattle and sheep grazing occur throughout the watershed, with the potential for the introduction of *Giardia lamblia* and *Cryptosporidium* into the creeks and streams entering the lake.

The Hungry Valley State Vehicular Recreation area is a potential source of eroded sediment resulting from off-road activities. Motor vehicle-related contaminants such as gasoline, oil, and some metals could also occur. Coliforms and other pathogens may also be of concern in an area heavily used for off-road recreation, since sanitary facilities may not be available at all locations.

The initial Sanitary Survey determined other potential contaminant sources in the watershed, which include the city of Gorman waste water treatment facilities, campgrounds using private waste water systems, mines, drainage from Interstate 5, rural cabins and commercial buildings using private waste water systems, and three airplane landing strips in Lockwood Valley.

Quail Lake

Land Use

The major activities in the Quail Lake (Figure 2-8) area are recreation (mostly fishing) and cattle grazing in areas around the northern part of the lake. Portable toilets are at the west end of the lake. Highway 138 passes near the lake to the south, with grazing occurring south of this road.

Environmental Database Records Search

The database search for Quail Lake includes sites within an area defined by 0.5 mile from the northern and southern boundaries of the lake, and 1.0 mile to the east.

Systech and National Cement Company are listed in the CERCLIS database search in Appendix G. Systech stores ignitable hazardous waste at its Gorman site. Most of the ignitable hazardous waste is used as fuel to help power cement kilns at National Cement. The operations at both sites are permitted through the Department of Toxic Substance Control. The two facilities are near, but not in, the watershed of Quail Lake.

One underground storage tank is in the watershed of the lake on Quail Lake Road at the Bakeman Farm. This tank has been at the site since 1944 and is listed as a 500-gallon fuel oil tank. This tank is not reported as leaking at the present time.

Other

The initial Sanitary Survey identified several pipes directing runoff to the lake from the livestock grazing areas to the north of the lake, and from the east side of the lake. A small landing strip with three residential buildings, which have private waste disposal systems, is at the southeast end of the lake. A cement production plant is also in the watershed.

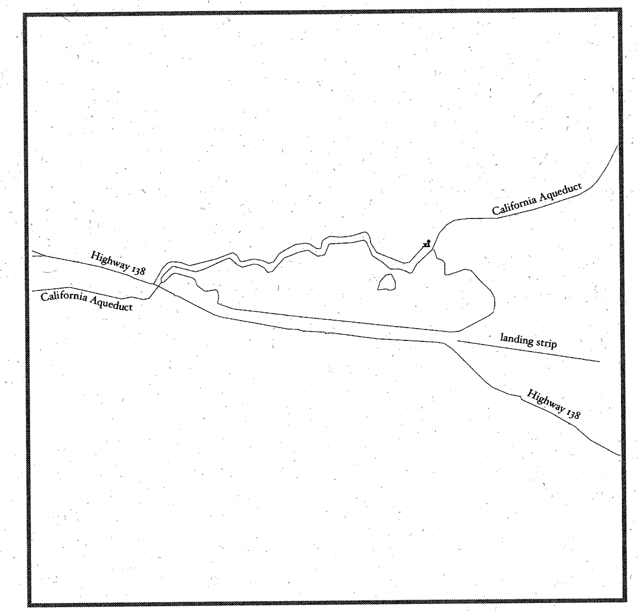
Summary of Existing and Potential Contamination Sources for Quail Lake

- *Recreational use in watershed*
- *Highway/road runoff*
- *Underground storage tanks*
- *Hazardous material spills*
- *Small Residential Waste Disposal Systems*
- *Livestock grazing*

Castaic Lake

Castaic Lake and Dam (Figure 2-9) are located at the confluence of Castaic Creek and Elizabeth Lake Canyon Creek, 45 miles northwest of Los Angeles and about 2 miles north of the community of Castaic. The Castaic project was completed in 1972, and provides regulatory storage for water deliveries, an emergency water storage facility, recreational development, power conversion, and fish and wildlife enhancement.

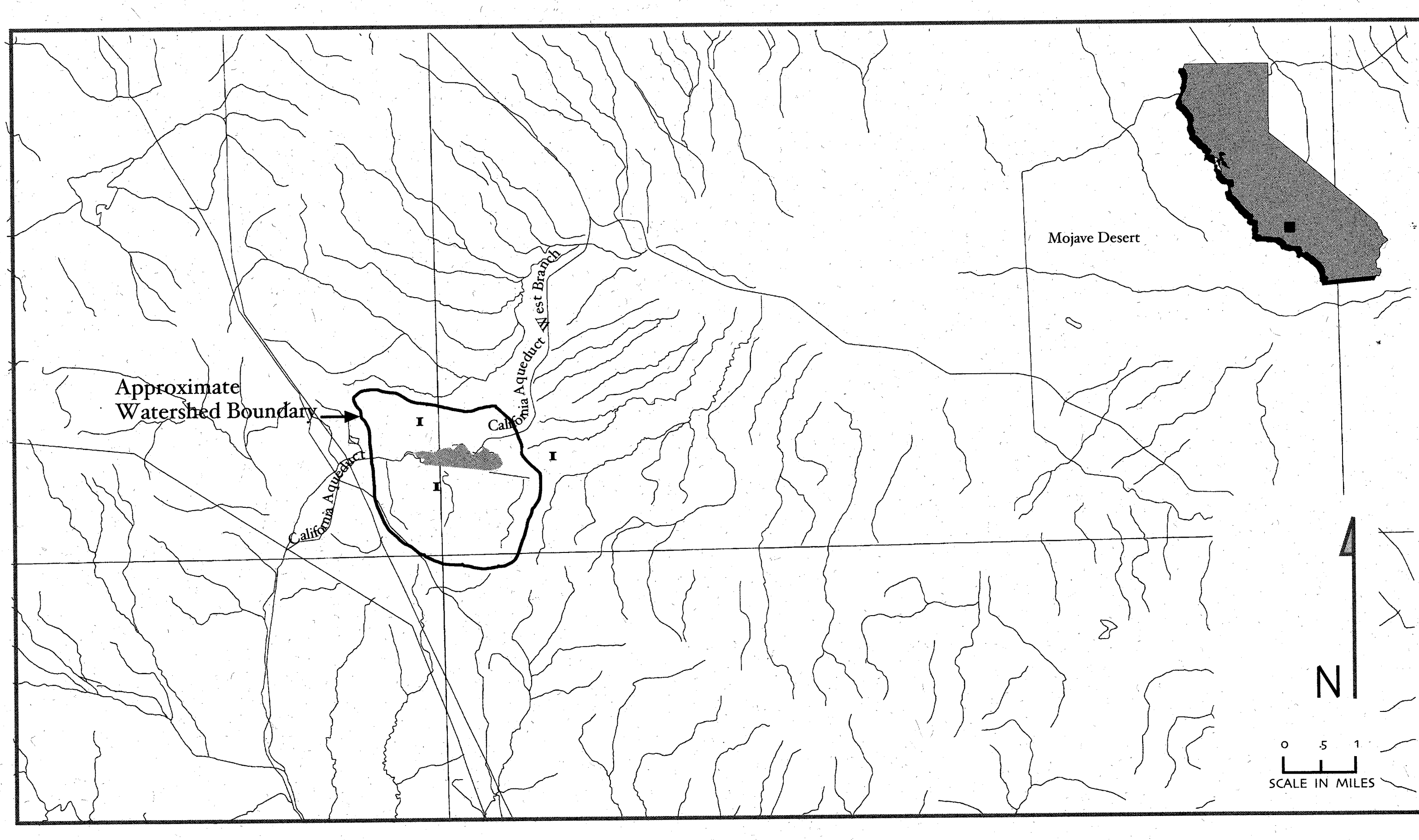
Quail Lake



LEGEND

- picnic area
- cattle grazing

Approximate area of watershed: 4 sq. mi. / 1840 acres



Castaic Lagoon is located downstream of the Dam and provides a recreation pool with a constant water surface elevation of 1,134 feet. It also functions as a recharge basin for the downstream groundwater basin. The lagoon provides an additional 3 miles of shoreline and 197 surface acres. Castaic Lake State Recreation Area is operated by the Los Angeles County Department of Parks and Recreation and offers fishing, boating, water-skiing, sailing, picnicking, and swimming. Visitors totalled 18,821,000 between 1972 and 1990.

Land Use

Sheep grazing occurs in the watershed on a seasonal, non-irrigated basis for fire hazard reduction in the northwest arm of Castaic Lake. Approximately 750 sheep (no cattle) graze a total of 2,560 acres, of which 135 acres are owned by DWR, and the remaining acres are owned by the Bureau of Land Management. The grazing season is dependent upon the amount of rainfall the area receives in any given year and can vary significantly. DWR has estimated that the average annual inflow into Castaic Lake from the watershed is about 23,000 acre-feet.

Between 1990 and 1995 the grazing season ranged from none in 1991, to six months (March-September) in 1995 (personal contact, Shawna Bautista, USFS, 1995). Runoff from the surrounding grazing areas entered the reservoir from creeks draining these areas.

A motocross track is in the watershed, with runoff flowing into Grasshopper Creek. A recreational vehicle park is present which accepts holding tank sanitary waste. A large brickyard is also located just east of the lower lake, with any runoff from this facility entering the lower lake lagoon.

The Castaic lagoon is operated as a recreational area, and is considered an afterbay of the main lake. It is not a part of either SWP or Castaic Lake. The lagoon was closed to body contact recreation intermittently from 1990 to 1992, and has been closed indefinitely since 1992. These closures resulted from high levels of coliforms measured in the water column by the Los Angeles County Health Department.

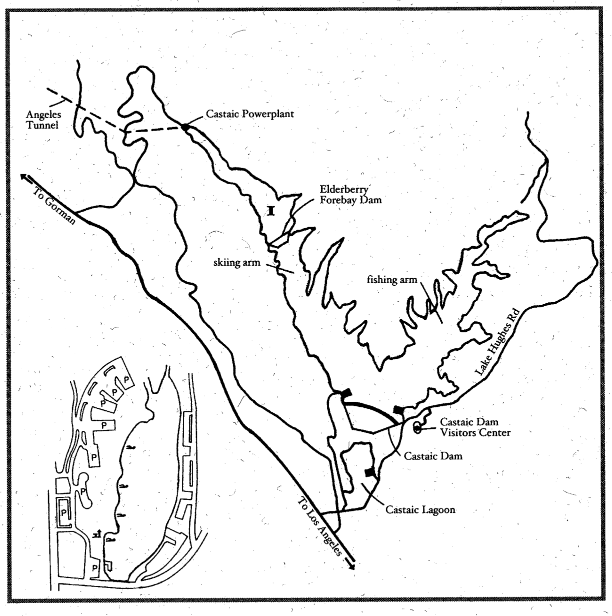
While fecal coliforms were monitored on a weekly basis when the swimming areas were open, monitoring is not currently being conducted. The beach areas have been fenced to prevent entry into the water, and DWR does not know when the afterbay will be reopened for body contact recreation.

Geology

The watershed of Castaic Lake, which is 153 square miles (98,006 acres), is composed primarily of non-marine sedimentary rocks and marine sedimentary rocks. The rocks located in the southern portion of the watershed consist of mostly well-consolidated sandstone, shale, and conglomerate. The northern portion of the watershed contains conglomerate, shale, sandstone, limestone dolomite, marble, gneiss, hornfel, and quartzite. The Sierra Nevada Batholith intrudes almost into the center of the watershed. A small outcrop of non-marine sedimentary rocks borders a southern portion of the watershed (Jennings and other 1977).

The watershed of Castaic Lake lies within 3 miles of faults on both the east and west sides. To the east lies the San Andreas Fault, and to the west lies the

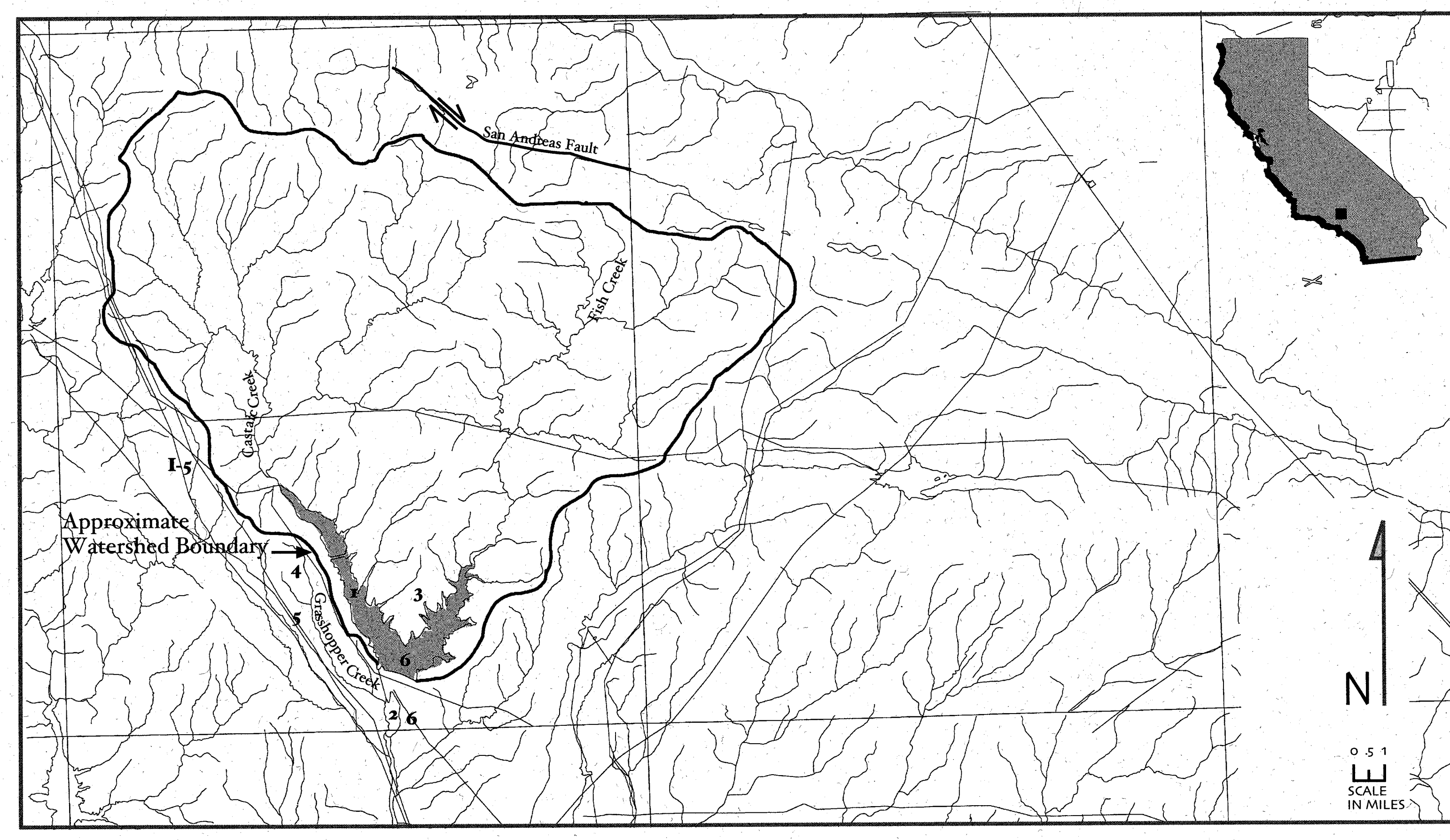
Castaic Lake



LEGEND

- vista point
- boat ramp
- 1 Elderberry Forebay
- 2 Castaic Lagoon
- 3 sheep grazing
- 4 cattle grazing
- 5 Old Ridge Route
- 6 Recreational Use Area

Approximate area of watershed: 153 sq. mi. / 98,006 acres



northern portion of the San Gabriel Fault. The watershed also contains well located fault traces as well as thrust faults which tend to mark rock type boundaries.

Vegetation

The vegetation of the watershed is mostly chaparral and is similar to Pyramid Lake. Variations of upper and lower chaparral exist throughout the watershed.

Castaic Lake – Potential Contaminants in the Watershed

Environmental Database Record Search

The database search for Castaic Lake includes sites within a 2-mile zone around the perimeter of the lake. Sites within the specified search range are listed in Appendix G.

Hazardous waste is generated at the lake through various maintenance activities by DWR. However, these DWR maintenance facilities are below the lake and pose little or no threat to SWP water quality. Since 1989, the following hazardous waste has been generated: asbestos (1.68 tons), waste oil (15.56 tons), oil containing waste (6.3 tons), organic liquid mixture (1.87 tons), and organic solids (2.25 tons).

Other

All sanitary waste from the recreational facilities at the lake are removed and transported to the county waste WTP in Castaic Junction. The Warm Springs Rehabilitation Center, which has its own waste water collection and treatment and disposal system, was identified as a possible contaminant source in the initial Sanitary Survey. Other possible sources of contaminants in the watershed include drainage from mines, runoff from Hughes Road, and cattle and sheep grazing.

Summary of Existing and Potential Contamination Sources for Castaic Lake

- *Recreational use in watershed*
- *Highway/road runoff*
- *Underground storage tanks*
- *Hazardous material spills*
- *Wasterwater treatment system spills/failures*
- *Livestock grazing*

Silverwood Lake

Silverwood Lake and Cedar Springs Dam (Figure 2-10) are located on the West Fork of the Mojave River within the San Bernardino National Forest, about 30 highway miles north of the city of San Bernardino. The facility is a multipurpose project completed in 1971 that serves as a regulatory facility, as well as a water source for agencies supplying the surrounding mountain and desert areas.

Land Use

The Silverwood Lake State Recreation Area is operated by DPR, and offers camping, picnicking, boating, water-skiing, fishing, swimming, bicycling, and hiking, on 2,400 acres. Visitors totalled 2,091,654 between 1990 and 1995 (DPR 1995).

Waste water collection systems exist at the Cedar Springs Dam, the Sawpit Canyon Recreational Area, and the Cleghorn Cove Recreational Area. At Cedar Springs Dam, septic tanks and a leach field are used for sanitary waste disposal. The sanitary waste from Sawpit Canyon is sent through lift stations and pipes to the Crestline Sanitation District Cleghorn Wastewater Treatment Plant located to the southwest of the lake. Sanitary waste from the Cleghorn Cove facilities is stored in an underground holding tank until it is pumped to the Crestline Sanitation District Cleghorn Waste WTP. Other recreational areas around the lake use chemical toilets for sanitary waste, which are serviced by truck, along with floating toilets which are serviced by barge-mounted truck.

Grazing has not occurred in the watershed area since 1990. Grazing in the Pilot Rock Allotment, located on the east side of the lake, has not occurred since permits were rescinded in 1993. The allotment was not in use in 1992, and records are not available for 1991. However, in 1990, 40 cattle were present on a seasonal basis between mid-March and mid-November. A total of 1,950 acres were grazed at that time (personal contact, Melody Lardner, USFS, 1995).

The Silverwood Lake watershed is 29 square miles (18,872 acres), and is located 5 miles northeast of the San Andreas Fault. DWR has estimated the average annual inflow to Lake Silverwood from the watershed to be about 30,000 acre-feet/year.

Geology

The central portion of the watershed contains granite, quartz monzonite, granodiorite, and quartz diorite. The southern portion of the watershed contains a complex of igneous and metamorphic rocks, consisting of mostly gneisses and schists. In the northern part of the watershed, Highway 138 bisects a region of alluvium, lake, playa, and terrace deposits, and a region of loosely consolidated sandstone, shale, and gravel deposits. The watershed contains well-located fault traces that occur in the batholith rocks as well as in the granites.

Soils primarily consist of sediments from the parent rock of the surrounding area. USDA has not conducted detailed soil surveys in this area of the county. Soils north of Cedar Springs Dam are described as loamy and sandy sediments (USDA 1971).

Vegetation

The lake is in the rain-shadow of the San Bernardino Mountains, which has a varying effect on the climate and weather of the watershed (Schoenherr 1992). Proximity to the ocean also plays a role in the regional climate and vegetation of the watershed.

The lower northern area of the lake is predominately Desert Chaparral. The East Fork of the Mojave River is similar to the West Fork in vegetation and precipitation, and both are mostly Desert Chaparral. The West Fork of the Mojave River flows seasonally and supports oaks and sycamores. Yellow Pine forests in higher elevations are in the southern portion of the lake.

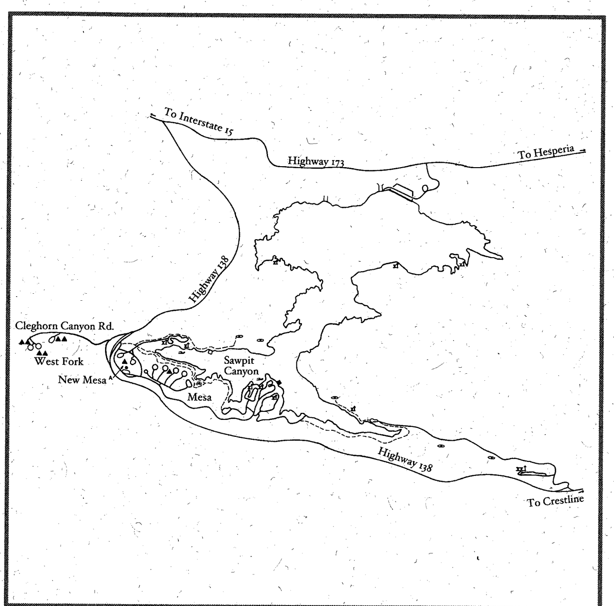
Silverwood Lake – Potential Contaminants in the Watershed

Environmental Database Records Search

The records search for Silverwood Lake includes sites within a 2-mile radius around the lake (except for the northern dam face); an area 1.0 mile wide up the west fork of the Mojave River for approximately 2.5 miles; and an area 1.0 mile wide up the East fork of the West fork of the Mojave River. Sites within the specified search area are listed in Appendix G.

Two leaking USTs were found in the watershed of the lake. Both were located at the Cedar Springs Dam, and DWR was identified as the responsible party. However, the DWR facility is located below the dam and poses little or no threat to SWP water quality. The removal of a 2,000-gallon gasoline UST

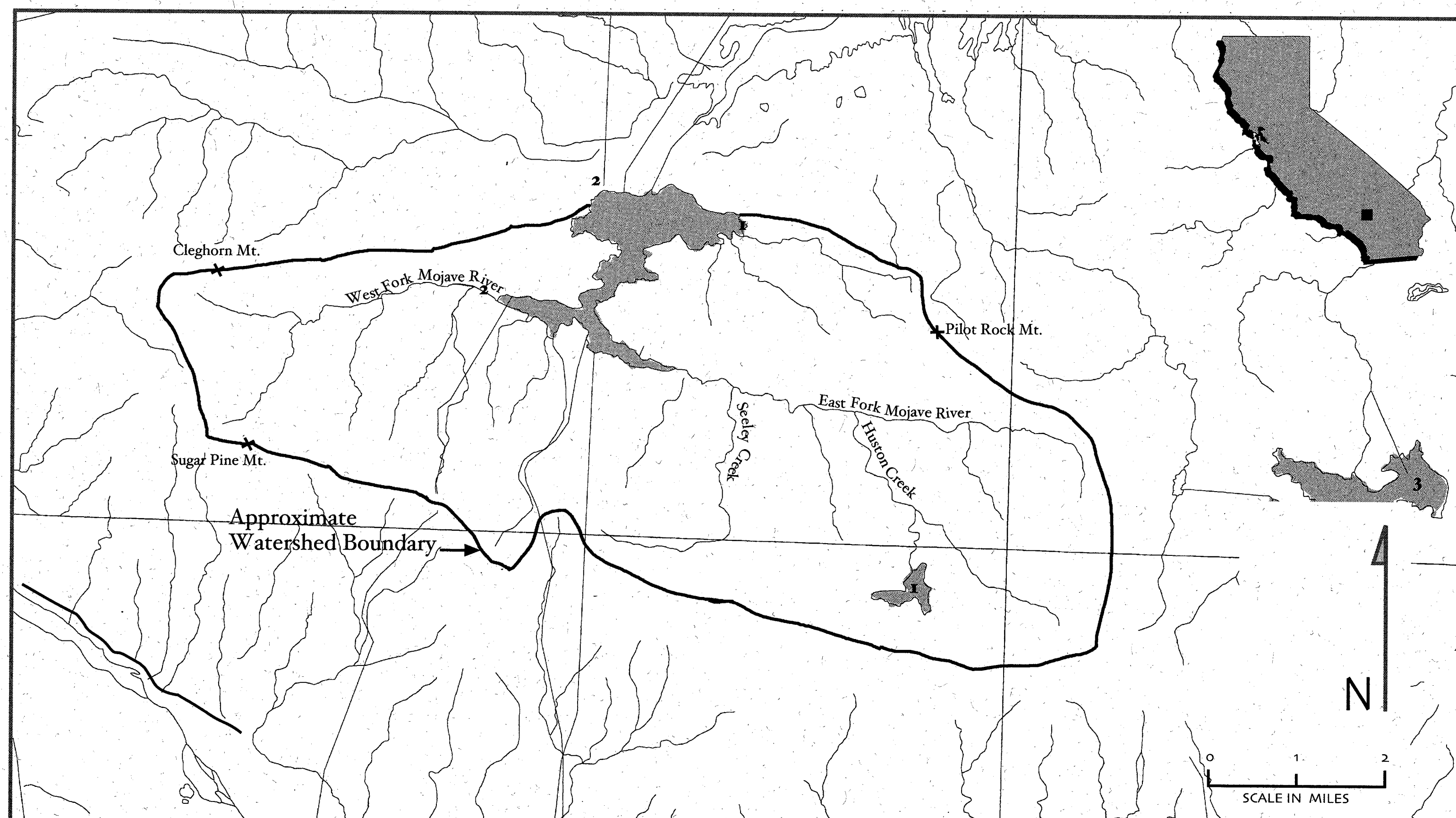
Silverwood Lake



LEGEND

- campground
- group campground
- swim beach
- picnic area
- RV dump site
- group picnic area
- vista point
- boat ramp
- 1 Crestline Lake
- 2 Cleghorn Wastewater Treatment
- 3 Lake Arrowhead

Approximate area of watershed: 29 sq. mi. / 18,872 acres



Summary of Existing and Potential Contamination Sources for Silverwood Lake

- *Recreational use in watershed*
- *Highway/road runoff*
- *Leaking underground storage tanks*
- *Hazardous material spills*
- *Wastewater treatment system spills/failures*

and a 2,000-gallon diesel UST occurred in 1994. All removal activities were in conjunction with San Bernardino County and Lahontan Regional Water Quality Control Board recommendations. No further action has been taken at the dam site.

Other

While there were no problems reported with the single floating toilet on the lake, there was one incident of vandalism involving a lift station. The incident, which DWR responded to, occurred in 1991 when tampering resulted in the release of an undetermined amount of the lift station content into the lake. The lift stations normally pump sanitary waste to the waste WTP.

Crestline Sanitation District. The waste water handling facilities consist of four waste WTPs, which include the Cleghorn, Seeley Creek, Pilot Rock, and Huston Creek plants. All plants provide secondary treatment of effluent (0.8 mgd average dry weather flow, combined), and all are located above Lake Silverwood. Effluent is discharged by a single 11-mile long outfall pipe to Summit Valley and the Las Flores Ranch, where it is applied to pasture land or is directed to percolation ponds.

Between January 16, 1993, and January 25, 1993, a failure resulted from construction-related damage to the outfall when a fence post was driven through the outfall pipe. Approximately 11 million gallons of treated and disinfected effluent was lost to the East Fork of the West Fork of the Mojave River. The spill was approximately 100 yards north of Highway 173 on Las Flores Ranch property, and eventually flowed 1.5 miles into the West Fork of the Mojave River. The location of the spill was below Lake Silverwood.

Repairs to the outfall pipe were completed on January 25, 1993. Due to the nature of the spill, it could not be cleaned up. As a result of the failure, modifications were made to the outfall, and a fine was assessed by the Lahontan Regional Water Quality Control Board. A low-flow alarm and a holding vault have been installed since the event.

Lake Arrowhead Sanitation District. The waste water handling facilities consist of two waste WTPs (Willow Creek and Grass Valley), with an average flow of 1.7 mgd. The treated effluent is conveyed by pipeline to a 380-acre farm located in Hesperia, where it is used to irrigate pasture land. As of 1994, there were 9,497 connections, which include 81 new connections added in 1994 (Lake Arrowhead Community Services 1994).

The system is currently being upgraded to a tertiary treatment standard, which is now undergoing review by the Lahontan Regional Water Quality Control Board. The sanitation district will ask the Regional Board for permission to discharge to wetland ponds located nearby when the tertiary upgrades have been completed. Any system failures would involve Grass Valley Creek or the Lake Arrowhead drainage basin, but not the Silverwood Lake watershed. Lake Arrowhead is a source of drinking water for the District.

Lake Perris

Lake Perris (Figure 2-11) is a terminal storage facility of the SWP. It is located in northwestern Riverside County about 13 miles southeast of the city of Riverside, and 5 miles northeast of the town of Perris which has a population 31,100 (California Department of Finance 1995). The reservoir, which was completed in 1974, is a multipurpose facility providing water supply, recreation, and fish and wildlife enhancement.

Land Use

Lake Perris State Recreation Area is operated by DPR, and offers camping, picnicking, horseback riding, sail and power boating, water-skiing, fishing, swimming, hiking, bicycling, hunting, and rock climbing. Many of the recreational facilities at the lake are located on either the north shore or on Allessandro Island, and include the marina, picnic areas, and campgrounds. Other smaller recreational areas are also located throughout the watershed. There is almost no other development in the watershed other than the recreational facilities associated with the lake, with all other new residential or commercial development currently being outside the watershed. Visitors totaled 6,988,868 between 1990 and 1995 (DPR 1995). Grazing does not occur in the watershed.

Geology

The rocks in the area consist of granite, quartz monzonite, granodiorite, and quartz diorite. The majority of the watershed is unconsolidated and semi-consolidated alluvium, lake, playa, and terrace deposits. The San Jacinto Fault borders the eastern side of the watershed, and is the only major known fault in the Lake Perris area.

Soils

Upland areas north, south, and east of the lake have well-drained sandy loams and fine sandy loams on granitic rock (USDA 1971). The lake bed and shoreline areas consist of well-drained sandy to sandy loam soils on alluvial fans.

Vegetation

Vegetation in the watershed is classified as a Coastal Sage Scrub community dominated by California Sagebrush (*Artemisia californica*) and Coast Brittle-brush (*Encelia californica*) (Schoenherr 1992).

Lake Perris – Potential Contaminants in the Watershed

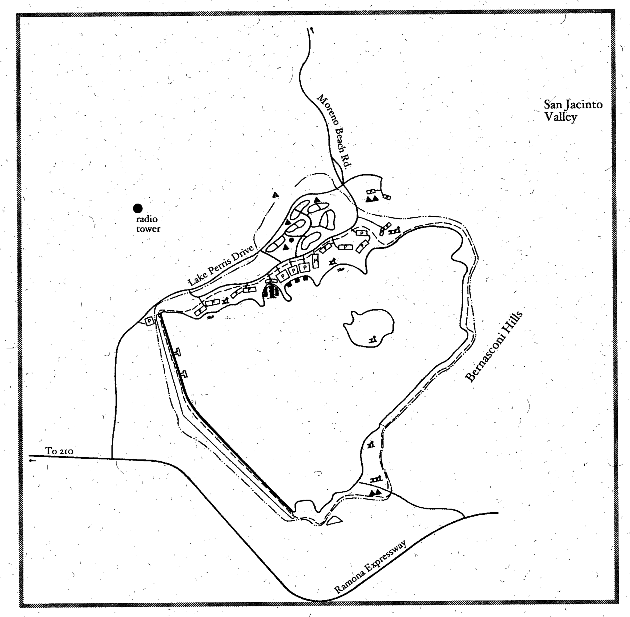
Environmental Database Records Search

The records search for Lake Perris included sites within a 2.5-mile radius from the approximate center of the reservoir. Sites contained within the search range are included in Appendix G.

An underground storage tank leak was located at the Lake Perris Marina. This tank was reported to have leaked gasoline in July 1994 which reached surface water. Volume Services Company reported a loss of 5,000 gallons of gasoline from one of the three 10,000-gallon storage tanks at the marina.

Volume Services Company is taking responsibility for cleanup and remediation at the marina. According to the Santa Ana Regional Water Quality Control Board, the tank was removed in February 1995, with the excavation observed by the Riverside County Health Department. A vapor extraction system and monitoring wells have been installed as part of the remediation effort.

Lake Perris



LEGEND

- campground
- fishing piers
- group campground
- swim beach
- picnic area
- RV dump site
- group picnic area
- P parking
- marina
- I UST leak

Approximate area of watershed: 16 sq. mi. / 10,240 acres

One five-gallon spill of hydraulic generator oil was reported at the reservoir intake tower, but the spill did not reach the water and the small amount of material posed little or no threat to SWP water quality. The Los Logos maintenance area appeared in the database searches as a RCRA hazardous waste generator of oxygenated solvents and pesticide wastes, but the significance of this site as a potential source of contamination has not been assessed. With the exception of individual cans of paint thinner, or similar waste, there were no reports of illegal dumping of either solid or hazardous waste materials in the watershed in either the environmental databases searched or from DPR staff at the lake.

Three active stone quarries were reported in the search area. These quarries, however, are not in the watershed.

Other

Permanent and portable sanitary waste facilities are located at various points around the lake, with the permanent facilities being supplemented with chemical toilets where necessary. Sanitary waste water from the permanent sanitary facilities is removed from the watershed by lift stations and piped to the Eastern Municipal Water District waste WTP. The waste from the portable chemical toilets is removed by truck (daily during the summer) and transported to the sanitary dump station at the campground where it is pumped out of the watershed to the same waste WTP. The main pump station for removing the sanitary waste from the watershed is located near the parking area for the boat launching area, and has experienced no reported problems.

There are 32 permanent restroom buildings in the park located at the campgrounds and at the marina at the north end of the lake. Thirteen are located in day-use areas above the two swimming beaches, and are about 200 feet to 1,000 feet from the lake. These permanent facilities are supplemented by 46 portable chemical toilets. During the summer, 16 chemical toilets are placed directly on the swim beaches approximately 50 feet from the water to encourage their use. No sanitary system problems or failures were reported at either the permanent or the chemical toilets. The single dump station at the campground, which has experienced no reported problems, is approximately 2,000 feet from the water, with the waste removed directly through the sewage system and out of the watershed to the waste WTP. No septic systems are in the watershed.

There have been some minor fires, none of which affected water quality. One was a brush fire on the east side of the park in the summer of 1995 that burned approximately 450 acres, and the other was a controlled burn at the site of the dam. Most fires are small and are associated with the campground areas.

While no equine or other stables are in the watershed, approximately 250 horses were brought into the park during 1995 for recreational trail riding.

As reported in the initial 1990 Sanitary Survey, the swimming beaches, particularly at the north end of the lake, had problems with high total and fecal coliform contamination in 1985 and 1986. The contamination resulted in the closure of beaches for short periods of time. Since that time, a visitor edu-

Summary of Existing and Potential Contamination Sources for Lake Perris

- *Recreational use in watershed*
- *Leaking underground storage tanks*
- *Wastewater treatment system spills/failures*

cation program has been in effect.

The program consists of notices posted at the park entrance regarding sanitary practices, and fliers given to visitors. Informational signs are also posted at the beaches, and lifeguards are alert for children wearing diapers entering the swimming areas, which is not allowed. The beaches have not been closed since the program began.

The Riverside County Health Department collects samples on a monthly basis for total and fecal coliforms. The park also samples the swimming areas from approximately Memorial Day to Labor Day.

Sanitary Survey Update Questionnaire

The questionnaire was sent to various municipal water agencies in the State of California that contract for and treat SWP water. It was intended to provide supplemental information in support of this Sanitary Survey Update. While some of the agencies did not report any problems using SWP water, other agencies did experience difficulties treating water supplied by SWP. A total of 16 questionnaires were returned out of 18 (89 percent). A sample questionnaire is in Appendix D.

The agencies that responded to the questionnaire were Alameda County Flood Control and Water Conservation District, Alameda County Water District, Antelope Valley/East Kern Water Agency, Casitas Municipal Water District, Castaic Lake Water Agency, Yuba City, Crestline-Lake Arrowhead Water Agency, Lime Saddle District, Kern County Water Agency, MWD, Mojave Water Agency, Napa County Flood Control and Water Conservation District, Plumas County Flood Control and Water Conservation District, San Gabriel Valley Municipal Water District, Santa Clara Valley Water District, and Solano County Water Agency.

SWP Water Treatment Concerns and Treatment Success

Agencies that experienced difficulties treating water for municipal and industrial users because of the quality of SWP water are summarized in Table 2-2.

The questionnaire asked the water agencies if they had difficulties treating SWP water, and to identify both the problem and any contributing factors. They were then asked to rate the level of concern they had for each of the problems identified. The questionnaire also asked the agencies to describe how they had addressed these problems in the treatment process, and to rate how successful they were in dealing with them.

Turbidity was a major concern for many of the 16

Table 2-2:
SWP Water Treatment Concerns and Treatment Success

PROBLEM	NUMBER OF RESPONDENTS	CONCERN Low	CONCERN Moderate	CONCERN High	SUCCESS Low	SUCCESS Moderate	SUCCESS High
Water Quality Parameters	2		1	1		2	
Turbidity	9*	2	1	6		2	6
Temperature Variations	3			3	1	1	1
pH	3	1		2		1	2
Alkalinity	2	1		1			2
Taste and Odor	8		6	2		6	2
Algae	7*	1	3	3		4	2
MIB/GEOSMIN	4		1	3	1	1	2
Trihalomethanes	5*		1	4	1	2	1
Total Organic Carbon	5		2	3	1	1	3
Bromide Levels	4		2	2	1	2	1
Metals	3			3	1		2

*Mojave Water Agency stated concern but does not have treatment facilities.

agencies responding. They stated that turbidity was related to storm water runoff into the Aqueduct, increased amounts of precipitation, flow changes within the Aqueduct and pipelines, increased use of water over the weekend, and in some places, high wind. Treatment methods used by various agencies to handle higher than normal turbidity included increased coagulant dosages, adjustments to the amount of disinfectant chemicals used, increased use of alum, reduced filtration rates, and increased levels of staffing for the water treatment operators.

One agency reported that 1995 was the most challenging year ever for turbidity-related problems. Turbidity as high as 200 NTU was seen in its source water. Another agency reported increased sludge buildup in its basins that had to be rinsed every 15 days, instead of every six months under normal conditions.

Water quality parameters such as temperature variations, pH, and alkalinity were concerns for a few agencies. Temperature variations were considered a high concern for several agencies on a daily basis. While the cold water in the morning was not a problem, when the water warmed up in the afternoon, flocculants were more difficult to manage making it harder on the filters. Shortened filter runs due to early breakthrough and increased filter washing were necessary changes in the treatment process. Temperature inversions were handled by trying to optimize the coagulation and sedimentation process with coagulant polymer dosage adjustments.

The pH variations were of both low and high concern depending on the agency. Changes in pH, particularly high alkalinity, create problems with the coagulants in the sedimentation basins resulting in the need to adjust the coagulant dose.

Taste and odor were other concerns expressed by many agencies, and appeared to be closely related to algae blooms and subsequent decay in the Aqueduct and reservoirs. Seasonal factors, such as warm summer months, were reported to have an effect on the taste and odor problem. Other responses related to algae blooms were methylisoborneol/geosmin, pondweed blooms, and high nutrient loading. Fresh water shrimp were also a concern. The agencies addressed these issues by blending SWP water with alternate sources, and by increasing the amount of treatment chemicals used. Mechanical removal was another method used to deal with the algae problem.

Total organic carbon (TOC) and bromide created many treatment challenges for some agencies. These two constituents have been shown to be related to an elevated level of trihalomethanes (THMs). Many responding agencies rated this problem highly. The high THM precursor levels are currently forcing water agencies to consider the use of ozone as a means of meeting any future THM regulations, and some believe they may have to secure other sources of water.

The agencies have reported that the increase in THMs is due to several factors, which include high organic matter content, decaying organic matter, and sea water intrusion in the Delta causing elevated levels of bromide. Agencies that currently use ozone to treat SWP source water responded that bromate production was a problem.

Finally, other responses to the questionnaire indicate that metal constituents in the water have created treatment problems for a few water agencies. Seasonal manganese concentrations have been around 3 to 4 mg/L, and are believed to be related to sediment accumulation in the Aqueduct. Water treatment facilities can treat high metal concentrations by increased use of pre-chlorination and by flushing out the distribution system more frequently. Iron and aluminum have created problems in treating water from the SWP. Iron is a problem for treatment facilities using ozone, since iron precipitates on the ozone diffusers. Aluminum is managed by adjusting the amount of alum used to treat the water. Other infrequent problems are asbestos and heavy metals.

Table 2-3
Disinfectants/Disinfection By-Products Rule, Phase 1

METHODS PROPOSED TO COMPLY WITH RULE	AGENCIES
Changes in coagulants	Alameda County Water District
Use different disinfectants; GAC or membranes	Antelope Valley/East Kern Water Agency
TOC removal before disinfection	Castaic Lake Water Agency San Bernardino Valley Municipal Water District
Use of chloramination as a secondary disinfectant	Castaic Lake Water Agency
Feed Pre-Cl2	Yuba City
Treatment process design and chemical treatment processes	Yuba City Crestline-Lake Arrowhead Water Agency Kern County Water Agency
Utilize ozone as a treatment practice	Crestline-Lake Arrowhead Water Agency Metropolitan Water District of Southern CA

Table 2-4
Contamination Sources, Situations, and Events

SITUATION	CONCERN
Agricultural runoff to source waters	Herbicides, pesticides, selenium, pathogens, TOC
Seawater intrusion	Chlorides and Bromides
Algae and other aquatic Plant blooms	Taste and odor, disinfectant by-products
Wastewater discharges to source waters	Various
Chemical spills	Various
Application of copper sulfate to Aqueduct	Elevated Copper levels
Infrequent sewage spills into Silverwood Lake	Coliform/pathogen contamination
Sediment in the Aqueduct	Heavy Metals in the source water
Asbestos	Natural occurring asbestos runoff into Aqueduct
Possibility of accident on an over crossing of the aqueduct	Major impacts to the SWP delivery system
Animal grazing in the watersheds	Cattle waste washing into the canal and reservoirs
Arroyo Pasajero Storm water	Large amount of sediment entered Aqueduct
Break in Chevron Oil Company pipeline	Crude oil released into Aqueduct
Groundwater Pump-in to SWP	Degradation of SWP water quality
Potential petroleum product pipeline contamination of SWP water supplies	Possibility of contamination of the water source

Proposed Regulation

The questionnaire also asked water agencies if they are anticipating difficulties complying with the proposed Disinfectants/Disinfection By-Products Rule, Phase 1. Of the 12 respondents to this question (66 percent), four of the agencies were currently operating under the Phase 1 specifications and were not anticipating compliance problems. Those eight agencies that were anticipating compliance problems were asked to state what changes they would have to make in order to meet these new requirements. These changes are summarized in Table 2-3.

Agencies were questioned about monitoring of either source and/or finished waters for *Giardia lamblia, Cryptosporidium*, or coliforms. They were asked to discuss their findings and the analytical method used. The number of agencies performing pathogen monitoring was 11 of 18 (61 percent). For coliforms and *E. coli*, a variety of analytical methods are presently being used, and include MMO-MUG, MFC (fecal coliform), C+MUG for fecal and *E. coli*, MPN for raw water, multiple tube method, and

MTF and Colilert methods. For *Giardia lamblia* and *Cryptosporidium*, only the Standard Method and ICR method are used. Pathogen data obtained from various water agencies are discussed in Chapter 4.

Contamination Sources, Situations, and Events

Finally, the questionnaire asked water agencies if they were aware of any sources of contamination, events, or situations that could adversely impact the quality of SWP source water. The responses of the 9 agencies providing information are summarized in Table 2-4.

DWR Groundwater Pump-in Policy

Based on drought emergency conditions, DWR instituted several interim one-year policies (1990, 1991, 1992, and 1994) for accepting groundwater pumped into SWP from water contractors. Acceptance of non-project water was allowed on an emergency basis during drought conditions provided it did not result in significant degradation of SWP water quality, toxicity to fish and wildlife, or adverse changes in the suitability of the water for its beneficial uses, including municipal, industrial, agricultural or recreational purposes. An example of the lastest version of these pump-in policies which were last amended in April 1994 is included in Appendix F, "Historical DWR Policy of Non-Project Groundwater Inflow."

Pump-in Water Quality Criteria

Groundwater in the San Joaquin Valley poses potential water quality concerns. Some groundwater in the San Joaquin Valley has high salt and trace element concentrations due to displacement of groundwater with irrigation water and drainage water (Fio and Leighton 1994). As part of its pump-in policy, DWR established water quality criteria based on DHS Drinking Water Standards to determine whether or not to accept water into the Aqueduct (see Appendix F). Fifteen water quality constituents were monitored, including arsenic, selenium, nitrate, chloride, sulfate, total dissolved solids, and specific conductance.

Pump-in Water Quality Monitoring

Water quality monitoring for the pump-ins to the California Aqueduct was conducted by DWR's O&M and USBR staff (Figure 2-12). Routine monthly and bimonthly sampling was established to monitor both pump-in and Aqueduct water quality. Water quality data from 1990 to 1992 were published by DWR in the report entitled, *Analysis of Water Quality Impacts from Groundwater Pump-in on the State Water Project, 1990-1992*. Table 2-5 presents a summary of water quality results for this time period.

The data indicate that much variation exists between the reaches of pump-in water quality when compared to Aqueduct water quality. Many reaches had pump-in water samples with higher constituent concentrations than water samples from the Aqueduct. However, for most reaches, downstream water quality changes in the Aqueduct were not observed.

Future Groundwater Pump-ins to the Aqueduct

Currently no policy provides for pump-ins on a

	Banks PP to Check 13	Check 13 to Check 21	Check 21 to Check 29	Check 29 to Check 41	Downstream of Check 41
	California Aqueduct	*San Luis Canal*	*California Aqueduct*		
Pump-in Period 1990	—	June – December	—	—	—
Pump-in Period 1991	—	January – December	March – December	February – December	May – December
Pump-in Period 1992	January – February	January – December	January – December*	January – December**	—
Pump-in Period Total (acre-feet)	128	216,214	91,537	16,256	11,966
Arsenic	EQUAL / NONE	MUCH HIGHER / HIGHER	HIGHER / HIGHER	HIGHER / NONE	MUCH HIGHER / NONE
Selenium	MUCH HIGHER / NONE	HIGHER / NONE	EQUAL / NONE	EQUAL / NONE	LOWER / NONE
Nitrate	MUCH HIGHER / NONE	EQUAL / NONE	LOWER / NONE	LOWER / NONE	MUCH HIGHER / NONE
Chloride	MUCH HIGHER / NONE	LOWER / NONE	LOWER / NONE	LOWER / NONE	LOWER / NONE
TDS	MUCH HIGHER / NONE	MUCH HIGHER / MUCH HIGHER	EQUAL / NONE	MUCH HIGHER / NONE	LOWER / NONE
Sulfate	MUCH HIGHER / NONE	MUCH HIGHER / MUCH HIGHER	LOWER / NONE	MUCH HIGHER / NONE	LOWER / NONE
Specific conductance	MUCH HIGHER / NONE	MUCH HIGHER / MUCH HIGHER	EQUAL / NONE	MUCH HIGHER / NONE	LOWER / NONE

* Except March, June, July, August, and October

** Except August

PUMP-INS:
Pump-ins compared to upstream Aqueduct value

LOWER:
More than 75% of pump-in samples had values lower than the maximum Aqueduct level during months of active pump-ins.

EQUAL:
25 - 50% of pump-in samples had values higher than the maximum Aqueduct level during months of active pump-ins.

HIGHER:
50 - 75% of pump-in samples had values higher than the maximum Aqueduct level during months of active pump-ins.

MUCH HIGHER:
More than 75% of pump-in samples had values higher than the maximum Aqueduct level during months of active pump-ins.

AQUEDUCT:
Downstream change in constituent value

LOWER:
Mean annual Aqueduct values were lower downstream of pump-ins.

NONE:
No detectable change in Aqueduct values downstream of pump-ins.

HIGHER:
Monthly or annual mean Aqueduct values were higher downstream of pump-ins.

MUCH HIGHER:
Mean annual Aqueduct values were significantly higher downstream of pump-ins.

drought emergency basis. Future non-drought programs may be allowed and will be governed by a long-term policy that is currently being developed by DWR and SWC.

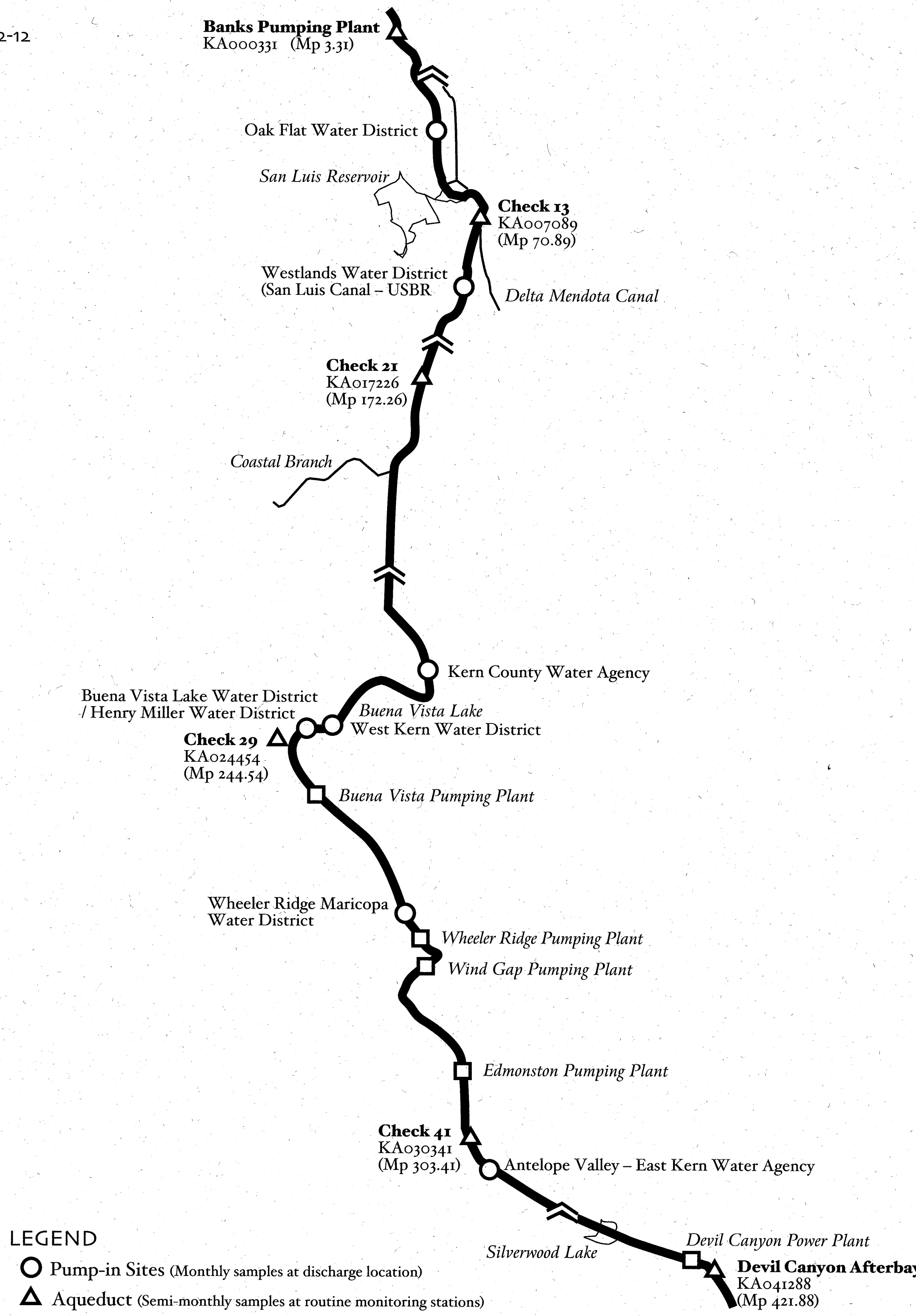
Population Growth

Population growth in the Central Valley of California has continued to increase during the past several years (Department of Finance 1995). Increased population growth is expected to place additional demands on the water supply system. Such growth will also likely impact the quality of existing water supplies through increased input of contaminants to source waters resulting from urban runoff and other non-point sources of contaminants, waste water treatment discharges, and point-sources of contaminants associated with industrial growth.

Pesticide Use by DWR

Various pesticides are used by DWR to control weeds and other pests along the Aqueduct and other associated SWP facilities. The pesticides listed in Appendix E are applied according to label instructions provided by the manufacturer for listed uses.

When pesticides have been found in SWP, they are usually at very low concentrations and widely distributed. In general, these chemicals have also been present in the Sacramento and San Joaquin rivers when they are found in SWP. Pesticide applications by DWR are too small and localized to account for the distribution found in SWP.



State Water Project Emergency Action Plan

Introduction

The main purpose of an Emergency Action Plan (EAP) is to provide comprehensive, easy to follow, and up-to-date information to the persons responding to emergencies. It also serves as a reference for pre-emergency training.

EAPs for each of the five Field Divisions of SWP follow essentially the same format. The standardized format serves two main purposes. First, personnel transferring from one Field Division to another will be able to more readily understand an EAP for their new location if the format is familar. Secondly, a consistent format expedites the response of the Project Operations Center (POC) to an emergency in any particular Field Division because the dispatchers know where to look within that Field Division's EAP. POC provides overall control of water flow within the SWP system. Area Control Centers (ACCs), linked to POC, share operational responsibility, and also utilize EAPs.

EAP format is designed to provide logical pre-emergency training, to provide quicker reference in emergencies, and to make updating easier. It is based upon the format recommended in Analysis of Emergency Plans of Agencies Operating State Water Project Facilities (G. Laverty May 1990), which was included in the initial Sanitary Survey of SWP.

The EAP is divided into five parts: Basic Information, Emergency Response, Appendices, Enclosures, and Over-sized References. Part 1: Basic Information includes background information and guidance as to how the EAP should be implemented. Part 2: Emergency Response contains specific emergency response procedures that are not expected to change over time. Part 3: Appendices contains information that may require updating occasionally. Items such as descriptions of aqueduct check structures, reporting forms, and turnout summaries are contained as appendices. Part 4: Enclosures include information that will be frequently updated (names, phone numbers, etc). Part 5: Over-Sized References contains fold-out maps and facility lists.

The emergency response procedure for a particular emergency consists of a core set of directives that may reference additional emergency response procedures, more specific information contained as an appendix or enclosure or, if necessary, an emergency reference not contained in the EAP. The EAP should be as self-contained as possible in order to shorten response time.

Copies of the EAP are kept at the Project Operations Control Center and all Area Control Centers.

Emergency Action Plan Maintenance Procedure

To be most effective, the EAP must be kept current. The format of these plans is designed to facilitate updating by putting information that requires frequent changes in a specific area. Part 4: Enclosures contains information which will be updated most frequently. The information contained in Part 3: Appendices may require occasional updating. Parts 1 & 2, Basic Information and Emergency Response, should require little updating.

Generally, the Field Division is responsible for updating the EAP. However, the information in certain sections originates from Headquarters and not from the Field Division. The maintenance of these sections is, therefore, the responsibility of the Civil Maintenance Branch of O&M. A list of the section maintenance assignments is located in Appendix C.

Copies of the revised plans are sent to all holders of the EAP with instructions to replace outdated pages with the revised pages. A list of the holders of the EAP for each Field Division is provided in each EAP (see example in Appendix C).

Emergency Action Plan Maintenance Responsibility

The O&M Field Division Emergency Command Coordinator and the Civil Maintenance Branch of O&M are responsible for updating the EAP by July 1 of each year. EAP also receives additional review during the annual Civil Maintenance Inspection.

Emergency Management and Duties

Unusual events in the SWP are classified into three general categories in order to help define the required management activities and personnel response. These categories are:

Incident
Emergency
Disaster

To define the proper response further, the Emergency category is divided into three classes: Class 1, Class 2, and Class 3. These terms are defined below.

SWP Incident: An occurrence affecting the integrity of some portion of the SWP and requiring action beyond the routinely prescribed maintenance and repair procedures, but within the capabilities and authority of normally assigned or assignable SWP personnel. An SWP Incident does not constitute an emergency and will be dealt with by intensified Field Division effort.

SWP Emergency: Any occurrence which involves actual or potential damage to SWP facilities and/or personnel or to the general public welfare which cannot be dealt with in a timely manner without using methods or procedures beyond those available in the normal operation and maintenance organization. SWP Emergency Status exists during an SWP emergency and lasts until the completion of remedial action. SWP Emergency status involves activation of the procedures contained in EAP and invokes special emergency fiscal procedures. The following classifications describe the severity of the emergency and help to further define the procedures to be followed.

Class 1 Emergency: Is within the capabilities of the Field Division O&M organization, and not materially affecting operations in any other Field Division. May require the use of private contractors under Field Division direction and use of exempt fiscal authority up to a maximum commitment of $50,000. Declarable by the Field

Division Chief or the designated alternate.

Class 2 Emergency: Requires use of exempt fiscal authority up to a maximum commitment of $500,000. Declarable by the O&M Division Chief or the designated alternate. Will probably require coordination with the Office of Emergency Services (OES) State Operations Center and the use of private contractors under Field Division direction.

Class 3 Emergency: Requires use of exempt fiscal authority for commitments in excess of $500,000. Declared only on authority of DWR Director. Will require coordination with above-mentioned entities.

SWP Disaster: A condition resulting in major damage to SWP facilities, which is beyond the physical or financial resources of the SWP. A disaster will generally involve a major re-evaluation of the involved and interrelated SWP facilities, and will probably require Legislative authorization of special funding.

Emergency Duties of Field Division Personnel

Each Field Division employee is required to thoroughly know his or her emergency duties. The management of SWP has confidence in the ability of all the Project's personnel to make rapid-action decisions and prefers reasonable error to non-action when time is critical. Listed below are the emergency responsibilities of positions that usually play key roles during emergencies.

Field Division Chief: Responsible for the overall plan for emergency operation and for bringing to the attention of management decisions which require approval of the O&M Headquarters. The Field Division Chief shall determine if a Headquarters' investigation is called for pursuant to Project O&M Instruction OP-24. If so, he/she shall notify the Chief of the Water and Plant Engineering Office as soon as practicable, but no later than 24 hours of the occurrence of the incident. Such notification may be channeled through ACC and POC to expedite contact.

Emergency Command Coordinator: Assigned to a particular individual (usually HEP Operations Superintendent) by the Field Division Chief. The Emergency Command Coordinator is under the direction of the Field Division Chief, is in charge of the Field Division Command Post, and coordinates all activities associated with the SWP Emergency or Disaster. The Emergency Command Coordinator is also responsible for maintenance of EAP.

HEP Operations Superintendent: Responsible for all operations involving plants, aqueducts, and reservoirs. Any work which affects system operation will be coordinated through HEP Operations Superintendent.

Chief HEP Operator: Responsible for the operation of plants, control of the remote operation of check structures, and the operation of the Area Control Center.

Area Control Center Senior Operator: Responsible for notifying the Chief HEP Operator, the Project Operations Center, and HEP Operations Superintendent of conditions affecting the system. This information will be used to determine if the procedure specified in the EAP is to be put into action. If necessary, POC will inform other Field Divisions affected by the emergency. All instructions to Field Division personnel for the operation of Plant units or gate operations will come through ACC Senior Operator.

Civil Maintenance Superintendent: Responsible for assignment of personnel to any affected area requiring aid. This includes moving equipment and supplies needed to take care of the emergency. The work will be coordinated with the HEP Operations and HEP Maintenance Superintendents.

HEP Maintenance Superintendent: Responsible for assigning mechanics, electricians, or technicians to the affected Plant or aqueduct check. If required, the work will be coordinated with HEP Operations Superintendent or the Civil Maintenance Superintendent.

Supervising Power O&M Engineer: Responsible for assigning Field Division Engineering Branch staff for technical support during an emergency. This effort should be coordinated with other Superintendents and the Emergency Command Coordinator as necessary.

Regional Administrative Officer: Responsible for obtaining emergency funds, supplies, and services (such as aerial flights). He or she is also responsible for providing security measures and for requesting staff from other sources.

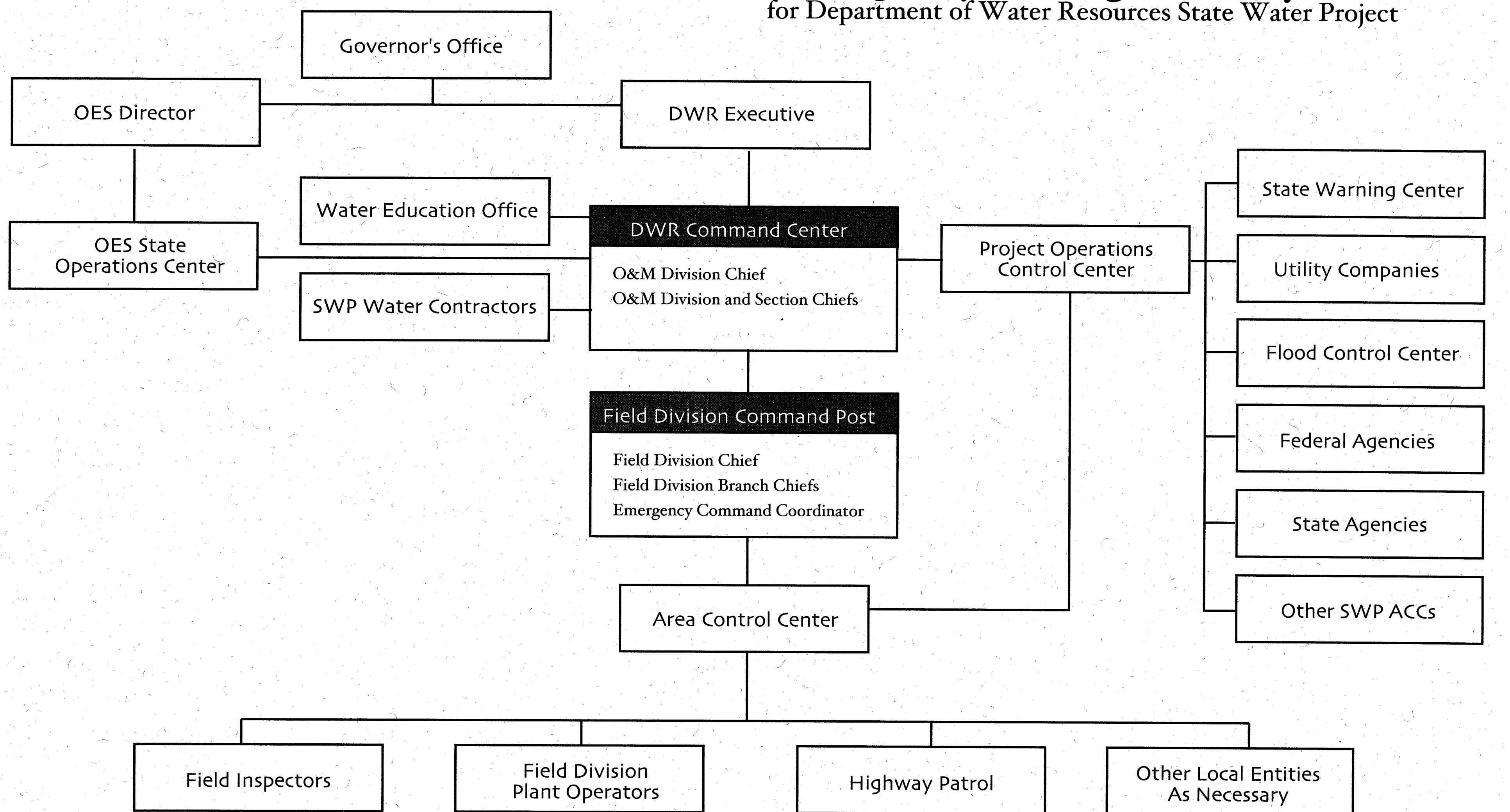
Figure 3-1 illustrates the general emergency management system for SWP. The number of entities shown on the chart that would become involved in the management of an SWP emergency depends upon its severity. For example, a Class 1 emergency would probably not require establishing DWR Command Center or coordinating with OES State Operations Center. During a SWP Disaster, however, all the entities identified in the diagram would be involved. This diagram only describes the general interaction between agencies and departments during an emergency, and should not be used as a notification chart.

Area Control Center and Project Operations Center Notification Responsibilities

ACC is responsible for notifying local agencies and for notifying POC. Local entities to be notified consist of appropriate Field Division personnel; local emergency response staff such as fire departments and police; local property owners and SWP water contractors; and local offices of State agencies such as the Department of Fish and Game, Department of Health Services, and the Highway Patrol; and other local government offices which include County Heath Departments.

POC is responsible for notifying the dispatchers of other power agencies or companies, CVP Dispatch Center and other water project dispatchers, the Office of Emergency Services, the Federal Energy Regulatory Commission, SWP Headquarters, DWR Division of Safety of Dams, and other SWP Area Control Centers as appropriate. Those that must notify POC for specific emergencies are listed on the notification charts in each EAP under the section called "Project Operations Center Notification List," which is a comprehensive listing of POC emer-

Emergency Management System
for Department of Water Resources State Water Project



gency contacts.

In order to expedite notifications, ACC may request and, if requesting, receives assistance from POC in making the necessary calls. The reverse is also true. If requested, ACC assists POC in making the required notifications.

Coordination with the Office of Emergency Services

The Office of Emergency Services

The Office of Emergency Services is part of the Governor's Office and performs executive functions assigned by the Governor. As outlined in the Government Code, OES has broad responsibilities for coordination as well as direction and control during emergency situations.

The authority of OES is established by sections contained in the California Emergency Services Act. An excerpt from this Act states:

"During a state of war emergency, a state of emergency, or a local emergency, the director shall coordinate the emergency activities of all state agencies in connection with such emergency, and every state agency and officer shall cooperate with the director in rendering all possible assistance in carrying out the provisions of this chapter."

OES is the key point of contact for the Governor's Office in any significant emergency situation, not solely in instances resulting in a State of Emergency. A "significant emergency situation" is defined as being one that involves:

- Serious threat to life
- Threat to a large amount of property
- Threat to natural resources
- Threat of disruption to "lifeline" systems, such as transportation or utilities

The OES Director is assisted by representatives from other State agencies. This assistance constitutes the State Emergency Management Staff. The Director of DWR is its representative to the State Emergency Management Staff.

Mutual Aid Regions

The State is divided into six mutual aid regions. OES maintains an office in each region. The Mutual Aid Regional offices are responsible for carrying out OES programs at the local level, and for maintaining working relationships with local emergency management organizations. In addition to emergency managers, staff members from Law Enforcement, Fire and Rescue, Telecommunications, and Hazardous Material Divisions are assigned to the regions.

During an emergency, the Mutual Aid Region offices are responsible for staffing their Emergency Operations Centers, collecting local damage assessment information and working with the affected areas in response and recovery efforts.

DWR/OES Interaction

The California Emergency Services Act requires that each State agency develop an Emergency Response Plan which coordinates that agency's emergency response with the State Emergency Plan. DWR is developing such a plan. In the meantime, DWR is operating under an Interim Emergency Response Plan.

As defined in the State Emergency Plan, DWR's response during a "significant emergency" is to provide support in the areas of construction and engineering, fire, rescue, transportation, public information, and emergency recovery. O&M Headquarters and Field Divisions will provide assistance to OES to the extent that support is not required for SWP operation and recovery.

Should DWR personnel become aware of a significant emergency, they are to report it to POC through ACC. POC must notify OES Warning Center without delay. This is a 24-hour communications point from which notification to the Governor's senior staff will be initiated.

During a "significant emergency" O&M will locate, assess, and report SWP damage to the OES State Operations Center. If appropriate, O&M will also identify damage to Field Division buildings, request an assessment by the Division of Design and Construction, and report the results to OES.

A map illustrating the Mutual Aid Regions and listing the office addresses and telephone numbers is contained in each EAP.

Office of Water Education and News Media Assistance

Crisis Information Contacts

DWR Office of Water Education (OWE) is the designated contact for communications with the news media and the public during emergencies. The management of OWE recognizes that staff will not be able to respond quickly enough to help Field Divisions handle media inquiries during the first hours of an emergency. Given this situation, along with the need to provide consistent and accurate information, and to keep the public and press from hindering emergency operations, staff in each Field Division have been designated as Crisis Information Contacts.

Two people in each Field Division are assigned as Crisis Information Contacts. One person is designated as the primary contact, the other as the secondary contact. These people have been trained to coordinate with OWE, the press, and the public. The Crisis Information Contacts for the Field Divisions are listed in the EAP section entitled, "SWP Crisis Information Contacts."

The Area Control Center and the Project Operations Center are to be kept apprised as to who is designated as the Crisis Information Contact and the means for contacting this individual in order to forward inquiries from the media.

Any inquiries from the public or news media regarding the emergency should be directed to the Crisis Information Contact.

The Crisis Information Contacts will need all data relative to the emergency as it becomes available. They will require the facts of the emergency, what steps have been taken, and what action is planned to mitigate the situation.

The Emergency Command Coordinator, or his/her designate, will keep the Crisis Information Contacts informed.

At the onset of an emergency, the Crisis Information Contact should immediately call the OWE Chief to determine if the situation warrants sending Public Information staff to the Field Division to assist in crisis communication. The OWE Chief will also discuss the need for video taping or photography to document the situation. The Crisis Information

Contact will also be responsible for updating OWE on the status of the emergency as needed. In an emergency, close communication between the Field Division and OWE is vital. What OWE and SWP Headquarters tell the media should be consistent with reports from Field Divisions.

All of OWE's Information Officers maintain a list of names, offices and home phone numbers of all Field Division Crisis Information Contacts. OWE staff may call them first or when necessary to ascertain the emergency conditions. Crisis Information Contacts also maintain a list of names, offices, and home phone numbers of OWE's Chief and Information Officers. OWE's Information Officers and the Crisis Information Contacts are expected to maintain the list in the office and at home. OWE is responsible for updating the list of Crisis Information Contacts on an annual basis.

Water Quality of the State Water Project System

Introduction

This chapter contains an analysis of current water quality regulations as well as a compilation of selected water quality data for SWP. The first section, on water quality regulations, includes descriptions of current water quality regulations and a discussion of significant changes in these regulations over the last five years. The water quality data section includes water quality data for major monitoring locations along SWP over the last five years. Pathogen data from various water districts and SWP locations, storm water monitoring data, and selected turbidity data are also presented in this chapter.

Water Quality Regulations

Microbiological Regulations

The Federal Total Coliform Rule was promulgated on June 29, 1990, and establishes microbiological standards and monitoring requirements which apply to all public water systems. Compliance is based on the presence or absence of total coliform in a sample rather than on an estimate of coliform density. For systems analyzing at least 40 samples per month, no more than 5 percent of the monthly samples may be total coliform positive to comply with the MCL. For systems analyzing less than 40 samples per month, no more than one sample per month may be total coliform positive to comply with the MCL.

The State Total Coliform Regulations are found under Title 22, Chapter 15, of the California Code of Regulations. DHS has set regulations almost identical to those of the Federal Total Coliform Rule. Under these regulations, each water supplier must provide a siting plan for total coliform analysis and then proceed to take routine bacteriological water samples. The monitoring, compliance, and sanitary survey requirements of the State regulations are also essentially identical to the federal regulations. *Giardia lamblia* and *Cryptosporidium* share many of the same characteristics that enhance the potential for disease transmission through water. Both pathogens are transmitted by the fecal-oral route in which the carrier excretes *Cryptosporidium* oocysts or *Giardia lamblia* cysts that may end up in a water supply system and be ingested by the consumer. Both pathogens can also be resistant to disinfectants introduced into the water in order to eliminate pathogens.

Currently, *Giardia lamblia* is the most frequently identified agent of waterborne disease in the United States (DWR 1995*c*). By comparison, *Cryptosporidium* is less common but has been responsible for some of the largest outbreaks in the United States.

Surface Water Treatment Rule

The federal Surface Water Treatment Rule (54 CFR 124) became effective on December 31, 1990, and requires all public water systems using surface water supplies, or groundwater supplies under the influence of surface water, to filter and disinfect for protection against *Giardia lamblia*, *Legionella viruses*, and heterotrophic bacteria. Systems that must filter, which include all systems that fail to continuously meet the disinfectant contact time criteria, may employ a variety of treatment techniques to assume removal of 99.9 (3 log removal) percent of *Giardia lamblia* cysts, and 99.99 (4 log removal) percent of viruses.

On July 29, 1995, USEPA proposed an Enhanced Surface Water Treatment Rule as an amendment to the federal Surface Water Treatment Rule. The ESWTR will provide additional protection against *Giardia lamblia, Cryptosporidium parvum,* and viruses in drinking water. The ESWTR outlines alternative treatment requirements based on source water concentrations of these pathogens.

Updated State regulations came into effect on June 5, 1991, and are found in Title 22, Chapter 17, of the California Code of Regulations. The regulations are the result of a series of amendments to the National Primary Drinking Water Regulations and require multi-barrier treatment for microbiological contaminants. Unlike the federal rule, however, nearly all public water systems in California must filter all their surface water (San Francisco has an exemption from filtration requirements), and the part of their groundwater that could be affected by surface water contaminations. A public water system is defined as a system with fifteen or more service connections or that regularly serves at least 25 year-long residents. The city of San Francisco has obtained a variance from the filtration requirement.

Table 4-1 presents USEPA and DHS drinking water standards (DWR 1995a). Pre-1990 federal and State standards have also been included to show any change in Maximum Contaminant Levels (MCLs) or Maximum Contaminant Level Goals (MCLGs) over the past five years.

MCLs are defined as the maximum permissible levels of contaminants in water which enter the distribution system of a public water system. The federal and State MCLs are enforceable and must be met by appropriate public drinking water systems. Secondary MCLs are designed to protect aesthetic aspects of water. While federal secondary MCLs are not enforceable, State MCLs are enforceable. The federal MCLG is defined as the maximum level of a contaminant in drinking water at which no known or anticipated adverse effect on the health of persons would occur, and which allows an adequate margin of safety. MCLGs are non-enforceable health goals and are strictly health based. The derivation of MCLGs does not include a technologic or economic evaluation.

Disinfectants/Disinfection By-Products Rule

The 1986 amendments to the federal Safe Drinking Water Act require that USEPA propose a rule for disinfectant and disinfection by-products which must balance the need for protection from cancer-causing by-products produced during the disinfection process, with the need for protection from waterborne disease. In 1992, the USEPA negotiated a rule-making process that resulted in a two-stage approach for regulation development. Stage 1 of the regulation is the draft Disinfectants/Disinfection By-Products Rule (D/DBPR) proposed by USEPA. The requirements apply to community water systems and

Contaminants	EPA NPDWR	Primary EPA MCL	Secondary EPA MCL	EPA MCLG	Primary DHS-DWS	Secondary DHS-DWS	Action Levels
INORGANICS							
Aluminum			0.05-0.2		1	0.2	
Antimony	0.005	0.006		0.006	0.006		
Arsenic	0.05	0.05			0.05		
Asbestos	7 MFL [a]	7 MFL [a]		7 MFL [a]	7 MFL [a]		
Barium	5	2		2	1		
Beryllium	0.001	0.004		0.004	0.004		
Boron							1
Cadmium	0.005	0.005		0.005	0.005		
Chloride			250	0.1	0.05	250-500-600 [l]	
Chromium	0.1						
Color			15 CU [b]			15 CU [b]	
Copper	1.3	TT (1.3) [c]	1	1.3		1	
Corrosivity			non-corrosive			non-corrosive	
Cyanide	0.2	0.2		0.2	0.2		
Fluoride	4	4		4	1.4-2.4 [k]		
Foaming Agents			0.5			0.5	
Iron			0.3			0.3	
Lead	0.005	TT (0.015) [d]			removed [o]		
Manganese			0.05			0.05	
Mercury	0.002	0.002		0.002	0.002		
Nickel	0.1	0.1		0.1	0.1		
Nitrate (as N)	10	10		10	45 (as NO_3)		
Nitrite (as N)	1	1		1	1		
Odor			3 OTN [e]			3 OTN [e]	
pH			6.5-8.5			6.5-8.5	
Selenium	0.05	0.05		0.05	0.05		
Silver			0.1		removed [p]	0.1	
Specific Conductance						900-1600-2200 [l]	
Sulfate	400/500		250			250-500-600 [l]	
Thallium	0.002/0.001	0.002		0.0005			
Total Dissolved Solids (TDS)			500			500-1000-1500 [l]	
Turbidity		0.5-1 [f] NTU					
Zinc			5			5	
ORGANICS							
Acrylamide	Treatment technique	Treatment tecnique [g]		0			
Adipates (Di (2-ethylhexyl)adipate)	0.5	0.4		0.4			
Alachlor (Alanex)	0.002	0.002		0	0.002		
Aldicarb (Temik)	0.01	0.003 (EDP)		0.001			0.01
Aldicarb sulfone	0.04	0.002 (EDP)		0.001			
Aldicarb sulfoxide	0.01	0.004 (EDP)		0.001			
Aldrin							0.00005

USEPA and DHS Drinking Water Standards

Contaminants	EPA NPDWR	Primary EPA MCL	Secondary EPA MCL	EPA MCLG	Primary DHS-DWS	Secondary DHS-DWS	Action Levels
Atrazine (AAtrex)	0.003	0.003		0.003	0.003		
Baygon							0.09
Bentazon (Basagran)					0.018		
Benzene	0.005	0.005		0	0.001		
a-Benzene Hexachloride (a-BHC)						0.0007	
b-Benzene Hexachloride (b-BHC)						0.0003	
Benzo(a)pyrene		0.0002		0	0.0002		
Captan							0.35
Carbaryl							0.06
Carbofuran (Furadan)	0.04	0.04		0.04	0.018		
Carbon tetrachloride	0.005	0.005		0	0.0005		
Chlordane	0.002	0.002		0	0.0001		
Chlorobenzene (Monochlorobenzene)	0.01	0.1		0.1	0.07		
Chlorodibromoethane (THM species)		0.1					
Chloroform (Trichloromethane) (THM species)	0.1						
Chloropicrin							0.05 (0.037) [m]
Chlorotoulene							0.045
Dalapon	0.2	0.2		0.2	0.2		
Diazinon							0.014
1,2-Dibromo-3-chloropropane (DBCP)	0.0002	0.0002		0	0.0002		
1,3-Dichchlorobenzene (m-Dichlorobenzene)							0.13 (0.02) [m, n]
1,2-dichlorobenzene (o-Dichlorobenzene)	0.6	0.6		0.6	0.6		0.13 (0.02) [m, n]
1,4-Dichlorobenzene (p-Dichlorobenzene)	0.075	0.075		0.075	0.005		
Dichlorodifluormethane (Freon 12)							1
1,1 Dichloroethane					0.005		
1,2 Dichloroethane	0.005	0.005		0	0.0005		
1,1 Dichloroethylene	0.007	0.007		0.007	0.006		
cis-1,2 Dichloroethylene	0.07	0.07		0.07	0.006		
trans-1,2-Dichloroethylene	0.1	0.1		0.1	0.01		
2,4 Dichlorophenoxyacetic acid (2,4-D)	0.07	0.07		0.07	0.07		
1,2 Dichloropropane	0.005	0.005		0	0.005		
1,3 Dichloropropene					0.0005		
Dieldrin							0.00005 [i]
Di-(ethylhexyl) adipate		0.4			0.4		
Di(2-ethylhexyl)phthalate (Phthalates)		0.006		0	0.004		
Dimethoate (Cygon)							0.14
2,4-Dimethylphenol							0.4

Contaminants	EPA NPDWR	Primary EPA MCL	Secondary EPA MCL	EPA MCLG	Primary DHS-DWS	Secondary DHS-DWS	Action Levels
Dinoseb	0.007	0.007		0.007	0.007		
Dioxin (2,3,7,8-TCDD)		$3x10^{-8}$		0	$3x10^{-8}$		
Diphenamide							0.04[m]
Diquat	0.02	0.02		0.02	0.02		
Endothall	0.1	0.1		0.1	0.1		
Endrin	0.002	0.002		0.002	0.002		
Epichlorohydrin	Treatment technique	Treatment tecnique[g]		0			
Ethion							0.035
Ethylbenzene	0.7	0.7		0.7	0.7		
Ethylene Dibromide (EDB) (Dibromoethane)	0.00005	0.00005		0	0.00005		
Formaldehyde							1.00
Glyphosate	0.7	0.7		0.7	0.7		
Heptachlor	0.0004	0.0004		0	0.00001		
Heptachlor Epoxide	0.0002	0.0002		0	0.00001		
Hexachlorobenzene	0.001	0.001		0	0.001		
Hexachlorocyclopentadiene	0.05	0.05		0.05	0.05		
Lindane	0.0002	0.0002		0.0002	0.0002		
Malathion							0.160
Methoxychlor	0.4	0.4		0.04	0.04		
Methyl Isobutyl Ketone							0.04
Methyl t-butyl ether							0.035
Methylene Chloride (Dichloromethane)	0.005	0.005		0			0.040
Methyl Parathion							0.030
Molinate					0.02		
Oxamyl (Vydate)		0.2		0.2	0.2		
Parathion							0.030
Pentachloronitrobenzene (Terrachlor)							0.0009
Pentachlorophenal	0.2	0.001		0	0.001		
Phenol							0.0050[m]
Picloram	0.5	0.5		0.5	0.5		
Polychlorinated biphenyls (PCBs)	0.0005	0.0005		0	0.0005		
Simazine	0.001	0.004		0.004	0.004		
Styrene	0.1	0.1		0.1	0.1		
Strychnine							0.01
2,3,7,8- TCDD (Dioxin)		$3x10^{-8}$		0	$3x10^{-8}$		
1,1,2,2-Tetrachloroethane					0.001		
Tetrachloroethylene	0.005	0.005		0	0.005		
Thiobencarb					0.07	0.001	
Toluene	2	1		1	0.15		
Total Trihalomethanes (TTHM)		0.1			0.1		
Toxaphene		0.003		0	0.003		

USEPA and DHS Drinking Water Standards

Contaminants	EPA NPDWR	Primary EPA MCL	Secondary EPA MCL	EPA MCLG	Primary DHS-DWS	Secondary DHS-DWS	Action Levels
Tribromomethane (Bromoform) (THM species)		0.1					
1,2,4-Trichlorobenzene	0.009	0.07		0.07	0.07		
1,1,1-Trichloroethane	0.2	0.2		0.2	0.2		
1,1,2-Trochloroethane	0.003	0.005		0.003	0.005		
Trichloroethylene	0.005	0.005		0	0.005		
Trichlorofluoromethane (Freon 11)					0.15		
Trichloromethane (Chloroform) (THM species)		0.1					
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)					1.2		
2,4,5-Triclorophenoxy proprionic acid (Silvex)		0.05		0.05	0.05		
Trithion							0.007
Vinyl Chloride	0.002	0.002		0	0.0005		
Xylenes (all isomers)	10	10		10	1.75		
MICROBIAL CONTAMINANTS							
Giardia Lamblia	SWTR [d]	Treatment tecnique [g]		0			
Heterotrophic plate count	SWTR [d]	Treatment tecnique [h]					
Legionella	SWTR [d]	Treatment tecnique [h]		0			
Total Coliforms	P/A concept [d]	P/A [l]		0			
Viruses	SWTR	Treatment tecnique [h]		0			
RADIONUCLIDES							
Radionuclides							
Adjusted gross alpha (excluding uranium and radon)		15 pCi/L			15 pCi/L		
Gross beta particle activity		4 mrem/yr			50 pCi/L		
Radium 226 (+228)		5 pCi/L		0	5 pCi/L		
Radium 228 (+226)		5 pCi/L		0	5 pCi/L		
Radon		300 pCi/L		0			
Strontium-90		8 pCi/L			8 pCi/L		
Tritium		20000 pCi/L			20000 pCi/L		
Uranium				0	20 pCi/L		

a MFL = million figers per liter, with fiber length > 10 microns
b CU = color units
c Treatment Technique (TT) triggered at Action Level of 1300 ppb
d Treatment Technique (TT) and public notification triggered at Action Level of 15 ppb
e Odor Threshold Numbers
f 0.5 NTU (Nephelometric Turbidity Unit) conventional treatment or direct filtration; 1 NTU, slow sand or diatomaceous earth filtration
g Treatment Technique in lieu of numeric MCL
h Surface waters and ground water under the direct influence of surface water only
i MCL is based on the presence/absence of total coliforms
k Depends on annual average of maximum daily air temperatures
l Limit of Quantification
m Taste and Odor Threshold (in parenthesis)
n For single or sum of isomers
o Lead is regulated under the federal Lead and Copper Rule
p Silver is now regulated as a secondary contaminant

EPA = Environmental Protecton Agency
DHS = Department of Health Services
MCL = Maximum Contaminant Level
MCLG = Maximum Contaminant Level Goal
AL = Action Level
EDP = Effective Date Postponed

nontransient noncommunity water systems that treat their water with a chemical disinfectant for either primary or residual treatment. The proposed date for promulgation of the Stage 1 regulations is December 1996; the regulations would go into effect 18 months after this date.

Stage 2 of the regulation involves an USEPA requirement for collection of data on parameters that influence DBP formation and occurrence of DBPs in drinking water through the Information Collection Rule process. Based on the information and new data collected, USEPA will reevaluate the Stage 1 regulations and make any necessary changes. The Stage 2 promulgation date for all community water systems and nontransient, noncommunity water systems is set for December 1998. The Stage 2 compliance date is set for 2004.

Metals Regulations

The federal Lead and Copper Rule sets provisions for monitoring first flush water samples from consumers' taps, and it establishes standards for lead and copper. If more than 10 percent of the first flush samples of consumers' tap water contain greater than the action level of 0.015 mg/L for lead, or 1.3 mg/L for copper, then three required actions must be taken which include corrosion control treatment, source water treatment, and public education.

In addition, the Lead and Copper Rule eliminates the current Maximum Contaminant Levels for lead and copper. The lead MCL of 0.05 mg/L and the copper secondary MCL of 1.0 mg/L were eliminated. The MCLG established for lead is 0 mg/L and the MCLG established for copper is 1.3 mg/L.

Organics Regulations

Phase I Rule

The final Phase I Rule, published in the Federal Register on July 8, 1987, established MCLs, MCLGs, and Best Available Technologies (BATs) for eight Volatile Organic Chemicals (VOCs). The rule also sets monitoring, reporting, and public notification requirements for these compounds.

Phase II & IIB Rules

The final Phase II Rule was promulgated in the Federal Register on January 30, 1991, to regulate 16 Synthetic Organic Chemicals (SOCs), 10 Volatile Organic Compounds (VOCs), and 7 Inorganic Compounds (IOCs). The rule also contains MCLs, MCLGs, and treatment techniques for the various chemicals, as well as monitoring, reporting, and public notification requirements for these compounds. The Phase IIB Rule includes five re-proposed chemicals of the original 38 chemicals in the Phase II Rule in which health-based changes for these chemicals were indicated. The Phase IIB Rule became effective on January 1, 1993.

Phase V Rule

The Phase V Rule, promulgated on July 17, 1992, regulates 13 SOCs, 5 IOCs, and 3 VOCs. Sulfate is not included in the final rule due to its potentially high treatment cost and low health risk. However, a proposed Sulfate Rule is expected by May 1998. The Phase V Rule establishes MCLs, MCLGs, laboratory criteria, and BATs for the 23 contaminants applicable to all community and nontransient noncommunity systems.

Radiological Regulations

As a result of the amendments to the 1986 Safe Drinking Water Act, USEPA has proposed a rule for radionuclides which establishes MCLs and National Primary Drinking Water Regulations for radium-226, radium-228, alpha emitters, and beta particle and photon emitters. Although the proposed final rule deadline was April 1995, USEPA has requested an eight-month extension. The draft of the 1991 radionuclides rule applies to all community and nontransient noncommunity public water systems.

Pathogen and Coliform Data

Total coliform bacteria measurements are intended to indicate the general level of urban and animal contamination of a water supply. Coliform bacteria are generally not harmful to humans; however, they could be indicators that other pathogenic organisms may be present.

Data Sources

Pathogen data were requested from member water agencies by the SWC. Ten water agencies submitted pathogen data (see Table 4-2 and Figure 4-1). For the purposes of this report, only raw water pathogen data were compiled. Where isolation of SWP water was possible, this was done, realizing that many agencies blend water of different sources. Pathogen data from other sources or blends were identified as such. Respondents were also asked to estimate what percentage of their source water came from SWP.

Delta Area

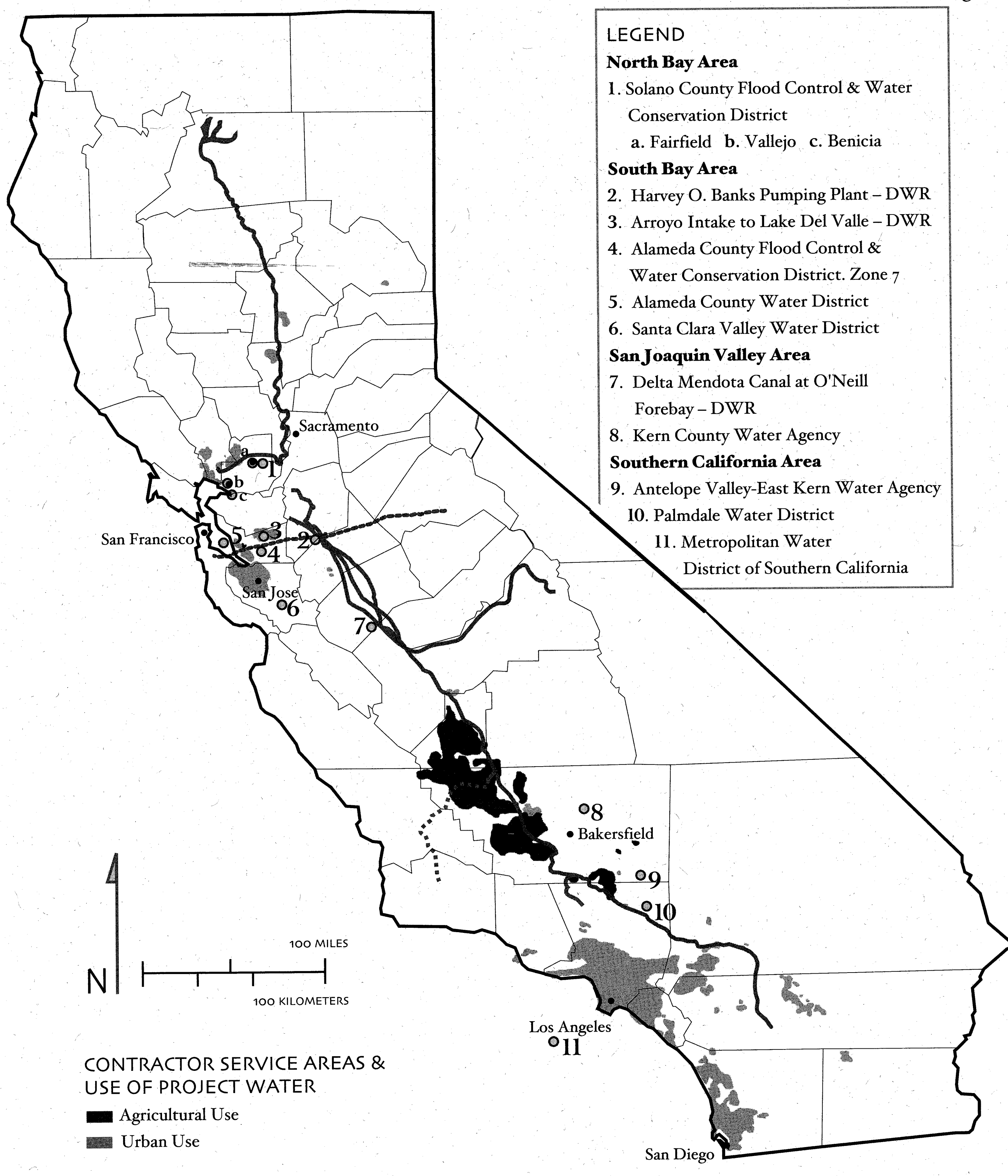
DWR's O&M sampled for *Giardia lamblia* and *Cryptosporidium* at Greenes Landing on the Sacramento River in 1992-93 and MWD performed the laboratory analyses.

North Bay Area

The city of Fairfield receives water from Lake Berryessa via the Putah South Canal and from the NBA (see Figure 4-2). Note that the Putah South Canal is not part of SWP. Water quality data are presented here for comparison purposes only. Water is diverted from the NBA to the cities of Fairfield, Suisun City, and Vacaville before it reaches Cordelia Pumping Plant. Approximately 45 percent of the city of Fairfield's water comes from the Putah South Canal and about 55 percent of their water comes from the NBA. The city of Fairfield monitored both sites for total coliform.

The city of Vallejo receives water from Cordelia Forebay (NBA water) and from Putah South Canal at the terminal reservoir, with approximately 35 percent of its water from the NBA and approximately 65 percent of its water from the Putah South Canal. The city of Vallejo submitted total and fecal coliform data for NBA water.

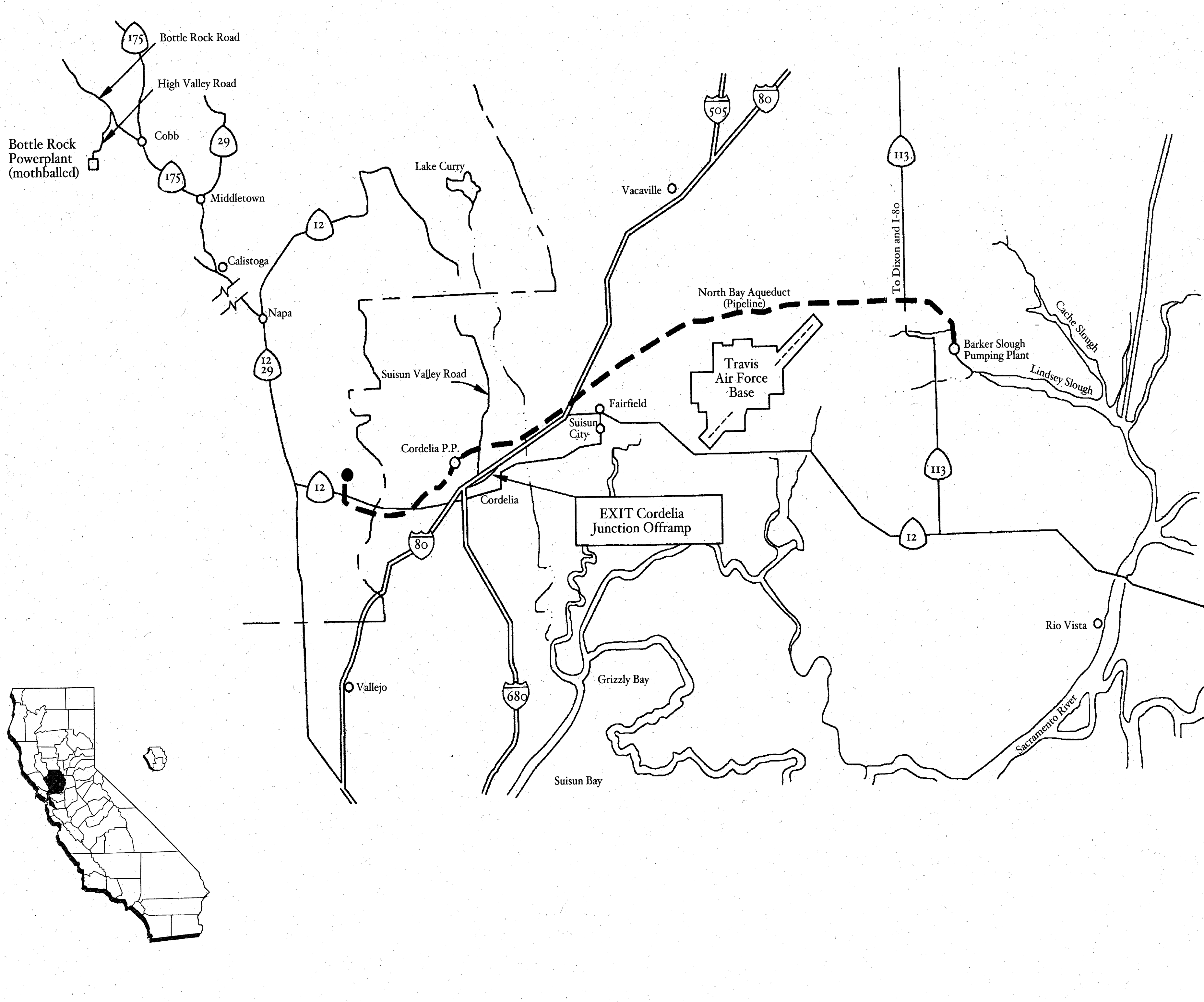
The city of Benicia receives water from the NBA at Cordelia Forebay and from Lake Herman. Lake Herman is a small reservoir that is used to store NBA water, and is a blend of NBA and local runoff from a small (< 10 square miles) watershed. The city of Benicia submitted total and fecal coliform data for NBA water, Cordelia Forebay water, and Lake Herman water.



LEGEND
North Bay Area
1. Solano County Flood Control & Water Conservation District
a. Fairfield b. Vallejo c. Benicia
South Bay Area
2. Harvey O. Banks Pumping Plant – DWR
3. Arroyo Intake to Lake Del Valle – DWR
4. Alameda County Flood Control & Water Conservation District. Zone 7
5. Alameda County Water District
6. Santa Clara Valley Water District
San Joaquin Valley Area
7. Delta Mendota Canal at O'Neill Forebay – DWR
8. Kern County Water Agency
Southern California Area
9. Antelope Valley-East Kern Water Agency
10. Palmdale Water District
11. Metropolitan Water District of Southern California
Sacramento
San Francisco
San Jose
Bakersfield
Los Angeles
San Diego
N
100 MILES
100 KILOMETERS
CONTRACTOR SERVICE AREAS & USE OF PROJECT WATER
Agricultural Use
Urban Use

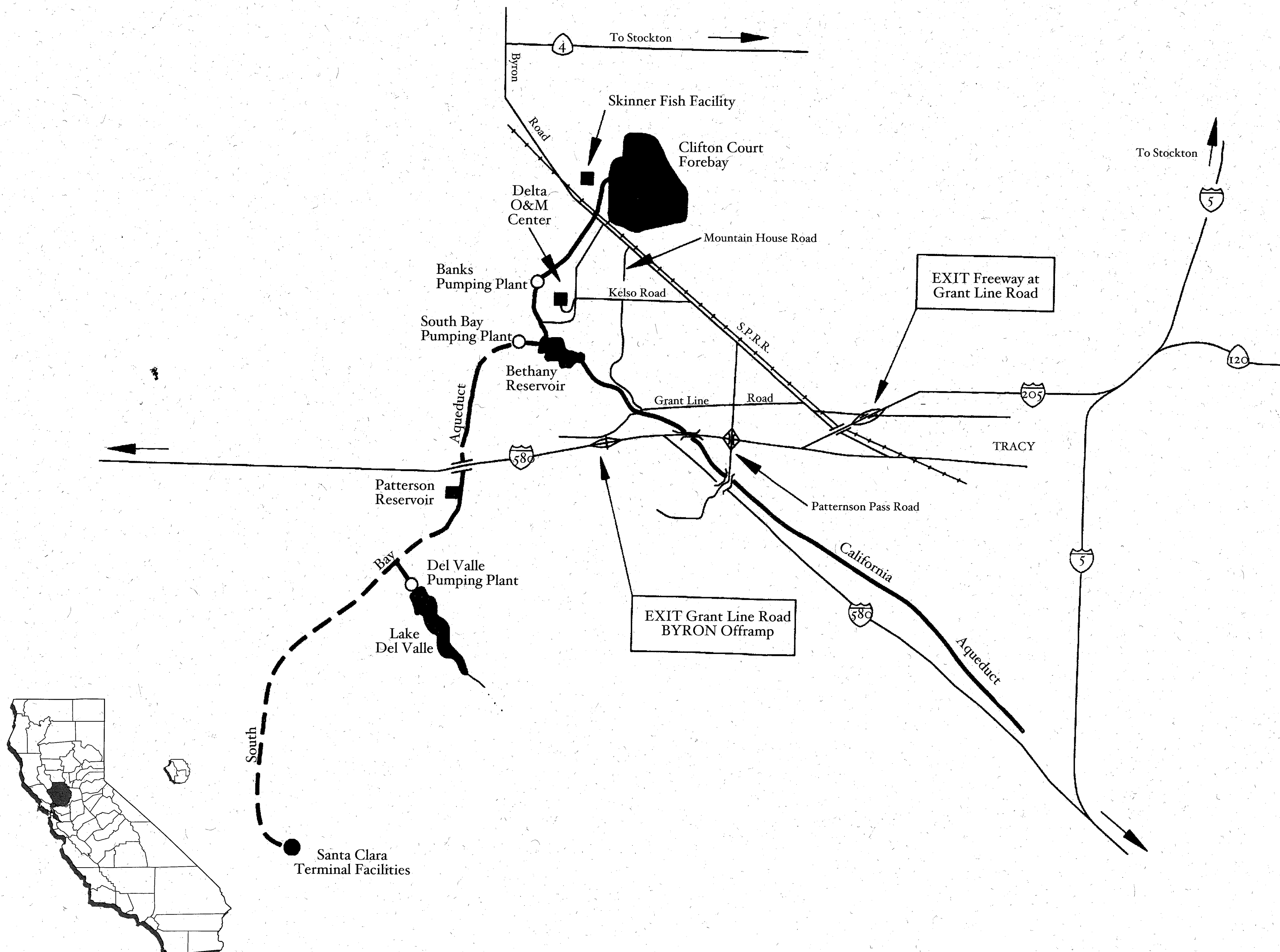
Table 4-2
Sources of Coliform and Pathogen Data

DATA SOURCE	SAMPLING SITE	TOTAL/ FECAL COLIFORM	GIARDIA/ CYPTO.
Delta Area			
DWR O & M / Metropolitan Water District of Southern California	Sacramento River at Greenes Landing	None	Both
DWR O & M	Harvey O. Banks Pumping Plant	None	Both
DWR O & M / Metropolitan Water District of Southern California	Harvey O. Banks Pumping Plant	None	Both
North Bay Area			
City of Fairfield	North Bay Aqueduct, Putah South Canal	Total only	None
City of Vallejo	Cordelia Forebay	Both	None
City of Benicia	North Bay Aqueduct, Lake Herman, Cordelia Forebay	Both	None
South Bay Area			
DWR O & M	Arroyo Intake to Del Valle	None	Both
Alameda County Flood Control and Water Conservation District, Zone 7	Del Valle WTP, Patterson Pass WTP	Total only	Both
Alameda County Water District	South Bay Aqueduct Del Valle Reservoir	Both	Both
Santa Clara Valley Water District	Penitencia WTP, Rinconada WTP, Santa Teresa WTP	Both	Both
San Luis Area			
DWR O & M	Delta-Mendota Canal at O'Neill Forebay	None	Both
DWR O & M / Metropolitan Water District of Southern California	Delta-Mendota Canal at O'Neill Forebay	None	Both
San Joaquin Valley Area			
DWR O & M / Metropolitan Water District of Southern California	Ca. Aqueduct, Check 29	None	Both
Kern County Water Agency	State Water Project, Kern Water Bank / Kern River	Total	None
Southern California Area			
Antelope Valley / East Kern Water Agency	Quartz Hill WTP, Eastside WTP	Both	None
Palmdale Water District	Palmdale WTP	Both	None
Metropolitan Water District of Southern California	Diemer WTP, Jensen WTP, Mills WTP Skinner WTP, Weymouth WTP, Lake Perris (Outlet Tower), Lake Perris Beach, Live Oak Reservoir, Foothill Pressure Control Structure, Silverwood Lake Outlet, Silverwood Lake Beach	Both	None



Bottle Rock Road
High Valley Road
Cobb
Bottle Rock Powerplant (mothballed)
Middletown
Calistoga
Napa
Lake Curry
Vacaville
To Dixon and I-80
North Bay Aqueduct (Pipeline)
Cache Slough
Barker Slough Pumping Plant
Lindsey Slough
Travis Air Force Base
Suisun Valley Road
Fairfield
Suisun City
Cordelia P.P.
Cordelia
EXIT Cordelia Junction Offramp
Rio Vista
Vallejo
Grizzly Bay
Sacramento River
Suisun Bay
175
29
12
505
80
113
12 29
680

 Figure 4-3 Map of South Bay Area



South Bay Area

DWR's O&M sampled for *Giardia lamblia* and *Cryptosporidium* at Banks Pumping Plant and at the Arroyo Intake to Del Valle Reservoir from May 1995 to September 1995 (see Figure 4-3). This period of sampling did not include periods of major runoff, such as at the peak runoff periods following the first flush from a watershed.

DWR's O&M sampled twelve times for *Giardia lamblia* and *Cryptosporidium* at Banks Pumping Plant from May 1992 to April 1993, and MWD performed the laboratory analyses.

The Alameda County Flood Control and Water Conservation District, Zone 7 (ACFCWCD, Zone 7) receives water from both the Del Valle WTP and the Patterson Pass WTP. The ACFCWCD, Zone 7 submitted total coliform, *Giardia lamblia*, and *Cryptosporidium* data for the Patterson WTP intake.

The Alameda County Water District (ACWD) receives water from the South Bay Aqueduct including water from Del Valle Reservoir (see Figure 4-3). ACWD submitted total coliform data for their treatment Plant, as well as *Giardia lamblia* and *Cryptosporidium* data for the South Bay Aqueduct bayside takeoff and other sites. For the pathogen data, ACWD estimated the percent of Delta water and the percent of Del Valle Reservoir water that made up the water that was sampled. Some of the sites they sampled along with DWR included sites downstream of farm bridges.

Santa Clara Valley Water District (SCVWD) receives water from the San Luis Reservoir, and SWP water from the South Bay Aqueduct and Del Valle Reservoir. Anderson, Almaden, and Coyote reservoirs were used primarily for groundwater recharge and provide some incidental flood protection. The district uses water from Anderson, Coyote, Calero, and Almaden reservoirs. However, various sources were used during the 1992-1993 drought.

Three treatment plants are used by SCVWD to produce drinking water. These are the Penitencia, Riconada, and Santa Teresa WTPs. Pentitencia receives largely South Bay Aqueduct water, and Riconada and Santa Teresa receive a blend of South Bay Aqueduct water and San Luis Reservoir non-SWP water.

SCVWD submitted total and fecal coliform data as well as *Giardia lamblia* and *Cryptosporidium* data for intakes to the three treatment plants. For the *Giardia lamblia* and *Cryptosporidium* data, SCVWD estimated the percent of source water from the San Luis Reservoir as opposed to water from SWP sources. Therefore, the *Giardia lamblia* and *Cryptosporidium* data for water which was one hundred percent San Luis Reservoir water were isolated from data for intakes to the three treatment plants that had blended water.

San Joaquin Valley Area

DWR's O&M staff sampled for *Giardia lamblia* and *Cryptosporidium* at the Delta-Mendota Canal and at Check 29 of the California Aqueduct from June 1992 to May 1993. MWD performed the laboratory analyses.

DWR's O&M also sampled for *Giardia lamblia* and *Cryptosporidium* at the Delta-Mendota Canal at McCabe Road from May 1995 to September 1995.

Kern County Water Agency receives water from the State Water Project, the Kern River, Kern Water Bank, and Friant Kern Canal. Kern County Water Agency submitted total coliform data for one hundred percent SWP water, a blend of SWP and Kern Water Bank water, and a blend of Kern River and SWP water.

Southern California Area

The Antelope Valley/East Kern Water Agency receives water from the east branch of the California Aqueduct (Figure 4-4). The Antelope Valley/East Kern Water Agency submitted total and fecal coliform data for intakes to two treatment plants, Quartz Hill WTP and Eastside WTP. Quartz Hill and Eastside WTPs receive 100 percent of their water from the east branch of the California Aqueduct. Data were not submitted for Rosamond WTP. Rosamond WTP receives water from a reservoir that stores California Aqueduct water transported to the reservoir via a long pipeline.

Of the fecal coliform data for Quartz Hill and Eastside WTPs, Colilert coliform data were not included. Antelope Valley/East Kern Water Agency identified the Colilert data as being likely to be erroneous (Comparison of Methods for Total and Fecal Coliforms in Untreated Surface Water 1992). Therefore, only fecal coliform data obtained via the multiple tube fermentation method were included in this report.

Palmdale Water District receives about 70 percent of its water from the east branch of the California Aqueduct, and 30 percent of its water from its local Littlerock Reservoir. Water from both the California Aqueduct and Littlerock Reservoir is blended and stored in Palmdale Lake. Palmdale Water District submitted total and fecal coliform data for the intake to the Palmdale WTP.

MWD receives water from the Colorado River, and from the SWP through Weymouth, Diemer, Jensen, Skinner and Mills WTPs. Water from these sources are blended in various combinations and supplied to member agencies. MWD submitted *Giardia lamblia* and *Cryptosporidium* data for the Diemer, Jensen, Mills, Skinner, and Weymouth WTPs; Lake Perris Outlet Tower; Lake Perris Beach; Live Oak Reservoir; Foothill Pressure Control Structure; Silverwood Lake Outlet Tower; and Silverwood Lake Beach.

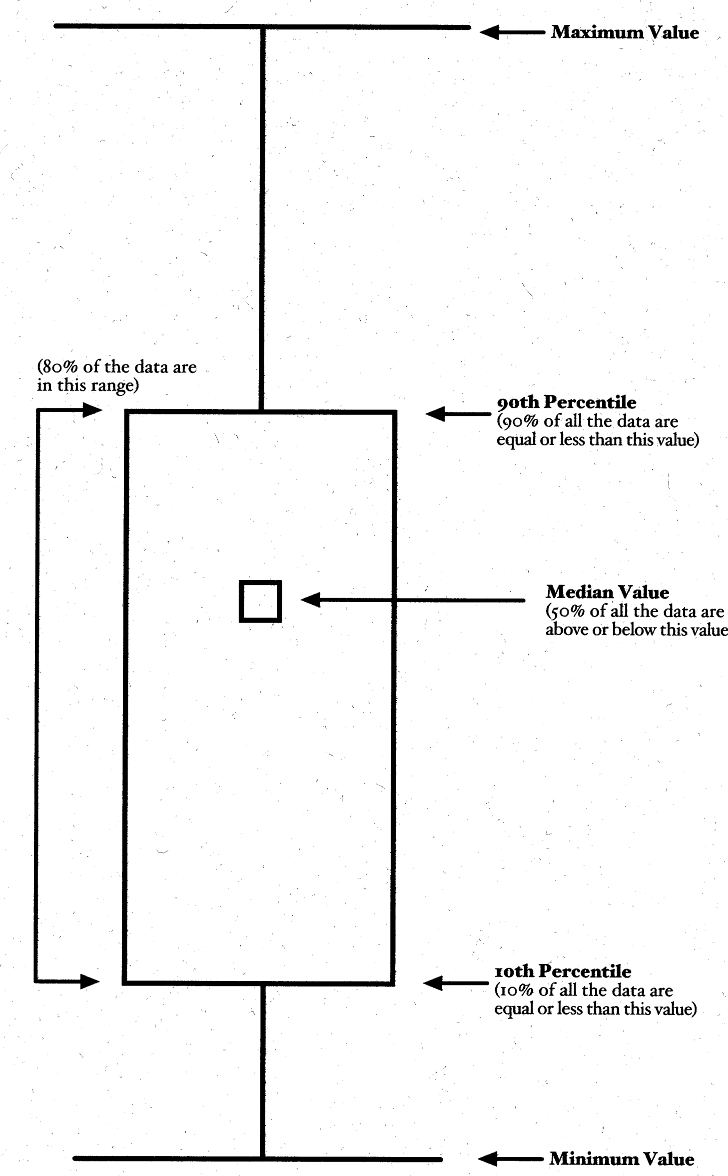
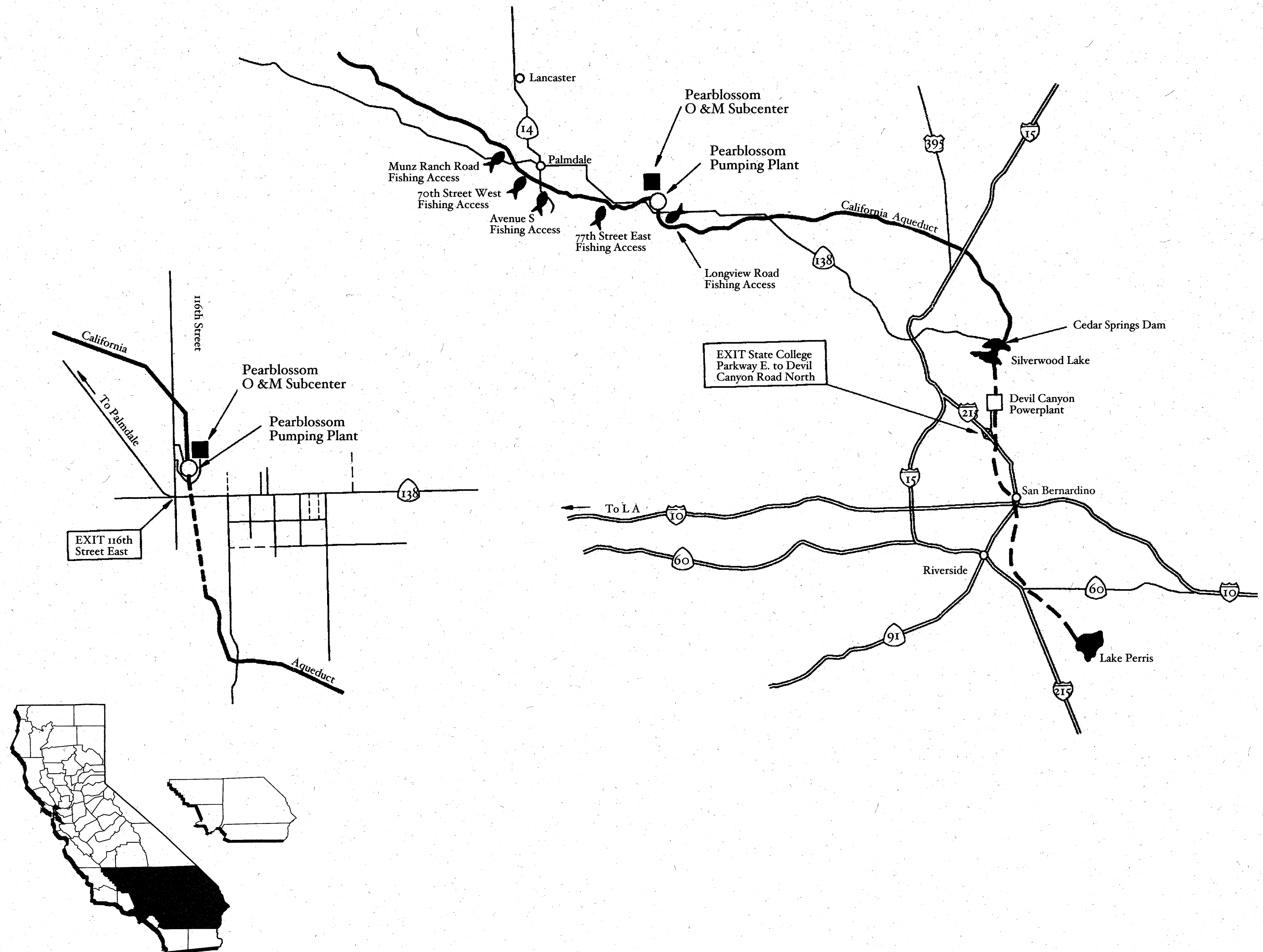


Figure 4-4 Guide to Box-and-Whisker Plots

Water Quality Data

The water quality data are presented in the format of box-and-whisker plots (Figure 4-5). These

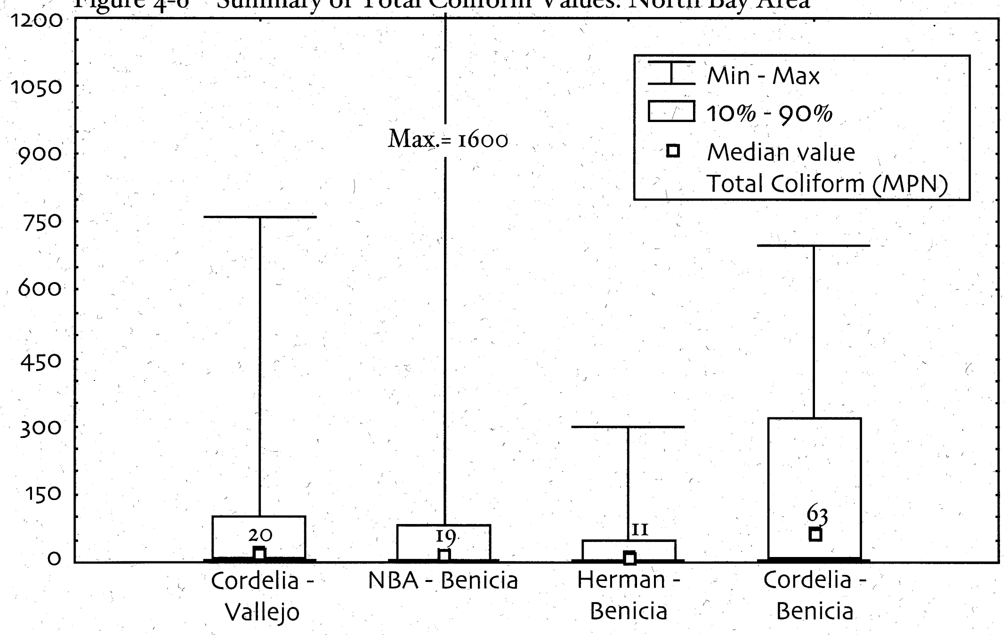

Lancaster
14
Palmdale
Pearblossom
O &M Subcenter
Pearblossom
Pumping Plant
Munz Ranch Road
Fishing Access
70th Street West
Fishing Access
Avenue S
Fishing Access
77th Street East
Fishing Access
Longview Road
Fishing Access
California Aqueduct
138
395
15
Cedar Springs Dam
Silverwood Lake
EXIT State College
Parkway E. to Devil
Canyon Road North
Devil Canyon
Powerplant
215
15
San Bernardino
To L A
10
60
Riverside
60
10
91
Lake Perris
215
California
116th Street
To Palmdale
Pearblossom
O &M Subcenter
Pearblossom
Pumping Plant
138
EXIT 116th
Street East
Aqueduct

plots show the median value (for the five-year period) as a central point. The box around the central value, the "box" of the box-and-whisker plot, shows where eighty percent of the data lie. The outlying values are the "whiskers" of the box-and-whisker plot and are the minimum and maximum values in the data set.

Coliforms

Raw water coliform values are reported here. These values are higher than treated water values and, therefore, should not be compared to regulatory standards. However, raw water coliform values are valuable in the selection of treatment processes to provide pathogen-free finished water. Figures 4-6 through 4-14 show total and fecal coliform concentrations for different regions of SWP.

Figure 4-6 Summary of Total Coliform Values: North Bay Area



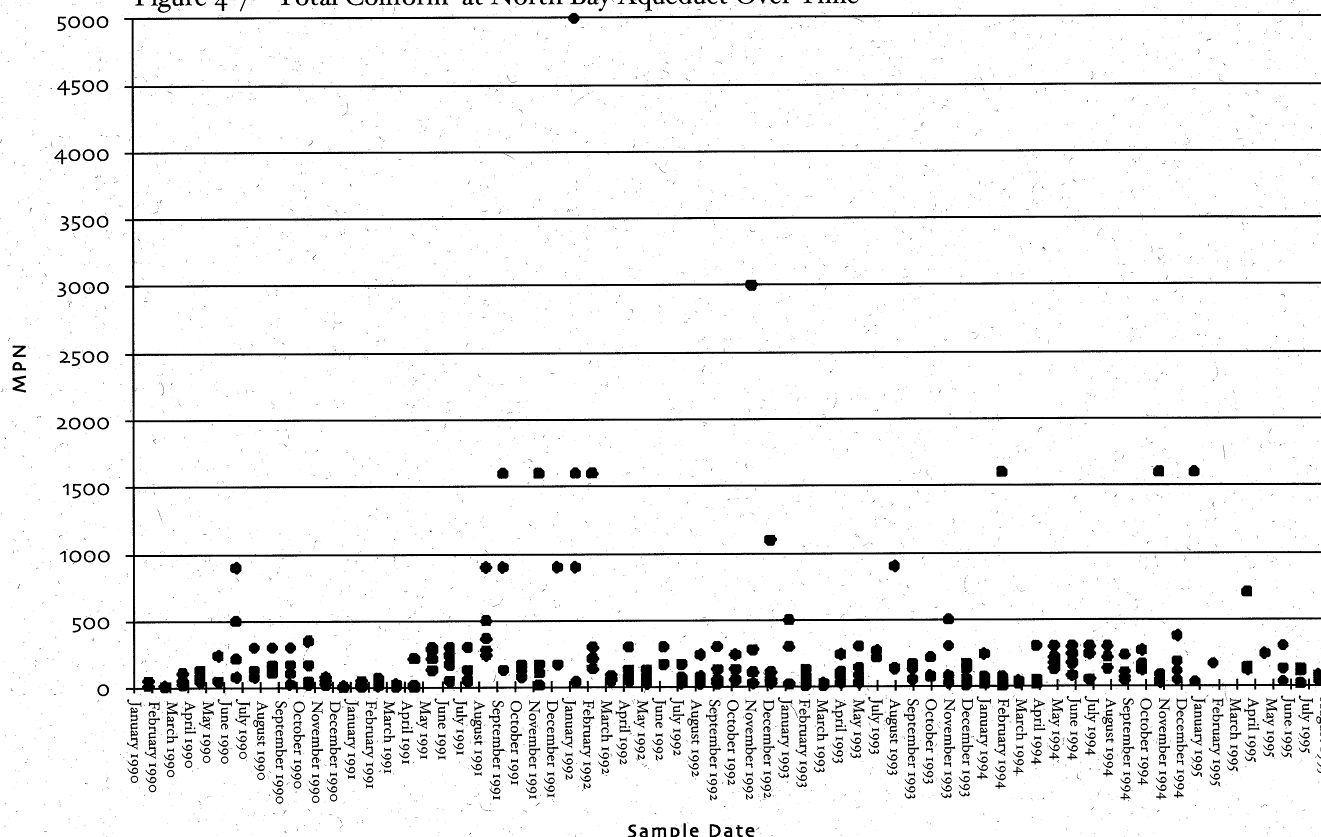
North Bay Area. Figure 4-6 shows total coliform values for water districts in the North Bay area. The cities of Benicia and Vallejo submitted coliform data in the form of most probable number (MPN) obtained by the multiple-tube fermentation technique. The city of Fairfield submitted total coliform data obtained by a Heterotrophic Plate Count. Therefore, it was not possible to compare data from the cities of Benicia and Vallejo with that of the city of Fairfield.

The highest total coliform concentration was measured in the NBA water (see Figure 4-6 for data from the cities of Benicia and Vallejo). NBA water had a median total coliform concentration of 110 MPN/100 ml. Lake Herman, a reservoir for excess NBA water that also drains a small watershed, had the lowest total coliform concentration of 23 MPN/100 ml. Cordelia Forebay, which stores NBA water, had a median total coliform concentration of 52-70 MPN/100 ml.

Figure 4-7 shows total coliform data collected by the city of Benicia at the NBA over time. Peaks in total coliform concentrations are seen in the winter months (January-February), with a high value of 5,000 MPN/100 ml seen in February 1992.

South Bay Area. The range of total coliform concentrations were lower in the South Bay area than the North Bay area (see Figure 4-8). The highest median total coliform concentration observed was at the bayside terminal of the South Bay Aqueduct (median = 240 MPN/100 ml, range = 2 to >1,600 MPN/100 ml). The lowest median coliform value was in the Santa Teresa WTP intake (median = 8 MPN/100 ml, range = 2 to 900 MPN/100 ml). Patterson Pass, Del Valle, and Penitencia WTP intakes had median total coliform values ranging from 17 to 30 MPN/100 ml.

Figure 4-7 Total Coliform at North Bay Aqueduct Over Time



San Joaquin Valley Area. In the San Joaquin Valley area, the Kern County Water Agency reported total coliform values that ranged from 1 to 2,015 MPN/100 ml in SWP water (median = 8 MPN/100 ml); total coliform values that ranged from 1 to 110 MPN/100 ml (median = 12 MPN/100 ml) in water that was a SWP/Kern Water Bank water blend; and total coliform values that ranged from 1 to 40 MPN/100 ml (median = 8 MPN/100 ml) in water at the Kern River Intertie with SWP (see Figure 4-9). It appears from this data that the coliform concentration in the SWP is increased when blended by Kern County Water Agency with Kern Water Bank water, and remains approximately the same when blended with Kern River water.

Southern California Area. The median total coliform values for Quartz Hill and Eastside WTPs were 11 and 18 MPN/100 ml, respectively (Figure 4-10). Data for the Palmdale WTP intake from January 3, 1990, to October 4, 1995, which receives water further south on the east branch of the California Aqueduct, shows a median total coliform value of 30 MPN/100 ml, slightly higher than the intakes for the Antelope Valley/East Kern Water Agency WTPs.

Summary. In general, the highest total coliform counts were seen in the NBA. The median total coliform values in the NBA was 110 MPN/100 ml. Other areas of elevated coliform concentrations were the South Bay Aqueduct terminus with a median total coliform

Figure 4-8 Summary of Total Coliform Values: South Bay Area

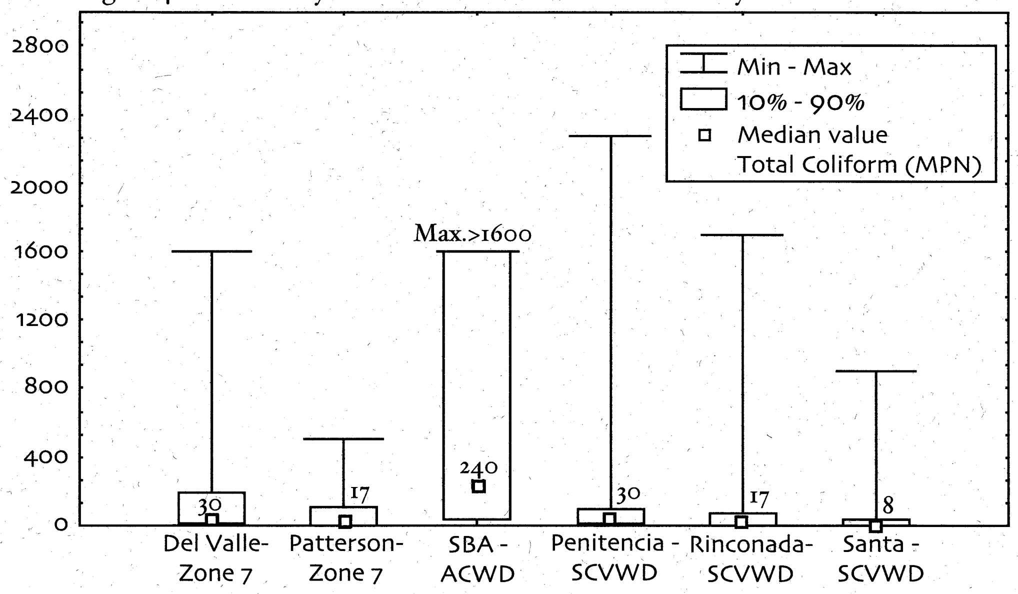
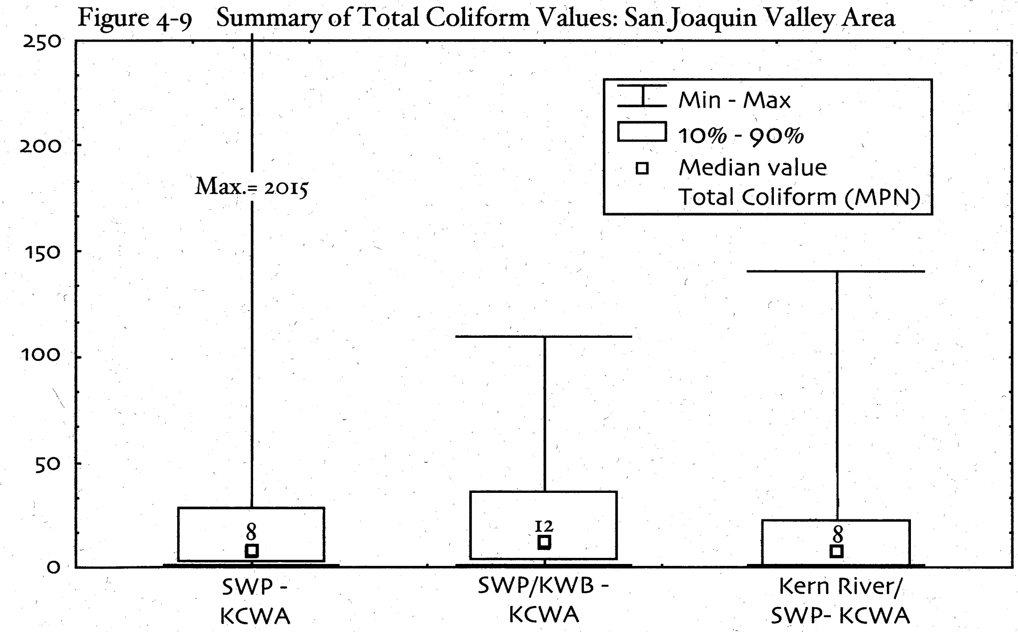


Figure 4-9 Summary of Total Coliform Values: San Joaquin Valley Area



value of 240 MPN/100 ml, and the Palmdale WTP, which receives water from the east branch of the California Aqueduct, with a median total coliform of 30 MPN/100 ml.

Fecal Coliform Data

North Bay Area. Fecal coliform concentrations showed similar trends as total coliform concentrations in the NBA (see Figure 4-11). The highest fecal coliform concentration (1,600 MPN/100 ml) was measured in the NBA by the city of Benicia. The low median fecal coliform concentration was 11 MPN/100 ml in Lake Herman (reservoir for excess NBA water and local runoff). Cordelia Forebay median fecal coliform concentrations measured by the city of Vallejo and the city of Benicia were 20 MPN/100 ml and 63 MPN/100 ml, respectively. Similar to the trends seen with total coliform, fecal coliform counts in-

Figure 4-10 Summary of Total Coliform Values: Southern California Area

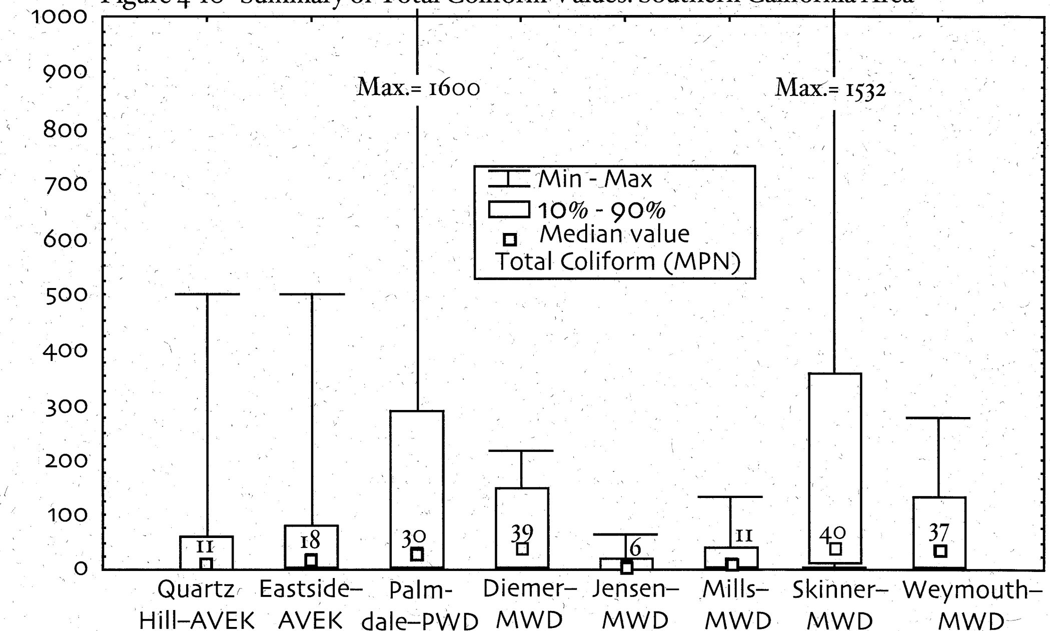
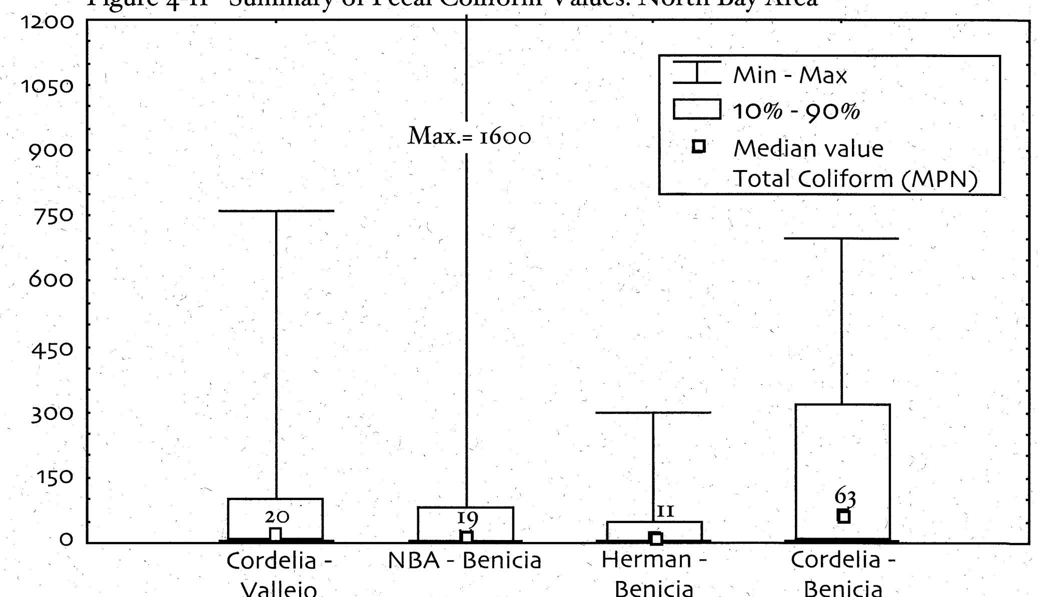


Figure 4-11 Summary of Fecal Coliform Values: North Bay Area

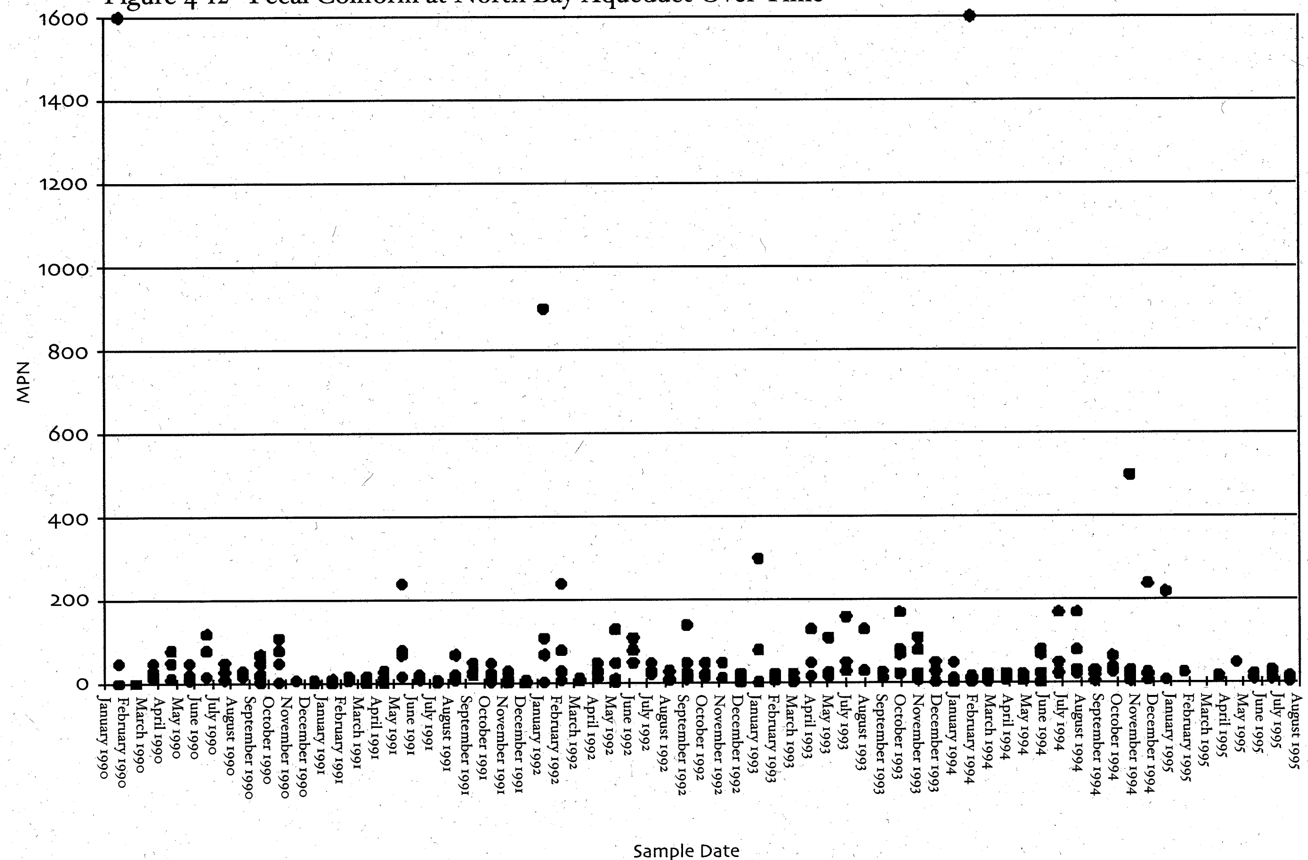


creased during the months of January to February (see Figure 4-12).

South Bay Area. Figure 4-13 shows fecal coliform concentrations for the SCVWD in the South Bay area. Penitencia WTP, which receives influent from the South Bay Aqueduct, had the highest median fecal coliform concentration of 11 MPN/100 ml. Rinconada and Santa Teresa WTPs, which receive blends of San Luis Reservoir and South Bay Aqueduct water, had lower median fecal coliform concentrations.

Southern California Area. Figure 4-14 shows fecal coliform concentrations for Quartz Hill and Eastside WTPs, as well as for Palmdale WTP. Quartz Hill and Eastside WTPs had relatively low median fecal coliform concentrations of 2 and 4 MPN/100 ml, respectively, while Palmdale WTP had higher median fecal coliform concentrations of 11 MPN/100 ml. Palmdale WTP also had a wider range of fecal coliform concentrations, from a low of less than 2 MPN/100 ml to a high of greater than 1,600 MPN/100 ml.

Figure 4-12 Fecal Coliform at North Bay Aqueduct Over Time



Summary. Of the data evaluated, the highest median fecal coliform values were in Cordelia Forebay (median = 63 MPN/100 ml) in the North Bay area. In the South Bay area, the median fecal coliform value for 100 percent South Bay Aqueduct water was higher than the median fecal coliform value for South Bay Aqueduct water blended with San Luis Reservoir water. In the Southern California area, Palmdale WTP intake had higher fecal coliform values than that of the Antelope Valley/East Kern Water Agency WTPs.

Giardia lamblia Data

Delta/San Luis/San Joaquin Areas. *Giardia lamblia* data for this area were provided by DWR's O&M and MWD. The only positive samples were seen at the Delta-Mendota Canal at O'Neill Forebay and at Greenes Landing on the Sacramento River, which

Figure 4-13 Summary of Fecal Coliform Values: South Bay Area

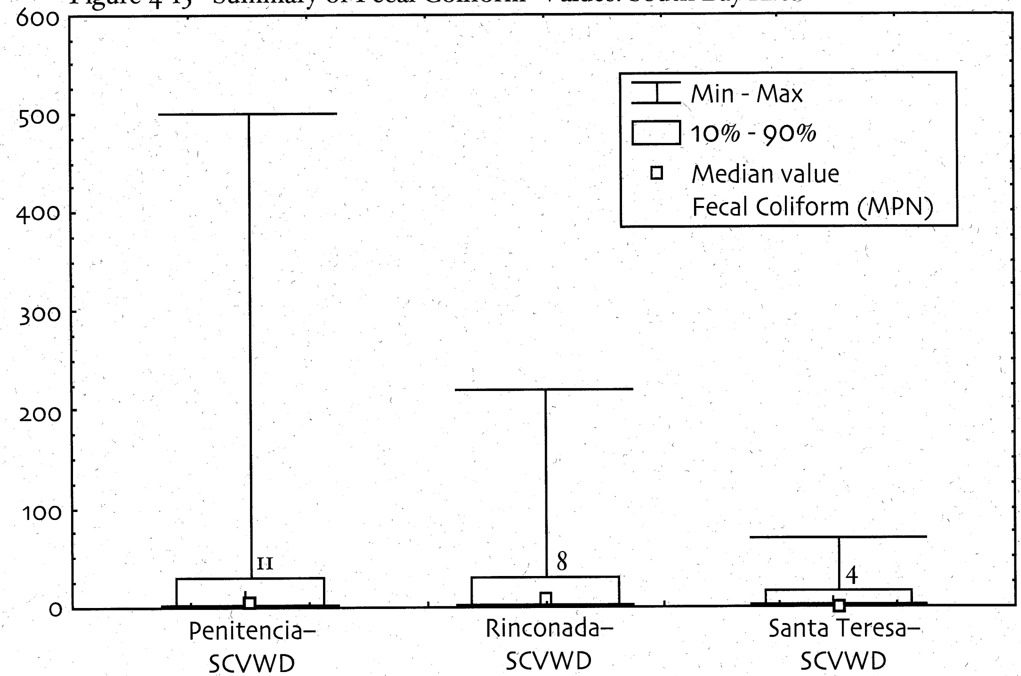
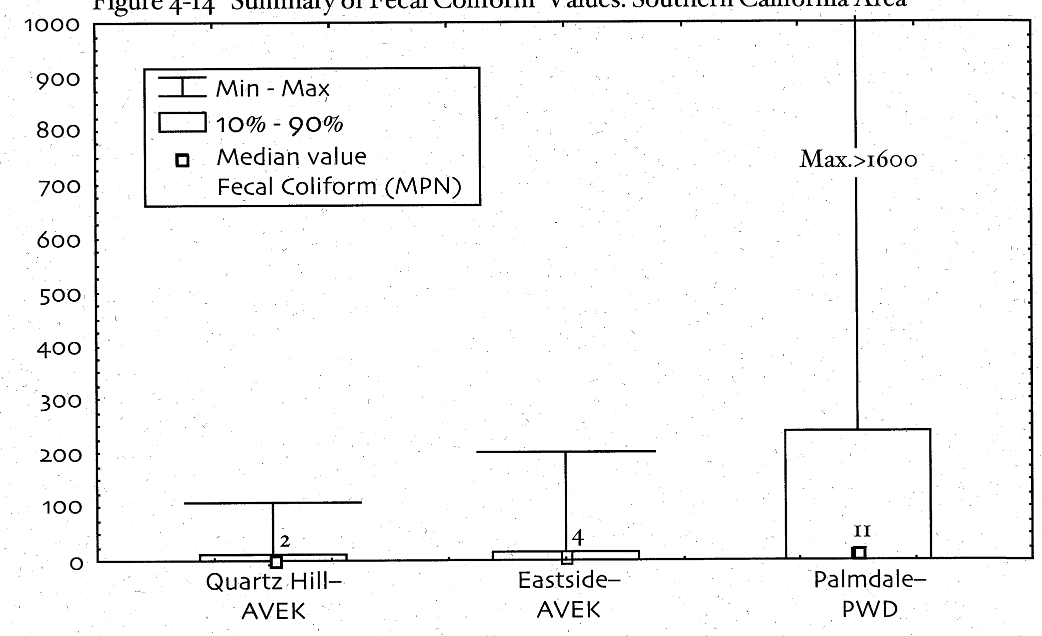


Figure 4-14 Summary of Fecal Coliform Values: Southern California Area



were sampled by DWR's O&M (and submitted to MWD for analyses) in 1992-93 (see Figure 4-15). The average *Giardia lamblia* concentrations at Greenes Landing and the Delta-Mendota Canal were 37 and

Figure 4-15 Summary of *Giardia* Results for the State Water Project: Delta/San Luis/San Joaquin Areas

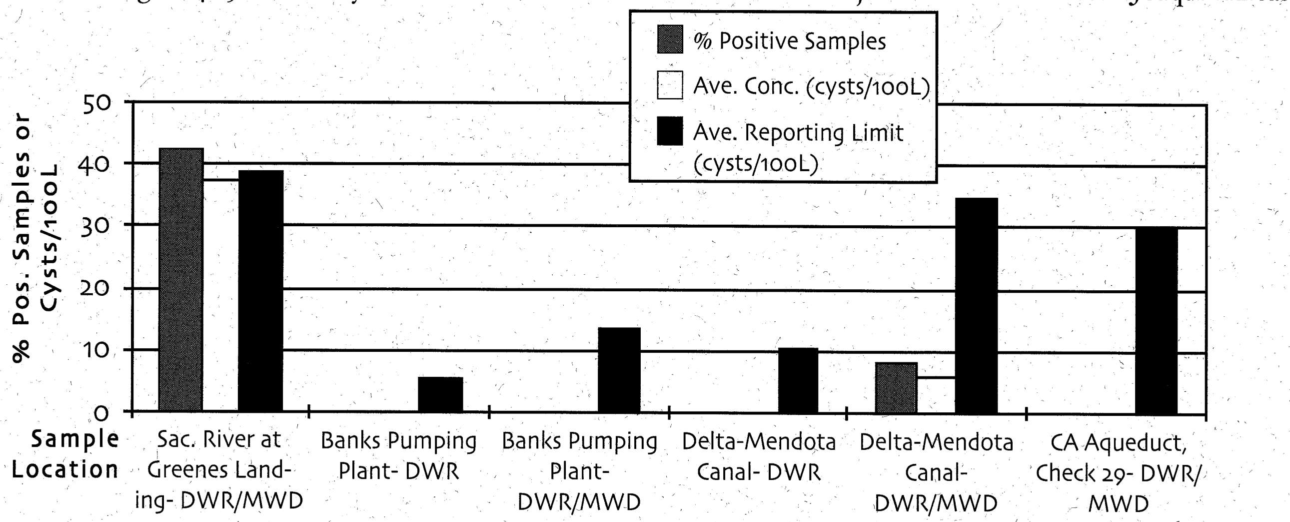
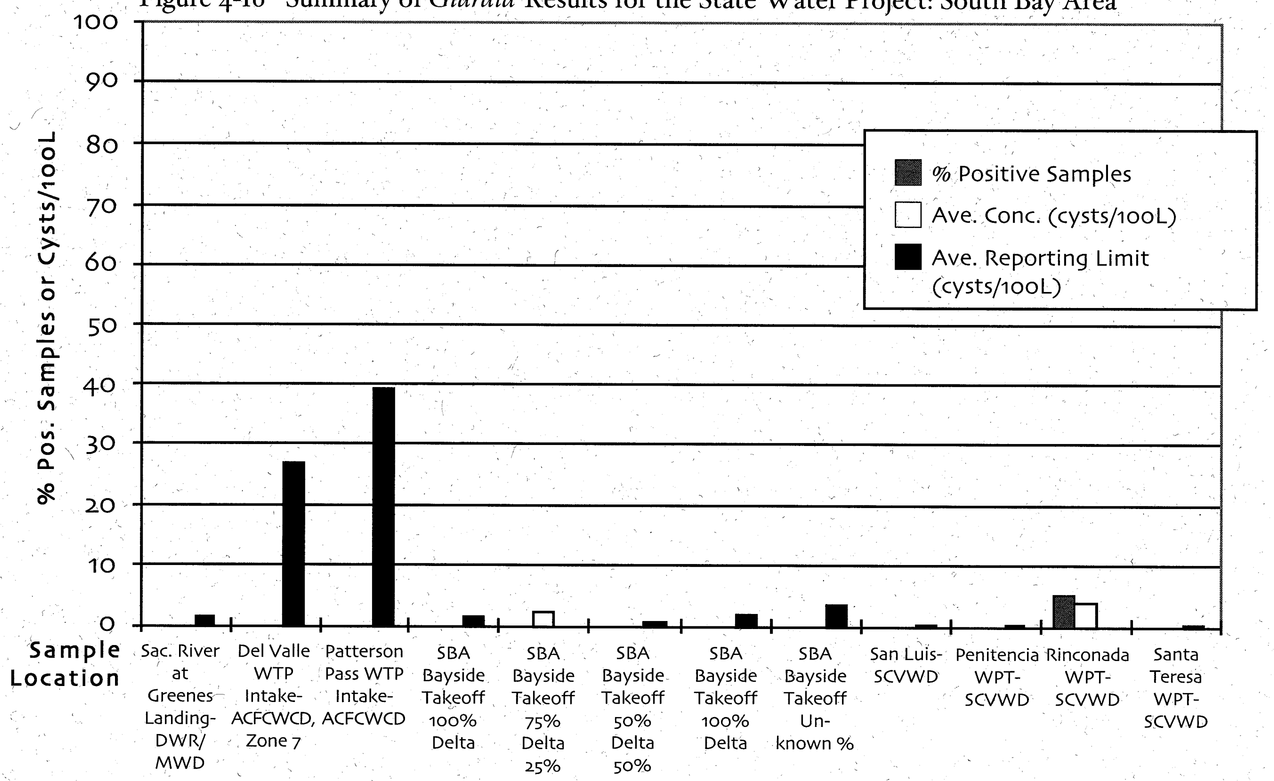


Figure 4-16 Summary of *Giardia* Results for the State Water Project: South Bay Area

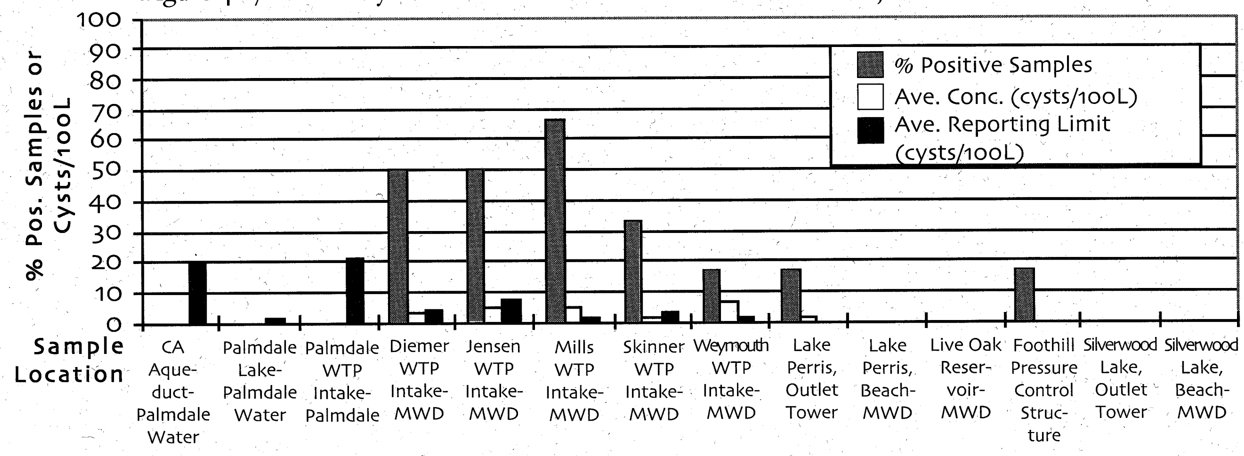


6 cysts/100 L, respectively.

DWR sampling for *Giardia lamblia* at Banks Pumping Plant, Delta-Mendota Canal, and the California Aqueduct at Check 29 in 1995 did not result in any positive samples. Average reporting limits for the 1995 DWR sampling ranged from approximately 5 to 30 cysts/100 L.

<u>South Bay Area.</u> Figure 4-16 shows *Giardia lamblia* concentrations in the South Bay Area. The only positive *Giardia lamblia* samples were detected in Rinconada WTP intake water (SCVWD), and in one South Bay Aqueduct bayside takeoff sample (Alameda County Water District). The one positive *Giardia lamblia* concentration for the Rinconada WTP was 4.4 cysts/100 L, which was for one out of 21 samples analyzed. The *Giardia lamblia* concentration for the one South Bay Aqueduct bayside takeoff sample, which was 75 percent Delta water and 25 percent Del Valle water, was 2.1 cysts/100 L. Average reporting limits for all reported data were as low as 0.1 cysts/100 L (at Rinconada WTP) to as high as 39 cysts/100 L at Patterson Pass WTP (ACFCWCD, Zone 7).

Figure 4-17 Summary of *Giardia* Results for the State Water Project: Southern California Area



<u>Southern California Area.</u> Figure 4-17 shows *Giardia lamblia* data in the Southern California area. Positive *Giardia lamblia* samples were obtained by MWD at the treatment plant intakes (Diemer, Jensen, Mills, Skinner, Weymouth), at the outlet tower to Lake Perris, and at the Foothill Pressure Control Structure. Average concentrations ranged from 1.5 cysts/100 L at Skinner WTP and Lake Perris, to 7 cysts/100 L at Weymouth WTP. Average reporting limits for all reported data ranged from 1 to 21 cysts/100 L.

Cryptosporidium Data

<u>Delta/San Luis Area.</u> *Cryptosporidium* data in the Delta area were obtained from DWR's O&M sampling in 1995, and from MWD sampling in 1992-93. Positive *Cryptosporidium* samples were detected at Greenes Landing, Banks Pumping Plant, the Delta-Mendota Canal, and Check 29 of the Califor-

nia Aqueduct in 1992-93 by MWD (see Figure 4-18). Average concentrations ranged from 17 oocysts/100 L at Check 29, to 54 oocysts/100 L at Banks Pumping Plant.

Sampling by DWR in 1995 at Banks Pumping Plant, Delta-Mendota Canal, and Arroyo Intake to

Figure 4-18 Summary of *Cryptosporidium* Results for the State Water Project: Delta/San Luis/San Joaquin Area

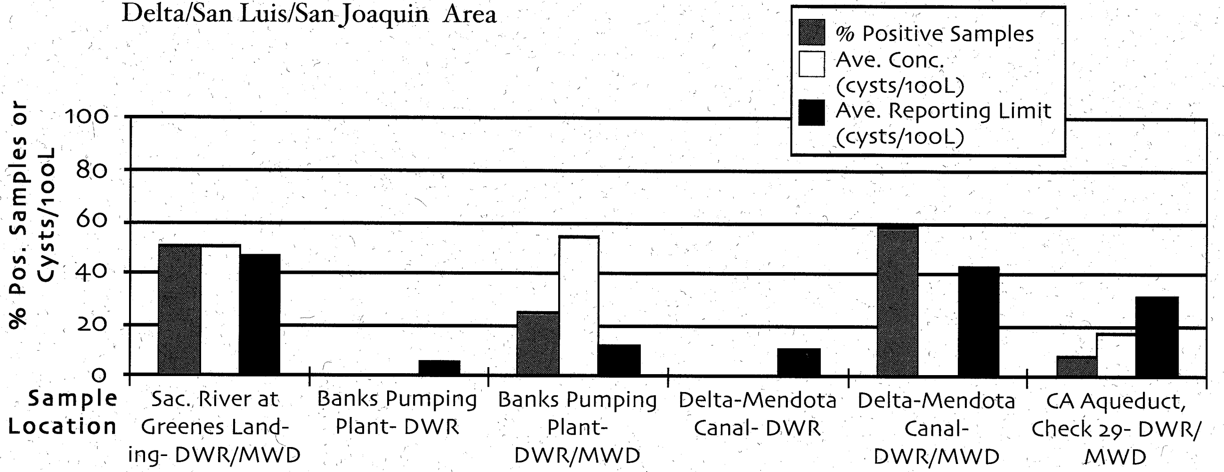
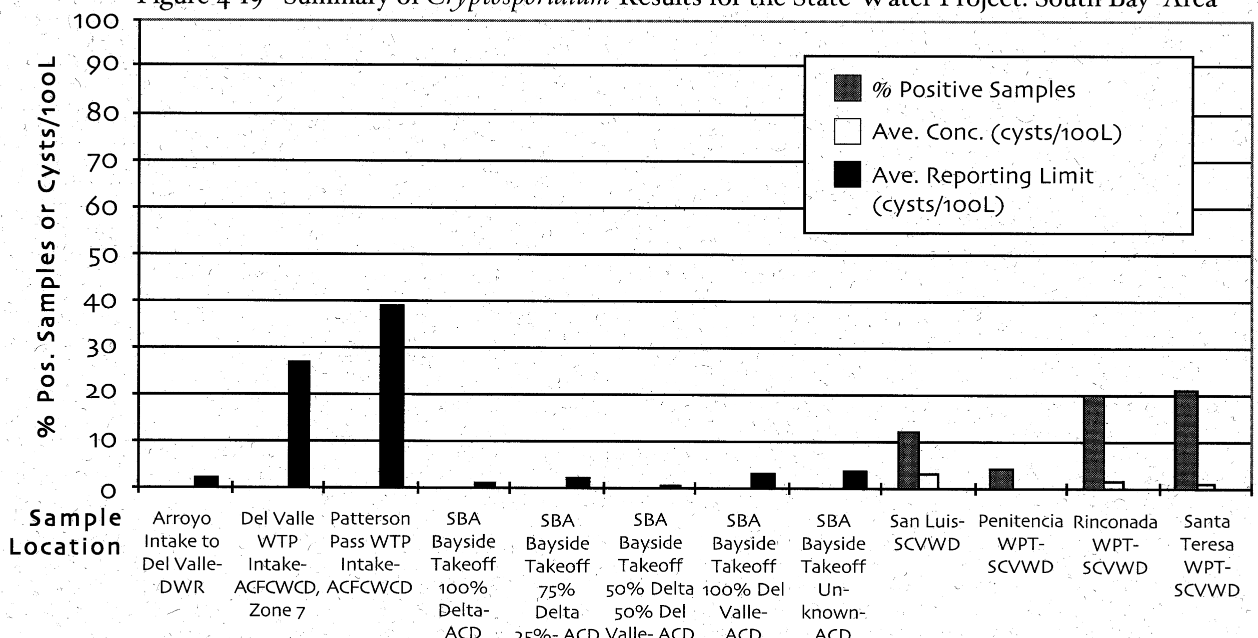
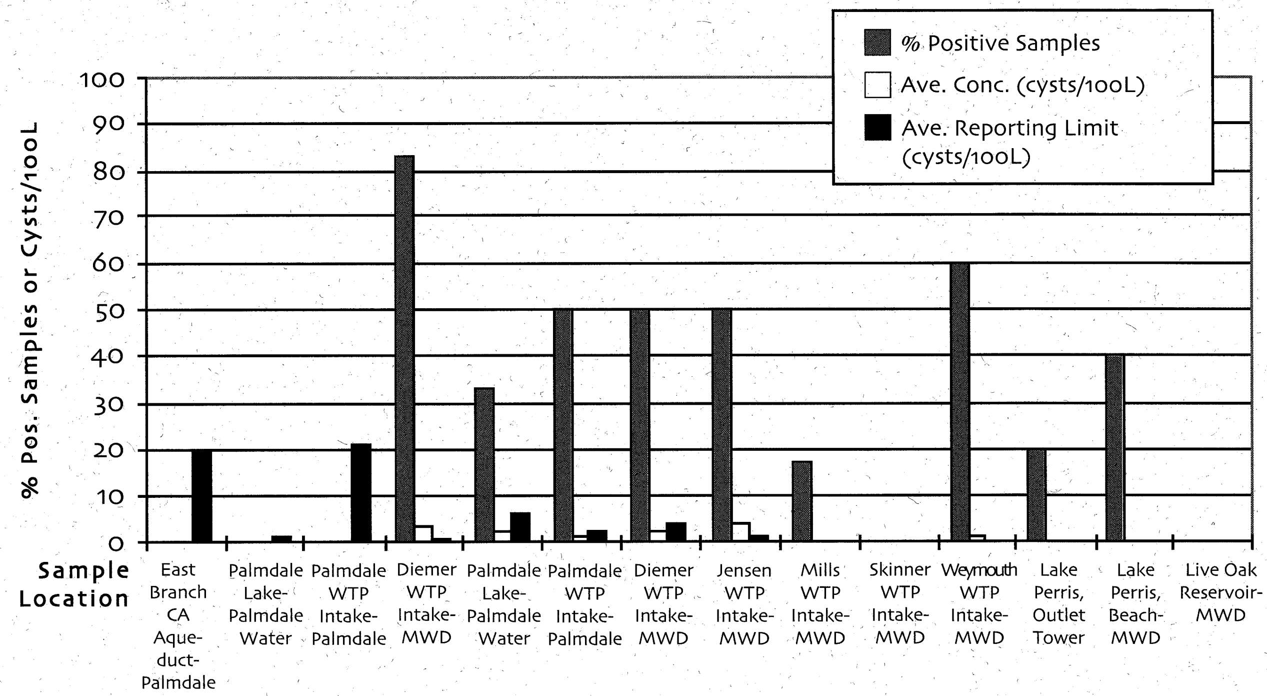


Figure 4-19 Summary of *Cryptosporidium* Results for the State Water Project: South Bay Area



Lake Del Valle did not result in positive *Cryptosporidium* samples. However, presumptive results of sampling at Banks Pumping Plant showed positive samples with concentrations of less than 10 oocysts/100 L. However, internal bodies of the oocysts were not identified (i.e., confirmed) with these presumptive results. Average reporting limits ranged from about 2 oocysts/100 L (Arroyo Intake to Lake Del Valle) to 11 oocysts/100 L at the Delta-Mendota Canal.

Figure 4-20 Summary of *Cryptosporidium* Results for the State Water Project: Southern California Area



<u>South Bay Area.</u> Figure 4-19 shows *Cryptosporidium* results for the South Bay area including data from DWR, Alameda County Flood Control and Water Conservation District, Zone 7, Alameda County Water District, and Santa Clara Valley Water District. Positive samples were only seen in 100 percent San Luis Reservoir water taken into SCVWD treatment plants, and in the intake water to Penitencia, Rinconada, and Santa Teresa WTPs. (Rinconada and Santa Teresa WTPs blend water from the South Bay Aqueduct and the San Luis Reservoir)

Average *Cryptosporidium* concentrations measured by SCVWD ranged from 0.1 oocysts/100 L at Penitencia WTP to 3.4 oocysts/100 L for 100 percent San Luis Reservoir water. These concentrations are relatively low compared to other *Cryptosporidium* concentrations measured throughout the State.

<u>Southern California Area.</u> Figure 4-20 shows *Cryptosporidium* concentrations for the Southern

California area, including data from Palmdale Water District and MWD. Positive concentrations were seen at the MWD treatment plants. Average concentrations ranged from 1.1 oocysts/100 L at Mills WTP to 3.7 oocysts/100 L at Weymouth WTP. The average reporting limits for samples obtained at the MWD treatment plants ranged from 1 to 7 oocysts/100 L. The average reporting limits for Palmdale WTP and the east branch of the California Aqueduct measured by Palmdale Water District were 20 oocysts/100 L.

Summary. Due to variations in the reporting limits and analytical laboratory performance, it was difficult to compare the results of *Giardia lamblia* and *Cryptosporidium* analyses between sites. Available data show, however, high positive concentrations of *Giardia lamblia* and *Cryptosporidium* in the Delta, as measured by MWD.

Cryptosporidium oocysts were detected by SCVWD due, in part, to very low reporting limits. For the most part, ACFCWCD, Zone 7 did not obtain positive *Giardia lamblia* and *Cryptosporidium* results. *Giardia lamblia* was detected, however, by both SCVWD and Alameda County Water District in 100 percent South Bay Aqueduct water (2-4 cysts/100 L).

In the Southern California area, *Giardia lamblia* and *Cryptosporidium* were seen in almost all of the intakes to MWD WTPs. Palmdale Water District did not obtain *Giardia lamblia* and *Cryptosporidium* concentrations with their reporting limits.

Data Sources

Municipal Water Quality Investigations Program

Water quality data for chemical constituents in the Sacramento-San Joaquin Delta and major inputs to the Delta were obtained from the MWQI Program.

Program History. The MWQI Program was established in 1989 by DWR. The Program unified DWR's drinking water quality studies in the Sacramento-San Joaquin Delta. The MWQI Program incorporated the project objectives of two predecessor programs, the Interagency Delta Health Aspects Monitoring Program and the Delta Island Drainage Investigation that began in July 1983 and January 1987, respectively. Participants in the program include representatives of the U.S. Environmental Protection Agency, the State Water Resources Control Board, the California Department of Health Services, Contra Costa Water District, and the municipal contractors of SWP.

Program Goals. Under the MWQI program, DWR staff monitor and assess the major sources of water quality impacts in the Delta, as related to drinking water supply. Sites being monitored include locations in the Bay-Delta estuary, river inflows, drainages from land surfaces, and Delta channels.

The Program's major goal is to assist water agencies in protecting and improving Delta drinking water supplies and to guide water treatment research. To achieve this, Program staff examine the major sources and causes of water quality changes in the Delta that affect drinking water quality. Key Delta channel and river stations and Delta island drains are monitored for trihalomethane formation potential, arsenic, copper, mercury, minerals, some pesticides, and currently unregulated constituents being considered for regulation.

MWQI staff collect water quality data for numerous purposes. The data are used to:

- Alert water agencies about potential contaminant sources to Delta water supplies;
- Document water quality under a variety of hydrologic conditions for studying water transfer alternatives, water quality standards, and for developing predictive modeling capabilities;
- Determine the influence of sea water intrusion, and external sources of farm drainage, river input, in-channel processes, weather, and SWP and CVP operations on Delta drinking water quality. Selenium, bromide, and other inorganic constituents are used to trace the movement and mixing of water from different sources; and
- Assist DWR and other participating water agencies in planning, protecting, and improving drinking water quality.

Program Advisors. The MWQI Committee provides policy-level guidance and recommends program modifications as needed to respond to changing drinking water quality concerns (see Table 4-3). The Committee provides specific expertise in laboratory methodologies, regulatory affairs, review of the analysis, interpretation, and reporting of program data. The Committee also reviews and comments on program reports.

Table 4-3
MWQI Program Advisors and Participants

MUNICIPAL WATER QUALITY INVESTIGATIONS ADVISORY COMMITTEE:	
Rick Woodard	Chairperson, California Department of Water Resources
Jim Beck	Kern County Water Agency
Bill Brennan	Central Coast Water Agency
Byron Buck	California Urban Water Agencies
Doug Chun	Alameda County Water District
Francis Chung	California Department of Water Resources
John Coburn	State Water Contractors
Richard Denton	Contra Costa Water District
Russ Fuller	Antelope Valley/East Kern Water Agency
Jim Horen	Contra Costa Water District
Judith Heath	California Department of Water Resources
Bob Hultquist	California Department of Health Services
Tom Howard	State Water Resources Control Board
Marvin Jung	Marvin Jung & Associates
Jerry Killingstad	Alameda County Flood Control and Water Conservation District
Stuart Krasner	Metropolitan Water District of Southern California
Bruce Kuebler	Los Angeles Department of Water and Power
Michael Lanier	Alameda County Water District
Bruce Macler	U.S. Environmental Protection Agency
Frank Maitski	Santa Clara Valley Water District
Alexis Milea	California Department of Health Services
Dale Newkirk	East Bay Municipal Utility District
Stanley Narwold	Palmdale Water District
Pankaj Parekh	Los Angeles Department of Water and Power

Monitoring Stations. The complete list of MWQI monitoring stations is presented in Table 4-

4. In the MWQI Program, channel stations (see Figure 4-21) and agricultural drains (see Figure 4-22) are monitored. Data from eight of the channel monitoring stations representing major stations in the Delta

Table 4-4 MWQI Monitoring Stations

ID	STATION NAME	ID	STATION NAME
1	American River at W.T.P.	107	Delta Cross Channel Gate nr Walnut Grove
2	Sacramento River @ Greenes Landing	108	Georgiana Sl. @ Walnut Grove Bridge
3	Cache Slough @ Vallejo P.P.	110	Middle R. @ Bacon Island Bridge
7	Little Connection Sl. @ Empire Tr.	111	Middle R. @ Mowry Bridge (Undine Rd.)
8	Ag Drain on Empire Tr.,W.end 8-Mi.Rd.	112	Turner Cut @ McDonald Island Ferry
9	Rock Slough @ Old River	113	Old River @ Sand Mound Slough
10	Clifton Court Intake	114	Middle R. nr. Latham Sl. (Ferry Site)
11	DMC Intake @ Lindemann Rd.	115	Connection Sl. @ Mandeville Is.Bridge
12	Delta P.P. Headworks	117	Santa Fe-Bacon Is. Cut nr. Old River
13	Middle R. @ Borden Hwy.	118	Woodward/N. Victoria Canal nr. Old R.
14	San Joaquin R. near Vernalis	119	North Canal nr. Old River
17	Sacramento R. @ Mallard Island	121	Grant Line/Fabian/Bell Canals nr Old
20	Natomas Main Drain	122	Old River U/S from DMC Intake
21	Ag Drain on Bouldin Tract, P.P. No.1	123	Ag Drain on Webb Tract, P.P. No. 1
22	Ag Drain on Bouldin Tract, P.P. No. 2	124	Ag Drain on Webb Tract, P.P. No. 2
25	Ag Drain on King Island, P.P.No.1	125	Ag Drain on Holland Tract, P.P. No. 1
26	Ag Drain on King Island, P.P.No.2	126	Ag Drain on Holland Tract, P.P. No. 2
27	Ag Drain on King Island, P.P.No.3	127	Ag Drain on Holland Tract, P.P. No. 3
44	Ag Drain on Pescadero Tract, P.P. No.1	128	Ag Drain on Bacon Island, P.P. No. 1
45	Ag Drain on Pescadero Tract, P.P. No. 2	129	Ag Drain on Bacon Island, P.P. No. 2
46	Ag Drain on Pescadero Tract, P.P. No. 3	130	San Joaquin River @ Jersey Point
51	Ag Drain on Rindge Tract, P.P. No. 2	131	False R. @ Southerly Tip of Webb Tr.
60	Ag Drain on Upper Jones Tract, P.P. No. 2	132	Old R. 6/10 mi. below DMC Intake
61	Ag Drain on Brannan Island, P.P. No. 1	133	Contra Costa P.P. No. 1
62	Ag Drain on Brannan Island, P.P. No. 2	140	Ag Drain on Staten Island P.P. No. 1
63	Ag Drain on Brannan Island, P.P. No. 3	141	Ag Drain on Staten Island P.P. No. 2
64	Ag Drain on Brannan Island, P.P. No. 4	142	Ag Drain on Venice Island
65	Ag Drain on Clifton Court	143	Ag Drain on Woodward Island
68	Ag Drain on Pescadero Tr., P.P. No. 4	144	Ag Drain on Mandeville Isl., P.P No. 1
69	Ag Drain on Pescadero Tr., P.P. No. 5	145	Ag Drain on Mandeville Isl., P.P. No. 2
75	San Joaquin R. @ Maze Rd. Bridge	146	Ag Drain on Orwood Tract
76	Ag Drain on Lower Jones Tr., P.P. No. 1	147	Ag Drain on Palm Tract
77	Ag Drain on Lower Jones Tr., P.P. No. 2	411	Mokelumne R. below Georgiana Slough
87	Barker Slough @ North Say P.P.	413	L. Potato Slough @ Terminous
88	Sacramento R. @ Rio Vista Bridge	602	San Joaquin R. @ Mossdale Bridge
91	Honker Cut @ Atherton Rd. Bridge	604	Old River near Tracy
100	Old River N/o Rock Sl. (St. 4b)	605	Middle R. @ Tracy Rd. Bridge
103	Old River near Byron (St. 9)	606	Grant Ln. Can. @ Tracy Rd. Bridge
105	West Canal @ Clifton Court FB Intake		

as well as major inflow and outflow stations to the Delta are presented in this report. The station abbreviations are noted in parentheses.

The American River at the WTP intake that serves the city of Sacramento (AMERICAN)

The Sacramento River at Greenes Landing, a station located downstream of the confluence of the Sacramento and American rivers, approximately eight miles south of Freeport Bridge on the Sacramento River (GREENES) (data from this station were used to characterize the quality of the Sacramento River as it flows into the Delta)

Barker Slough at North Bay Pumping Plant that serves Solano and Napa counties (BARKER-NOBAY)

Middle River at Borden Highway, an interior Delta site (MIDDLER)

Clifton Court Intake to the Clifton Court Forebay from which water is taken to the Harvey O. Banks Pumping Plant (CLIFTON)

Harvey O. Banks Delta Pumping Plant, which is the Headwaters of the California Aqueduct (BANKS)

Delta-Mendota Canal Intake at Lindemann Road, which is located in the intake channel of the Tracy Pumping Plant for the Delta-Mendota Canal (DMC)

The San Joaquin River near Vernalis, which represents water quality of the San Joaquin River before it enters the interior of the Delta (VERNALIS) (station is upstream of the cities of Stockton and Tracy)

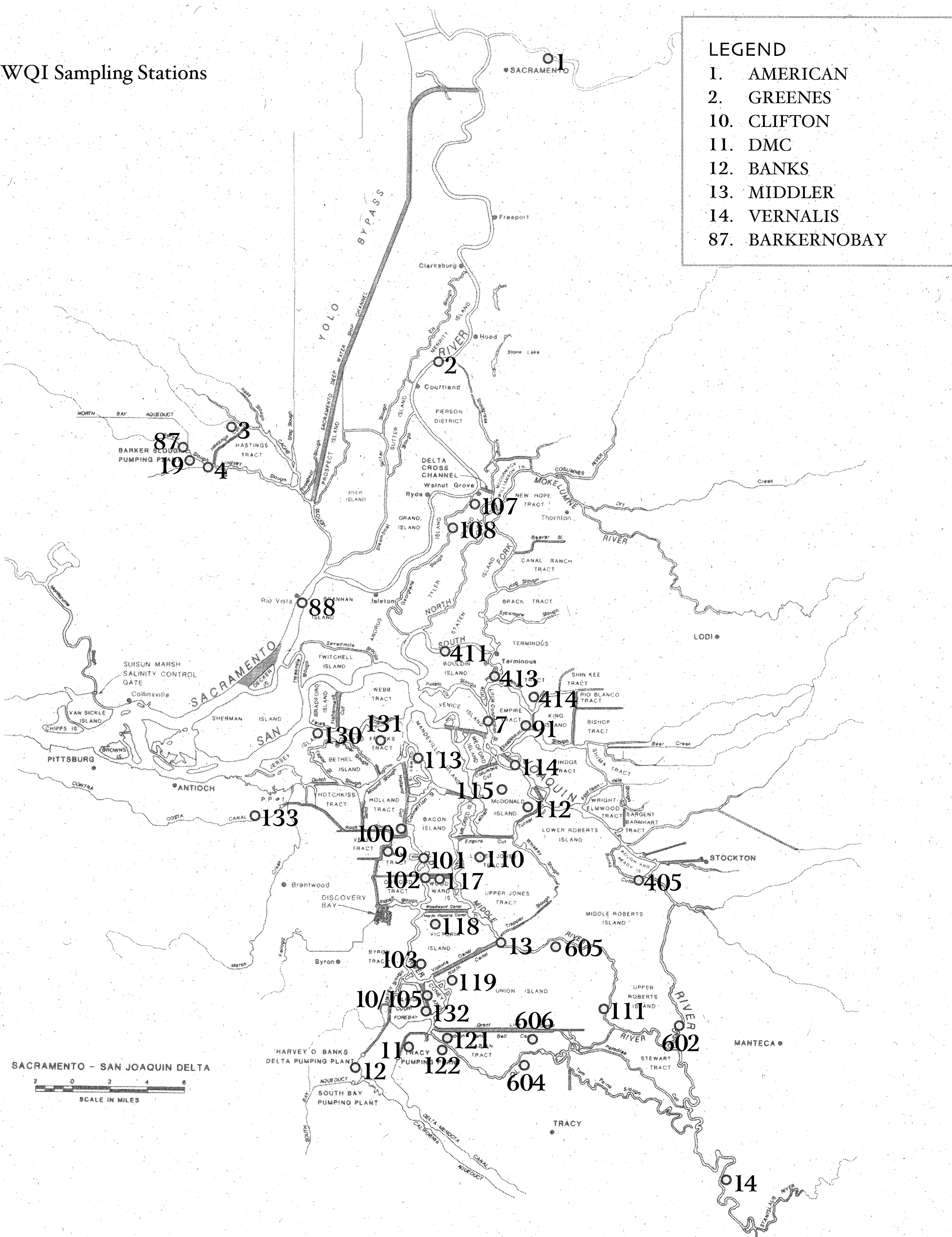
DWR Division of Operations and Maintenance

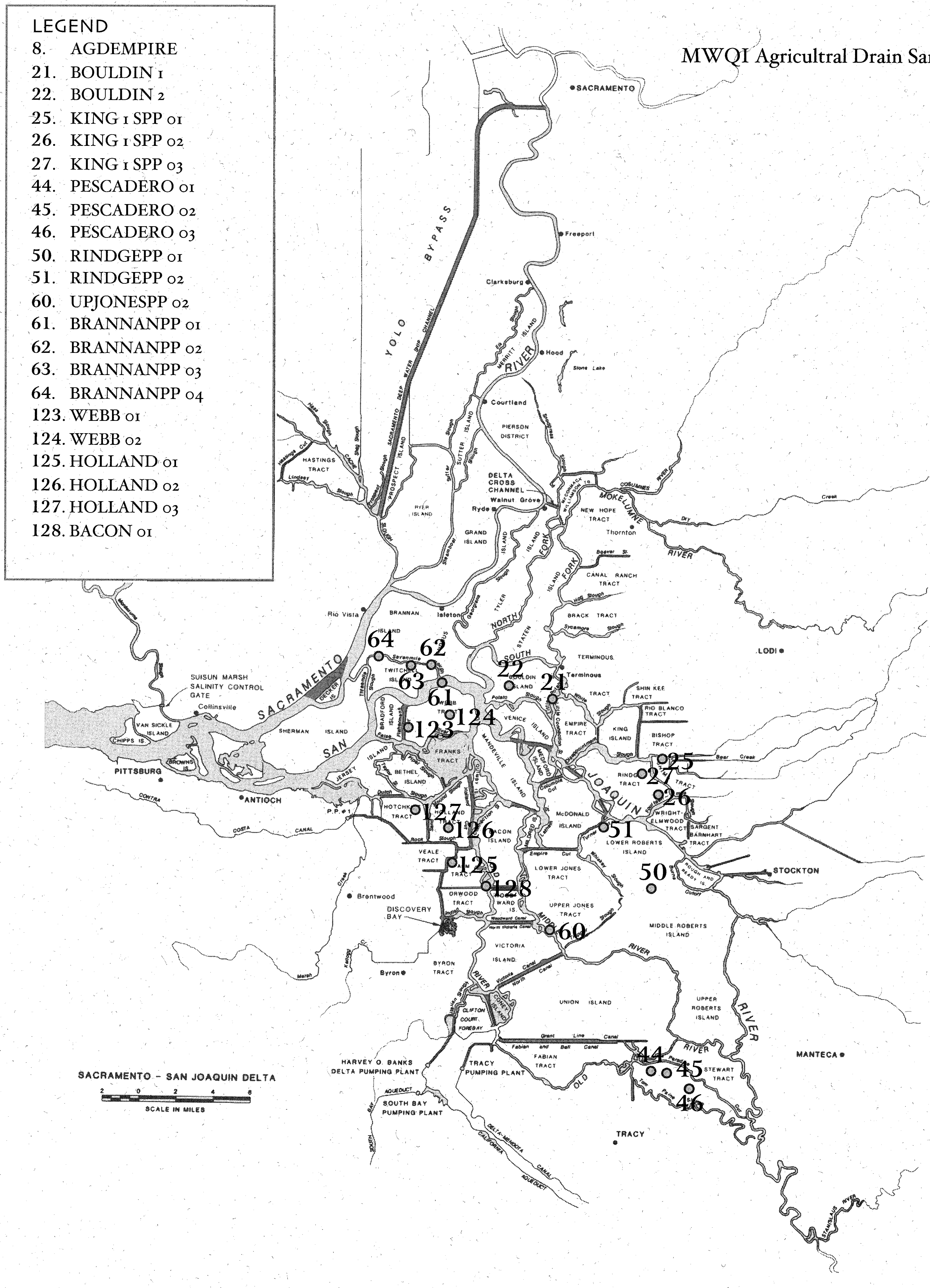
Water quality data for major stations along SWP south of the Delta were obtained from DWR's O&M Water Quality Monitoring Program. *Giardia lamblia* and *Cryptosporidium* data were also obtained from O&M and are presented in the report section on pathogen data.

Program History. Water quality monitoring of SWP began in 1968 with the completion of the California Aqueduct. The focus of the early water quality monitoring was on mineral quality and controlling eutrophication (increased productivity) in the Aqueduct and reservoirs of SWP. Objectives included documenting SWP water quality, assessing trends, identifying potential problems, and performing special studies in areas of unique importance.

Water quality monitoring of SWP is carried out by staff of the five Field Divisions. In the northern part of the State, Oroville Field Division and the Beckwourth Subcenter are responsible for sampling in Lake Oroville and Feather River reservoirs, respectively. Delta Field Division monitors the North and South Bay Aqueducts, Lake Del Valle, and stations in the California Aqueduct near Clifton Court, at the head of the California Aqueduct. San Luis Field Division monitors from Milepost 46.18 to Check 21 at Milepost 172.44 of the California Aqueduct near Kettleman City. San Joaquin Field Division conducts the water quality monitoring in the

 Figure 4-21 MWQI Sampling Stations




LEGEND
8. AGDEMPIRE
21. BOULDIN 1
22. BOULDIN 2
25. KING 1 SPP 01
26. KING 1 SPP 02
27. KING 1 SPP 03
44. PESCADERO 01
45. PESCADERO 02
46. PESCADERO 03
50. RINDGEPP 01
51. RINDGEPP 02
60. UPJONESPP 02
61. BRANNANPP 01
62. BRANNANPP 02
63. BRANNANPP 03
64. BRANNANPP 04
123. WEBB 01
124. WEBB 02
125. HOLLAND 01
126. HOLLAND 02
127. HOLLAND 03
128. BACON 01
SACRAMENTO
Freeport
Clarksburg
YOLO BYPASS
Hood
Courtland
RIVER
MOKELUMNE
COSUMNES
Walnut Grove
Ryde
Thornton
Rio Vista
Isleton
LODI
SACRAMENTO
SAN
JOAQUIN
SUISUN MARSH SALINITY CONTROL GATE
Collinsville
PITTSBURG
ANTIOCH
Brentwood
DISCOVERY BAY
Byron
STOCKTON
MANTECA
TRACY
HARVEY O. BANKS DELTA PUMPING PLANT
TRACY PUMPING PLANT
SOUTH BAY PUMPING PLANT
CLIFTON COURT FOREBAY
SACRAMENTO - SAN JOAQUIN DELTA
SCALE IN MILES
64
62
63
61
124
123
22
21
25
27
26
51
50
127
126
125
128
60
44
45
46

Coastal Aqueduct and from about Milepost 173 to 293 in the California Aqueduct. Southern Field Division samples and monitors the California Aqueduct south of Edmonston Pumping Plant, as well as Silverwood Lake and Lake Perris on the East Branch, and Pyramid Lake and Castaic Lake on the West Branch. All Field Divisions are responsible for sampling non-Project inflows.

The water quality goals of O&M and the Maintenance Operations Control Office are to:

- Monitor SWP water quality in comparison to drinking water standards and Article 19 Water Quality Objectives (Article 19 of "Standard Provisions for Water Supply Contract" contains objectives for several water quality parameters),
- Document temporal and spatial changes in SWP water quality,
- Provide SWP contractors with water quality data to assess WTP operational needs, and
- Conduct studies as needed to characterize the effect of specific activities on SWP water quality.

Monitoring Stations Within the State Water Project. SWP monitoring stations are distributed over a distance of more than 500 miles (800 km) from the upper Feather River Reservoirs in Plumas County in the north to the terminus of the Project at Lake Perris in Southern California (see Figure 4-23).

Data from major stations along the California Aqueduct were selected for this report. These stations are:

NBA at Barker Slough. The NBA is a pipeline between the Barker Slough Pumping Plant and the terminal tank. Water flows from Lindsey Slough into Barker Slough. Water is pumped out of Barker Slough at the Barker Slough Pumping Plant.

Harvey O. Banks Pumping Plant. This pumping Plant pumps water from a channel connected to Clifton Court Forebay into the California Aqueduct. Water is diverted into the Forebay from West Canal and Old River.

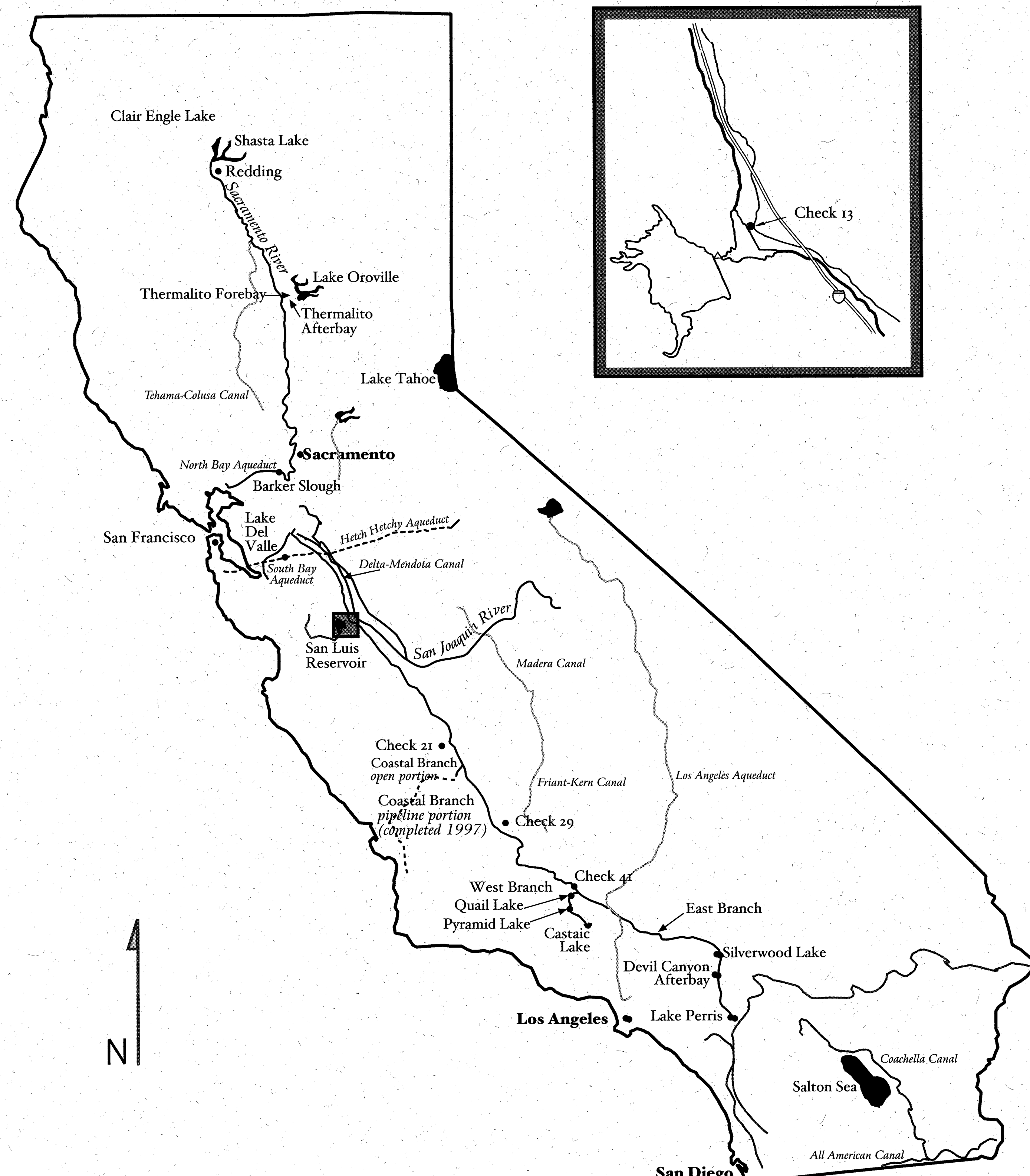
South Bay Aqueduct at Terminal Tank. The South Bay Aqueduct consists of both open canal and pipeline segments between its inception at the South Bay Pumping Plant and the storage tank, which is located at the terminus of the South Bay Aqueduct.

Delta-Mendota Canal at McCabe Road. Water quality data from this location represent the quality of water in the DMC that is pumped from the DMC into O'Neill Forebay where it mixes with water from the SWP system.

San Luis Reservoir at Tunnel Island. This station is located near intake to the Pacheco Pumping Plant on the West side of the San Luis Reservoir.

California Aqueduct/O'Neill Outlet (Check 13). This station is at the O'Neill Forebay outlet to the San Luis Reach of the California Aqueduct. The data characterize the combined quality of waters from the Delta-Mendota Canal and California Aqueduct as well as storage water from San Luis Reservoir.

California Aqueduct (Check 21). Check 21 is located on the California Aqueduct near Kettleman City and is at the downstream end of the San Luis Canal joint-use reach of the Aqueduct.


Clair Engle Lake
Shasta Lake
Redding
Sacramento River
Lake Oroville
Thermalito Forebay
Thermalito Afterbay
Lake Tahoe
Tehama-Colusa Canal
North Bay Aqueduct
Sacramento
Barker Slough
Lake Del Valle
San Francisco
Hetch Hetchy Aqueduct
South Bay Aqueduct
Delta-Mendota Canal
San Joaquin River
San Luis Reservoir
Madera Canal
Check 21
Coastal Branch open portion
Coastal Branch pipeline portion (completed 1997)
Friant-Kern Canal
Los Angeles Aqueduct
Check 29
Check 41
West Branch
Quail Lake
Pyramid Lake
Castaic Lake
East Branch
Silverwood Lake
Devil Canyon Afterbay
Los Angeles
Lake Perris
Coachella Canal
Salton Sea
All American Canal
San Diego
N
Check 13

California Aqueduct (Check 29). This station is on the California Aqueduct just below the Kern River Intertie.

Figure 4-24 Total Trihalomethane Formation Potential in the Delta Region

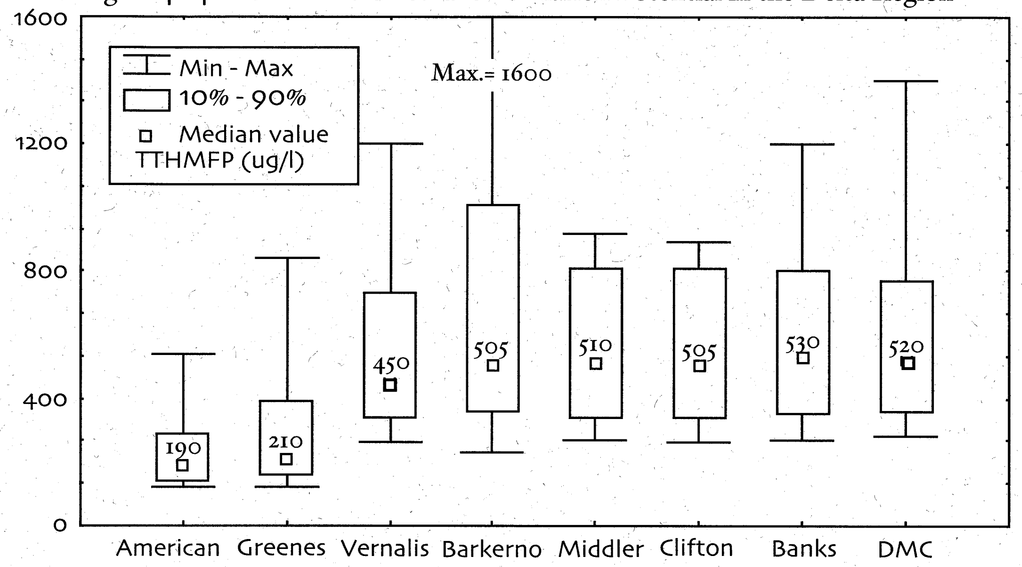
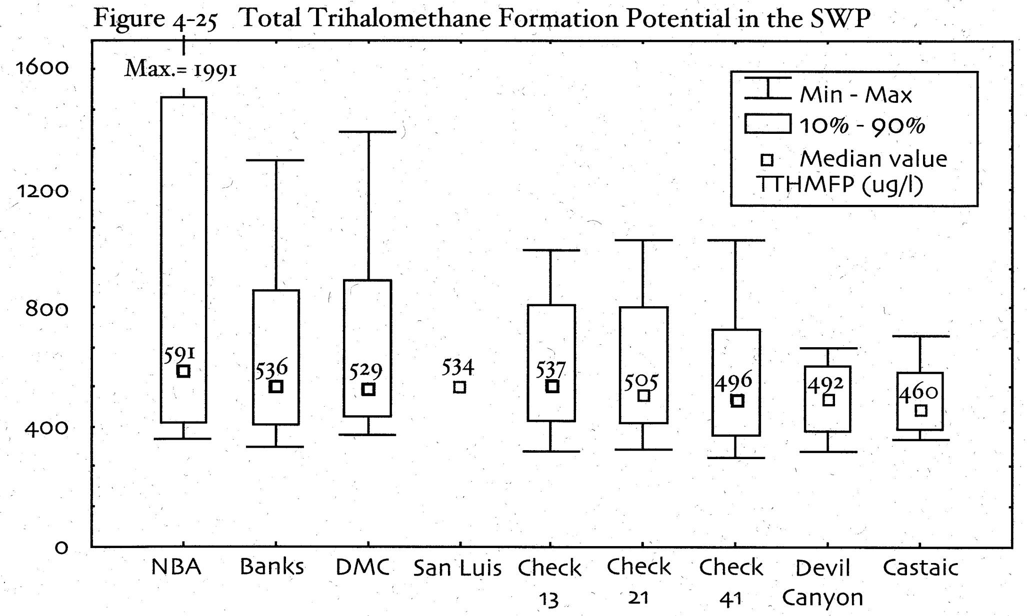


Figure 4-25 Total Trihalomethane Formation Potential in the SWP



California Aqueduct (Check 41) – Tehachapi Afterbay. This station is located just downstream of the tunnels through the Tehachapi Mountains at the point where the California Aqueduct bifurcates into the east and west branches.

Silverwood Lake at Tunnel Inlet. This lake is on the east branch of the California Aqueduct, at the point where water is sent through the San Bernardino Tunnel to Devil Canyon Power Plant.

California Aqueduct at Devil Canyon. Samples are collected in the afterbay of the Devil Canyon Power Plant. Water from this location is delivered to contractors in the San Bernardino and Riverside areas, and sent to Lake Perris.

Lake Perris at Outlet. Lake Perris is the terminal reservoir on the east branch of the California Aqueduct. The monitoring station is located at the point where deliveries are made to MWD's facilities. There is a pipeline that bypasses Lake Perris.

Pyramid Lake at Tunnel Inlet. Pyramid Lake is one of two large reservoirs on the west branch of the California Aqueduct. The sample station is located at the point where water is released to Castaic Lake.

Castaic Lake at Outlet Tower. Castaic Lake is a large reservoir on the west branch of the California Aqueduct. These data characterize the quality of water delivered at the terminus of the west branch at the point where MWD facilities begin.

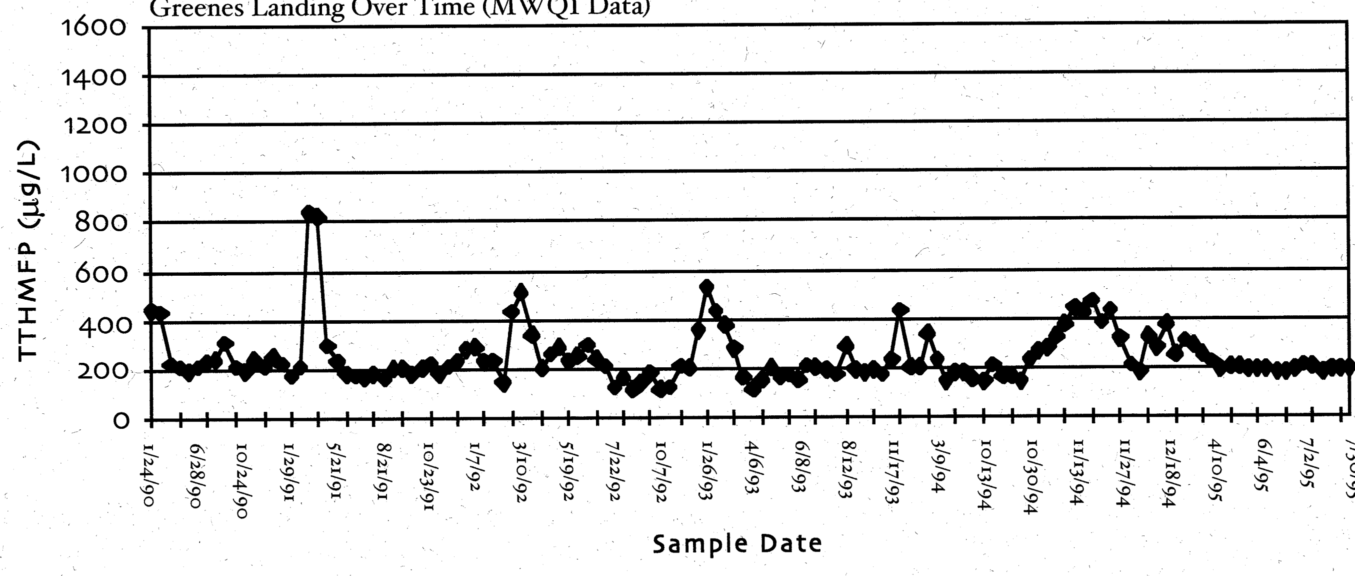
Water Quality Data

The water quality data from the MWQI and O&M monitoring programs are described in this section. Summary tables of the data are in Appendix B. These tables contain information on the constituents sampled, the number of samples, the range of values, the median, the tenth percentile, and the ninetieth percentile values. The period of record varies for each location and constituent. In general, the data presented in this section were collected between 1990 and 1995.

Disinfection By-Products

Total Trihalomethane Formation Potential. Since untreated water does not generally contain significant quantities of trihalomethanes (THMs), waters of the Delta and its tributaries are analyzed for total trihalomethane formation potential (TTHMFP), which is a test of the maximum capacity of a water source to form THMs upon chlorination. TTHMFP values obtained in this assay do not reflect trihalomethane concentrations actually produced in drinking water treatment facilities. Actual THM concentrations produced in drinking water treatment facilities are expected to be much lower

Figure 4-26 Total Trihalomethane Formation Potential in the Sacramento River at Greenes Landing Over Time (MWQI Data)



than the concentrations reported here.

Figure 4-24 shows TTHMFP concentrations at major stations in the Delta and its tributaries and Figure 4-25 shows TTHMFP concentrations along SWP. The NBA at Barker Slough has the highest TTHMFP values (range 120 µg/L to 1,600 µg/L) using data from both the MWQI Program and DWR's O&M. Banks Pumping Plant also has relatively high TTHMFP values (range 330 µg/L to 1,292 µg/L).

The American and Sacramento rivers at Greenes Landing inflows to the Delta have relatively low TTHMFP values, in the range of 120 to 840 µg/L (median values 190 µg/L and 210 µg/L, respectively). The San Joaquin River inflow has TTHMFP values in the range of 260-1,200 µg/L (median value 450 µg/L). These values are similar to TTHMFP values seen

Figure 4-27 Total Trihalomethane Formation Potential in the San Joaquin River at Vernalis Over Time (MWQI Data)

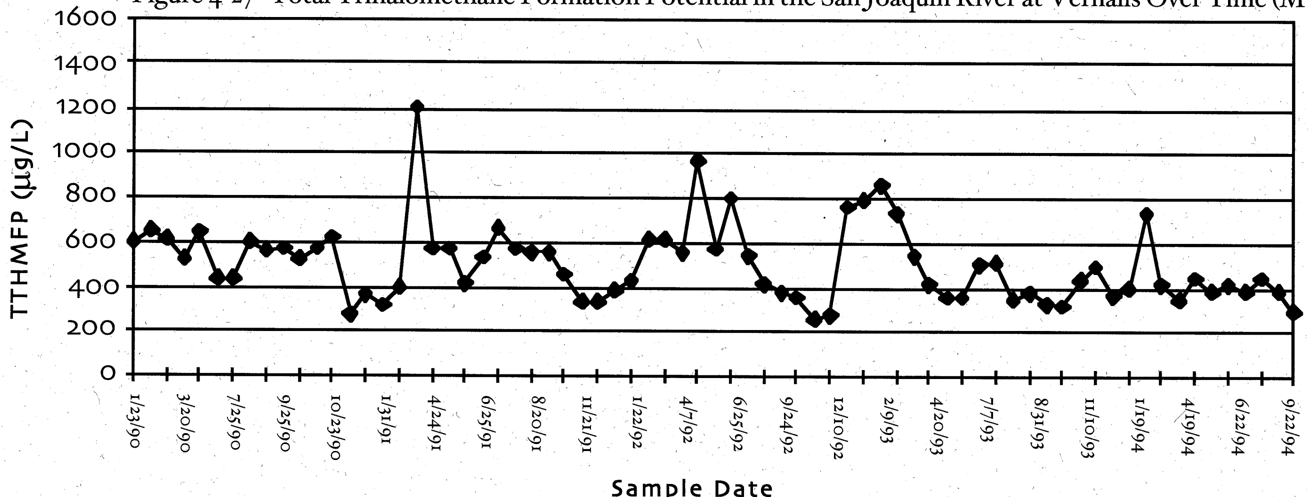
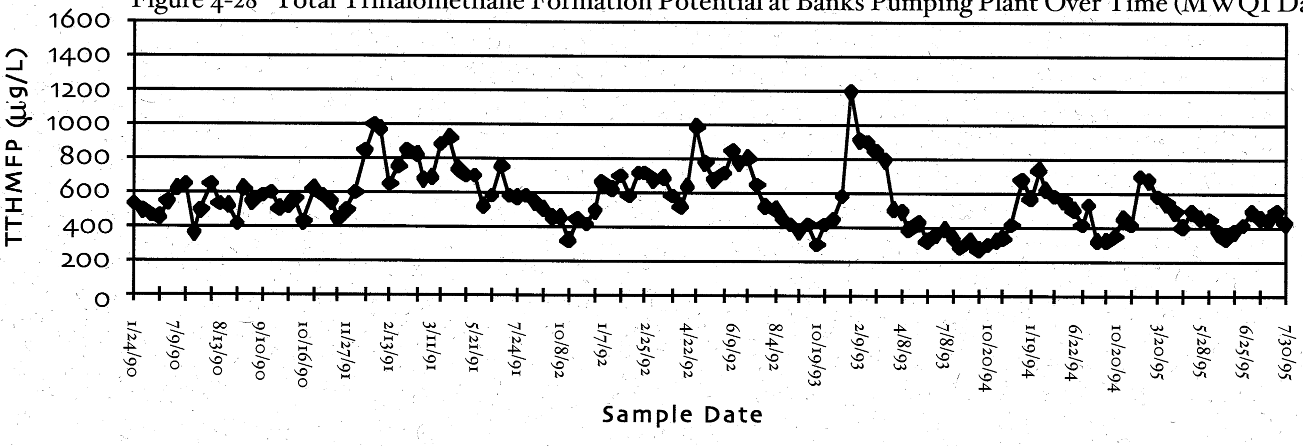
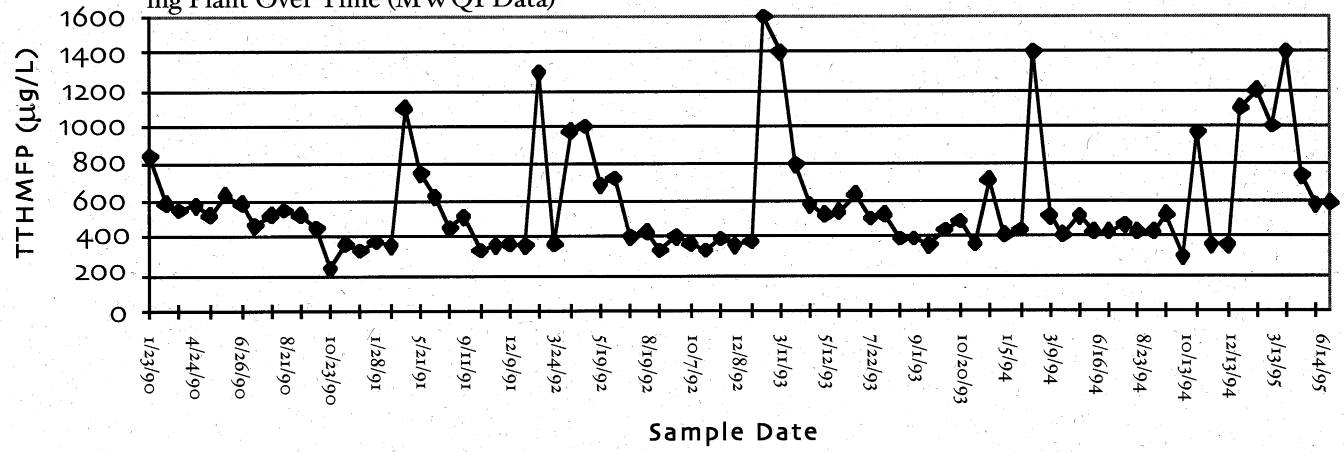


Figure 4-28 Total Trihalomethane Formation Potential at Banks Pumping Plant Over Time (MWQI Data)



in the last Sanitary Survey which included data from 1975 to 1989. In the last Sanitary Survey, median TTHMFP values for the American and Sacramento rivers were 210 µg/L and 255 µg/L, respectively. The median TTHMFP value of the San Joaquin River at Vernalis (from 1975 to 1989) was 470 µg/L, which is very close to the median value measured from 1990 to 1995 (450 µg/L).

Figure 4-29 Total Trihalomethane Formation Potential at Barker Slough at the North Bay Pumping Plant Over Time (MWQI Data)



The TTHMFP values of the Sacramento and American rivers are increased by about 300 µg/L by the time the water reaches Delta outflow stations. The TTHMFP values of the San Joaquin River are increased by about 100 µg/L by the time the water reaches Delta outflow stations.

TTHMFP values along the California Aqueduct are in the range of 500 µg/L. The values decrease somewhat from Banks Pumping Plant (median value 536 µg/L), to Check 13 (median value 537 µg/L), Check 21 (median value 505 µg/L), Check 41 (median value 496 µg/L), Devil Canyon (median value 492 µg/L), and Castaic (median value 460 µg/L). Maximum TTHMFP values are in the range of 1,000 µg/L and minimum TTHMFP values are in the range of 300 µg/L.

At the time of the last Sanitary Survey for SWP, DWR's O&M had just begun to monitor for TTHMFP. Therefore, there were no DWR data for stations south of the Sacramento-San Joaquin Delta.

Figures 4-26 through 4-29 show seasonal variation of TTHMFP values. In general, peak TTHMFP values are seen in the winter months. The highest TTHMFP values are seen at the NBA at Barker Slough and may be due to nonpoint source runoff during the winter months.

Although the TTHMFP results are not directly comparable to the actual amount of trihalomethanes formed at a treatment plant after disinfection, the TTHMFP values do indicate an increased likelihood of formation of THMs after treatment plant disinfection of water. Almost all of the TTHMFP values were greater than the MCL for total THMs of 100 µg/L. The greatest enrichment of SWP water with THM formation material occurs in the Delta and in the NBA at the Barker Slough watershed. This TTHMFP enrichment is on the order of 100-300 µg/L. General degradation of TTHMFP along the California Aqueduct decreases TTHMFP values at Southern California export sites by about 50 µg/L. The increase in TTHMFP in Delta waters is likely due to high organic carbon concentrations and high bromide concentrations. TTHMFP values are greatest in the winter months, probably due to winter nonpoint source runoff.

Figure 4-30 Dissolved Carbon in the Delta Region

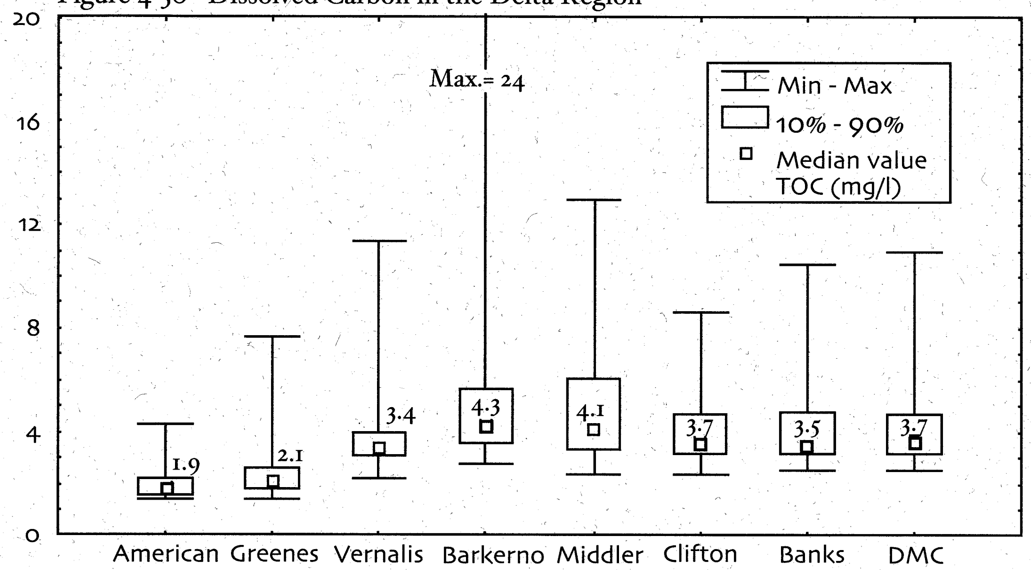
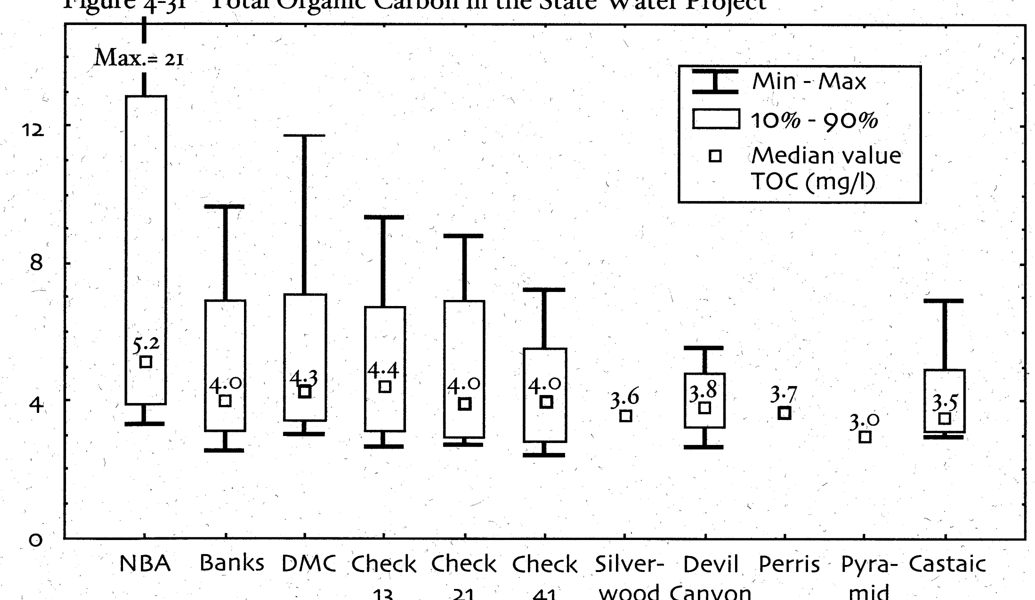


Figure 4-31 Total Organic Carbon in the State Water Project



Organic Carbon. The high TTHMFP levels in Delta waters are likely due to the relatively high organic carbon content. Organic carbon and chlorine are the basic and essential precursors in the formation of THMs during water treatment. Waters high in organic carbon may be highly colored and usually contain substantial quantities of humic and fulvic acids that produce DBPs upon chlorination. Figure 4-30 shows dissolved organic carbon (DOC) data for the Delta region and Figure 4-31 shows total organic carbon (TOC) data for SWP. Dissolved organic carbon is the fraction of carbon measured after filtration with a 0.45 micron filter, whereas total organic carbon water samples are not filtered.

Figure 4-32 Dissolved Organic Carbon at the Sacramento River at Greenes Landing Over Time (MWQI Data)

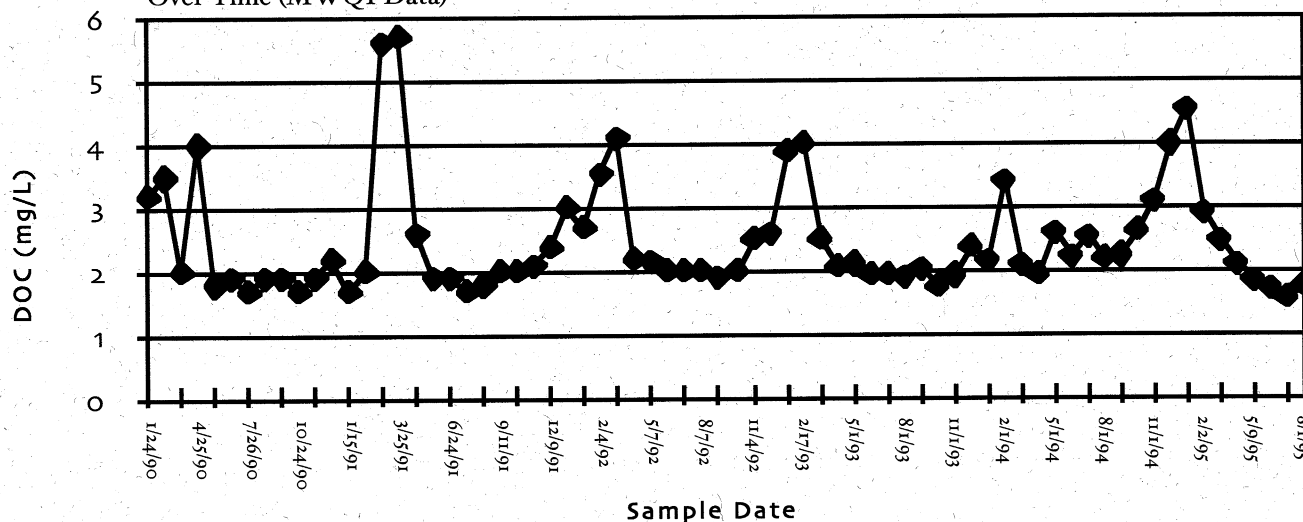
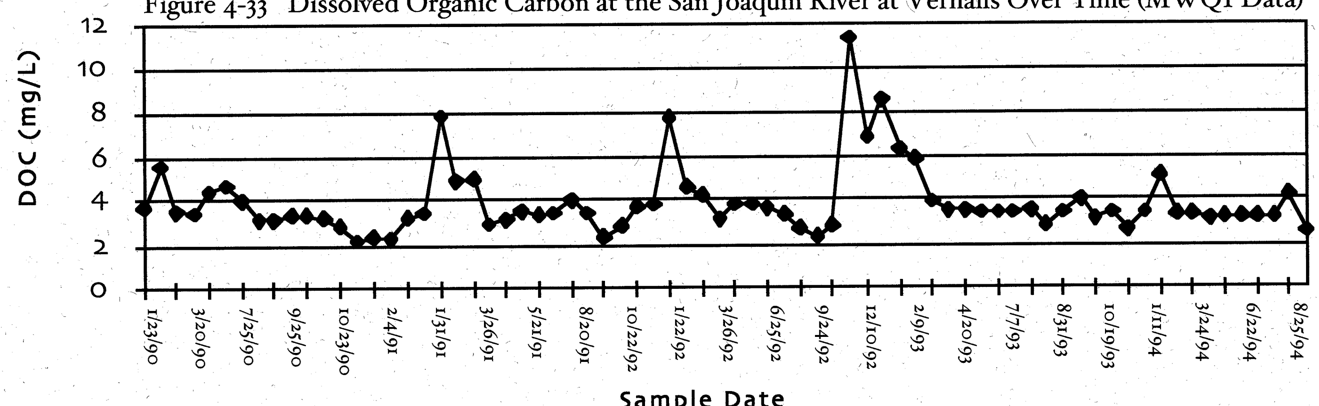


Figure 4-33 Dissolved Organic Carbon at the San Joaquin River at Vernalis Over Time (MWQI Data)



DOC and TOC concentrations of water supplies are a rough indication of the potential for THM formation, since the TOC and DOC measurements include the organic THM precursors. However, since not all TOC and DOC form THMs in the presence of chlorine, the relationship is not exact. Seasonal variation in DOC is seen in Figures 4-32 through 4-35.

The median DOC concentrations in the Delta increase as the water flows through the Delta. The median DOC concentration at the American River WTP inlet in Sacramento is 1.9 mg/L. The median DOC concentration in the Sacramento River at Greenes Landing, after the confluence of the American and Sacramento rivers, is 2.1 mg/L. Banks Pumping Plant, a Delta export site, has a median DOC value of 3.5 mg/L. These median concentrations are

Figure 4-34 Dissolved Organic Carbon at Banks Pumping Plant Over Time (MWQI Data)

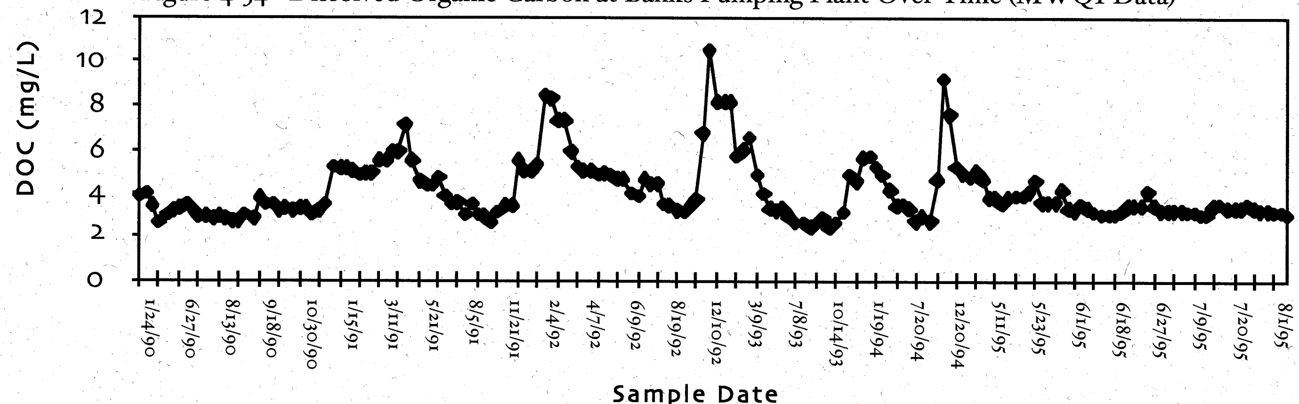
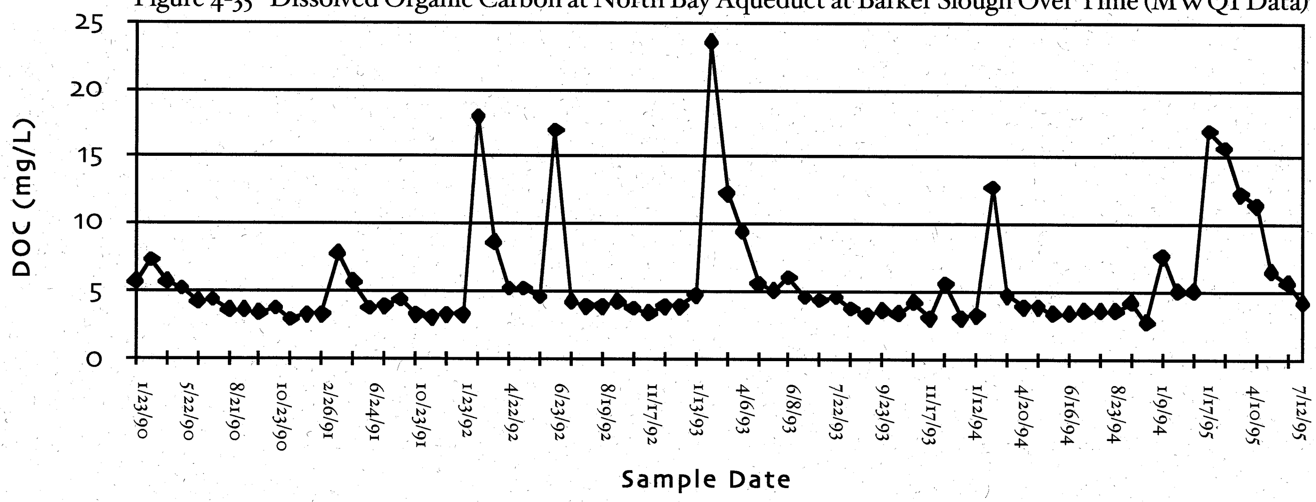


Figure 4-35 Dissolved Organic Carbon at North Bay Aqueduct at Barker Slough Over Time (MWQI Data)



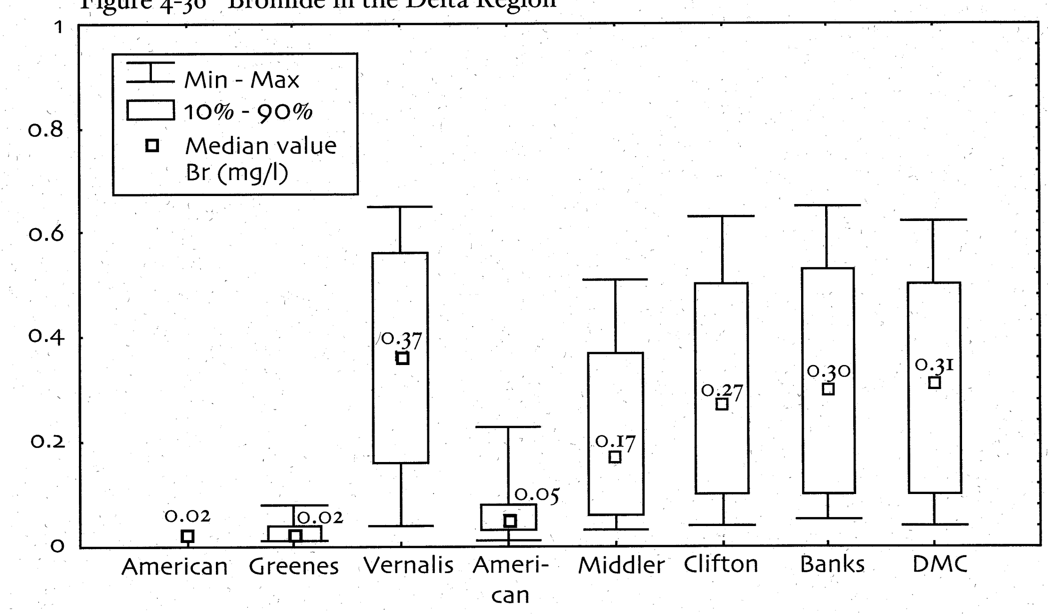
very similar to median TOC concentrations obtained during the last Sanitary Survey (1975-1989) of 2.0 mg/L at Greenes Landing and 3.9 mg/L at Banks. The NBA at Barker Slough had the highest median DOC value of 4.3 mg/L (with a maximum value of 24 mg/L), and the Middle River at Borden Highway (southern Delta) had the second highest median value of 4.1 mg/L.

Because DWR's O&M data were in terms of total organic carbon as opposed to dissolved organic carbon (MWQI data), the values for SWP and the Delta cannot be directly compared. For samples obtained at the NBA at Barker Slough, the MWQI median value for DOC was 4.3 mg/L and the median value for TOC measured by DWR's O&M was 5.2 mg/L. Therefore, there was an approximate concentration difference of 1 mg/L between the DOC and TOC values at this station. These concentrations are slightly less than the concentrations measured in the last Sanitary Survey at Barker Slough (median value 5.7 mg/L for 1975-1989).

The NBA at Barker Slough had the highest median TOC concentration of all the SWP sites monitored by DWR's O&M. The next highest median TOC concentrations were at DMC and Check 13 (O'Neill Forebay) with TOC concentrations of 4.3 mg/L and 4.4 mg/L, respectively. TOC concentrations decreased as water moved along the Aqueduct, ranging from 3.0 to 3.8 mg/L at the terminal reservoirs of the east and west branches of the Aqueduct. The previous Sanitary Survey reported median TOC values at terminal facilities of SWP ranging from 2.6 to 3.7 mg/L, which are similar to the median values obtained in this survey. The TOC and DOC median values measured in SWP were, in many cases, just below the proposed Disinfectants / Disinfection By-Products Rule limit of 4.0 mg/L TOC (depending upon source water alkalinity) in source water prior to treatment.

The higher concentrations of DOC in the Delta and SWP as opposed to the Sacramento River upstream of the Delta are probably due to a variety of factors including drainage from peat soils on islands in the Delta, organic inputs from the rivers, and bro-

Figure 4-36 Bromide in the Delta Region



mides of sea water origin. When present in the water, bromides readily enter the trihalomethane forming reaction to produce bromine-containing trihalomethanes.

Bromide. Bromides are of concern because formation of disinfection by-products increases in the presence of bromides. Also, THMs that contain bromine weigh more than chloroform, thereby increasing the likelihood of violating the current and proposed MCLs for total trihalomethanes in finished drinking water. Brominated methanes are also generally more difficult to control and remove than chloroform using current treatment processes (DWR 1994).

Bromides are important in the formation of THMs. THM formation increases in the presence of bromides and brominated THMs weigh more than THMs with chlorine, thereby increasing the likelihood that regulatory standards might be exceeded with respect to THMs. Bromide also can be converted to bromate upon ozonation. Bromate may be regulated under the proposed Disinfectants/Disinfection By-Products Rule at a level of 0.010 mg/L after water treatment.

Figure 4-37 Bromide in the State Water Project

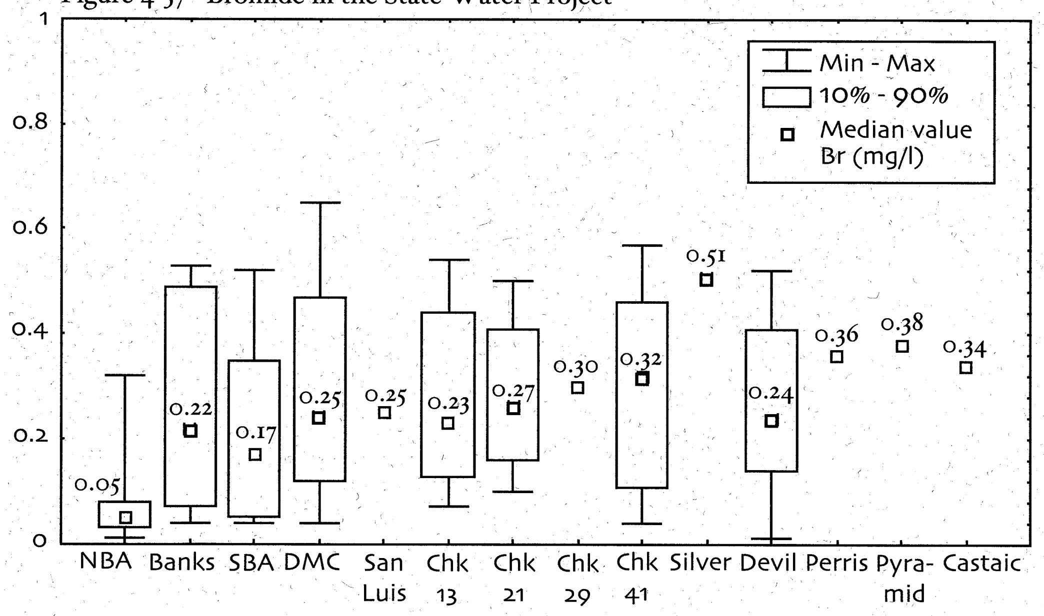


Figure 4-36 shows bromide concentrations in the Delta region and Figure 4-37 shows bromide concentrations in SWP. Median bromide values in the Delta ranged from 0.02 mg/L at the American River and the Sacramento River, to 0.37 mg/L at the San Joaquin River at Vernalis. The NBA at Barker Slough had a relatively low median concentration of bromide of 0.05 mg/L. The median concentration of bromide at Banks and the Delta-Mendota Canal was 0.3 mg/L. The station at the Banks Pumping Plant showed median bromide values of 0.22 mg/L. Bromide concentrations of 0.35 to 0.50 mg/L were seen at the reservoirs (Silverwood, Perris, Pyramid, and Castaic). However, these concentrations are single-point measurements based on the result of a single sample taken at each reservoir, and are not median values representing the entire range of concentrations which actually occur in each reservoir.

Sea water intrusion is the primary source of bromide in SWP, as can be seen in the substantial difference in bromide concentrations at the American and Sacramento rivers, as compared to the Southern Delta. Other sources of bromide include the San Joaquin River and connate water beneath some Delta islands.

<u>Total Dissolved Solids.</u> Total dissolved solids (TDS) is a measure of the solids present after filtration through a 1.2 micrometer filter. Particles that pass through the filter are considered dissolved. TDS is an indirect measure of salinity. Excess dissolved solids are objectionable in drinking water because of possible physiological effects, unpalatable mineral tastes, and higher costs because of corrosion or the necessity of treatment for corrosion control and softening. Figure 4-38 shows TDS

Figure 4-38 Total Dissolved Solids in the State Water Project

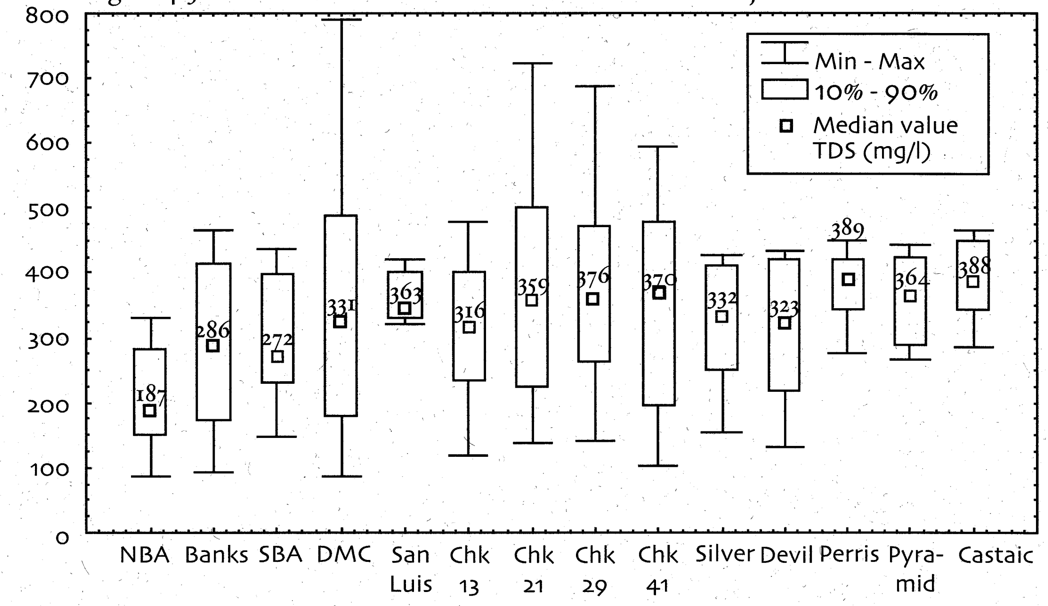


Figure 4-39 Specific Conductance in the Delta Region

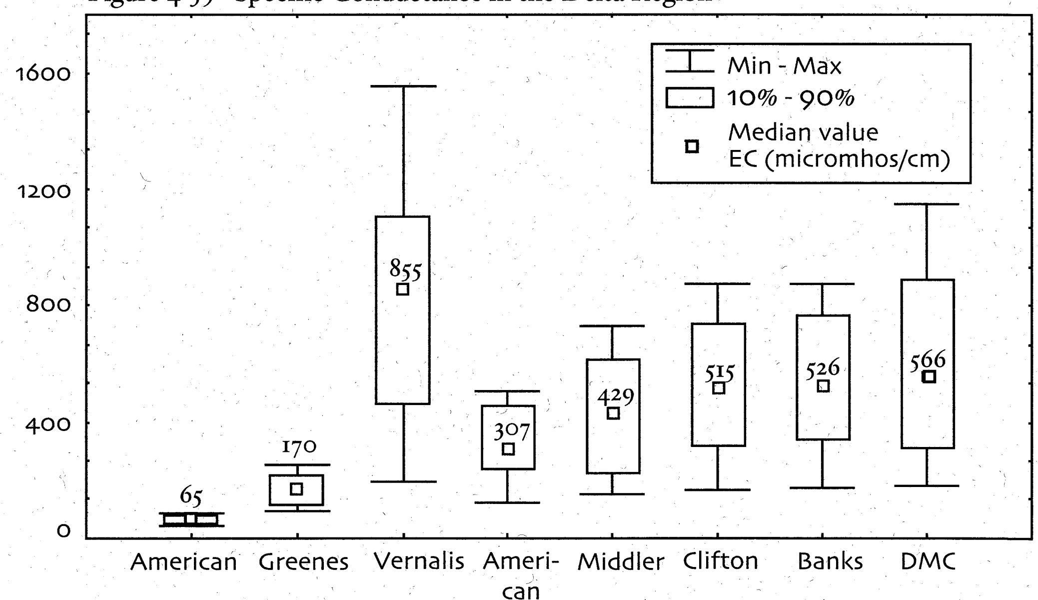
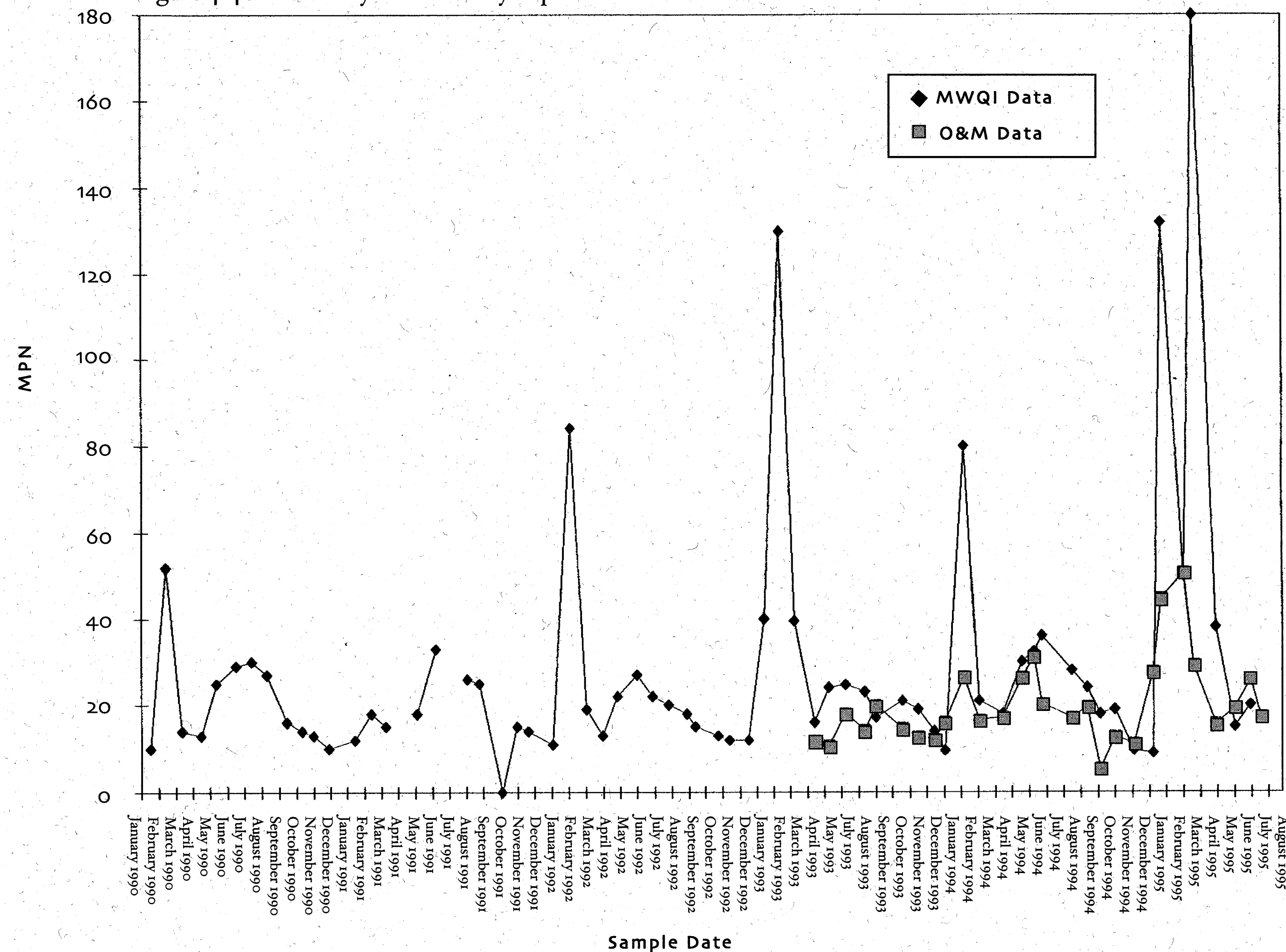


Figure 4-40 Turbidity at North Bay Aqueduct Over Time



concentrations throughout SWP. The NBA had a median TDS concentration of 176 mg/L. Other stations along the Aqueduct had TDS concentrations that ranged from 315-390 mg/L. The San Joaquin River contributes, in part, to TDS concentrations south of the Delta.

Electrical Conductivity. MWQI monitoring of electrical conductivity (EC) (specific conductance), another indirect measure of salinity, in the Delta region shows low EC values for the American and Sacramento rivers (median EC values of 65 and 170 micromhos/cm, respectively) (see Figure 4-39). San Joaquin River water introduces high concentrations of salts into the Delta as seen by the median EC value of 855 micromhos/cm at Vernalis. (The approximate relationship of TDS to EC is: TDS = 0.6 * EC).

Turbidity. Seasonal variation in turbidity at the NBA was examined. The DWR MWQI Program staff monitors the NBA on a monthly basis. DWR's O&M staff installed an auto sampler to monitor turbidity in May 1993. Figure 4-40 shows turbidity data plotted over time with MWQI data points representing individual samples and O&M data points representing monthly averages.

Turbidity median values ranged from 16 NTU (DWR O&M data) to 20 NTU (DWR MWQI data) in the NBA. Turbidity was generally higher during the winter months of January through March. The highest turbidity value (180 NTU) was observed in March 1995, a time of unusually heavy precipitation.

Figure 4-41 Chloride in the State Water Project

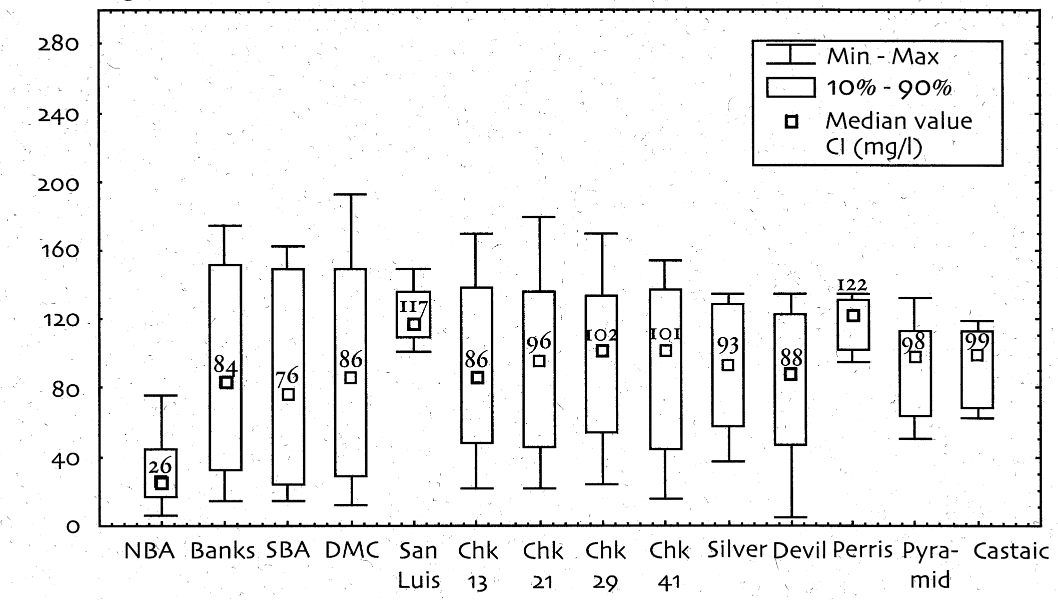
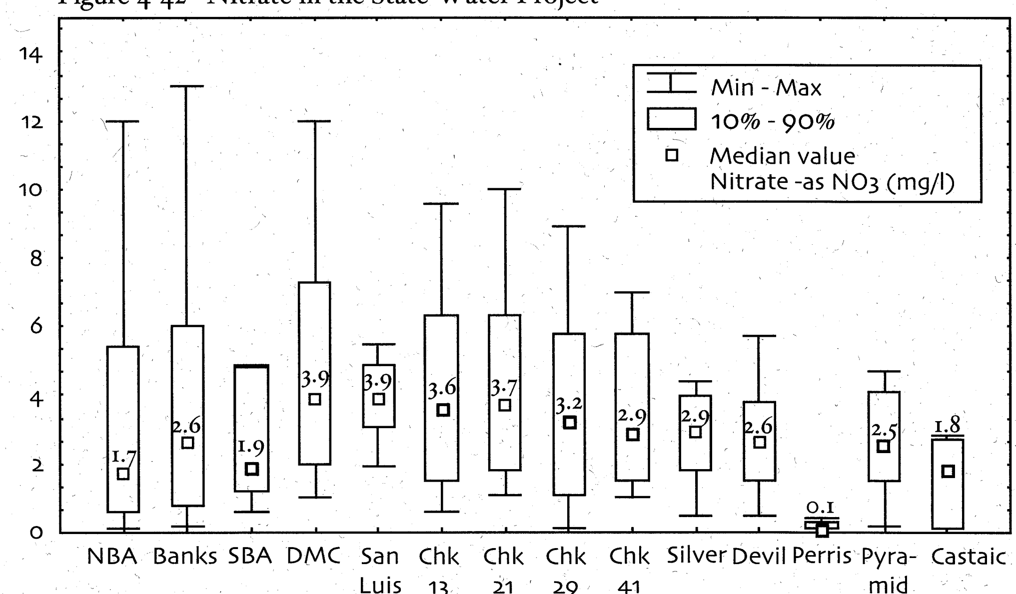


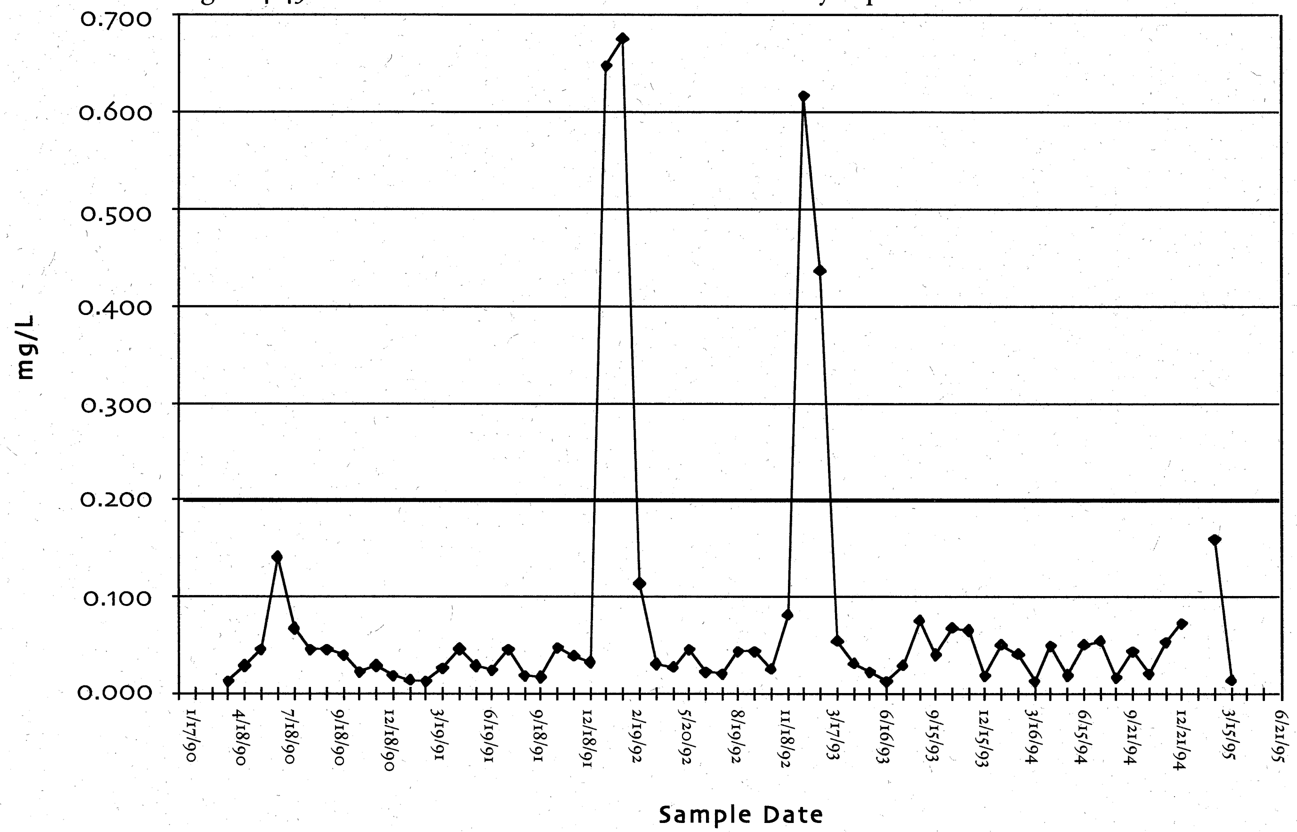
Figure 4-42 Nitrate in the State Water Project



<u>Chloride.</u> Chloride concentrations are also an in-

dicator of salinity in source water. Median chloride concentrations in the SWP ranged from 26 mg/L at the NBA at Barker Slough to approximately 120 mg/L at Lake Perris and San Luis Reservoir (see Figure 4-41). The South Bay Aqueduct median chloride concentration was 76 mg/L, which was lower than other stations along the Aqueduct that had median chloride values of 80 to 100 mg/L. All the chloride concentrations measured along the Aqueduct were well below the Secondary MCL of 250 mg/L.

Figure 4-43 Aluminum Concentrations in the North Bay Aqueduct Over Time



Algae and Nutrients

In the Delta and SWP, nitrogen is often a limiting nutrient for algal growth. As such, it is important to monitor. Excessive algal growth can lead to taste and odor problems, as well as filter clogging in WTPs and nuisance conditions in reservoirs.

Figure 4-42 shows nitrate concentrations (as NO_3) at SWP stations. All of the nitrate values are less than the State MCL of 45 mg/L. Median nitrate values range from 0.10 mg/L at Lake Perris, to 3.9 mg/L at the Delta-Mendota Canal. These concentrations are much less than the State MCL of 45 mg/L.

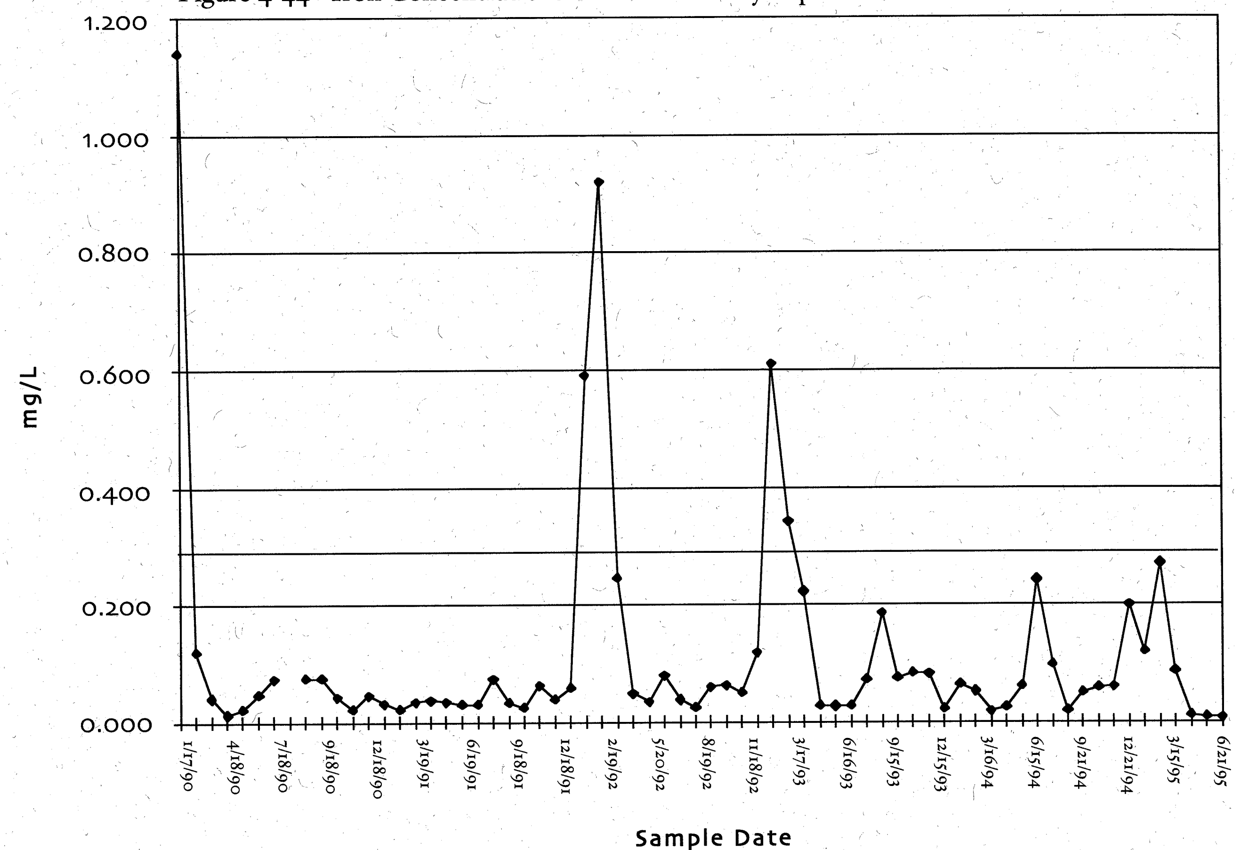
Nitrate is probably introduced in the California Aqueduct primarily from agricultural drainage in the San Joaquin and Sacramento rivers and in the Delta, and from waste WTP discharges.

Toxic Elements

Aluminum. The median aluminum concentrations measured in SWP ranged from 0.019 mg/L at Castaic to 0.042 at the Delta-Mendota Canal. These concentrations are much less than the secondary State and federal MCLs for aluminum of 0.2 mg/L. A few stations had maximum value concentrations that exceeded the secondary MCL. These stations were the NBA at Barker Slough (maximum = 0.7 mg/L), Check 13 of the California Aqueduct (maximum = 0.5 mg/L), and Check 21 of the California Aqueduct (maximum value = 0.4 mg/L).

Figure 4-43 shows aluminum concentrations at the NBA over time. The median value at the NBA was 0.041 mg/L, much less than the secondary MCL of 0.2 mg/L. Aluminum concentrations tended to

Figure 4-44 Iron Concentrations in the North Bay Aqueduct Over Time



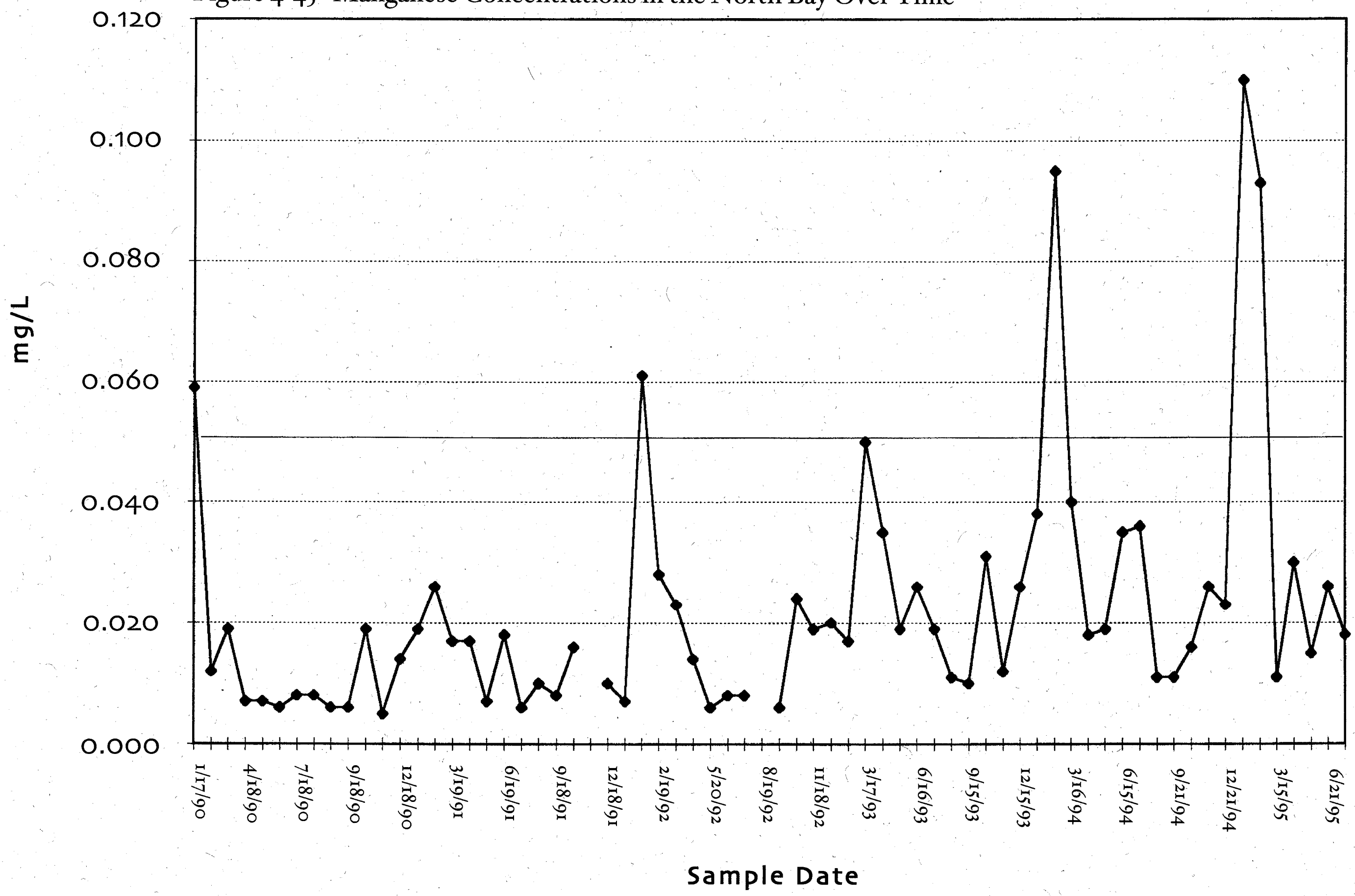
peak during winter months. In only 4 of 61 measurements were aluminum concentrations greater than the secondary MCL.

Arsenic. Arsenic median concentrations were 0.002 mg/L at all SWP monitoring stations except for Check 29 (at the California Aqueduct just below the Kern River Intertie) and Pyramid Reservoir where median arsenic concentrations were 0.003 mg/L. These concentrations are less than the federal and State MCL for arsenic of 0.05 mg/L.

Barium. Median barium concentrations along the California Aqueduct ranged from 0.05 mg/L to 0.06 mg/L. These concentrations are well below the federal MCL of 2 mg/L and the State MCL of 1 mg/L.

Cadmium. All of the cadmium concentrations measured along the California Aqueduct were less than the reporting limit of 0.005 mg/L, except for one sample which was measured at the 0.005 mg/L reporting limit at Pyramid Reservoir. The federal and State MCL for cadmium is 0.005 mg/L.

Figure 4-45 Manganese Concentrations in the North Bay Over Time



Chromium. All of the chromium concentrations measured along the California Aqueduct were less than the reporting limit of 0.005 mg/L. The federal and State MCL for chromium is 0.05 mg/L.

Copper. Most of the copper measurements were below the reporting limit of 0.005 mg/L. A few measurements were above the reporting limit, such as 0.012 mg/L at Check 29 and 0.009 mg/L at the South Bay Aqueduct. All of the copper concentrations were less than the primary treatment technique of 1.3 mg/L and the secondary MCL of 1.0 mg/L.

Iron. The maximum values ranged from 0.006 mg/L at Castaic to 0.052 mg/L at the NBA. All of the median values were much less than the secondary MCL of 0.3 mg/L. Only maximum values at the NBA at Barker Slough (1.1 mg/L) and at Check 13 of the California Aqueduct (0.4 mg/L) were slightly greater than the secondary MCL of 0.3 mg/L.

Figure 4-44 shows the variation in iron concentration over time at the NBA. Only four of fifty-eight samples exceeded the iron secondary MCL of 0.3 mg/L. These values occurred during the winter months of January through March. The median value at the NBA at Barker Slough (0.052 mg/L) was much less than the secondary MCL of 0.3 mg/L.

Lead. All of the lead concentrations at SWP stations were less than the reporting limit of 0.005 mg/L, except for one sample at Banks Pumping Plant which measured 0.005 mg/L. All of the samples were less than the federal action level for treatment for lead which is 0.015 mg/L.

Manganese. Many of the manganese measurements were less than the reporting limit of 0.005 mg/L. Median values ranged from 0.005 mg/L at Check 41 to 0.025 mg/L at Castaic. The maximum values at a few stations, NBA at Barker Slough (0.11 mg/L), the South Bay Aqueduct (0.13 mg/L), Check 13 (0.06 mg/L), Check 21 (0.14 mg/L) and Check 29 (0.26 mg/L) were greater than the secondary MCL for manganese, 0.05 mg/L; however, a majority of the data were less than the secondary MCL.

Figure 4-45 shows manganese concentrations over time at the NBA. The median value was 0.018 mg/L. Five of sixty-six measurements exceeded the secondary MCL. These high values occurred during the winter months of January and February.

Mercury. All of the mercury concentrations measured along the California Aqueduct were less than the reporting limit of 0.001 mg/L, except for one measurement taken on February 19, 1992. One of fifty-seven samples taken at this station was above the reporting limit. Therefore, this sample, which had a concentration of 0.006 mg/L, appears to be an anomaly.

Selenium. Many of the water quality samples taken along the California Aqueduct had concentrations less than the reporting limit of 0.001 mg/L. However, the Delta-Mendota Canal station, Check 13, Check 21, and Check 29 had reportable median selenium concentrations of 0.001 mg/L and 0.002 mg/L. These concentrations were less than the State and federal selenium MCLs of 0.05 mg/L. The maximum value measured (0.005 mg/L) was also well below the MCLs.

Silver. The median concentrations measured along the Aqueduct were all below the reporting limit of 0.005 mg/L. The secondary State and federal MCLs for silver are 0.1 mg/L.

<u>Zinc.</u> About half of the monitoring samples had zinc concentrations less than the reporting limit of 0.005 mg/L. Median zinc values ranged from 0.007 mg/L at Check 41 and Devil Canyon to 0.035 mg/L at the South Bay Aqueduct. All of the samples were much less than the zinc secondary MCL of 5 mg/L.

<u>Summary.</u> Most of the metals measured along the Aqueduct were below reporting limits and below State and federal MCLs. Aluminum, iron, and manganese were above the secondary MCLs at a few locations.

National Pollutant Discharge Elimination System Stormwater Monitoring Data

Storm water data from the County of Sacramento are presented here. Data from this program were included in the survey because storm water from the urban area of Sacramento drains into the watershed of the Sacramento-San Joaquin Delta through the Sacramento and American rivers. The data from this program may be significant with respect to the water quality of SWP.

Table 4-5
City of Sacramento Storm Water Monitoring Data – January 1994

Date	Location	Dissolved Organic Carbon (mg/L)	UVA 254nm (abs/cm)	Dissolved Ammonia (mg/L)	Bromodichloromethane (µg/L)	Bromoform (µg/L)	Chloroform (µg/L)	Dibromo chloromethane (µg/L)	Total TTHMFP (µg/L)
1/23/94	Sump 111	4.4	0.113	0.32	5	5	430	5	445
1/23/94	Sump 104	7.7	0.240	0.37	5	5	810	5	825
1/23/94	Strong Ranch Slough	8.2	0.245	0.39	6	5	780	5	796

Table 4-6
City of Sacramento Storm Water Monitoring Data – March 1995

Date	Location	Sample Number	Temp. (deg.C)	EC (uS/cm)	DOC (mg/L)	UVA 254nm (abs/cm)	Dissolved Ammonia (mg/L)	Bromodichloromethane (µg/L)	Bromoform (µg/L)	Chloroform (µg/L)	Dibromochloromethane (µg/L)	Total TTHMFP (µg/L)
3/2/95	Sump 111	50259	7.4	30	4.5	0.119	0.30	6	ND	410	ND	420
3/2/95	Sump 104	50260	4.6	64	8.9	0.252	0.80	9	ND	840	ND	850
3/2/95	Strong Ranch Slough	50261	5.0	43	8.0	0.238	0.45	7	ND	720	ND	730
3/9/95	Sump 111	50745	7.3	24	6.1	0.070	0.20	ND	ND	200	ND	200
3/9/95	Sump 104	50746	7.2	41	3.1	0.202	0.25	5	ND	480	ND	490
3/9/95	Strong Ranch Slough	50747	7.6	59	8.0	0.297	0.14	7	ND	670	ND	680

Data Source

County of Sacramento Storm water Monitoring Program

Since 1992, the County of Sacramento has been monitoring urban storm water in accordance with the Sacramento Urban Storm water NPDES Permit CA0082597, Order 90-158. The permit requires monitoring of urban runoff into the American and Sacramento rivers.

Program Description. To determine the impact of urban runoff on drinking water quality, the SWCs requested that the city of Sacramento collect storm water runoff samples for analyses pertinent to drinking water quality. The county of Sacramento performed storm water sampling for the cities of Sacramento, Galt, and Folsom. Storm water sampling data for the city of Sacramento are summarized here.

Water Quality Data

Storm water water quality samples were collected during three separate storm water sampling events and at three different sampling sites during each sampling event. Samples were collected on January 23, 1994, March 2, 1995, and March 9, 1995, at Sump 111, Sump 104, and Strong Ranch Slough. The samples were analyzed for dissolved organic carbon, total trihalomethane formation potential, ultraviolet absorbance at 254 nm, and nutrients.

The laboratory results of the storm water samples are shown in Table 4-5 and Table 4-6. The dissolved organic carbon concentrations ranged from 3.1 to 8.9 mg/L, while the total trihalomethane formation potential concentrations ranged from 200 to 850 µg/L. In all samples, chloroform was the primary trihalomethane analyte measured from the runoff samples, indicating bromide was not present in significant concentrations.

Summary

The results of the Sacramento storm water monitoring suggest that storm water runoff may be a significant source of organic carbon for the Sacramento River watershed, but the impact on the watershed has not been fully assessed.

San Luis Canal Segment of California Aqueduct – Turbidity Data

Storm water inflows from drain inlets and both portable and permanent pump emplacements are allowed into the Aqueduct (San Luis Canal at O'Neill Forebay segment) at times. Most of these storm water inflows occur over a 30-mile segment of the Aqueduct between Milepost 130 and Milepost 160, as shown in Figure 4-46. During the period of 1973 to 1993, these floodwater inflow volumes ranged from 0 to 41,938 acre-feet annually, and occurred on an average of 14 out of every 100 months. Such flood waters normally make up less than 10 percent of the San Luis Canal volume (DWR 1995*c*).

Between 1986 and 1993, Cantua and Salt creeks have accounted for most of the total inflow volumes. Prior to this period, the Arroyo Pasajero was the single largest source of floodwater to this segment of the Aqueduct. Operational modifications were made in 1986 to increase the ponding capacity in the Arroyo Pasajero watershed, which decreased inflows to

 Figure 4-46 Schematic of the California Aqueduct/San Luis Canal

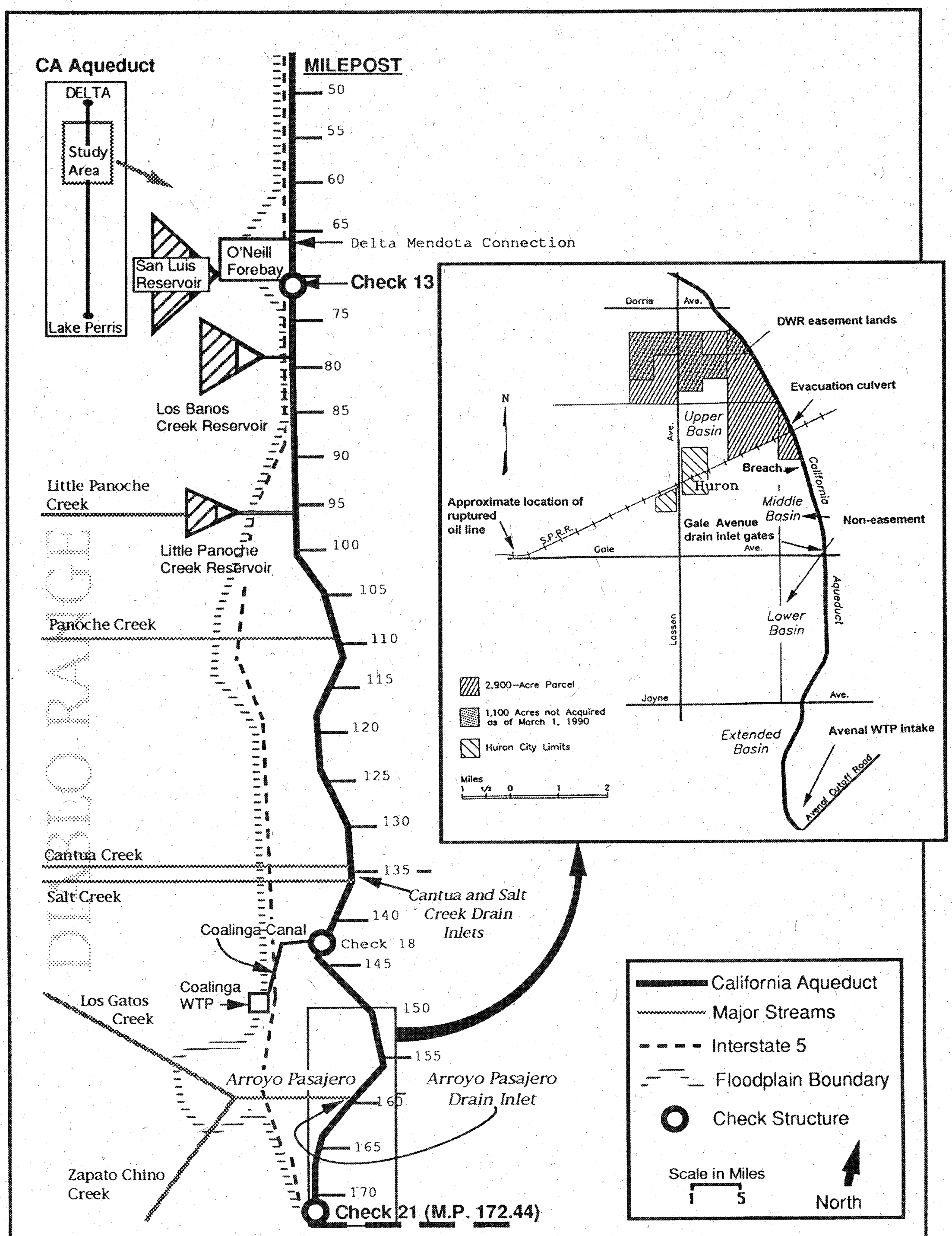


Figure 4-47 Pools 18-20, August 1995 Silt Depths

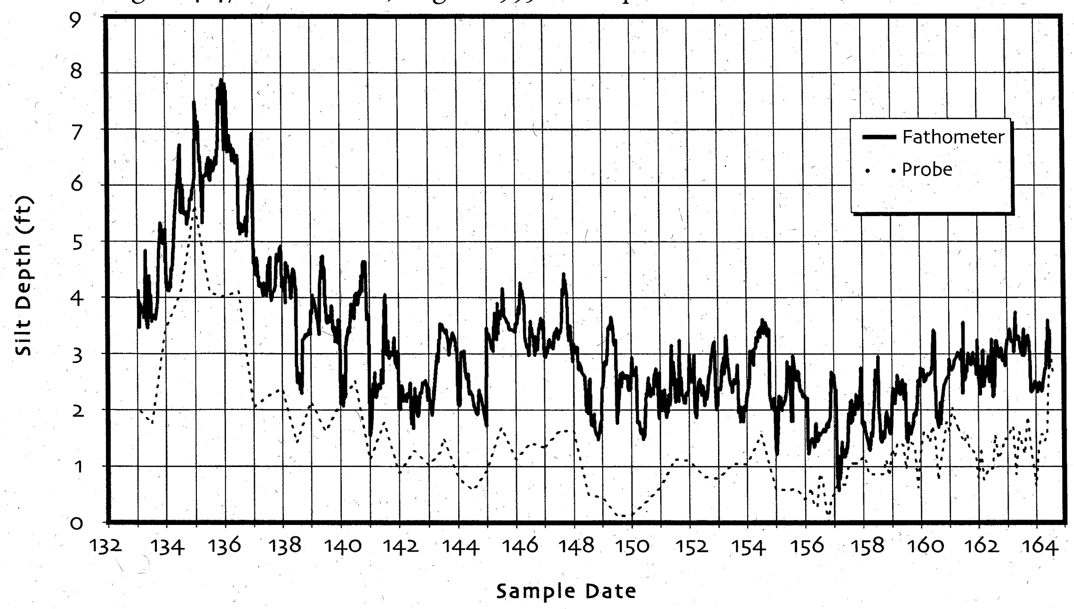
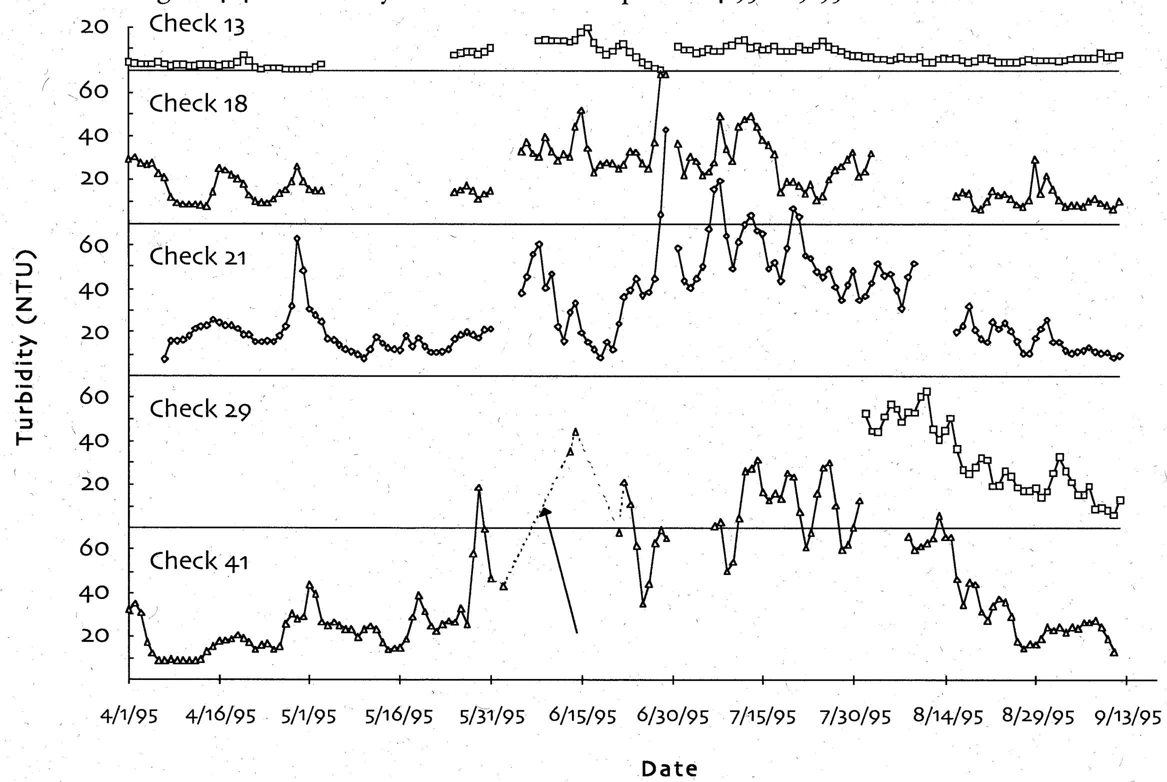


Figure 4-48 Turbidity in the California Aqueduct 4/95 to 9/95



the Aqueduct from this source. These flood waters are very turbid and contribute substantially to Aqueduct sediment loads. Iron, aluminum, selenium, magnesium, asbestos, TOC, and nitrate concentrations were found at high levels in the flood waters of some of the smaller watersheds, but have not been found to influence water quality in the Aqueduct in general (DWR 1995*e*).

Water Quality Data

The Storm Event of March 1995

On March 11, 1995, an embankment at the Arroyo Pasajero impoundment area failed at Milepost 157.4 on the Aqueduct (Figure 4-46). Flood waters from Cantua and Salt creeks also came over the Aqueduct embankment at Mileposts 134.93, 136.96, and 138.96. The failure occurred in the presence of heavy storm-related flood waters, and an improperly constructed private landowner encroachment through the embankment which may have contributed to the failure. The storm event also caused an oil pipeline to rupture, releasing oil to Arroyo Pasajero, some of which was ultimately carried into the Aqueduct through the damaged dike. The location of the damaged oil pipeline is shown in Figure 4-46.

The runoff into Arroyo Pasajero during the period was greater than 25,000 cfs. The breach of the embankment allowed approximately 600 cfs of floodwater to flow into the Aqueduct, while displacing a number of concrete panels which line the Aqueduct. Large amounts of sediment were carried into the Aqueduct by these floodwaters. The depth of silt in the Aqueduct was surveyed by DWR's San Luis Field Division at various points along the affected segment, and the measurements are displayed in Figure 4-47. The silt depth obtained using the probe is believed to be more accurate then the results obtained from the fathometer. This amount of sediment may no longer be present. A dredge test conducted December 1 to December 4, 1994 found less sediment than earlier measurements indicated.

Turbidity remained high in water deliveries south of Cantua and Salt creeks well after the event. The elevated turbidity resulted from the residual sediment/silt introduced into the Aqueduct from the March floodwater flows. The turbidity increased again beginning about June 1995, and is believed to be related to increased flows in the Aqueduct coinciding with agricultural crop production irrigation deliveries. Turbidity measurements performed by DWR's O&M for the period from April 1995 to September 1995 are displayed in Figure 4-48. Various methods of removing the sediment, if necessary, from the Aqueduct are currently being evaluated by DWR.

Fresno and Kings County Water Treatment Plant Emergencies

On the morning of March 10, 1995, storm-related flooding conditions occurred in this segment of the Aqueduct, with turbidities as high as 2,900 NTU reported at the Avenal WTP. The plant was eventually shut down due to a water main failure, the second such failure of this water main since 1988 (Avenal WTP Operator, personal communication May 1995). Upon start up of the plant, the operators were unable to comply with the drinking water treatment plant turbidity performance standards. This plant supplies both the Avenal State Prison and the city of Avenal with drinking water. The event was reported to the California Department of Health Services office in Fresno and to the Kings County Health Department. A boil order was issued two days later, and remained in effect for approximately ten days. At the time of the event, approximately 5.8 million gallons of water were held in storage tanks. Potable water was brought in by truck approximately five days after the event.

In a May 22, 1995, interview with the Avenal WTP operator, staff of the MWQI Program found that at the time of the emergency the WTP was receiving an estimated 30 to 50 percent of feed water from the SWP intake in the form of storm water. The Avenal WTP intake is located approximately 100 yards downstream of Check 21, an aqueduct flow control structure.

The cities in Fresno and Kings counties that were directly impacted by the floodwater and emergencies in the California Aqueduct are USBR water contractors and not SWP contractors. The cities of Coalinga and Huron also experienced similar sediment-related problems. However, due to the locations of their intakes on the Pleasant Valley Canal in the case of Coalinga, and a lateral off the main Aqueduct in the case of Huron, they did not experience the level of turbidity seen at the Avenal plant. The city of Huron did have to shut down its plant for several days to avoid having to treat highly turbid water. At start up, it was only able to operate one of its three treatment trains (the conventional treatment train) at 25 to 30 percent of design capacity.

As a result of the high turbidity in the water delivered to small systems and the Westlands Water District system, the County of Fresno issued an area-wide boil water advisory to all systems using this source. This advisory remained in effect for over two weeks. The contract operators of these smaller plants worked 10 to 12 hours per day during this period in order to return the plants to normal operation. These operators indicated that operational problems related to the high raw water turbidity were experienced until late August 1995.

According to the Avenal WTP operator, the package WTP installed by the prison generally does not handle high turbidity or sediment loads as well as other designs. While there was more sludge and mud than would normally be present, the plant sustained no permanent damage. There were also no adverse effects from a damaged petroleum product pipeline located approximately 10 miles upstream of the WTP.

The city of Avenal also operates an older conventional treatment plant with an up-flow clarifier, which was able to handle the high sediment loads more effectively than the new package treatment plant. The operators of the city of Huron treatment facilities, which consist of three different treatment plants, experienced the same problems seen with the package treatment plants they also operate.

Summary

Increased turbidities were experienced in the San Luis Reach of the California Aqueduct during spring 1995. These turbidities were the result of storm events, the breach of a dike in the Arroyo Pasajero and the flooding of Cantua and Salt creeks. The water quality events related to the spring storms are still being evaluated. However, higher sediment loads in the Aqueduct contribute to the following adverse effects on water supply systems:

Higher coagulant chemical costs are incurred to remove solids.

Higher disinfectant costs are incurred for systems that predisinfect.

Shorter filter runs result in an increased use of finished water for backwash operations.

Increased general equipment wear and shorter pump life are associated with raw water.

Solids disposal and wash water disposal cost more.

Inability to recharge in groundwater recharge spreading basins results in less stored water available for drought periods.

Increased plant operational oversight is needed to assure proper plant performance.

Treated effluent water quality deteriorates.

Conclusions and Recommendations

SWP Sanitary Survey Review and Action Plan Committee

Conclusion: This report is the five-year update of the initial 1990 Sanitary Survey of SWP. This survey update was designed and conducted to focus on the recommendations resulting from the initial survey, and to identify and evaluate water quality of SWP during the past five years since the initial survey was conducted.

In response to the initial survey, a SWP Sanitary Survey Review Committee was created to review the conclusions and recommendations of the 1990 report. The committee prioritized the recommendations made in the report, and actions were taken as follow-up to these recommendations. These follow-up actions were documented in SWP Sanitary Survey Action Plan.

Recommendation: To formulate an action plan for the recommendations made in this report, a SWP Sanitary Survey Review and Action Plan Committee should be created to prioritize the recommendations, and to determine the necessary actions for follow-up to these recommendations. In addition, the committee should review the status of all actions taken in response to the 1990 Sanitary Survey recommendations.

Pathogens

Conclusion: The Giardia lamblia and Cryptosporidium data from raw water sources now available vary in quantity and quality from treatment plant to treatment plant. The data are not adequate to observe trends in Giardia lamblia and Cryptosporidium concentrations over time, and it is difficult to compare results of Giardia lamblia and Cryptosporidium data between raw water sources of treatment plants due to difficulties with the current analytical techniques. The limited information on Giardia lamblia and Cryptosporidium suggest that raw water concentrations of these pathogenic organisms from SWP water are very low, with average concentrations of Giardia lamblia cysts and Cryptosporidium oocysts approximately five times lower than nationwide averages reported by M.W. LeChevallier, et. al. (September 1995, AWWA Journal).

Giardia lamblia cysts were detected in 23 (9 percent) of the 260 raw water samples collected by all of the reporting water agencies including DWR. The highest average concentration of *Giardia lamblia* cysts was found at the Sacramento River at Greenes Landing as sampled in the study conducted jointly by DWR and MWD (37 cysts/100L; range <8 to 82 cysts/100L, with one sample reported as <125 cysts/100L). *Cryptosporidium* oocysts were reported in 43 (17 percent) of the 253 raw water samples collected by all of the reporting water agencies including DWR. The highest average concentrations of *Cryptosporidium* oocysts were found at Greenes Landing on the Sacramento River, Banks Pumping Plant, and the Delta-Mendota Canal as sampled in the study conducted jointly by DWR and MWD (40-55 oocysts/100L; range <2 to 132 oocysts/100L).

The nationwide survey recently reported in September 1995 by LeChevallier, et. al., provided results of samples collected from 72 surface WTPs in 15 states and 2 Canadian provinces between March 1991 and January 1993. *Giardia lamblia* cysts were detected in 118 (45.0 percent) of 262 raw water samples. The geometric mean of detectable *Giardia lamblia* was 2.0 cysts/L (200 cysts/100L), with levels ranging from 0.02 to 43.8 cysts/L (2 to 4,380 cysts/100L). *Cryptosporidium* oocysts were detected in 135 (51.5 percent) of the 262 raw water samples. The geometric mean of detectable *Cryptosporidium* was 2.4 oocysts/L (240 oocysts/100L), with levels ranging from 0.065 to 65.1 oocysts/L (6.5 to 6,510 oocysts/100L).

Table 5-1
Potential Sources of Pathogenic Organisms in Watersheds

Watershed	Livestock Grazing	Wastewater Treatment	Recreational Use/Facilities	Wildlife Areas
Barker Slough/North Bay Aqueduct	✘	✘	✘	
Lake Del Valle/South Bay Aqueduct	✘	✘	✘	
San Luis Reservoir/O'Neill Forebay	✘	✘	✘	✘
Coastal Branch		✘		
Pyramid Lake	✘	✘	✘	
Quail Lake	✘		✘	
Castaic Lake	✘		✘	
Silverwood Lake	✘	✘	✘	
Lake Perris			✘	

The potential sources of pathogenic organisms in the watersheds are livestock grazing, recreational use and facilities, waste WTP failures, and wildlife areas.

Potential sources which exist in each individual watershed are listed in Table 5-1, Potential Sources of Pathogenic Organisms in Watersheds. Of the nine watersheds surveyed, livestock grazing occurs in eight watersheds, waste WTPs are found in five watersheds, recreational facilities and use are available in seven watersheds, and wildlife areas are found in one watershed.

Total and fecal coliform data from raw water sources now available are difficult to evaluate for comparisons due to differences in analytical techniques used by the water agencies.

For example, Palmdale Water District experienced increased coliform counts after a change was made in the analytical method. In addition, actual coliform counts in SWP water could not, in most cases, be determined because of blending of water at the treatment plants.

In general, however, raw water coliform values reported by the water agencies were highest for those agencies receiving water from the NBA and the South Bay Aqueduct.

Recommendation: Giardia lamblia and Cryptosporidium sampling should continue, and total and fecal coli-form sampling should be implemented, at selected locations on SWP. When problems with recoveries and precision of the analytical method for Giardia lamblia and Cryptosporidium are

solved, monitoring for these pathogens should be implemented at more locations.

Further investigation of each watershed should be conducted to further evaluate the potential sources of microbial contaminants identified.

Accurate numbers and types of livestock animals which graze in each watershed should be determined. In addition, for watersheds in which recreational facilities and use are available, the total number and locations of sanitary facilities should be determined. Coliform and turbidity sampling would provide information on the extent and significance of microbial contamination which occurs in each watershed.

In addition, the microbiological safety of SWP source waters should be comprehensively evaluated on an ongoing basis, and should include implementation of the following elements:

(a) Institute total and fecal coliform monitoring of SWP source water at key locations.

While coliforms may not be good indicators of pathogenic organisms (protozoa, viruses), coliform and turbidity measurements may be the only reliable measurements of general microbial contamination. Current analytical methods for *Giardia lamblia* and *Cryptosporidium* have been shown to have unreliable recoveries and precision.

(b) Work with municipal SWP contractors to coordinate monitoring in such a manner as to make data collected by the contracting agencies comparable to data collected from within the SWP system.

Effort should be made to develop comparable analytical techniques, and to provide monitoring data from unmixed SWP water supplies.

(c) On an ongoing basis, monitoring data from contracting agencies should be accumulated, along with data collected from within SWP.

These data should be comprehensively evaluated to: determine trends in microbiological source water quality, identify potential sources of sanitary degradation, and enhance the ability of contracting agencies to produce safely disinfected drinking water.

(d) Results of the data analyses and evaluations should be shared on an ongoing basis among municipal contractors and DWR staff.

Contractors experiencing unusual treatment experiences or events should coordinate among the participating agencies to maximize information exchange and opportunity for timely and effective response to microbiological treatment challenges.

Delta Enrichment of Trihalomethane Formation Potential and Organic Carbon in SWP Water

Conclusion: Water is enriched substantially in trihalomethane formation potential (THMFP) and organic carbon as it passes through the Sacramento-San Joaquin Delta.

THMFP and organic carbon levels at Delta export sites and in the NBA at Barker Slough are approximately double the levels in the Sacramento and American rivers. The San Joaquin River has the highest concentrations of THMFP and organic carbon entering the Delta, but even these concentrations are increased in the Delta before the water reaches Delta export sites.

Although THMFP and organic carbon concentrations decrease slightly in the California Aqueduct from the levels in the Delta, the terminal THMFP and organic carbon concentrations are still a drinking water quality concern. Terminal THMFP concentrations are in the range of 500 µg/L, and terminal organic carbon concentrations are in the range of 3.0-3.8 mg/L. The current maximum contaminant level for total trihalomethanes is 100 µg/L, and the proposed alkalinity dependent threshold for source water organic carbon removal is 2.0 mg/L of total organic carbon. The THMFP and organic carbon enrichment of SWP water in the Delta represents a significant cost to water treatment operators in maintaining trihalomethane and organic carbon levels within regulatory limits. (THMFP and the drinking water MCL for trihalomethanes are not comparable, as the THMFP measures the maximum capacity of a water source to produce trihalomethanes. Concentrations of trihalomethanes actually produced in WTPs are lower.)

Recommendation: ***Studies should be implemented to investigate means of reducing total and dissolved organic carbon levels in the Delta and in the NBA at Barker Slough.***

The MWQI Program of DWR has implemented studies which will investigate alternatives to reducing organic carbon loading in agricultural drainage:

(a) The MWQI Treatment of Delta Island Drainage to Reduce Total Organic Loads Study is an investigation of the use of flocculants to reduce organics and solids in agricultural drainage. This study should be expanded to investigate the feasibility of treating Barker Slough water.

(b) The MWQI Characterization of Dissolved Organic Carbon from Delta Island Soils Study is an investigation of the process in which organic carbon is leached from irrigated fields. The study should be continued to support the investigation of the effect of alternative land and water management practices and their efficacy at reducing dissolved organic carbon and silt in agricultural drainage.

(c) The MWQI Delta Island Water Use Study is an investigation of the mass load of organics and drainage contributed to Delta water by drainage from Delta islands. As part of this study, a model has been developed which characterizes water use on Delta islands. This model and water quality data can be used to investigate the results that alternative water management practices on Delta islands may have in improving the quality of Delta agricultural drainage. This study should also include investigation of the feasibility of implementing agricultural Best Management Practices to reduce agricultural drainage in the Delta.

(d) The MWQI Rice Field Drainage Study is an investigation on the contribution of total and dissolved organic carbon in agricultural drainage from rice fields to the Sacramento River. Because this study was initiated during an extremely wet year (1994-95), it was not possible to determine the contribution of organic carbon from rice fields based on the results of the first year of the study. The study should be expanded to include other drainages, rice fields, and channel waters, and to collect data for other types of water years.

Dissolved Solids and Turbidity in the Aqueduct

Conclusion: ***Elevated dissolved solids and turbidity measurements were found in the California Aqueduct, south of the Delta. The elevated dissolved solids and turbidity appear to be primarily a result of salts and sediment in the Delta estuary and the San Joaquin River, and of flood water inflows to the California Aqueduct from Cantua and Salt creeks.***

During the storm conditions of spring 1995, turbidity was increased in the San Luis Reach of the Aqueduct due to a breach in the Aqueduct arising from flood conditions.

Recommendation: ***The efficacy of measures to reduce turbidity in the Aqueduct should be investigated. This could include the implementation of measures to reduce the silt load in agricultural drainage, greater restrictions on the dissolved constituent content of any groundwater pump-ins to the Aqueduct, and preventative measures to reduce the possibility of breaches to the Aqueduct, such as the Arroyo Pasajero incident which is currently undergoing extensive study.***

In response to flooding problems in Arroyo Pasajero, an Arroyo Pasajero Multi-Agency Forum was created. Among other water-related problems in the area, the Forum will be reviewing and commenting on the development and implementation of a feasibility study created jointly by the U.S. Army Corps of Engineers and DWR on corrective actions to prevent similar incidents from reoccurring. The progress of this feasibility study and of the implementation of corrective actions should be monitored. In addition, the SWP Sanitary Survey Review and Action Plan Committee should monitor all activities in Arroyo Pasajero.

Two draft EIRs, submitted by Westlands Water District for proposed groundwater pump-ins to SWP are currently under review. The progress of these proposals should be monitored to prevent the degradation of drinking water quality in SWP by the proposed pump-ins. In addition, the Inflow Committee of DWR is currently in the process of developing a revised policy for pump-ins. The activities and decisions of this committee should also be monitored to ensure that the adopted policy is adequate to prevent the degradation of drinking water quality in SWP.

Bromide

Conclusion: ***Elevated bromide concentrations were found in the export sites of the Delta, the San Joaquin River at Vernalis, and at some of the reservoirs in the east and west branches of the California Aqueduct.***

These concentrations, which ranged from 0.30 to 0.50 mg/L, complicate achievement of the bromate and trihalomethane levels required by the Disinfectants/Disinfection By-Products Rule.

Recommendation: ***Monitoring should be continued for bromide in the Delta, in the San Joaquin River, and in the terminal reservoirs of SWP.***

The primary source of bromide to SWP is from the intrusion of sea water into the Delta. The possibility of controlling bromide concentrations in source waters should be investigated.

Table 5-2
Hazardous Waste Facilities/Hazardous Materials Releases

Watershed	Hazardous Waste Facility within Watershed	Hazardous Waste Facility in Adjacent Watershed	Emergency Responses to Hazardous Materials Releases within Watershed	Emergency Responses to Hazardous Materials Releases in Adjacent Watershed
Barker Slough/ North Bay Aqueduct	4	12	0	1
Lake Del Valle/ South Bay Aqueduct	0	2	0	0
San Luis Reservoir/ O'Neill Forebay	3	5	0	3
Coastal Branch	2	3	4	1
Pyramid Lake	0	1	0	6
Quail Lake	0	3*	0	2
Castaic Lake	1	1	1	1
Silverwood Lake	1	2	2	1
Lake Perris	0	4	1	2

* Two of these sites are also listed on the CERCLIS list

Hazardous Waste Facilities/Hazardous Materials Releases

Conclusion: ***Of the nine watersheds surveyed, five watersheds were identified as having facilities which generate, transport, treat, store, or dispose of hazardous waste, existing within the watershed.***

A total of 11 facilities were identified within these five watersheds. In watersheds adjacent to the nine watersheds, a total of 33 hazardous waste facilities were identified.

In addition, a total of 25 emergency responses to hazardous materials releases, both within the watersheds and in adjacent watersheds, were identified.

The majority of identified hazardous waste facilities were in adjacent watersheds, as were the majority of emergency responses to accidental releases of hazardous materials. The total number of hazardous waste facilities and emergency responses to hazardous materials releases are summarized in Table 5-2, Hazardous Waste Facilities/Hazardous Materials Releases.

Recommendation: ***Although the majority of hazardous waste facilities exists and the majority of incidences of hazardous materials releases occurs outside of the immediate watershed area, potential contamination in the watershed could occur if contaminants are transported through the watershed area. To further evaluate the potential for contamination from all of the hazardous waste facilities, both within the watersheds and***

in adjacent watersheds, an inventory of hazardous materials, business plan, and emergency response plan of each facility should be obtained and reviewed.

This information would provide an estimate of the volume of hazardous waste which exists in the watershed areas, and the standard operating and emergency response procedures of the facilities in storing and handling hazardous waste.

Incidences of emergency responses to hazardous materials releases should be reviewed in detail to determine the types and amounts of materials released and the potential for contamination in the watershed from the release.

This information would be valuable in evaluating conditions which make the watersheds vulnerable to contamination, such as current and alternate routes of transportation for hazardous materials transporters.

Urban Runoff

Conclusion: Storm water runoff from the city of Sacramento contributes total and dissolved organic carbon to the rivers that flow into the Delta. This runoff may be a significant source of organic carbon to the Delta.

Recommendation: Storm water sampling for the city of Sacramento should be continued and expanded to include analysis of parameters of drinking water concern.

The proposed sampling for the 1995-96 County of Sacramento Storm water Monitoring Program includes total and dissolved organic carbon, total and fecal coliforms, and nutrients.

The MWQI Program will monitor the results of the samples collected under this program.

In addition, storm water monitoring in other cities and urbanized areas should be monitored and reviewed to determine the extent of discharge of contaminants of drinking water concern into the watersheds.

These areas would include other cities and urbanized areas along the Sacramento River and the San Joaquin River, and tributaries to these rivers.

Barker Slough

Conclusion: Approximately 80 percent of the entire watershed is used for grazing by cattle and sheep.

Based on 1994 county records, 52,000 cattle and calves and 50,000 sheep were estimated in the county. Although the actual number of livestock animals in the watershed is not exactly known,

coliform concentrations at drinking water supply intakes of the NBA suggest that significant microbial contamination may exist in the watershed.

In July 1994, DWR responded to the draft EIR for the proposed expansion of the Argyll Park/Campbell Ranch project, a motocross race track facility located 1.5 miles to the west of the NBA pump house.

The planned construction activities at the site are subject to the provisions of the National Pollutant Discharge Elimination System (NPDES) permit process, which controls waste discharges to waters under the Clean Water Act. In addition, a Storm Water Pollution Prevention Plan (SWPPP) is required to establish physical and management controls of storm water runoff for construction at the site, and for when the recreational site is in operation. DWR's concern was for inadequate safeguards for runoff during operation of the recreational site, which may contribute pollutants to Barker Slough. The draft EIR is scheduled for review and approval by Solano County in early 1996.

Organic carbon concentrations are highest in the NBA watershed.

Potential sources of organic carbon in this watershed include agricultural and urban runoff, and upstream releases of stagnant waters.

While most of the metals measured along the Aqueduct were below reporting limits and below State and federal MCLs, aluminum, iron, and manganese were above the secondary MCLs at the NBA.

The NBA was found to have more water quality problems when compared to other components of the SWP.

Recommendation: To assess the potential and extent of microbial contamination in Barker Slough, total and fecal coliform sampling should be implemented atand around the NBA Pumping Plant, as part of implementing Recommendation #2.

This information would provide better estimates on the extent of microbial contamination in the watershed.

Raw water monitoring data collected by NBA contractors should be gathered and comprehensively assessed on an on-going basis.

The progress on the development of the Argyll Park/Campbell Ranch project should be monitored to determine if the recommendations made by DWR are being followed.

Studies should be conducted to identify and characterize organic carbon inputs into the NBA watershed.

The source(s) for the levels of the metals aluminum, iron, and manganese above the secondary MCLs at the NBA should be characterized.

A system should be developed to alert NBA contractors when significant degradation of water quality has occurred.

It is anticipated that the recommendations in this report will be addressed by a Sanitary Survey Action Committee in much the same manner as the recommendations resulting from the 1990 Sanitary Survey were addressed by the orignial Sanitiary Survey Action Committee, and can be considered as work in progress.

Lake Del Valle and the South Bay Aqueduct

Conclusion: Significant microbial contamination of the Lake Del Valle watershed may occur as a result of two potential significant sources: 1) cattle grazing in the Arroyo Valle drainage, and 2) recreational facilities and activities in the lake.

Raw water coliform values provided by the Alameda County Water District, the Alameda Flood Control District, and the Santa Clara Valley Water District suggest that significant microbial contaminants could exist in Lake Del Valle and the South Bay Aqueduct.

Limited information on Giardia lamblia and Cryptosporidium in raw water sources provided by DWR's Operations and Maintenance; Alameda County Water District; Alameda County Flood Control and Water Conservation District, Zone 7; and Santa Clara Valley Water District suggests that concentrations of these pathogenic organisms from Lake Del Valle and the South Bay Aqueduct are not significant.

This information is difficult to evaluate, however, because of the variable recoveries of current analytical methods.

Table 5-3
Solid Waste Landfill Sites

Watershed	Within Watershed	In Adjacent Watershed
Barker Slough/ North Bay Aqueduct	2	2
Lake Del Valle/ South Bay Aqueduct	0	0
San Luis Reservoir/ O'Neill Forebay	0	2
Coastal Branch	0	1
Pyramid Lake	0	0
Quail Lake	0	0
Castaic Lake	0	0
Silverwood Lake	0	0
Lake Perris	0	1

Recommendation: To assess the potential and extent of microbial contamination in Lake Del Valle and the South Bay Aqueduct, total and fecal coliform sampling should be implemented at several locations along the Aqueduct and Lake Del Valle, as part of implementing Recommendation #2.

This information would provide better estimates on the extent of microbial contamination in this watershed, and the relative contributions of microbial contaminants from potential sources.

Solid Waste Landfills

Conclusion: Of the nine watersheds surveyed, four watersheds were identified as having solid waste landfills existing either within the watershed or in adjacent watersheds. A total of 8 landfill sites were identified within these four watersheds.

Table 5-3 Solid Waste Landfill Sites summarizes the locations of the identified sites. The majority of identified solid waste landfill sites exist in adjacent watersheds. The Barker Slough watershed had the most number of landfill sites, two of which are within the watershed and two in adjacent watersheds.

Potential contamination in the watershed from the solid waste landfill sites and operations would include runoff from the landfill sites, accidental releases of solid waste during transportation through the watershed, and failure of the leachate collection systems. Contaminants released from the landfill sites and operations could include nutrients, organic carbon, coliforms, and pathogenic organisms.

Recommendation: To further evaluate the potential for contamination from all of the solid waste landfill sites, a review of each landfill site should be conducted to determine the types and volume of solid waste which exists at each site, the topography of the landfill site, any records of accidental releases, the design of the landfill sites, and *the standard operating and emergency response procedures. Incidences of accidental releases should be reviewed to determine the frequency and potential for contamination in the watershed from the release. Any monitoring data of surface runoff from the landfill should be reviewed to determine the types of contaminants which may be released from the landfill operation.*

This information would be valuable in evaluating conditions which place the watersheds vulnerable to contamination, and which may be corrected by changes in operational procedures.

Underground Storage Tanks

Conclusion: Leaking underground storage tanks typically result in subsurface contamination to soil and groundwater, which may impact surface water. All of the watersheds contain underground storage tanks (USTs) for diesel fuel or gasoline storage.

In five of the watersheds, leaking underground storage tanks (LUSTs) were identified. The location of the leaking tanks were determined, and the status of each tank was reported when data on the tank was available. These five tanks were associated with operation of equipment or recreation activities at the lakes, and were within 1,000 feet of a surface water body. One tank at Pyramid Lake (Emigrant Landing area) was identified as leaking; however, the status of removal is unknown at this time.

Recommendation: Further evaluation of the status of underground storage tanks within the watersheds should be performed, particularly those known to have leaked. Records from regulatory agencies should be reviewed, and progress of any remedial activities should be closely followed.

Emergency Action Plan

Conclusion: An emergency action plan has been developed by DWR to provide comprehensive, easy to follow, and up-to-date information to persons responding to emergencies, and to serve as a reference for pre-emergency training. The emergency action plan for each of the five Field Divisions of the SWP follow the same format. The format was designed to provide logical pre-emergency training, to provide quicker reference in emergencies, and to reduce obsoles-cence by making updating easier.

Recommendation: The SWP Sanitary Survey Review and Action Plan Committee should review the information and organization of the emergency action plan to ensure that the document is up-to-date and functionally adequate.

Drinking Water Standards

Conclusion: A recommendation was made in the 1990 Sanitary Survey Report that DWR should stay abreast of drinking water standards of the U.S. Environmental Protection Agency and the California Department of Health Services, and that DWR should review and revise SWP monitoring programs in response to changes to drinking water standards.

Recommendation: DWR's water quality monitoring program should continue to be updated to

reflect the current water quality regulations.

This has already been initiated in the MWQI Program under the New Parameters Plan, which started in June 1995. The New Parameters Plan consists of quarterly monitoring of parameters that have been newly regulated, or are anticipated to be regulated. These new parameters include chemical compounds newly regulated under the Phase II Rule and the Phase V Rule, and chemical compounds soon to be regulated under the proposed Phase VIB Rule.

Since O&M operates five DHS licensed WTPs, it is necessary to follow developments in the drinking water industry and modify monitoring to respond to regulatory changes. A one-year Phase II/Phase V monitoring effort is now underway at these plants in response to DHS requirements.

Petroleum product pipelines

Conclusion: Several oil pipelines exist within close proximity of SWP facilities.

During the March 1995 storm, a Chevron oil pipeline ruptured, releasing oil to Arroyo Pasajero, some of which was ultimately carried into the Aqueduct. Other incidences of oil pipeline breaks near SWP facilities include the April 1993 failure of ARCO's Line 63 which released 147,000 gallons, and the failure of ARCO's Line 1 during the January 17, 1994 Northridge earthquake.

Recommendation: The incidence of pipeline failures resulting in releases of petroleum products to the environment should be reviewed to determine the potential for SWP water quality contamination.

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Appendix A

State Water Project Sanitary Survey Action Plan

STATE WATER PROJECT

SANITARY SURVEY

ACTION PLAN

Prepared by the State Water Contractors

in consultation with the

SWP Sanitary Action Committee

March 19, 1994

STATE WATER CONTRACTORS
ACTION PLAN
TO IMPLEMENT THE RECOMMENDATIONS OF THE STATE WATER PROJECT SANITARY SURVEY

PREPARED IN CONSULTATION WITH THE SWP SANITARY ACTION COMMITTEE

The State Water Project (SWP) Sanitary Survey Action Plan (Action Plan) was prepared by the State Water Contractors[1] (SWC) in consultation with the State Water Project Sanitary Action Committee (SWPSAC). The Action Plan was prepared in response to recommendations included in the SWP Sanitary Survey Report - October, 1990 prepared by Brown & Caldwell, Consultants. The SWP Sanitary Survey Report documented possible sources of contamination of the SWP and the possible mitigating factors affecting those contaminants such as dilution, time of flow, storage time, and sanitary control measures.

The SWC undertook the SWP Sanitary Survey as a result of a February 2, 1988 letter from Mr. Peter A. Rogers, Chief, Department of Drinking Water, California Department of Health Services (CDHS). The CDHS was concerned that no comprehensive Sanitary Survey of the SWP had ever been undertaken. The Sanitary Survey was necessary for the SWP contractors and the CDHS to appraise the effectiveness of the operation of existing water treatment plants and to adequately evaluate new treatment plant design requirements using SWP water as a source supply. The SWC conducted the Sanitary Survey because it was more practical to do one Sanitary Survey that all SWP M&I contractors could use to meet their CDHS permit requirements. The SWP Sanitary Survey Report was completed and transmitted to CDHS on October 26, 1990.

One of the key recommendations of the SWP Sanitary Survey Report was to form a committee to review the report and develop implementation plans for appropriate actions and future studies. This committee, the SWPSAC was formed with letters of participation sent out on April 24, 1991. The following agencies were invited and participated in the SWPSAC to develop the Action Plan:

Department of Water Resources
U.S. Environmental Protection Agency
Department of Health Services
State Water Resources Control Board
Central Valley Regional Water Quality Control Board
U.S. Bureau of Reclamation
State Water Contractors Member Agencies and Staff

[1] The State Water Contractors is a private, non-profit corporation representing 27 of the 29 public agencies which hold water supply contracts with the State of California.

While the Action Plan was developed by the SWPSAC, the representatives of the various agencies involved participated in an advisory role at a staff level. Therefore, many of the recommended actions of a policy nature may not represent the official policies or priorities of the participating agencies. Also, many of the tasks listed in the Action Plan affect the staffing and budgets of the participating agencies. The SWC understands this and requests the agencies pursue implementation of tasks within their available budgets and staffing levels to meet the identified schedules.

The Action Plan format for addressing each of the recommendations is as follows:

1. Recommendation Title
2. Sanitary Survey Recommendation
   - A SWPSAC recommendation if applicable
3. Problem identification - background information
4. Solution
5. Costs
6. Benefits
7. Implementation Plan

The Action Plan identifies a priority for each recommendation. The SWPSAC established the priorities based upon the following criteria:

PRIORITY A - Actions that are important to address current high profile water quality concerns. Agencies should manage their staff and funds to accomplish these action within the identified schedule.

PRIORITY B - Actions that are designed to address current water quality concerns of a non-critical nature. These actions should be integrated into the Agencies ongoing work schedules to accomplish the work within the identified schedules as staff and funds permit.

PRIORITY C - Actions that should be done as staff and funds are available.

NO ACTION REQUIRED - In some cases, the SWPSAC believed that the Sanitary Survey recommendation was either addressed in another recommendation or the recommendation was beyond the scope of the SWPSAC.

In some cases the SWP Sanitary Survey Report did not have a recommendation, but the SWPSAC believed an action is required. In such cases, the SWPSAC recommendation is listed below the report recommendation in bold print. The Action Plan identifies costs, the agencies responsible for the work, and the time schedule to complete the various tasks involved. The SWC will coordinate with the involved agencies in the attempt to insure the identified actions are completed within the time schedules. However, since many of the actions are subject to other agencies' budgets and staffing limitations, the SWC cannot guarantee that all of the actions will be completed in accordance within the Action Plan schedules.

STATE WATER CONTRACTORS
STATE WATER PROJECT SANITARY SURVEY
ACTION PLAN

ACKNOWLEDGEMENTS

The State Water Contractors wish to thank the individuals that served on the State Water Project Sanitary Action Committee (SWPSAC). Their assistance and input into the development of the Action Plan has been invaluable. The SWPSAC members worked closely to produce an Action Plan that will help protect and improve the drinking water supplies to over 20,000,000 Californians.

STATE WATER PROJECT SANITARY ACTION COMMITTEE

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A special thanks is in order for Mr. Woodard for his helpful editing of the final draft Action Plan, and his gentle prodding to complete the project. Also, Ms. Elaine Archibald and Ms. Jeanne Wallberg of Brown & Caldwell were helpful in providing clarification and advice on the SWP Sanitary Survey Report recommendations.

STATE WATER CONTRACTORS
SANITARY SURVEY
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TABLE OF ABBREVIATIONS AND ACRONYMS

BAT	BEST AVAILABLE TECHNOLOGY
BDOC	BAY-DELTA OVERSIGHT COUNCIL
BMPs	BEST MANAGEMENT PLANS
CCFB	CLIFTON COURT FOREBAY
CDHS	CALIFORNIA DEPARTMENT OF HEALTH SERVICES
CalEPA	CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY
CALTrans	CALIFORNIA DEPARTMENT OF TRANSPORTATION
COE	U.S. CORPS OF ENGINEERS
CVRWQCB	CENTRAL VALLEY REGIONAL WATER QUALITY CONTROL BOARD
CVP	CENTRAL VALLEY PROJECT
DBP	DISINFECTION BY-PRODUCT
DOC	DISSOLVED ORGANIC CARBON
DPR	DEPARTMENT OF PESTICIDE REGULATION
DWR	DEPARTMENT OF WATER RESOURCES
GAC	GRANULAR ACTIVATED CARBON
KCWA	KERN COUNTY WATER AGENCY
LRWQCB	LAHONTAN REGIONAL WATER QUALITY CONTROL BOARD
MCL	MAXIMUM CONTAMINANT LEVEL
MWDSC	METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA
NPDES	NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
NPS	NON-POINT SOURCE
OES	CALIFORNIA OFFICE OF EMERGENCY SERVICES
PAHs	POLYNUCLEAR AROMATIC HYDROCARBONS
POTWs	PUBLICLY OWNED TREATMENT WORKS
PPB	PARTS PER BILLION
SBA	SOUTH BAY AQUEDUCT
SFRWQCB	SAN FRANCISCO REGIONAL WATER QUALITY CONTROL BOARD
SLC	SAN LUIS CANAL
SWC	STATE WATER CONTRACTORS
SWP	STATE WATER PROJECT
SWPSAC	STATE WATER PROJECT SANITARY ACTION COMMITTEE
SWRCB	STATE WATER RESOURCES CONTROL BOARD
SWTR	SURFACE WATER TREATMENT RULE
THM	TRIHALOMETHANE
TOC	TOTAL ORGANIC CARBON
TTHMFP	TOTAL TRIHALOMETHANE FORMATION POTENTIAL
TMDL	TOTAL MAXIMUM DAILY LOADING
USEPA	U.S. ENVIRONMENTAL PROTECTION AGENCY
UV 254	ULTRA VIOLET 254

STATE WATER CONTRACTORS
STATE WATER PROJECT SANITARY SURVEY
ACTION PLAN

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STATE WATER PROJECT SANITARY SURVEY
Recommendation #1

PRIORITY #B

1. Title: Source Waters - Sacramento Basin Upstream of Greene's Landing - General

2. Recommendation: The Regional Board's efforts to develop a mass loading estimate of key contaminants for the Sacramento Basin should be supported and expanded. The contributions of key contaminants from M&I discharges, urban runoff, agricultural drainage, and mine discharges can then be better determined.

3. Problem Identification: The Sacramento River at Greene's Landing is of poorer quality than its major Sierra tributaries. Waste dischargers responsible for the degradation have not been identified because of the lack of data on mass loadings for all major pollutants and sources.

38 municipal wastewater treatment plants with a combined average flow of 204 mgd, 38 industrial and other discharges with a combined average flow of 324 mgd, urban runoff primarily from the Sacramento metropolitan area, agricultural drainage and mine drainage contribute to the degradation of water quality at Greene's Landing.

Many of these dischargers, with the exception of agricultural drainage and most mine drainage, are regulated by National Pollutant Discharge Elimination System (NPDES) permits and have water quality monitoring programs required by the Central Valley Regional Water Quality Control Board (CVRWQCB). Water quality data for agricultural drainage, mine drainage and urban runoff is limited.

The City of Sacramento (City) and Sacramento County (County) have initiated legal action against the State Water Resources Control Board (SWRCB) in response to the April 1991 adoption of the Inland Surface Waters Plan (Plan). The City and County contend the SWRCB did not comply with the California Environmental Quality and Porter - Cologne Acts in adopting the Plan. The purpose of this lawsuit is to achieve site specific water quality objectives, obtain corrective efforts at significant pollutant sources and achieve a watershed-wide approach to improved water quality. It now appears this litigation may be resolved in favor of the City and County. However, in the event the Plan is upheld, or if the U.S. Environmental Protection Agency (USEPA) imposes a similar plan, it could result in sufficient data to implement a wasteload allocation process and subsequent control over major sources of pollution.

The agencies involved in this issue are the USEPA, CVRWQCB, SWRCB, City of Sacramento, and Sacramento County.

4. Solution: The Plan establishes a program for compliance with water quality objectives including a wasteload allocation process. The CVRWQCB needs to vigorously pursue monitoring programs for all major sources of pollution and implement wasteload allocation programs as necessary.

5. Cost: The costs have not been identified.

6. Benefits: Implementation of this program, including the wasteload allocation will result in improved water quality of the Sacramento River at Greene's Landing.

7. Implementation Plan: The CVRWQCB should include provisions to meet the requirements of the Plan when waste discharge requirements are issued or reissued. The CVRWQCB was directed to require dischargers to monitor for compliance with water quality objectives and is required to establish time schedules for compliance with the Plan's numerical objectives prior to April, 2001. The Plan further provides for implementation of a Mass Emissions Strategy consistent with the SWRCB's Pollutant Policy Document.

The following task should be undertaken to implement the recommendation:

A. The State Water Contractors (SWC) should write a letter to the CVRWQCB requesting they take the following actions:

1. Request short term studies or amend existing self-monitoring programs for significant dischargers to the Sacramento River system covered by NPDES permits to require monitoring consistent with the Plan.

2. Issue and reissue waste discharge requirements for dischargers to the Sacramento River system to implement the water quality objectives consistent with the Plan.

3. Compile and evaluate self-monitoring discharge data.

4. Develop a Mass Emissions Strategy/Total Maximum Daily Loading (TMDL) process.

5. Conduct wasteload allocation pursuant to USEPA's <u>Guidance for Water Quality - based Decisions: The TMDL Process.</u>

6. Amend and issue waste discharge requirements to implement Mass Emissions Strategy/TMDL.

The following program is recommended to accomplish the above task:

Task	Estimated Costs	Responsible Agency	Schedule
A	--	SWC	Completed - February 14, 1994 letter attached

NOTE: The cost and schedule of the CVRWQCB to implement this request is unknown.

STATE OF CALIFORNIA - ENVIRONMENTAL PROTECTION AGENCY PETE WILSON, Governor
CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION
3443 Routier Road, Suite A
Sacramento, CA 95827-3098
PHONE: (916) 361-5600
(916) 361-5686

20 July 1992

RECEIVED
JUL 21 1992

Mr. George R. Baumli, General Manager
State Water Contractors
555 Capitol Mall, Suite 725
Sacramento, CA 95814

SANITARY SURVEY OF THE STATE WATER PROJECT

Thank you for your 13 July 1992 letter in which you transmit three recommendations from your subject report. let me reply in the order you have presented them:

1. RECOMMENDATION: The San Joaquin River at Vernalis is not designated as having an existing beneficial use of municipal water supply. Yet this water, exported at the south Delta pumps, is used for drinking water purposes. The Regional Board should recognize this use and adopt standards that protect the municipal water supply beneficial use classification of the San Joaquin River at Vernalis.

   The Regional Board's *Water Quality Control Plan, Second Edition*, lists the Delta as having the designated beneficial use of municipal and domestic water supply in recognition of the fact that many diversions within the Delta indeed supply that use. In fact, it is estimated that 20 million Californians received all or part of their municipal water from Delta diversions. This same Plan lists the San Joaquin River upstream of the Delta as having the designated beneficial use of potential municipal and domestic water supply. The difference in designation recognizes the fact that there are no known municipal or domestic users of that river segment, but it might, at some future time, be so used.

   The California Water Code, Section 12220, gives us a legal definition of the Delta's boundaries. Its southern boundary is the point at which Durham Ferry Road, in San Joaquin County, crosses the San Joaquin River. For convenience, this point is commonly referred to as Vernalis. There is nothing that legally tells us Vernalis lies within the Delta, immediately upstream of the Delta, or truly on the Delta boundary. But if you wish to think of it as being within the Delta, then the river at that point would have the Delta's beneficial use designations.

In any case, the south Delta project pumps inarguably lie within the Delta. And the water they draw is presently designated as having the beneficial use of municipal and domestic supply, thus assuring your project water enjoys that protection.

2. **RECOMMENDATION: A mass loading estimate of key contaminants from discharges to the San Joaquin Basin should be developed by the Regional Board.**

   We understand this recommendation refers to a portion of the Inland Surface Water Plan's program of implementation. We are presently working, to the best of our ability, on implementing the ISWP, with emphasis on the provisions that have near-term time schedules. Our continued ability to perform these tasks depends on our receiving the designated funding in this year's budget request. At this time, we see little reason to be optimistic.

3. RECOMMENDATION: None (Source Waters - Sacramento Basin Upstream of Greene's Landing - Agricultural Drainage)

   As a result of improved pesticide management practices by rice growers, under the direction of the Regional Board and the Department of Pesticide Regulation, pesticide loads in the Sacramento River were reduced from 40,000 pounds in 1982 to less than 218 pounds in 1991. The Board will continue its efforts to effect control of such discharges.

We welcome your participation in future Basin Planning activities and will endeavor to keep you informed of them.

WILLIAM H. CROOKS
Executive Officer

cc: Mr. James Strock, California Environmental Protection Agency, Sacramento
Mr. Walter Pettit, State Water Resources Control Board, Sacramento

RECOMMENDATION: None (Source Waters - Sacramento Basin Upstream of Greene's Landing - .gricultural Drainage)

Upon completion of the Sanitary Survey Report, a Sanitary Survey Review Committee was formed to develop an Action Plan to deal with the Report recommendations. The Review Committee has reviewed the California Department of Pesticide Regulation's report dated January 10, 1992 related to discharges of herbicides and pesticides into the Sacramento River upstream of the City of Sacramento. Based upon the findings of the report, the Review Committee concluded that pesticides and herbicides currently utilized in upstream rice growing operations do not represent any threat to State Water Project drinking water supplies. The Review Committee also found that the Central Valley Regional Water Quality Control Board's efforts have been very successful in achieving improved water quality for water users in the Sacramento Metropolitan area. The Review Committee is comprised of representatives of the Department of Health Services, the Central Valley Regional Water Quality Control Board, the State Water Resources Control Board, the U.S. Environmental Protection Agency, the U.S. Bureau of Reclamation, the Department of Water Resources, and the State Water Project contractors.

The State Water Contractors urge the Regional Board to continue their strict regulation of the currently applied rice farming herbicides and pesticides. The Regional Board should also remain alert to the use of new or substitute chemicals that may be used in place of those chemicals which they currently have regulated with great success.

We look forward to the opportunity of working with the Regional Board in making appropriate modifications to the Basin Plan and in helping to develop a monitoring program for San Joaquin Valley pollutant inputs.

Sincerely,

George R. Baumli
General Manager

Xc: Mr. James Strock, Cal EPA
SWC Member Agencies
Sanitary Survey Review Committee

state water contractors

555 Capitol Mall, Suite 725 • Sacramento, CA 95814-4502
George R. Baumli, *General Manager* (916) 447-7357 • FAX 447-2734

February 14, 1994

COPY

Mr. William H. Crooks, Executive Officer
Central Valley Regional Water Quality
Control Board
3443 Routier Road
Sacramento, CA 95827

Dear Mr. Crooks:

In February 1988, the Department of Health Services requested the State Water Contractors to conduct a sanitary survey of the State Water Project (SWP), pursuant to requirements of the new Surface Water Treatment Rule. The report, "Sanitary Survey of the State Water Project," prepared by Brown and Caldwell, Consultants and published in October 1990, documented the findings and recommendations of the survey.

The report contains 35 recommendations for implementing measures to protect municipal water supplies taken from the Sacramento-San Joaquin Delta into the State Water Project. Following publication of the report, the State Water Contractors organized a SWP Sanitary Action Committee to evaluate the recommendations of the report and to formulate an implementation plan. The Central Valley Regional Water Quality Control Board's (CVRWQCB) representative on the Committee was Mr. Bill Johnson.

Recommendation #1 of the report reads:

> **The Regional Board's efforts to develop a mass loading estimate of key contaminants for the Sacramento Basin should be supported and expanded. The contributions of key contaminants from M&I discharges, urban runoff, agricultural drainage, and mine discharges can then be better determined.**

The Sacramento River at Greene's Landing is of poorer quality than its major Sierra tributaries. Waste dischargers responsible for the degradation have not been identified because of the lack of data on mass loadings for all major pollutants and sources.

Municipal wastewater treatment plants, industrial and other discharges with a combined average flow of 528 mgd, urban runoff primarily from the Sacramento metropolitan area, agricultural drainage and mine drainage contribute to the degradation of water quality at Greene's Landing.

Many of these dischargers, with the exception of agricultural drainage and most mine drainage, are regulated by National Pollutant Discharge Elimination System (NPDES) permits and have water quality monitoring programs required by the CVRWQCB. Water quality data for agricultural drainage, mine drainage and urban runoff is limited.

The City of Sacramento and Sacramento County have initiated legal action against the State Water Resources Control Board (SWRCB) in response to the April 1991 adoption of the Inland Surface Waters Plan (Plan). The City and County contend the SWRCB did not comply with the California Environmental Quality and Porter - Cologne Acts in adopting the Plan. The purpose of the lawsuit is to achieve site specific water quality objectives, obtain corrective efforts at significant pollutant sources on a watershed-wide basis and achieve a watershed-wide approach to improved water quality. It now appears this litigation, may be resolved in favor of the City and County. However, in the event the Plan is upheld, or if the U.S. Environmental Protection Agency (USEPA) imposes a similar plan, it could result in generating sufficient data to implement a wasteload allocation process and subsequent control over major sources of pollution.

The Plan establishes a program for compliance with water quality objectives including a wasteload allocation process. The CVRWQCB needs to vigorously pursue monitoring programs for all major sources of pollution and implement wasteload allocation programs as necessary. Implementation of this program including the wasteload allocation will result in improved water quality at Greene's Landing.

The Plan requires the CVRWQCB to include provisions to meet the requirements of the Plan when waste discharge requirements are issued or reissued. The CVRWQCB was directed to require dischargers to monitor for compliance with water quality objectives and is required to establish time schedules for compliance with the Plan's numerical objectives prior to April, 2001. The Plan further provides for implementation of a Mass Emissions Strategy consistent with the SWRCB's Pollutant Policy Document.

Therefore, the State Water Contractors request the CVRWQCB take the following actions:

1. Request short term studies or amend existing self-monitoring programs for significant dischargers to the Sacramento River system covered by NPDES permits to require monitoring consistent with the Plan.

2. Issue and reissue waste discharge requirements for dischargers to the Sacramento River system to implement the water quality objectives consistent with the Plan.

3. Compile and evaluate self-monitoring discharge data.

4. Develop a Mass Emissions Strategy/Total Maximum Daily Loading (TMDL) process.

5. Conduct a waste load allocation pursuant to USEPA's Guidance for Water Quality-based Decisions: The TMDL Process.

6. Amend and issue waste discharge requirements to implement Mass Emissions Strategy/TMDL process.

Sincerely,

George R. Baumli

George R. Baumli
General Manager

Xc: SWC Member Agencies
SWP Sanitary Action Committee
SWC Water Quality Technical Committee
Mr. John Caffrey, SWRCB

STATE WATER PROJECT SANITARY SURVEY
Recommendations #2 & #8 Combined

PRIORITY A

1. **Title (2):** Source waters - Sacramento Basin Upstream of Greene's Landing - Municipal & Industrial

Title (8): Source waters - San Joaquin River Upstream of Vernalis - M&I Dischargers

2. **Recommendations:** Monitoring requirements for National Pollutant Discharge Elimination System (NPDES) discharges, such as municipal wastewater treatment plants, should be increased to cover *Giardia lamblia, Cryptosporidium sp.*, and viruses. The State Water Project Sanitary Action Committee (SWPSAC) should encourage the Regional Board to include these constituents in discharge compliance monitoring programs.

3. **Problem Identification:** Municipal wastewater treatment plants discharge approximately 206 mgd into the Sacramento River Basin and approximately 58 mgd into the San Joaquin River Basin. In general, these plants meet their NPDES discharge requirements. However, current NPDES permits do not require monitoring for viruses and pathogenic cysts such as *Giardia lamblia* and *Cryptosporidium sp.*. Research has shown that these organisms, which are common in municipal wastewater, are not completely removed by conventional wastewater treatment. Because a database does not exist on discharges of these pathogens to the watershed, it is currently not possible to evaluate the impacts of those discharges on pathogen levels.

Giardia lamblia and *Cryptosporidium sp.* oocysts are extremely resistant to disinfection by normal water treatment methods, and are most effectively removed by filtration. Recently, *Cryptosporidium sp.* has been implicated as the cause of major outbreaks in Medford, Oregon and Milwaukee, Wisconsin. In the Oxford and Swindon areas outside of London, England, it is estimated the 50,000 to 100,000 people contracted cryptosporidiosis from the water supply. *Giardia lamblia* has also been implicated in numerous episodes over the years.

The USEPA and the California Department of Health Services (CDHS) recently promulgated regulations for removal of *Giardia lamblia* and viruses from drinking water supplies. Regulations for *Cryptosporidium sp.* removal have not been promulgated at this time, but are under consideration. The Surface Water Treatment Rule (SWTR) requires all water treatment plants to achieve a minimum removal of 99.9 percent (3 logs) of *Giardia lamblia*, and 99.99 percent (4 logs) of viruses. If there is reason to believe pathogen levels in the raw water are excessively high, *Giardia lamblia* removal of 4 or 5 logs can be required. Requirements to obtain 4 or 5 logs of *Giardia lamblia* removal would have major impacts on water treatment plants in terms of additional disinfection and/or filtration facilities.

The CVRWQCB establishes NPDES discharge limitations. The primary municipal wastewater treatment plant within the Sacramento River Basin is the Sacramento Regional County Sanitation District Wastewater Treatment Plant, which discharges an average of 150 mgd into the Sacramento River. There are 14 other wastewater treatment plants within the Sacramento basin which discharge more than 1 mgd. There are eight wastewater treatment plants within the San Joaquin Basin which discharge more than 1 mgd.

Currently, there is no known monitoring of municipal wastewater treatment plant effluents in the Sacramento or San Joaquin River Basins for *Giardia lamblia*, *Cryptosporidium sp.*, and viruses. Limited data have been collected on these pathogens by the Department of Water Resources (DWR), Kern County Water Agency (KCWA), and the Metropolitan Water District of Southern California (MWDSC) at points along the northern portion of the California Aqueduct and at Greene's Landing on the Sacramento River. The data is limited and inconclusive because of analytical problems due to high turbidity and interfering organic matter in the samples (see November 4, 1993 letter attached).

In southern California, the MWDSC has collected pathogen data on the East and West Branches of the California Aqueduct. The data show *Giardia lamblia*, was found in only one sample in Lake Perris, and *Cryptosporidium sp.* was found at extremely low levels (less than one cyst in 100 liters) in most samples. Less than 10 percent of the samples were positive for enteric viruses. Based on these data, CDHS has tentatively ruled that MWDSC's plants need only achieve the minimum 3 - 4 log removal of *Giardia lamblia*.

The lack of pathogens found in the southern areas of the SWP is most likely the result of the natural die off that occurs as the water is conveyed through the aqueduct system and the detention time in the SWP terminal reservoirs. However, this may not be the case for SWP contractors that take water from the South Bay or North Bay Aqueducts.

4. Solution: The extent of the problem should be determined by sampling for one year in the Delta and northern areas of the SWP California Aqueduct. If significant numbers of pathogens are found, a workplan should be developed for municipal wastewater dischargers to begin a one-year, bimonthly monitoring program for *Giardia lamblia*, *Cryptosporidium sp.*, and viruses. Samples of the plant effluent and upstream receiving water should be collected and analyzed. Once compiled, this information would allow an assessment of the impacts of these discharges on the SWP.

5. Costs: The costs of initial sampling in the Delta and northern area of the California Aqueduct should be borne by the DWR and interested SWP contractors. The cost of monitoring wastewater discharges for pathogenic cysts and viruses, if required, would be borne by the dischargers. The analytical cost for these parameters for six bimonthly samplings of the plant effluent and the upstream receiving water, would be $12,000. If all 15 discharges within the Sacramento River Basin (greater than 1 mgd) were monitored, the total annual cost of monitoring would be $180,000. If all eight discharges within the San Joaquin River Basin (greater than 1 mgd) were monitored, the total annual cost of monitoring would be $96,000. The administrative costs associated with this additional data collection should be minimal, as monthly compliance reporting is already required. After the first year of data collection, the sampling frequency could be adjusted accordingly.

6. Benefits: If pathogens are not controlled to low levels in the source water, SWP Municipal & Industrial (M&I) contractors could be required to provide additional filtration and/or disinfection capacity, and use higher disinfectant dosages. For MWDSC alone, the additional annual operating cost of achieving 4 logs of *Giardia lamblia* removal, rather than the minimum 3 logs, is estimated to cost $2,000,000 per year. This assumes that the ozone dosage would have to be increased by 0.5 mg/L to achieve the higher *Giardia lamblia* removal. The additional capital cost of providing this capacity is estimated to be over $17 million for MWDSC alone.

7. Implementation Plan: Sufficient data on pathogen levels in the SWP does not currently exist to justify the cost of requiring extensive pathogen monitoring of individual wastewater treatment plant effluents.

The following tasks should be undertaken to implement the recommendation:

A. Develop a workplan for collecting and reporting pathogen data in the Delta and northern California Aqueduct area.

B. Collect and analyze monthly samples for one year for *Giardia lamblia*, *Cryptosporidium sp.*, enteric virus, and total coliforms at the following locations:

- Sacramento River at Greene's Landing
- H. O. Banks Delta Pumping Plant
- Delta Mendota Canal at McCabe Rd. bridge
- California Aqueduct upstream of the Cross Valley Canal Turnout

C. Analyze the data from the one year sampling to determine if additional sampling or analyses of specific wastewater discharges are justified.

D. If necessary, request CVRWQCB to require individual dischargers which appear to be discharging significant levels of pathogens to the SWP to begin monitoring their discharges.

The following program is recommended to accomplish these tasks:

Task	Estimated Cost	Responsible Party	Schedule
A	--	DWR	Completed
B	--	MWDSC,DWR, & KCWA	Completed - (see November 4, 1993 letter)
C	$10,000	SWC, DWR	March 1994
D	To be determined	CVRWQCB	As Req'd

MWD
METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

RECEIVED
NOV - 8 1993

November 4, 1993

Reply to: 700 Moreno Ave.
La Verne, CA 91750

Mr. John Coburn
State Water Contractors
555 Capital Mall
Suite 725
Sacramento, California 95814

Dear Mr. Coburn:

State Project/Delta Water Pathogen Monitoring Project

Attached is a copy of the State Project/Delta Water Pathogen Monitoring Project Report. It is my understanding that you will distribute this report to members of the State Project Sanitary Survey Review Committee and to other interested parties as appropriate. I am looking forward to discussing the results of this project with you and your staff during the upcoming State Water Contractors meeting to be held on November 16, 1993, at Metropolitan's Water Quality Laboratory.

If you have any questions concerning the State Project/Delta Water Pathogen Monitoring Project Report, please contact me at (909) 392-5296.

Very truly yours,

Mic H. Stewart, Ph.D.
Principal Microbiologist

MHS/ew

Attachment

MEMORANDUM

November 1, 1993

To: Associate Director of Water Quality

From: Principal Microbiologist M. H. Stewart

Subject: Results of State Project/Delta Water Pathogen Monitoring Project

<u>Summary</u>

1. A pathogen monitoring survey of selected upstream and downstream sites in the State project water (SPW)/Delta water system was conducted from April 1992 through April 1993. The objective of this study was to evaluate sites that potentially impacted pathogen loading within the SPW/Delta water system. The sites selected in this study included Greene's Landing, Banks Pumping Plant (milepost 3.3), Delta Mendota Canal (milepost 67), and Checkpoint 29 (located in the Kern County area) of the California Aqueduct. A total of 48 samples were collected and analyzed for <u>Giardia</u>, <u>Cryptosporidium</u>, and enteric viruses.

2. Interpretation of the results of this study must be tempered by the limitations of the current detection methodology and highly variable detection limits which were the result of interference due to high turbidity and high levels of organic material. The percent positive and mean concentration (cysts/100L) of <u>Giardia</u> at each of the four locations were as follows: Greene's Landing (42 percent, 37); Banks Pumping Plant (0, 0); Delta Mendota Canal (8 percent, 6); Checkpoint 29 (0, 0). The percent positive and mean concentration (oocysts/100L) of <u>Cryptosporidium</u> at each of the four locations were as follows: Greene's Landing (50 percent, 50); Banks Pumping Plant (25 percent, 54); Delta Mendota Canal (58 percent, 40); Checkpoint 29 (8 percent, 17). Three (two from Greene's Landing and one from Banks Pumping Plant) of the 48 samples collected in this study were positive for enteric viruses. <u>Giardia</u> and <u>Cryptosporidium</u> concentrations in State Project/Delta water were approximately 6 times lower than surface waters compared in nationwide surveys, but were 200-600 times higher than those observed in Metropolitan's survey of

reservoirs located in the Southern California area receiving SPW and Colorado River water (CRW). Because of the variable detection limits, it is premature to conclude that passage through the Delta region affected the microbial quality of the water. Based on frequency of pathogen occurrence, Greene's Landing appeared to be associated with poorer microbial water quality compared to the other sample sites. Checkpoint 29 of the California Aqueduct had the lowest pathogen activity of the four sample sites suggesting possible pathogen die-off during transport through the aqueduct.

Background

3. Recent events such as the waterborne disease outbreaks of Cryptosporidium in Milwaukee, Wisconsin, and Medford, Oregon; new surface water filtration requirements and possible pathogen standards; and the inability of traditional indicators of water quality to accurately predict the presence of pathogens in drinking water have provided the impetus for direct monitoring of waterborne pathogens. The potential impacts of these developments on the water industry could include costly treatment modifications and ultimately the monitoring of drinking water and/or wastewater discharges for these pathogens. To determine the concentrations of pathogens in the SPW/Delta water system, and in particular the Delta region, a one-year pathogen monitoring program was implemented by Metropolitan at the request of the State Water Project Sanitary Survey Review Committee.

Description of Pathogen Monitoring Sites

4. Four sampling sites (Greene's Landing; Banks Pumping Plant, milepost 3.3; Delta Mendota Canal, milepost 67; and Checkpoint 29 on the California Aqueduct in the Kern County area) were selected to assess the relative concentration of pathogens prior to entering the Delta area and from sites within and downstream of the Delta (Figure 1). Greene's Landing (Sacramento River) was selected to represent water prior to entering the Delta and is located approximately 10 miles downstream from wastewater discharges from the City of Sacramento. Samples from Banks Pumping Plant were used to assess pathogen levels in water immediately after passage through the Delta region, while samples collected from the Delta Mendota Canal were used to assess pathogen quality of Central Valley Project water introduced at the Banks Pumping Plant. Finally, samples were collected at Checkpoint 29 of the California Aqueduct

(in the Kern County area) to represent water quality prior to entering the Southern California area.

Pathogen Monitoring Sample Analyses

5. Pathogens assayed for included enteric viruses, Giardia cysts, and Cryptosporidium oocysts. Enteric virus samples were analyzed by Professor Aaron Margolin of the University of New Hampshire using conventional tissue culture techniques. Enteric viruses were cultured on buffalo green monkey cells, and results were reported in a presence/absence format based on observation of cytopathic effect. Giardia and Cryptosporidium samples were analyzed by Metropolitan's Water Quality Laboratory using the immunofluorescent antibody procedure as described in the 1992 Annual Book of ASTM Standards (ASTM, 1992; D-19 proposal P229). In this procedure, the number of Giardia cysts and Cryptosporidium oocysts are recorded both as "Total Count" and "Count With Internal Structures" per 100 liters. Total Count describes the number of Giardia cysts or Cryptosporidium oocysts based on size, shape, and fluorescent properties as observed using epifluorescent microscopic examination. Count With Internal Structures relies upon the detection of internal structures within the organism (e.g., Giardia cysts contain 2-4 nuclei, axonemes, and median bodies and Cryptosporidium oocysts contain 1-4 sporozoites and a granular residual body). Although no reporting standard has been established, the use of the "Total Count" is the most conservative estimate of cysts or oocysts in a sample and has been used to calculate pathogen density in this study. All samples were also analyzed for the presence of total and fecal coliforms using methods as described in Standard Methods for the Examination of Water and Wastewater (18th Edition, 1992).

Data Evaluation Methods and Use of Detection Limits

6. Currently, the density of Giardia and Cryptosporidium in potable water is commonly reported as the number of cysts or oocysts/100L. Therefore, in samples of 100L where no cysts or oocysts are observed, a density value of "0" is recorded. However, in samples in which no cysts or oocysts were observed and it was not possible to examine an aliquot representing a 100L volume because of interfering material (such as algae and organic compounds) the detection limit value was recorded. Consequently, the detection limit may vary considerably and therefore may be of questionable value for computation of pathogen density. In this study, densities of Giardia and Cryptosporidium were calculated as

the arithmetic mean based on the actual detection of cysts or oocysts in the sample using the Total Count criteria.

Results

7. The *Giardia* and *Cryptosporidium* results of this study are difficult to interpret because most samples that were not positive for detectable cysts or oocysts contained extensive amounts of interfering material resulting in high detection limit values. Consequently, it is not possible to accurately assess "actual" levels in many of the samples. This is especially problematic in samples with variable or high detection limit values. For example, detection limits ranged from <2 to <126 throughout the study. Therefore, the actual level of pathogens in many samples may have been underestimated.

8. A summary of the pathogen monitoring results are presented in Table 1. Six samples contained detectable *Giardia* cysts (Tables 2-5). The percent positive (of all samples collected at each site) and mean concentration (cysts/100L) of *Giardia* in the positive samples at each of the four locations were as follows: Greene's Landing (42 percent, 37); Banks Pumping Plant (0, 0); Delta Mendota Canal (8 percent, 6); Checkpoint 29 (0, 0). These results suggest that *Giardia* occurred more frequently at Greene's Landing compared to the other sites. Seventeen samples contained detectable *Cryptosporidium* oocysts (Tables 2-5). The percent positive (of all samples collected at each site) and mean concentration (oocysts/100L) of *Cryptosporidium* in the positive samples at each of the four locations were as follows: Greene's Landing (50 percent, 50); Banks Pumping Plant (25 percent, 54); Delta Mendota Canal (58 percent, 40); Checkpoint 29 (8 percent, 17). The frequency of occurrence and concentration of *Cryptosporidium* were similar at Greene's Landing, Banks Pumping Plant, and Delta Mendota Canal. The frequency of occurrence and concentration of *Cryptosporidium* were the lowest at the California Aqueduct Checkpoint 29 sampling location.

9. Three samples of the 48 collected in this study were positive for the presence of enteric viruses. Two of the positive samples were recovered from Greene's Landing and the third positive sample was recovered from Banks Pumping Plant.

10. Mean total coliform/fecal coliform concentrations for Greene's Landing, Banks Pumping Plant, Delta Mendota Canal, and Checkpoint 29 were 666/24, 112/76, 268/16, and

20/11, respectively (Table 6). In general, these results suggest that the highest coliform activity occurred at Greene's Landing while the lowest occurred at Checkpoint 29.

Significance of Findings

11. An objective of this study was to assess pathogen quality of water as it passed through the Delta. Due to high turbidity and interfering organic material and limitations of current detection methods for *Giardia* and *Cryptosporidium*, it was difficult to evaluate the impact of the Delta on pathogen loading. However, the results of this study suggest that the highest level of pathogen activity was associated with Greene's Landing. *Giardia* levels were highest at this site and *Cryptosporidium* levels were equivalent or higher compared to the other three sites in this study. Moreover, two of the three positive enteric virus samples were recovered at Greene's Landing. This site also had the highest level of coliforms. The source of pathogens observed in Greene's Landing samples is not known, however, it may include effluent from upstream sewage treatment plants, release of sewage from boats, upstream recreational activity, and/or nonpoint fecal discharge. Pathogen levels at Banks Pumping Plant and Delta Mendota Canal were relatively similar, however, one sample collected at Banks Pumping Plant was positive for enteric virus. Checkpoint 29 of the California Aqueduct had the lowest pathogen activity of the four sample sites suggesting possible pathogen die-off during transport through the aqueduct.

12. Metropolitan has also conducted a comprehensive pathogen monitoring survey of reservoirs located in the Southern California area receiving SPW and CRW. The results of this study indicated that in both source waters (i.e., SPW and CRW) levels of *Giardia* cysts ranged from 0 to 1.5 cysts/100L with a mean of 0.05 cysts/100L, while *Cryptosporidium* oocysts ranged from 0 to 1.8 oocysts/100L with a mean of 0.18 oocysts/100L. Levels of *Giardia* and *Cryptosporidium* in Metropolitan's immediate supply of SPW were similar to those in CRW. These levels were approximately 200 to 600 times lower than those observed in the present SPW/Delta pathogen survey. Enteric virus sampling in Metropolitan's earlier survey indicated that 12 percent of the samples collected from reservoirs receiving SPW were positive compared to 6 percent positive from those sites receiving in CRW.

13. Two national surveys have been conducted to assess *Giardia* and *Cryptosporidium* concentrations in surface waters. LeChevallier et al. (1991), in a survey of filtration plants predominantly receiving water from rivers, found that *Giardia* concentrations ranged from 0-6,600 cysts/100L with a mean of 277 cysts/100L and that *Cryptosporidium* ranged from 0-48,000 oocysts/100L with a mean of 270 oocysts/100L. In another study conducted by Rose et al. (1991) of surface and groundwater sites, *Giardia* levels ranged from 0-625 cysts/100L with a mean of 3 cysts/100L and *Cryptosporidium* ranged from 0-29,000 oocysts/100L with a mean of 43 oocysts/100L. In comparison, with LeChevallier's study of surface waters, levels of pathogens in SPW/Delta survey were approximately six times lower than national levels.

Mic H. Stewart

MHS/pa

cc w/attachments:

M. D. Beuhler
E. G. Means
T. H. Quinn
K. L. Wattier
M. H. Stewart
C. M. Paszko-Kolva
M. C. Simpson
Water Quality file

REFERENCES

Annual Book of ASTM Standards. Proposed Test Method for Giardia Cysts and Cryptosporidium Oocysts in Water by a Fluorescent Antibody Procedure. (D-19. Proposal P. 229). American Society for Testing and Materials (Philadelphia, PA)(1991).

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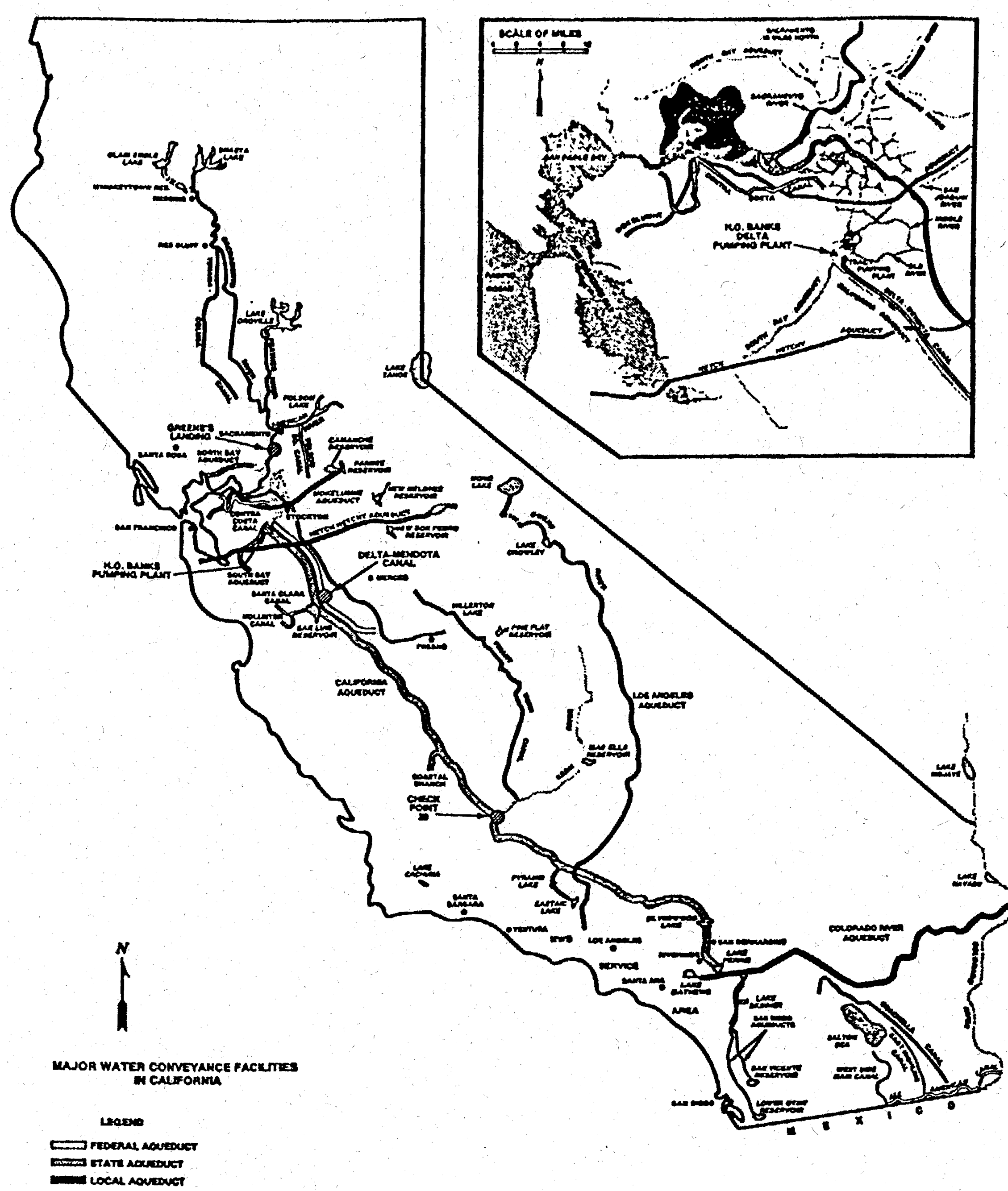

STATE PROJECT/DELTA WATER PATHOGEN MONITORING
SAMPLE LOCATIONS
FIGURE 1

TABLE 1

State Project Water/Delta Pathogen Monitoring Survey
Summary of Pathogen Results

Sample Location	Giardia (cysts/100L)	Cryptosporidium (oocysts/100L)	Enteric Virus
Greene's Landing			
Number Positive Samples	5(42%)[a]	6(50%)	2(17%)
Mean Concentration	37	50	NA[b]
Range	8-82	5-132	NA
Banks Pumping Plant			
Number Positive Samples	0	3(25%)	1(8%)
Mean Concentration	NA	54	NA
Range	NA	32-79	NA
Delta Mendota Canal			
Number Positive Samples	1(8%)	7(58%)	0
Mean Concentration	6	40	NA
Range	6	9-92	NA
California Aqueduct Checkpoint 29			
Number Positive Samples	0	1(8%)	0
Mean Concentration	NA	17	NA
Range	NA	17	NA

[a]Percent of positive samples collected per sample location
[b]Not applicable

TABLE 2

STATE PROJECT WATER/DELTA PATHOGEN MONITORING SURVEY

Giardia/Cryptosporidium Results

GREENE'S LANDING

Sample Date	*Giardia* spp. calculated cysts per 100 L		*Cryptosporidium* spp. calculated cysts per 100 L	
	Total[a] Count	Count with[b] Internal Structures	Total Count	Count with Internal Structures
05-13-92	<[c] 11	< 11	< 53	< 53
06-09-92	22	22	< 13	< 13
07-21-92	8	< 8	< 33	< 33
08-12-92	< 11	< 11	< 18	< 18
09-09-92	< 8	< 8	< 18	< 18
10-07-92	< 8	< 8	< 8	< 8
11-04-92	10	5	< 7	< 7
12-02-92	82	25	< 3	< 3
01-06-93	< 47	< 47	< 21	< 21
02-09-93	< 125	< 125	< 126	< 126
03-03-93	< 58	< 58	17	17
04-07-93	65	65	< 44	< 44
MEAN[d]	37	17	50	20
RANGE	8 to 82	5 to 25	5 to 132	11 to 33

[a] Total count: Number of *Giardia* cysts or *Cryptosporidium* oocysts based on external morphological and fluorescent properties.

[b] Count with internal structures: Number of *Giardia* cysts or *Cryptosporidium* oocysts from total count that have distinguishable internal morphological characteristics.

[c] "<": indicates no cysts or oocysts were detected. The number indicates the detection limit of the procedure, based on the volume of sample analyzed.

[d] Mean-Arithmetic mean: based only on samples with detectable cysts or oocysts.

TABLE 3

STATE PROJECT WATER/DELTA PATHOGEN MONITORING SURVEY

Giardia/Cryptosporidium Results

BANKS PUMPING PLANT

Sample Date	*Giardia* spp. calculated cysts per 100 L		*Cryptosporidium* spp. calculated cysts per 100 L	
	Total[a] Count	Count with[b] Internal Structures	Total Count	Count with Internal Structures
05-12-92	<[c] 13	< 13	79	26
06-09-92	< 47	< 47	< 47	< 47
07-21-92	< 7	< 7	< 7	< 7
08-12-92	< 32	< 32	32	< 32
09-09-92	< 23	< 23	< 23	< 23
10-07-92	< 9	< 9	< 9	< 9
11-04-92	< 13	< 13	52	13
12-02-92	< 6	< 6	< 6	< 6
01-06-93	< 3	< 3	< 3	< 3
02-09-93	< 3	< 3	< 3	< 3
03-03-93	< 2	< 2	< 2	< 2
04-07-93	< 5	< 5	< 5	< 5
MEAN[d]	NONE DETECTED	NONE DETECTED	54	20
RANGE	NONE DETECTED	NONE DETECTED	32 to 79	13 to 26

[a] Total count: Number of *Giardia* cysts or *Cryptosporidium* oocysts based on external morphological and fluorescent properties.

[b] Count with internal structures: Number of *Giardia* cysts or *Cryptosporidium* oocysts from total count that have distinguishable internal morphological characteristics.

[c] "<": indicates no cysts or oocysts were detected. The number indicates the detection limit of the procedure, based on the volume of sample analyzed.

[d] Mean-Arithmetic mean: based only on samples with detectable cysts or oocysts.

TABLE 4
STATE PROJECT WATER/DELTA PATHOGEN MONITORING SURVEY
Giardia/Cryptosporidium Results
DELTA MENDOTA CANAL

Sample Date	*Giardia* spp. calculated cysts per 100 L		*Cryptosporidium* spp. calculated cysts per 100 L	
	Total[a] Count	Count with[b] Internal Structures	Total Count	Count with Internal Structures
05-12-92	<[c] 3	< 3	18	13
06-09-92	6	6	55	22
07-21-92	< 9	< 9	9	< 9
08-12-92	< 12	< 12	12	< 12
09-09-92	< 22	< 22	< 22	< 22
10-07-92	< 22	< 22	22	22
11-04-92	< 80	< 80	< 80	< 80
12-02-92	< 8	< 8	< 8	< 8
01-06-93	< 8	< 8	< 8	< 8
02-09-93	< 98	< 98	< 98	< 98
03-03-93	< 73	< 73	73	< 73
04-07-93	< 46	< 46	92	46
MEAN[d]	6	6	40	26
RANGE	6	6	9 to 92	13 to 46

[a] Total count: Number of *Giardia* cysts or *Cryptosporidium* oocysts based on external morphological and fluorescent properties.

[b] Count with internal structures: Number of *Giardia* cysts or *Cryptosporidium* oocysts from total count that have distinguishable internal morphological characteristics.

[c] "<": indicates no cysts or oocysts were detected. The number indicates the detection limit of the procedure, based on the volume of sample analyzed.

[d] Mean-Arithmetic mean: based only on samples with detectable cysts or oocysts.

TABLE 5

STATE PROJECT WATER/DELTA PATHOGEN MONITORING SURVEY

Giardia/Cryptosporidium Results

CALIFORNIA AQUEDUCT CHECK POINT 29

Sample Date	*Giardia* spp. calculated cysts per 100 L		*Cryptosporidium* spp. calculated cysts per 100 L	
	Total[a] Count	Count with[b] Internal Structures	Total Count	Count with Internal Structures
06-15-92	<[c] 53	< 53	< 53	< 53
07-14-92	< 13	< 13	< 13	< 13
08-11-92	< 33	< 33	< 33	< 33
09-08-92	< 18	< 18	< 18	< 18
10-12-92	< 18	< 18	< 18	< 18
11-23-92	< 8	< 8	< 8	< 8
12-16-92	< 7	< 7	< 7	< 7
01-18-93	< 3	< 3	< 3	< 3
02-10-93	< 21	< 21	< 21	< 21
03-10-93	< 126	< 126	< 126	< 126
04-07-93	< 17	< 17	17	17
05-18-93	< 44	< 44	< 44	< 44
MEAN[d]	NONE DETECTED	NONE DETECTED	17	17
RANGE	NONE DETECTED	NONE DETECTED	17	17

[a] Total count: Number of *Giardia* cysts or *Cryptosporidium* oocysts based on external morphological and fluorescent properties.

[b] Count with internal structures: Number of *Giardia* cysts or *Cryptosporidium* oocysts from total count that have distinguishable internal morphological characteristics.

[c] "<": indicates no cysts or oocysts were detected. The number indicates the detection limit of the procedure, based on the volume of sample analyzed.

[d] Mean-Arithmetic mean: based only on samples with detectable cysts or oocysts.

TABLE 6

State Project Water/Delta Pathogen Monitoring Survey
Total and Fecal Coliform Results

Sample Location	Total Coliform MPN/100mL[a]		Fecal Coliform MFC/100mL[b]	
	Mean	Range	Mean	Range
Greene's Landing	666	140-1,600	24	0-120
Banks Pumping Plant	112	11-500	76	0-310
Delta Mendota Canal	268	13-1,600	16	0-100
California Aqueduct Checkpoint 29	20	2-50	11	0-99

[a]Most Probable Number
[b]Membrane Fecal Coliform

STATE WATER PROJECT SANITARY SURVEY
Recommendation #3

PRIORITY B

1. Title: Source Waters - Upstream of Greene's Landing - Urban Runoff Discharges

2. Recommendation: As the Sacramento area urban runoff water quality data become available, the SWPSAC should reevaluate the impacts of urban runoff discharges into the Sacramento Basin.

3. Problem Identification: Urban runoff contains significant concentrations of heavy metals, pesticides, herbicides, polynuclear aromatic hydrocarbons (PAHs) and nutrients and in the Sacramento metropolitan area is regulated by a NPDES permit. The permit requires monitoring of urban runoff into the American and Sacramento Rivers. The impact of urban runoff on drinking water quality has not been evaluated primarily because of the limited data collection to date.

The agencies involved in this issue are the SWRCB, CVRWQCB, City of Sacramento, USEPA and Sacramento County.

4. Solution: Existing regulatory programs can include collection of data necessary to assess the impact of urban runoff on drinking water quality. The SWPSAC should review the stormwater NPDES permit monitoring requirements to ensure that constituents that impact drinking water quality are being analyzed.

5. Cost: Funds will be needed to analyze the data and assess the impacts on drinking water quality.

6. Benefits: This program will generate data that can be used in the wasteload allocation process and more stringent regulation of urban runoff, if required.

7. Implementation Plan: The NPDES permit issued to the Sacramento Area Storm Water Program requires implementation of a monitoring program to assess compliance with water quality standards and stormwater pollutant loadings.

The following tasks should be undertaken to implement the recommendation:

A. Obtain and review the current monitoring program to determine whether it is adequate to assess the impacts on drinking water quality and supplies.

B. Provide recommendations on necessary amendments to the monitoring program to the Sacramento Program and the Regional Board.

C. Obtain and evaluate results of the monitoring program to determine the impacts of storm water discharges on drinking water supplies.

The following program is recommended to accomplish the above tasks:

Task	Estimated Costs	Responsible Agency	Schedule
A	--	SWPSAC	Completed - see attached June 24, 1993 memo
B	--	SWPSAC	Completed - see attached December 22, 1993 memo
C	minimal	DWR & SWC	Ongoing

MEMORANDUM

June 24, 1992

To: Water Purification Engineer

From: Senior Engineer T. S. Tanaka

Subject: Review of Documents Regarding Source Waters Upstream of Greene's Landing--Urban Runoff Discharges; Sanitary Survey Recommendation No. 3

1. Background. The Sanitary Survey of the State Water Project includes a recommendation that the State Water Project Sanitary Action Committee should reevaluate the impacts of urban runoff discharges into the Sacramento Basin as urban runoff data become available for the Sacramento area. Staff of the Water Quality Division have reviewed several documents which discuss water quality monitoring of Sacramento area urban runoff. These documents include:

- Annual Report 1990/1991 Monitoring Program NPDES Permit 90-158 (July 1, 1991) by Sacramento County Water Agency, City of Sacramento, City of Folsom, and City of Galt

- Task Report 5-4 Lower American River Urban Runoff Project and Task Report 6-3 Sacramento River Compliance Monitoring Project Data Report-Storm Event Sampling, February 2, 1991 (June 7, 1991) by Brown and Caldwell Consultants

- Sacramento NPDES Stormwater Permit Monitoring Program, Summary of First Flush Sampling Results Permittees: Sacramento County Water Agency, City of Sacramento, City of Folsom, and City of Galt; Monitoring Consultant: HDR Engineering

2. Critical Water Quality Parameters. The document review has revealed that several key water quality parameters that Metropolitan considers to be critical are missing. These critical parameters include the following:

- ammonia-nitrogen

- dissolved organic carbon (DOC)

- ultraviolet light absorption at 254 nanometers [UV(254)]
- total trihalomethane formation potential (TTHMFP)
- aluminimum
- iron
- magnesium
- molybdenum

These critical parameters could be added to the table entitled, "Constituents to be Analyzed, Sacramento Storm Water Monitoring Program," on page 4 of Sacramento NPDES Stormwater Permit Monitoring Program, Summary of First Flush Sampling Results.

3. Other Water Quality Constituents. An alternative method to screen the urban runoff water for toxic effects, such as the microtox assay, may prove faster and more sensitive than those mentioned in the reviewed documents. Metropolitan has also evaluated other organic water quality constituents that would normally require monitoring under Title 22 but are not mentioned in the reviewed documents. These constituents are summarized in the attached list; however, from Metropolitan's standpoint, they are not considered critical, at this time, for urban runoff.

ORIGINAL SIGNED BY
T.S. TANAKA

Theodore S. Tanaka

KLWatts
Sanda

TST/pa

cc w/attachments:

E. G. Means
M. D. Beuhler
M. K. Davis
S. E. Barrett
W. D. Taylor
B. Koch
T. S. Tanaka
Water Quality file

Organic Constituents Requiring Monitoring Under Title 22

Triazine herbicides

- atrazine
- simazine
- prometryn

Organophosphorous pesticides (expand Method 8140 to include):

- dimethoate
- molinate
- bentazon
- thiobencarb

Organochlorine pesticides (expand Method 608 to include):

- alachlor
- chlorothalonil
- bromacil

Carbamate pesticides (use Methods 632 and 531):

- carbofuran
- aldicarb
- aldicarb sulfone
- aldicarb sulfoxide

Other pesticides:

Fumigants (use Method 504):

- ethylene dibromide
- dibromochloropropane

Organic Constituents Requiring Monitoring Under Title 22 (continued)

Miscellaneous:

- glyphosate
- endothal
- picloram
- 2,3,7,8-TCDD (dioxin)
- diquat

Semi-volatile organics (expand Method 525 to include):

- di(ethylhexyl)adipate

Volatiles (expand Method 624 to include):

- bromobenzene
- bromochloromethane
- n-butylbenzene
- sec-butylbenzene
- tert-butylbenzene
- chlorobenzene
- 2-chlorotoluene
- 4-chlorotoluene
- dibromomethane
- dichlorodifluoromethane
- 1,3-dichloropropane
- 2,2-dichloropropene
- isopropylbenzene
- p-isopropyltoluene
- n-propylbenzene
- 1,1,1,2-tetrachloroethane
- 1,2,3-trichloropropane
- 1,2,4-trimethylbenzene
- 1,3,5-trimethylbenzene
- 1,2,3-trichlorobenzene
- 1,1-dichloropropene

DEPARTMENT OF WATER RESOURCES

State of California | The Resources Agency

OFFICE MEMO

TO: Mike Sutliff	DATE: December 22, 1993
FROM: Rick Woodard	SUBJECT: SWP Sanitary Survey Implementation Plan

Recommendation #3 of the 1990 report "Sanitary Survey of the State Water Project - Brown and Caldwell Engineers" concerns monitoring urban runoff from the City of Sacramento. Subsequent to publication of the report, the State Water Contractors formed a Sanitary Survey Review Committee for the purpose of analyzing the report's recommendations and formulating an implementation plan for acting upon the recommendations.

Attachment A is the draft (near final) implementation plan for Recommendation #3 of the implementation plan, concerning monitoring of storm runoff from the City of Sacramento. The City has a well developed storm flow monitoring program, and have already made one sampling during an earlier storm event this year.

Attachment B is a draft letter from the State Water Contractors to the City asking to have the following parameters added to the City's monitoring program:

TOC
TTHMFP
UV 254
Ammonia nitrogen

John Coburn has been in contact with:

Dave Brent
City of Sacramento
Department of Utilities
5770 Freeport Blvd, Suite 100
Sacramento, CA

phone: 433-6634

Please organize sampling containers and collection, preservation, handling and other QC information and arrange to have sufficient containers delivered to collect some samples. Please call Dave Brent to make the specific arrangements, including getting him the number of containers he feels he needs. We will arrange for the analyses, so it will be necessary to have him inform us when samples have been collected. Please let me know if any problems arise, and please notify me when this has been done. I want to keep John informed on it. Thanks.

cc: John Coburn
Bruce Agee
Judy Heath

1222MS

STATE WATER PROJECT SANITARY SURVEY
Recommendation #4

PRIORITY A

1. Title: Source Waters - Sacramento Basin Upstream of Greene's Landing - Agricultural Drainage

2. Recommendation: None

SWPSAC Recommendation: **Determine if current assessment, which is the impact of agricultural drainage at Greene's Landing is negligible, is correct. If it is not, implement necessary actions to correct problem.**

3. Problem Identification: Crop irrigation is the largest single use of water from the Sacramento River in the Sacramento Basin upstream of Greene's Landing. A portion of the water delivered to agricultural users returns to the river as agricultural drainage. The drainage water can contain chemicals and minerals associated with agricultural practices. As this water re-enters the river it could contribute to the degradation of the water quality in the Sacramento River.

A vast area of the land in the Sacramento Basin is in active agricultural production and requires a significant amount of water and therefore produces an equally significant amount of drainage water. Typically, agricultural water which is not used in crop production is drained from the field and, if possible, used on adjacent acreage. In passing through the fields, chemicals present on the land can become dissolved or suspended in the applied water. These chemicals may be present as a result of cultural practices or native to the land itself.

A significant amount of drainage enters the Sacramento River. It is estimated that 80% of the agricultural drainage discharges into the Sacramento River between the Colusa Basin drain outfall and Suisun Bay. Drainage in this area is a primary contributor to the heavy silt load carried in the lower Sacramento River. The drainage also has carried detectable levels of herbicides used in the production of rice, and of insecticides associated with orchards.

The main impacts of agricultural drainage in the Sacramento River on drinking water supplies are the increased contribution of silt, herbicides, and pesticides. At present, it would appear that the silt load has not affected the ability of Sacramento River water at Greene's Landing to meet drinking water standards. The presence of the herbicide Bolero at the City of Sacramento water treatment plant intake in the mid-80s was an aesthetic problem, and has since been controlled.

The concern over herbicide levels in the river has been reduced as rice growers have implemented "Best Management Practices (BMPs)" which have lowered their herbicide use and potential loading to the river. Current monitoring data shows that the detectable levels of the rice herbicides in the Sacramento River throughout this area are well below drinking water standards. Recent data indicate dormant insecticide sprays enter the Sacramento

River during storm events. Though these concentrations found are well below drinking water standards, they may adversely affect aquatic organisms.

Another related agricultural drainage concern is the copper concentration in the agricultural discharges. Rice fields in the Central Valley use large quantities of copper sulfate as a herbicide to control algae. The San Francisco Regional Water Quality Control Board (SFRWQCB) is directing Bay Area water purveyors, and DWR to investigate alternatives to reduce copper concentrations in the water supply imported from the Central Valley. This will allow publicly owned treatment works (POTWs) in the San Francisco Bay area to meet strict discharge standards. Standards for the POTWs are becoming increasingly more stringent to protect aquatic organisms. The discharge standard for copper is 2.9 micrograms/liter (ug/l) which is substantially below the copper action level of 1300 ug/l set to protect human health. The CVRWQCB would be responsible for regulating a reduction in these copper concentrations, if required.

Agencies involved with this issue include; the POTWs, SFRWQCB, SWRCB, CVRWQCB, DWR, and the California Environmental Protection Agency (CalEPA).

4. Solution: Determine if agricultural drainage upstream of Greene's Landing is a threat to the SWP drinking water supplies.

5. Cost: Minimal

6. Benefits: Improved drinking water supplies at Greene's Landing.

7. Implementation Plan: Appropriate measures should be taken to insure that the current evaluation, which states that the impact of agricultural drainage in this area is negligible, is correct.

The following tasks should be undertaken to implement the recommendation:

A. Gather and review all information available on Sacramento River agricultural drainage upstream of Greene's Landing and prepare a report documenting the findings. This should include a description of all monitoring programs and data that have been collected to date.

B. Based upon the outcome of Task A, write letter to CVRWQCB with SWPSAC recommendations.

The following program is recommended to accomplish the above tasks:

Task	Estimated Cost	Responsible Agency	Schedule
A.	--	SWPSAC	Completed - see May 15, 1992 memo attached
B.	--	SWC	Completed - see July 13 & 20, 1992 letters attached

State of California

RECEIVED
MAY 18 1992

Department of Health Services

Memorandum

To: State Water Contractors
555 Capitol Mall, Suite 725
Sacramento, CA 95814-4502

ATTN John Coburn

Date : May 15, 1992

Subject: State Water Project Sanitary Survey Recommendation No. 4

From : Richard L. Haberman
ODW - Visalia District

A subcommittee of the Sanitary Review Committee has obtained and reviewed the January 10, 1992 Report prepared by the Department of Pesticide Regulation (DPR) and submitted to the Central Valley Regional Water Quality Control Board (CVRWQCB) which documents the results of the CVRWQCB efforts to control and reduce the discharge of rice pesticides. These efforts have targeted areas that drain to the Sacramento River above Greens Landing. Attached to this memo is a summary of the Report dated April 2, 1992, prepared by T.S. Tanaka of the Metropolitan Water District of Southern California. Tanaka's summary concludes that the pesticides and herbicides utilized by the rice growing operations on land which drain to the Sacramento River above Greens Landing "do not present a problem for SP water in Southern California."

It is also the subcommittee's opinion that the efforts of the CVRWQCB have been very successful in achieving improved water quality for water users in the Sacramento metropolitan area. The subcommittee recommends that the State Water Contractors acknowledge the success of the CVRWQCB efforts and urged them to continue the strict enforcement of their requirements so that water quality problems related to these chemicals do not develop in the future. The Board must also remain alert to the use of new or substitute chemicals that may be used in place of those which they currently regulated with great success.

The approach used by the CVRWQCB to control the discharge of rice pesticides in this area of the State should serve as a model of the kind of approach that could possibly be followed to control discharges of other agricultural chemicals used in California's greater Central Valley.

RLH/jw
M511RH1.DOC

MEMORANDUM

April 2, 1992

To: Water Purification Engineer

From: Senior Engineer T. S. Tanaka

Subject: Review of Department of Pesticide Regulation Document--Information on Rice Pesticides; Sanitary Survey Recommendation No. 4

1. Background. The California Department of Pesticide Regulation (DPR) issued a report describing programs to reduce discharges of herbicides and pesticides from rice fields into waterways of the Sacramento Valley, which included monitoring of these organic chemicals. Monitored were the herbicides; molinate and thiobencarb, and the insecticides; carbofuran, methyl parathion, malathion, and bensulfuron methyl (Londax). These programs have been in existence since 1983, but apparently were made more stringent in 1991 and 1992 to meet water quality objectives in Sacramento Valley surface waters.

2. Metropolitan Water District of Southern California (Metropolitan) Experience. None of the above chemicals have been detected by Metropolitan in State project water (SPW) in Southern California. The only herbicides or pesticides that have been detected in SPW in Southern California by Metropolitan have been atrazine and simazine (both are herbicides).

Results of Monitoring in Sacramento Valley

3. Of the organic chemicals monitored in 1991, only one (molinate), exceeded the maximum contaminant level (MCL) of 20 ppb (Title 22). However, this sample was taken in Butte Slough at Highway 20 in Sutter County. Of the samples in the Sacramento River at the Intake to one of the City of Sacramento water treatment facilities, most were below the limits of detection (0.5 ppb) and none exceeded 0.60 ppb.

4. Thiobencarb was not detected in any of the sampling points in the waterways adjacent to the rice fields or in the Sacramento River (detection limit of 0.5 ppb). The MCL for thiobencarb is 70 ppb.

5. Bensulfuron methyl was detected at a maximum level of about 0.8 ppb at two sites in waterways in the Sacramento Valley. There is no MCL for bensulfuron methyl.

6. Carbofuran was detected at a maximum level of 0.6 ppb in Sacramento Valley waterways (the MCL is 18 ppb).

7. Methyl parathion was detected in Sacramento Valley waterways at a maximum level of 0.30 ppb, and malathion was detected at a maximum concentration of 0.20 ppb. Neither of these chemicals has an MCL in the latest version of Title 22. However, methyl parathion has an action level (nonenforceable, recommended level set by the California Department of Health Services) of 30 ppb, and malathion has an action level of 160 ppb.

Programs Instituted by DPR

8. The DPR is requiring rice growers to hold water following the application of herbicides and pesticides for certain minimum time periods. It appears that these time periods were selected to exceed the half-life of these chemicals by a minimum of approximately 100 percent. Thus, the required minimum holding time (based on emergencies) is 7 days for molinate, which has a half-life of 3 to 4 days. Under normal situations, the required holding time in tailwater recovery systems for molinate is 28 days, with discharge permitted on the 29th day. Thiobencarb must be held for 6 to 29 days depending on location of the rice fields or number of permittees controlling the system. For fields with carbofuran, discharge is not permitted for 24 days following initial flooding or after the last application. For methyl parathion, the water must be held, normally, for 24 days following application.

Conclusions

9. It appears that pesticides and herbicides utilized by rice growing operations do not represent a problem for SPW in Southern California. Recent trends indicate that levels of molinate and thiobencarb in the Sacramento River at Sacramento have been generally decreasing with time from maximum concentrations of 16.0 ppb of molinate and 57 ppb of thiobencarb in 1982 to 0.60 ppb of molinate and nondetectable levels of thiobencarb in 1991. Programs utilizing holding periods, following application, appear to be effective in reducing levels of molinate and thiobencarb (the number of thiobencarb application permits was also limited).

Theodore S. Tanaka

Theodore S. Tanaka

TST/dmn

state water contractors

555 Capitol Mall Suite 725 • Sacramento CA 95814 (916) 447-7357
George R. Baumli, General Manager FAX 447-2734

July 13, 1992

Mr. William H. Crooks
Executive Officer
Central Valley Regional
Water Quality Control Board No. 5
3443 Routier Road
Sacramento, CA 95827

Dear Mr. Crooks:

In February 1988, the Department of Health Services, Office of Drinking Water, required the State Water Contractors to conduct a Sanitary Survey of the State Water Project. The report, "Sanitary Survey of the State Water Project", produced by Brown and Caldwell Engineers and dated October 1990, contains some recommendations which relate to the authority of the State and Regional Boards. Three of those recommendations have a direct bearing on the Central Valley Regional Board.

<u>RECOMMENDATION :</u> The San Joaquin River at Vernalis is not designated as having an existing beneficial use of municipal water supply. Yet this water, exported at the south Delta pumps, is used for drinking water purposes. The Regional Board should recognize this use and adopt standards that protect the municipal water supply beneficial use classification of the San Joaquin River at Vernalis.

Currently, the Water Quality Control Plan for Basin 5b designates the lower San Joaquin River potentially supporting a Municipal and Domestic Supply beneficial use. In the next review of the Basin Plan, which we understand is scheduled for 1993, we hereby request the San Joaquin River from

‧ mouth of the Merced River to Vernalis be redesignated as fully supporting an Existing Municipal d Domestic Supply beneficial use.

The Department of Water Resources estimates that, overall, about 30 percent of the inflow to the State Water Project comes from the San Joaquin River. Under wet hydrologic conditions, the proportion can approach 100 percent. A large share of the water pumped into the State Water Project is used for municipal and domestic water supply. Accordingly, it is certainly the case that significant quantities of water reaching domestic consumers comes through the San Joaquin River.

The reach of the San Joaquin River from the Merced River to Vernalis reflects the combined effects of discharges and fresh water inflows in the entire San Jaoquin River system upstream of the Delta. Therefore, the quality which is found in this reach of the river is a correct reflection of the water from this river which mingles with Delta drinking water supplies. As this condition exists presently and has for some time, we believe it is appropriate that this reach of the San Joaquin River be classed as supporting an existing municipal and domestic beneficial use.

The State Water Contractors hereby request notification of all Board proceedings relative to the issue of designating beneficial uses of San Joaquin River waters and Delta waters in general. It is our intent to participate in public proceedings and submit factual information as necessary to support our ‧tition for this change.

RECOMMENDATION: A mass loading estimate of key contaminants from discharges to the San Joaquin Basin should be developed by the Regional Board.

The State Water Contractors are aware that the State Water Resources Control Board's Inland Surface Water Plan requires implementation of performance goals for agricultural drainage with a phased program which establishes a monitoring program of agricultural discharges. It is also our understanding the required monitoring program is scheduled to begin in October 1993. Further, we understand that the Regional Board is required to establish an accelerated schedule for implementing Agricultural Drainage Best Management Practices.

The State Water Contractors believe the data to be collected under the monitoring plan will prove crucial to developing mass loading estimates for parameters of concern. Accordingly, the State Water Contractors urge the Regional Board to not delay the scheduled October 1993 implementation of the monitoring plan. The State Water Contractors are interested in participating in development of the monitoring program, or providing any other possible assistance to the Regional Board in getting the necessary data collected as soon as possible. The State Water Contractors will coordinate its efforts with the U.S. Bureau of Reclamation and the Department of Water Resources.

STATE WATER PROJECT SANITARY SURVEY
Recommendation #5

PRIORITY C

1. Title: Source Waters - Sacramento Basin Upstream of Greene's Landing: Mine Discharges

2. Recommendation: None

3. Problem Identification: There are numerous documented and undocumented discharges of mine drainage into the Sacramento River system. Drainage from abandoned mining operations can be extremely acidic and laden with high concentrations of heavy metals. If a significant amount of mine drainage enters a drinking water source, Maximum Contaminant Levels (MCLs) can easily be exceeded. Mining operations in the upper reaches of the Sacramento River have been contributing drainage to adjacent streams for well over one hundred years. This drainage has had some dramatic impacts on the local environment. The Iron Mountain Mine, the largest single source of acid mine drainage in the Sacramento Basin, enters the Sacramento River below Lake Shasta. At this site and others, mine drainage impacts are primarily local and affect aquatic life.

Another related water quality concern is the heavy metals loading to San Francisco Bay originating in water imported from the Central Valley. The SFRWQCB continues to adopt very strict heavy metals discharge standards for POTWs in the San Francisco Bay Area. Through a source control program, both the SFRWQCB and the POTWs have requested water suppliers to monitor for heavy metals at low detection limits and develop alternatives for control of copper. The CVRWQCB would be responsible for regulating a reduction in heavy metal concentrations from the sources such as mine drainage in the Central Valley, if required. With the possible exception of arsenic, mine discharges in the Sacramento Basin do not appear to significantly affect the drinking water quality of Sacramento River water at Greene's Landing . This is a function of the relatively small quantity of flow from the mines discharges, on-site mitigation measures and river mileage between the mines and Greene's Landing. Mine drainage may, however, be a significant source of arsenic. This may be a problem, if as anticipated, the MCL for arsenic in drinking water is significantly reduced in the near term future. Agencies involved include; the POTWs, SFRWQCB, SWRCB, CVRWQCB, U.S. Bureau of Reclamation (USBR), USEPA and CalEPA.

4. Solution: No recommended action was presented in the Sanitary Survey Report. A substantial body of data have been collected which demonstrate that acid mine drainage currently has a negligible effect on the quality of the lower Sacramento River, from the perspective of a drinking water source.

5. Cost: Unknown.

6. Benefits: Unknown.

7. Implementation Plan: The SWC will monitor the implementation of any new arsenic MCLs.

STATE WATER PROJECT SANITARY SURVEY
Recommendation #6

PRIORITY A

1. **Title**: Source Waters - San Joaquin Basin Upstream of Vernalis.

2. **Recommendation:** The San Joaquin River at Vernalis is not designated as having an existing beneficial use of municipal water supply. Yet this water, exported at the south Delta pumps, is used for drinking water purposes. The Regional Board should recognize this use and adopt standards that protect the municipal water supply beneficial use classification of the San Joaquin River at Vernalis.

3. **Problem Identification:** The Water Quality Control Plan - Basin Plan 5b does not recognize the San Joaquin River as sustaining a municipal water supply beneficial use. Water Quality Control Plans for all the water basins in California are required as part of the Federal Clean Water Act. Originally produced in the early 1970's, the Water Quality Control Plans are periodically updated to reflect current beneficial uses and water quality conditions. Basin Plan 5b which includes the Vernalis area of the San Joaquin River is scheduled to be updated in 1994.

Basin Plan 5b, Second Edition, as updated in 1991, contains the following beneficial use designations which apply to the San Joaquin River from the mouth of the Merced River to Vernalis:

	Existing	Potential
Municipal and Domestic Supply		X
Agricultural Irrigation	X	
Agricultural - Stock Watering		X
Industrial - Process water	X	
Recreation - Contact		X
Recreation - Canoeing, Rafting	X	
Recreation - Other		X
Freshwater Habitat - Warm		X
Migration - Warm	X	
Migration - Cold		X
Spawning - Warm	X	
Wildlife Habitat		X

Agencies involved include the SWRCB, CVRWQCB, and DWR.

4. **Solution:** In 1989, the SWRCB established a "Sources of Drinking Water Policy" which, in effect, declares all waters of the State to be drinking water, with specific exceptions such as wastewater discharges and ground water of high salinity. Accordingly, the Basin Plan need not specifically identify a Municipal beneficial use for this river in order for municipal beneficial uses to be protected there.

With the current Basin Plan 5b and the "Sources of Drinking Water Policy", municipal and domestic beneficial uses of the lower San Joaquin River enjoy a degree of protection at the present time. However, it is recommended that as part of the normal update of Basin Plan 5b, the beneficial use designation of Municipal and Domestic Supply be changed from "Potential" to "Existing", based on the fact that San Joaquin River water is included in water exported from the Delta for municipal supply.

5. **Cost:** Costs are estimated to be less than $10,000.

6. **Benefits:** If the lower San Joaquin River carries an "existing" municipal water supply designation, the State and Regional Water Quality Control Boards will be fully obligated to protect this beneficial use in their decision making concerning discharges into the river.

7. **Implementation Plan:** The following tasks should be undertaken to implement the recommendation:

A. Prepare and send a letter petitioning the CVRWQCB to designate the lower San Joaquin River as supporting an existing municipal and domestic beneficial use.

B. The SWC' SWP Water Quality Technical Committee should closely follow progress of the Basin Plan 5b review and when appropriate during this process, present factual information in support of the petition.

C. During the course of the Basin Plan 5b review, the Department of Water Resources should present factual information demonstrating the relationship of San Joaquin River water to sources of domestic water supplies taken from the Sacramento-San Joaquin Delta.

D. Update the Basin Plan 5b to designate the San Joaquin River near Vernalis as supporting an "existing", rather than a "potential" Municipal and Domestic Supply beneficial use.

The following program is recommended to accomplish the above tasks:

Task	Estimated Costs	Responsible Agency	Schedule
A.	--	SWC	Completed - see July 13 & 20, 1993 letters attached to Recommendation #4
B.	--	SWC	Completed - November 30, 1993 letter attached
C.	$ 5,000	DWR	Dependent on Basin Plan update.
D.	$ 5,000	SWRCB CVRWQCB	Dependent on Basin Plan update.

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George R. Baumli, *General Manager* (916) 447-7357 • FAX 447-2734

November 30, 1993

Mr. William H. Crooks, Executive Officer
Central Valley Regional Water Quality
Control Board
3443 Routier Road
Sacramento, CA 95827

Subject: Submission for Consideration at November 30, 1993 Basin Plan Workshop

Dear Mr. Crooks:

In February 1988, the Department of Health Services requested the State Water Contractors to conduct a sanitary survey of the State Water Project, pursuant to requirements of the new Surface Water Treatment Rule. The report, "Sanitary Survey of the State Water Project," prepared by Brown and Caldwell Consultants and published in October 1990, documented the findings and recommendations of the survey.

The report contains 34 recommendations for implementing measures to protect municipal water supplies taken from the Sacramento-San Joaquin Delta into the State Water Project. Following publication of the report, the State Water Contractors organized a Sanitary Action Committee to evaluate the recommendations of the report and to formulate an implementation plan. The Regional Board was represented on the Committee.

Recommendation number 6 of the report reads:

> The San Joaquin River at Vernalis is not designated as having an existing beneficial use of municipal water supply. Yet this water, exported at the South Delta pumps, is used for drinking water purposes. The Central Valley Regional Water Quality Control Board should recognize this use and adopt standards that protect the municipal water supply beneficial use classification of the San Joaquin River at Vernalis.

The Sanitary Action Committee determined the need to communicate with the Board on this issue and, on July 13, 1992, sent a letter indicating the intent to request the Board to change the designation of municipal beneficial use at Vernalis from "Potential" to "Existing" when the Basin Plan was next reviewed.

As the Board has announced the November 30, 1993 workshop to address the need for Basin Plan changes, it is appropriate at this time to request the change in designation for Vernalis.

Water quality at Vernalis reflects the impacts of the entire San Joaquin River watershed and, therefore, represents the overall quality of the water entering the Delta from the San Joaquin River system. Once in the Delta, water is taken by a number of municipal agencies for use as drinking water supply. There is no doubt that San Joaquin River water finds its way into virtually all drinking water supplies taken from the Delta. Accordingly, although there may not be a municipal intake in the immediate vicinity of Vernalis, water flowing into the Delta past that location is actually, rather than potentially, used for municipal supply.

Designating Vernalis as having an "Existing" municipal beneficial use will improve the ability to protect the drinking water supplies of over two-thirds of California's population. This change is well justified and is needed. Please consider this request at the November 30 workshop. Representatives of the State Water Contractors will be pleased to submit other testimony or evidence as needed to substantiate the need for this beneficial use designation.

Sincerely,

George R. Baumli

George Baumli
General Manager

Xc: SWC Member Agencies
SWC Water Quality Technical Committee

STATE WATER PROJECT SANITARY SURVEY
Recommendation #7

PRIORITY A

1. Title: San Joaquin Basin Upstream of Vernalis

2. Recommendation: A mass loading estimate of key contaminants from discharges to the San Joaquin Basin should be developed by the Regional Board.

3. Problem Identification: The San Joaquin River water quality at Vernalis is degraded by west side agricultural dischargers. The causes of degradation include toxic metals, dissolved solids, suspended solids and pesticides. Regulatory programs to control agricultural drainage have not been fully developed or implemented.

Agencies involved are the SWRCB, CVRWQCB, DWR, USBR, and agricultural drainage districts.

4. Solution: The SWRCB's Inland Surface Waters Plan (Plan) requires implementation of performance goals for agriculture drainage with a phased program which establishes a monitoring program of agricultural discharges and begins implementation of Best Management Plans (BMPs). The monitoring program was not to begin until October 1993 so meaningful key contaminant data will not be available until after 1995. The CVRWQCB is required to establish an accelerated schedule for agricultural dischargers to implement BMPs and controls to reduce levels of known problem constituents. The CVRWQCB is also required to immediately pursue regulatory-based encouragement of BMPs or issuance of waste discharge requirements if agricultural dischargers do not cooperate.

The Plan is being challenged in court, and it appears that it may be set aside. If this occurs, it is unclear what requirements agricultural discharges might be required to meet. The USEPA could mandate its own plan.

5. Cost: The costs for collection and analysis of the data are unknown.

6. Benefits: Implementation of a program to regulate agricultural drainage to reduce key contaminants will result in the improvement of water quality at Vernalis.

7. Implementation Plan: A mass loading estimate of key contaminants from discharges to the San Joaquin Basin should be developed by the CVRWQCB.

The following tasks should be undertaken to implement the recommendation:

A. The SWC should write a letter to the CVRWQCB requesting the monitoring program not be delayed.

B. The SWC should maintain contact with CVRWQCB staff to assure appropriate opportunity is provided for technical input to development of the monitoring program. The DWR and USBR will provide additional data and participate as appropriate in the monitoring program design process.

C. Develop mass loading estimate of key contaminants from discharges to the San Joaquin River Basin.

The following program is recommended to accomplish the above tasks:

Task	Estimated Costs	Responsible Agency	Schedule
A.	--	SWC	Completed - see July 13 & 20, 1993 letters attached to Recommendation #4
B.	$ 10,000	DWR, USBR SWC, CVRWQCB	Ongoing
C.	unknown	CVRWQCB	1994 - 1995**

** Estimated schedule. Timing will depend on development of a data base which is adequate for this evaluation.

STATE WATER PROJECT SANITARY SURVEY
Recommendation #9

PRIORITY C

1. Title: San Joaquin River Upstream of Vernalis - Urban Runoff Discharges.

2. Recommendation: None

3. Problem Identification: There is no evidence that urban runoff from the cities upstream of Vernalis is responsible for the poor drinking water quality of the San Joaquin River at Vernalis; however, a mass loading analysis has not been completed.

The agencies involved in this issue are the CVRWQCB, CDHS, City of Modesto and City of Manteca.

4. Solution: The 1987 amendments to the Clean Water Act will require that all cities regardless of size, apply for and obtain NPDES permits for stormwater discharges. USEPA regulations require monitoring of urban runoff to determine the significance of these discharges. The City of Modesto has established a stormwater management program to control pollutants in urban runoff. The SWC should review the stormwater NPDES permit monitoring requirements to ensure that constituents that impact drinking water quality are being analyzed.

5. Costs: The annual cost for collection and analysis of the data is estimated to be $200,000 per city and is the responsibility of each city.

6. Benefits: Possible improvement of the drinking water quality in the San Joaquin River at Vernalis.

7. Implementation Plan: The storm water NPDES permits issued for the cities upstream of Vernalis require implementation of a monitoring program to assess compliance with water quality standards, impact on beneficial uses, and stormwater pollutant loadings.

The following tasks should be undertaken to implement the recommendation:

A. SWC should write a letter to the CVRWQCB requesting copies of the storm water monitoring plans for the cities upstream of Vernalis. These plans should have been available by January 1, 1994.

B. SWC should review the programs and the NPDES stormwater permit monitoring requirements in particular, to ensure that constituents that adversely impact drinking water quality are analyzed. The SWC should coordinate closely with the CDHS in conducting this review.

C. If the permit monitoring program review indicates that adequate data are being collected, it is recommended that one year of data be compiled for performing an assessment of impacts on drinking water quality. If the NPDES permit monitoring program does not provide sufficient data, the SWC should request the CVRWQCB amend the monitoring program to provide the necessary data. It is again recommended that one year of data be collected under any revised program.

The following program is recommended to accomplish the above tasks:

Task	Estimated Cost	Responsible Agency	Schedule
A	-	SWC	Completed - see February 7 & 22, 1994 letters attached
B	$2,000	SWC	April 1994
C	$1,000	SWC	September 1994

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George R Baumli, *General Manager* (916) 447-7357 • FAX 447-2734

February 7, 1994

COPY

Mr. Bill Johnson, Assistant Executive Officer
Central Valley Regional Water Quality Control Board
3443 Routier Road
Sacramento, CA 95827

Dear Mr. Johnson:

At the January 27, 1994 meeting of the State Water Project Sanitary Action Committee, the report recommendations listed below were discussed. Since you were not able to attend the meeting, the committee did not have the benefit of your input on the discussion. Therefore, I would appreciate your assistance on the following items:

1. Recommendation No. 3 refers to the litigation over the April 1991 Inland Surface Waters Plan. I am aware this issue remains unresolved, and have received the indication that the Plan is likely to be overturned. Can you provide us with any late indication of what the outcome is likely to be, and when we will know of it?

2. Recommendation No. 7 refers to a monitoring program, which was to have begun in October 1993, in connection with development of Best Management Plans (BMPs) under the Inland Surface Waters Plan. Please tell us whether this monitoring program has begun and, if so, whom we might contact for the data. Has the previously mentioned litigation affected this monitoring program?

Mr. Bill Johnson
February 7, 1994
Page 2

3. The implementation plan for Recommendation No. 9, part A, is to contact the Central Valley Regional Board to get copies of the storm water monitoring plans for the cities upstream of Vernalis. These were to have been available by January 1, 1994. Please provide us copies when they are available.

4. Part A of the implementation plan for Recommendation No. 13 is to send a letter to the Regional Board urging the Board to require the communities of Rio Vista, Lodi, Byron, and Brentwood to file for and obtain National Pollution Discharge Elimination System (NPDES) storm water permits. We hereby make that request.

Thank you for your assistance in this matter, and for your expertise and cooperation throughout development of this project.

Sincerely,

George R. Baumli

George R. Baumli
General Manager

Xc: SWC Member Agencies
SWP Sanitary Action Committee
SWC Water Quality Technical Committee

STATE OF CALIFORNIA - Environmental Protection Agency

PETE WILSON, *Governor*

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION
3443 Routier Road, Suite A
Sacramento, CA 95827-3098
PHONE: (916) 255-3000
FAX: (916) 255-3015

RECEIVED

FEB 23 1994

22 February 1994

Mr. George R. Baumli, General Manager
State Water Contractors
555 Capitol Mall, Suite 725
Sacramento, CA 95814-4502

STATE WATER PROJECT SANITARY ACTION COMMITTEE RECOMMENDATIONS

Thank you for your letter of 7 February 1994 requesting assistance on four issues associated with the Committee's recommendations. My responses to those issues, in the order you posed them, are:

1. I have no late indication of what the litigation outcome will be concerning the April 1991 Inland Surface Waters Plan (ISWP). The Office of Chief Counsel of the State Water Resources Control Board may be able to assist you with this question. Please call Ms. Kathleen Keber, Senior Staff Counsel, at (916) 657-2086.

2. The Committee's recommendation No. 7 refers to a monitoring program in connection with development of Best Management Plans under the ISWP. All funds for monitoring of surface waters to measure the effects of nonpoint source discharges were withdrawn by the State Water Board following the U.S. EPA's disapproval of relevant sections of the ISWP. Presently, there are no plans for funding to do such monitoring for as far into the future as we can project.

3. You have requested copies of the storm water monitoring plans for the cities upstream of Vernalis under Recommendation 9A. To do so would require assembling a large package involving considerable staff time. I would like to suggest your staff contact Wayne Pierson, Unit Chief at the Regional Board, at (916) 255-3026. Arrangements can be made, convenient to both parties, for your staff to visit the Regional Board and see what we have and what you may want.

4. Recommendation 13, Part A, called for a letter to be sent to the Regional Board requesting that the communities of Rio Vista, Lodi, Byron, and Brentwood be required to file for NPDES stormwater permits. We plan no actions for the four communities since the law currently does not require them to obtain stormwater permits.

I very much enjoyed working with John Coburn and the other committee members on the project. I look forward to other such opportunities in the future.

W.S. Johnson

WILLIAM S. JOHNSON
Assistant Executive Officer

cc: Ms. Kathleen Keber, Office of Chief Counsel, State Water Resources Control Board, Sacramento
Mr. Wayne Pierson, Central Valley Regional Water Quality Control Board, Sacramento

STATE WATER PROJECT SANITARY SURVEY
Recommendation #10

PRIORITY A

1. Title: Source Waters - San Joaquin Basin Upstream of Vernalis: Agricultural Drainage

2. Recommendation: Because the west side subsurface agricultural discharges into the San Joaquin River are the single largest cause of the poor water quality of the San Joaquin River at Vernalis, the Regional Board's and USBR's efforts to find solutions for these discharges should be supported and monitored by the SWPSAC.

3. Problem Identification: Water from the San Joaquin River Basin and imported water from the Delta is used to irrigate crops within the region upstream of Vernalis. The use of native and imported water for irrigation produces significant amounts of agricultural drainage. The drainage water can contain high levels of minerals associated with agricultural practices, and may also contain agricultural chemicals. Typically, excess applied agricultural water is drained from the field and, if possible, used on adjacent acreage. In passing through the fields, minerals and agricultural chemicals present on the land can become dissolved or suspended in the applied water. These chemicals may be present as a result of cultural practices or native to the land itself.

Subsurface agricultural drainage is the primary source of salts and trace elements to the San Joaquin River. Elevated levels of these constituents are the major reason that San Joaquin River water at Vernalis is of relatively poor drinking water quality. The Sierra tributaries, which receive only surface agricultural drainages, are of significantly higher quality.

Surface and subsurface agricultural drainage is discharged into the San Joaquin River from Mud and Salt Sloughs and constitutes most of the flow in the river immediately upstream of the Merced River. Subsurface agricultural drainage is also discharged to the San Joaquin River from the west side of the basin between Mud Slough and Vernalis.

Agencies involved are the SWRCB, CVRWQCB, USBR, Local Water/Drainage Districts and the DWR - San Joaquin Valley Drainage Implementation Program.

4. Solution: Programs to control subsurface and surface agricultural discharges to the San Joaquin River are in their early stages. These control programs should be evaluated, as more intense efforts may be required. Agricultural management practices to control agricultural drainage in the San Joaquin Basin are being investigated by the CVRWQCB. Management alternatives being evaluated include water conservation methods such as more efficient use and recycling of water, sediment control, retirement of farmed land, and changing crops grown in some areas. The CVRWQCB's Basin Plan identifies "out of basin" export and discharge to saline, less sensitive waters to be the best long-term technical solution to the problems caused by agricultural drainage.

The San Joaquin Valley Inter-Agency Drainage Program, produced detailed recommendations regarding agricultural drainage management throughout the San Joaquin Valley. Development of an implementation program for these recommendations is being coordinated under the direction of the DWR. Continued support of these efforts is essential to properly address this issue.

5. Cost: The CVRWQCB is currently evaluating alternative management practices as part of its current budgeting process. Additional costs to other agencies should be negligible, as they provide technical support and review. Costs to implement solutions may be significant to the agricultural entities involved.

6. Benefits: Development and implementation of an agricultural drainage management plan for the San Joaquin Basin will improve the water quality of the San Joaquin River at Vernalis.

7. Implementation Plan: Support and monitor the CVRWQCB's and USBR's efforts to develop solutions to this problem. A key element of the overall implementation plan will be the agricultural monitoring and management plan which must be developed under the SWRCB's Inland Surface Waters Plan.

The following tasks should be undertaken to implement the recommendation.

A. The SWPSAC should review the San Joaquin Valley Agricultural Drainage Program reports titled " A Management Plan for Agricultural Subsurface Drainage and Related Problems on the Westside San Joaquin Valley, September 1990" and " A Strategy for Implementation of the Management Plan for Agricultural Subsurface Drainage and Related Problems on the Westside San Joaquin Valley, December 1991". This review should focus on the recommendations as they relate to impacts on domestic water quality in the State Water Project.

B. The SWC should transmit the findings and recommendations of the SWPSAC to the San Joaquin Valley Drainage Implementation Program's Public Health Workgroup.

C. The SWC should monitor the ongoing process.

The following program is recommended to accomplish the above tasks:

Task	Estimated Cost	Responsible Agency	Schedule
A	--	SWPSAC	Completed - see October 5, 1992 memo attached
B	--	SWC	Completed - see January 28, 1994 letter attached
C	$ 1000	SWC	Ongoing

State of California

Memorandum

Department of Health Services

Date : October 5, 1992

: State Water Contractors
555 Capitol Mall, Suite 725
Sacramento, CA 95814-4502

Attention: John Coburn

RECEIVED
OCT - 7 1992

From : Office of Drinking Water
5545 East Shields Avenue
Fresno, CA 93727

Subject :

State Water Project
<u>Sanitary Survey Recommendation No. 10</u>

The State Water Project Sanitary Survey Action Committee (SWPSAC) has obtained and reviewed the reports entitled "A Management Plan for Agricultural Subsurface Drainage and Related Problems on the West Side San Joaquin Valley, September 1990" and "A Strategy for Implementation of the Management Plan for Agricultural Subsurface Drainage and Related Problems on the West Side San Joaquin Valley, December 1991." The plan recommended for management of subsurface drainage contained in these two documents included the following major components:

1. Source control.
2. Drainage reuse.
3. Evaporation system.
4. Land retirement.
5. Groundwater management.
6. Discharge to San Joaquin River.
7. Protection, restoration, and provision of substitute water for water supplies for fish and wildlife habitats.
8. Institutional change.

State Water Contractors
October 5, 1992
Page 2

Of the above program elements, discharge of drainage water to the San Joaquin River is of the greatest interest and concern to the State Water Contractors. A large percentage of the San Joaquin River water which flows to the Delta is returned down the Delta Mendota Canal and State Water Project to water purveyors in Central and Southern California for domestic use.

Recommendations

The Plan calls for controlled and limited discharge of drainage water from the San Joaquin basin to the San Joaquin River while meeting water quality objectives. The State Contractors must also closely monitor the implementation of these water quality objectives. This should include a review of the water quality data obtained by the RWQCB and the data submitted to the RWQCB in compliance with the drainage operation plans submitted by the agricultural drain discharges.

Every three years the Basin Plan for the San Joaquin River is reviewed. This review includes an evaluation of these water quality objectives. The State Water Contractors should participate in this review.

The State Contractors should also continue to insist that the Regional Water Quality Control Board recognize the use of the San Joaquin River at Vernalis as a domestic water supply source thereby requiring them to adopt standards that protect this use when setting discharge water quality requirements for drainage water.

Implementation of the other management plan components will help to minimize the need for discharge to the San Joaquin River and therefore be supported by the State Contractors.

Richard L. Haberman, P.E.
Senior Sanitary Engineer

RLH/jw

M915RH1.DOC

state water contractors

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George R. Baumli, *General Manager* (916) 447-7357 • FAX 447-2734

January 28, 1994

Anna M. Fan, Ph.D., Chair
Public Health Assessment Workgroup
San Joaquin Valley Drainage
Implementation Program
Office of Environmental Health Hazard Assessment
2151 Berkeley Way, Annex 11
Berkeley, CA 94704

Dear Dr. Fan:

In February 1988, the California Department of Health Services requested the State Water Contractors (SWC) to perform a sanitary survey of the State Water Project (SWP). The purpose of the survey was to characterize actual and potential contaminants in the State Water Project, one of the State's primary sources of drinking water supplies.

The October 1990 consultant report, "Sanitary Survey of the State Water Project" documented the findings of the survey, and made recommendations for actions to reduce the vulnerability of SWP drinking water supplies to contamination.

The report recognizes the significance of subsurface drainage in the San Joaquin Valley as the largest cause of poor quality water in the San Joaquin River at Vernalis, where the river begins to mix with the drinking water supplies of the Delta. The plan, which was subsequently developed for implementing the report recommendations requires that developments in the San Joaquin Valley Drainage Implementation Program be closely monitored and appropriate input be provided.

In that context, we have reviewed the draft report, "San Joaquin Valley Drainage Implementation Program", and have the following comments:

- Overall, the report is well written and, taken together, the short and long term actions underway and planned should substantially improve agricultural wastewater management in the San Joaquin Valley.

- Our only substantial comment has to do with arsenic. On page 109, a statement appears that monitoring in the San Joaquin River should include analyses of arsenic, among other elements. We agree with this recommendation and would add that the detection limit for arsenic analyses be 1.0 microgram per liter (one part per billion) or below, in order to be sufficiently sensitive to enable an adequate public health assessment.

  The Environmental Protection Agency intends to review and revise the current 50 ug/L Maximum Contaminant Level (MCL) for arsenic in drinking water. Recent health effects data suggest the need to reduce the MCL. Through personal communication with EPA regulatory staff, we believe the new regulation for arsenic will probably be between 2 and 20 ug/L, but could be as low as 0.5 ug/L.

  At the present time, the waters of the State Water Project typically contain 2 to 3 ug/L arsenic. Depending on the arsenic limit set by the new regulation, it may be the case that the Department of Water Resources and its municipal contractors will have to be concerned about all significant sources of arsenic to the State Water Project waters. In this regard, in addition to the monitoring, we request your committee conduct a health risk assessment based on arsenic contributions to the drinking water supplies of the Delta, with emphasis on the State Water Project.

Also, we would appreciate being added to your list of reviewers for all documents related to health effects of San Joaquin Valley waters entering the Delta.

Thank you for the opportunity to comment.

Sincerely,

George R. Baumli
General Manager

Xc: SWC Member Agencies
SWP Sanitary Action Committee
SWC Water Quality Technical Committee

STATE WATER PROJECT SANITARY SURVEY
Recommendation #11

PRIORITY C

1. Title: Source Waters - San Joaquin Basin Upstream of Vernalis: Mine Discharges

2. Recommendation: None

3. Problem Identification: As with the Sacramento Basin, there are numerous documented and undocumented discharges of mine drainage into the San Joaquin River system. Drainage from mining operations can be extremely acidic and laden with high concentrations of toxic metals and other elements. If a significant amount of mine drainage enters a water supply, drinking water standards could be easily exceeded. Major inactive mines in the San Joaquin River watershed include the Penn (copper), Mt. Diablo (mercury), and New Idria (mercury) mines.

Mine drainage is a source of arsenic in the San Joaquin River and there is increasing concern over sources of arsenic found in the State Water Project. Though the ability of municipal SWP contractors to meet the current drinking water standard for arsenic is not significantly affected by mine drainage, this may not continue to be true. It is anticipated the federal and state MCLs for arsenic will be lowered in the near future, perhaps to levels which may present problems using SWP source waters.

Also, low level copper and mercury concentrations are also becoming an important water quality issue for water suppliers in the San Francisco Bay area. POTWs that discharge into the Bay are having to meet increasingly strict discharge standards for heavy metals. Currently the discharge standard for copper is 2.9 micrograms per liter (ug/l) and 0.012 ug/l for mercury. To accomplish this, the SFRWQCB and the POTWs are conducting a source control program, and have requested water suppliers to monitor for heavy metals at low detection limits and develop alternatives for their control. The CVRWQCB would be responsible for regulating a reduction in heavy metal concentrations from the sources such as mine drainage in the Central Valley, if required.

Agencies involved in this issue include; the POTWs, SWRCB, CVRWQCB, SFRWQCB, USBR, USEPA and CalEPA.

4. Solution: No recommended action was presented in the Sanitary Survey Report. A substantial body of data have been collected which currently demonstrates that mine drainage has a negligible effect on the quality of the San Joaquin River, from the perspective of a drinking water source.

5. Cost: Unknown

6. Benefits: Unknown

7. Implementation Plan: SWC will monitor the implementation of any new arsenic MCLs and may have to revisit the mine drainage issue in the future.

STATE WATER PROJECT SANITARY SURVEY
Recommendation #12

PRIORITY A

1. Title: Source Waters - The Tulare Basin

2. Recommendation: None

SWPSAC Recommendation: Develop an appropriate monitoring program to be implemented during future flood events when Kings River water is flowing north through the James Bypass and also when water is being pumped north from the Tulare Basin via the James Bypass..

3. Problem Identification: During periods of high flow, excess water from the Kings River and the Tulare Lake Basin can be diverted into the San Joaquin River through the James Bypass. Since this bypass system is located in an area with intensive agricultural development, there is a possibility that delivery of this water to the San Joaquin River may result in the transport of agricultural contaminants.

Delivery of water to the San Joaquin River from the Kings River and Tulare Lake Basin occurs only during flood years. When this occurs, the excess water delivered to the river is predominately Sierra runoff and contains only small contributions from agricultural drainage or mine discharges. The delivery of this water to the San Joaquin River most likely improves the quality of the receiving water.

Agencies involved in this issue include; SWRCB, CVRWQCB, DWR, and USBR.

4. Solution: No recommended action was presented in the Sanitary Survey Report. However, the SWPSAC believes that appropriate sampling and analyses should be performed during the appropriate flood events.

5. Cost: The cost of the data collection and analysis for 2-3 sampling events should not exceed $20,000.

6. Benefits: Possible improvement of water quality in San Joaquin River at Vernalis.

7. Implementation Plan: Data must be collected to determine if the flows entering the San Joaquin River from the Kings River and Tulare Basin via the James Bypass present a water quality problem. This can be done by collecting water samples during flood events when the James Bypass is in operation. The sampling would cover periods when just Kings River water is flowing and also when water from the Tule, Kaweah, and Kern are being pumped north from the Tulare Lake Basin as occurred in 1983. Sampling would start at beginning of the flood event and include Title 22 constituents plus *Giardia lamblia* and *Cryptosporidium sp.*.

The data collection would be accomplished by DWR staff. Monitoring sites must be chosen in advance to insure accessibility during a flood event. Some sort of "tickler" file must be set up to track this and other Action Plan flood related items to insure the data are collected when the floods occur.

The following tasks should be undertaken to implement this recommendation:

A. Develop sampling program. Program should identify sampling locations, number of samples required, and constituents of concern. Develop "tickler" to ensure execution of the sampling plan during flood events.

B. When flood event occurs, execute sampling program.

The following program is recommended to accomplish the above tasks:

Task	Estimated Costs	Responsible Agency	Schedule
A	$ 2,000	DWR	May 1994
B	$20,000	DWR	During flood(s)

STATE WATER PROJECT SANITARY SURVEY
Recommendation #13

PRIORITY C

1. Title: Source waters - The Delta

2. Recommendation: As allowed by the Clean Water Act, the Regional Board should consider expanding the areas where NPDES permits for urban runoff are required to include rapidly urbanizing areas in and near the Delta with populations under 100,000. The approach used in Sacramento County to adopt a county-wide permit would address this need if followed in other urbanizing counties in the area.

3. Problem Identification: The quality of water at the SWP Banks Pumping Plant is clearly degraded over the quality of water in its major source, the Sacramento River. Local urban runoff is just one of the many causes of the deterioration of water quality in the Delta. Other causes include agricultural drainage from Delta islands, sea water intrusion, municipal wastewater treatment plant effluent from the Stockton area, possibly local discharges to Cache Slough (north Delta) and the poor quality of San Joaquin River water (primarily south Delta).

Major urban developments are proposed in the Delta area including an increase in the population of Rio Vista from 3500 to 20,000. Urban runoff has been identified as a significant source of heavy metals, pesticides, PAHs etc.

The agencies involved in this issue are the CVRWQCB, and the cities of Rio Vista, Byron, Lodi, Brentwood, etc.

4. Solution: The CVRWQCB should require all communities with significant growth within the Delta to implement stormwater management programs under the direction of a NPDES permit. This would allow new developments to plan and implement coordinated stormwater management controls that would be achieved through compliance with the proposed general permits to regulate construction activities.

5. Costs: The costs of developing the stormwater management programs are estimated to be $250,000 per community.

6. Benefits: Reduction of key contaminants in municipal storm water runoff and improvement in the quality of water at SWP's Delta Pumping Plant.

7. Implementation Plan: The following task should be undertaken to implement the recommendation:

A. The SWC should send a letter to the CVRWQCB urging them to require the communities at Rio Vista, Lodi, Byron, Brentwood, etc. file for and obtain NPDES storm water permits and that all new developments requiring NPDES permits also be required to develop and implement new development controls.

The following program is recommended to accomplish the above task:

Task	Estimated Costs	Responsible Agency	Schedule
A	--	SWC	Completed - see February 7 & 22, 1994 letters attached to Recommendation #9

STATE WATER PROJECT SANITARY SURVEY
Recommendation #14

PRIORITY C

1. Title: Source Waters - The Delta

2. Recommendation: The SWPSAC should initiate a water-year type study of south Delta water quality data to aid in making an evaluation of whether the limited Barker Slough water quality data are representative. This study will also help identify problems particular to low flow conditions in the south Delta area. If this study indicates that the apparently relatively poorer quality of SWP water in the North Bay Aqueduct is not due to drought conditions, then the Regional Board should more extensively evaluate the local discharges into Cache Slough.

SWPSAC Recommendation: The SWPSAC, after carefully consideration, disagrees that this action would prove worthwhile. The southern Delta is very different from the North Bay Aqueduct area. Therefore, the committee recommended no attempt be made to relate the water quality of the two areas. However, the SWPSAC believes that more information is needed to obtain a better understanding of the factors influencing the North Bay Aqueduct water quality.

3. Problem Identification: Data collected during the initial years of operation of the North Bay Aqueduct indicate local drainage is affecting the water quality in the area; however, pumping has reached only partial capacity.

Earlier studies by the DWR indicated that, as exports from the North Bay Aqueduct reached full scale, good quality water would be increasingly drawn from the Sacramento River. These studies indicated water exported through Barker Slough would, therefore, improve from its initial levels. The recent drought, however, produced unusual conditions which have made it difficult to determine whether the predicted improvement will occur. The City of Vacaville's Easterly Wastewater Treatment Facility discharges into a channel tributary to Cache Slough and is a potential source of water quality degradation in the Barker Slough area. The City of Vacaville, with the assistance of the DWR has recently completed a dye study to determine the concentration of treated wastewater entering Cache Slough.

Agencies involved include the DWR, CVRWQCB, and the City of Vacaville.

4. Solution: Collect additional data to determine if there is a problem.

5. Cost: $80,000

6. Benefits: Possible improvement of the North Bay Aqueduct water quality.

7. Implementation Plan: The following tasks should be undertaken to implement the SWPSAC recommendation:

A. Continue data collection in the North Bay area through a full range of hydrologic and pumping conditions.

B. Coordinate with other data collection efforts and studies, including studies by the City of Vacaville concerning the discharge from the Easterly Wastewater Treatment Plant.

C. When adequate data is collected to represent a range of hydrologic and pumping conditions, conduct an analysis to determine the importance of the drought as a water quality factor.

The following program is recommended to accomplish the above tasks:

Task	Estimated Costs	Responsible Agency	Schedule
A.	$75,000*	DWR	Ongoing
B.	$ 1,000	DWR	Ongoing
C.	$ 5,000	DWR	**

* Funds for this work are already incorporated in the funding of the SWP Municipal Water Quality Investigations Program.

** Timing is dependent on having an opportunity to collect data during non-drought conditions.

STATE WATER PROJECT SANITARY SURVEY
Recommendation #15

PRIORITY A

1. Title: Source Waters - Agricultural Drainage

2. Recommendation: The Delta Islands Drainage Investigation project is critically important to understanding the degradation of Delta water and the impact of agricultural drainage on SWP drinking water quality. This project should be supported and, if possible, accelerated.

3. Problem Identification: Since 1982, the DWR has been researching sources of disinfection by-product (DBP) precursors in the Sacramento-San Joaquin Delta. Preliminary findings indicate discharges from Delta islands can be a significant source of DBP and dissolved organic carbon (DOC) precursors. In its 1989 report "Delta Island Drainage Investigation", the DWR estimated that during the critically dry year 1988, up to 40 percent of the trihalomethane (THM) precursor concentration in Delta waters was of Delta island origin. (This work is considered preliminary because the data were collected only during dry hydrologic conditions, and because a number of important islands were not included in the monitoring.)

In the draft DBP rule currently being promulgated, there will be a treatment requirement to remove DBP precursors in addition to complying with the limits for DBPs. Total organic carbon (TOC) will be used as a surrogate for DBP precursors and for determining if adequate amounts of TOC (or DOC) are removed during treatment. Agencies involved include the DWR, CVRWQCB, CDHS, SWRCB, USEPA, Contra Costa Water District, SWP M&I contractors, and Delta landowners.

4. Solution: Since publication of the Sanitary Survey Report, the Delta Islands Drainage Investigations Program has merged with the Delta Health Aspects Monitoring Program to become the Municipal Water Quality Investigations (MWQI) Program. The SWC supported accelerating the agricultural drainage investigation in July 1991.

5. Cost: Funding for the overall MWQI Program is about $1,500,000. The portion of the MWQI Program attributable to the Delta Island Drainage Program is about $800,000 per year.

6. Benefits: The MWQI Program will improve our understanding of the effects of Delta island drainage on drinking water quality.

7. Implementation Plan: The following task should be undertaken:

A. Complete the Delta Island Drainage Program.

The following program is recommended to accomplish the above task:

Task	Cost	Agency	Schedule
A	$1,200,000	DWR & SWC	June 1995

STATE WATER PROJECT SANITARY SURVEY
Recommendation #16

NO ACTION REQUIRED

1. Title: Source Waters - The Delta - Sea Water Intrusion

2. Recommendation: It is in the best interest of the drinking water quality of SWP water to improve salinity standards in the Delta. The SWC have recommended to the State Board a 50 milligram per liter (mg/l) chloride standard, when feasible, to control bromide from sea water intrusion. "When feasible" means when facilities are installed in the Delta to isolate SWP export water from sea water intrusion effects. The State Board should adopt the recommended 50 mg/l chloride standard.

3. Problem Identification: Hydraulic constraints in the Delta, combined with pumping at the SWP Banks and CVP Tracy Pumping Plants, often causes seawater from San Francisco Bay to flow into the Delta. This "reverse flow" results in elevated chloride and bromide levels at the pumping plants. Bromide reacts with chlorine to form brominated trihalomethanes (THMs), and with ozone to form bromate. Regulatory negotiations based on recent health effects studies of the brominated THMs and bromate have led to a draft regulation which, when finalized, will reduce allowable levels of THMs to 80 and 40 ug/l in stages one and two respectively and limit bromate concentrations to 10 ug/l in stage one. These regulations may preclude using both chlorine and ozone in treating SWP water. Enhanced coagulation with free chlorination has been established as the best available technology (BAT) for meeting the stage one THM standard. This technology should work for approximately 90% of the U.S. surface waters. However, because the bromide level of Delta water is in the 90th - 95th percentile of bromide occurrence in the U.S. waters, the BAT will not work for Delta waters. Additional treatment changes (e.g., ozonation and/or chloramination) will be required. The alternative treatment processes (e.g., granular activated carbon,or membranes) are extremely costly, and the technical feasibility of implementing these technologies has not been fully established. Furthermore, the latter technologies remove organic carbon but do not remove bromide.

The existing total THM (TTHM) standard of 100 ug/l is the sum of four individual THM species. Three of the four species contain bromine. Bromide levels in SWP water correlate directly with chloride levels, which are the result of sea water intrusion. At least one M&I user of SWP water has already violated the current 100 ug/l TTHM standard. The stage one standard of 80 ug/l will require most Delta users to change their treatment processes to stay in compliance. In addition, USEPA has considered regulating the individual THMs, bromate and other DBPs. USEPA normally sets levels for carcinogens at the 1 in 10,000 to 1 in 1,000,000 excess cancer risk level. For bromate, these risk levels correspond to 5 to 0.5 ug/l. The USEPA would thus like a stage two bromate level standard of between 0.5 to 5.0 ug/l. In pilot tests, ozonation of SWP water containing bromide commonly produces 10 to 20 ug/l of bromate with peaks over 50 ug/l. Failure to control bromide (seawater intrusion) may compromise the effective use of ozone, and could require M&I users of SWP water to convert to very expensive treatment methods, such as granular activated carbon (GAC) or desalination.

The SWRCB established new salinity objectives in its Water Quality Control Plan for Salinity - San Francisco Bay/Sacramento-San Joaquin Delta Estuary, May 1991. The SWRCB adopted the 50 mg/l chloride recommendation as a "goal", but not an objective of the plan. The plan recommends that municipal water supply agencies work with DWR and USBR to ensure development of off-stream storage, relocation of water supply intakes to better locations, elimination of problem discharges within the Delta, and development of alternative water treatment technologies.

DWR is currently studying the construction of a large off- stream storage reservoir, Los Banos Grandes. Also, the Contra Costa Water District is studying an off-stream reservoir site. These off-stream reservoirs could reduce source bromide levels by allowing more water to be exported during wet weather periods when high Delta outflows have flushed the seawater out of the Delta.

The Metropolitan Water District of Southern California is studying the feasibility of installing GAC regeneration facilities in southern California. Research of different types of desalination is ongoing at numerous locations.

The agencies involved are the DWR, USEPA, CalEPA, SWRCB, USBR, and COE.

4. Solution: The negotiated regulation process has resulted in proposed new and lower disinfection by-product regulations, which will require water treatment modifications. Advanced treatment options such as ozone, GAC adsorption, and membranes will continue to be studied, but have enormous costs, and perhaps insurmountable waste disposal problems. Furthermore, bromate presents problems for all these technologies. Isolating the drinking water supply from the negative quality influences of the Delta would eliminate the seawater intrusion problem.

5. Costs: The costs of advanced water treatment to meet more stringent drinking water regulations in the future could range from one to three billion dollars for all SWP contractors that use Delta water.

6. Benefits: If seawater intrusion is controlled, the potential need to install expensive advanced treatment systems would be reduced.

7. Implementation Plan: Additional Delta facilities will have be identified to reduce the chloride levels of SWP water to the 50 mg/l "goal". The cost of these facilities must be weighed against the additional treatment costs which will be realized if the facilities are not constructed. Also, the impact of new Delta facilities on the water supply is significant.

The selection of new Delta facilities and their operational rules will be complex process involving DWR, USEPA, COE, USBR, U.S. Fish and Wildlife Service, SWRCB, California Department of Fish and Game, environmental groups, local interests, and others. The schedule for resolving the sea water intrusion problem will be determined by numerous technical and political factors which are beyond the control of the SWPSAC. The SWC will continue to take an active role in this process.

STATE WATER PROJECT SANITARY SURVEY
Recommendation #17

PRIORITY A

1. Title: Source Waters - The Delta

2. Recommendation: It is in the best interest of the drinking water quality of SWP water to reduce the seismic vulnerability of Delta levees and protect SWP water supplies from catastrophic sea water intrusion.

3. Problem Identification: The central Delta islands are composed mainly of peat soils, which have oxidized over the years. These islands are now mostly below sea level, and the levees are subjected to higher static pressures than they were designed to withstand. Also, recent studies have shown the Delta to be susceptible to levee collapse or damage from earthquakes. It has been projected that there is a 67 percent chance of a large magnitude earthquake occurring within the next 30 years on faults near the Delta. Such an earthquake could cause widespread levee failure and flooding in the Delta. If this occurs, large quantities of seawater from San Francisco Bay would fill the islands, and Delta water would become unusable for export. It has been estimated that it would take from two months to one year to repair the levees and flush the seawater out of the Delta. Agencies relying on the Delta would need to utilize their other supplies (if available) until the Delta was repaired, and many could experience serious water shortages.

Agencies involved include the COE, DWR, USBR, and numerous Delta Reclamation Districts.

4. Solution: The SWC should support activities to enhance the Delta levees.

5. Costs: No current estimates of the cost to stabilize the Delta levees are available. The COE in 1982 estimated it would cost $1 billion to improve levees to COE standards.

6. Benefits: Stabilizing the Delta levees could avoid a catastrophic interruption in the SWP water supply.

7. Implementation Plan: The following task should be undertaken to implement the recommendation:

A. The SWC should send letters to the USBR and DWR, with a copy to the CVRWQCB, highlighting the need for reducing the seismic vulnerability of the Delta levees to protect SWP water quality.

The following program is recommended to accomplish the above tasks:

Task	Estimated Cost	Responsible Agency	Completion Date
A	--	SWC	Completed - see February 7, 1994 letters attached

SWP SANITARY ACTION COMMITTEE
RECOMMENDATION #19
OPERATION OF STATE WATER PROJECT - O'NEILL FOREBAY

ACTION MEMO

OCTOBER 2, 1992

The SWPSAC has reviewed the DWR and USBR monitoring programs and data for Delta Mendota Canal water entering O'Neill Forebay and agrees that the following actions will insure that drinking water quality in the California Aqueduct is protected:

1. <u>Monitoring of DMC inflow</u>. - DWR will continue its current monthly monitoring program at McCabe Road bridge in the DMC immediately upstream of the O'Neill intake channel. USBR will continue its current monthly monitoring program in the O'Neill intake channel staggered by two weeks from the DWR program.

2. <u>Monitoring in the SLC</u> - DWR will continue its existing monitoring program at Check 13 within the SLC.

3. <u>Constituents</u> - DWR will continue its existing monitoring program which covers Title 22, specific herbicides and pesticides, and total and fecal coliform. No additional analysis is required.

STATE WATER PROJECT SANITARY SURVEY
Recommendation #19

PRIORITY A

1. Title: Operation of the State Water Project - O'Neill Forebay

2. Recommendation: DWR is currently expanding its monitoring program at O'Neill Forebay. The SWPSAC should monitor DWR's new program for its effectiveness in determining the impact of Delta Mendota Canal (DMC) water on drinking water quality of the SWP.

SWPSAC Recommendation: **In addition to the Sanitary Survey recommendation, the SWPSAC should also review the CVP's DMC monitoring program.**

3. Problem Identification: The CVP and the SWP are directly linked together at the O'Neill Forebay. The water coming in from the CVP's Delta Mendota Canal via the O'Neill Pumping Plant is more heavily influenced by the lower quality San Joaquin River water. Also, the CVP allows the pumping of agricultural drain water and ground water into the DMC. The introduction of the CVP water into O'Neill may degrade the SWP water pumped south through the Dos Amigos Pumping Plant.

The DMC was constructed and put into operation in 1951 to deliver water to the Exchange Contractors near Mendota Pool. The demand was all agricultural so only water quality standards related to crop production were considered important. When the Joint Use CVP-SWP San Luis Unit was built in the mid-1960's, the Bureau entered into contracts to deliver approximately 1,300,000 AF of water via the DMC and O'Neill Pumping Plant to the new San Luis Unit service area. Currently, the O'Neill Pumping Plant accounts for approximately 30 percent of the annual flow into O'Neill Forebay.

DWR has expanded its water quality monitoring to determine the effects of DMC water entering the Forebay through the O'Neill Pumping Plant.

The agencies involved are the DWR, USBR, CVRWQCB, and CDHS.

4. Solution: The SWPSAC should review USBR and DWR monitoring programs and recommend changes as necessary.

5. Cost: Unknown.

6. Benefits: If the DMC water is causing a drinking water supply problem, it may be easier to prevent its degradation than deal with it in the treatment process.

7. Implementation Plan: The following tasks should be undertaken to implement the recommendations:

A. The SWPSAC should obtain and review USBR and DWR monitoring plans for the O'Neill intake channel.

B. The SWPSAC should review all water quality data for waters entering O'Neill Forebay via the O'Neill Pumping Plant.

C. Based upon review of monitoring plans and existing data, the SWPSAC should determine if any changes to the monitoring plans are required. Recommend and support expanded monitoring plan, if required.

The following program is recommended to accomplish the above tasks:

Task	Cost	Responsible Agency	Schedule
A	--	SWPSAC	Completed
B	--	SWPSAC	Completed
C	--	SWPSAC	Completed - See attached memo

state water
contractors

Mall, Suite 725 • Sacramento, CA 95814-4502
General Manager (916) 447-7357 • FAX 447-2734

February 7, 1994

David N. Kennedy, Director
Department of Water Resources
P.O. Box 942836
Sacramento, CA 94236-0001

COPY

Dear Mr. Kennedy:

In February 1988, the California Department of Health Services requested the State Water Contractors to perform a sanitary survey of the State Water Project. The purpose of the survey was to characterize actual and potential contaminants in the State Water Project, the State's most important drinking water supply.

The October 1990 consultant report, "Sanitary Survey of the State Water Project" documented the findings of the survey, and made 35 recommendations for actions to reduce the vulnerability of SWP drinking water supplies to contamination.

Following publication of the report, the State Water Contractors formed a SWP Sanitary Action Committee for the purpose of developing a plan to implement the report recommendations. Mr. Rick Woodard represented your agency on that committee.

Recommendation No. 17 reads:

It is in the best interest of the drinking water quality of SWP water to reduce the seismic vulnerability of Delta levees and protect SWP water supplies for catastrophic sea water intrusion.

The committee agreed with this statement and, in its implementation plan, recommended the State Water Contractors correspond with the Department and the Bureau concerning this matter.

Clearly, seismic stability of Delta levees is a critical factor in the security of the State's drinking water supply. Catastrophic levee failure in the Delta would cause this critical water supply to temporarily become unusable. Moreover, once saline water had intruded into the Delta, depending on the hydrologic conditions at the time, it could prove difficult or impossible to flush the salt out within a tolerable time frame.

I know that the Department is concerned about the importance of maintaining the integrity of Delta levees and is involved in various activities to address this issue. The State Water Contractors are aware of and support the comprehensive joint investigation with the Corps of Engineers to define the Delta levee problems and develop a State/Federal action plan for solutions. We would appreciate the Department providing us a brief written summary of all Department activities related to maintaining the integrity of Delta levees.

The SWP Sanitary Action Committee sincerely appreciates your making Rick Woodard available to serve on the Committee. He played a key role in the Committee's effort.

Sincerely,

George R. Baumli

George R. Baumli
General Manager

Xc: SWC Member Agencies
SWP Sanitary Action Committee
SWC Water Quality Technical Committee
Mr. William Crooks, CVRWQCB
Mr. Roger Patterson, USBR

state water contractors

[illegible] Suite 725 • [illegible], CA 95814-4502
[illegible] General Manager [illegible] 447-7357 • FAX [illegible]-2734

February 7, 1994

COPY

Mr. Roger Patterson, Regional Director
U.S. Bureau of Reclamation
2800 Cottage Way
Sacramento, CA 95825

Dear Mr. Patterson:

In February 1988, the California Department of Health Services requested the State Water Contractors to perform a sanitary survey of the State Water Project. The purpose of the survey was to characterize actual and potential contaminants in the State Water Project, the State's most important drinking water supply.

The October 1990 consultant report, "Sanitary Survey of the State Water Project" documented the findings of the survey, and made 35 recommendations for actions to reduce the vulnerability of SWP drinking water supplies to contamination.

Following publication of the report, the State Water Contractors formed a SWP Sanitary Action Committee for the purpose of developing a plan to implement the report recommendations. Mr. John Fields represented your agency on that committee.

Recommendation No. 17 reads:

It is in the best interest of the drinking water quality of SWP water to reduce the seismic vulnerability of Delta levees and protect SWP water supplies for catastrophic sea water intrusion.

The committee agreed with this statement and, in its implementation plan, recommended the State Water Contractors correspond with the Bureau and the Department concerning this matter.

Clearly, seismic stability of Delta levees is a critical factor in the security of the State's drinking water supply. Catastrophic levee failure would cause this critical water supply to temporarily become unusable. Moreover, once saline water had intruded into the Delta, depending on the hydrologic conditions at the time, it could prove difficult or impossible to flush the salt out within a tolerable time frame.

I know you are aware that the Department of Water Resources has underway a comprehensive joint investigation with the Corps of Engineers to define the Delta levee problems and develop a State/Federal action plan for solutions. We encourage the Bureau to support this joint effort and budget resources to participate in implementation of the action plan when it is completed.

The SWP Sanitary Action Committee appreciates John Fields participation in the Committee's effort.

Sincerely,

George R. Baumli

George R. Baumli
General Manager

Xc: SWC Member Agencies
SWP Sanitary Action Committee
SWC Water Quality Technical Committee
Mr. William Crooks, CVRWQCB
Mr. David N. Kennedy, DWR

STATE WATER PROJECT SANITARY SURVEY
Recommendation #20

PRIORITY C

1. Title: Operation of State Water Project Facilities - The Kern River Intertie

2. Recommendation: None

SWPSAC Recommendation: Develop and implement a monitoring program at the Kern River Intertie to insure water entering the California Aqueduct is not being degraded.

3. Problem Identification: During periods of high flows in the Kern River, water from the river is diverted through the Kern River Intertie into the California Aqueduct near Bakersfield. The Kern River has its origin in the Sierras, near Mt. Whitney. Its two forks converge at Lake Isabella, a manmade lake built for flood control. The Kern River water serves as a primary source of domestic and agricultural water for the Bakersfield area and Kern County. During wet years, excess water from the river is recharged in the local ground water basin for use in dry years. When recharge capacity is unavailable, the water can be delivered into the California Aqueduct via the Kern River Intertie.

Kern River water has a lower salt content and produces lower THM concentrations than SWP water. However, during periods of high flow, the turbidity of the river water can increase significantly. Detention basins at the Intertie have been installed to reduce the turbidity of the river water discharged into the California Aqueduct. Kern River water does not appear to degrade the drinking water quality of SWP water supplies. Downstream users are able to adjust to the higher silt loads and softer water. Operating standards are in place which regulate the conditions (turbidity limitations) under which water may be delivered to the aqueduct through the intertie.

It is anticipated that operation of the Kern River Intertie will become increasingly less frequent, as Kern River flood waters are diverted to recharge areas being developed along the Kern River Fan.

Agencies involved in this issue include the SWRCB, DWR and KCWA.

4. Solution: Ensure that appropriate sampling and analyses be performed during the next event when flood waters enter the aqueduct through the Intertie. Analyses should include extensive bacteriological analyses to insure that urban runoff is being excluded from the flood waters. Additionally, information prepared by local agencies as required by EPA Stormwater Regulations should be examined.

5. Cost: $25,000

6. Benefits: Action will insure the SWP water quality is not being degraded by the operation of the Intertie.

7. Implementation Plan: The following tasks should be undertaken to implement the recommendation:

A. Monitoring of the Kern River Intertie - DWR will develop an appropriate plan to monitor the inflows into the California Aqueduct during the next Intertie operation. The plan would identify the appropriate parameters to be monitored including those to insure that urban runoff is being excluded from the floodwaters. After the plan is developed, it will be reviewed by the SWC' Water Quality Technical Committee in consultation with the appropriate agencies, and become an "on the shelf" program of DWR, to be implemented the next time the Intertie is operated .

B. Review of Available Information from Local Agencies - Agencies which use or impact Kern River water supplies have collected a significant amount of data on the quality of the water. These local agencies have implemented programs as part of the regulatory process, which should be reviewed in order to obtain additional insight into potential impacts from the receipt of Kern River flood flows into the SWP. Specific projects that should be reviewed are the KCWA's Sanitary Survey of the Kern River Watershed and information prepared by local agencies as required by the EPA Stormwater Regulations. This task would only be implemented if Intertie data indicate there is a problem.

C. Examination of Intertie Operating Conditions - A review of forecasted Intertie operating events should be performed. Prior to its construction, detailed forecasts were prepared on the operating frequency of the Intertie. Since that time, a number of recharge facilities have been constructed to handle the floodwaters. These facilities would reduce the operating frequency of the Kern River Intertie. Preparation of new forecasts, using existing hydrologic conditions on the Kern River and State Water Project, would provide a clearer perspective on the potential impact of this facility on the quality of California Aqueduct water. This task would only be implemented if Intertie data indicate there is a problem.

The following program is recommended to accomplish the above tasks:

Tasks	Estimated Costs	Responsible Agency	Schedule
A	$ 5,000	DWR	July 1994
B	$10,000	DWR	After Completion of Task A (If necessary)
C	$10,000	DWR	After Completion of Task A (If necessary)

State of California Department of Health Service

Memorandum

Date : October 20, 1992

To : John Coburn
555 Capitol Mall #725
Sacramento, CA 95814

From : Richard L. Haberman
ODW - Visalia District

Subject : Emergency Notification Letter

The attached letter was sent to all water suppliers in the Merced, Fresno, Kings and Kern Counties who are using the State Project as a source of supply.

RLH/jw

M1020RH.DOC

RECEIVED
OCT 23 1992

STATE OF CALIFORNIA—HEALTH AND WELFARE AGENCY PETE WILSON Governor

DEPARTMENT OF HEALTH SERVICES
OFFICE OF DRINKING WATER
4545 EAST SHIELDS AVENUE
NO, CA 93727
445-5321

October 19, 1992

System No. 16-002

City of Avenal
919 Skyline Boulevard
Avenal, CA 93204

Gentlemen:

Water suppliers hope that the coming winter months will bring several large rain storms to the State. We share this feeling. However, we also want to be ready for the possibility that the winter storms may result in the need to divert runoff originating from lands upgradient of the California Aqueduct into the Aqueduct. This would be done to prevent damage to the Aqueduct and would most likely result in a deterioration of the water quality in the Aqueduct.

The Department of Water Resources (DWR) has agreed to try and keep the water suppliers who use the Aqueduct well informed of their operational practices which may have an adverse impact on the raw water quality. This includes the diversion of runoff into the Aqueduct which may significantly increase the turbidity of the raw water and interfere with your ability to properly operate your treatment plant(s).

Listed below are the phone numbers of the DWR field division Area Control Centers which are manned 24 hours a day, 7 days a week. The On Duty Operator at these Control Centers can be reached at the phone numbers below:

AREA CONTROL CENTERS

San Luis Area (209) 825-0718, Ext. 210

This Center covers the San Luis Reservoir and O'Neil Forebay to Check 21 at Kettleman City.

San Joaquin Field Area (805) 858-2211, 858-2214 or 858-2213

This area is from Check 21 at Kettleman City to the Edmonston pumping plant at the base of the Tehachapi's.

SWP SANITARY ACTION COMMITTEE
FIELD SURVEY OF STATE WATER PROJECT FACILITIES
COASTAL DRAINAGE
RECOMMENDATION #21

ACTION MEMO

OCTOBER 2, 1992

The SWPSAC has reviewed the monitoring program of the Coastal Drainage water entering the San Luis Canal (SLC). The SWPSAC agrees that the following actions will insure that drinking water quality in the SLC is protected:

1. Monitoring of inflows. - Arroyo Pasajero and Salt and Cantua Creeks flow into the SLC from the Coastal mountains adjacent to the canal. At Arroyo Pasajero, water quality samples will be taken from the area between the inlet gates and the decanting weir immediately prior to water being released into the SLC. At Salt and Cantua Creeks, San Luis F.D. water quality staff will sample inflows when feasible. Every attempt will be made to sample the first inflows at the beginning of the winter season. Inflow volumes at Arroyo Pasajero and Cantua Creek will be calculated from stage-discharge curves. Inflows from Salt Creek will be estimated visually by San Luis F.D. personnel.

2. Monitoring in the SLC - DWR will continue its existing monitoring program at Checks 13 and 21 within the SLC. Additional monitoring will be implemented at the checks immediately downstream of the inflows of the Arroyo Pasajero and Salt and Cantua Creeks for a one year period when inflows occur to obtain additional data on how these inflows impact the overall canal water quality.

3. Constituents - DWR will continue its existing program which covers Title 22, specific herbicides and pesticides, and total and fecal coliform. No additional analysis is required.

4. Notification - DWR will review current notification list and update as necessary. DHS will contact local water treatment plant operators along SLC and make sure they have the phone numbers of the San Luis F.D. and San Joaquin F.D. Area Control Centers to contact if have any questions regarding canal operations or flood inflow conditions.

5. Documentation - DWR will make sure its written SLC O&M instructions are consistent with these actions.

STATE WATER PROJECT SANITARY SURVEY
Recommendation #21

PRIORITY A

1. Title: Field Survey of State Water Project Facilities - Coastal Drainage

2. Recommendation: Existing monitoring programs should be modified to determine the impact on SWP drinking water quality of the Coast Range Drainage.

SWPSAC Recommendation: The SWPSAC should review existing monitoring program and data to determine if current monitoring program is adequate. If it is not, the SWPSAC should recommend an appropriate monitoring program.

3. Problem identification: During storm events which occur intermittently over the west side of the San Joaquin Valley, flood waters from the Coast Range are allowed to enter the San Luis Canal (SLC) between the Dos Amigos Pumping Plant and Kettleman City. The main inflow from this source is the Arroyo Pasajero. The inflow at this point can be regulated with the gated inlet structure and water quantity and quality data can be easily obtained. The other significant coastal drainage inflows are from Salt and Cantua Creeks. Sampling these inflows is a problem because the inlets are ungated in the winter period and the intermittent frequency of the storm events makes it difficult to obtain data when the flood flows enter the SLC.

In the mid-1960's when the SLC was constructed, the USBR wanted to allow up-slope (west side) drainage to enter the Canal. This would capture the flows for the Projects' use and would eliminate flooding to farmlands on the east side of the Canal. DWR did not want to allow these inflows into the SLC, but acquiesced to the USBR's request. The concern is these flood waters bring down asbestos from the Coastal Mountains and also pick up agricultural chemicals when they flow over the fields enroute to the SLC inlets. There are studies underway to keep drainage from Arroyo Pasajero and Salt and Cantua Creeks from entering the aqueduct.

The San Luis Field Division has an existing monitoring program to obtain data from key drainage inlet locations along the San Luis Canal at the beginning of storm events each fall. However, it is difficult to collect all of the required data at the ungated inlets during flood events.

The Agencies involved are the DWR, CDHS, and USBR.

4. Solution: SWPSAC should review existing monitoring program to determine if it is adequate.
5. Cost: Minimal if the monitoring program is adequate. Cost to modify the existing monitoring program if it is not adequate cannot be determined until the program deficiencies, if any, are known.

6. Benefits: Data will help identify the impact of Coast Range drainage entering SLC.

7. Implementation Plan: The following tasks should be undertaken to implement the SWPSAC recommendation:

A. The DWR should provide the SWPSAC with the existing monitoring program and data. The SWPSAC should review the monitoring program information in order to determine its adequacy.

B. The SWPSAC should recommend appropriate changes, if necessary.

C. If required, DWR should implement the recommendations of the SWPSAC.

The following program is recommended to accomplish the above tasks:

Task	Estimated Cost	Responsible Agency	Schedule
A	--	SWPSAC	Completed
B	--	SWPSAC	Completed - October 2 & 2C 1992 memos attached
C	--	DWR	Completed

Southern Field Area (805) 944-1103

This area is from Check 41 to Lake Perris near Riverside. This also includes the West Branch to Castaic Lake.

We strongly recommend that you contact the Control Center for your area and confirm with them the proper phone numbers of the operator(s) of your plant(s). This will allow the personnel responsible for chemical and hydraulic plant adjustments to be quickly informed of changes in raw water quality. We also recommend that you periodically provide the Control Center with updates on any changes in the plant staffing and phone numbers.

Sincerely,

Richard L. Haberman, P.E.
Senior Sanitary Engineer
OFFICE OF DRINKING WATER

RLH/CAF/bd

cc: Dan Peterson, Department of Water Resources
P.O. Box 942836
Sacramento, CA 94236-0001

Kings County Environmental Health Department

STATE WATER PROJECT SANITARY SURVEY
Recommendation #22

PRIORITY A

1. Title: Field Survey of State Water Project Facilities - Agricultural Drainage

2. Recommendation: Existing monitoring programs should be modified to determine the impact on SWP drinking water quality from agricultural discharges (particularly in the San Luis Canal).

SWPSAC Recommendation: The existing monitoring programs and data should be reviewed to determine the impact on SWP drinking water supplies, if any, of stormwater inflows into the San Luis Canal.

3. Problem Identification: The SWP Sanitary Survey lists 108 agricultural drain inlets between Clifton Court Forebay and the end of the SLC. THE SANITARY SURVEY'S DESCRIPTION OF THESE DRAIN INLETS AS RECEIVING AGRICULTURAL DRAINAGE IS INCORRECT. The 108 drain inlets are in fact, STORMWATER INLETS which allow upslope storm runoff to enter the aqueduct. These inlets do not allow agricultural drainage (tailwater) to enter the aqueduct. DWR policy is to allow only stormwater to enter the aqueduct via these drain inlets. There are 11 stormwater inlets that enter the South Bay Aqueduct. Because of the intermittent nature of when the stormwater runoff enters the aqueduct, the existing monthly monitoring programs may be inadequate to determine the effects of these discharges on the aqueduct water quality.

The San Luis Field Division has an existing monitoring program to obtain data from key stormwater inlets along the SLC at the beginning of the storm events. Water quality samples are also taken in conjunction with the operation of the portable pumps used to pump the flood waters from the fields adjacent to the SLC.

The involved agencies are the DWR, USBR, and CDHS.

4. Solution: The SWPSAC should review existing monitoring program and data to determine if it is adequate. If it is not, the SWPSAC should recommend the necessary changes.

5. Cost: Minimal if the monitoring program is adequate. Cost to modify existing program if it is inadequate cannot be determined until the program deficiencies, if any, are known.

6. Benefits: Data will help identify the severity of the problem of stormwater entering the California and South Bay Aqueducts and the SLC.

7. Implementation Plan: The following tasks should be undertaken to implement the SWPSAC recommendation:

A. The SWPSAC should review the monitoring programs and data.

B. The SWPSAC should recommend appropriate modifications, if required.

C. If required, DWR should implement the recommendations of the SWPSAC.

The following program is recommended to accomplish the above tasks:

Task	Estimated Cost	Responsible Agency	Schedule
A	--	SWPSAC	Completed
B	--	SWPSAC	Completed - October 2, 1992 memo attached and October 20, 1992 memo attached to Rec. #21
C	--	DWR	Completed

SWP SANITARY ACTION COMMITTEE
FIELD SURVEY OF STATE WATER PROJECT FACILITIES
STORMWATER INLETS
RECOMMENDATION #22

ACTION MEMO

OCTOBER 2, 1992

The SWPSAC has reviewed the monitoring program for the stormwater drainage entering the San Luis Canal (SLC), the California Aqueduct (CA), and the South Bay Aqueduct (SBA). The SWPSAC agrees the following actions will insure that drinking water quality in the facilities is protected:

1. Monitoring of inflows.

   Portable Pump-ins -- A sample of stormwater ponded adjacent to the canal will be taken immediately prior to the pump-in of any water into the SLC. Volumes of water pumped will be calculated from pump records.

   Gravity inflows. -- Samples will be taken by Delta F.D. and San Luis F.D. water quality personnel when feasible. Volumes will be estimated visually.

   Fixed pump-ins -- Samples will be taken by Delta F.D. and San Luis F.D. water quality personnel when inflows are occurring and when feasible. Volumes will be calculated from pump records.

2. Monitoring in the SLC - DWR will continue its existing monitoring program at Checks 13 and 21 within the SLC.

3. Constituents - DWR will continue its existing program which covers Title 22, specific herbicides and pesticides, and total and fecal coliform. No additional analysis is required.

4. Notification - DWR will review current notification list and update as necessary. DHS will contact local water treatment plant operators along SLC and make sure they have the phone numbers of San Luis F.D. and San Joaquin F.D. Area Control Centers to contact if have any questions regarding canal operations or flood inflow conditions.

5. Documentation - DWR will make sure its written O&M instructions are consistent with these actions.

STATE WATER PROJECT SANITARY SURVEY
Recommendation #23

PRIORITY B

1. Title: Field Survey of the State Water Project Facilities - Urban Runoff

2. Recommendation: Existing monitoring programs should be modified to determine the impact on SWP drinking water quality of these urban runoff discharges.

3. Problem Identification: Along a 1.1-mile long section of the East Branch of the California Aqueduct near Hesperia, there are 44 drain inlets that convey urban drainage from residential/commercial developments into the Aqueduct. These drains range in size from 30 to 36 inches in diameter. Urban drainage, particularly the first flush each year, may contain high levels of turbidity, pathogens, nutrients which could stimulate algae growths, metals and organics. The contaminants could negatively impact water quality, and require additional treatment processes at the downstream treatment plants.

The storm drains were constructed at a time when the drainage area was primarily rural, undeveloped high desert land. Since that time, the area has developed into a residential/commercial area. Rerouting the drainages either under or over the aqueduct has been evaluated by DWR. Monitoring of the quality of the discharges is currently not required by the Lahontan Regional Water Quality Control Board (LRWQCB) because these discharges are stormwater, not industrial wastewater discharges.

Agencies which should be involved are DWR, City of Hesperia, and LRWQCB.

4. Solution: Stormwater inflows should be monitored to determine if they are impacting the downstream water quality.

5. Costs: The cost per sample to analyze for the above constituents is estimated at $3,000 for the complete analysis. It is recommended that two representative discharge locations be sampled, plus samples in the Aqueduct upstream and downstream of Hesperia. Assuming that a first flush sample and one later sample are collected, the total number of samples would be eight, for a total cost of $24,000.

6. Benefits: Characterization of the quality of stormwater entering the East Branch Aqueduct would help to quantify any impacts of these discharges on water quality. The costs of these impacts, including downstream treatment costs, could then be compared to other physical solutions, such as installing detention ponds, or rerouting the drainages across the Aqueduct.

7. Implementation Plan: The following tasks should be undertaken to implement the recommendation:

A. DWR should meet with the LRWQCB staff to discuss the stormwater runoff into the California Aqueduct.

B. DWR should design and implement a monitoring program to determine if the stormwater inflow is impacting the downstream water quality.

C. If a problem is detected, DWR should work with the City of Hesperia, LRWQCB and the downstream SWP M&I contractors to determine the most feasible solution.

The following program is recommended to accomplish the above tasks:

Task	Estimated Costs	Responsible Agency	Schedule
A	--	DWR	Completed - see March 10, 1994 memo attached
B	$24,000	DWR	April 1995
C	Unknown	DWR, LRWQCB City of Hesperia	June 1996 - if necessary

State of California DEPARTMENT OF WATER RESOURCES The Resources Agency

OFFICE MEMO

To: **Files**	Date: **March 10, 1994**
From: /s/ **Larry Joyce, Chief Water Quality Control**	Subject: **Inspection of Hesperia Drains**

RECEIVED MAR 14 1994

Dan Peterson and I met with John Coburn, John Kemp, and Ted Saari of the Lahontan RWQCB on the California Aqueduct at Hesperia on February 23, 1994. The purpose of the meeting was to inspect the inlets that drain an urbanized area of Hesperia that can allow uncontrolled runoff to enter the aqueduct and discuss possible water quality impacts.

There are forty-five 36-in. drains located within a three-mile segment of the aqueduct on the south bank. The terrain slopes slightly from the southwest down to the north. The drop inlets were initially put in to take natural storm runoff into the aqueduct in order to avoid potential damage to urban property that was developed downstream. At that time, there was little development to the south. Since then, the area south of and up slope from the aqueduct has become urbanized. Single family homes and ranchettes predominate the newly developed area.

The new urban development has the potential to change the makeup of the runoff that enters the aqueduct. However, at this time there has only been one sample collected of storm water entering the aqueduct through the drains. This limited analysis showed suspended solids, iron and manganese to be elevated relative to SWP water. Beyond that, no detrimental substances have been found in the drain inflows.

Possible control measures and regulatory concerns were discussed briefly. In most cases, the drains are above grade and a few have been excavated to allow some ponding as the only control measure prior to water entering the aqueduct.

It was decided that not enough information exists on the quality, quantity, and frequency of storm runoff entering the aqueduct to make any estimate of impacts on the aqueduct. It was agreed that DWR would continue the effort to collect samples of the drain inflow (although, the intermittency of inflows make such efforts difficult). DWR will try to better characterize the inflows and maintain communications with the RWQCB transmitting new information as it is developed. No other remedial action is planned at this time.

cc: Mr. John Coburn
State Water Contractors
555 Capitol Mall, Suite 750
Sacramento, California 95814

John Kemp - Southern Field Division
Dan Peterson - 1618-17

LARRY JOYCE:hys
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STATE WATER PROJECT SANITARY SURVEY
Recommendation #24 & #25

PRIORITY A

1. Title (24): Field Survey of State Water Project Facilities - Highway drainage

Title (25): Field Survey of State Water Project Facilities - Other Potential Sources of Contamination to Open Canal Sections

2. Recommendation (24): DWR should consider the recommendations of the Laverty Report in updating and standardizing their Emergency Response Plans. The value of developing a geographical information system which identifies potential drains that could allow tanker truck spillage to reach SWP facilities should be evaluated. Such information may speed the identification of which drainage inlets to block during spills. DWR should also consider constructing containment structures at vulnerable points.

Recommendation (25): The SWPSAC should consider the potential for contamination of the SWP from these sources (canal roadside drainage, overcrossings, undercrossings, bridges, water service turnouts, and fishing areas) as priorities permit.

3. Problem Identification: The SWP is at risk of contamination from spillage due to a truck accident or the other sources listed above. The California Aqueduct and Interstate 5 essentially parallel each other from the Delta to Pyramid lake in Southern California. There have been incidences of tanker trucks either going directly into the aqueduct or being involved in accidents adjacent to the aqueduct resulting in some fluids entering the aqueduct. DWR has modified drainage inlets or facilities at selected high risk locations.

DWR has not acted upon the recommendations contained in the Laverty Report.

The agencies involved are DWR, USBR, CDHS, CalTrans and Office of Emergency Services (OES).

4. Solution: The DWR is currently updating its Emergency Action Plan for the SWP. The SWC should review the updated Emergency Response Plan and provide recommendations, if required. A Geographical Information System is not appropriate for this type of problem because of the complexity of the Project Facilities and the times required to react to this type of emergency.

5. Cost: To be determined based upon review of the updated Emergency Action Plan.

6. Benefits: The updated Emergency Action Plan should increase the protection of the SWP water supplies.

7. Implementation Plan: The following Tasks should be undertaken to implement the recommendation:

A. Review updated Emergency Action Plan.

B. Based upon the review of the updated Emergency Action Plan, the SWC should make recommendations as required to insure the aqueduct is protected against contamination from highway drainage and all other sources.

The following program is recommended to accomplish the above tasks:

Task	Estimated Costs	Responsible Agency	Schedule
A	$ 1,000	SWC	May 1994
B	$ 1,000	SWC	June 1994 - if required

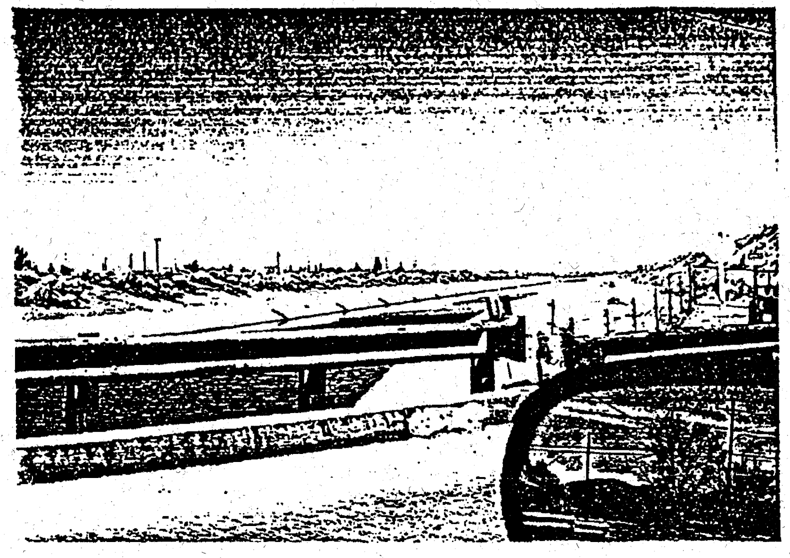

PHOTO OF HESPERIA AREA DRAIN INLETS, TAKEN FROM MAPLE STREET.
PHOTO TAKEN ON FEBRUARY 23, 1994.

PHOTO OF AQUEDUCT RIGHT OF WAY AND WATERSHED NEAR A DRAIN INLET AT MAPLE STREET, HESPERIA. PHOTO TAKEN ON FEBRUARY 23, 1994.

PHOTOS OF INLET SIDE OF DRAIN INLET. INVERT OF INLETS WERE ABOUT 24" ABOVE TOP OF SOIL ON RIGHT OF WAY. SOME INVERT APRONS HAD BEEN EXCAVATED TO ALLOW ADDITIONAL WATER PONDING BEFORE ENTRANCE TO AQUEDUCT. PHOTOS TAKEN FEBRUARY 23, 1994 NEAR MAPLE STREET.

STATE WATER PROJECT SANITARY SURVEY
Recommendation #26

PRIORITY A

1. Title: Other Potential Sources of Contamination in Open Canal Segments - Body Contact

2. Recommendation: The SWPSAC should consider the potential for contamination of the SWP from these sources as priorities permit.

3. Problem Identification: Body contact recreation in Lake Oroville, Thermalito Forebay, Thermalito Afterbay, Lake Del Valle, O'Neill Forebay, San Luis Reservoir, Pyramid Lake, Castaic Lake, Lake Silverwood, and Lake Perris may contribute pathogens to the SWP water. A wide variety of microbial contaminants may result from body contact recreation in source-water reservoirs. The potential for contamination exists when individuals infected with bacterial, viral, or parasitic pathogens engage in body contact with water. These pathogens are transmitted via the fecal-oral route and are commonly associated with waterborne outbreaks of disease. Individuals exhibiting symptoms of disease, as well as asymptomatic carriers, can excrete these pathogens in extremely high numbers per day (e.g., up to 900 million *Giardia lamblia* cysts, 10 billion enteric viruses, and 100 million bacterial pathogens) and may drastically impact the water quality of the reservoirs. This, in turn, could affect swimmers as well as downstream users, such as water utilities. Importantly, ingesting even one organism may be sufficient to produce illness by some of these pathogens. Body contact recreation in Lake Perris has resulted in verified cases of Shigellosis. Despite the potential for bacteriological contamination of the reservoirs, the bacteriological quality of raw water supplies is quite good along the SWP. Treated water coliform levels are consistently less than 2/100 ml, indicating that existing treatment processes successfully reduce coliforms to acceptable levels.

It is important to note that any filtration plant treating surface water can be overwhelmed if enough pathogens are present in the raw water. The Surface Water Treatment Rule (SWTR), which sets forth filtration and disinfection regulations became effective in June 1993. Under this regulation, water utilities must provide treatment to achieve a minimum of 3-log removal of *Giardia lamblia* and 4-log removal of viruses. Filtration is generally given credit for 2 to 2½-log removal of these pathogens; disinfection must inactivate the remainder. However, if the CDHS determines that there is a significant hazard to raw source water quality from recreational uses, higher levels of removal would be required. This would result in a substantial increase in treatment costs to downstream water utilities.

The involved agencies are DWR, USBR, CDHS, Department of Parks and Recreation, and County Health Departments.

4. Solution: The CDHS should review existing domestic water supply reservoir regulations, the implementation of the regulations, and water treatment requirements in regard to their adequacy for protecting public health.

5. Costs: Minimal if present regulations relative to the protection of surface water supplies are adequate.

6. Benefit: Review will identify if a problem exists.

7. Implementation Plan: The following task should be undertaken to implement this recommendation:

A. CDHS should review existing domestic water supply reservoir regulations as they relate to body contact on both SWP and non-SWP reservoirs.

The following program is recommended to accomplish the above task:

Task	Estimated Cost	Responsible Agency	Schedule
A	--	CDHS	Completed - see October 2, 1992 memo attached.

SWP SANITARY ACTION COMMITTEE
OTHER POTENTIAL SOURCES OF CONTAMINATION
IN OPEN SEGMENTS - BODY CONTACT
RECOMMENDATION #26

ACTION MEMO

OCTOBER 2, 1992

The SWPSAC has reviewed the adequacy of the California statutes and regulations to protect public health with regard to body contact recreation on SWP and non-SWP reservoirs.

Title 17, Sections 7625-7629 requires that recreation be authorized by a domestic water supply permit. The permit should specify the limits and controls on the recreation appropriate for the reservoir and water treatment. Title 22 Sections 64650 - 64665 of the surface water treatment regulations require treatment sufficient to deal with the microbiological threat for approved sources. A source may not be approved if it is subject to excessive contamination. The permit process controlling recreation, in concert with the surface water treatment regulations enable adequate protection of surface water supplies.

Uncontrolled recreation can overwhelm water treatment with extreme concentrations of pathogens and pose an unacceptable risk of waterborne illness. However, body contact recreation on domestic water supply reservoirs can be consistent with the production of safe drinking water if the treatment is commensurate with the type and degree of recreation.

STATE WATER PROJECT SANITARY SURVEY
Recommendation #27

PRIORITY C

1. Title: Field Survey of the State Water Project Facilities --Wastewater Handling Facilities

2. Recommendation: The SWPSAC should consider the potential for contamination of the SWP from these sources as priorities permit.

3. Problem Identification: Wastewater handling facilities in the watersheds of Lake Del Valle, Pyramid Lake, Castaic Lake and Lake Silverwood are potential sources of pathogens, nutrients, and organics. The only documented problems have occurred in the Lake Silverwood watershed. The piping and pumping stations that convey raw wastewater out of the watershed have failed and resulted in spills into the lake on several occasions. Elevated coliform levels have been detected in the lake following these spills. However, this has not resulted in coliform problems at downstream water treatment plants. Floating toilets in Pyramid Lake, Castaic Lake, and Lake Silverwood may also allow raw wastewater to enter SWP waters.

The involved agencies are DWR, CDHS, and County Health Departments.

4. Solution: Complete Implementation Plan.

5. Cost: Unknown.

6. Benefits: The review will help identify problems with wastewater handling facilities.

7. Implementation Plan: The following tasks should be undertaken to implement the recommendation:

A. DWR and CDHS should jointly evaluate the wastewater treatment facilities in the Pyramid Lake, Castaic Lake, and Lake Silverwood watersheds. Also, evaluate the adequacy of floating toilet facilities in Pyramid Lake, Castaic Lake, and Lake Silverwood to prevent pathogens from entering the reservoirs and CDHS's criteria for approval of these facilities.

B. DWR should recommend revisions, if required.

The following program is recommended to accomplish the above tasks:

Task	Estimated Costs	Responsible Agency	Schedule
A	$2,000	DWR & CDHS	May 1994
B	$2,000	DWR	July 1994

STATE WATER PROJECT SANITARY SURVEY
Recommendation #28

NO ACTION REQUIRED

1. Title: Water Quality - Water Quality Degradation

2. Recommendation: The committee should be particularly concerned with the well documented degradation of the drinking water quality of SWP water in the Delta. Data collected by the Delta Islands Drainage Investigation, existing monitoring programs, and studies recommended by this report should be routinely evaluated to better define the causes of water quality degradation in the Delta.

SWPSAC Recommendation: **No action required. Implementation covered under Recommendation #15.**

STATE WATER PROJECT SANITARY SURVEY
Recommendation #29

NO ACTION REQUIRED

1. Title: Water Quality - Water Quality Degradation

2. Recommendation: Studies recommended by this report to determine the impacts of direct sources of contamination to the SWP should be implemented.

SWPSAC Recommendation: No action is required. Studies are implemented under other Recommendations in this Action Plan.

STATE WATER PROJECT SANITARY SURVEY
Recommendation #30

PRIORITY A

1. Title: Water quality - Drinking Water Standards

2. Recommendation: The DWR should stay abreast of the EPA and DHS drinking water standards programs. As drinking water standards are proposed for new constituents and lowered for existing constituents, the DWR should review and revise SWP monitoring programs to collect data on these constituents.

SWPSAC Recommendation: The DWR should stay abreast of USEPA and CDHS drinking water standards. As drinking water standards are proposed for new constituents and lowered for existing constituents, the DWR in consultation with the CDHS, should review and revise SWP monitoring programs to collect necessary data.

3. Problem Identification: Drinking water standards are constantly changing. The known problems SWP M&I contractors will face in the near future are revised regulations for arsenic, THMs and other DBPs. The Safe Drinking Water Act required that USEPA initially regulate 83 contaminants, and that an additional 25 contaminants be regulated every three years. Any number of new regulations could impact SWP M&I contractors.

Several of the SWP M&I contractors are actively involved in reviewing and monitoring drinking water regulations at the Federal, State and local level. Through the American Water Works Association, the Association of Metropolitan Water Agencies, the Association of California Water Agencies, and others, the SWP M&I contractors provide input into the regulatory process. These associations are well equipped to work with DWR to revise monitoring programs to evaluate the impacts of new regulations.

4. Solution: To ensure the necessary water quality data are efficiently collected, DWR water quality monitoring programs should be jointly reviewed by the DWR, CDHS and the SWC' SWP Water Quality Technical Committee. This review should be repeated annually.

5. Cost: The initial review will be approximately $10,000 and the subsequent annual reviews approximately $2,000.

6. Benefits: The benefits resulting from the maintaining a current monitoring program are an accurate and cost effective definition of the water quality throughout the SWP. This information will make assessments of potential improvements possible, so that the cost of improvements can be compared with the expected water quality enhancement. As drinking water regulations become more stringent, source water protection may be the most cost effective way to meet new regulations.

7. Implementation Plan: The following tasks should be undertaken to implement the recommendation:

A. DWR should stay abreast of new USEPA and CDHS regulations and in consultation with SWC, review and revise existing monitoring programs.

B. Annually review and revise monitoring programs as required to respond to changing needs.

The following program is recommended to accomplish the above tasks:

Task	Estimated Cost	Responsible Party	Completion Date
A.	$ 10,000	DWR, SWC	June 1994
B.	$ 1,000	DWR, SWC	Annually

STATE WATER PROJECT SANITARY SURVEY
Recommendation #31

PRIORITY A

1. Title: Water Quality - Water Quality Monitoring Programs

2. Recommendation: DWR has begun and should continue to elevate the drinking water monitoring of the SWP system. DWR should consider the centralization and coordination of ecological, operational, and drinking water monitoring programs, and special water quality investigations under the supervision of a water quality program manager responsible for coordination of water monitoring programs, identification of needed studies, implementation of the studies, and management of the data in a centralized data bank.

SWPSAC Recommendation: SWC should write letter to DWR expressing the SWPSAC support of recommendation.

3. Problem Identification: DWR' water quality functions are included in various programs within the Division of O&M, Division of Local Assistance, Ecological Services, Division of Planning and the District Field Offices. The total budget for the water quality programs is currently estimated to be $15 million/year. Having the water quality functions spread out over this many Divisional boundaries within the DWR is not an efficient way to manage the water quality program. Also, the increasing complexity and cost of meeting current and proposed drinking water standards requires the DWR to place a much higher priority on drinking water impacts in operating the existing SWP facilities and planning future facilities.

4. Solution: The SWC should write a letter conveying support of the recommendation.

5. Cost: Minimal

6. Benefits: The centralization of the DWR' water quality programs will provide a more efficient approach to meeting the SWP's water quality needs

7. Implementation Plan: The following task should be undertaken to implement the recommendation:

A. The SWC should write a letter expressing SWPSAC support of a centralized water quality program within the DWR.

The following program is recommended to accomplish the above task:

Task	Estimated Costs	Responsible Agency	Schedule
A.	Minimal	SWC	April 1994

STATE WATER PROJECT SANITARY SURVEY
Recommendation #32

NO ACTION REQUIRED

1. Title: Effectiveness of Regulations - Water Quality Standards

2. Recommendation: None

3. Problem Identification: The regulatory programs that require the establishment of drinking water standards and ambient water quality criteria have been effectively implemented by CDHS, the SWRCB, and the Regional Boards. Drinking water standards established by USEPA and CDHS are extremely protective of public health and drinking water regulations are rigorously enforced by CDHS. The Inland Surface Water Plan and the Enclosed Bays and Estuaries Plan contain water quality objectives that protect human health and aquatic life and time schedules for compliance with these objectives.

The agencies involved in this issue are the CalEPA, SWRCB, CDHS and CVRWQCB.

4. Solution: The CDHS and SWRCB have proposed significant increases in fees to support their programs rather than reliance on general fund revenues. The SWRCB has also proposed fees on all waste dischargers to implement the Bay Protection Program.

5. Costs: The costs to implement these new regulations and plans are uncertain at this time.

6. Benefits: Effective implementation of the regulations and plans is needed to protect drinking water quality.

7. Implementation Plan: No action required by the SWPSAC.

STATE OF CALIFORNIA - CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY
PETE WILSON, *Governor*
STATE WATER RESOURCES CONTROL BOARD
PAUL R. BONDERSON BUILDING
91 P STREET
O. BOX 100
ACRAMENTO, CALIFORNIA 95812-0100
6/657-1134

FAX: 916/657-2388

OCT 7 1992

RECEIVED
OCT - 9 1992

Mr. John Coburn
State Water Project Sanitary
Action Committee
State Water Contractors
555 Capitol Mall, Suite 725
Sacramento, CA 95814

Dear Mr. Coburn:

COLLECTING FEES RELATIVE TO TWO CATEGORIES OF NPDES PERMITS

In response to your request for review of Recommendation No. 33 of the State Water Project Sanitary Survey titled "Effectiveness of Regulations: Control of Contaminant Sources", the following brief discussion is provided relative to the State Water Resources Control Board's (State Water Board) experience in collecting fees relative to two categories of NPDES permits.

Annual permit fees excluding storm water permit fees. The State Water Board has charged annual fees to holders of waste discharge permits (including NPDES permits) since 1990. Problems encountered include refusal to pay in a very few cases, protestations of ability to pay, refusal to accept registered letters, etc., which contain bills, incorrect names and addresses in the State Water Board's computer system, changes in holders of waste discharge requirements which have not been reflected in the computer system, rescissions of waste discharge requirements no longer needed, and incorrect or reputedly incorrect classifications of dischargers, which requires attention by California Regional Water Quality Control Boards. Allowing for all of the above, we have collected about 90+ percent of the money we have billed.

Annual storm water permit fees. We are currently collecting initial year annual fees from persons wishing to be covered by general permits for storm water discharge. Problems encountered include incorrect amounts paid, checks included separately, checks not included, and incorrect or insufficient information to register dischargers.

If I can be of further assistance, please telephone me at 657-1134.

Sincerely,

Stan M. Martinson, Chief
Nonpoint Source Section
Division of Water Quality

STATE WATER PROJECT SANITARY SURVEY
Recommendation #33

PRIORITY C

1. Title: Effectiveness of Regulations - Control of Contaminant Sources

2. Recommendation: The Regional Board(s) will need increased funding to bring non-point source pollution under regulation.

3. Problem Identification: The Regional Boards have developed an effective program for regulating the discharge of treated wastewater through the issuance of NPDES permits and the collection of effluent monitoring data by the permittees. The SWRCB has implemented a Bay Protection and Toxic Cleanup Program to address both point and non-point source pollution. USEPA regulations require many industries and all municipalities to apply for and obtain NPDES permits for urban runoff discharges. Agricultural drainage in the Bay-Delta Estuary will be regulated through the Enclosed Bays and Estuaries Plan and through the Inland Surface Waters Plan in the drainage areas tributary to the Delta. The regulatory program to control drainage from inactive mines does not appear to be very effective since many reaches of streams tributary to the Sacramento and San Joaquin Rivers have been listed by the Regional CVRWQCB and the SWRCB as impaired water bodies. The discharge of dairy or feedlot wastes to surface waters is illegal. Due to staffing constraints, the Regional Boards respond to reported violations, but do not have an active enforcement programs.

The implementation of the non-point source control programs requires additional funding. The SWRCB recently adopted a new fee schedule for NPDES permits and adopted a statewide industrial general NPDES permit that will generate funds for the Non-point Source (NPS) program. The CVRWQCB is currently developing programs to regulate and reduce non-point source discharges, but it lacks resources and funding to effectively carry out these programs.

Agencies involved in this issue are CalEPA, Regional Boards, and SWRCB.

4. Solution: The SWRCB has proposed significant increases in waste discharge fees to support the Regional Boards' regulatory programs rather than rely on general fund revenues. The SWRCB has implemented fees on all NPDES holders to implement the Bay Protection and Toxic Cleanup Program. The SWRCB and Regional Boards should determine the funding and staffing requirements necessary to implement the current mandated point and non-point source control programs. Fees should be imposed on all waste dischargers and those benefiting from the increased regulatory protection. Funds must be spent only on those regulatory programs from which they are collected.

5. Costs: The costs to implement these programs are uncertain at this time.

6. Benefits: Effective implementation of current regulatory programs will help protect the quality of SWP drinking water supplies.

7. Implementation Plan: The following task should be undertaken to implement the recommendation:

A. SWRCB should provide a report to the SWPSAC on the fee collection experience from stormwater permits and the resource requirements for an effective NPS program.

The following program is recommended to accomplish this task:

Task	Estimated Cost	Responsible Agency	Schedule
A	--	SWRCB	Completed - see attached October 7, 1992 letter

STATE WATER PROJECT SANITARY SURVEY
Recommendation #34

NO ACTION REQUIRED

1. Title: Effectiveness of Regulations - Control of Contaminant Sources

2. Recommendation: The Regional Board will need increased funding to conduct studies to determine if discharge limitations must be lowered for water supply agencies to meet more stringent drinking water standards with SWP source water.

3. Problem Identification: As drinking water standards become more stringent, it will be necessary to fully characterize discharges and receiving waters with respect to the constituents being regulated. The Regional Boards may need to revise discharge limitations for both point and non-point discharges to protect source water quality. This increased protection of source water quality may be necessary for water supply agencies to meet future drinking water standards.

The agencies involved in this issue are CalEPA, SWRCB, and the CVRWQCB.

4. Solution: Reevaluate Regional Boards' funding needs when current Inland Surface Waters Plan litigation is resolved.

5. Cost: Minimal at present. May be expensive to fund extensive monitoring programs.

6. Benefits: Monitoring programs will allow water suppliers to obtain data necessary to evaluate drinking water supply sources.

7. Implementation Plan: No action required at this time. SWC and DWR will monitor status of Inland Surface Waters Plan.

STATE WATER PROJECT SANITARY SURVEY
Recommendation #35

NO ACTION REQUIRED

1. **Title:** Control of Contaminant Sources

2. **Recommendation:** As discussed previously, the State Board should adopt the 50 mg/l chloride standard recommended by the SWC to protect the drinking water quality of SWP water.

SWPSAC Recommendation: No action required. Implementation covered under Recommendation #16.

Appendix B

Water Quality Data Summary Tables

Summary of Total Coliform Values for Water Treatment Plant Intakes

Location	Mean Turbidity	N[1]	Range		Median	Percentile		Period of Record	
			Minimum	Maximum		Tenth	Ninetieth	Starting Date	Ending Date
NORTH BAY AREA									
Solano County Flood Control District									
City of Fairfield[2]									
North Bay Aqueduct	30.1	739	8	88000	1450	435	6400	3/1/91	5/31/95
Putah South Canal	11.1	753	20	22050	545	155	1832	3/1/91	5/31/95
City of Vallejo									
Cordelia Forebay	31.9	286	<4	>1600	52	18	190	7/1/92	7/1/95
City of Benicia									
North Bay Aqueduct	28.1[3]	262	2	5000	110	21	300	2/5/90	8/28/95
Lake Herman	28.1[3]	76	<2	500	23	4	170	1/2/90	6/14/93
Cordelia Forebay	28.1[3]	18	4	1250	70	11	915	2/13/90	6/5/95
SOUTH BAY AREA									
Alameda County Flood Control and Water Conservation District, Zone 7									
Del Valle Water Treatment Plant	8.7	244	<2	1600	30	5	190	1/2/90	9/25/95
Patterson Pass Water Treatment Plant	5.7	253	<2	500	17	4	110	1/2/90	9/25/95
Alameda County Water District									
South Bay Aqueduct	12.1	1005	2	>1600	240	30	1600	6/7/90	10/31/95
Santa Clara Valley Water District									
Penitencia Water Treatment Plant	9.5	525	2	2280	30	8	90	08/20/92	08/03/95
Riconada Water Treatment Plant	7.5	545	2	1700	17	4	70	08/20/92	08/03/95
Santa Teresa Water Treatment Plant	5.0	541	2	900	8	2	35	08/19/92	08/03/95
SAN JOAQUIN VALLEY AREA									
Kern County Water Agency									
State Water Project	2.6	312	<1	2015	8	3	28	1/3/90	9/30/94
SWP/Kern Water Bank	3.2	111	<1	110	12	4	36	1/1/91	1/18/93
Kern River Intertie/SWP	3.2	38	<1	40	8	1	23	1/4/90	1/17/94
SOUTHERN CALIFORNIA AREA									
Antelope Valley-East Kern Water Agency									
Quartz Hill Water Treatment Plant	8.4	198	1	500	11	2	60	12/5/91	9/25/95
Eastside Water Treatment Plant	10.6	192	<2	500	18	4	80	12/5/91	9/27/95

[1] N is the number of samples taken.
[2] Coliform data were obtained by the Heterotrophic Plate Count method as opposed to the Multiple-Tube Fermentation Technique.
[3] Turbidity data was for all three water sources combined.

Summary of Total Coliform Values for Water Treatment Plant Intakes (cont.)

Location	Mean Turbidity	N[1]	Range		Median	Percentile		Period of Record	
			Minimum	Maximum		Tenth	Ninetieth	Starting Date	Ending Date
Palmdale Water District									
Palmdale Plant[4]		1685	<2	>1600	30	4	290	1/3/90	10/4/95
Metropolitan Water District of So. Ca.									
Diemer Water Treatment Plant		1733	0.2	216	39	6	148	1/1/91	9/30/95
Jensen Water Treatment Plant		1582	0.0	64	6	0.8	22	1/1/91	9/30/95
Mills Water Treatment Plant		1633	1.4	131	11	3.3	41	1/1/91	9/30/95
Skinner Water Treatment Plant		1694	6.0	1532	40	13.5	357	1/1/91	9/30/95
Weymouth Water Treatment Plant		1488	0.0	278	37	4.6	134	1/1/91	9/30/95

[1] N is the number of samples taken.

[4] Data from 2/13/92 to 4/24/92 were not included in calculations as they used an Estimation of Bacteria Density Technique as opposed to the Multiple-Tube Fermentation Technique.

Summary of Fecal Coliform Values for Water Treatment Plant Intakes

Location	Mean Turbidity	N[1]	Range		Median	Percentile		Period of Record	
			Minimum	Maximum		Tenth	Ninetieth	Starting Date	Ending Date
NORTH BAY AREA									
Solano County Flood Control District									
City of Vallejo									
Cordelia Forebay	31.9	251	2	760	20	9	100	7/1/92	7/1/95
City of Benicia									
North Bay Aqueduct	28.1[2]	251	<2	1600	19	4	80	2/5/90	8/28/95
Lake Herman	28.1[2]	75	<2	300	11	2	50	1/2/90	6/14/93
Cordelia Forebay	28.1[2]	17	<2	700	63	8	320	2/13/90	6/5/95
SOUTH BAY AREA									
Santa Clara Valley Water District									
Penitencia Water Treatment Plant	9.5	525	2	500	11	2	30	08/20/92	08/03/95
Riconada Water Treatment Plant	7.5	545	1	220	8	2	30	08/20/92	08/03/95
Santa Teresa Water Treatment Plant	5.0	541	2	70	4	2	16.4	08/19/92	08/03/95
SOUTHERN CALIFORNIA AREA									
Antelope Valley-East Kern Water Agency									
Quartz Hill Water Treatment Plant	8.4	1192	1	110	2	2	11	1/1/90	9/29/95
Eastside Water Treatment Plant	10.6	1220	<2	200	4	2	14	1/1/90	9/30/95
Palmdale Water District									
Palmdale Plant[3]		1042	<1.1	>1600	11	2	240	4/25/92	10/2/95

1 N is the number of samples taken.
2 Turbidity data was for all three water sources combined.
3 Data from 2/13/92 to 4/24/92 were not included in calculations as they used an Estimation of Bacteria Density Technique as opposed to the Multiple-Tube Fermentation Technique.

Summary of Giardia Monitoring

Location	Ave. Turbidity (NTU)	N[1]	% Positive Samples[2]	Ave. Conc. (oocysts/100L)[3]	Ave. Reporting Limit (oocysts/100L)[4]	Period of Record Starting Date	Period of Record Ending Date
DELTA/SAN LUIS/SAN JOAQUIN AREA							
DWR Operations and Maintenance							
Harvey O. Banks Pumping Plant	16	5	0	N/A	5.6	5/23/95	9/26/95
Delta-Mendota Canal at O'Neill Forebay	35	5	0	N/A	10.6	5/23/95	9/26/95
DWR Operations and Maintenance/Metropolitan Water District of S. CA							
Sacramento River at Greenes Landing		12	42	37.4	38.3	5/13/92	4/7/93
Harvey O. Banks Pumping Plant		12	0	N/A	13.6	5/12/92	4/7/93
Delta-Mendota Canal at O'Neill Forebay		12	8	6.0	34.6	5/12/92	4/7/93
CA Aqueduct, Check 29		12	0	N/A	30.1	6/15/92	5/18/93
SOUTH BAY AREA							
DWR Operations and Maintenance							
Arroyo Intake to Lake Del Valle	1	2	0	N/A	1.5	5/23/95	9/26/95
Alameda County Flood Control District							
Del Valle Water Treatment Plant	9	9	0	N/A	27.0	1/23/95	9/19/95
Patterson Pass Water Treatment Plant	6	9	0	N/A	27.0	1/23/95	9/20/95
Alameda County Water District							
SBA Bayside Takeoff (100% Delta Water)	11	4	0	N/A	1.2	12/15/94	7/12/95
SBA Bayside Takeoff (75% Delta Water/25% Del Valle Water)	10	1	N/A	2.1	N/A	5/16/95	5/16/95
SBA Bayside Takeoff (50% Delta Water/50% Del Valle Water)	19	2	0	N/A	0.6	11/17/94	4/11/95
SBA Bayside Takeoff Mi. 29.9 (100% Del Valle Water)	34	5	0	N/A	1.9	10/17/94	3/23/95
SBA Bayside Takeoff (Unknown % Delta/Del Valle Water)	6	3	0	N/A	3.6	10/17/94	3/23/95
Farm Bridge (d/s Hwy. 580) (50% Delta/50% Del Valle Water)	6	1	0	N/A	1.8	3/20/95	3/20/95
Farm Bridge d/s Mocho (DWR) (Unknown % Delta/Del Valle Water)	10	1	0	N/A	1.8	3/20/95	3/20/95
Backsurge Pool (50% Delta/50% Del Valle Water)	8	1	0	N/A	1.8	3/20/95	3/20/95
Drain Inlet from Pasture (DWR) (100% Del Valle Water)	18	1	0	N/A	1.2	3/26/95	3/26/95

[1] N is the number of samples taken.
[2] The percent of positive samples is the number of samples above the reporting limit divided by the total number of samples taken.
[3] The average concentration is the average of all samples that were above the reporting limit. Note that when there were no positive samples, this calculation was not applicable.
[4] The average reporting limit is the average of all reporting limits where the samples were less than the reporting limit.

Summary of Giardia Monitoring (cont.)

Location	Ave. Turbidity (NTU)	N[1]	% Positive Samples[2]	Ave. Conc. (oocysts/100L)[3]	Ave. Reporting Limit (oocysts/100L)[4]	Period of Record Starting Date	Ending Date
SOUTHERN CALIFORNIA AREA							
Palmdale Water District							
East Branch CA Aqueduct		2	0	N/A	20.2	12/6/94	7/27/95
Palmdale Lake		1	0	N/A	1.1	12/13/93	12/13/93
Palmdale Water Treatment Plant		3	0	N/A	20.9	12/6/94	7/28/95
Metropolitan Water District of So. Ca.							
Diemer Water Treatment Plant	1	6	50	2.5	3.8	10/25/94	3/23/95
Jensen Water Treatment Plant	1	6	50	4.7	7.3	10/27/94	3/30/95
Mills Water Treatment Plant	3	6	67	4.4	1.1	10/20/94	3/29/95
Skinner Water Treatment Plant	2	6	33	1.5	3.1	10/18/94	3/14/95
Weymouth Water Treatment Plant	1	6	17	7.0	1.1	10/19/94	3/21/95
Lake Perris, Outlet Tower		6	17	1.5	0.0	3/5/91	1/31/92
Lake Perris Beach		6	0	0.0	0.0	5/16/91	1/31/92
Live Oak Reservoir		5	0	0.0	0.0	6/5/91	2/4/92
Foothill Pressure Control Structure		5	17	0.3	0.0	6/19/91	2/5/92
Silverwood Lake Outlet Tower		6	0	0.0	0.0	3/12/91	1/14/92
Silverwood Lake Beach		6	0	0.0	0.0	5/27/91	1/14/92

Summary of Cryptosporidium Monitoring

Location	Ave. Turbidity (NTU)	N[1]	% Positive Samples[2]	Ave. Conc. (oocysts/100L)[3]	Ave. Reporting Limit (oocysts/100L)[4]	Period of Record Starting Date	Period of Record Ending Date
DELTA/SAN LUIS/SAN JOAQUIN AREA							
DWR Operations and Maintenance							
Harvey O. Banks Pumping Plant	16	5	0	N/A	5.6	5/23/95	9/26/95
Delta-Mendota Canal at O'Neill Forebay	35	2	0	N/A	11.0	5/23/95	9/26/95
DWR Operations and Maintenance/Metropolitan Water District of So. Ca.							
Sacramento River at Greenes Landing		12	50	49.8	45.8	5/13/92	4/7/93
Harvey O. Banks Pumping Plant		12	25	54.3	11.7	5/12/92	4/7/93
Delta-Mendota Canal at O'Neill Forebay		12	58	40.1	43.2	5/12/92	4/7/93
CA Aqueduct, Check 29		12	8	17.0	31.3	6/15/92	5/18/93
SOUTH BAY AREA							
DWR Operations and Maintenance							
Arroyo Intake to Lake Del Valle	1	2	0	N/A	1.5	5/23/95	9/26/95
Alameda County Flood Control and Water Conservation District, Zone 7							
Del Valle Water Treatment Plant		9	0	N/A	27.0	1/23/95	9/19/95
Patterson Pass Water Treatment Plant		6	0	N/A	39.0	1/23/95	9/20/95
Alameda County Water District							
SBA Bayside Takeoff (100% Delta Water)	11	4	0	N/A	1.2	12/15/94	7/12/95
SBA Bayside Takeoff (75% Delta/25% Del Valle Water)	10	1	0	N/A	2.1	5/16/95	5/16/95
SBA Bayside Takeoff (50% Delta/50% Del Valle Water)	19	2	0	N/A	0.3	11/17/94	4/11/95
SBA Bayside Takeoff Mi. 29.9 (100% Del Valle Water)	34	5	0	N/A	3.2	10/17/94	3/23/95
SBA Bayside Takeoff (Unknown % Delta/Del Valle Water)	6	3	0	N/A	3.6	8/21/95	10/24/95
Farm Bridge (d/s Hwy. 580) (50% Delta/50% Del Valle Water)	6	1	0	N/A	1.8	3/20/95	3/20/95
Farm Bridge d/s Mocho (DWR) (Unknown % Delta/Del Valle Water)	10	1	0	N/A	3.1	3/20/95	3/20/95
Backsurge Pool (50% Delta/50% Del Valle Water)	8	1	0	N/A	1.8	3/20/95	3/20/95
Drain Inlet from Pasture (DWR) (100% Del Valle Water)	18	1	0	N/A	1.2	3/26/95	3/26/95

Note : Where presumptive and confirmed are not indicated, the results for both of these analyses were the same.

1 N is the number of samples taken.

2 The percent of positive samples is the number of samples above the reporting limit divided by the total number of samples taken.

3 The average concentration is the average of all samples that were above the reporting limit. Note that when there were no positive samples, this calculation was not applicable.

4 The average reporting limit is the average of all reporting limits where the samples were less than the reporting limit.

Summary of Cryptosporidium Monitoring (cont.)

Location	Ave. Turbidity (NTU)	N[1]	% Positive Samples[2]	Ave. Conc. (oocysts/100L)[3]	Ave. Reporting Limit (oocysts/100L)[4]	Period of Record Starting Date	Ending Date
Santa Clara Valley Water District							
San Luis		25	12	3.4	0.1	6/19/91	8/28/95
Penitencia Water Treatment Plant	13	23	4	0.1	0.2	6/20/91	8/29/95
Riconada Water Treatment Plant	4	20	20	1.6	0.2	6/14/91	8/29/95
Santa Teresa Water Treatment Plant	4	24	21	0.7	0.2	6/19/91	8/28/95
SOUTHERN CALIFORNIA AREA							
Antelope Valley-East Kern Water Agency							
Palmdale Water District							
East Branch CA Aqueduct		2	0	N/A	20.2	12/6/94	7/27/95
Palmdale Lake		1	0	N/A	1.1	12/13/93	12/13/93
Palmdale Water Treatment Plant		3	0	N/A	20.9	12/6/94	7/28/95
Metropolitan Water District of So. Ca.							
Diemer Water Treatment Plant	1	6	83	3.6	1.0	10/25/94	3/23/95
Jensen Water Treatment Plant	1	6	33	2.4	6.6	10/27/94	3/30/95
Mills Water Treatment Plant	3	6	50	1.1	2.0	10/20/94	3/29/95
Skinner Water Treatment Plant	2	6	50	2.3	3.7	10/18/94	3/14/95
Weymouth Water Treatment Plant	1	6	50	3.7	1.1	10/19/94	3/21/95
Lake Perris, Outlet Tower		6	17	0.3	0.0	3/5/91	1/31/92
Lake Perris Beach		6	0.0	0.0	0.0	5/16/91	1/31/92
Live Oak Reservoir		5	60	1.3	0.0	6/5/91	2/4/92
Foothill Pressure Control Structure		5	20	0.3	0.0	6/19/91	2/5/92
Silverwood Lake Outlet Tower		6	40	0.6	0.0	3/12/91	1/14/92
Silverwood Lake Beach		6	0.0	N/A	0.0	5/27/91	1/14/92

Note : Where presumptive and confirmed are not indicated, the results for both of these analyses were the same.

[1] N is the number of samples taken.

[2] The percent of positive samples is the number of samples above the reporting limit divided by the total number of samples taken.

[3] The average concentration is the average of all samples that were above the reporting limit. Note that when there were no positive samples, this calculation was not applicable.

[4] The average reporting limit is the average of all reporting limits where the samples were less than the reporting limit.

American River at Treatment Plant

Location	N[1]	N (<RL)	Range		Median	Percentile		Period of Record	
			Minimum	Maximum		Tenth	Ninetieth	Starting Date	Ending Date
Trihalomethane Formation Potential (ug/l)	50		120	540	190	139	291	3/21/90	7/13/95
Dissolved Organic Carbon (mg/l)	65		1.4	4.3	1.9	1.5	2.4	3/21/90	7/13/95
Spec. Conductance (micromhos/cm)	37		46	83	65	50	79	11/13/90	10/13/94
Bromide (mg/l)	43		N/A	N/A	0.02	N/A	N/A	5/22/90	7/13/95

[1] N is the number of samples taken.
Note : Median, range, and percentile values were calculated from data greater than the reporting limit.
N/A : These calculations are not applicable for sample sets less than five.
Source: DWR Division of Operations and Maintenance Environmental Assessment Branch.

Delta Pumping Plant Headworks

Location	N[1]	Range		Median	Percentile		Period of Record	
		Minimum	Maximum		Tenth	Ninetieth	Starting Date	Ending Date
Trihalomethane Formation Potential (ug/l)	136	270	1200	530	355	805	1/24/90	7/30/95
Dissolved Organic Carbon (mg/l)	174	2.5	10.5	3.5	2.83	5.7	1/24/90	8/17/95
Spec. Conductance (micromhos/cm)	115	174	877	526	342	763	6/27/90	6/22/95
Bromide (mg/l)	110	0.05	0.65	0.30	0.10	0.53	1/24/90	6/22/95

[1] N is the number of samples taken.
Note : Median, range, and percentile values were calculated from data greater than the reporting limit.
N/A : These calculations are not applicable for sample sets less than five.
Source: DWR Division of Operations and Maintenance Environmental Assessment Branch.

Barker Slough at North Bay Pumping Plant

Location	N[1]	Range		Median	Percentile		Period of Record	
		Minimum	Maximum		Tenth	Ninetieth	Starting Date	Ending Date
Trihalomethane Formation Potential (ug/l)	80	230	1600	505	359	1010	1/23/90	7/12/95
Dissolved Organic Carbon (mg/l)	76	2.8	23.5	4.3	3.2	11.8	1/23/90	7/12/95
Spec. Conductance (micromhos/cm)	74	122	506	308	241	458	6/26/90	7/12/95
Bromide (mg/l)	68	0.01	0.23	0.05	0.03	0.08	2/21/90	7/12/95
Turbidity (NTU)	69	9	180	20	12	50	1/23/90	7/12/95

[1] N is the number of samples taken.
Note : Median, range, and percentile values were calculated from data greater than the reporting limit.
N/A : These calculations are not applicable for sample sets less than five.
Source: DWR Division of Operations and Maintenance Environmental Assessment Branch.

Clifton Court Intake

Location	N[1]	Range		Median	Percentile		Period of Record	
		Minimum	Maximum		Tenth	Ninetieth	Starting Date	Ending Date
Trihalomethane Formation Potential (ug/l)	60	260	890	505	338	811	2/21/90	10/20/94
Dissolved Organic Carbon (mg/l)	62	2.4	8.6	3.7	2.7	5.7	2/21/90	10/20/94
Spec. Conductance (micromhos/cm)	56	166	875	515	320	734	8/21/90	10/20/94
Bromide (mg/l)	47	0.04	0.63	0.27	0.10	0.50	2/21/90	10/20/94

1 N is the number of samples taken.
Note : Median, range, and percentile values were calculated from data greater than the reporting limit.
N/A : These calculations are not applicable for sample sets less than five.
Source: DWR Division of Operations and Maintenance Environmental Assessment Branch.

DMC Intake at Lindemann Road

Location	N[1]	Range		Median	Percentile		Period of Record	
		Minimum	Maximum		Tenth	Ninetieth	Starting Date	Ending Date
Trihalomethane Formation Potential (ug/l)	123	280	1400	520	360	768	1/24/90	6/22/95
Dissolved Organic Carbon (mg/l)	125	2.5	11.0	3.7	2.9	5.82	1/24/90	6/22/95
Spec. Conductance (micromhos/cm)	116	180	1150	556	312	885	2/21/90	6/22/95
Bromide (mg/l)	107	0.04	0.62	0.31	0.10	0.50	1/24/90	6/22/95

[1] N is the number of samples taken.
Note : Median, range, and percentile values were calculated from data greater than the reporting limit.
N/A : These calculations are not applicable for sample sets less than five.
Source: DWR Division of Operations and Maintenance Environmental Assessment Branch.

Sacramento River at Greenes Landing

Location	N[1]	Range		Median	Percentile		Period of Record	
		Minimum	Maximum		Tenth	Ninetieth	Starting Date	Ending Date
Trihalomethane Formation Potential (ug/l)	131	120	840	210	160	390	1/24/90	7/30/95
Dissolved Organic Carbon (mg/l)	858	1.4	7.7	2.1	1.7	3.6	1/24/90	8/10/95
Spec. Conductance (micromhos/cm)	93	90	253	170	113	218	6/28/90	7/13/95
Bromide (mg/l)	89	<0.01	0.08	0.02	0.01	0.04	1/24/90	7/13/95

[1] N is the number of samples taken.
Note : Median, range, and percentile values were calculated from data greater than the reporting limit.
N/A : These calculations are not applicable for sample sets less than five.
Source: DWR Division of Operations and Maintenance Environmental Assessment Branch.

Middle River at Borden Highway

Location	N[1]	Range		Median	Percentile		Period of Record	
		Minimum	Maximum		Tenth	Ninetieth	Starting Date	Ending Date
Trihalomethane Formation Potential (ug/l)	75	270	920	510	340	808	1/24/90	7/19/95
Dissolved Organic Carbon (mg/l)	711	2.4	13.0	4.1	3.0	7.9	1/24/90	7/19/95
Spec. Conductance (micromhos/cm)	70	153	726	429	225	613	9/24/90	7/19/95
Bromide (mg/l)	70	0.03	0.51	0.17	0.06	0.37	1/24/90	7/19/95

[1] N is the number of samples taken.
Note : Median, range, and percentile values were calculated from data greater than the reporting limit.
N/A : These calculations are not applicable for sample sets less than five.
Source: DWR Division of Operations and Maintenance Environmental Assessment Branch.

San Joaquin River at Vernalis

Location	N[1]	Range		Median	Percentile		Period of Record	
		Minimum	Maximum		Tenth	Ninetieth	Starting Date	Ending Date
Trihalomethane Formation Potential (ug/l)	71	260	1200	450	340	730	1/23/90	10/20/94
Dissolved Organic Carbon (mg/l)	72	2.2	11.4	3.4	2.8	5.6	1/23/90	10/20/94
Spec. Conductance (micromhos/cm)	70	195	1550	856	461	1102	1/9/90	10/20/94
Bromide (mg/l)	65	0.04	0.65	0.37	0.16	0.56	1/23/90	10/20/94

[1] N is the number of samples taken.
Note : Median, range, and percentile values were calculated from data greater than the reporting limit.
N/A : These calculations are not applicable for sample sets less than five.
Source: DWR Division of Operations and Maintenance Environmental Assessment Branch.

North Bay Aqueduct at Barker Slough

Location	N[1]	N (<RL)[2]	Range		Median	Percentile		Period of Record	
			Minimum	Maximum		Tenth	Ninetieth	Starting Date	Ending Date
Trihalomethane Formation Potential (ug/l)	63		360	1991	591	413	1509	4/16/90	8/16/95
Total Organic Carbon(mg/l)	62		3.3	21.3	5.2	3.9	12.9	4/18/90	7/19/95
Nitrate (mg/l)	54		0.1	12.0	1.7	0.6	5.4	2/19/91	7/19/95
Sulfate (mg/l)	67		6	64	24	15	49	1/17/90	7/19/95
Bromide (mg/l)	55		0.01	0.32	0.05	0.03	0.08	1/15/91	7/19/95
Alkalinity (mg/l)	67		48	163	95	78	128	1/17/90	7/19/95
Boron (mg/l)	66		0.1	0.5	0.2	0.1	0.3	1/17/90	7/19/95
Calcium (mg/l)	67		6	25	16	13	22	1/17/90	7/19/95
Chloride (mg/l)	67		6	76	26	17	44	1/17/90	7/19/95
Fluoride (mg/l)	67		0.1	0.5	0.1	0.1	0.2	1/17/90	7/19/95
Hardness (mg/l)	67		36	166	98	74	137	1/17/90	7/19/95
Magnesium (mg/l)	67		5	25	14	11	20	1/17/90	7/19/95
pH	67		6.7	8.1	7.7	7.2	7.9	1/17/90	7/19/95
Silica (mg/l)	1		N/A	N/A	10.8	N/A	N/A	10/16/90	10/16/90
Sodium (mg/l)	67		13	59	29	20	49	1/17/90	7/19/95
Spec. Conductance (micromhos/cm)	67		126	564	322	247	492	1/17/90	7/19/95
Total Dissolved Solids (mg/l)	67		88	331	187	151	283	1/17/90	7/19/95
Turbidity (NTU)	816		0.3	99.9	16.4	6.1	35.1	5/1/93	8/31/95
Aluminum (mg/l)	65	4	0.013	0.676	0.041	0.017	0.114	4/18/90	7/19/95
Arsenic (mg/l)	68	N/A	0.001	0.004	0.002	0.002	0.003	1/17/90	7/19/95
Barium (mg/l)	65	40	0.052	0.118	0.064	0.055	0.083	4/18/90	7/19/95
Cadmium (mg/l)	65	65	N/A	N/A	0.005	N/A	N/A	4/18/90	7/19/95
Chromium (mg/l)	65	65	N/A	N/A	0.005	N/A	N/A	2/20/90	7/19/95
Copper (mg/l)	68	50	0.005	0.033	0.007	0.005	0.009	1/17/90	7/19/95
Iron (mg/l)	68	1	0.007	1.140	0.052	0.022	0.244	1/17/90	7/19/95
Lead (mg/l)	68	68	N/A	N/A	0.005	N/A	N/A	1/17/90	7/19/95
Manganese (mg/l)	68	2	0.005	0.110	0.018	0.007	0.039	1/17/90	7/19/95
Mercury (mg/l)	65	65	N/A	N/A	0.001	N/A	N/A	4/18/90	7/19/95
Selenium (mg/l)	68	67	N/A	N/A	0.001	N/A	N/A	1/17/90	7/19/95
Silver (mg/l)	65	65	N/A	N/A	0.005	N/A	N/A	4/18/90	7/19/95
Zinc (mg/l)	60	17	0.005	0.043	0.010	0.006	0.026	9/18/90	7/19/95

[1] N is the number of samples taken.
[2] N (<RL) is the number of samples taken where the result is less than the reporting limit.
Note : Median, range, and percentile values were calculated from data greater than the reporting limit.
N/A : These calculations are not applicable for sample sets less than five.

Harvey O. Banks Pumping Plant

Location	N[1]	N (<RL)[2]	Range		Median	Percentile		Period of Record	
			Minimum	Maximum		Tenth	Ninetieth	Starting Date	Ending Date
Trihalomethane Formation Potential (ug/l)	66		330	1292	536	408	858	4/18/90	8/16/95
Total Organic Carbon(mg/l)	63		2.5	9.6	4.0	3.1	6.9	4/18/90	7/19/95
Nitrate (mg/l)	53		0.2	13.0	2.6	0.8	6.0	2/19/91	7/19/95
Sulfate (mg/l)	67		9	69	38	21	60	1/16/90	7/19/95
Asbestos (>10m MFL)	32		<0.1	<110.0				5/24/91	11/17/93
Bromide (mg/l)	56		0.04	0.53	0.22	0.07	0.49	6/17/90	7/19/95
Alkalinity (mg/l)	67		29	90	69	58	83	1/16/90	7/19/95
Boron (mg/l)	67		0.1	0.4	0.2	0.1	0.3	1/16/90	7/19/95
Calcium (mg/l)	67		9	30	19	14	25	1/16/90	7/19/95
Chloride (mg/l)	67		14	175	84	32	152	1/16/90	7/19/95
Fluoride (mg/l)	66		0.1	0.6	0.1	0.1	0.1	1/16/90	7/19/95
Hardness (mg/l)	67		39	170	109	74	138	1/16/90	7/19/95
Magnesium (mg/l)	67		4	24	14	10	19	1/16/90	7/19/95
pH	67		6.5	8.1	7.6	7.2	7.9	1/16/90	7/19/95
Sodium (mg/l)	67		12	108	57	25	93	1/16/90	7/19/95
Spec. Conductance (micromhos/cm)	67		162	840	515	300	743	1/16/90	7/19/95
Total Dissolved Solids (mg/l)	67		94	466	286	174	414	1/16/90	7/19/95
Aluminum (mg/l)	65	5	0.010	0.190	0.031	0.013	0.095	4/18/90	7/19/95
Arsenic (mg/l)	69	N/A	0.001	0.003	0.002	0.002	0.003	1/16/90	7/19/95
Barium (mg/l)	65	59	0.052	0.073	0.060	0.055	0.068	4/18/90	7/19/95
Cadmium (mg/l)	65	65	N/A	N/A	0.005	N/A	N/A	4/18/90	7/19/95
Chromium (mg/l)	66	66	N/A	N/A	0.005	N/A	N/A	2/20/90	7/19/95
Copper (mg/l)	69	58	N/A	N/A	0.005	N/A	N/A	1/16/90	7/19/95
Iron (mg/l)	69	1	0.009	0.196	0.038	0.017	0.131	1/16/90	7/19/95
Lead (mg/l)	69	68	N/A	N/A	0.005	N/A	N/A	1/16/90	7/19/95
Manganese (mg/l)	69	3	0.005	0.067	0.022	0.009	0.046	1/16/90	7/19/95
Mercury (mg/l)	65	65	N/A	N/A	0.001	N/A	N/A	4/18/90	7/19/95
Selenium (mg/l)	116	115	N/A	N/A	0.001	N/A	N/A	1/16/90	7/19/95
Silver (mg/l)	65	65	N/A	N/A	0.005	N/A	N/A	4/18/90	7/19/95
Zinc (mg/l)	56	24	0.005	0.060	0.013	0.006	0.033	10/16/90	7/19/95
Phenol (mg/l)	1	N/A	N/A	N/A	0.005	N/A	N/A	2/20/90	2/20/90

[1] N is the number of samples taken.
[2] N (<RL) is the number of samples taken where the result is less than the reporting limit.
Note : Median, range, and percentile values were calculated from data greater than the reporting limit.
N/A : These calculations are not applicable for sample sets less than five.

South Bay Aqueduct at Terminal Tank

Location	N[1]	N (<RL)[2]	Range Minimum	Range Maximum	Median	Percentile Tenth	Percentile Ninetieth	Period of Record Starting Date	Period of Record Ending Date
Nitrate (mg/l)	22		0.6	4.9	1.9	1.2	4.8	2/19/91	5/17/95
Sulfate (mg/l)	28		10	64	39	24	55	1/16/90	5/17/95
Bromide (mg/l)	14		0.04	0.52	0.17	0.05	0.35	2/19/91	5/17/95
Alkalinity (mg/l)	28		47	121	80	62	114	1/16/90	5/17/95
Boron (mg/l)	28		0.1	0.3	0.2	0.1	0.3	1/16/90	5/17/95
Calcium (mg/l)	28		10	35	22	15	29	1/16/90	5/17/95
Chloride (mg/l)	28		14	163	76	24	149	1/16/90	5/17/95
Fluoride (mg/l)	28		0.1	0.2	0.1	0.1	0.1	1/16/90	5/17/95
Hardness (mg/l)	27		50	170	124	85	149	1/16/90	5/17/95
Magnesium (mg/l)	28		6	20	16	12	19	1/16/90	5/17/95
pH	28		6.9	8.1	7.8	7.4	8.0	1/16/90	5/17/95
Sodium (mg/l)	28		14	100	53	24	91	1/16/90	5/17/95
Spec. Conductance (micromhos/cm)	28		168	801	475	384	731	1/16/90	5/17/95
Total Dissolved Solids (mg/l)	27		146	436	272	230	397	1/16/90	5/17/95
Aluminum (mg/l)	27	7	0.010	0.076	0.023	0.011	0.062	5/15/90	5/17/95
Arsenic (mg/l)	30	N/A	0.001	0.003	0.002	0.001	0.003	1/16/90	5/17/95
Barium (mg/l)	27	20	0.053	0.091	0.057	0.053	0.081	5/15/90	5/17/95
Cadmium (mg/l)	27	27	N/A	N/A	0.005	N/A	N/A	5/15/90	5/17/95
Chromium (mg/l)	28	28	N/A	N/A	0.005	N/A	N/A	2/20/90	5/17/95
Copper (mg/l)	69	17	0.005	0.056	0.009	0.005	0.048	1/16/90	5/17/95
Iron (mg/l)	30	2	0.014	0.217	0.040	0.019	0.093	1/16/90	5/17/95
Lead (mg/l)	30	30	N/A	N/A	0.005	N/A	N/A	1/16/90	5/17/95
Manganese (mg/l)	30	2	0.007	0.130	0.014	0.009	0.027	1/16/90	5/17/95
Mercury (mg/l)	30	27	N/A	N/A	0.001	N/A	N/A	5/15/90	5/17/95
Selenium (mg/l)	27	29	N/A	N/A	0.001	N/A	N/A	1/16/90	5/17/95
Silver (mg/l)	30	27	N/A	N/A	0.005	N/A	N/A	5/15/90	5/17/95
Zinc (mg/l)	24	5	0.006	0.122	0.035	0.007	0.081	11/13/90	5/17/95
Phenol (mg/l)	1	N/A	N/A	N/A	0.004	N/A	N/A	2/20/90	2/20/90

[1] N is the number of samples taken.
[2] N (<RL) is the number of samples taken where the result is less than the reporting limit.
Note : Median, range, and percentile values were calculated from data greater than the reporting limit.
N/A : These calculations are not applicable for sample sets less than five.

O'Neill PG&E Plant DMC at McCabe

Location	N[1]	N (<RL)[2]	Range Minimum	Range Maximum	Median	Percentile Tenth	Percentile Ninetieth	Period of Record Starting Date	Period of Record Ending Date
Trihalomethane Formation Potential (ug/l)	39		375	1387	529	437	894	6/16/92	8/16/95
Total Organic Carbon(mg/l)	49		3.0	11.7	4.3	3.4	7.1	4/17/91	7/19/95
Nitrate (mg/l)	50		1.0	12.0	3.9	2.0	7.3	4/17/91	7/19/95
Sulfate (mg/l)	50		14	206	57	25	103	4/17/91	7/19/95
Bromide (mg/l)	50		0.04	0.65	0.25	0.12	0.47	4/17/91	7/19/95
Alkalinity (mg/l)	50		28	155	80	55	102	4/17/91	7/19/95
Boron (mg/l)	50		0.1	0.8	0.2	0.1	0.5	4/17/91	7/19/95
Calcium (mg/l)	50		8	64	25	15	38	4/17/91	7/19/95
Chloride (mg/l)	50		12	193	86	29	149	4/17/91	7/19/95
Fluoride (mg/l)	50		0.1	0.3	0.1	0.1	0.1	4/17/91	7/19/95
Hardness (mg/l)	49		36	300	137	81	190	4/17/91	7/19/95
Magnesium (mg/l)	50		4	34	17	10	22	4/17/91	7/19/95
pH	50		6.9	8.2	7.9	7.4	8.0	4/17/91	7/19/95
Sodium (mg/l)	50		12	157	61	26	94	4/17/91	7/19/95
Spec. Conductance (micromhos/cm)	50		142	1320	579	305	844	4/17/91	7/19/95
Total Dissolved Solids (mg/l)	50		86	789	331	180	487	4/17/91	7/19/95
Aluminum (mg/l)	48	3	0.011	0.179	0.042	0.017	0.092	4/17/91	7/19/95
Arsenic (mg/l)	48	N/A	0.001	0.004	0.002	0.002	0.003	4/17/91	7/19/95
Barium (mg/l)	48	34	0.050	0.093	0.064	0.052	0.088	4/17/91	7/19/95
Cadmium (mg/l)	48	48	N/A	N/A	0.005	N/A	N/A	4/17/91	7/19/95
Chromium (mg/l)	48	48	N/A	N/A	0.005	N/A	N/A	4/17/91	7/19/95
Copper (mg/l)	48	42	0.005	0.018	0.008	0.005	0.014	4/17/91	7/19/95
Iron (mg/l)	48	0	0.009	0.222	0.047	0.025	0.156	4/17/91	7/19/95
Lead (mg/l)	48	48	N/A	N/A	0.005	N/A	N/A	4/17/91	7/19/95
Manganese (mg/l)	48	29	0.005	0.030	0.014	0.007	0.023	4/17/91	7/19/95
Mercury (mg/l)	57	56	N/A	N/A	0.006	N/A	N/A	4/17/91	7/19/95
Selenium (mg/l)	56	39	0.001	0.003	0.002	0.001	0.002	4/17/91	7/19/95
Silver (mg/l)	48	48	N/A	N/A	0.005	N/A	N/A	4/17/91	7/19/95
Zinc (mg/l)	48	31	0.005	0.036	0.009	0.006	0.020	4/17/91	7/19/95

[1] N is the number of samples taken.
[2] N (<RL) is the number of samples taken where the result is less than the reporting limit.
Note : Median, range, and percentile values were calculated from data greater than the reporting limit.
N/A : These calculations are not applicable for sample sets less than five.

San Luis Reservoir at Tunnel Island

Location	N[1]	N (<RL)[2]	Range Minimum	Range Maximum	Median	Percentile Tenth	Percentile Ninetieth	Period of Record Starting Date	Period of Record Ending Date
Trihalomethane Formation Potential (ug/l)	1		N/A	N/A	534	N/A	N/A	12/18/92	12/18/92
Nitrate (mg/l)	16		1.9	5.5	3.9	3.1	4.9	2/19/91	5/19/92
Sulfate (mg/l)	29		41	58	49	42	57	1/16/90	5/19/92
Bromide (mg/l)	1		N/A	N/A	0.25	N/A	N/A	5/19/92	5/19/92
Alkalinity (mg/l)	29		69	85	82	74	84	1/16/90	5/19/92
Boron (mg/l)	29		0.2	0.3	0.2	0.2	0.2	1/16/90	5/19/92
Calcium (mg/l)	29		20	27	24	21	26	1/16/90	5/19/92
Chloride (mg/l)	29		101	149	117	109	136	1/16/90	5/19/92
Fluoride (mg/l)	29		0.1	0.4	0.1	0.1	0.2	1/16/90	5/19/92
Hardness (mg/l)	29		112	147	134	114	143	1/16/90	5/19/92
Magnesium (mg/l)	29		15	20	18	15	19	1/16/90	5/19/92
pH	29		7.0	8.8	8.0	7.3	8.4	1/16/90	5/19/92
Sodium (mg/l)	29		69	92	77	70	83	1/16/90	5/19/92
Spec. Conductance (micromhos/cm)	29		588	767	660	610	709	1/16/90	5/19/92
Total Dissolved Solids (mg/l)	29		322	420	363	331	400	1/16/90	5/19/92

[1] N is the number of samples taken.
[2] N (<RL) is the number of samples taken where the result is less than the reporting limit.
Note : Median, range, and percentile values were calculated from data greater than the reporting limit.
N/A : These calculations are not applicable for sample sets less than five.

California Aqueduct Outlet at Check 13

Location	N[1]	N (<RL)[2]	Range Minimum	Range Maximum	Median	Percentile Tenth	Percentile Ninetieth	Period of Record Starting Date	Period of Record Ending Date
Trihalomethane Formation Potential (ug/l)	65		320	994	537	421	809	4/18/90	8/16/95
Total Organic Carbon(mg/l)	63		2.6	9.3	4.4	3.1	6.7	4/18/90	7/19/95
Nitrate (mg/l)	104		0.6	9.6	3.6	1.5	6.3	2/20/91	7/19/95
Sulfate (mg/l)	118		17	99	49	31	67	1/17/90	7/19/95
Bromide (mg/l)	55		0.01	0.32	0.05	0.03	0.08	1/15/91	7/19/95
Asbestos (>10m MFL)	41		<0.2	19.0	5.1	2.0	14.8	4/17/91	11/17/93
Alkalinity (mg/l)	118		35	101	76	64	84	1/17/90	7/19/95
Bromide (mg/l)	57		0.07	0.54	0.23	0.13	0.44	1/16/91	7/19/95
Boron (mg/l)	117		0.1	0.7	0.2	0.1	0.3	1/17/90	7/19/95
Calcium (mg/l)	117		10	36	23	17	28	1/17/90	7/19/95
Chloride (mg/l)	118		21	170	87	48	138	1/17/90	7/19/95
Fluoride (mg/l)	116		0.1	0.4	0.1	0.1	0.1	1/17/90	7/19/95
Hardness (mg/l)	117		46	189	124	94	147	1/17/90	7/19/95
Magnesium (mg/l)	117		5	24	15	11	20	1/17/90	7/19/95
pH	118		6.9	8.6	7.8	7.4	8.1	1/17/90	7/19/95
Potassium (mg/l)	1		N/A	N/A	1.5	N/A	N/A	9/1/93	9/1/93
Silica (mg/l)	1		N/A	N/A	10.8	N/A	N/A	10/16/90	10/16/90
Sodium (mg/l)	117		19	106	61	39	88	1/17/90	7/19/95
Spec. Conductance (micromhos/cm)	118		199	856	560	401	725	1/17/90	7/19/95
Total Dissolved Solids (mg/l)	118		117	478	316	233	402	1/17/90	7/19/95
Turbidity (NTU)	725		1	23	5	2	10	7/1/93	8/31/95
Aluminum (mg/l)	67	9	0.010	0.527	0.032	0.015	0.082	4/18/90	7/19/95
Arsenic (mg/l)	121	N/A	0.001	0.004	0.002	0.002	0.003	1/17/90	7/19/95
Barium (mg/l)	70	63	0.052	0.068	0.057	0.053	0.064	4/18/90	7/19/95
Cadmium (mg/l)	70	70	N/A	N/A	0.005	N/A	N/A	4/18/90	7/19/95
Chromium (mg/l)	115	115	N/A	N/A	0.005	N/A	N/A	2/21/90	7/19/95
Copper (mg/l)	120	99	0.005	0.028	0.006	0.005	0.017	1/17/90	7/19/95
Iron (mg/l)	120	3	0.006	0.416	0.041	0.013	0.143	1/17/90	7/19/95
Lead (mg/l)	120	119	N/A	N/A	0.005	N/A	N/A	1/17/90	7/19/95
Manganese (mg/l)	120	30	0.005	0.060	0.013	0.006	0.027	1/17/90	7/19/95
Mercury (mg/l)	94	94	N/A	N/A	0.001	N/A	N/A	4/18/90	7/19/95
Selenium (mg/l)	122	114	0.001	0.001	0.001	0.001	0.001	1/17/90	7/19/95

[1] N is the number of samples taken.
[2] N (<RL) is the number of samples taken where the result is less than the reporting limit.
Note : Median, range, and percentile values were calculated from data greater than the reporting limit.
N/A : These calculations are not applicable for sample sets less than five.

Source: DWR Division of Operations and Maintenance Environmental Assessment Branch.

California Aqueduct Outlet at Check 13 (cont.)

Location	N[1]	N (<RL)[2]	Range		Median	Percentile		Period of Record	
			Minimum	Maximum		Tenth	Ninetieth	Starting Date	Ending Date
Silver (mg/l)	70	70	N/A	N/A	0.005	N/A	N/A	4/18/90	7/19/95
Zinc (mg/l)	112	56	0.005	0.210	0.008	0.005	0.022	2/21/90	7/19/95
Phenol (mg/l)	1	N/A	N/A	N/A	0.003	N/A	N/A	2/21/90	2/21/90

[1] N is the number of samples taken.
[2] N (<RL) is the number of samples taken where the result is less than the reporting limit.
Note : Median, range, and percentile values were calculated from data greater than the reporting limit.
N/A : These calculations are not applicable for sample sets less than five.

Source: DWR Division of Operations and Maintenance Environmental Assessment Branch.

California Aqueduct at Check 21

Location	N[1]	N (<RL)[2]	Range Minimum	Range Maximum	Median	Percentile Tenth	Percentile Ninetieth	Period of Record Starting Date	Period of Record Ending Date
Trihalomethane Formation Potential (ug/l)	22		321	1029	505	413	802	5/16/90	8/16/95
Total Organic Carbon(mg/l)	18		2.7	8.8	4.0	2.9	6.9	5/16/90	5/17/95
Nitrate (mg/l)	102		1.1	10.0	3.7	1.8	6.3	2/20/91	7/19/95
Sulfate (mg/l)	117		20	364	67	39	135	1/16/90	7/19/95
Bromide (mg/l)	18		0.10	0.50	0.27	0.16	0.41	2/20/91	5/17/95
Alkalinity (mg/l)	117		41	106	79	65	87	1/16/90	7/19/95
Boron (mg/l)	116		0.1	0.6	0.3	0.2	0.4	1/16/90	7/19/95
Calcium (mg/l)	117		13	84	25	19	32	1/16/90	7/19/95
Chloride (mg/l)	116		21	179	96	46	136	1/16/90	7/19/95
Fluoride (mg/l)	115		0.1	0.5	0.1	0.1	0.2	1/16/90	7/19/95
Hardness (mg/l)	117		57	354	130	93	162	1/16/90	7/19/95
Magnesium (mg/l)	117		6	35	16	11	20	1/16/90	7/19/95
pH	117		6.9	8.7	7.9	7.4	8.1	1/16/90	7/19/95
Potassium (mg/l)	2		N/A	N/A	2.9	N/A	N/A	10/7/92	9/1/93
Sodium (mg/l)	117		20	138	76	38	113	1/16/90	7/19/95
Spec. Conductance (micromhos/cm)	116		231	1030	643	383	858	1/16/90	7/19/95
Total Dissolved Solids (mg/l)	116		137	722	359	224	500	1/16/90	7/19/95
Turbidity (NTU)	770		1	93	7	2	32	7/1/93	8/31/95
Aluminum (mg/l)	68	13	0.002	0.369	0.021	0.011	0.062	4/17/90	7/19/95
Arsenic (mg/l)	119	N/A	0.001	0.004	0.002	0.002	0.003	1/16/90	7/19/95
Barium (mg/l)	69	59	0.050	0.084	0.056	0.051	0.075	4/17/90	7/19/95
Cadmium (mg/l)	69	69	N/A	N/A	0.005	N/A	N/A	4/17/90	7/19/95
Chromium (mg/l)	114	114	N/A	N/A	0.005	N/A	N/A	2/20/90	7/19/95
Copper (mg/l)	119	110	0.005	0.014	0.006	0.005	0.009	1/16/90	7/19/95
Iron (mg/l)	119	6	0.005	0.316	0.025	0.010	0.076	1/16/90	7/19/95
Lead (mg/l)	119	119	N/A	N/A	0.005	N/A	N/A	1/16/90	7/19/95
Manganese (mg/l)	119	87	0.005	0.141	0.010	0.006	0.022	1/16/90	7/19/95
Mercury (mg/l)	91	91	N/A	N/A	0.001	N/A	N/A	4/17/90	7/19/95
Selenium (mg/l)	117	106	0.001	0.005	0.001	0.001	0.003	1/16/90	7/19/95
Silver (mg/l)	69	69	N/A	N/A	0.005	N/A	N/A	4/17/90	7/19/95
Zinc (mg/l)	110	51	0.005	0.048	0.008	0.005	0.017	10/17/90	7/19/95
Phenol (mg/l)	1	N/A	N/A	N/A	0.003	N/A	N/A	2/20/90	2/20/90

[1] N is the number of samples taken.
[2] N (<RL) is the number of samples taken where the result is less than the reporting limit.
Note : Median, range, and percentile values were calculated from data greater than the reporting limit.
N/A : These calculations are not applicable for sample sets less than five.

Source: DWR Division of Operations and Maintenance Environmental Assessment Branch.

California Aqueduct at Check 29

Location	N[1]	N (<RL)[2]	Range Minimum	Range Maximum	Median	Percentile Tenth	Percentile Ninetieth	Period of Record Starting Date	Period of Record Ending Date
Nitrate (mg/l)	84		0.1	8.9	3.2	1.1	5.8	2/19/91	7/18/95
Sulfate (mg/l)	103		22	268	68	38	118	1/16/90	7/18/95
Bromide (mg/l)	1		N/A	N/A	0.30	N/A	N/A	12/20/94	12/20/94
Alkalinity (mg/l)	102		44	118	81	67	89	1/16/90	7/18/95
Boron (mg/l)	103		0.1	0.6	0.3	0.2	0.4	1/16/90	7/18/95
Calcium (mg/l)	101		14	51	26	19	32	1/16/90	7/18/95
Chloride (mg/l)	103		24	170	102	54	133	1/16/90	7/18/95
Fluoride (mg/l)	100		0.1	1.4	0.1	0.1	0.2	1/16/90	7/18/95
Hardness (mg/l)	99		60	247	133	99	156	1/16/90	7/18/95
Magnesium (mg/l)	101		6	29	16	11	20	1/16/90	7/18/95
pH	102		5.0	8.8	7.8	7.2	8.1	1/16/90	7/18/95
Potassium (mg/l)	1		N/A	N/A	3.9	N/A	N/A	2/18/92	2/18/92
Sodium (mg/l)	103		21	131	77	46	108	1/16/90	7/18/95
Spec. Conductance (micromhos/cm)	102		243	1080	663	453	825	1/16/90	7/18/95
Total Dissolved Solids (mg/l)	101		142	687	376	263	472	1/16/90	7/18/95
Turbidity (NTU)	770		1	70	6	3	18	1/2/92	6/30/95
Aluminum (mg/l)	102	22	0.010	0.096	0.030	0.012	0.063	4/17/90	7/18/95
Arsenic (mg/l)	119	N/A	0.001	0.035	0.003	0.002	0.005	1/16/90	7/18/95
Barium (mg/l)	102	85	0.050	0.094	0.060	0.051	0.068	4/17/90	7/18/95
Cadmium (mg/l)	102	102	N/A	N/A	0.005	N/A	N/A	4/17/90	7/18/95
Chromium (mg/l)	102	102	N/A	N/A	0.005	N/A	N/A	4/17/90	7/18/95
Copper (mg/l)	105	65	0.005	0.061	0.012	0.006	0.027	1/16/90	7/18/95
Iron (mg/l)	105	7	0.005	0.156	0.027	0.009	0.071	1/16/90	7/18/95
Lead (mg/l)	104	104	N/A	N/A	0.005	N/A	N/A	1/16/90	7/18/95
Manganese (mg/l)	103	83	0.005	0.264	0.008	0.006	0.025	3/20/90	7/18/95
Mercury (mg/l)	101	99	N/A	N/A	0.001	N/A	N/A	4/17/90	7/18/95
Selenium (mg/l)	104	93	0.001	0.003	0.001	0.001	0.002	1/16/90	7/18/95
Silver (mg/l)	102	102	N/A	N/A	0.005	N/A	N/A	4/17/90	7/18/95
Zinc (mg/l)	97	42	0.005	0.064	0.010	0.006	0.029	9/18/90	7/18/95

[1] N is the number of samples taken.
[2] N (<RL) is the number of samples taken where the result is less than the reporting limit.
Note : Median, range, and percentile values were calculated from data greater than the reporting limit.
N/A : These calculations are not applicable for sample sets less than five.

Source: DWR Division of Operations and Maintenance Environmental Assessment Branch.

California Aqueduct at Check 41

Location	N[1]	N (<RL)[2]	Range Minimum	Range Maximum	Median	Percentile Tenth	Percentile Ninetieth	Period of Record Starting Date	Period of Record Ending Date
Trihalomethane Formation Potential (ug/l)	62		297	1029	496	370	731	4/19/90	8/16/95
Total Organic Carbon (mg/l)	58		2.4	7.2	4.0	2.8	5.5	9/19/90	7/19/95
Nitrate (mg/l)	60		1.0	7.0	2.9	1.5	5.8	1/18/90	7/19/95
Sulfate (mg/l)	68		17	157	67	31	114	1/18/90	7/19/95
Asbestos (>10m MFL)	37		<0.8	21.0	7.1	1.7	19.8	5/15/91	11/17/93
Bromide (mg/l)	53		0.04	0.57	0.32	0.11	0.46	1/16/91	7/19/95
Alkalinity (mg/l)	68		38	105	81	65	90	1/18/90	7/19/95
Boron (mg/l)	68		0.1	0.7	0.3	0.1	0.4	1/18/90	7/19/95
Calcium (mg/l)	68		11	35	25	16	31	1/18/90	7/19/95
Chloride (mg/l)	68		15	154	102	44	137	1/18/90	7/19/95
Fluoride (mg/l)	68		0.1	0.5	0.1	0.1	0.2	1/18/90	7/19/95
Hardness (mg/l)	61		44	178	129	77	153	1/18/90	7/19/95
Magnesium (mg/l)	68		4	22	16	10	19	1/18/90	7/19/95
pH	68		7.2	8.8	8.0	7.6	8.2	1/18/90	7/19/95
Potassium (mg/l)	37		1.4	5.0	3.6	2.1	4.6	1/18/90	7/19/95
Silica (mg/l)	11		3.8	13.0	9.3	6.5	12.5	1/18/90	11/14/90
Sodium (mg/l)	68		14	159	76	34	107	1/18/90	7/19/95
Spec. Conductance (micromhos/cm)	68		160	998	632	319	823	1/18/90	7/19/95
Total Dissolved Solids (mg/l)	68		103	593	370	196	479	1/18/90	7/19/95
Turbidity (NTU)	724		1	101	8	3	33	1/1/90	9/28/95
Aluminum (mg/l)	73	14	0.010	0.101	0.023	0.014	0.058	4/18/90	7/19/95
Arsenic (mg/l)	77	N/A	0.001	0.010	0.002	0.002	0.004	1/18/90	7/19/95
Barium (mg/l)	73	61	0.050	0.086	0.060	0.051	0.077	4/18/90	7/19/95
Cadmium (mg/l)	72	72	N/A	N/A	0.005	N/A	N/A	4/18/90	7/19/95
Chromium (mg/l)	74	74	N/A	N/A	0.005	N/A	N/A	4/18/90	7/19/95
Copper (mg/l)	77	61	0.005	0.024	0.008	0.005	0.021	1/18/90	7/19/95
Iron (mg/l)	77	5	0.006	0.153	0.027	0.010	0.080	1/18/90	7/19/95
Lead (mg/l)	77	77	N/A	N/A	0.005	N/A	N/A	1/18/90	7/19/95
Manganese (mg/l)	75	72	N/A	N/A	0.005	N/A	N/A	3/21/90	7/19/95
Mercury (mg/l)	75	75	N/A	N/A	0.001	N/A	N/A	1/18/90	7/19/95
Selenium (mg/l)	77	74	N/A	N/A	0.001	N/A	N/A	1/18/90	7/19/95
Silver (mg/l)	72	72	N/A	N/A	0.005	N/A	N/A	4/18/90	7/19/95
Zinc (mg/l)	71	47	0.005	0.013	0.007	0.006	0.012	2/21/90	7/19/95

1 N is the number of samples taken.
2 N (<RL) is the number of samples taken where the result is less than the reporting limit.
Note : Median, range, and percentile values were calculated from data greater than the reporting limit.
N/A : These calculations are not applicable for sample sets less than five.

Source: DWR Division of Operations and Maintenance Environmental Assessment Branch.

Silverwood Lake at Tunnel Inlet

Location	N[1]	N (<RL)[2]	Range Minimum	Range Maximum	Median	Percentile Tenth	Percentile Ninetieth	Period of Record Starting Date	Period of Record Ending Date
Total Organic Carbon (mg/l)	2		N/A	N/A	3.6	N/A	N/A	11/15/90	3/20/91
Nitrate (mg/l)	21		0.5	4.4	2.9	1.8	4.0	1/17/90	2/16/95
Sulfate (mg/l)	25		25	88	62	34	82	1/17/90	2/16/95
Bromide (mg/l)	1		N/A	N/A	0.51	N/A	N/A	2/20/91	2/20/91
Alkalinity (mg/l)	25		55	92	78	70	86	1/17/90	2/16/95
Boron (mg/l)	24		0.1	0.3	0.2	0.1	0.3	2/21/90	2/16/95
Calcium (mg/l)	25		14	27	23	18	27	1/17/90	2/16/95
Chloride (mg/l)	25		37	135	93	57	129	1/17/90	2/16/95
Fluoride (mg/l)	24		0.1	0.5	0.1	0.1	0.2	1/17/90	2/16/95
Hardness (mg/l)	23		65	150	120	89	145	1/17/90	2/16/95
Magnesium (mg/l)	25		7	20	15	10	19	1/17/90	2/16/95
pH	25		7.4	8.8	8.0	7.6	8.5	1/17/90	2/16/95
Potassium (mg/l)	15		1.2	4.6	3.6	2.6	4.2	1/17/90	2/16/95
Silica (mg/l)	8		0.9	10.0	8.9	3.4	9.7	1/17/90	11/15/90
Sodium (mg/l)	25		32	97	71	45	88	1/17/90	2/16/95
Spec. Conductance (micromhos/cm)	25		288	775	581	415	720	1/17/90	2/16/95
Total Dissolved Solids (mg/l)	25		154	426	332	249	411	1/17/90	2/16/95

[1] N is the number of samples taken.
[2] N (<RL) is the number of samples taken where the result is less than the reporting limit.
Note : Median, range, and percentile values were calculated from data greater than the reporting limit.
N/A : These calculations are not applicable for sample sets less than five.

Source: DWR Division of Operations and Maintenance Environmental Assessment Branch.

California Aqueduct at Devil Canyon

Location	N[1]	N (<RL)[2]	Range Minimum	Range Maximum	Median	Percentile Tenth	Percentile Ninetieth	Period of Record Starting Date	Period of Record Ending Date
Trihalomethane Formation Potential (ug/l)	62		319	666	492	383	604	4/18/90	8/16/95
Total Organic Carbon (mg/l)	57		2.6	5.5	3.8	3.2	4.8	9/19/90	6/21/95
Nitrate (mg/l)	58		0.5	5.7	2.6	1.5	3.8	2/21/90	6/21/95
Sulfate (mg/l)	65		7	320	62	33	83	2/21/90	6/21/95
Bromide (mg/l)	53		0.01	0.52	0.24	0.14	0.41	1/16/91	6/21/95
Alkalinity (mg/l)	65		45	110	79	67	89	2/21/90	6/21/95
Boron (mg/l)	65		0.1	0.3	0.2	0.1	0.3	2/21/90	6/21/95
Calcium (mg/l)	65		17	29	24	19	27	2/21/90	6/21/95
Chloride (mg/l)	64		5	135	88	47	123	2/21/90	6/21/95
Fluoride (mg/l)	65		0.1	0.5	0.1	0.1	0.2	2/21/90	6/21/95
Hardness (mg/l)	59		76	152	120	89	146	2/21/90	6/21/95
Magnesium (mg/l)	65		4	20	15	10	19	2/21/90	6/21/95
pH	65		6.4	8.7	7.9	7.6	8.3	2/21/90	6/21/95
Potassium (mg/l)	35		1.1	4.4	3.4	2.7	4.0	2/21/90	6/21/95
Silica (mg/l)	9		2.0	10.3	9.0	4.8	10.1	2/21/90	10/17/90
Sodium (mg/l)	65		11	96	66	39	87	2/21/90	6/21/95
Spec. Conductance (micromhos/cm)	64		197	771	553	364	728	2/21/90	6/21/95
Total Dissolved Solids (mg/l)	65		130	434	323	217	420	2/21/90	6/21/95
Turbidity (NTU)	724		1	101	8	3	33	1/1/90	9/28/95
Aluminum (mg/l)	65	36	0.010	0.099	0.020	0.011	0.056	4/18/90	7/26/95
Arsenic (mg/l)	68	N/A	0.001	0.010	0.002	0.002	0.004	2/21/90	7/26/95
Barium (mg/l)	65	53	0.050	0.142	0.053	0.050	0.060	4/18/90	7/26/95
Cadmium (mg/l)	65	65	N/A	N/A	0.005	N/A	N/A	4/18/90	7/26/95
Chromium (mg/l)	66	66	N/A	N/A	0.005	N/A	N/A	4/18/90	7/26/95
Copper (mg/l)	68	48	0.005	0.018	0.007	0.005	0.012	2/21/90	7/26/95
Iron (mg/l)	68	14	0.005	0.063	0.010	0.006	0.035	2/21/90	7/26/95
Lead (mg/l)	68	68	N/A	N/A	0.005	N/A	N/A	2/21/90	7/26/95
Manganese (mg/l)	67	52	0.005	0.013	0.006	0.006	0.0122	3/21/90	7/26/95
Mercury (mg/l)	66	65	N/A	N/A	0.001	N/A	N/A	2/21/90	7/26/95
Selenium (mg/l)	68	68	N/A	N/A	0.001	N/A	N/A	2/21/90	7/26/95
Silver (mg/l)	64	64	N/A	N/A	0.005	N/A	N/A	4/18/90	7/26/95
Zinc (mg/l)	63	42	0.005	0.042	0.007	0.005	0.018	7/18/90	7/26/95

[1] N is the number of samples taken.
[2] N (<RL) is the number of samples taken where the result is less than the reporting limit.
Note : Median, range, and percentile values were calculated from data greater than the reporting limit.
N/A : These calculations are not applicable for sample sets less than five.

Source: DWR Division of Operations and Maintenance Environmental Assessment Branch.

Lake Perris at Outlet

Location	N[1]	N (<RL)[2]	Range		Median	Percentile		Period of Record	
			Minimum	Maximum		Tenth	Ninetieth	Starting Date	Ending Date
Total Organic Carbon (mg/l)	2		N/A	N/A	3.7	N/A	N/A	11/14/90	2/19/91
Nitrate (mg/l)	17		0.1	0.4	0.1	0.1	0.3	5/13/91	2/16/95
Sulfate (mg/l)	20		42	83	54	47	67	5/15/90	2/16/95
Bromide (mg/l)	1		N/A	N/A	0.36	N/A	N/A	2/19/91	2/19/91
Alkalinity (mg/l)	20		83	114	104	94	108	5/15/90	2/16/95
Boron (mg/l)	20		0.2	0.4	0.2	0.2	0.3	5/15/90	2/16/95
Calcium (mg/l)	20		22	30	26	23	28	5/15/90	2/16/95
Chloride (mg/l)	20		95	135	123	102	131	5/15/90	2/16/95
Fluoride (mg/l)	20		0.1	0.4	0.1	0.1	0.3	5/15/90	2/16/95
Hardness (mg/l)	18		125	157	140	131	152	5/15/90	2/16/95
Magnesium (mg/l)	20		16	21	16	20	5/15/90	2/16/95	
pH	20		7.5	8.6	8.2	7.8	8.5	5/15/90	2/16/95
Potassium (mg/l)	10		2.5	5.6	5.1	3.7	5.3	11/14/90	2/16/95
Silica (mg/l)	2		N/A	N/A	1.0	N/A	N/A	8/14/90	11/14/90
Sodium (mg/l)	20		63	98	87	73	94	5/15/90	2/16/95
Spec. Conductance (micromhos/cm)	20		544	762	693	579	731	5/15/90	2/16/95
Total Dissolved Solids (mg/l)	20		276	449	389	342	419	5/15/90	2/16/95
Turbidity (NTU)	724		1	101	8	3	33	1/1/90	9/28/95
Aluminum (mg/l)	20	18	N/A	N/A	0.010	N/A	N/A	5/15/90	2/16/95
Arsenic (mg/l)	20	N/A	0.001	0.002	0.002	0.002	0.002	5/15/90	2/16/95
Barium (mg/l)	20	7	0.050	0.099	0.057	0.053	0.082	5/15/90	2/16/95
Cadmium (mg/l)	20	20	N/A	N/A	0.005	N/A	N/A	5/15/90	2/16/95
Chromium (mg/l)	20	20	N/A	N/A	0.005	N/A	N/A	5/15/90	2/16/95
Copper (mg/l)	20	8	0.005	0.042	0.009	0.006	0.039	5/15/90	2/16/95
Iron (mg/l)	20	12	0.006	0.010	0.007	0.006	0.009	5/15/90	2/16/95
Lead (mg/l)	20	20	N/A	N/A	0.005	N/A	N/A	5/15/90	2/16/95
Manganese (mg/l)	20	18	N/A	N/A	0.007	N/A	N/A	5/15/90	2/16/95
Mercury (mg/l)	23	22	N/A	N/A	0.001	N/A	N/A	5/15/90	2/16/95
Selenium (mg/l)	21	21	N/A	N/A	0.001	N/A	N/A	5/15/90	2/16/95
Silver (mg/l)	20	20	N/A	N/A	0.005	N/A	N/A	5/15/90	2/16/95
Zinc (mg/l)	19	11	0.005	0.027	0.010	0.006	0.020	8/14/90	2/16/95

[1] N is the number of samples taken.
[2] N (<RL) is the number of samples taken where the result is less than the reporting limit.
Note : Median, range, and percentile values were calculated from data greater than the reporting limit.
N/A : These calculations are not applicable for sample sets less than five.

Source: DWR Division of Operations and Maintenance Environmental Assessment Branch.

Pyramid Lake at Tunnel Inlet

Location	N[1]	N (<RL)[2]	Range Minimum	Range Maximum	Median	Percentile Tenth	Percentile Ninetieth	Period of Record Starting Date	Period of Record Ending Date
Total Organic Carbon (mg/l)	2		N/A	N/A	3.0	N/A	N/A	11/14/90	2/19/91
Nitrate (mg/l)	20		0.2	4.7	2.5	1.5	4.1	1/18/90	2/16/95
Sulfate (mg/l)	23		44	146	65	47	93	1/18/90	2/16/95
Bromide (mg/l)	1		N/A	N/A	0.38	N/A	N/A	2/19/91	2/19/91
Alkalinity (mg/l)	23		71	100	83	74	90	1/18/90	2/16/95
Boron (mg/l)	23		0.1	0.4	0.3	0.2	0.4	1/18/90	2/16/95
Calcium (mg/l)	23		22	39	27	23	31	1/18/90	2/16/95
Chloride (mg/l)	23		50	132	98	63	113	1/18/90	2/16/95
Fluoride (mg/l)	23		0.1	0.3	0.1	0.1	0.2	1/18/90	2/16/95
Hardness (mg/l)	21		115	176	130	118	157	1/18/90	2/16/95
Magnesium (mg/l)	23		13	20	15	14	19	1/18/90	2/16/95
pH	23		7.4	9.3	8.1	7.8	8.8	1/18/90	2/16/95
Potassium (mg/l)	14		1.4	4.3	3.6	3.1	4.0	1/18/90	2/16/95
Silica (mg/l)	7		5.3	11.0	10.0	7.4	10.6	1/18/90	11/14/90
Sodium (mg/l)	23		46	87	68	51	85	1/18/90	2/16/95
Spec. Conductance (micromhos/cm)	23		438	747	575	489	706	1/18/90	2/16/95
Total Dissolved Solids (mg/l)	23		267	442	364	290	424	1/18/90	2/16/95
Turbidity (NTU)	724		1	101	8	3	33	1/1/90	9/28/95
Aluminum (mg/l)	16	7	0.010	0.096	0.020	0.011	0.051	5/15/90	8/17/93
Arsenic (mg/l)	21	N/A	0.002	0.010	0.003	0.002	0.010	1/19/90	8/17/93
Barium (mg/l)	16	14	N/A	N/A	0.050	N/A	N/A	5/15/90	8/17/93
Cadmium (mg/l)	16	15	N/A	N/A	0.005	N/A	N/A	5/15/90	8/17/93
Chromium (mg/l)	16	15	N/A	N/A	0.005	N/A	N/A	5/15/90	8/17/93
Copper (mg/l)	21	15	0.005	0.050	0.005	0.005	0.014	1/19/90	8/17/93
Iron (mg/l)	21	9	N/A	N/A	0.010	N/A	N/A	1/19/90	8/17/93
Lead (mg/l)	21	21	N/A	N/A	0.005	N/A	N/A	1/19/90	8/17/93
Manganese (mg/l)	19	15	N/A	N/A	0.005	N/A	N/A	3/20/90	8/17/93
Mercury (mg/l)	21	21	N/A	N/A	0.001	N/A	N/A	1/19/90	8/17/93
Selenium (mg/l)	21	19	N/A	N/A	0.001	N/A	N/A	1/19/90	8/17/93
Silver (mg/l)	16	16	N/A	N/A	0.005	N/A	N/A	5/15/90	8/17/93
Zinc (mg/l)	17	9	0.005	0.028	0.015	0.006	0.024	8/14/90	8/17/93

[1] N is the number of samples taken.
[2] N (<RL) is the number of samples taken where the result is less than the reporting limit.
Note : Median, range, and percentile values were calculated from data greater than the reporting limit.
N/A : These calculations are not applicable for sample sets less than five.

Source: DWR Division of Operations and Maintenance Environmental Assessment Branch.

Castaic Lake at Outlet Tower

Location	N[1]	N (<RL)[2]	Range Minimum	Range Maximum	Median	Percentile Tenth	Percentile Ninetieth	Period of Record Starting Date	Period of Record Ending Date
Trihalomethane Formation Potential (ug/l)	21		361	707	460	391	584	5/14/90	8/14/95
Total Organic Carbon (mg/l)	17		2.9	6.9	3.5	3.1	4.9	11/13/90	2/14/95
Nitrate (mg/l)	19		0.1	2.8	1.8	0.1	2.7	1/18/90	2/14/95
Sulfate (mg/l)	21		41	172	89	47	137	1/18/90	2/14/95
Bromide (mg/l)	1		N/A	N/A	0.34	N/A	N/A	2/19/91	2/19/91
Alkalinity (mg/l)	22		72	104	91	77	96	1/18/90	2/14/95
Boron (mg/l)	22		0.1	0.4	0.3	0.2	0.3	1/18/90	2/14/95
Calcium (mg/l)	23		23	40	32	24	40	1/18/90	2/14/95
Chloride (mg/l)	21		62	119	99	68	113	1/18/90	2/14/95
Fluoride (mg/l)	23		0.1	0.4	0.2	0.1	0.4	1/18/90	2/14/95
Hardness (mg/l)	21		118	186	155	127	182	1/18/90	2/14/95
Magnesium (mg/l)	23		14	21	18	16	20	1/18/90	2/14/95
pH	21		7.5	9.1	8.1	7.9	8.8	1/18/90	2/14/95
Potassium (mg/l)	13		1.8	4.1	3.6	3.3	4.0	1/18/90	2/14/95
Silica (mg/l)	6		0.9	12.0	9.8	4.7	11.1	1/18/90	11/13/90
Sodium (mg/l)	23		55	89	72	58	82	1/18/90	2/14/95
Spec. Conductance (micromhos/cm)	22		498	721	631	576	711	1/18/90	2/14/95
Total Dissolved Solids (mg/l)	22		287	465	388	342	448	1/18/90	2/14/95
Turbidity (NTU)	527		0	148	3	1	22	9/1/93	5/4/95
Aluminum (mg/l)	21	16	0.012	0.040	0.019	0.012	0.038	5/14/90	2/14/95
Arsenic (mg/l)	24	N/A	0.001	0.010	0.002	0.002	0.003	1/18/90	2/14/95
Barium (mg/l)	21	19	N/A	N/A	0.056	N/A	N/A	5/14/90	2/14/95
Cadmium (mg/l)	21	21	N/A	N/A	ND	N/A	N/A	5/14/90	2/14/95
Chromium (mg/l)	21	21	N/A	N/A	ND	N/A	N/A	5/14/90	2/14/95
Copper (mg/l)	24	20	N/A	N/A	0.005	N/A	N/A	1/18/90	2/14/95
Iron (mg/l)	24	16	0.005	0.036	0.006	0.005	0.017	1/18/90	2/14/95
Lead (mg/l)	24	24	N/A	N/A	ND	N/A	N/A	1/18/90	2/14/95
Manganese (mg/l)	22	21	N/A	N/A	0.025	N/A	N/A	3/19/90	2/14/95
Mercury (mg/l)	24	24	N/A	N/A	ND	N/A	N/A	1/18/90	2/14/95
Selenium (mg/l)	24	23	N/A	N/A	0.001	N/A	N/A	1/18/90	2/14/95
Silver (mg/l)	21	21	N/A	N/A	ND	N/A	N/A	5/14/90	2/14/95
Zinc (mg/l)	20	11	0.005	0.015	0.009	0.006	0.015	8/13/90	2/14/95

[1] N is the number of samples taken.
[2] N (<RL) is the number of samples taken where the result is less than the reporting limit.
Note : Median, range, and percentile values were calculated from data greater than the reporting limit.
N/A : These calculations are not applicable for sample sets less than five.

Source: DWR Division of Operations and Maintenance Environmental Assessment Branch.

Appendix C

Department of Water Resources Emergency Action Plan: Supplementary Material

Maintenance Responsibility
DWR State Water Project Emergency Action Plan
Field Division

(HQ = Headquarters FD = Field Division)

Section	Maintenance Responsibility HQ	FD
Table of Contents		X
Introduction	X	
Emergency Action Plan Maintenance Procedure		X
Emergency Management and Duties	X	
ACC and POC Notification Responsibilities	X	
Coordination with OES	X	
Public Information & News Media Assistance	X	
Employee and Public Safety	X	
Field Division Security Plan		X
General Emergency Response		X
Earthquake Response		X
Fire Response		X
Bomb Threat/Event Response		X
Flood Response		X
Dam or Aqueduct Failure Response		X
Hazardous Spill Response		X
Civil Disturbance Response		X
Death or Injury Response		X
Equipment Malfunction Affecting Deliveries		X
ACC/POC Control Transfer Procedure	X	
Emergency Evacuation Procedure	X	X
Emergency Purchases and Contracts Procedure	X	
Bomb Search Procedure		X
Bomb Threat Phone Call Record & Checklist		X
East Branch Contaminant Velocity Chart		X
Aqueduct Check Structures		X
Turnout Summary		X
Pipeline Crossing Summary		X
Earthquake Inspection Reports		X
Report of Hazardous Material Spill	X	

Maintenance Responsibility
DWR State Water Project Emergency Action Plan
Field Division

Section	Maintenance Responsibility HQ	Maintenance Responsibility FD
SARA Title III Section 304 Report	X	
Proposition 65 Report Form	X	
Bomb Threat/Bomb Event Notification Chart		X
Death or Injury Reporting & Notification		X
Fire Emergency Notification Chart		X
Threat Notification Chart		X
Civil Disturbance Notification Chart		X
Evacuation Notification Chart		X
Dam or Aqueduct Failure Notification Chart		X
Hazardous Spill Notification Chart		X
DWR Phone Directory	X	X
Radio List - Field Division & State Police		X
Pager List - Field Division & State Police		X
SWP Crisis Information Contacts		X
Communication Technician Callout List		X
Emergency Callout List		X
Mobile Equipment Callout List		X
State Police Personnel Roster		X
Medical, Fire, Law Emergency Phone Numbers		X
Hazardous Material Information Sources	X	
Gas & Oil Pipeline Crossing Contacts		X
Downstream Release Contacts		X
Water Supply Contractors Directory	X	
Project Operations Center Notification List	X	
Organizational Chart		X
State and County Agencies	X	
Service and Supply Contact List		X
Contractors and Vendors		X
Chemical Labs and Suppliers		X
Solid Waste Disposal Sites		X
HazMat Clean-up Equipment Location		X
Facility Lists and Location Maps		X

Example

Emergency Action Plan Distribution List
Southern Field Division

Volume Number	
01	Field Division Chief, OFFICE
02	Field Division Chief, VEHICLE
03	Administration Officer, OFFICE
04	Senior Power O&M Engineer, VEHICLE
05	Emergency Command Coordinator, VEHICLE
06	Operations Superintendent, VEHICLE
07	Chief, H.E.P. Operator, VEHICLE
08	Area Control Center, OFFICE
09	William E. Warne Power Plant, CONTROL ROOM
10	Oso Pumping Plant, CONTROL ROOM
11	Pearblossom Pumping Plant, CONTROL ROOM
12	Devil Canyon Power Plant, CONTROL ROOM
13	Plant Maintenance Superintendent, VEHICLE
14	Civil Maintenance Superintendent, VEHICLE
15	Civil Maint. Assist. Super., East, VEHICLE
16	Pearblossom Sub-Center
17	State Police (Castaic)
18	State Police (Pearblossom)
19	Spare
20	Project Operations Center
21	Oroville Area Control Center
22	Delta Area Control Center
23	San Luis Area Control Center
24	San Joaquin Area Control Center
25	O&M Headquarters Civil Maintenance Chief, OFFICE
26	O&M Headquarters EAP Coordinator, OFFICE
27-31	Federal Energy Regulatory Commission (S.F.)

State of California | The Resources Agency

Memorandum

Date : August 30, 1995

To : Rich Sapudar
Division of Local Assistance
1020 Ninth Street

Richard L. Jacobi, Chief
Civil Maintenance Branch
Division of Operations and Maintenance

From : Department of Water Resources

Subject: EAP Status Information for Final Sanitary Survey

In response to your memorandum of August 18, 1995 and pursuant to your telephone conversation with Wes Faubel of my staff, we are providing a sample copy of an Operations and Maintenance Field Division Emergency Action Plan. We understand that this information and the summary that will be provided to you are to be incorporated as our input into the five-year update of the State Water Project Sanitary Survey required by the Department of Health Services.

The EAP for San Joaquin Field Division is representative of each of the five field division plans and serves as a generic example for review. Each field division EAP is identical in organization and differs only in data that are particular to each field division (e.g. telephone contact numbers, radio call signs, personnel lists, facilities lists, etc.).

We are compiling a summary of the implementation and revision status of each field division EAP to be forwarded to you approximately mid-September. This summary will detail implementation dates and revision schedules for each field division's EAP. If you have further questions, please contact Wes Faubel at CALNET 453-5746.

cc: E. Huntley/605
L. Long/SFD/Castaic
R. Williams/OFD
D. Starks/DFD
D. Knittel/SLFD
G. Gordon/SJFD

SURNAME				
DWR 155 (Rev. 2/86)	W Faubel 8/30	[illegible] 8/30	[illegible] for R Jacobi 8/30	

State of California | The Resources Agency

Memorandum

Date : October 10, 1995

To : Rich Sapudar
Division of Local Assistance
1020 Ninth Street

Richard L. Jacobi, Chief
Civil Maintenance Branch
Division of Operations and Maintenance

From : Department of Water Resources

Subject : **EAP Status Information for Final Sanitary Survey, Field Division Status Report**

In response to your memorandum of August 18, 1995 and as indicated in our August 30, 1995 memorandum, the following is a status summary of the Emergency Action Plans for each field division. This information is provided as our input into the five-year update of the State Water Project Sanitary Survey required by the Department of Health Services.

FIELD DIVISION	IMPLEMENTATION DATE	REVISION SCHEDULE	LAST REVISION
Delta	Mar. 1994	Annual	Sep. 1994
Oroville	Feb. 1996[1]	Annual	
San Joaquin	Nov. 1994	Annual	Feb. 1995
San Luis	Nov. 1994	Annual	Apr. 1995
Southern	Jan. 1996[1]	Annual	

[1]Planned implementation date. EAP still in draft.

If you have further questions, please contact Wes Faubel at CALNET 453-5746.

cc: E. Huntley/605
L. Long/SFD
R. Williams/OFD
D. Starks/DFD
D. Knittel/SLFD
G. Gordon/SJFD

SURNAME | W Faubel 10/10 | L. Pritten for C. Tromley 10/10/95 | RJacobi 10/10

DWR 155 (REV. 2/86)

Appendix D

Sample Questionnaire

State Water Project
Sanitary Survey Update Questionnaire
California Department of Water Resources

July 25, 1995

Please respond to the following questions in as detailed a manner as possible. Use the back of this form or additional sheets if necessary. You may also attach or enclose any additional information you feel is relevant. Please contact the person listed at the end of this form if you have any questions, or wish to arrange for a telephone response. Also, please remember to provide us with a contact person should we need to further discuss your responses or the information you have provided. **Please return the completed questionnaire to the address at the end of this form by August 21, 1995**. Thank you for your cooperation.

1. Please identify your agency name and address.

2. Within the past 5 years, have you experienced any difficulties treating water for M & I users related to the quality of water provided by the SWP?

3. If you have experienced treatment difficulties attributable to SWP source water quality, please identify the contributing factors or specific constituents responsible for these difficulties, and indicate whether they are of Low, Moderate, or High concern to your treatment operation.

4. If you have experienced treatment difficulties attributable to SWP source water quality please briefly describe how you have addressed them in the treatment process, and if you consider your success Low, Moderate, or High.

5. Please describe any difficulties you anticipate complying with the proposed Disinfection-Disinfectants By-Products Rule, Phase 1, and any changes to the operation of your treatment process that would be required.

6. If you have performed monitoring of either source and/or finished waters for Giardia, Cryptosporidium, or coliforms within the past five years, please identify or describe the waters monitored, the analytical method used, and briefly discuss any findings.

7. Please describe and briefly discuss any planned construction of new water treatment facilities, change of locations of existing facilities, or change of intake structures.

8. Please briefly discuss any sources of contamination, events, or situations that you are aware of that could adversely impact the quality of SWP source water, and identify any agencies or entities having information about them.

9. Please identify a contact person (and telephone number) able to provide additional information on your responses.

Please return the completed questionnaire and any additional materials you are providing to:

Richard Sapudar
Water Quality Assessment BranchTelephone (916) 445-9191
Division of Local AssistanceFAX(916) 327-1648
Department of Water ResourcesEmailrsapudar@water.ca.gov
1020 Ninth Street
Sacramento, CA 95814

PLEASE RETURN THIS QUESTIONNAIRE BY AUGUST 21, 1995.

Appendix E

Historical DWR Policy of Non-Project Groundwater Inflow

FIELD DIVISIONS USE OF CHEMICALS ON OR NEAR THE AQUEDUCT

Product Name	Active Ingredient	Pesticide Class	Application
Hyvar	Bromacil	preemergent herbicide	fall to mid-winter
Karmex	Diuron	preemergent herbicide	fall to mid-winter
Oust	Sulfometuron methyl	preemergent herbicide	fall to mid-winter
Telar	Chlorsulfuron	preemergent and postemergent herbicide	fall to early spring fall to early spring
Surflan	Oryzalin	preemergent herbicide	
Roundup	Glyphosate	postemergent herbicide	late spring throughout summer
Rodeo	Glyphosate	contact herbicide	late spring throughout summer
Garion 4	Triclopyr	contact herbicide	growing season of woody plants and broadleaf weeds
Diazinon	Diazinon	insecticide	when problem pests arise
Copper Sulfate	Copper	algicide	when algal blooms and odor in raw water arise
Diphacinone	2-diphenylacetyl-1, 3-indandione	rodenticide	late spring and early summer at sites of squirrel activity

FIELD DIVISIONS USE OF CHEMICALS ON OR NEAR THE AQUEDUCT

Pesticide	Manufacturer	Properties
Hyvar	Dupont	Bromacil, active ingredient (AI); Nonselective preemergence surface applied herbicide; LD50 oral:5,200mg/kg, Category IV (practically non-toxic); applied in fall to mid-winter.
Karmex	Dupont	Diuron, AI; Nonselective preemergence surface applied herbicide; LD50 oral: 5,000mg/kg; LC5O fish: 3.5mg/kg, Category IV (practically non-toxic); applied in fall to mid-winter.
Oust	Dupont	Sulfometuron methyl, AI; Nonselective preemergence surface applied herbicide; LD50 oral: >5,000mg/kg, Category IV (practically non-toxic); applied in fall to early spring.
Telar	Dupont	Chlorsulfuron, AI; Selective preemergence and early post-emergence surface applied herbicide; LD5O oral: >5.500mg/kg, Category IV (practically non-toxic); applied in fall to early spring.
Surflan	DowElanco	Oryzalin, AI; Selective premergence surface- applied herbicide; LC50 Bluegill: 2.5mg/L; LD5O oral: 10,000mg/kg Category IV (almost non-toxic); applied in fall to early winter.
Roundup	Monsanto	Glyphosate, AI; Nonselective, postemergence herbicide; LD50 oral: 4,000-5,000mg/kg; Category III; eye irritant;easily denatured by organic material-clean water necessary for best results; applied in late spring throughout summer.
Rodeo	Monsanto	Glyphosate, AI, formulated to aquatic, weeds; sold without the surfactant; a nonionic surfactant needs to be added prior to application; practically nontoxic to fish; applied in late spring throughout summer.
Garlon 4	DowElanco	Triclopyr, AI, Selected systemic, contact herb-icide, LD50 l58lmg/kg; Category III; Toxic to fish when applied directly into water; primarily used during the growing season for woody plants and broadleaf weed control.
Diazinon	Various, patent expired	Diazinon, AI,insecticide for inside use only by DWR.
Copper Sulfate	Various, patent expired	Algicide used for control of blooms and odor in raw water;
Diphacinone	Local Ag. Commissioner	applied at check structure for rapid dispersal; LC50 fish; LD50 Oral, 472mg/kg, applied when water treatment plant monitors indicate a buildup occurring. Anticogulant used for period of 5-7 days to prevent blood clotting in a squirrel pest;used in bait stations during the late spring and early summer period and again in the fall at sites of squirrel activity.

Information received from DWR Civil Maintencnce.

Appendix F

Historical DWR Policy of Non-Project Groundwater Inflow

DEPARTMENT OF WATER RESOURCES
Policy on Acceptance of Non-Project Ground Water Inflow
to the State Water Project During Periods
of Entitlement Deficiency
Original June 1990
Amended March 1991
Amended March 1992
Amended March 1993
Amended April 1994

This policy is effective from March 1, 1994 through February 28, 1995, except as may be amended.

Non-Project ground water may be considered by the Department of Water Resources for acceptance into State Water Project facilities (including the San Luis Canal) during years when SWP water contractors or other water users have taken significant entitlement deficiencies, as judged by DWR.

DWR may accept Non-Project water into SWP facilities provided that its acceptance will not result in the significant degradation of SWP water quality, toxicity to fish and wildlife, or adverse changes in the suitability of the water for its beneficial uses, including municipal, industrial, agricultural, or recreational purposes. No such water shall be accepted under any arrangement that would hinder the operation of the SWP to fulfill its stated purposes, or which would result in additional, unreimbursed cost of SWP or SWP contractors operations.

SPECIFIC PROVISIONS

Non-Project water shall meet the water quality criteria specified in Table 1 at the point of input into the State Water Project. Blending of multiple ground water sources to meet these standards prior to input into the SWP is acceptable. Water diverted from the SWP shall not be used for blending purposes.

Prior to Non-Project water being accepted into the SWP, the proponent of the proposed arrangement shall provide to DWR completed water quality analyses for the constituents listed in Table 1. Analyses shall be performed on each well to be pumped into the SWP, by a Department of Health Services certified laboratory. The analytical methods shall be those used for drinking water and performed by U. S. Environmental Protection Agency or DHS approved laboratories with adequate accuracy, precision, and laboratory quality control to allow comparison with the standards specified in this policy. Analytical adequacy shall be judged by DWR. When blending multiple sources, flow measurements and analytical data must show that standards are met upon input to the SWP.

Policy on Acceptance of Non-Project Ground Water Inflow
to the State Water Project During Periods
of Entitlement Deficiency
Page Two

Notwithstanding whether analysis indicates the quality of the proposed water meets the standards listed in Table 1, the proponent of the arrangement shall demonstrate the source of the water to be entered into SWP facilities is of consistent, predictable, and acceptable quality. DWR shall consider each proposal on a case-by-case basis, and reserves the right to deny, modify, or terminate permission for entry of Non-Project water at its sole discretion.

If at any time the Non-Project ground water is determined by DWR not to be in compliance with the provisions of this policy, the input of that water shall cease as specified by DWR.

DWR may, at its discretion, require the operator of the arrangement to provide additional quality analyses of Non-Project ground water that is being pumped into the SWP. Also, DWR will perform or request the proponent to perform, routine water quality monitoring of Non-Project water for constituents that it deems necessary and at the frequency needed to determine any impacts to SWP water quality. DWR shall be reimbursed for reasonable costs associated with maintaining and monitoring Non-Project ground water pump-in projects.

The operator of the arrangement shall maintain accurate and current records of quantity and quality of Non-Project ground water introduced into the SWP and provide them to DWR upon request. All ground water inflow shall be metered to determine inflow quantity.

DWR shall maintain, review, and analyze water quality test results of the Non-Project inflow and will make them available to State Water Project contractors or the Department of Health Services upon request.

The foregoing policy is subject to revision or revocation at the discretion of DWR, based on establishment of new or modified drinking water criteria, emergency, or other issues of concern. SWP water contractors will be notified prior to any change in this policy.

April 20, 1994

Table 1

WATER QUALITY CRITERIA
INORGANIC CHEMICALS

CHEMICAL	STANDARD (mg/L)
Aluminum	1.0
Arsenic	0.05
Barium	1.0
Cadmium	0.005
Chromium	0.05
Lead	0.05
Mercury	0.002
Nitrate	45.0 (as NO3 10 as N)
Selenium	0.01
Silver	0.05
Fluoride	1.4-2.4[a]
Specific Conductance	2,200 (μS/cm)
Total Dissolved Solids	1,500
Copper	1.0
Chloride	600
Iron	1.0
Manganese	0.2
Sulfate	600
Zinc	5.0

RADIOACTIVITY	STANDARD (pCi/L)
Radium-226 + Radium-228	5
Gross Alpha[b]	15
Tritium	20,000
Strontium-90	8
Gross Beta	50
Uranium	20

a] Depends on ambient air temperature.
b] Analyze for gross alpha; if it exceeds criteria, analyze other constituents.

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Table 1 (Continued)

ORGANIC CHEMICALS

CHEMICAL	**STANDARD (mg/L)**
Atrazine	0.003
Bentazon	0.018
Carbofuran	0.018
Chlordane	0.0001
2,4-D	0.07
Dibromochloropropane	0.0002
Endrin	0.0002
Ethylene Dibromide	0.00002
Glyphosate	0.7
Heptachlor	0.00001
Heptachlor Epoxide	0.00001
Lindane	0.0002
Methyoxychlor	0.04
Molinate	0.02
Simazine	0.0004
Thiobencarb	0.0001
Toxaphene	0.0003
2,4,5-TP(Silvex)	0.05

Appendix G

Summary of Environmental Database Search Results

Summary of Environmental Data Base Records Search Results - Barker Slough

Environmental Databases	Site Name	Contaminant Source	
UST	A. Abruzzini Vineyards	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
RCRA (G) (T)	AAA Sales	Hazardous waste transporter	Possibly In the Watershed During Transport
RCRA (G) (T)	Allwaste Services of SF	Hazardous waste transporter	Possibly In the Watershed During Transport
RCRA (G) (T)	Amerada Hess Corp	Hazardous waste transporter	Possibly In the Watershed During Transport
UST	Anderson Rowland Property	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Andrews Ranch	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
SWIS	Aqua Clear Farms	Solid Waste Landfill Runoff	Adjacent to the Watershed
UST	Armour Petrol Prod 12-88	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
WIS, UST	B & J Sanitary Landfill	Landfill Runoff, Potential Petroleum Hydrocarbons	In the Watershed
RCRA (G)	Ball Metal Container Corp	Hazardous waste transporter	Adjacent to the Watershed
UST	Berry Ranch	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
LUST, UST	Blackwelders	Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Bowlsbey Ranch	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Brann Bros. Ranch	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
RCRA (G)	Busy Bee Transmissions	Hazardous Waste	Adjacent to the Watershed
RCRA (G) (T)	Cal Chief Chem	Hazardous Waste	Adjacent to the Watershed
UST	Cal Dept. Fish Game	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Campbell Ranch A Calif. Corp	Potential Petroleum Hydrocarbons	In the Watershed
UST	Cheaper #31	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
RCRA (G)	Clorox CO	Hazardous Waste	Possibly In the Watershed During Transport
UST	Coelho Ranch	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Compressor #6	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Cripps Ranch	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Denverton Dehydrator	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Dixon Overseas	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Dixon Overseas Radio	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Drouin Comp St.	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
RCRA (G)	Dutra Construction	Hazardous Waste	Adjacent to the Watershed
UST, SWIS	E&L Anderson	Potential Petroleum Hydrocarbons, Landfill Runoff	Adjacent to the Watershed
LUST, SWIS	Easterly Sewage Trt Plant	Potential Petroleum Hydrocarbons, Landfill Runoff	Adjacent to the Watershed
LUST	Fairfield Suisun Unified	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
LUST	Fairhill Foods	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	G.W. Lonely Ranch	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
LUST	Hastings Island	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
RCRA (G)	IT Corp Montezuma	Hazardous Waste	Adjacent to the Watershed
UST	Kirby Hills Dehy	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Lopez Enterprises	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Maine Prairie Meter Stn.	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Millar Meter Stn	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST, LUST	Naval Radio Transmitting Facil	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Outrigger Marina	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST, LUST, RCRA (G)	Owens Illinois Plastics	Potential Petroleum Hydrocarbons, Hazardous Waste	Adjacent to the Watershed
RCRA (G) (T)	Pacific Bell Suisun	Hazardous Waste	Adjacent to the Watershed
RCRA (G)	Pauls Engine and Machine Shop	Hazardous Waste	Adjacent to the Watershed
RCRA (G), LUST	PG&E Compressor	Potential Petroleum Hydrocarbons, Hazardous Waste	Adjacent to the Watershed

Summary of Environmental Data Base Records Search Results - Barker Slough (cont.)

Environmental Databases	Site Name	Contaminant Source	
UST	Plumbing Workshop	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	QIX-RMLR	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Robert W. Dittmer	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	S & W Paving	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
RCRA (G)	Safeway Inc	Hazardous Waste	Adjacent to the Watershed
UST	Sheriff Claybank	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Sherman-West Company	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
LUST	Snug Harbor Marina	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Solano County OES	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Solano Electric	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Southern Pacific	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Southern Pacific Suisun	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	The Hoffmann Company	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
MULTIPLE SITES	Travis AFB	Multiple Sources	Adjacent to the Watershed
RCRA (G) LUST	Travis Unified School District	Potential Petroleum Hydrocarbons, Hazardous Waste	Adjacent to the Watershed
UST	Travis Water Treatment Site	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
RCRA (T)	U.S. Eagle Inc.	Hazardous Waste	Adjacent to the Watershed
ERNS	Unknown Hwy 12-Hwy 113	Hazardous Waste	Adjacent to the Watershed
UST	Vaca Hill Radio	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
LUST	Voice of America	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Wal-Mart	Potential Petroleum Hydrocarbons	Adjacent to the Watershed

Summary of Environmental Data Base Records Search Results - Lake Del Valle

Environmental Databases	Site Name	Contaminant Source	
RCRA (G)	Arroyo Del Valle Sanitarium	Hazardous Waste	Adjacent to the Watershed
RCRA (G)	U.S.V.A. Medical Center	Hazardous Waste	Adjacent to the Watershed
LUST	Del Valle Regional Park	Potential Petroleum Hydrocarbons	In the Watershed
LUST	Sunol 94586	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
LUST	Sweetwater Forest Fire Station	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
LUST	Richmond Tank Car	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
LUST	17505 Mines Rd., Livermore	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	San Antone Forest Fire Station	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Cornelius H. Woods	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	San Antone Valley Ranch Corp	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Sunol Aggregate Plant #120	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Keller Canyon	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Thomas Joe Copeland	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Mountain House Earth Station	Potential Petroleum Hydrocarbons	Adjacent to the Watershed

Summary of Environmental Data Base Records Search Results - San Luis Reservoir Complex

Environmental Databases	Site Name	Contaminant Source	
RCRA (G)	Shell Station	Hazardous Waste	In the Watershed
RCRA (G)	PG&E Los Banos	Hazardous Waste	In the Watershed
ERNS	Unknown Gustine	Hazardous Waste	Adjacent to the Watershed
UST	I-5 Truck Services Inc.	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Cox Shell	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Los Banos Substation	Potential Petroleum Hydrocarbons	In the Watershed
UST	Los Banos Abattoir Co.	Potential Petroleum Hydrocarbons	In the Watershed
UST	Forebay Unocal	Potential Petroleum Hydrocarbons	In the Watershed
UST	Los Banos Fire Fighting Station	Potential Petroleum Hydrocarbons	In the Watershed
UST	San Joaquin Valley National	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
RCRA (G), UST	California Dept. Water Resources	Hazardous Waste	In the Watershed
RCRA	Chevron USA Inc Los Banos	Hazardous Waste	Adjacent to the Watershed
RCRA	Pacific Bell Los Banos	Hazardous Waste	Adjacent to the Watershed
RCRA	San Luis Res SRA	Hazardous Waste	Adjacent to the Watershed
RCRA	Turner Island farms	Hazardous Waste	Adjacent to the Watershed
RCRA	Phillips Road Property	Hazardous Waste	Adjacent to the Watershed
ERNS	Best Western Hotel	Hazardous Waste	Adjacent to the Watershed
ERNS	Unknown Hwy 152	Hazardous Waste	Adjacent to the Watershed
ERNS	Dos Amigos Pumping Plant	Hazardous Waste	Adjacent to the Watershed
LUST	San Luis Reservoir	Potential Petroleum Hydrocarbons	In the Watershed
LUST	San Luis Dam	Potential Petroleum Hydrocarbons	In the Watershed
LUST	Los Banos Project	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
LUST	Fast Boy	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
SWIS	Billy Wright Disposal Site	Landfill Runoff	Adjacent to the Watershed
SWIS	City of Los Banos Disposal Site	Landfill Runoff	Adjacent to the Watershed
UST	Freeway Mobil	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	John M. Arburua	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Hammonds Substation	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Santa Rita Substation	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	County of Merced	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	French Ranch	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Duarte Farms	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Gustine Radio	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Pacheco Pass Radio	Potential Petroleum Hydrocarbons	Adjacent to the Watershed

Summary of Environmental Data Base Records Search Results - Coastal Branch

Environmental Databases	Site Name	Contaminant Source	
ERNS	Unknown Hwy. 33	Hazardous Waste	In the Watershed
ERNS	Unknown Barker Rd	Hazardous Waste	In the Watershed
RCRA (G)	Pacific Bell Avenal	Hazardous Waste	Adjacent to the Watershed
RCRA (G)	Avenal State Prison	Hazardous Waste	Adjacent to the Watershed
RCRA (G)	Dudleyridge Farms	Hazardous Waste	Adjacent to the Watershed
RCRA (G)	Paramount Farms	Hazardous Waste	In the Watershed
RCRA (G)	Paramount Farms	Hazardous Waste	In the Watershed
ERNS	Mobil Oil	Hazardous Waste	Adjacent to the Watershed
ERNS	California Aqueduct	Hazardous Waste	In the Watershed
ERNS	UNOCAL	Hazardous Waste	In the Watershed
LUST	Cottonwood Station	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
LUST	Caltrans Kettleman Road	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
SWIS	Kettleman City Sanitary Landfill	Landfill Runoff	Adjacent to the Watershed
UST	West Hills Almond Co-op	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Berrenda Mesa Water Dist.	Potential Petroleum Hydrocarbons	In the Watershed
UST	Coalinga Pump Station	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	West Side Shop	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	California State Prison Avenal	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Bingo Fuel Stop	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Pyramid Hills Radio	Potential Petroleum Hydrocarbons	Adjacent to the Watershed

Summary of Environmental Data Base Records Search Results - Pyramid Lake

Environmental Databases	Site Name	Contaminant Source	
ERNS (ER)	Griffith Company	Hazardous Waste	Adjacent to the Watershed
ERNS (ER)	Northbound 15 at Youngs Hill	Hazardous Waste	Adjacent to the Watershed
ERNS (ER)	Northbound I-5	Hazardous Waste	Adjacent to the Watershed
ERNS (ER)	Northbound I-5	Hazardous Waste	Adjacent to the Watershed
ERNS (ER)	I-5 at Hungry Valley Road	Hazardous Waste	Adjacent to the Watershed
ERNS (ER)	Leagnear and Sons Trucking	Hazardous Waste	Adjacent to the Watershed
LUST(S)	Emigrant Landing	Hydrocarbons	In the Watershed
HWIS (HW)	US Dept of Agriculture	Hazardous Waste	Adjacent to the Watershed
UST (UT)	2 Underground Storage Tanks	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
Mines and Geology	Summerville Mine	Potential Mine Runoff	In the Watershed
Mines and Geology	Desert View Deposit	Potential Mine Runoff	In the Watershed
Mines and Geology	Unnamed Prospect	Potential Mine Runoff	In the Watershed
Mines and Geology	Trail Canyon Deposit	Potential Mine Runoff	In the Watershed
Mines and Geology	Gold Hill Prospects	Potential Mine Runoff	In the Watershed
Mines and Geology	Red Rock Claims Deposit	Potential Mine Runoff	In the Watershed
Mines and Geology	Bear Number One	Potential Mine Runoff	In the Watershed
Mines and Geology	Castaic Mine	Potential Mine Runoff	In the Watershed
Mines and Geology	Unnamed Deposit	Potential Mine Runoff	In the Watershed
Mines and Geology	Golden Bloom Group of Claims	Potential Mine Runoff	In the Watershed
Mines and Geology	Unnamed Prospect	Potential Mine Runoff	In the Watershed
Mines and Geology	Alamo Mountain Mica Mine	Potential Mine Runoff	In the Watershed

Summary of Environmental Data Base Records Search Results - Quail Lake

Environmental Databases	Site Name	Contaminant Source	
CERCLIS	Systech Los Robles Resource Ct	Hazardous Waste	Adjacent to the Watershed
CERCLIS	National Cement Co Los Robles	Hazardous Waste	Adjacent to the Watershed
ERNS (ER)	Peace Valley Road/Gorman Road	Hazardous Waste	Adjacent to the Watershed
ERNS (ER)	Systech Corporation	Hazardous Waste	Adjacent to the Watershed
LUST(S)	Los Robles Cement Plant	Potentially Petroleum Hydrocarbons	Adjacent to the Watershed
LUST(S)	National Cement Company	Potentially Petroleum Hydrocarbons	Adjacent to the Watershed
RCRA (G)	Systech Los Robles Resource Ct	Hazardous Waste	Adjacent to the Watershed
RCRA (G)	National Cement Co Los Robles	Hazardous Waste	Adjacent to the Watershed
PB, AFS	Systech Los Robles Resource Ct	Hazardous Waste	Adjacent to the Watershed
AFS, FIFRA	National Cement Co Los Robles	Pesticide Waste	Adjacent to the Watershed
HWIS	Systech Environmental Corp	Hazardous Waste	Adjacent to the Watershed
HWIS	National Cement Co	Hazardous Waste	Adjacent to the Watershed
HWIS	Walter Grover	Hazardous Waste	Adjacent to the Watershed
UST	4 Underground Storage Tanks	Potentially Petroleum Hydrocarbons	Adjacent to the Watershed

Summary of Lists Searched - Castaic Lake

Environmental Databases	Site Name	Contaminant Source	
ERNS (ER)	Mobil Oil	Hazardous Waste	Adjacent to the Watershed
Mines & Geology	Silver Mountain Deposit	Potential Mine Waste	In the Watershed
Mines & Geology	Great West Deposit	Potential Mine Waste	In the Watershed
Oil & Gas	24 Oil and Gas Wells	Abandoned	In the Watershed
RCRA (RN)	DWR Lake Hughes Road	Hazardous Waste	In the Watershed
HWIS (HW)	DWR Lake Hughes Road	Hazardous Waste	In the Watershed
HWIS (HW)	Mike Malow North Oldridge Road	Hazardous Waste	In the Watershed
HWIS (HW)	LA Water and Power/Castaic PP	Hazardous Waste	Adjacent to the Watershed
UST	Shell CA Products	Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Foothill Feeder Control Sturcture	Petroleum Hydrocarbons	In the Watershed
UST	CA Depart. of Water Resources	Petroleum Hydrocarbons	In the Watershed
UST	Federal Aviation Administration	Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Castaic Clay MFG Company	Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Castaic Lake	Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Upper Castaic Boat Rentals	Petroleum Hydrocarbons	Adjacent to the Watershed
UST	USDA Forest Service	Petroleum Hydrocarbons	Adjacent to the Watershed

Summary of Environmental Data Base Records Search Results - Silverwood Lake

Environmental Databases	Site Name	Contaminant Source	
ERNS (ER)	Devil's Canyon Road Top in Foothills	Hazardous Waste	Adjacent to the Watershed
ERNS (ER)	Marina at Silverwood Lake	Hazardous Waste	In the Watershed
ERNS (ER)	Parks and Recreation	Hazardous Waste	In the Watershed
LUST(S)	Cedar Dam Maintenance Station	Potentially Petroleum Hydrocarbons	In the Watershed
LUST(S)	Cedar Dam Maintenance Station	Potentially Petroleum Hydrocarbons	In the Watershed
RCRA (G)	Silverwood Lake SRA	Hazardous Waste	In the Watershed
RCRA (G)	Silverwood Ventures INC	Hazardous Waste	Adjacent to the Watershed
RCRA (G)	TJ Edwards	Hazardous Waste	Adjacent to the Watershed
FINDS	Crestline DRMO	Hazardous Waste	Adjacent to the Watershed
UST	19 Underground Storage Tanks	Potentially Petroleum Hydrocarbons	Adjacent to the Watershed

Summary of Lists Searched - Perris Reservoir

Environmental Databases	Site Name	Contaminant Source	
NFRAP	Techalloy Western INC	Hazardous Waste	Adjacent to the Watershed
ERNS (ER)	DWR Perris Intake Tower	Hazardous Waste	In the Watershed
ERNS (ER)	Rider Ave adn Ramona EXP	Hazardous Waste	Adjacent to the Watershed
ERNS (ER)	Rider Ave adn Ramona EXP	Hazardous Waste	Adjacent to the Watershed
RCRA (G)	Techallow Western INC	Hazardous Waste Generator	Adjacent to the Watershed
LUST	E.M.W.D.	Potential Petroleum Hydrocarbon	Adjacent to the Watershed
LUST	Lake Perris Marina	Potential Petroleum Hydrocarbon	In the Watershed
SWAT (R)	Sere Camp	Solid Waste	Adjacent to the Watershed
RCRA (G)	Techalloy Western INC	Hazardous Waste Generator	Adjacent to the Watershed
RCRA (G)	Lake Perris SRA	Hazardous Waste Generator	Adjacent to the Watershed
RCRA (G)	Los Lagos Dist./Lake Perris SRA	Hazardous Waste Generator	Adjacent to the Watershed
FIFRA	Val Verde ESD	Pesticide Waste	Adjacent to the Watershed
HWIS	Department of Water Resources	Hazardous Waste	Adjacent to the Watershed
HWIS	Los Lagos Dist/Lake Perris SRA	Hazardous Waste	Adjacent to the Watershed
HWIS	Sultana Development Corp	Hazardous Waste	Adjacent to the Watershed
HWIS	Perris Power Plant	Hazardous Waste	Adjacent to the Watershed
HWIS	Camper Resorts of America	Hazardous Waste	Adjacent to the Watershed
UST	18 Underground Storage Tanks	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Riverside Co Gravel Pit	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Bernasconi Quarry	Potential Petroleum Hydrocarbons	Adjacent to the Watershed
UST	Smith Sand Pit	Potential Petroleum Hydrocarbons	Adjacent to the Watershed

Appendix H

Checklists

BARKER SLOUGH WATERSHED

	Significant	Not Significant	Unknown	Comments
I. General Conditions				
Changes in available water quality			✘	This topic is being covered by a questionnaire. Users of raw water from the State Water Project are receiving the questionnaire and results will be documented for the Sanitary Survey.
Construction of water diversion reservoir projects			✘	Currently determining if any construction has occurred in this area of the State Water Project.
Relocation of intakes		✘		Relocation of intakes has not occurred.
II. Contaminant Sources				
Wastewater treatment			✘	The Easterly Wastewater Treatment Plant Discharges approximately 6.2 million gallons/day (mgd) average dry weather flow to Alamo Creek. Alamo Creek drains into Cache Slough. This effluent is approximately 15 river miles from the Barker Slough intake for the North Bay Aqueduct.
Treatment plant effluent discharges			✘	As mentioned the Easterly Wastewater Treatment Plant for the city of Vacaville is the nearest treatment plant with effluent being discharged to Alamo Creek.
Storage, transport, treatment, disposal to land			✘	The exact location of land application of sludge is not known at this time. Easterly Waste water Treatment Plant will be consulted to determine the location of such activities.
Residential Septic systems			✘	Solano County Health Department is being consulted to determine the location of septic systems in the watershed of Barker Slough.
Commercial /industrial septic systems			✘	Solano County Health Department is being consulted to determine the location of septic systems in the watershed of Barker Slough.
Reclaimed Water			✘	This topic is currently under research.
Urban Areas		✘		The watershed for Barker Slough does not contain any urban areas.
Agricultural Crop Land Use			✘	Alfalfa, barley, and corn were the major crops identified in our spring 1995 survey.
Pesticide/Herbicide Use			✘	The University of California at Davis maintains a data base with information on pesticide/herbicide use. This data base showed 1300-6500 lb./sq. mile of pesticide use in an eastern portion of the Barker Slough watershed and with the majority of the watershed showing less than 1300 lb./sq. mile between 1982 and 1991. The significance and link to water quality needs to be established for the watershed.
Grazing Animals			✘	Approximately 80% of the watershed land use activities are cattle and sheep grazing. All pathogen data for the area needs to be reviewed to determine if any impacts to water quality can be termed "significant." It is anticipated that this land use is impacting water quality.
Concentrated Animal Facilities (i.e. Feedlots)		✘		This type of facility is not known to exist in the watershed. Cattle and sheep grazing is limited to pasture type grazing.
Wild Animal Populations		✘		The Jepson Prairie Reserve (3/4 miles to the west) is in the watershed of Barker Slough. The reserve is suitable habitat for resident and migratory water birds. These birds do not appear to pose a threat to water quality.

	Significant	Not Significant	Unknown	Comments
Mines			✘	The Division of Mines and Geology is being consulted for this information.
Inactive			✘	The Division of Mines and Geology is being consulted for this information.
Active			✘	The Division of Mines and Geology is being consulted for this information.
Disposal Facilities			✘	Records searches will be conducted to determine the existence of hazardous waste sites, landfills and spills in the watershed.
Solid Waste			✘	
Hazardous waste			✘	The B&J landfill exists to the north and west of the Barker Slough pumphouse. The landfill may not be in the Barker Slough watershed and has not been identified as a threat to surface water quality in the watershed. Determining its existence in the watershed is currently under investigation as well as potential impacts to surface water quality.
Logging		✘		Records searches will be conducted to determine the existence of hazardous waste sites, landfills and spills in the watershed.
Recreation			✘	Logging is not a land use activity in the watershed.
Reservoir body contact			✘	The Argyle Park site, located 1.7 miles west of the NBA pump house, is the only known site where recreation activities occur at in the watershed. Impacts to the environment are outlined in an Environmental Impact Report (EIR). DWR has submitted comments to the developer of the project. The comments are documented in the final EIR dated April 1995. The project is known as Campbell Ranch. A review of this project and its potential as a "significant impact" to the NBA will be documented in the Sanitary Survey.
Reservoir non-body contact			✘	Incidental body contact may occur at Argyle Park, 1.7 miles from the North Bay Aqueduct (NBA) intake. This activity is being assessed for its potential to impact water quality in Barker Slough.
Watershed Activities			✘	Non-body contact exists at Argyle Park 1.7 miles from the NBA intake. This activity is being assessed for its potential to impact water quality in Barker Slough.
Unauthorized Activity			✘	Activities at Argyle Park are the only known and observable in the watershed which pose a threat to surface water quality.
Illegal Dumping			✘	Records searches will uncover this type of activity if it exists in the watershed.
Underground storage tank leaks			✘	Records searches will uncover this type of activity if it exists in the watershed.
Other			✘	Records searches will uncover this type of activity if it exists in the watershed.
Traffic Accidents/Spills			✘	Records searches will uncover this type of activity if it exists in the watershed.
				Records searches will uncover this type of activity if it exists in the watershed.

	Significant	Not Significant	Unknown	Comments
Transportation Corridors			✘	Road 113 bisects the slough just west of the North Bay Aqueduct intake(.25 miles) and the Sacramento Northern Railroad exists approximately 1.5 miles to the west.
History of accidents/spills			✘	Records searches of reported toxic releases will be conducted to determine if any spills associated with railroad traffic and other transit activities have occurred in the watershed.
Groundwater Discharges			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.
Natural Discharge			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.
Gas, oil, geothermal wells			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.
Seawater intrusion			✘	Historical water quality data is being reviewed to determine if seawater has reached this part of the slough.
Geologic Hazards			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.
Landslides		✘		Not significant.
Earthquakes	✘			Earthquakes occur in this region of California.
Floods			✘	Flood maps are being consulted to determine the extent and type of flooding that occurs in the watershed.
Fires			✘	Approximately 80% of the watershed land use activities are cattle and sheep grazing on grasslands. These lands could experience natural and management induced burning. It has not been determined what impacts runoff from burning will have on water quality. Rice field burning data will be consulted to help determine impacts.

III. Growth

	Significant	Not Significant	Unknown	Comments
Population/General Urban Area Increase			✘	The Solano County Planning Office is being consulted for this information.
Land use changes			✘	The Solano County Planning Office is being consulted for this information.
Industrial use increases			✘	The Solano County Planning Office is being consulted for this information.

IV. Water Quality

	Significant	Not Significant	Unknown	Comments
Changes in raw water quality			✘	This topic is being covered by a questionnaire. Users of raw water from the State Water Project are receiving the questionnaire and the results will be documented for the Sanitary Survey.
Difficulty meeting drinking water standards			✘	This topic is being covered by a questionnaire. Users of raw water from the State Water Project are receiving the questionnaire and the results will be documented for the Sanitary Survey.

LAKE PERRIS WATERSHED

	Significant	Not Significant	Unknown	Comments
I. General Conditions				
Changes is available water quality?			✘	This topic is being covered by a questionnaire. Users of raw water from the State Water Project are receiving the questionnaire and results will be documented for the Sanitary Survey.
Construction of water diversion or reservoir projects			✘	Currently determining if any construction has occurred in this area of the State Water Project.
Relocation of intakes		✘		Relocation of intakes has not occurred.
II. Contaminant Sources				
Wastewater Treatment			✘	Waste water discharges are not permitted to the lake.
Treatment plant effluent discharges		✘		Not significant.
Storage, transport, treatment, disposal to land			✘	Currently under investigation to determine the existence of such activities.
Residential Septic systems			✘	Currently under investigation to determine the existence of septic systems in streams discharging to the lake.
Commercial /industrial septic systems			✘	Currently under investigation to determine the existence of septic systems in streams discharging to the lake.
Reclaimed Water			✘	Currently under investigation to determine the existence of reclamation projects associated with the lake.
Urban Areas		✘		There are no urban areas in the watershed.
Agricultural Crop Land Use		✘		Not significant.
Pesticide/Herbicide Use			✘	It is not known if herbicides are used as weed control around the lake.
Grazing Animals		✘		Not significant.
Concentrated Animal Facilities (i.e. Feedlots)		✘		This type of animal facility is not present in the watershed.
Wild Animal Populations		✘		Not significant.
Mines			✘	Division of Mines and Geology data base will be consulted for this information.
Inactive			✘	Division of Mines and Geology data base will be consulted for this information.
Active			✘	Division of Mines and Geology data base will be consulted for this information.
Disposal Facilities			✘	Records searches will uncover this type of activity if it exists in the watershed.
Solid Waste			✘	Records searches will uncover this type of activity if it exists in the watershed.
Hazardous waste			✘	Records searches will uncover this type of activity if it exists in the watershed.
Logging		✘		Logging is not a land use activity being conducted in the watershed.
Recreation			✘	Lake Perris was completed in 1974 and is a multipurpose facility. The lake provides terminal storage for water deliveries from the State Water Project as well as recreational opportunities and incidental flood protection.

	Significant	Not Significant	Unknown	Comments
Reservoir body contact			✘	Swimming has been identified as an impact to water quality. Sampling results as well as an update since the last Sanitary Survey in 1990 will be documented in the update to the initial survey.
Reservoir non-body contact			✘	The recreation area of the lake is operated by the California Department of Parks and Recreation. The area offers camping, picnicking, horseback riding, hiking, boating and fishing.
Watershed Activities			✘	To be determined.
Unauthorized Activity			✘	Records searches will uncover this type of activity if it exists in the watershed.
Illegal Dumping			✘	Records searches will uncover this type of activity if it exists in the watershed.
Underground storage tank leaks			✘	Records searches will uncover this type of activity if it exists in the watershed.
Other			✘	Records searches will uncover this type of activity if it exists in the watershed.
Traffic Accidents/Spills			✘	Records searches will uncover this type of activity if it exists in the watershed.
Transportation Corridors			✘	Lake Perris Drive and Bernasconi Road are the only major roads into the watershed.
Groundwater Discharges			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.
Natural Discharge			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.
Gas, oil, geothermal wells			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.
Seawater intrusion		✘		Not significant.
Geologic Hazards			✘	The Division of Mines and Geology is being consulted for this information.
Landslides		✘		Landslides could occur on the southeast shore in the Bernasconi Hill region, however, are not viewed as significant.
Earthquakes	✘			Earthquakes occur in this region of California.
Floods			✘	Flood maps are being consulted to determine the extent and type of flooding that occurs in the watershed.
Fires			✘	Vegetation in the watershed is chaparral type and is prone to natural fires. It has not been determined what impacts fire has on water quality.

III. Growth

	Significant	Not Significant	Unknown	Comments
Population/General Urban Area Increase		✘		Not significant.
Land Use Changes		✘		Not significant.
Industrial Use Increase		✘		Not significant.

	Significant	Not Significant	Unknown	Comments
IV. Water Quality				
Changes in Raw Water Quality			✘	This topic is being covered by a questionnaire. Users of raw water from the State Water Project are receiving the questionnaire and results will be documented for the Sanitary Survey.
Difficulty in Meeting Drinking Water Standards			✘	This topic is being covered by a questionnaire. Users of raw water from the State Water Project are receiving the questionnaire and results will be documented for the Sanitary Survey.

SILVERWOOD LAKE WATERSHED

	Significant	Not Significant	Unknown	Comments
I. General Conditions				
Changes in available water quality			✘	This topic is being covered by a questionnaire. Users of raw water from the State Water Project are receiving the questionnaire and results will be documented for the Sanitary Survey.
Construction of water diversion or reservoir projects			✘	Currently determining if any construction has occurred in this area of the State Water Project.
Relocation of intakes		✘		Relocation of intakes has not occurred.
II. Contaminant Sources				
Wastewater Treatment			✘	Several small resorts and rural areas exist on ephemeral streams that discharge to Silverwood Lake. These streams are currently under investigation to determine their proximity to septic systems. Waste water treatment discharges are not permitted to the lake.
Treatment plant effluent discharges		✘		Not significant.
Storage, transport, treatment, disposal to land			✘	Currently under investigation to determine the existence of such activities.
Residential Septic systems			✘	Currently under investigation to determine the existence of septic systems discharging to the lake.
Commercial /industrial septic systems			✘	Currently under investigation to determine the existence of septic systems discharging to the lake.
Reclaimed Water			✘	Currently under investigation to determine the existence of reclamation projects associated with the lake.
Urban Areas			✘	Several small rural areas exist. These are the only type of residential areas in the watershed of the lake. The population change from 1990 to 1995 will be documented for the Crestline area south of the lake. There are no urban areas in the watershed of the lake.
Agricultural Crop Land Use		✘		Not significant.
Pesticide/Herbicide Use			✘	It is not known if herbicides are used as weed control around the lake.
Grazing Animals			✘	Cattle grazing exists in the watershed. Grazing occurs in several allotment area in cooperation with the Forest Service. There are several privately owned allotments in the watershed and the number of cattle grazing in this area is currently being determined.
Concentrated Animal Facilities (i.e. Feedlots)		✘		This type of animal facility is not present in the watershed.
Wild Animal Populations		✘		Not significant.
Mines			✘	Division of Mines and Geology data base will be consulted for this information.
Inactive			✘	Division of Mines and Geology data base will be consulted for this information.
Active			✘	Division of Mines and Geology data base will be consulted for this information.
Disposal Facilities			✘	Records searches will uncover this type of activity if it exists in the watershed.

	Significant	Not Significant	Unknown	Comments
Solid Waste			✘	Records searches will uncover this type of activity if it exists in the watershed.
Hazardous waste			✘	Records searches will uncover this type of activity if it exists in the watershed.
Logging		✘		Logging is not a land use activity presently occurring in the watershed.
Recreation			✘	Silverwood Lake and Cedar Springs Dam are within the San Bernadino National Forest. Silverwood lake was completed in 1971 and is a multipurpose facility. The lake provides regulatory storage for water deliveries from the State Water Project as well as recreational opportunities and incidental flood protection.
Reservoir body contact			✘	Silverwood Lake offers swimming, boating, and water-skiing.
Reservoir non-body contact			✘	The recreation area of the lake is operated by the California Department of Parks and Recreation. The area offers camping, picnicking, hiking, boating and fishing.
Watershed Activities			✘	To be determined.
Unauthorized Activity			✘	Records searches will uncover this type of activity if it exists in the watershed.
Illegal Dumping			✘	Records searches will uncover this type of activity if it exists in the watershed.
Underground storage tank leaks			✘	Records searches will uncover this type of activity if it exists in the watershed.
Other			✘	Records searches will uncover this type of activity if it exists in the watershed.
Traffic Accidents/Spills			✘	Records searches will uncover this type of activity if it exists in the watershed.
Transportation Corridors			✘	Highway 138 is the main road into the watershed. Cleghorn Canyon Road follows the west arm of the lake and winds into the west fork of the Mojave River as a dirt road. Several other smaller roads exist through out the watershed. These roads are used for travel into US Forest Service lands. These roads are associated with cattle operations, recreation, and maintenance, and private land holdings in the watershed. The only Road used as a corridor for transport of hazardous materials into the watershed is Highway 138.
History of accidents/spills			✘	Record searches will uncover this type of activity if it exists in the watershed.
Groundwater Discharges			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.
Natural Discharge			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.
Gas, oil, geothermal wells			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.
Seawater intrusion		✘		Not Significant.

	Significant	Not Significant	Unknown	Comments
Geologic Hazards			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.
Landslides			✘	Silverwood Lake has the surrounding topography for landslides to occur. Their frequency and occurrence have not been determined.
Earthquakes			✘	Earthquakes occur in this region of California.
Floods			✘	Flood maps are being consulted to determine the extent and type of flooding that occurs in the watershed.
Fires			✘	The vegetation in the watershed is chaparral type and is prone to natural fires. It has not been determined what impacts runoff from burning will have on water quality.
III. Growth				
Population/General Urban Area Increase			✘	San Bernadino County Planning Office is being consulted for this information.
Land Use Changes			✘	San Bernadino County Planning Office is being consulted for this information.
Industrial Use Increase			✘	San Bernadino County Planning Office is being consulted for this information.
IV. Water Quality				
Changes in Raw Water Quality			✘	The topic is being covered by a questionnaire. Users of raw water from the State Water Project are receiving the questionnaire and results will be documented for the Sanitary Survey.
Difficulty in Meeting Drinking Water Standards			✘	The topic is being covered by a questionnaire. Users of raw water from the State Water Project are receiving the questionnaire and results will be documented for the Sanitary Survey.

LAKE CASTAIC WATERSHED

	Significant	Not Significant	Unknown	Comments
I. General Conditions				
Changes in available water quality			✘	This topic is being covered by a questionnaire. Users of raw water from the State Water Project are receiving the questionnaire and results will be documented for the Sanitary Survey.
Construction of water diversion or reservoir projects			✘	Currently determining if any construction has occurred in this area of the State Water Project.
Relocation of intakes		✘		Relocation of intakes has not occurred.
II. Contaminant Sources				
Wastewater treatment		✘		Waste water treatment discharges to the lake are not permitted.
Treatment plant effluent discharges		✘		Not significant
Storage, transport, treatment, disposal to land			✘	Currently under investigation to determine the existence of such activities.
Residential Septic systems			✘	Currently under investigation to determine the existence of septic systems in streams discharging to the lake.
Commercial /industrial septic systems.			✘	Currently under investigation to determine the existence of septic systems in streams discharging to the lake.
Reclaimed Water			✘	Currently under investigation to determine the existence of reclamation projects associated with the lake.
Urban Areas		✘		There are no urban areas in the watershed.
Agricultural Crop Land Use		✘		Not significant.
Pesticide/Herbicide Use			✘	It is not known if herbicides are used as weed control around the lake.
Grazing Animals		✘		Not Significant.
Concentrated Animal Facilities (i.e. Feedlots)		✘		This type of animal facility is not present in the watershed.
Wild Animal Populations		✘		Wild animal populations do not pose a threat to water quality in the lake.
Mines			✘	Division of Mines and Geology data base will be consulted for this information.
Inactive			✘	Division of Mines and Geology data base will be consulted for this information.
Active			✘	Division of Mines and Geology data base will be consulted for this information.
Disposal Facilities			✘	Records searches will uncover this type of activity if it exists in the watershed.
Solid Waste			✘	Records searches will uncover this type of activity if it exists in the watershed.
Hazardous waste			✘	Records searches will uncover this type of activity if it exists in the watershed.
Logging		✘		Logging is not a land use activity being conducted in the watershed.

	Significant	Not Significant	Unknown	Comments
Recreation			✘	Lake Castaic was completed in 1974 and is a multipurpose facility. The lake provides terminal storage for water deliveries from the State Water Project as well as recreational opportunities and incidental flood protection.
Reservoir body contact			✘	Lake Castaic offers swimming, boating, and water-skiing.
Reservoir non-body contact			✘	The recreation area of the lake is operated by the California Department of Parks and Recreation. The area offers camping, picnicking, horseback riding, hiking, boating and fishing.
Watershed Activities			✘	To be determined.
Unauthorized Activity			✘	Records searches will uncover this type of activity if it exists in the watershed.
Illegal Dumping			✘	Records searches will uncover this type of activity if it exists in the watershed.
Underground storage tank leaks			✘	Records searches will uncover this type of activity if it exists in the watershed.
Other			✘	Records searches will uncover this type of activity if it exists in the watershed.
Traffic Accidents/Spills			✘	Records searches will uncover this type of activity if it exists in the watershed
Transportation Corridors			✘	Lake Hughes Road follows the eastern arm of the lake. The Templin Hwy. enters the watershed on the northwestern arm of the lake. Ridge Route follows the western arm as well. Numerous storm drains exist on these roads. Their locations are currently being determined
Groundwater Discharges			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.
Natural Discharge			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.
Gas, Oil, geothermal wells			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.
Seawater intrusion		✘		Not significant.
Geologic Hazards			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.
Landslides			✘	Castaic Lake has the surrounding topography for landslides to occur. Their frequency and occurrence have not been determined.
Earthquakes	✘			Earthquakes occur in this region of California.
Floods			✘	Flood maps are being consulted to determine the extent and type of flooding that occurs in the watershed.
Other				
Fires			✘	The vegetation in the watershed is chaparral type and is prone to natural fires. It has not been determined what impacts runoff from burning will have on water quality.

	Significant	Not Significant	Unknown	Comments
III. Growth				
Population/General Urban Area Increase			✘	Los Angeles County Planning Office is being consulted for this information.
Land use changes			✘	Los Angeles County Planning Office is being consulted for this information.
Industrial Use Increase			✘	Los Angeles County Planning Office is being consulted for this information.
IV. Water Quality				
Changes in Raw Water Quality			✘	This topic is being covered by a questionnaire. Users of raw water from the State Water Project are receiving the questionnaire and results will be documented for the Sanitary Survey.
Difficulty meeting drinking water standards			✘	This topic is being covered by a questionnaire. Users of raw water from the State Water Project are receiving the questionnaire and results will be documented for the Sanitary Survey.

QUAIL LAKE WATERSHED

	Significant	Not Significant	Unknown	Comments
I. General Conditions				
Changes in available water quality			✘	This topic is being covered by a questionnaire. Users of raw water from the State Water Project are receiving the questionnaire and results will be documented for the Sanitary Survey.
Construction of water diversion or reservoir projects			✘	Currently determining if any construction has occurred in this area of the State Water Project.
Relocation of intakes		✘		Relocation of intakes has not occurred.
II. Contaminant Sources				
Wastewater treatment			✘	Waste water discharges are not permitted to the lake.
Treatment plant effluent discharges			✘	Several small resorts and rural areas exist in the lakes's watershed. These are currently under investigation to determine the existence of septic systems and waste water treatment plants.
Storage, transport, treatment, disposal to land			✘	These are currently under investigation to determine the existence of septic systems and waste water treatment plants.
Residential Septic systems			✘	These are currently under investigation to determine the existence of septic systems and waste water treatment plants.
Commercial /industrial septic systems			✘	These are currently under investigation to determine the existence of septic systems and waste water treatment plants.
Reclaimed Water			✘	This activity is currently under investigation.
Urban Areas		✘		There are no urban areas in the watershed of the lake.
Agricultural Crop Land Use		✘		This type of land use does not exist in the watershed.
Pesticide/Herbicide Use		✘		Not significant.
Grazing Animals			✘	Cattle grazing exits in the watershed. The number of cattle grazing in this area is currently being determined.
Concentrated Animal Facilities (i.e. Feedlots)		✘		This type of animal facility is not present in the watershed.
Wild Animal Populations			✘	Wild animal populations do not pose a threat to water quality in the reservoir.
Mines			✘	Division of Mines and Geology data base will be consulted for this information.
Inactive			✘	Division of Mines and Geology data base will be consulted for this information.
Active			✘	Division of Mines and Geology data base will be consulted for this information.
Disposal Facilities			✘	Records searches will uncover this type of activity if it exists in the watershed.
Solid Waste			✘	Records searches will uncover this type of activity if it exists in the watershed.
Hazardous waste			✘	Records searches will uncover this type of activity if it exists in the watershed.

	Significant	Not Significant	Unknown	Comments
Logging		✘		Logging is not a land use activity currently being conducted in the watershed.
Recreation			✘	Fishing is the only recreational activity at the lake.
Reservoir body contact		✘		None.
Reservoir non-body contact		✘		Fishing is the only recreational activity at the lake.
Watershed Activities			✘	Cattle grazing and fishing are the only activities which are known to occur. It is suspected that hazardous material transport may occur on State Highway 138. However, that has not been determined. Records searches will uncover this type of activity if it exists in the watershed.
Unauthorized Activity			✘	Records searches will uncover this type of activity if it exists in the watershed.
Illegal Dumping			✘	Records searches will uncover this type of activity if it exists in the watershed.
Underground storage tank leaks			✘	Records searches will uncover this type of activity if it exists in the watershed.
Other			✘	Records searches will uncover this type of activity if it exists in the watershed.
Traffic Accidents/Spills			✘	Records searches will uncover this type of activity if it exists in the watershed.
Transportation Corridors			✘	State Highway 138 is the only major road into the watershed. There are several paved roads and dirt roads for secondary traffic in the area. These roads are associated with local activities which include livestock grazing.
Groundwater Discharges			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.
Natural Discharge			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.
Gas, oil, geothermal wells			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.
Seawater intrusion		✘		Not significant.
Geologic Hazards			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.
Landslides			✘	Quail Lake has the surrounding topography for landslides to occur. Their frequency and occurrence have not been determined.
Earthquakes	✘			Earthquakes occur in this region of California.
Floods			✘	Flood maps are being consulted to determine the extent and type of flooding that occurs in the watershed.
Fires			✘	The vegetation in the watershed is desert grassland type and is prone to natural fires. It has not been determined what impacts runoff from burning will have on water quality.

	Significant	Not Significant	Unknown	Comments
III. Growth				
Population/General Urban Area Increase			✘	Los Angeles County Planning Office is being consulted for this information.
Land Use Changes			✘	Los Angeles County Planning Office is being consulted for this information.
Industrial Use Increase			✘	Los Angeles County Planning Office is being consulted for this information.
IV. Water Quality				
Changes in Raw Water Quality			✘	This topic is being covered by a questionnaire. Users of raw water from the State Water Project are receiving the questionnaire and results will be documented for the Sanitary Survey.
Difficulty in Meeting Drinking Water Standards			✘	This topic is being covered by a questionnaire. Users of raw water from the State Water Project are receiving the questionnaire and results will be documented for the Sanitary Survey.

PYRAMID LAKE WATERSHED

	Significant	Not Significant	Unknown	Comments
I. General Conditions				
Changes in available water quality				This topic is being covered by a questionnaire. Users of raw water from the State Water Project are receiving the questionnaire and results will be documented for the Sanitary Survey.
Construction of water diversion or reservoir projects			✘	Currently determining if any construction has occurred in this area of the State Water Project.
Relocation of intakes		✘		Relocation of intakes has not occurred.
II. Contaminant Sources				
Waste water treatment			✘	Waste water discharges are not permitted to the lake.
Treatment plant effluent discharges			✘	Several small resorts and rural areas exist in the Piru Creek and Gorman Creek area. These are currently under investigation to determine the existence of septic systems and waste water treatment plants.
Storage, transport, treatment, disposal to land			✘	Several small resorts and rural areas exist in the Piru Creek and Gorman Creek area. These are currently under investigation to determine the existence of septic systems and waste water treatment plants.
Residential Septic systems			✘	Several small resorts and rural areas exist in the Piru Creek and Gorman Creek area. These are currently under investigation to determine the existence of septic systems and waste water treatment plants.
Commercial /industrial septic systems			✘	Several small resorts and rural areas exist in the Piru Creek and Gorman Creek area. These are currently under investigation to determine the existence of septic systems and waste water treatment plants.
Reclaimed Water			✘	Currently under investigation.
Urban Areas		✘		Several small resorts and rural areas exist in the Piru Creek and Gorman Creek area. These are the only residential type areas in the watershed of the lake.
Agricultural Crop Land Use		✘		This type of land use does not exist in the watershed.
Pesticide/Herbicide Use		✘		Not significant.
Grazing Animals			✘	Cattle grazing exists in the Piru Creek watershed, the number of cattle grazing in this area is currently being determined.
Concentrated Animal Facilities (i.e. Feedlots)			✘	This type of animal facility is not present in the watershed.
Wild Animal Populations			✘	Wild Animal populations do not pose a threat to water quality in the reservoir.
Mines			✘	Division of Mines and Geology data base will be consulted for this information.
Inactive			✘	Division of Mines and Geology data base will be consulted for this information.
Active			✘	Division of Mines and Geology data base will be consulted for this information.
Disposal Facilities			✘	Records searches will uncover this type of activity if it exists in the watershed.
Solid Waste			✘	Records searches will uncover this type of activity if it exists in the watershed.

	Significant	Not Significant	Unknown	Comments
Hazardous waste			✘	Records searches will uncover this type of activity if it exists in the watershed.
Logging			✘	Logging is not a land use activity being conducted in the watershed.
Recreation			✘	Pyramid Lake and Dam are within the Angels and Los Padres National Forests. Pyramid Lake was completed in 1973 and is a multipurpose facility. The lake and William E. Warne Power Plant provide regulatory storage for water deliveries from the west branch of the Aqueduct as well as recreational opportunities and incidental flood protection.
Reservoir body contact			✘	Pyramid Lake offers swimming, boating, and water-skiing.
Reservoir non-body contact			✘	The recreation area of the lake is operated by the U. S. Forest Service. The area offers camping, picnicking, horseback riding, hiking, boating and fishing.
Watershed Activities			✘	To be determined.
Unauthorized Activity			✘	Records searches will uncover this type of activity if it exists in the watershed.
Illegal Dumping			✘	Records searches will uncover this type of activity if it exists in the watershed.
Underground storage tank leaks			✘	Records searches will uncover this type of activity if it exists in the watershed.
Other			✘	Records searches will uncover this type of activity if it exists in the watershed.
Traffic Accidents/Spills			✘	Records searches will uncover this type of activity if it exists in the watershed.
Transportation Corridors			✘	Interstate 5 is the main road into the watershed. Lockwood Valley Road enters the watershed approximately 15 miles to the north west of the Pyramid Lake. Several other smaller roads exist through out the watershed. These roads are used for travel into Hungry Valley Vehicular Recreation Area (north of the lake) and US Forest Service roads (west of the lake). These roads are associated with cattle operations, recreation, and maintenance on private lands in the watershed. The only road used as a corridor for transport of hazardous materials into the watershed is Interstate 5.
Groundwater Discharges			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.
Natural Discharge			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.
Gas, oil, geothermal wells			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.
Seawater intrusion		✘		Not significant.
Geologic Hazards			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.

	Significant	Not Significant	Unknown	Comments
Landslides			✘	Pyramid Lake has the surrounding topography for landslides to occur. Their frequency and occurrence have not been determined.
Earthquakes			✘	Earthquakes occur in this region of California.
Floods			✘	Flood maps are being consulted to determine the extent and type of flooding that occurs in the watershed.
Fires			✘	The vegetation in the watershed is chaparral type and is prone to natural fires. It has not been determined what impacts runoff from burning will have on water quality.
III. Growth				
Population/General Urban Area Increase			✘	Los Angeles County Planning Office is being consulted for this information.
Land Use Changes			✘	Los Angeles County Planning Office is being consulted for this information.
Industrial Use Increase			✘	Los Angeles County Planning Office is being consulted for this information.
IV. Water Quality				
Changes in Raw Water Quality			✘	This topic is being covered by a questionnaire. Users of raw water from the State Water Project are receiving the questionnaire and results will be documented for the Sanitary Survey.
Difficulty in Meeting Drinking Water Standards			✘	This topic is being covered by a questionnaire. Users of raw water from the State Water Project are receiving the questionnaire and results will be documented for the Sanitary Survey.

COASTAL BRANCH AQUEDUCT (Open Portion)

	Significant	Not Significant	Unknown	Comments
I. General Conditions				
Changes is available water quality			✘	This topic is being covered by a questionnaire. Users of raw water from the State Water Project are receiving the questionnaire and results will be documented for the Sanitary Survey.
Construction of water diversion or reservoir projects			✘	Construction is ongoing to extend the Coastal Branch south of its present location.
Relocation of intakes		✘		Not Significant.
II. Contaminant Sources				
Waste water treatment		✘		Not significant
Treatment plant effluent discharges		✘		Not Significant.
Storage, transport, treatment, disposal to land			✘	Under investigation.
Residential Septic systems			✘	Under investigation.
Commercial /industrial septic systems			✘	Under investigation.
Reclaimed Water			✘	Under investigation.
Urban Areas		✘		Not significant.
Agricultural Crop Land Use			✘	Alfalfa is the main crop grown in the vicinity of the aqueduct. Several other "truck crops" are grown in the same area along with cotton.
Pesticide/Herbicide Use			✘	Pesticides are used on the crops grown in the area. They are applied by use of a crop duster plane. Some residual spray may enter the aqueduct during application.
Grazing Animals			✘	Sheep and cattle grazing exists adjacent to the aqueduct. Impacts are unknown.
Concentrated Animal Facilities (i.e. Feedlots)		✘		Not significant.
Wild Animal Populations		✘		Not Significant.
Mines			✘	Division of Mines and Geology data base will be consulted for this information.
Inactive			✘	Division of Mines and Geology data base will be consulted for this information.
Active			✘	Division of Mines and Geology data base will be consulted for this information.
Disposal Facilities			✘	Records searches will be conducted to determine the existence of hazardous waste sites, landfills and spills in the watershed.
Solid Waste			✘	Records searches will be conducted to determine the existence of hazardous waste sites, landfills and spills in the watershed.
Hazardous waste			✘	Records searches will be conducted to determine the existence of hazardous waste sites, landfills and spills in the watershed.
Logging		✘		Not Significant.
Recreation		✘		Not Significant.
Reservoir body contact		✘		Not Significant.
Reservoir non-body contact		✘		Not Significant.
Watershed Activities			✘	Not Significant.

	Significant	Not Significant	Unknown	Comments
Unauthorized Activity			✘	Records searches will be conducted to determine the existence of hazardous waste sites, landfills and spills in the watershed.
Illegal Dumping			✘	Records searches will be conducted to determine the existence of hazardous waste sites, landfills and spills in the watershed.
Underground storage tank leaks			✘	Records searches will be conducted to determine the existence of hazardous waste sites, landfills and spills in the watershed.
Other			✘	Records searches will be conducted to determine the existence of hazardous waste sites, landfills and spills in the watershed.
Traffic Accidents/Spills			✘	Records searches will be conducted to determine the existence of hazardous waste sites, landfills and spills in the watershed.
Transportation Corridors			✘	Records searches will be conducted to determine the existence of hazardous waste sites, landfills and spills in the watershed.
Groundwater Discharges			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.
Natural Discharge			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.
Gas, oil, geothermal wells			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.
Seawater intrusion		✘		Not significant.
Geologic Hazards			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.
Landslides		✘		Not significant.
Earthquakes	✘			Earthquakes occur in this region of California.
Floods			✘	Flood maps are being consulted to determine the extent and type of flooding that occurs in the watershed.
Fires			✘	Approximately 80% of the surrounding land use activities are cattle and sheep grazing on grasslands. These lands could experience natural and management induced burning. It has not been determined what impacts runoff from burning will have on water quality. Rice field burning data will be consulted to determine impacts.

III. Growth

	Significant	Not Significant	Unknown	Comments
Population/General Urban Area Increase			✘	The Kings and Kern County Planning Offices will be consulted for this information.
Land Use Changes			✘	The Kings and Kern County Planning Offices will be consulted for this information.
Industrial Use Increase			✘	The Kings and Kern County Planning Offices will be consulted for this information.

IV. Water Quality	Significant	Not Significant	Unknown	Comments
Changes in Raw Water Quality			✘	This topic is being covered by a questionnaire. Users of raw water from the State Water Project are receiving the questionnaire and results will be documented for the Sanitary Survey.
Difficulty in Meeting Drinking Water Standards			✘	This topic is being covered by a questionnaire. Users of raw water from the State Water Project are receiving the questionnaire and results will be documented for the Sanitary Survey.

SAN LUIS RESERVOIR COMPLEX WATERSHED

	Significant	Not Significant	Unknown	Comments
I. General Conditions				
Changes in available water quality			✘	This topic is being covered by a questionnaire. Users of raw water from the State Water Project are receiving the questionnaire and results will be documented for the Sanitary Survey.
Construction of water diversion or reservoir projects	✘			Planning work for the Los Banos Grande Project has been completed and is currently on hold and is not in the same watershed as San Luis Reservoir.
Relocation of intakes	✘			Relocation of intakes has not occurred.
II. Contaminant Sources				
Wastewater treatment	✘			There are no waste water treatment plant effluent discharges in the watershed surrounding the reservoir
Treatment plant effluent discharges			✘	All waste water for the reservoir complex is treated through evaporation ponds and is not discharged to any water bodies. A treatment plant exists near the O'Neill Forebay.
Storage, transport, treatment, disposal to land			✘	There are no waste water discharges to any State Water Project water bodies.
Residential Septic systems			✘	Merced County Health Department is being consulted to determine the existence of septic systems in the watershed.
Commercial /industrial septic systems			✘	Merced County Health Department is being consulted to determine the existence of septic systems in the watershed.
Reclaimed Water			✘	Reclamation projects exist in the watershed and have not been identified at this time.
Urban Areas	✘			Santa Nella is the nearest urban area and does not discharge waste water to any State Water Project reservoirs or aqueduct structures.
Agricultural Crop Land Use			✘	An almond orchard exists on the north and east shore of the O'Neill Forebay.
Pesticide/Herbicide Use			✘	The University of California at Davis maintains a data base with information on pesticide/herbicide use. This data base will be queried to determine the use of pesticides and herbicides in the watershed.
Grazing Animals			✘	Land use activities in the watershed include cattle and sheep grazing. All pathogen data for the area needs to be reviewed to determine if any impacts to water quality can be termed "significant".
Concentrated Animal Facilities (i.e. Feedlots)	✘			This type of facility is not known to exist in the watershed. Cattle and sheep grazing is limited to pasture type grazing.
Wild Animal Populations	✘			Not significant.
Mines			✘	Division of Mines and Geology data base will be consulted for this information.
Inactive			✘	Division of Mines and Geology data base will be consulted for this information.
Active			✘	Division of Mines and Geology data base will be consulted for this information.

	Significant	Not Significant	Unknown	Comments
Disposal Facilities			✘	Records searches will be conducted to determine the existence of hazardous waste sites, landfills and spills in the watershed.
Solid Waste			✘	Records searches will be conducted to determine the existence of hazardous waste sites, landfills and spills in the watershed.
Hazardous waste			✘	Records searches will be conducted to determine the existence of hazardous waste sites, landfills and spills in the watershed.
Logging			✘	Logging is not a land use activity being conducted in the watershed.
Recreation			✘	
Reservoir body contact			✘	Swimming is allowed in the O'Neill Forebay only.
Reservoir non-body contact			✘	Boating and fishing are allowed in the Forebay and Reservoir.
Watershed Activities			✘	To be determined.
Unauthorized Activity			✘	Records searches will uncover this type of activity if it exists in the watershed.
Illegal Dumping			✘	Records searches will uncover this type of activity if it exists in the watershed.
Underground storage tank leaks			✘	Records searches will uncover this type of activity if it exists in the watershed.
Other			✘	Records searches will uncover this type of activity if it exists in the watershed.
Traffic Accidents/Spills			✘	Records searches will uncover this type of activity if it exists in the watershed.
Transportation Corridors			✘	Highway 152 borders the northern shore of the Reservoir and follows the southern shore of O'Neill Forebay.
History of accidents/spills			✘	Records searches of reported toxic releases will be conducted to determine if any spills associated with railroad traffic and other transit activities have occurred in the watershed.
Groundwater Discharges			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.
Natural Discharge			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.
Gas, oil, geothermal wells			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.
Seawater intrusion			✘	Not significant
Geologic Hazards			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.
Landslides			✘	San Luis Reservoir has the surrounding topography for landslides to occur. Their frequency and occurrence have not been determined.
Earthquakes	✘			Earthquakes occur in this region of California.
Floods			✘	Flood maps are being consulted to determine the extent and type of flooding that occurs in the watershed.
Fires			✘	The vegetation in the watershed is chaparral type and is prone to natural fires. It has not been determined what impacts runoff from burning will have on water quality.

	Significant	Not Significant	Unknown	Comments
III. Growth				
Population/General Urban Area Increase			✘	Merced County Planning Office is being consulted for this information.
Land Use Changes			✘	Merced County Planning Office is being consulted for this information.
Industrial Use Increase			✘	Merced County Planning Office is being consulted for this information.
IV. Water Quality				
Changes in Raw Water Quality			✘	This topic is being covered by a questionnaire. Users of raw water from the State Water Project are receiving the questionnaire and results will be documented for the Sanitary Survey.
Difficulty in Meeting Drinking Water Standards			✘	This topic is being covered by a questionnaire. Users of raw water from the State Water Project are receiving the questionnaire and results will be documented for the Sanitary Survey.

DELL VALLE RESERVOIR WATERSHED

	Significant	Not Significant	Unknown	Comments
I. General Conditions				
Changes is available water quality			✘	This topic is being covered by a questionnaire. Users of raw water from the State Water Project are receiving the questionnaire and results will be documented for the Sanitary Survey.
Construction of water diversion or reservoir projects			✘	Currently determining if any construction has occurred in this area of the State Water Project.
Relocation of intakes		✘		Relocation of intakes has not occurred.
II. Contaminant Sources				
Wastewater treatment		✘		All waste water for the reservoir complex is treated through evaporation ponds and is not discharged to any water bodies.
Treatment plant effluent discharges			✘	There are no treatment plant effluent discharges to the reservoir.
Storage, transport, treatment, disposal to land			✘	Currently under investigation.
Residential Septic systems			✘	Currently under investigation.
Commercial /industrial septic systems			✘	Currently under investigation.
Reclaimed Water		✘		Currently under investigation.
Urban Areas		✘		There are no urban areas in the watershed of the reservoir.
Agricultural Crop Land Use			✘	Grazing is the primary land use in the watershed. Its impacts on water quality have not been assessed.
Pesticide/Herbicide Use			✘	Currently under investigation.
Grazing Animals			✘	Grazing occurs in several drainages in the watershed. The number of cattle are currently being determined.
Concentrated Animal Facilities (i.e. Feedlots)			✘	Not present in the watershed.
Wild Animal Populations		✘		Not significant.
Mines			✘	Division of Mines and Geology data base will be consulted for this information.
Inactive			✘	Division of Mines and Geology data base will be consulted for this information.
Active			✘	Division of Mines and Geology data base will be consulted for this information.
Disposal Facilities			✘	Records searches will uncover this type of activity if it exists in the watershed.
Solid Waste			✘	Records searches will uncover this type of activity if it exists in the watershed.
Hazardous waste			✘	Records searches will uncover this type of activity if it exists in the watershed.
Logging			✘	Logging is not a land use activity being conducted in the watershed.
Recreation			✘	Lake Del Valle was created in 1968 to provide recreation and fish and wildlife enhancement, flood control for Alameda Creek, and regulatory storage for the South Bay Aqueduct. The Lake offers camping , picnicking, horseback riding, swimming , hiking, windsurfing, boating and fishing in the watershed of the lake.

	Significant	Not Significant	Unknown	Comments
Reservoir body contact			✘	Lake Del Valle offers swimming, boating, and windsurfing. These activities involve body contact.
Reservoir non-body contact			✘	Lake Del Valle offers camping, picnicking, horseback riding, hiking, boating, and fishing in the watershed of the lake.
Watershed Activities			✘	To be determined.
Unauthorized Activity			✘	Records searches will uncover this type of activity if it exists in the watershed.
Illegal Dumping			✘	Records searches will uncover this type of activity if it exists in the watershed.
Underground storage tank leaks			✘	Records searches will uncover this type of activity if it exists in the watershed.
Other			✘	Records searches will uncover this type of activity if it exists in the watershed.
Traffic Accidents/Spills			✘	Records searches will uncover this type of activity if it exists in the watershed.
Transportation Corridors			✘	Del Valle Road is the main road into the watershed. Arroyo Road enters the watershed to the north west of the watershed; however, this is a service road for DWR or emergency vehicles only. Several other smaller roads exist through out the watershed. These roads are used for travel into the Arroyo Valle watershed area south and west of the lake. These roads are associated with cattle operations on private lands in the watershed. Arroyo Valle drains into the lake. The only road used as a corridor for transport of hazardous materials into the water shed is Del Valle Road.
History of accidents/spills			✘	Record searches of reported toxic releases will be conducted to determine if any spills associated with railroad traffic and other transit activities have occurred in the watershed.
Groundwater Discharges			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.
Natural Discharge			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.
Gas, oil, geothermal wells			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.
Seawater intrusion		✘		Not significant.
Geologic Hazards			✘	The Division of Mines and Geology and the Regional Water Quality Control Board are being consulted for this information.
Landslides			✘	Del Valle Reservoir has the surrounding topography for landslides to occur only in areas without vegetation. The frequency and occurrence of landslides has not been determined.
Earthquakes	✘			Earthquakes occur in this region of California.
Floods			✘	Flood maps are being consulted to determine the extent and type of flooding that occurs in the watershed.

	Significant	Not Significant	Unknown	Comments
Fires			✘	Approximately 80% of the watershed land use activities are cattle and sheep grazing in grasslands. These lands could experience natural and management induced burning. It has not been determined what impacts runoff from burning will have on water quality. Rice field burning data will be consulted to help determine impacts.
III. Growth				
Population/General Urban Area Increase			✘	Alameda County and East Bay Regional Parks Planning Agencies will be consulted for this information.
Land Use Changes			✘	Alameda County and East Bay Regional Parks Planning Agencies will be consulted for this information.
Industrial Use Increase			✘	Alameda County and East Bay Regional Parks Planning Agencies will be consulted for this information.
IV. Water Quality				
Changes in Raw Water Quality			✘	This topic is being covered by a questionnaire. Users of raw water from the State Water Project are receiving the questionnaire and results will be documented for the Sanitary Survey.
Difficulty in Meeting Drinking Water Standards			✘	This topic is being covered by a questionnaire. Users of raw water from the State Water Project are receiving the questionnaire and results will be documented for the Sanitary Survey.

Appendix I

North Bay Aqueduct – City of Benicia Comments

CITY HALL • 250 EAST L STREET • BENICIA, CA 94510 • (707)746-4200

THE CITY OF BENICIA CALIFORNIA
Public Works Department

January 16, 1996

RECEIVED
JAN 17 1996
STATE WATER CONTRACTORS

Mr. John Coburn
State Water Contractors
555 Capitol Mall, Suite 725
Sacramento, CA 95814-4502

SUBJECT: REVIEW OF CALIFORNIA STATE WATER PROJECT SANITARY SURVEY REPORT 1996

Dear Mr. Coburn:

The City of Benicia has reviewed the Draft Final California State Water Project Sanitary Survey Report prepared by the California Department of Water Resources (DWR) for the State Water Contractors. Our review of the report concentrated on the adequacy of the sections on the North Bay Aqueduct (NBA).

We believe the Sanitary Survey Report is deficient in several areas. The report does not include all of the information required by the Department of Health Services (DHS) for a sanitary survey.

- The AWWA Guidance Manual, adopted by DHS, requires a discussion of existing watershed management practices designed to protect drinking water quality. The report does not contain a discussion of existing watershed management practices or practices recommended to correct problems identified in the report. The report needs to be revised to include watershed management practices and recommendations. The "Scope of Work Five-Year Update of the State Water Project Sanitary Survey" specifically requires an evaluation of watershed management practices.

- The report includes an inventory of contaminant sources in the eight watersheds selected for intensive study but it does not include a discussion of any changes in these sources since the 1990 sanitary survey was completed (as required by the Scope of Work) or a discussion of the significance of these contaminant sources with respect to drinking water quality. The report needs to include a discussion of the significance of contaminant sources based on the water quality data.

- The checklist, referred to in the report, should also be included as an appendix to the report.

The appendices should also include field notes from the site visits to the watersheds.

Executive Summary

The Executive Summary needs to be revised after responding to the comments on the individual chapters.

Chapter 1 - Introduction

Action Plan - The report contains a discussion of the actions taken by the SWP Action Committee in response to the 1990 sanitary survey report. Many of the actions involved sending a letter to a regulatory agency asking the agency to address the concerns. There is no discussion in the report on whether the regulatory agencies followed up on the letters. The report should describe any actions taken (or not taken) by the regulatory agencies so that the reader can determine if the problem identified in 1990 has been corrected. For example, did the Regional Board expand its monitoring program on contaminant sources in the Sacramento Basin and develop a revised mass loading analysis, as recommended in 1990? After reviewing the *Giardia* and *Cryptosporidium* data, does DWR recommend that the Regional Board include pathogens in discharge permits?

Chapter 2 - Water Supply System, Watersheds, and Potential Contaminants

We realize that the size and complexity of the State Water Project watershed precludes a detailed evaluation of all contaminant sources in the entire watershed; however, the report states the eight watersheds within the State Water Project system were evaluated in detail. We found the evaluation of the NBA watershed to lack the detail and discussion of significance that should be found in a sanitary survey of a specific watershed.

Maps - This report needs a high quality map showing the watershed of the State Water Project and then individual maps showing the watersheds of each of the eight watersheds studied in more detail. Figure 2-2 is inadequate for this purpose. The watershed maps need to show the contaminant sources identified in the report. It is impossible to determine from the report the extent of the NBA watershed. Figure 2-3 shows the area around Barker Slough but the figure does not contain topographical boundaries. It is unclear from the text if the area shown on the figure was considered to be the entire watershed.

Agricultural Land Use - The report states that agriculture is a dominant land use in the watershed but it does not contain a discussion of the types and quantities of pesticides used on crops grown in the watershed. Have there been any studies on the quality of agricultural drainage in the NBA watershed? Is there anecdotal information from DWR operators or others that indicates that agricultural drainage may adversely affect NBA drinking water quality? The watershed map, referred to previously, should show the areas of the watershed devoted to agriculture.

Furthermore, although agricultural drainage is identified as a possible contaminant source, there does not appear to be any agricultural drain sampling stations located in the Barker Slough watershed. Because of the significant problems with TOCs that Benicia experiences during storm events, we suggest that one be installed.

Grazing Animals - There is a discussion on page 2-8 of grazing animals in Solano County but there is no indication of the number of animals found in the NBA watershed. There is a statement in the Conclusions and Recommendations chapter that 80 percent of the watershed is used for grazing but this statement is not supported in the text of Chapter 2. The watershed map should show the general areas where animals are grazed and specific locations of ranches and confined animal facilities. There should also be a discussion of waste handling procedures and runoff control measures from areas containing high densities of animals. On page 2-10 there is a discussion about DWR's inability to control land use in the area of Barker Slough. If grazing animals are found to be a significant source of contaminants to the NBA, DWR could work with the County Planning Department to develop control measures.

Hazardous Waste Sites - The report contains a discussion of hazardous waste sites on page 2-12 and Table 2-1 contains a list of many of these sites. The text indicates that most of these sites are not in the NBA watershed. The discussion of the sites outside of the watershed, specifically Travis Air Force Base, should be deleted. This section should focus on the sites actually found in the watershed, the status of those sites, and their effects on the NBA drinking water quality. These sites should be shown on the map of the NBA watershed. What is the status of the landfills - capacity, leachate collection systems, history of problems, monitoring data, etc.? Are the underground storage tanks at Campbell Ranch and Cripps Ranch leaking? Have there been any hazardous materials spills in the watershed? The report should discuss the frequency and severity of any spills that have occurred.

Wastewater Treatment Plants - The location of the Vacaville Wastewater Treatment Plant should be shown on the watershed map.

Recreational Use - The location at Argyll Park should be shown on the watershed map. Are there any other recreational uses in the watershed? Is there body contact recreation on the sloughs?

Urban Runoff - There is no discussion in the report on the effects of urban runoff from Vacaville. The discussion of Sacramento urban runoff indicates that urban runoff may be a significant source of total organic carbon. Could urban runoff from Vacaville be contributing to the high TOC values found in the NBA during the winter months?

Chapter 3 - State Water Project Emergency Action Plan

Adequacy of Emergency Plan - The emergency plan appears to be adequate to cover emergencies on the State Water Project. There is no assessment of how this plan has worked during emergencies, such as the turbidity event of 1995.

Notification of NBA Water Contractors - In addition to the actions described in this chapter of the report, DWR should have a policy of alerting the NBA contractors when operations staff observations or water quality monitoring results indicate that Barker Slough water quality is degraded. In Chapter 4, the goals of the Municipal Water Quality Investigations (MWQI) Program are discussed. One of the goals of the MWQI Program is to "Alert water agencies about potential contaminant sources to Delta water supplies". To my knowledge, Benicia has never been alerted of poor water quality conditions by DWR.

Chapter 4 - Water Quality of the State Water Project System

This report shows that the NBA has the worst water quality in the State Water Project system. Over the past 5 years, these water quality problems include unexplained (but significant) changes in raw water quality, dissolved and particulate metals in the water, spikes of TOC concentrations, and seasonal high turbidities. Some of these conditions cause extreme treatment challenges, sometimes jeopardizing compliance with current drinking water standards, especially DHS's new *Cryptosporidium Action Plan.*

Data Presentation - The NBA data should be presented in the same order (upstream to downstream) on all figures. The tables in the appendix should be organized in the same order.

Coliforms - The discussion of total and fecal coliform data for the NBA should include a description of the maximum values detected, seasonal trends, and annual trends. The report should also explain that Lake Herman is a blend of NBA water and local runoff so it is not a good indicator of the bacteriological quality of NBA water arriving at Benicia. The potential sources of coliforms should be discussed in this section or in a following chapter that assesses the significance of the contaminant sources in light of the water quality data.

Page 4-17 of the survey states that Benicia submitted coliform data for the "Cordelia Forebay" and that is not correct. We do not take samples from the forebay. Perhaps the author confused this coliform data with the data from Terminal Reservoir (Lake Berryessa water source) which we do take.

Trihalomethane Formation Potential (THMFP) and Total Organic Carbon (TOC) - The high NBA THMFP values are attributed to "non point source runoff". Page 4-64 contains a discussion of the sources of organic carbon in the Delta but there is not a discussion of the sources of organic carbon for the NBA. The report states on page 4-64, "The TOC and DOC median values measured in the State Water Project were, in many cases, just below the proposed Disinfectants/Disinfection By-Products Rule limit of 4.0 mg/l TOC...". The NBA median values exceed 4.0 mg/l. The report needs to contain a discussion of the significance of these high TOC levels for NBA contractors. The discussion of TOC in the NBA on page 4-64 needs to state the median value of 5.2 mg/l.

Anecdotal reports suggest one cause for the periodic (and unexplainable) spikes of TOC in the NBA is upstream releases of stagnant waters. If this is the case, DWR should implement a program to test waters before any releases or changes in the transmission system and inform downstream users of such anticipated changes.

Metals - The discussion of metals data on pages 4-72 to 4-74 refers repeatedly to the California Aqueduct, implying that the NBA data is not included in this discussion. Metals data are available and are summarized in Table B-13 for the NBA. The discussion needs to be expanded to include the NBA data. There is no discussion of the aluminum, copper, iron, manganese, or zinc data. The report should contain a discussion of these metals, particularly since NBA water at times exceeds the secondary standards for aluminum, iron, and manganese.

DWR should consider conducting some studies to determine where dissolved and particulate metals (i.e., iron, manganese, and aluminum) are originating and how they can be minimized. For example, river and tributary "profiles" can be conducted to see if specific anoxic conditions in lakes or reservoirs dissolve and release metals into the system. If this occurs, source water system controls such as reservoir aeration can be implemented at certain times to prevent the release of these metals. This may be more effective than the City implementing a downstream chemical feed system, such as with potassium permanganate, to oxidize dissolved metals to the particulate phase. The Benicia Water Treatment Plant has had problems filtering high levels of *particulate* metals too, not just dissolved metals. Therefore, it may be prudent to manage the system to **prevent or minimize** the significant release of these key metals before they cause treatment problems.

Turbidity - Although, as stated on page 2-59, "Turbidity was a major concern for many of the 16 agencies responding" to the Sanitary Survey questionnaire, turbidity is only discussed with respect to the March 1995 incident on the California Aqueduct. Benicia experiences difficulty treating NBA water due to high turbidities in the winter months. The survey goes on to state that some agencies reported turbidities as high as 200 NTUs. Benicia has actually seen significantly higher turbidity -- over 400 NTUs. The turbidity data for the NBA and other components of the State Water Project system should be presented and evaluated in the report. Recommendations should be made for watershed management practices to reduce turbidities in NBA source water.

Chapter 5 - Conclusions and Recommendations

Recommendation 1 - Action Plan Committee - This recommendation includes a review of the 1990 sanitary survey recommendations. The 1996 report contains a review of the 1990 recommendations. After DWR responds to our comments on this review, it should be adequate and not needed again for at least several years.

Recommendation 2 - Pathogens - We agree that *Giardia* and *Cryptosporidium* monitoring should continue and be expanded. The recommendation should state that a high priority area for expansion

is the NBA, given that the NBA coliform data, and other water quality data, indicate that NBA water is subject to contamination. The NBA monitoring should start with the next round of sampling. Table 5-1 should indicate that recreation is a potential source of coliforms for the NBA.

Recommendation 3 - Organic Carbon - We support this recommendation to identify the sources of TOC and DOC in the NBA watershed. We urge DWR to identify this as a high priority recommendation.

Recommendation 6 - Hazardous Waste Facilities - We do not support expenditure of funds on gathering information on emergency response plans of hazardous waste facilities based on the information presented in this report. This report needs to be improved as discussed above so that the significance of the hazardous waste facilities can be assessed. At that time, it can be determined if the expenditure of funds on this effort is warranted.

Recommendation 7 - Urban Runoff - As stated previously, information on urban runoff quality from the City of Vacaville should be included in this report, if data is available. Urban runoff monitoring data is available from Stockton, Modesto, and Fresno. The data on constituents of concern to drinking water should be included in this report rather than included as a recommendation for additional work.

Recommendation 8 - Barker Slough Coliform Monitoring - We support this recommendation and add a recommendation that the coliform data be analyzed quickly by DWR and summary quarterly reports prepared and distributed to all NBA users.

Recommendation 10 - Landfills - The information listed in this recommendation should be included in this report rather than listed in additional work to be completed. The information should be obtained only for the landfills actually located in the watersheds - not the adjacent watersheds.

Recommendation 13 - Drinking Water Standards Monitoring - We support the recommendation to update the MWQI Program in response to new drinking water standards and regulations. The data from this program should be more accessible to the SWP contractors. Brief quarterly reports containing the data and a short discussion of any potential areas of concern should be submitted to the contractors.

We appreciate the opportunity to review this report and look forward to reviewing the revised report. However, I would like to add that we would appreciate more time (at least 30 days) to review subsequent submittals. Furthermore, we strongly suggest that future survey updates be separated into individual reports for each SWP sub-watershed area. This is a suggestion that appears to be warranted because the vastness of the SWP renders separate reports necessary. Our concern is that DWR needs to address concerns for each area and avoid making general system changes to the NBA system that provide marginal benefits.

Please call me at (707)746-4238 if you have any questions on our comments.

Sincerely,

Toni Bertolero

Antoinette M. Bertolero
Utilities Engineer-Manager

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cc: Virgil A. Mustain, Director of Public Works
Vicki Willis, Water Quality Supervisor
David Spath, Department of Health Services
David Okita, Solano County Water Agency

Organization

STATE OF CALIFORNIA
Pete Wilson, Governor

THE RESOURCES AGENCY
Douglas P. Wheeler, Secretary for Resources

DEPARTMENT OF WATER RESOURCES
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