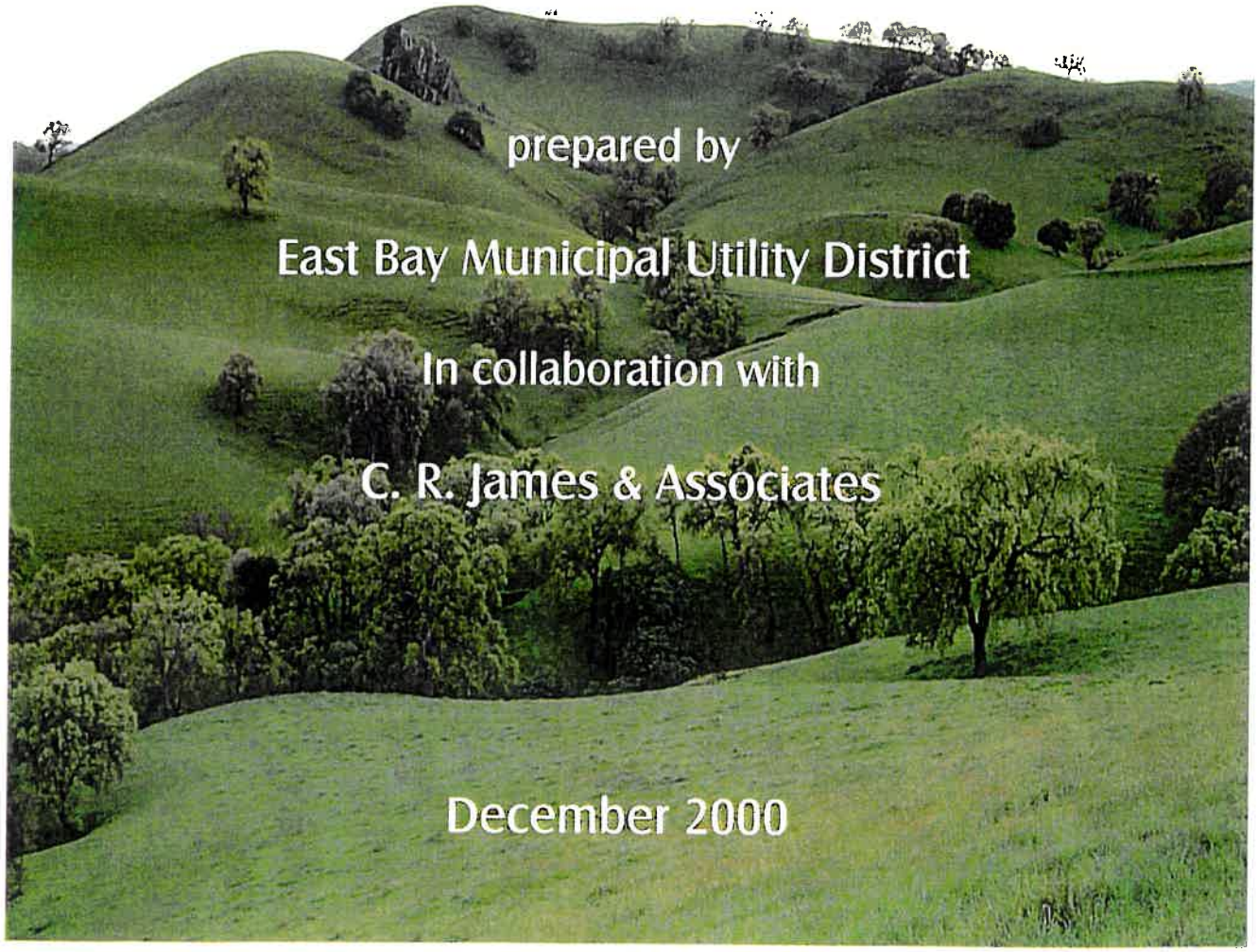
Mokelumne River Watershed Sanitary Survey Update 2000



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Project Staff

Richard Stein	Project Manager
Rick Kanazawa	Project Engineer
Carol James	Technical Consultant

Technical Review

Andy Enos	Hubert Lai
Eileen Fanelli	Eileen White
Ron Hunsinger	

District Support

Cynthia Adkisson	Rod Jung
Alex Coate	Karen Love
Rey Encarnacion	Jim Pierner
Eileen Fanelli	Ali Sheikholeslami
Bob Gardner	Maria Tikkanen
Judi Garland	Steve Wollmer
Bill Harris	

MOKELUMNE RIVER WATERSHED SANITARY SURVEY- UPDATE 2000

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EXECUTIVE SUMMARY

Background

The Environmental Protection Agency's (EPA) Surface Water Treatment Rule (SWTR), approved by the U.S. Congress in 1989, includes a recommendation for all surface water systems to conduct watershed control plans. As the primacy agency for the implementation of the SWTR, the California Department of Health Services (DHS) specifies that all surface water systems conduct the first five-year update of the watershed sanitary survey of their water supply watersheds by January 1, 1996 and every five years thereafter.

In compliance with the EPA Surface Water Treatment Rule, the East Bay Municipal Utility District (District) has completed the first five-year update of the 1995 Mokelumne River Watershed Sanitary Survey. C.R. James & Associates, Consulting Engineers was hired to assist the District in preparing this document -- the Year 2000 Update of the Mokelumne River Watershed Sanitary Survey (MRWSS Update 2000).

The Year 2000 Update of the Mokelumne River Watershed Sanitary Survey focuses on the portion of the Mokelumne River Watershed that is associated with the District's water supply facilities at Pardee and Camanche Reservoirs.

The portions of the Mokelumne River watershed that contribute to flows into the Pardee Reservoir – from the North Fork, Middle Fork, South Fork, and Mainstem of the Mokelumne River -- constitute the Upper Mokelumne River Watershed. The watershed lands that drain to Camanche Reservoir below Pardee Dam and above Camanche Dam are identified as Camanche Watershed. These two watersheds represent 620 square miles and are located along the Mokelumne River in the Sierra-Nevada foothill counties of Alpine, Amador, and Calaveras.

Water Quality Conditions

For the past five years, Pardee and Camanche Reservoirs have generally exhibited excellent raw water quality characteristics. The raw water quality parameters that exceeded either the primary or secondary drinking water standards are presented in Table ES-1. The raw waters met the primary treated water MCLs for all general physical (excluding turbidity), general mineral (excluding aluminum and/or manganese), inorganics, organics and radionuclide parameters for the monitoring period of 1995-1999. The raw water turbidity and total coliform levels were above the treated water MCLs that is expected. Iron was detected at concentrations above the secondary standard at Pardee Reservoir. At Camanche Reservoir, both iron and manganese were detected at concentrations above the corresponding secondary standards. Secondary standards are focused on the aesthetic quality of the water such as taste or appearance rather than health risk.

Table ES-1: Raw Water Quality Parameters That Exceeded Treated Water Drinking Water Standards (1995-1999)

Mokelumne River Reservoirs	Primary Drinking Water Standards (Health Based)	Secondary Drinking Water Standards (Aesthetic)	Treatment Standard
Pardee Reservoir	Turbidity Total Coliform	Aluminum Iron	*Giardia* *Cryptosporidium*
Camanche Reservoir	Turbidity Total Coliform	Aluminum Iron Manganese	*Giardia* *Cryptosporidium*

There were no synthetic organic chemicals detected at concentrations above primary treated water MCLs in either of these two reservoirs. The water quality monitoring data indicates that MTBE concentrations decreased after the District initiated a proactive program that required all District-owned and concessionaire-owned 2-stroke high emission engines be replaced with 4-stroke low emission engines.

Also presented in Table ES-1 are the raw water quality parameters -- *Giardia* and *Cryptosporidium* -- that are targeted for treatment requirements under the Interim Enhanced Surface Water Treatment Rule (IESWTR). Both of these pathogens were detected at low levels in Pardee and Camanche Reservoirs. However, treatment plant performance data (based on turbidity removal and finished water quality sampling) indicate that the District's water treatment plants met the required inactivation or removals for these two parameters.

While not listed in Table ES-1, total organic carbon (TOC) is another water quality parameter, which was recently regulated through a treatment requirement in the Stage 1 - D/DBP Rule. The 1994-1999 raw water quality monitoring data for both Pardee and Camanche Reservoirs indicate that low levels of TOC occur in both these reservoirs. Due to the low concentrations of TOC observed, specific TOC removals are not required for any of the District's water treatment plants that draw from these sources of supply.

In general, the five-year monitoring period does not reflect any deteriorating trend for any water quality parameter at Pardee and Camanche Reservoirs. The water quality data for the period 1995-1999 is very similar to the 1990-1994 water quality data that was reported in the 1995 Mokelumne Watershed Sanitary Survey.

Water Treatment Facilities

EBMUD operates a total of seven water treatment plants (WTPs) -- three large systems and four small systems -- that treat water from Pardee or Camanche Reservoirs. The three large systems (serving over 10,000 people each) are the Walnut Creek, Orinda, and Lafayette WTPs located in the District's East Bay service area. These water treatment plants treat Mokelumne River water transported from Pardee Reservoir through the Mokelumne Aqueducts. The four small systems (serving less than 10,000 people each) are the Pardee Recreation Area, Pardee Center, Camanche South Shore, and Camanche North Shore WTPs. Pardee Recreation Area and Pardee Center WTPs treat Pardee Reservoir water. Camanche South Shore WTP treats Camanche Reservoir water. Camanche North Shore WTP treats groundwater from three wells.

The District's water treatment plants are very effective and reliable at removing particulates and microorganisms. The monthly WTP reports, annual water quality reports, and annual inspection reports submitted to DHS indicate that the treated or finished waters from these WTPs met and surpassed all treated water quality regulations. In addition, disinfection residual and bacteriological monitoring data from the distribution systems reflect that the District had no problems meeting the detectable disinfectant residual criteria of the SWTR. It is expected that the District will be able to meet the recently promulgated *Cryptosporidium* inactivation requirements as defined in the IESWTR. With regards to the recently promulgated Stage 1 - D/DBP Rule, the source water TOC concentrations in both Pardee and Camanche reservoirs indicate that the District will not be required to pursue enhanced coagulation at any of the WTPs treating these source waters.

Major Sources of Contaminants

The contaminants that have the potential to most significantly degrade the drinking water supplies have been identified in Section 5 as the following: sanitation facilities, urban area runoff, rural area runoff, utilities - hydropower generation, transportation corridors, wildlife and livestock, recreation, mines, geologic hazards, fires and fire management, and logging. As shown in Table ES-2, these land uses and activities are rated low to high with regards to their potential for affecting water quality. Two other potential contaminant sources - agriculture and unauthorized activities - are rated as insignificant to low.

Table ES-2: Summary of Contaminant Sources and Their Impact on Water Quality

Contaminant Source	Key Contaminants	Potential to Impact Drinking Water Quality
Sanitation Facilities	Algae, Taste and Odor **Microorganisms** TOC	*Low to High* Impacts from leaks and spills are dependent on location of incident, amount and type of material, and response time Failed septic systems have been documented
Urban Area Runoff - Residential Commercial	Turbidity Algae/Taste and Odor **Microorganisms** General minerals and metals TOC **SOCs**, VOCs, **pesticides, herbicides** **Oil and grease, other hydrocarbons**	*Low to High* Urban areas are relatively small in size. Urban areas are the largest contributors of water quality contaminants on a per area unit basis Sewage overflows occur on an infrequent basis Urban development is increasing
Rural Area Runoff - Residential	Turbidity Algae/Taste and Odor **Microorganisms** General minerals and metals TOC SOCs, VOCs, pesticides, herbicides Oil and grease, other hydrocarbons	*Low to High* Rural areas are sparsely populated, but there are less control measures for erosion and sanitation facilities Rural development is increasing

Table ES-2: Summary of Contaminant Sources and Their Impact on Water Quality – (continued)

Contaminant Source	Key Contaminants	Potential to Impact Drinking Water Quality
Utilities - Hydroelectric Power Generation	**Turbidity** **Algae**/Taste and Odor **Temperature** General minerals & metals TOC SOCs, VOCs, herbicides Oil and grease, other hydrocarbons	*Low to High* Extensive hydroelectric facilities occur throughout Pardee and Camanche watersheds. Hydroelectric facilities are integrated into the complex system of reservoirs, canals, and tunnels. Hydroelectric power generation activities represent a high priority for the District concerning potential water quality impacts.
EBMUD Facilities (Excluding recreation)	Microorganisms Turbidity **General minerals** Metals **TOC** Oil and grease, other hydrocarbons	*Low to High* Facilities including septic systems proximate to the reservoirs and tributaries. Impacts from spills can be significant. Maintenance activities can contribute contaminants.
Transportation Corridors	**Turbidity** General minerals and Metals TOC SOCs, VOCs, pesticides, herbicides **Oil and grease, other hydrocarbons**	*Low to Medium* Main thoroughfares proximate to reservoirs. Storm water drains feed directly into the reservoirs. Accidents occur along main thoroughfares. Maintenance activities can contribute contaminants. Logging activities require extensive system of roads throughout watershed lands
Agriculture	Nutrients Turbidity Algae/Taste and Odor General minerals TOC SOCs, VOCs, Pesticides, herbicides	*Insignificant* Agricultural properties are few and small. Some agricultural activities have eliminated the use of pesticides and herbicides.

Table ES-2: Summary of Contaminant Sources and Their Impact on Water Quality – (continued)

Contaminant Source	Key Contaminants	Potential to Impact Drinking Water Quality
Wildlife and Livestock	Turbidity Algae/Taste and Odor **Microorganisms** General minerals and Metals **TOC** **Nutrients**	*Medium to High* The impact of cattle grazing on microorganisms especially *Cryptosporidium* can be significant. The impacts of cattle grazing on erosion and TOC loadings can be significant.
Recreation (EBMUD)	Turbidity Algae/Taste and Odor **Microorganisms** General minerals and metals TOC Oil, grease, other hydrocarbons, MTBE	*Medium to High* Recreation is encouraged at both reservoirs. Recreation is prohibited near the outlet towers. Body contact is permitted in Camanche Reservoir. Cross contamination from privately owned boats can be a significant issue. Fire hazards increase with visitor use.
Recreation (Sierra Pacific, Eldorado & Stanislaus National Forests, Bureau of Land Management, PG&E)	**Turbidity** Algae/Taste and Odor **Microorganisms** General minerals, Metals TOC Oil and grease, other hydrocarbons, MTBE	*Medium to High* Recreational activities occur at reservoir and river locations throughout the watershed.
Mines	**Turbidity** Radionuclides General minerals and metals Oil and grease, other hydrocarbons	*Medium to High* Active and inactive mines exist throughout watersheds. Water quality degradation due to mine discharges has been significant. Mines are proximate to reservoirs and main tributaries.

Table ES-2: Summary of Contaminant Sources and Their Impact on Water Quality – (continued)

Contaminant Source	Key Contaminants	Potential to Impact Drinking Water Quality
Geologic Hazards	**Turbidity** Radionuclides General minerals and Metals TOC Nutrients	*Medium to High* High erosion risk lands within watersheds and in close proximity to waterbodies, waterways, and conveyances. Historically landslides have occurred in close proximity to waterbodies.
Fires and Fire Management	**Turbidity** Algae/Taste and Odor TOC SOCs, VOCs, pesticides, herbicides	*Medium to High* Fires due to lightning strikes are a significant threat. While fires make land vulnerable to erosion, heavy rainfall is necessary to induce major erosion and impact water quality.
Logging	**Nutrients** **Turbidity** **Algae/Taste and Odor** **General minerals** and Metals Microorganisms TOC SOCs, VOCs, herbicides oil and grease, other hydrocarbons	*Medium to High* Extensive logging in Upper Mokelumne River Watershed. Logging roads traverse watersheds and cross tributaries. Herbicides used for vegetation management.

Table ES-2: Summary of Contaminant Sources and Their Impact on Water Quality – (continued)

Contaminant Source	Key Contaminants	Potential to Impact Drinking Water Quality
Unauthorized Activities	Turbidity Algae Microorganisms General minerals and Metals TOC SOCs, VOCs, pesticides, herbicides Oil and grease, other hydrocarbons	*Low to Medium* Disturbance of soil and deposition of contaminants in areas proximate to reservoirs and/or tributaries increases the risk of impacting downstream water quality.

NOTES: Bold indicates contaminants of greatest concern.
Ranking of land uses and activities is based on contaminants of concern, proximity to waterbodies, magnitude of sources, watershed characteristics, and any mitigating factors. Contaminants are prioritized as follows:

1. Microbiological contaminants with the potential for acute illness.
2. Algae and inorganic compounds which contribute to taste and odor problems.
3. Turbidity which also transports adsorbed contaminants.
4. Total organic carbon that is a precursor DBPs.
5. Other organic and inorganic compounds which are at or below detection limits in raw waters.

Key Conclusions and Recommendations

The reservoir raw water qualities are very good and the WTPs are capable and reliable at treating or removing particulates, pathogens and other water quality contaminants. However, with stricter regulations and improved understanding of water quality parameters and related health effects, source protection has become an integral part of water quality management. The SWTR, IESWTR and Stage 1 - D/DBP Rule highlight the need for managing activities within the watershed to minimize degradation of raw water quality.

As part of this MRWSS Update 2000, potential corrective actions were developed based on a review of the 1995 MRWSS, water quality monitoring data, potential contaminant source management, and other watershed management practices. The District has developed the Draft Rangeland Resource Management Plan and the Draft East Bay Habitat Conservation Plan for the East Bay Watersheds which address management practices for the protection of reservoir water quality. Concepts developed for both of these efforts will be applied to the District's watershed management practices on lands owned by EBMUD, where EBMUD has access, or where permitted under agreements with other agencies.

The minimization of water quality degradation is the key focus of these potential corrective actions. These recommendations with medium to high or high priority ratings are summarized in Table ES-3. The recommendations take into account watershed characteristics, type and magnitude of potential contaminants, and potential risk to public health. While most of these recommendations were developed for this Mokelumne Watershed Sanitary Survey Update, activities pertaining to them are ongoing to some degree in the Pardee and Camanche Watersheds, including actions taken in the North Fork Mokelumne River Watershed through negotiations with PG&E. Therefore, a status column is included in Table ES-3 that reflects whether the action corresponding to a recommended activity has been completed, is ongoing, or has not been implemented. Many of these recommendations have been pursued and continue to be pursued, through the District's ongoing efforts. However, the District does not own facilities or lands within the North Fork Mokelumne River Watershed and must currently rely on cooperation and coordination with regulatory agencies and among existing landowners, users, and facility managers to implement programs to monitor and protect

water quality in this portion of the Pardee Watershed. This collaboration has historically been informal and limited by the willingness of private parties to participate and by regulations governing public participation in regulatory processes. In order for the District to be able to control the quality of the water inflow to Pardee Reservoir, it will need better control over land and facility management in the upper reaches of the Pardee Watershed.

In light of its concern over the potential threat to water quality posed by the proposed sale of PG&E's hydroelectric facilities and associated lands in the North Fork Mokelumne basin, the District has participated in the formation of the Upper Mokelumne River Watershed Authority (Authority). The Authority is a joint power authority consisting of the Alpine County Water Agency, Amador Water Agency, Calaveras County Water District, Calaveras Public Utility District, Jackson Valley Irrigation District and the District. The Authority was formalized by agreement between the participating agencies on August 15, 2000 and was established for the purpose of effectuating the acquisition, operation, and maintenance of PG&E's hydroelectric facilities on the Upper Mokelumne River. A major benefit of Authority ownership of these facilities would be the coordinated use and management of resources within the North Fork Mokelumne River Watershed. If successful, in its attempt to acquire these facilities, the Authority could implement the corrective actions outlined in Table ES-3 within the North Fork Mokelumne River Watershed in order to preserve the quality of the inflow to Pardee Reservoir.

Table ES-3: Status of High Priority Potential Corrective Actions

Watershed Management Categories	Recommended Activity	Actions	Status
Water Quality Monitoring	Monitoring Related to Land Use and Activities	Determine contributions from various contaminants associated with FERC Project 137 and grazing practices.	Ongoing*
	Reservoir Temperature Monitoring	Evaluate reservoir thermal stratification and the impacts to water temperatures due to upstream hydroelectric powerplant operations.	Ongoing*
	TOC Monitoring	Continue monitoring of TOC in Pardee and Camanche Reservoirs.	Ongoing
	MTBE Monitoring	Conduct monitoring of Pardee and Camanche Reservoirs to determine if further control measures are needed.	Ongoing
	Herbicide Monitoring	Monitoring herbicide applications within Pardee and Camanche watersheds.	Ongoing
	Land Disposal Monitoring	Request that increased inspection of and surveillance of wastewater collection and disposal systems that are external to EBMUD-owned lands are conducted by RWQCB.	Initiate Discussions
Watershed Control and Management Practices	Forest Practices and Logging	Support efforts to develop protection measures for forest resources and associated vegetation, wildlife, and aquatic resources.	Ongoing
	Grazing Practices	Develop Grazing Plan for District lands, which incorporates appropriate consideration of water quality preservation.	Complete
	Access Control Programs	Continue programs which control human access and protect riparian and sensitive watershed land within Pardee and Camanche watersheds.	Ongoing

*Ongoing within Pardee and Camanche watershed lands owned by EBMUD. EBMUD has requested that the Federal Energy Regulatory Commission require monitoring by PG&E within lands owned by PG&E.

Table ES-3: Status of High Priority Potential Corrective Actions- continued

Watershed Management Categories	Recommended Activity	Actions	Status
Watershed Control and Management Practices - *cont.*	In-Reservoir Recreation	Promote inspection of recreational watercraft to prevent introduction of exotic species.	Ongoing
	Recreation – Body Contact	Continue to prohibit body-contact recreation in Pardee Reservoir to reduce the risk of pathogen contamination.	Ongoing
	Road and Landing Construction & Maintenance	Develop management guidelines to address soil erosion and sediment delivery mechanisms from road construction and maintenance activities within EBMUD-owned lands.	Ongoing
	Fire Roads and Hiking Trails	Review and identify policies for fire road and hiking trail construction and maintenance to minimize impacts to water quality within EBMUD-owned lands.	Ongoing
	Reservoir Shoreline	Assess measures to restore and protect eroded reservoir shorelines.	Completed
	Protection of Riparian Corridors	Promote protection of riparian corridors and encourage the implementation of effective BMPs for protecting riparian zones.	Ongoing

Table ES-3: Status of High Priority Potential Corrective Actions- continued

Watershed Management Categories	Recommended Activity	Actions	Status
Inter-jurisdictional Coordination	Upper Mokelumne River Water Quality Coordination Committee	Form a multi-agency committee of stakeholder agencies to discuss and resolve potential watershed water quality problems.	Ongoing
	Emergency Response	Coordinate with other agencies whose activities or jurisdiction may impact water quality to define and prioritize actions and responses in case of emergencies.	Under Consideration
	Future Development	Review all proposed development plans, provide comments based on water quality impacts, and develop strategies to cope with increasing urban pressure on watershed lands.	Under Consideration
Public Education	Residential and Commercial Neighbors	Develop public information campaign for residents and neighbors regarding source water protection.	Under Consideration

SECTION 1

SECTION 1
INTRODUCTION

Background

The Environmental Protection Agency (EPA) Surface Water Treatment Rule (SWTR) approved by Congress in 1989 includes a recommendation for all surface water systems to conduct watershed control plans. As the primacy agency for the implementation of the SWTR, the California Department of Health Services (DHS) specified that all surface water utilities shall prepare a watershed sanitary survey of their water supply watersheds by January 1, 1996 and update it every five years thereafter. In December 1995, the East Bay Municipal Utility District (District) submitted the Mokelumne River Watershed Sanitary Survey (1995 MRWSS) to DHS in compliance with this regulation. The document herein represents the first five-year update of the original watershed sanitary survey.

This document -- the Year 2000 Update of the Mokelumne River Watershed Sanitary Survey (MRWSS Update 2000) -- focuses on the watershed lands that drain to the District's Pardee and Camanche Reservoirs. For the purposes of this project, the portions of the Mokelumne River watershed that drain into the Pardee Reservoir are identified as the Upper Mokelumne Watershed. The watershed lands that lay between Pardee Dam and Camanche Dam and drain to Camanche Reservoir are identified as Camanche Watershed. The addition of Camanche Watershed and the District's Camanche Reservoir facilities in the MRWSS Update 2000 is intended to establish documentation regarding Camanche Reservoir water quality issues.

Title 22 of the California Code of Regulations requires that the watershed sanitary survey includes a physical and hydrological description of the watershed, an evaluation of raw and finished water quality data, a description of activities and sources of potential contamination, a description of watershed control and management practices, an evaluation of the system's ability to meet requirements of Title 22 - Chapter 17: Surface Water Filtration and Disinfection Treatment, and recommendations for corrective actions. All of these elements were included in the 1995 MRWSS and are discussed herein as part of this first five-year update.

The major emphasis in the MRWSS Update 2000 continues to be the identification of potential contaminant sources and their corresponding water quality concerns. While all regulated water quality parameters are addressed, microbiological parameters are the primary focus. Of particular interest are the potential sources of

Giardia and *Cryptosporidium*, in part due to the treatment challenges associated with these pathogens.

Objectives

There are several objectives of this update: (1) to document changes that have taken place in the Upper Mokelumne River watershed from 1995 through 2000; (2) to produce a report that updates the 1995 MRWSS while retaining pertinent information documented in the original report; (3) to document and evaluate the water quality concerns pertaining to Camanche Reservoir and the District's Camanche Reservoir facilities; and (4) to develop a document that complements the District's Year 2000 Update of the East Bay Watershed Sanitary Survey (EBWSS Update 2000). The fourth objective was established to bring consistency to document the District's efforts that focus on the protection and enhancement of source water quality.

Survey Methods

C.R. James & Associates, Consulting Engineers was hired to assist the District in conducting this first five-year update of the 1995 MRWSS. The 1995 MRWSS report was reviewed and all text, tables, and figures that required potential updating were identified. A series of tables was developed that highlighted each of these items and identified potential sources for updated information. The project team was formed and District staff was identified to provide key elements of the report. Information was then gathered and compiled. As part of this effort, documents were reviewed, water quality data were analyzed, hydrologic data were updated, and a field survey of the District's Pardee and Camanche small water systems was conducted.

SECTION 1
INTRODUCTION

Report Organization

While much of the content of the 1995 MRWSS served as the basis for the MRWSS Update 2000, the update is organized to parallel the content and format of the EBWSS Update 2000. The document is organized into seven sections which reflect the changes in information pertaining to watershed conditions, water quality (raw and treated), water treatment, watershed management practices, potential sources of contamination, and recommended corrective actions.

Section 2 is an overview of the District's water supply system, including raw water systems and water treatment plant facilities and operations. As the District is a minor landowner within the Camanche and Upper Mokelumne River Watersheds, agencies with water supply facilities or whose activities directly impact water quality and quantity are also highlighted in Section 2. **Section 3** contains a description of watershed characteristics (location, geology and soils, vegetation and wildlife, drainage basins, precipitation and evaporation, local runoff and diversions). Section 3 also documents the land uses, land ownership and jurisdictional authority for the Camanche and Upper Mokelumne River Watershed lands. A discussion of drinking water regulations, water quality monitoring that is conducted by the District, analysis of raw and finished water data, and evaluation of the District's water treatment facilities to meet the requirements of the SWTR and IESWTR is provided in **Section 4**. **Section 5** documents the locations of potential contaminant sources in the watersheds and identifies the key water quality parameters of concern associated with each contaminant source. In addition, the relationships between the water quality parameters of concern and the significance of the potential corresponding contaminant sources identified are discussed. **Section 6** provides an overview of the District's management practices pertaining to the watersheds and to the protection of source water. Also, the management practices of other agencies with jurisdiction over the watershed lands are discussed in this section. In **Section 7**, recommended corrective actions based on the evaluation of water quality, potential contaminant sources, and management practices, are documented. **Appendices C, D, and E** document supporting information for Sections 3, 5, and 6, respectively. The other appendices contain other pertinent information to the overall updating effort.

SECTION 2

SECTION 2

WATER SUPPLY, CONVEYANCE & TREATMENT SYSTEMS

Overview

The District supplies water to nearly 1.3 million people within 20 incorporated cities and 15 communities in Alameda and Contra Costa Counties. The water system provides water to a 325 square-mile area from Crockett to San Lorenzo and the San Ramon Valley, from Walnut Creek to the San Francisco Bay. In addition, the District operates four small water systems adjacent to Pardee and Camanche Reservoirs.

Mokelumne River water – draining from the North Fork, Middle Fork, South Fork and Mainstem of the Mokelumne River – to Pardee Reservoir is the primary water supply source (over 90 percent) for the District. From Pardee Reservoir, Mokelumne River water is diverted and transported to EBMUD's service area in the San Francisco Bay Area. In addition, Pardee Reservoir is the source of supply for the District's Pardee Center and Pardee Recreation Area facilities.

Camanche Reservoir, located just downstream of Pardee Reservoir, serves as the source of supply for the District's Camanche South Shore Recreation Area. The District's Camanche North Shore Recreation Area is located along the northern shoreline of Camanche Reservoir, but is supplied by groundwater. Figure 2-1 provides an overview of the Pardee and Camanche Reservoir facilities. Figure 2-2 depicts the flow and distribution of water for the District's water supply facilities.

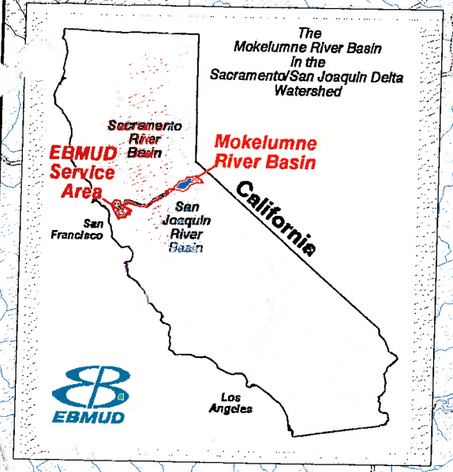
All raw water, whether taken directly from the District's reservoirs or aqueducts, is treated at one of the District's water treatment plants (WTPs). The District operates four small water systems that are proximate to the Pardee and Camanche Reservoirs – Pardee Recreation Area WTP, Pardee Center WTP, Camanche South Shore WTP and Camanche North Shore WTP. Camanche North Shore WTP is the only small water system that is supplied by groundwater only. In addition to the small water systems, the District operates six large system WTPs in the East Bay; three of which, the Orinda, Lafayette and Walnut Creek WTPs treat Mokelumne River water directly (although the Orinda WTP can also treat stored Mokelumne water from Briones Reservoir). Only the four small water systems and the Walnut Creek, Lafayette, and Orinda WTPs are discussed within this document. The District's other East Bay WTPs and facilities are discussed at length in the East Bay Watershed Sanitary Survey Update 2000.

SECTION 2

WATER SUPPLY, CONVEYANCE & TREATMENT SYSTEMS

Raw Water System, Storage, and Operation

The focus of this document is the Upper Mokelumne River watershed lands in association with the District's water supply facilities at Pardee and Camanche Reservoirs. The District has secured water rights (up to 325 MGD) to the 577 square-mile Upper Mokelumne River watershed on the west slopes of the Sierra Nevada Mountains. Representing the District's major source of supply, the Mokelumne River has supplied the District with an average annual draft of 169.3 MGD from 1995 through 1999.



El Dorado County

North Fork Sub-Basin

Alpine County

Amador County

Middle Fork Sub-Basin

Tuolumne County

Main Stem Sub-Basin

South Fork Sub-Basin

Calaveras County

Camanche Sub-Basin

San Joaquin County

Kirkwood

Bear Valley

Salt Springs Reservoir

Lower Bear River Reservoir

Upper Bear River Reservoir

Meadow Lake

Twin Lakes

Silver Lake

Lower Blue Lake

Upper Blue Lake

Highland Lakes

Tryon Creek

Bear River

Blue Creek

Cole Creek

Deer Creek

Lower Bear River Reservoir

Bear Creek Diversion Dam

Bear Creek Diversion Pipeline

Bear Creek Diversion Reservoir

Bear Creek Penstock

Bear Creek Powerhouse

Bear Creek Tunnel

Bear Creek Tunnel Adit

Bear Creek Tunnel Shaft

Electra Powerhouse

Electra Tailrace

Electra Penstock

Electra Canal

Electra Headworks

Lake Tabeaud

Tabeaud Spillway

Tabeaud Penstock

Tabeaud Tailrace

Tabeaud Canal

Tabeaud Headworks

Upper Bear River Reservoir

Lower Bear River Reservoir

Salt Springs Reservoir

Salt Springs Powerhouse

Salt Springs Penstock

Salt Springs Tailrace

Upper Blue Lake

Lower Blue Lake

Meadow Lake

Twin Lakes

Silver Lake

Highland Lakes

North Fork Mokelumne River

Middle Fork Mokelumne River

South Fork Mokelumne River

Mokelumne River

Big Trees

West Point

Schaads Reservoir

Middle Bar Reservoir

Pardee Reservoir

Pardee Powerhouse

Pardee Penstock

Pardee Tailrace

Pardee Canal

Pardee Headworks

Camanche Reservoir

Camanche Powerhouse

Camanche Penstock

Camanche Tailrace

Camanche Canal

Camanche Headworks

Camanche Dam

Camanche Spillway

Camanche Intake

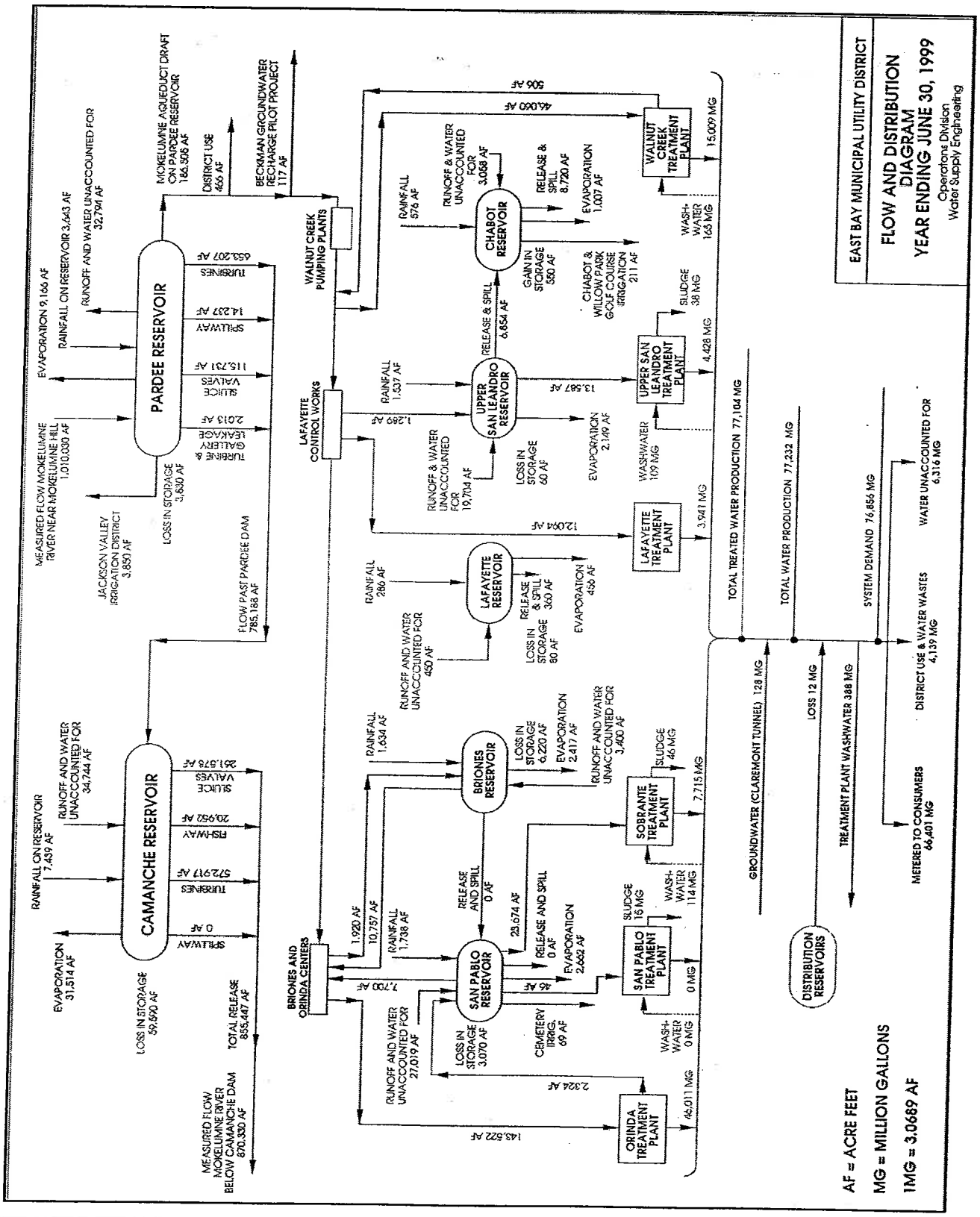
Camanche Tunnel

Camanche Shaft

Camanche Adit

Camanche Pipeline

FIGURE 2-2 – Flow and Distribution Diagram, Year Ending June 30, 1999



Upper Mokelumne Watershed Area Facilities

The Upper Mokelumne Watershed is defined as the watershed lands that contribute to flows in the North Fork, Middle Fork, South Fork, and Mainstem of the Mokelumne River which then drain to Pardee Reservoir (as shown in Figure 2-1). For the purposes of this document, the sub-basin immediately surrounding Pardee Reservoir and extending upstream to include the Mainstem of the Mokelumne River is referred to as Pardee Watershed, as depicted in Figure 2-3 *Pardee Watershed Facilities*.

Mokelumne River water is diverted from Pardee Reservoir at the District's Pardee Outlet Tower. The water is conveyed through the Pardee Tunnel to the Campo Seco facility where it trifurcates to the three Mokelumne Aqueducts. The water then flows by gravity 91.5 miles to the District's service area in the San Francisco Bay Area. In Walnut Creek, the Mokelumne Aqueducts connect with the east terminus of the two Lafayette Aqueducts where it is conveyed directly to several WTPs or stored in the District's Briones, San Pablo, and Upper San Leandro Reservoirs (Figure 2-2).

Pardee Reservoir has 37 miles of shoreline, a maximum storage capacity of 197,950 acre-feet at its spillway crest (elevation 568) and a surface area of 2,257 acres. It is used for municipal water supply and for power generation. In addition, EBMUD operates Pardee Reservoir in conjunction with Camanche Reservoir (and considering available storage in upstream reservoirs) to provide flood control protection for the Lower Mokelumne River area. Water for downstream use is released through the Pardee hydroelectric power plant, through sluice valves at the base of Pardee Dam, or released over the Pardee Dam spillway. The Pardee Outlet Tower is located in the southern part of the reservoir near the dam site. Diversions are typically drawn through gate inlets at elevations 490 and 460 feet.

EBMUD has water rights and facilities to divert up to 325 MGD from the Mokelumne River, subject to the availability of Mokelumne River runoff and the prior water rights of other users. Figure 2-4 provides an overview of the Mokelumne River diversions and flows including the District's water rights. Conditions that restrict the District's ability to use its 325 MGD entitlement include upstream water use by prior right holders, downstream water use by riparian and senior appropriators and other downstream obligations,

drought, or less than normal rainfall for more than 1 year, and emergency outage.

The District's position in the hierarchy of Mokelumne water users is determined by a variety of agreements between Mokelumne water right holders, the appropriative water rights permits and licenses which have been issued by the state, pre-1914 rights, and riparian rights (see Figure 2-5). Before water can be put to use or diverted to storage under the District's water rights, the needs of all senior users and fishery release requirements must be met. Riparian landowners and other individuals and agencies with appropriative water rights that predate the District's rights have claims on the river that are senior to the District's rights.

In addition to the District's Pardee Reservoir facilities, there are five upstream agencies -- Amador Water Agency, Jackson Valley Irrigation District, Calaveras County Public Utility District, Calaveras County Water District, and PG&E -- that have diversion structures and/or powerhouses along the Mokelumne River that can impact the availability of the District's Mokelumne River supplies. With the exception of PG&E, Table 2-1 summarizes the future water demands for these agencies. The following sections address the facilities of these agencies in accordance with its location within the North Fork, Middle Fork, South Fork, or Mainstem Mokelumne River sub-basins of the Upper Mokelumne River Watershed. Of primary importance is PG&E's Project 137 due to its proximity to EBMUD's facilities (most downstream location is approximately 6 miles upstream from the upper reaches of Pardee Reservoir). Approximately 84 percent of the total inflow to Pardee Reservoir originates from the North Fork of the Mokelumne River.[1]

[1] Based on USGS Water Resources Data, Water Years 1930-1999.

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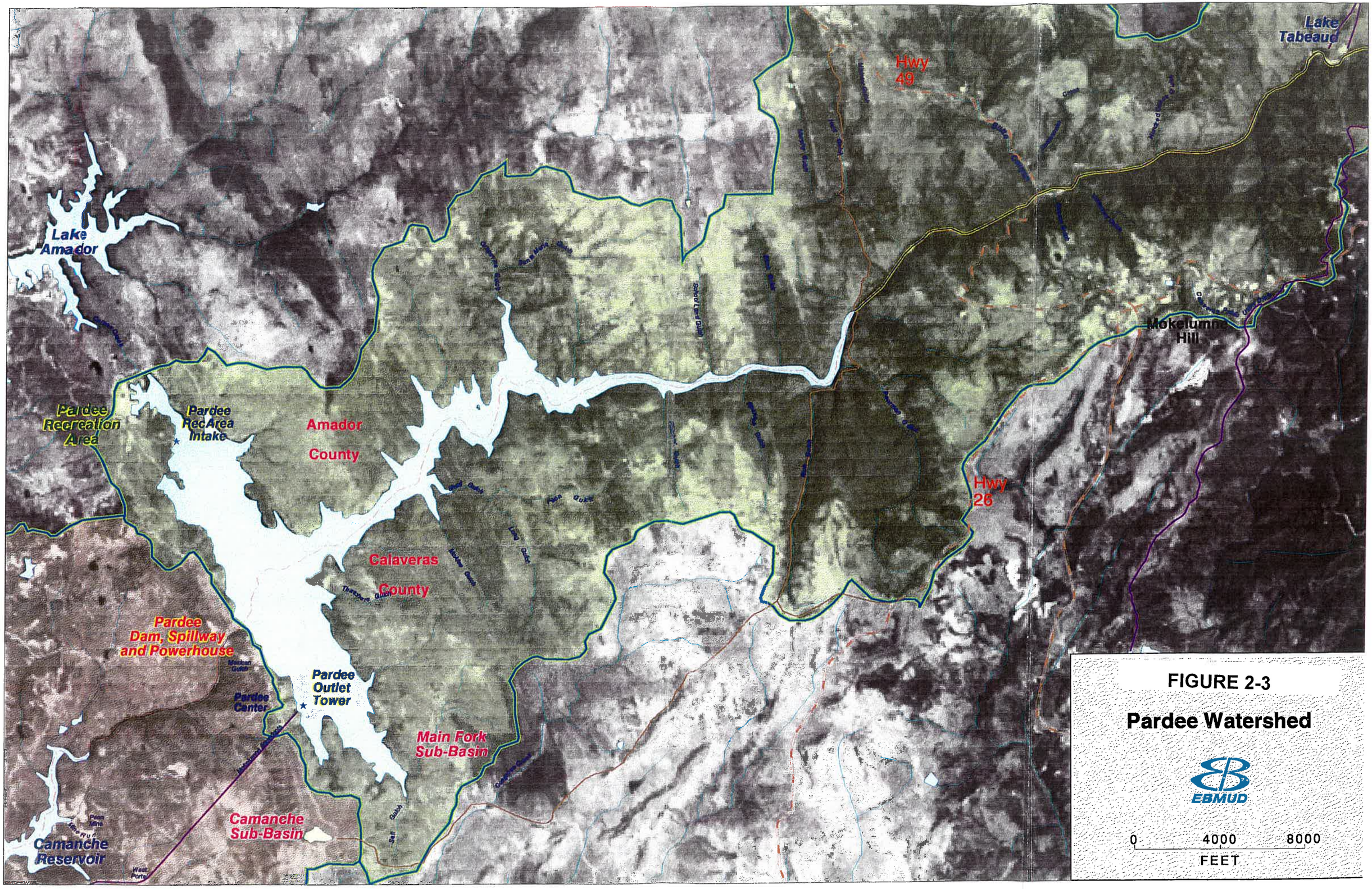


FIGURE 2-3

Pardee Watershed

FIGURE 2-4 – Upper Mokelumne River Diversions and Flow



BASIN RUNOFF	DIVERSIONS & LOSSES	DIVERSIONS AND FLOWS (TAF/YEAR) Maximum	1999 Releases, Diversions, and Losses
	Amador & Calaveras Counties	47.0	15.3
	Mokelumne Hill Gage		880
	Jackson Valley Irrigation District	3.85	3.85
	EBMUD Aqueduct Draft	364.0 (325 MGD)	189
	EBMUD Diversions to Storage	562.9	
	Fish Releases (per Joint Settlement Agreement)	165.9(1)	144
	North San Joaquin Water Conservation District	20.0	2.8
	Woodbridge Irrigation District	60.0 (2)	64.3
	Riparians and Senior Appropriators	20.1	12.6
	Channel Losses	130.0	101.7
	Woodbridge Gage		519.3

Notes:

(1) Fish Releases from Camanche are based on a 2020 Level of Development, 228 MGD Level of Demand Model Study per Joint Settlement Agreement.

(2) Ebmud's obligation to release water to the Woodbridge Irriation District is limited by a series of water rights settlement agreements to a maximum of 60 TAF/yr.

Table 2-1: Present and Future Demands of Agencies Other Than the District (By Type of Water Year)

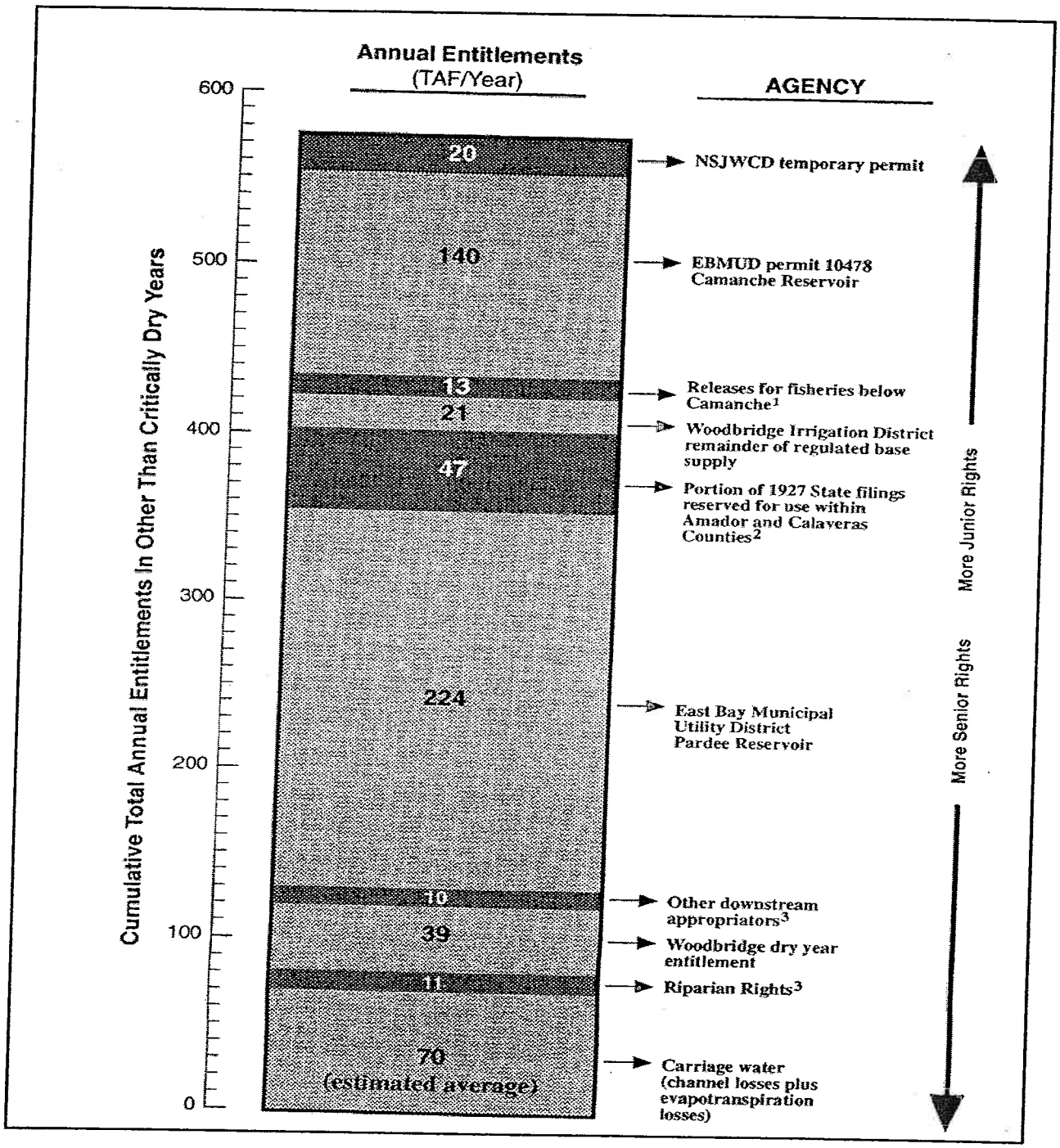
Agency	1990[1]		2020[2]	
	Wet & Normal (ac-ft/yr)	Dry (ac-ft/yr)	Wet & Normal (ac-ft/yr)	Dry (ac-ft/yr)
Amador Water Agency	10,000	10,000	18,040	18,040
Central Amador Water Project	600	600	1,960	1,960
Jackson Valley Irrigation District	3,850	3,850[3]	3,850[3]	3,850[3]
Calaveras Public Utility District	1,482	1,482	4,910	4,910
Calaveras County Water District	498	498	6,762	6,762
TOTAL	16,430	12,580	31,672	31,672

NOTES:

[1] 1990 demands represent an average of actual use from 1980 - 1989.
[2] Demands based on projected growth.
[3] Estimate based on projected shortages in Mokelumne River supplies, no water would be available from this source to satisfy JVID demands.

Source: EDAW, December 1992

FIGURE 2-5 – Hierarchy of Upper Mokelumne River Water Rights & Other Flow Commitments



NOTES:

1. Fish agreement is related to the Camanche permit.
2. Includes pre-1914 water rights.
3. Total of riparian and other downstream appropriations is estimated to be approximately 21 TAF total (10 TAF appropriations + 11 TAF riparian).

North Fork of the Mokelumne River. Two agencies that divert water along the North Fork of the Mokelumne River include PG&E (for hydropower generation) and Amador Water Agency (for consumptive use). The storage reservoir capacities and associated engineering data for the facilities that are managed by PG&E are listed in Table 2-2.

PG&E. The PG&E Mokelumne Hydroelectric Project is operated in accordance with judgments and decrees associated with the City of Lodi and the District. These decrees, commonly known as the "Lodi Decree" define the relative rights of the City of Lodi, PG&E, the District, and areas around Jackson and Sutter Creek. Under the Lodi Decree, PG&E must operate in accordance with a strict set of operating rules that address the timing and quantity of PG&E discharges of water into the Mokelumne River. While these rules limit PG&E's operations, there is sufficient flexibility in the operations such that releases from PG&E's Mokelumne hydroelectric system can have impacts upon the District's exercise of its Pardee and Camanche water rights.

PG&E's Mokelumne Hydroelectric Project consists of seven storage reservoirs (having a combined capacity of about 220,000 ac-ft), various tunnels (16 miles in total length), stream diversions, conduits, regulating reservoirs, and four powerhouses (with a total capacity of 215 megawatts). The four powerhouses include: Salt Springs, Tiger Creek, West Point, and Electra. Electric power generated from these facilities is used to serve the California power grid.

Salt Springs Powerhouse contains two generating units which operate on releases from Salt Springs Reservoir and from Lower Bear Reservoir. Water flowing from the "Old Reservoirs" -- Upper and Lower Blue Lakes, Meadow Lake, and Twin Lakes -- on the North Fork is stored at Salt Springs Reservoir. Water is then diverted from Salt Springs Reservoir through a 945-foot long tunnel. A 475-foot long penstock then conveys water to Salt Springs Powerhouse Unit 1. Water diverted from Bear River and Cole Creek is stored in Upper and Lower Bear River Reservoirs and is conveyed by 13,214 feet of tunnel and 4,679 feet of penstock to the Salt Springs Powerhouse Unit 2. After passing through the two turbines, a maximum of 550 cfs is diverted to Tiger Creek conduit; the remainder is returned to the North Fork of the Mokelumne River.

Tiger Creek Powerhouse receives water directly from the tailrace of the Salt Springs Powerhouse through the 20.3-mile long Tiger Creek conduit. The upper section of the conduit discharges to the Tiger Creek Regulator. The lower section extends from the regulating reservoir to the Tiger Creek Forebay. The Tiger Creek conduit is a rectangular concrete bench flume, except for short tunnels and siphon sections. Facilities along the conduit divert waters from Bear River and four small creeks. Maximum capacity is 550 cubic feet per second in the upper section. The lower section can convey a maximum of 625 cfs. The Tiger Creek Afterbay is located on the North Fork and receives water directly from the Tiger Creek tailrace.

An agreement between the District and PG&E enables PG&E to take the Tiger Creek conduit out of service for periods of up to 15 consecutive days, on the condition that at least 50 percent of any shortfall in required PG&E flows is provided to the District prior to the start of the canal outage, and the remainder of the shortfall made up after the canal is returned to service. The primary activity requiring outage of the Tiger Creek conduit is to perform annual mechanical cleaning of the canal.

The West Point Powerhouse receives water directly from the Tiger Creek Afterbay by means of a 14,200-foot tunnel -- the West Point Tunnel. A 623-foot long penstock conveys water from the tunnel and from the North Fork Mokelumne River to the powerhouse. Water exiting the West Point Powerhouse flows from the tailrace to a 35 acre-foot pond created by the Electra Diversion Dam which, in turn, provides water for the Electra Powerhouse. Additional water from the North Fork can also be diverted to the Electra Tunnel.

Table 2-2: Upper Mokelumne River and Camanche Watershed Storage Reservoir Summary

Storage Reservoir	Maximum Capacity (acre-ft)	Surface Area (acres)	Maximum Water Surface Elevation (ft)	Dam Crest Length (ft)	Type of Structure	Year Storage Began	Drainage Area (sq mi)
Upper Blue Lake	7,300	343	8,138	837	Earth & Rock Fill	1881	2.7
Lower Blue Lake	5,091	198	8,053	1,063	Earth & Rock Fill	1885	4.6
Twin Lake	1,207	106	8,145	1,520	Earth & Rock Fill	1898	0.8
Meadow Lake	5,656	140	7,774	775	Rock Fill/Gunite Face	1903	5.5
Upper Bear River	7,306	173	5,878	1,121	Rock Fill/Gunite Face	1900	28
Lower Bear River	52,025	746	5,822	979/865	Rock Fill/Concrete Face	1952	37
Salt Springs	141,857	963	3,960	1,945	Rock Fill/Concrete Face	1931	169
Tiger Creek Forebay	39	2.3	3,559	900	Earth Fill	1931	NA
Tiger Creek Regulator	533	13	3,587	510	Concrete Slab & Buttress	1931	9
Tiger Creek Afterbay	2,607	70	2,334	448	Concrete Arch Dam	1931	357
Lake Tabeaud	1,259	44	1,966	636	Earth Fill	1901	0.75
Electra Afterbay	40	--	672	319	Concrete Gravity	1948	NA
Electra Diversion	35	--	2,029	188	Concrete Gravity	1931	NA
Middle Fork (Schaad's)	1,700	45	3,020	900	Earth Fill	1939	28.5
Pardee	209,900	2,300	567	1,377	Curved Concrete Gravity	1929	578
Camanche	417,120	7,470	235	2,640	Earth & Rock Fill	1963	621

Sources: (1) PG&E Proponent's Environmental Assessment, Vol. 9, Appendix C Water Supplement.
(2) USGS, Water Resources Data for California, Vol. 3
(3) CA Dept. of Water Resources, Bulletin 17-88, October 1988, Dams Within Jurisdiction of the State of California

NA = Not Applicable

Water travels 43,200 feet through the Electra Tunnel and is discharged into Lake Tabeaud which serves as a forebay to the Electra Powerhouse. Some water is diverted from Lake Tabeaud into the Amador Canal for domestic and irrigation uses within Amador County. Water that is not diverted from Lake Tabeaud by the Amador Canal is conveyed to the powerhouse through about 4,000 feet of penstock. Electra Powerhouse has three turbine-generator units each having a capacity of 350 cfs. Water discharged from Electra Powerhouse returns to the main stem of the Mokelumne River and then flows about five miles downstream into Pardee Reservoir.

Amador Water Agency. The Central Amador Water Project is owned and operated by the Amador Water Agency. The agency has entitlements from the Mokelumne River that allows it to divert 1,600 acre-feet of water from the Mokelumne River. Water is diverted from the Tiger Creek Afterbay and lifted 1,230 feet to treatment facilities on the Highway 88 ridge.

Middle and South Forks of the Mokelumne River. Two agencies that divert water along the Middle and South Forks of the Mokelumne River include Calaveras Public Utility District and Calaveras County Water Agency. Table 2-1 documents the future water demands of these agencies and Table 2-2 summarizes the storage reservoir capacities and associated engineering data.

Calaveras Public Utility District. The Calaveras Public Utility District (CPUD) services approximately 1,800 households in the communities of San Andreas and Mokelumne Hill. CPUD diverts water to storage in Schaad's Reservoir. The Middle Fork Ditch (Sandy Gulch or Harris Ditch) begins at a pool below Schaad's Reservoir and intercepts the Licking Fork at about one-mile above its confluence with the South Fork. These supplies are then pumped to the Jeff Davis Reservoir in the Calaveras River Watershed through a 20-inch diameter steel transmission pipeline, for treatment and distribution to local customers (EDAW, Inc.; December 1992, and February 1985). Jeff Davis Reservoir, which has a storage capacity of 2,000 acre-feet, also receives water supplies from other sources in the Calaveras River watershed.

The 1940 and 1970 agreements between CPUD and the District entitle CPUD to divert up to 2,130 acre-feet annually to storage, and up to 15 cfs for direct offstream use. The projected water demand from the Mokelumne River by CPUD in the year 2020 is 4,910 acre-feet. The Mokelumne Hill Ditch (owned and operated by CPUD) on the South Fork of the Mokelumne River has been out of service since 1974 and is not anticipated to be used in the future due to excessive leakage.

Calaveras County Water District. Calaveras County Water District (CCWD) diverts water through its West Point diversion from Bear Creek, approximately 6 miles above the confluence with the Middle Fork. CCWD's entitlement is for up to 400 acre-feet per year, at a rate not to exceed 6 cfs, in conformance with the 1958 and 1964 agreements between CCWD and the District. Projected demand may increase to 6,800 acre-feet per year by the year 2020.

Wilseyville receives its water from a diversion on the Middle Fork, about two miles above the Highway 26 river crossing.

Mainstem of the Mokelumne River. For the purposes of this document, the portion of the Mokelumne River (including Pardee Reservoir) that extends upstream from Pardee Dam to the confluence of the North and South Forks is referred to as the Mainstem of the Mokelumne River. The three agencies that divert water along the Mainstem of the Mokelumne River include Jackson Valley Irrigation District, Amador Water Agency, and PG&E. Table 2-1 documents the future water demands of these agencies and Table 2-2 summarizes the storage reservoir capacities and associated engineering data for these facilities.

Jackson Valley Irrigation District. The Jackson Valley Irrigation District (JVID) provides irrigation water to farmlands in the lower elevations of Amador County. Water for use by JVID is diverted at the Jackson Creek spillway structure on the north arm of Pardee Reservoir into Carson Creek for export to Lake Amador. JVID has an entitlement to divert up to 3,850 acre-feet annually from Pardee Reservoir under an assignment of the 1927 State Department of Finance filing, and also maintains water rights to divert up to 6,000 acre-feet per year from Jackson Creek.

Amador Water Agency. The Amador Canal is owned and operated by the Amador Water Agency (AWA). Water is diverted from Lake Tabeaud through the canal to purveyors for Jackson, Ione, Amador City, Sutter Creek, and Drytown. The Lake Tabeaud contract with PG&E allows 15,000 acre-feet to be diverted into the canal during normal and wet years. The diversion is subject to a 25 percent reduction in dry years but delivers only about half of this supply because of conveyance losses. A potential for shortages by the year 2000 was noted within the 1995 MRWSS if additional improvements were not made to the system. AWA also operates a raw water diversion from Tiger Creek Afterbay into the Central Amador Water Project (CAWP) to serve the communities of Pioneer and Pine Grove. AWA's entitlements are subject to 1977 and 1978 agreements among AWA, EBMUD, Amador County, and Pioneer Community Services District. Although the Amador Canal was purchased by AWA from PG&E in 1985, PG&E retained ownership of the water rights.

PG&E. The Electra Powerhouse facility briefly mentioned under the North Fork section is located on the Mainstem of the Mokelumne River. As previously mentioned, water which travels 43,200 feet through PG&E's Electra Tunnel in the North Fork sub-watershed is discharged into Lake Tabeaud which serves as a forebay to the Electra Powerhouse. Water that is not diverted from Lake Tabeaud by the Amador Canal is conveyed to the powerhouse through about 3,400 feet of penstock. Electra Powerhouse has three turbine-generator units each having a capacity of 350 cfs. Water discharged from Electra Powerhouse returns to the Mainstem of the Mokelumne River and then flows about five miles downstream into Pardee Reservoir.

Camanche Watershed Area Facilities

Figure 2-6 depicts the Camanche Watershed, Camanche Reservoir and its corresponding facilities. Camanche Reservoir is located 10 miles downstream from Pardee Reservoir. It has 63 miles of shoreline, a maximum storage capacity of 417,120 acre-feet, and a maximum water surface area of 7,470 acres. Camanche Dam is a gravel and earthfill structure that rises 171 feet above the Mokelumne River riverbed. The main dam has a crest length of 2,640 feet and there are approximately 4 miles of earthen dikes.

Camanche Reservoir is operated in tandem with Pardee Reservoir to provide water for downstream fisheries and environmental

needs, irrigation and streamflow regulations, recreation, flood control, water supply, downstream water rights holders, and hydroelectric power generation. A 10.6 megawatt power plant at the dam generates approximately 40 million kilowatt hours of energy in average or above average years. While stored water is released to meet obligations to downstream water rights holders, storage withdrawals are also made to supply the Camanche South Shore recreation facilities and community. Additional downstream releases are made to supply the California Department of Fish and Game (CDF&G) operated fish hatchery and to satisfy Mokelumne River instream fish flow requirements.

Terms in the District's water rights permit for its Camanche Reservoir project required the District to reach agreement with the CDF&G regarding releases for the protection of fish in the lower Mokelumne River and to provide the opportunity for local or federal participation in flood control. Accordingly, in 1961, the District entered into an agreement with CDF&G that required the District to build a fish hatchery at the toe of Camanche Dam and to release from Camanche Reservoir 13,000 acre-feet annually, in addition to the releases for the Woodbridge Irrigation District, riparian and senior appropriators, and channel losses, for fishery protection. The District also reached agreement, in 1962, with the U.S. Army Corps of Engineers for the operation of the proposed Camanche Reservoir to accommodate the reservation of up to 200,000 acre-feet of flood control space for the protection of downstream areas in San Joaquin County. Management of the Mokelumne River Fish Facility, including the timing and amounts of water to be released downstream for fishery benefits, was further defined in a Joint Settlement Agreement (JSA), effective November 27, 1998 between the U.S. Fish and Wildlife Service, California Department of Fish and Game, and the District.

Reservoir Releases

Water is released from Pardee Dam into the Mokelumne River above Camanche Reservoir which is released from Camanche Reservoir into the Mokelumne River to meet the water rights of downstream users and fishery protection needs. Figure 2-7 depicts the average monthly reservoir releases for both Pardee and Camanche Reservoirs for the 1974 through 1999 period. Releases from the reservoirs vary greatly from year to year but generally peak in June for Pardee Reservoir and March for Camanche Reservoir.

Reservoir Operations

There are a number of criteria under which both Pardee and Camanche Reservoirs are operated. Water rights, water quality, flood control, storage, water supply, and power generation are main categories of operating criteria used for both reservoirs. Each criterion is discussed below as it pertains to each reservoir. Given that thermal stratification is a common criteria used for both reservoirs it is discussed herein. Pardee and Camanche Reservoirs are managed to maintain thermal stratification of the water column as late as possible in the fall. Stratification in Camanche Reservoir through the end of October is enhanced by providing cold water releases from Pardee Reservoir when necessary. Preserving as much cold water in Camanche Reservoir as practical, while at the same time providing Camanche's warmer water to the downstream fishery, is met by releasing Camanche's warmer, upper level water through the high-level outlet, generally during the period January through April, or as late as July depending on ambient river temperatures. Cold water is preserved in Pardee Reservoir during the period March through September for release during October by directing water available for Pardee power generation early in the year through Units No. 1 and No. 2 (high level Pardee release) as a first priority, within practical limits, and then through Unit No. 3 (low level Pardee release). Pardee Reservoir is typically operated with the objective of not spilling. Releases from Pardee to Camanche during October are directed through Pardee Unit No. 3 as a first priority to provide cold water to maintain stratification in Camanche Reservoir during the fall.

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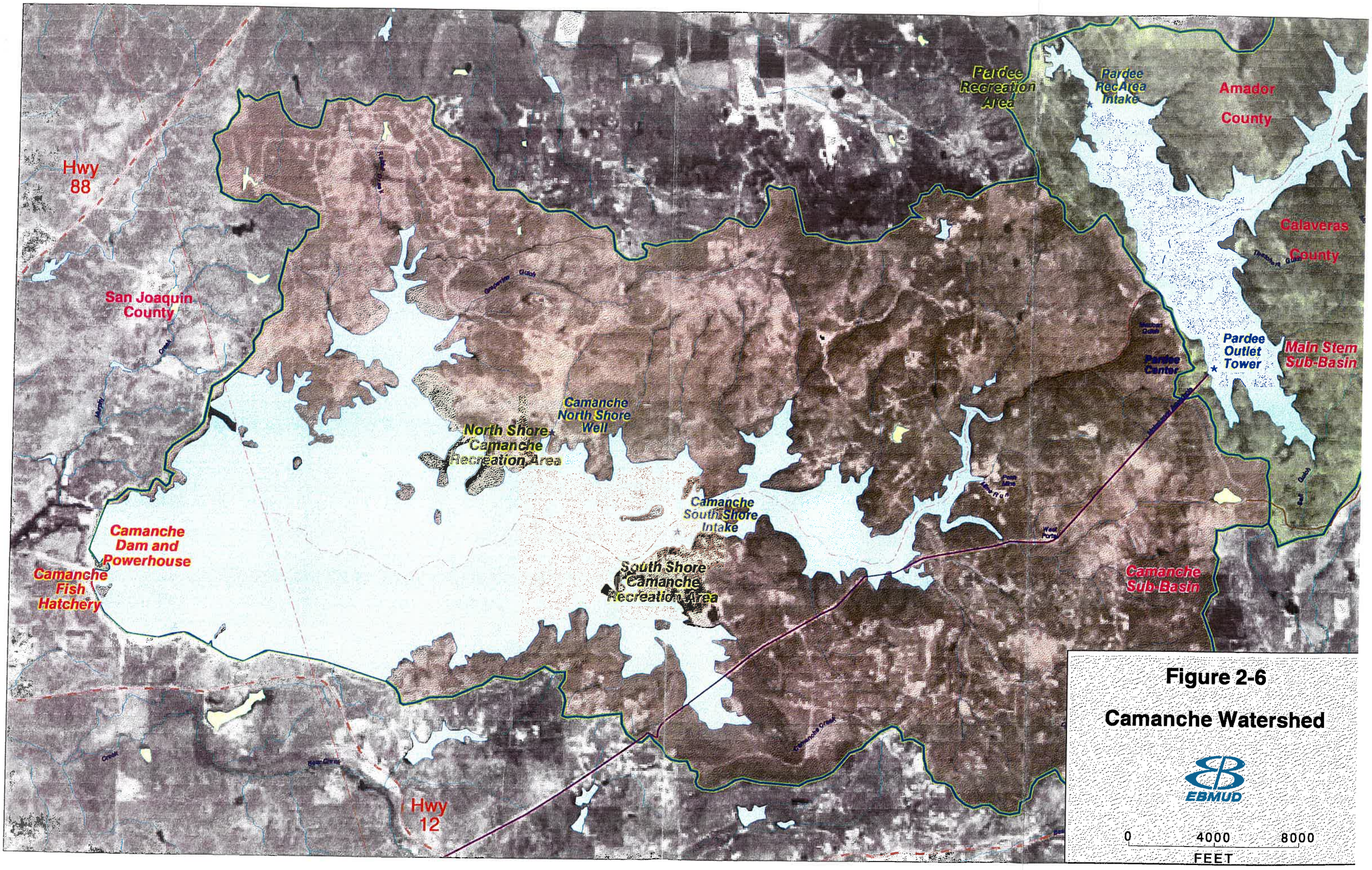


Figure 2-6

Camanche Watershed

In addition to thermal stratification criteria, both Pardee and Camanche Reservoirs are operated to meet a common carryover storage requirement. Pardee and Camanche Reservoirs are operated each year with the objective of achieving a combined storage on October 31 which meets, but does not exceed, flood control space requirements (no excess space). Pardee Reservoir is operated with the objective of maintaining at least 161,000 acre-feet of storage (elevation 550 feet) by October 31st of each year. Camanche Reservoir's storage can be as high as 320,000 acre-feet (elevation 222 feet) if the upstream PG&E reservoirs are providing maximum flood control space credit. However, storage at Camanche Reservoir between 290,000 acre-feet (elevation 217 feet) and 310,000 acre-feet (elevation) are much more typical on October 31st.

Pardee Reservoir Operations. Pardee Reservoir is operated with the objective of not spilling. Sluicing is initiated when inflows are in excess of full generation amounts. Power generation, fish requirements, water rights storage, and diversions are the additional key operating criteria for Pardee Reservoir, which are highlighted below.

Power Generation. Pardee Reservoir is operated at or above elevation 550 feet whenever possible provided all other criteria can be met. Power generation efficiency begins to decline when the water surface drops below elevation 550 feet. A drawdown below elevation 547 feet impacts operation of the Pardee Recreation Area launching facilities.

Fish and Aquatic Resources Requirements. Sufficiently broad operating ranges, usually +/- 1.5 feet, are provided for Pardee Reservoir operations in order to minimize the frequency of release rate adjustments. An additional objective of no more than two adjustments each week is used to minimize the impact to aquatic resources affected by reservoir level fluctuations. Minimizing reservoir level fluctuation is most critical during the period May through August.

Decreases in Pardee Reservoir releases from September through April are ramped whenever flows are reduced below 400 cfs in order to avoid stranding Kokanee salmon or rainbow trout fry. Ramping criteria provide that flow reductions below 400 cfs will be made at a maximum rate of change of 100 cfs every hour. Ramping is not required from May through August. Ramping is not required for flow increases.

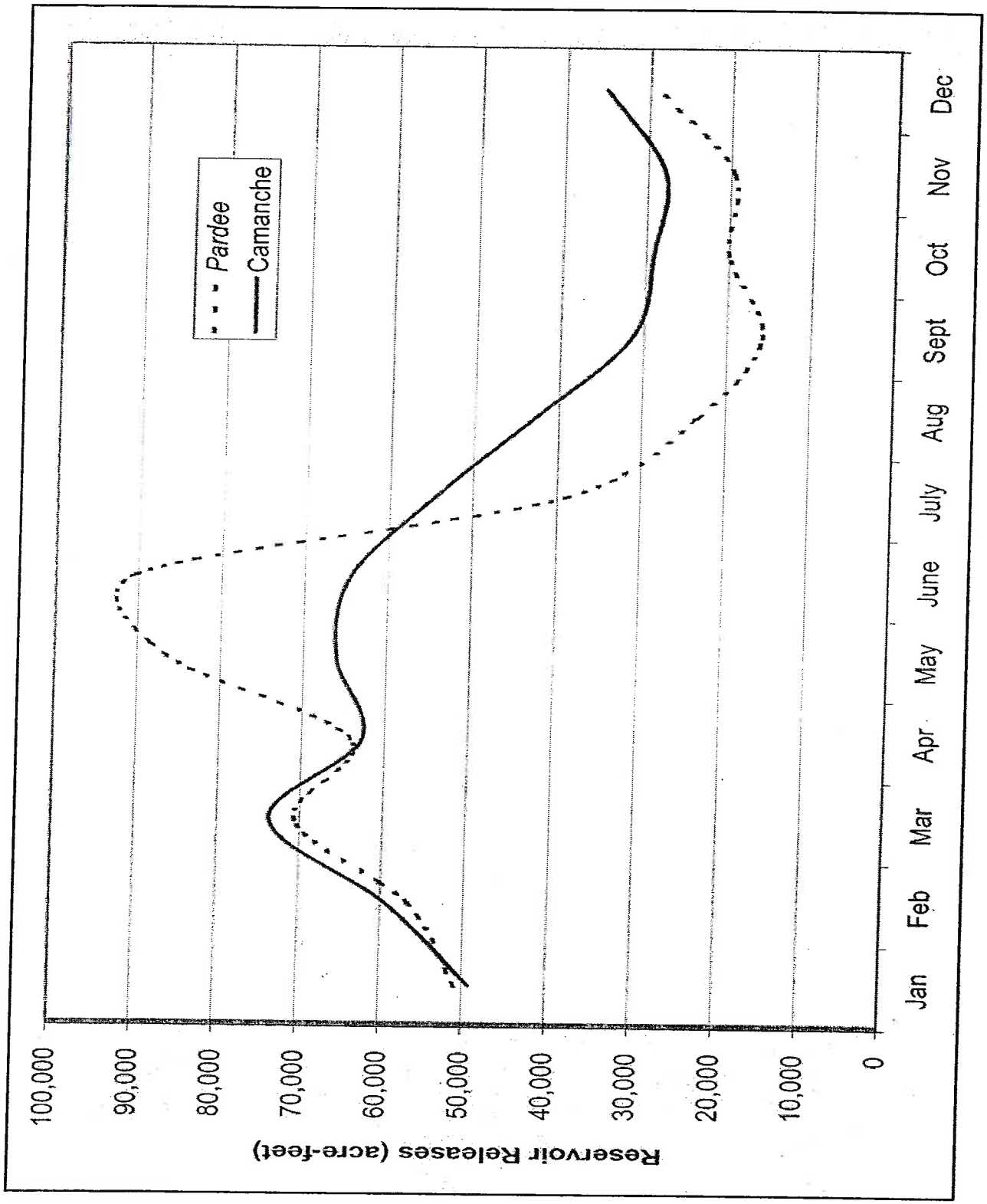
Water Rights Storage. Water will not be stored in Pardee Reservoir, other than temporary pondage, from July 31st through October 1st.

Diversions. Subject to the availability of water under Jackson Valley Irrigation District's water right, a maximum of 3,850 acre-feet of water per year can be diverted past Pardee's North Spillway to Jackson Creek. Release of this water from Pardee Reservoir is limited to a maximum diversion rate of 50 cfs and typically occurs during the period March through October.

Transfer of water to the East Bay to meet in-line water treatment plant demands, and to meet East Bay reservoir storage objectives, is conducted under gravity flow conditions whenever possible to minimize raw water pumping costs. Figure 2-8 depicts the average daily draft from Pardee Reservoir to the Mokelumne Aqueducts for the 1974 through 1999 period. As shown in Figure 2-8, the average daily draft peaks in the June through August period. As demand for water gradually increases, operation of the District's Walnut Creek Pumping Plants will occur more frequently, particularly during the period July through September.

Camanche Reservoir Operations. The additional key operating criteria for Camanche Reservoir include: flood control, fishery requirements, water quality, temperature management, water rights storage, diversions, riparian diversions and appropriators, carriage water, and gravel replacement. Each of these key-operating criteria is highlighted below.

FIGURE 2-7 – Pardee and Camanche Reservoirs – Average Monthly Reservoir Releases



Flood Control. The Corps of Engineers (COE), Camanche Dam and Reservoir Water Control Manual requires that a combined storage reservation of up to a maximum of 200,000 acre-feet be maintained in Camanche and Pardee Reservoirs between September 15th and July 31st of each year. A portion of the 200,000 acre-feet of flood control reservation may be transferred (up to a maximum of 70,000 acre-feet) to available space in PG&E's Salt Springs and Lower Bear Reservoirs. At all times, releases from Camanche are restricted insofar as possible to quantities which will not cause flows in the Lower Mokelumne River (below Camanche Dam) to exceed the controlling flow rate of 5,000 cfs. When space is available for flood control that is less than required, water is released from Camanche Reservoir as rapidly as possible, in consultation with the COE and in consideration of current conditions.

EBMUD's operating criteria for Camanche Reservoir includes limiting flood control release increases (when possible) to a maximum rate of change of 400 cfs every three hours. Flood control flow release reductions are made at a maximum rate of 400 cfs per day during periods of flood space encroachment. When flood control releases are not being made, river flow reductions will not exceed 50 cfs per day October through March, and not more than 100 cfs per day at other times consistent with FERC requirements. The reason for the gradual reduction in the release rate is to avoid river bank sloughing, which could occur during rapid drawdown, since the river banks and levees become saturated during extended periods of high flows, and to help prevent stranding of fish that may be occupying habitat in flooded areas and near the edges of the river as water drains toward the main channel. Flood control flow changes, for both increases and decreases, at ramping rates higher than specified above, are permitted by the District's agreement with the COE (up to a maximum change of 1,000 cfs every two hours), and are made when necessary.

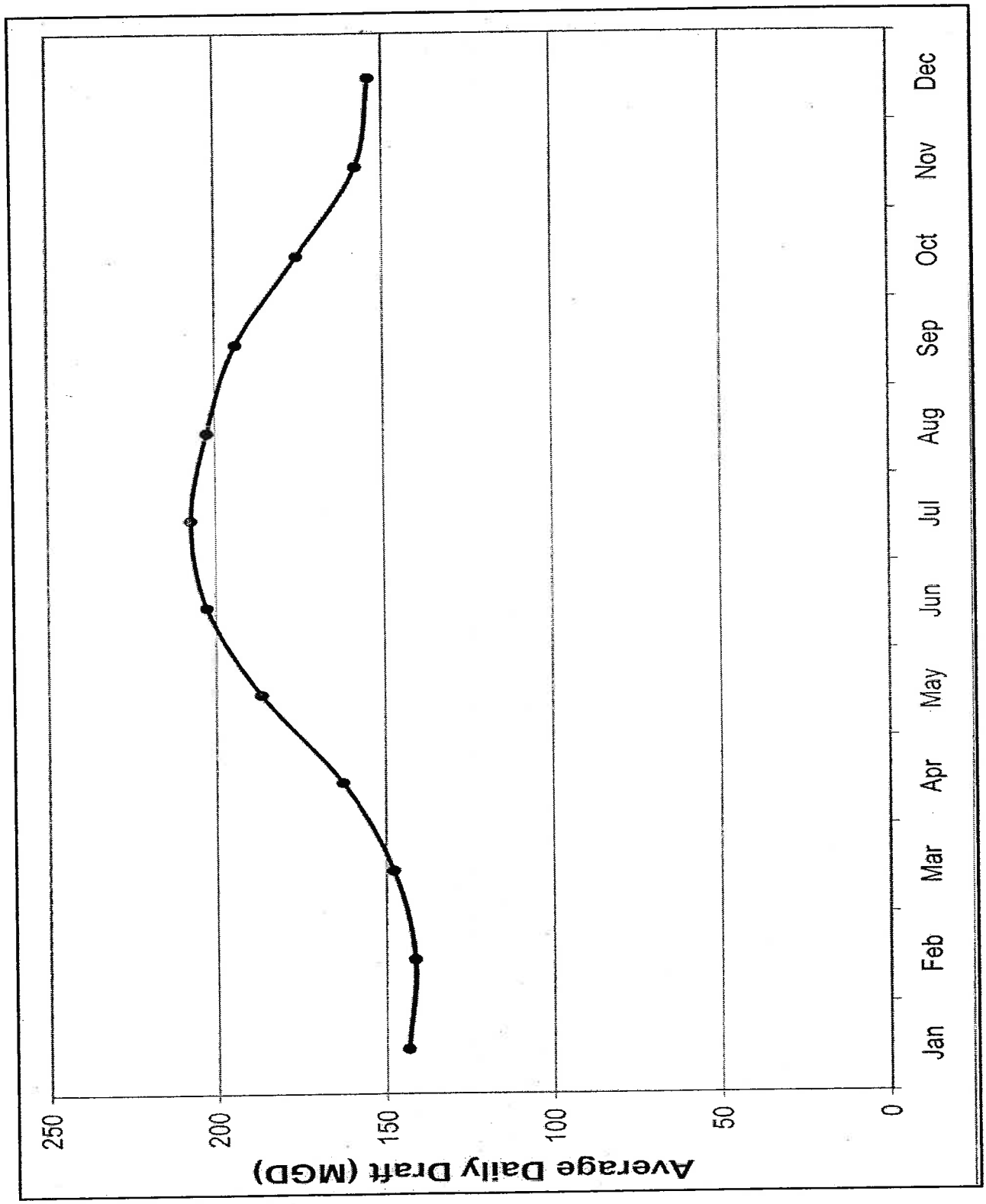
Fishery Requirements. Releases from Camanche Reservoir are made to meet the FERC-approved JSA minimum flows for downstream fisheries with additional releases made as necessary to meet flood control requirements. Release changes start one day before the required date and end one day after, to assure that fisheries flows are met at Camanche Reservoir and below the Woodbridge Dam.

Water Quality. The District's Hypolimnetic Oxygenation System (HOS), which feeds pure oxygen into deeper, colder (hypolimnetic) portion of Camanche Reservoir, is designed to prevent the bottom waters from going anoxic, thereby preventing the natural formation of hydrogen sulfide (H_2S). The HOS is started during the period May through October when the dissolved oxygen (DO) level in the hypolimnion of Camanche Reservoir is projected to drop to 2 mg/L (at the lower elevations near Camanche Dam). The HOS will be started by September even if DO have been above 2 mg/L and will remain in service until at least reservoir turnover in the fall.

An additional back-up treatment system to neutralize H_2S is to use the potassium permanganate treatment system located in the Camanche Dam valve house. The potassium permanganate treatment system is considered an emergency back-up system for the hatchery, since the HOS is considerably more efficient, and provides benefit to the hatchery and the Mokelumne River below Camanche Dam.

Power generation at Camanche Power Plant is reduced or suspended and releases are redirected through the sluice valves as necessary to assure meeting a minimum downstream DO level of 7.0 mg/L below Camanche Dam. Transfer of releases from generation to sluice to manage DO is not required in all years. When this form of DO management is required, generation is typically impacted starting in August and some years as early as June, and may be required through November.

FIGURE 2-8 – Average Daily Draft from Pardee Reservoir to Mokelumne Aqueducts



Temperature Management. During the summer and early fall, maintaining the temperature of the water supply to the Mokelumne River Fish Hatchery and to the Mokelumne River below Camanche Dam below 15.5°C or less is considered acceptable to provide cold water during the migration and spawning period (October through December). In order to increase the growth rate and promote earlier out-migration of Chinook salmon juveniles in spring -- particularly during March, April, and May -- the Camanche high-level outlet is opened to draw Camanche Reservoir's warmer, upper-level water into the Mokelumne River below Camanche Dam. The trigger for closing the high-level outlet is 18°C at Woodbridge, or August 1st, which ever occurs first.

An additional consideration in operating the Camanche high-level outlet is that vortexing in the vicinity of the outlet occurs when the water surface falls below approximately elevation 215 feet and prevents maximizing high-level releases. Re-scheduling releases from Pardee to Camanche Reservoir is considered in the event that the water surface of Camanche Reservoir is projected to drop below elevation 215 feet.

Water Rights Storage. Water is not diverted to storage in Camanche Reservoir between July 1st and December 1st, except on a short-term basis consistent with the need to maintain stratification in Pardee and Camanche Reservoirs.

Diversions. Camanche Reservoir releases can include water for diversion by the North San Joaquin Water Conservation District up to a maximum of 20,000 acre-feet per year, subject to availability under their water entitlement. Annual diversion quantities since 1995 have typically been 3,000 acre-feet or less.

Releases from Camanche Reservoir also include water for the Woodbridge Irrigation District. The Woodbridge Irrigation District is entitled to receive a regulated supply of 60,000 acre-feet of water whenever water year inflows to Pardee Reservoir are projected to exceed 375,000 acre-feet. Also, Woodbridge may divert water in addition to its base supply derived from surplus water abandoned by the District and released from Camanche Reservoir. The availability of excess water for additional diversion from Woodbridge depends upon actual rainfall and runoff conditions. Deficiencies of up to 35 percent of the regulated base are imposed if water-year inflows to Pardee Reservoir are projected to be less than 375,000 acre-feet.

Riparian and Appropriators. Releases from Camanche Reservoir include water for use by riparian diversions and appropriators estimated to be 20,800 acre-feet during near-average runoff years.

Carriage Water. Lower Mokelumne River carriage water releases are made to assure that all downstream flow requirements are fully met. Carriage water includes losses due to evaporation, seepage from the river, evapotranspiration by riparian vegetation, and water necessary for daily fluctuations to assure net positive flow at all times -- minimum flow of 10 cfs at Frandy near Thornton.

Gravel Replacement. Consistent with meeting all downstream release requirements, and within practical operating limits, the rate of release from Camanche Reservoir is reduced to 400 cfs or less for a minimum duration of two weeks prior to September 15th, in order to facilitate the placement of spawning gravels below Camanche Dam.

Outlet Tower Locations and Protection Features

The locations of the District's outlet towers are shown in Figure 2-3 (Pardee Reservoir) and Figure 2-6 (Camanche Reservoir). All of the District's outlet towers are protected by exclusion zones with warning signs posted on the reservoir and shorelines.

The Pardee Outlet Tower has gates (at elevations 550 feet, 520 feet, 490 feet, and 460 feet) which are operated to obtain the best quality water available at the outlet tower for diversion to the District's service area. Reservoir turbidity and algae data is used to determine which outlet gates are to be open at any one time.

Chemical Additions to Raw Water

The Pardee Chemical Building located at Pardee Center is operated to maintain pH and disinfection levels in the water being conveyed through the Mokelumne Aqueducts. Lime is added at Pardee Center to maintain a target pH of 8.7 to 8.9. This target pH is required to protect the aqueduct steel pipe wall from corrosion and to control lead and copper corrosion in the District's treated water distribution system.

The District adds chlorine solution in the form of sodium hypochlorite to the Mokelumne Aqueducts to control biological growth and meet the disinfection (Ct) requirement of the SWTR. Sodium hypochlorite is added at Pardee Center and, if needed again, at Bixler Chemical Facility in the Sacramento-San Joaquin Delta.

Water Treatment Plant Facilities and Operations

EBMUD operates a total of seven water treatment plants (WTPs) -- three large systems and four small systems -- that treat water from either the Pardee or Camanche Reservoirs. The three large systems (serving over 10,000 people each) are the Walnut Creek, Orinda, and Lafayette WTPs located in the District's East Bay service area. These water treatment plants treat Mokelumne River water transported from Pardee Reservoir through the Mokelumne Aqueducts (refer to Figure 2-2 for a schematic diagram showing the flows and distribution to these water treatment plants). The four small systems (serving less than 10,000 people each) are the Pardee Recreation Area, Pardee Center, Camanche South Shore, and Camanche North Shore WTPs. Pardee Recreation Area and Pardee Center WTPs treat Pardee Reservoir water. Camanche South Shore WTP treats Camanche Reservoir water. Camanche North Shore WTP treats groundwater from three wells.

Pardee Recreation Area Water Treatment Plant

The Pardee Recreation Area WTP serves a transient, non-community small water system which is located on the north shore of Pardee Reservoir. The water treatment plant intake is located south of the Recreation Area marina (Figure 5-1). The maximum capacity of the plant is 100 gpm. Raw water is pumped through a 6-inch pipeline from the reservoir by two, 100 gpm pumps mounted on a floating platform. The intake depth is suspended approximately 40 feet below the water surface. An exclusion zone restricts recreation in proximity to the intake both from the shore and from the reservoir. The Pardee Recreation Area WTP employs membrane filtration and uses sodium hypochlorite for disinfection. The sodium hypochlorite is stored in 50-gallon containers with spill containment around each.

Pardee Center Water Treatment Plant

The Pardee Center WTP is a non-transient, non-community small water system which is located on the west shore of Pardee Reservoir. The water treatment plant intake is located adjacent to the Pardee Outlet Tower along the southwestern arm of Pardee Reservoir (Figure 5-2). The maximum capacity of the plant is 10 gpm. Raw water is pumped from the reservoir by two, 100 gpm pumps through a 6-inch pipeline. An exclusion zone restricts recreation in proximity to the intake both from the shore and from the reservoir. Similar to the Pardee Recreation facility, the Pardee Center WTP employs membrane filtration and uses sodium hypochlorite for disinfection. The sodium hypochlorite is stored in 50-gallon containers with spill containment around each. Soda ash is used for corrosion control.

Camanche South Shore Water Treatment Plant

The Camanche South Shore WTP supplies the Camanche South Shore Recreation Area and adjacent residences. The maximum capacity of the plant is 480 gpm. The outlet tower supplying the water treatment plant is located about 1,200 feet from the shore along the north side of the recreation area (refer to Figure 5-16). A minimum 500-foot protection zone is established around the intake location. Raw water is continuously withdrawn from Camanche Reservoir by two, 250 gpm pumps mounted on a floating platform which draw water from a depth of 32 feet below the surface of the water. Treatment consists of the addition of coagulant and coagulant-aid; in-line filtration through two banks of four filters each; and pre-filtration and post-filtration chlorination. Filtration consists of eight dual media, anthracite/sand, filters with each 20 square foot filter rated at 3 gpm/sf. Equipment for pH adjustment has been installed to aid in corrosion control and compliance with the Lead and Copper Rule.

Camanche North Shore Water Treatment Plant

The Camanche North Shore WTP is a small water system that supplies the Camanche North Shore Recreation Area with potable water (Figure 5-17). The source of supply for the Camanche North Shore Recreation Area is groundwater drawn from three wells. Table 2-3 contains information on the Camanche North Shore WTP well system. The raw water is treated by two manganese greensand filters and chlorination to reduce the iron and manganese in the source water. Calcium hypochlorite is stored in dry 100-pound sacks and potassium permanganate used during treatment is stored in 200-gallon double-walled containers. Spill containment facilities are provided.

Walnut Creek Water Treatment Plant

Walnut Creek WTP generally treats Mokelumne Aqueduct water from Pardee Reservoir. Due to the high quality of the Mokelumne Aqueduct water, the Walnut Creek WTP was designed and permitted to operate as an in-line water treatment plant. In emergency situations water from Briones Reservoir can also be treated at the Walnut Creek WTP. Pre-treatment consists of coagulant (polyaluminum chloride and cationic polymer) and sodium hypochlorite addition at the rapid mix. The plant has four gravity filters with anthracite/sand media. Sodium hypochlorite, fluoride and caustic soda are added in the combined filter effluent pipe before the treated water is delivered into an open-cut clearwell. Ammonia is added to the clearwell effluent. The level of the clearwell is controlled by the District's Operation Control Center (OCC) in Oakland.

Backwash water is discharged to a one million-gallon washwater basin. Anionic polymer is added to the waste washwater to improve solids settling. Supernatant from the waste washwater basin is pumped into the Lafayette Aqueduct #2 downstream of Walnut Creek WTP influent turnout. Sludge from the washwater basin is periodically drained and hosed to a 0.5-MG sludge detention basin prior to removal by trucks to the District's wastewater plant (SD1).

Until 1999, the filters were permitted by the California Department of Health Services (DHS) to operate at a maximum rate of 6 gpm/sf, i.e., 20 MGD per filter. This limited the plant capacity to 80 MGD with all four filters on-line and 60 MGD with one filter off-line. However, the maximum summer demands have been steadily increasing to above 80 MGD and there is an obvious need for increased plant capacity. In 1998, the District initiated a high-rate filtration demonstration project, which indicated that, the Walnut Creek WTP filters could be operated at higher rates with acceptable water quality. As a result of this demonstration study, in April 1999, DHS granted permission to operate the filters at rates up to 8 gpm/sf provided that the raw water turbidity remains less than 1.0 NTU and the District suspends time-of-use pumping operations.

Table 2-3: Camanche North Shore WTP Well System

	Construction Date	Depth	Well Capacity (varies w/head)
Well #2	1977	320 ft.	150 gpm max.
Well #3	1979	228 ft.	130 gpm max
Well #4	1997	420 ft.	125 gpm max

The Walnut Creek WTP Expansion Project is currently in the design stage. This plant is the last of the District's active plants in the District's East Bay Service Area to be upgraded under part of the Treatment Improvement Projects (TIP) program. The major objectives of this project are as follows:

- Increase reliable treatment capacity -- with one filter off-line -- to 91 mgd
- Upgrade chemical systems to improve reliability and increase storage and feed capacity
- Upgrade the waste stream treatment system to increase reliable treatment capacity and improve treatment performance
- Upgrade instrumentation and control systems
- Improve seismic safety of buildings

Lafayette Water Treatment Plant

Lafayette WTP is the smallest of the District's water treatment plants in the District's East Bay Service Area. Under normal conditions Lafayette WTP treats Mokelumne Aqueduct water from Pardee Reservoir during high demand periods. An average flow of 15 MGD is treated at the Lafayette WTP during the high demand periods. During the low demand periods in winter, the plant is taken out of service for two to four months.

Due to the high quality of the Mokelumne Aqueduct water, the Lafayette WTP was designed and permitted to operate as an in-line water treatment plant. The Lafayette WTP process train consists of chemical pre-treatment, in-line filtration, and chemical post-treatment. Pre-treatment consists of coagulant (polyaluminum chloride and cationic polymer) and sodium hypochlorite addition at the rapid mix. After chemical addition, the water flows to the filters. The plant has a total of 8 declining rate filters. Normally, the plant operates with anywhere from 3 to 6 filters in service with at least 2 filters in reserve. After filtration, sodium hypochlorite, fluoride, caustic soda and ammonia are added to the water as it flows by gravity through a 48-inch pipe into an above ground, cylindrical clearwell. The plant has no influent or effluent control valves. Flow through the plant is automatically regulated by combination of water elevation at the control works and the water elevation in the clearwell. The level of the clearwell is adjusted by the District's Operation Control Center (OCC) in Oakland.

Backwash water from the Lafayette WTP is discharged to the washwater solids handling facility which includes an equalization basin, solids thickener basin (clarifier), and solids storage basin. Anionic polymer (solids conditioner) is added to the spent backwash water as it is pumped from the equalization basin to the solids thickener.

Orinda Water Treatment Plant

The Orinda WTP is the largest of the District's water treatment plants. Over the last 10 years the plant has provided 58 percent of the water to the District's Bay Area distribution system and has a design peak capacity of 200 MGD. It was built in 1935 with 8 sand filters and an original design capacity of 42 MGD. In 1948, twelve additional filters were added and the design capacity was increased to 105 MGD. In 1961, a layer of anthracite media was placed over the sand in the filters and new filter controllers were installed increasing the design peak capacity to 200 MGD. A new chemical building, new chemical system, filter improvements (including new underdrains and added anthracite media) and miscellaneous plant improvements were added between 1995 and 1997.

Under normal conditions Orinda WTP treats Mokelumne Aqueduct water from Pardee Reservoir. Due to the high quality of the Mokelumne Aqueduct water, the Orinda WTP was designed and permitted to operate as an in-line water treatment plant. The Briones Reservoir near the Orinda WTP is used as a supplemental water source when demand is high or when water quality and/or supply issues occur in the Mokelumne Aqueduct from Pardee Reservoir.

The Orinda WTP process train consists of chemical pre-treatment, in-line filtration, and chemical post-treatment. Pre-treatment consists of coagulant -- polyaluminum chloride (PACl) or a PACl blend (PACl and cationic polymer) -- and sodium hypochlorite addition in the influent. After chemical addition, the water flows to the filters. The plant has a total of 20 gravity dual media filters. After filtration, fluoride, caustic soda and ammonia are added to the water. The filtered water flows by gravity through two pipes (Effluent Pipes #1 and #2) with 95 percent of the water flowing through the Claremont Tunnel and 5 percent serving the nearby water distribution system.

The plant has no influent or effluent control valves. The District's OCC in Oakland communicates by telephone with the WTP to adjust the flow from the plant based on system demand. Flow through the plant is set through each individual filter by pre-setting filter effluent valve settings.

Orinda WTP filter backwash water is pumped to one of two washwater settling basins where the supernatant is dechlorinated (using sodium bisulfate) and discharged to San Pablo Creek via the waste discharge channel. Settled sludge is periodically pumped to District trucks and hauled offsite for disposal at the District's Wastewater Treatment Plant.

Process Changes at the Water Treatment Plants

In 1998 the District began using chloramines as the primary disinfectant at all the East Bay WTPs for maintaining disinfectant residual throughout the District's finished water distribution system. The conversion from chlorine to chloramines was pursued to address taste and odor concerns associated with chlorine addition, to comply with anticipated DBP drinking water regulations, and to ensure that residual disinfection is sustained throughout the distribution system. As part of the chloramine conversion project, the District upgraded their chlorine addition facilities by replacing chlorine gas with liquid sodium hypochlorite. Using sodium hypochlorite instead of chlorine gas significantly improves operator safety.

SECTION 3

SECTION 3
WATERSHED DESCRIPTION

Background

The 1995 Mokelumne River Watershed Sanitary Survey focused on the lands designated as the Upper Mokelumne Watershed -- those lands which drain into or are upstream of the Pardee Reservoir. In an effort to include all District facilities in the Mokelumne River Watershed as part of the MRWSS Update 2000, the study area was expanded to include Camanche Reservoir and facilities and Camanche Watershed.

The study area -- comprised of both the Upper Mokelumne River and Camanche Watersheds -- lies on the western slope of the Sierra Nevada Mountains in Alpine, Amador, Calaveras, and San Joaquin counties. It covers an area of 627 square miles and extends from Highland Peak (elevation 10,934 ft) near the crest of the Sierras to Camanche Reservoir (crest elevation 235 ft) located in the lower western foothills near Clements. Most of the watershed is forested land within the Eldorado and Stanislaus National Forests.

Natural Resources of the Upper Mokelumne River Watershed

The Upper Mokelumne River Watershed is composed of the lands above Pardee Dam, which drain to Pardee Reservoir. The natural resources of the watershed described herein include geology, soils, vegetation and wildlife, and hydrology. General land use, ownership, and jurisdictional authority are also discussed.

Location

The Upper Mokelumne River Watershed encompasses 578 square miles in Alpine, Amador, and Calaveras counties. Figure 2-3 depicts the sub-watersheds and hydrologic features. The watershed is bounded in the north by the basins of the American River, Cosumnes River, and Dry Creek; in the south by the basins of the Stanislaus River, Calaveras River, and Bear Creek; in the west by Pardee Reservoir; and in the east by the basin of the East and West Forks of the Carson River. Elevations within the watershed range from about 10,400 feet on the highest mountain peaks to 570 feet at Pardee Dam. Figure C-1 in Appendix C provides a detailed overview of the elevations in the Upper

Mokelumne River Watershed. The river system flows through impressively deep and remote canyons ranging from 1,000 to 4,000 feet in depth. The higher sub-watersheds, above the confluence of the forks -- North, Middle, and South Forks sub-watersheds -- are extremely rugged, consisting largely of granite overlain by volcanics carved into moderate to high relief.

The North Fork of the Mokelumne River originates from several high snow courses to the north and south of Blue Lakes along the crest of the Sierra Nevada at elevations ranging from approximately 7,500 to 10,400 feet. From here the North Fork flows predominantly northwest to the junction with Meadow Lake Creek and then changes direction and flows southwest toward the confluence of the Forks. The North Fork sub-watershed lies partially within Alpine and Calaveras Counties, but mostly in Amador County. Residential communities within the North Fork sub-watershed are: Roden Estates, Silverlake Pines, Robb Park Estates, and Blue Creek Subdivision. The major transportation routes are Highways 26 and 88. The North Fork drains approximately 370 square miles or two-thirds of the total area of the upper Mokelumne River basin.

The Middle Fork Mokelumne River sub-watershed is approximately 80 square miles and lies entirely within Calaveras County between the North Fork and South Fork of the Mokelumne River. The major communities in the Middle Fork sub-watershed include West Point, Wilseyville, Lily Valley, and Lynn Park Estates. State Highway 26 passes through its western boundary connecting West Point and Wilseyville.

The South Fork Mokelumne River sub-watershed is approximately 79 square miles and lies entirely within Calaveras County. Major communities within the South Fork sub-watershed include Wilseyville, Railroad Flat, and Glencoe. There are no major transportation routes through this sub-watershed area, except for Highway 26, which crosses the South Fork of the Mokelumne River. Highway 26 is a local thoroughfare extending from West Point to Mokelumne Hill.

The Mainstem Mokelumne River sub-watershed -- from the confluence of the North and South Forks to Pardee Dam -- lies in Amador and Calaveras Counties. This sub-watershed is approximately 50 square miles. It begins at the confluence of the North and South Forks of the Mokelumne River at an elevation of approximately 900 feet and extends downstream 20 miles southwesterly to Pardee Reservoir. Highway 49 is the main

transportation route through the sub-watershed area. The major residential communities located in the Mainstem sub-watershed are Mokelumne Hill and Paloma.

Geology

The Upper Mokelumne River Watershed is located in the Sierra Nevada Geomorphic Province and is characterized by three major lithologic groups -- Paleozoic metamorphic rocks, granitic rocks of the Sierra Nevada batholith, and Tertiary volcanic rocks. A general geologic map of the watershed is depicted in Figure 3-1. In addition, Table C-1 in Appendix C provides a summary of the major geologic features for each of the four sub-watersheds within the Upper Mokelumne River Watershed -- North Fork, Middle Fork, South Fork, and Mainstem of the Mokelumne River.

Paleozoic metamorphic rocks crop out prominently in the Western Sierra Foothills. These highly variable and complex deformed rocks are the result of low-grade metamorphism of argillaceous sedimentary and volcanic rocks. The rocks have been assigned to the Calaveras Formation in the past. This formation includes lenses of recrystallized limestone and dolomite with some quartz-mica schist, graphitic schist, metachert, quartzite, and slate. Road cut observations made by PG&E in 1981 in the project area indicate that weathering may be quite variable within relatively small areas. In the past, these rocks have been described as part of the Shoo Fly Complex.

Granitic rocks of probable Jurassic age underlie the Sierra Nevada and intrude the metamorphic rocks of the study area. Equigranular, medium-grained, granodiorite comprises the most common lithology. True granites are not present in adequate quantity, and the percentage of mafic minerals varies. The granitic rocks in the area have weathered unevenly to depths ranging from a few feet to over 100 feet.

The decomposed granite of the surface materials is usually a silty, sandy, granular material that retains much of the original granitic texture. Diorific rocks can be observed south of the North Fork Mokelumne River sub-watershed. They contain less quartz, but more iron and magnesium-rich minerals, than granitic rocks.

Tertiary volcanic rocks are present on ridge tops and probably once formed a thick sequence of pyroclastic rocks over the project area. These rocks have been assigned to the Mehrten Formation and the Valley Springs Formation. They consist of andesitic detritus, mudflows, massive andesite, sand and gravel. Only erosional remnants remain in the upper watershed. A thick unit of welded rhyolite tuff of the Valley Springs Formation crops out on the hill just east of the Licking Fork. The Valley Springs Formation is Miocene in age and is composed of a series of interbedded, light-colored vitric tuff and welded tuff units. Five small, flow-banded dacitic and rhyodacitic volcanic domes of Miocene-Pliocene age occur along the Melones fault near Mokelumne Hill.

A series of northwest trending faults form a 30- to 50-mile-wide band of rocks that parallels the Sierra Nevada Range. Collectively called the Foothills fault system, the faults can be subdivided into two fault zones -- the Bear Mountains and Melones zones. The area has little recent history of fault movement and few epicenters larger than 3.5 have occurred in the area since 1910. However, it is located in Seismic Zone 3, where damage potentials are considered to be major. The Calaveras, San Andreas, and Genoa Faults are all capable of producing earthquakes over magnitude 7.0 that could adversely affect the infrastructure of the Upper Mokelumne River Watershed.

Soils

Upper Mokelumne River Watershed soils represent two basic groups -- 1) those in the higher elevations of the Sierra Nevada above the confluence of the North, Middle, and South Forks and 2) those in the lower elevations of the Sierra Nevada and its foothills below the confluence of the Forks along the Mainstem. To complement the soil information, Figure C-2 in Appendix C depicts the slopes that exist in Upper Mokelumne River Watershed. Slopes of the soils are important, as they are a key component affecting erosion, which takes place within the watershed resulting in soil transport.

North, Middle, and South Fork Soils. The higher elevations of the Upper Mokelumne River Watershed, above the confluence of the forks, have shallow-to-deep, medium-textured-to-stony soils. Most have weathered from metasedimentary or granitic rock, and are located in a variety of topographic settings ranging from ridge tops to steep canyon sides. Five soil associations are present in these higher elevations.

Mariposa-Josephine-Sites Association. These soils range from shallow to very deep, they are generally very rocky, or are gravelly-silt loams, and loams. Soils of this association are found on rolling hills and sharp parallel ridges at elevations near 1,200 feet, and on higher mountainous uplands; on parent materials derived from metasedimentary rocks.

Holland-Musick-Chaix Association. These soils are commonly very rocky, micaceous, porous, and very deep. They consist of well-drained coarse, sandy loam to very rocky, coarse sandy loam. Most soils were formed from parent materials derived from granitic rocks such as granodiorite. Soils of this association are found on both rolling and smooth terrain, at elevations exceeding 1,600 feet. The Chaix series are well drained, very rocky, coarse sandy loams (usually 24 to 40 inches deep) which overlie granite and occur from 2,000 to 4,000 feet in elevation. The Musick series (greater than 48 inches deep) occur between the elevations of 2,000 and 5,000 feet, over igneous rocks.

Mainstem Mokelumne River Sub-Watershed. Soils found in the Mainstem Mokelumne River sub-watershed consist of generally shallow to moderately deep, medium-textured and stony soils. Most are weathered from fractured metamorphic rocks and granite. Deep loamy soils have developed on gently rounded ridges underlain by granitic rocks, on occasional gently sloping table-top ridges underlain by volcanic flow deposits, and on sharp ridges underlain by schists and slates. Three soil associations are present within the Mainstem sub-watershed.

Auberry-Ahwahnee-Sierra Assoication. These soils are well-drained coarse, sandy loams and sandy loams formed in materials weathered from granitic rocks. The Auberry Series is generally found at elevations between 700 and 1,800 feet where granite is between 40 and 60 inches deep. The Ahwahnee Series are coarse, sandy loams to very rocky, coarse, sandy loams located where granite bedrock lies 24 to 40 inches deep, between 500 to 2,500 feet elevations. The Sierra Series are found at elevations between 1,000 and 2,000 feet where underlying granite is from 40 to 60 inches deep.

Auburn-Argonaut Association. These soils consist of well-drained silt loams to gravelly loams, formed in materials weathered from basic and metasedimentary rocks characteristic of this association. The Auburn Series is a heavy subsoil variant consisting of cobbly, clay loam. It has formed 8-to 27-inch soil layers above vertically tilted schists and associated rocks of the Calaveras Formation at elevations between 1,000 and 1,700 feet. The Argonaut Series have formed over metabasic or basic rocks.

Boomer-Auburn Association. These soils consist of well-drained silt loams and gravelly loams formed from weathered basic igneous rocks or metasedimentary rocks. The Boomer Series is a very rocky loam ranging from 24 to 52 inches thick above basic schists at elevations of 1,000 to 3,500 feet. The Auburn Series is a heavy subsoil variant consisting of cobbly, clay loam. It lies in 8- to 27-inch layers above vertically tilted schists and associated rocks of the Calaveras Formation at elevations between 1,000 and 1,700 feet.

Vegetation and Wildlife

The Upper Mokelumne River Watershed features vegetative communities typical of the Sierra Nevada Mountains and foothills. Distributions of the major vegetative communities are shown in Figure 3-2. The primary vegetative communities can be described in two major groups: those typical of the upper sub-watersheds -- the North Fork, Middle Fork, and South Fork -- and those typical of the lowest sub-watershed -- the Mainstem. Therefore, to complement Figure 3-2, Tables C-2 and C-3 in Appendix C summarize the vegetative communities, locations, and species in the upper three sub-watersheds (North, Middle, and South forks) and the lowest sub-watershed (Mainstem), respectively.

Ponderosa pine, black oak, and other mixed conifer community species that are adapted to light and periodic ground fires are dominant. Ponderosa pine predominates on dry sites between 2,000 and 5,000 feet in elevation. Black oak is abundant in the lower canyons. Mixed conifers are most common in moist areas between 3,000 and 6,000 feet. White fir is the most common coniferous species of northern exposures at the higher elevations.

Open annual grasslands, dense oak woodlands, and oak savannah communities are common at the lower elevations. Sub-dominant vegetation types include chaparral and riparian scrub communities. Canyon chaparral, which is limited by the steep, rocky terrain of the canyon walls, includes Mariposa manzanita, buckbrush, and poison oak.

The banks of the Mokelumne River and its perennial tributaries support the bulk of the Upper Mokelumne River Watershed riparian vegetation, although several of the ephemeral tributaries support minor riparian communities. The riparian zones are limited to narrow strips along waterway embankments. Hydrophilic, deciduous trees and shrubs, such as alders, dogwoods, and willows, are typical of the riparian communities.

As part of a recent watershed assessment conducted by Sierra-Pacific Industries[1], vegetation communities were identified based on elevation within the Upper Mokelumne River Watershed. This information provides additional details which complement the

[1] Sierra Pacific Industries Watershed Assessment Upper Mokelumne River – Volumes I and II, prepared by Foster Wheeler Environmental Corporation. August 2000.

information depicted in Figure 3-2. Therefore, an overview of the information documented in the Sierra-Pacific watershed assessment is provided below:

Subalpine Conifer. The subalpine conifer vegetation community includes fragented forests of foxtail, limber, and whitebark pines interspersed with shrublands, meadows, and riparian corridors. It occupies areas above elevations of 8,500 to 9,000 feet, depending upon aspect. This vegetation type occurs on approximately 6 percent of the Upper Mokelumne River Watershed.

Jeffery Pine. The Jeffery pine vegetation community forms an open layer, usually between 40 to 70 percent crown closure, over a lower canopy of hardwoods that ususally has less than 50 percent crown closure. A shrub layer is common on most Jeffery pine sites. Aspen commonly dominate the lower canopy layer and huckleberry oak, manzanita, and mountain misery are common shrubs. The Jeffery pine vegetation community occurs downslope of the subalpine conifer type and upslope of the mixed conifer type. It occupies approximately 1 percent of the Upper Mokelumne River Watershed.

Lodgepole Pine. The lodgepole pine forest generally forms open stands downslope of the subalpine conifer type, beginning at elevations of about 6,500 feet, depending upon aspect. Lodgepole pine occupies the dryer areas in this elevation band. It overwhelmingly dominates these sites, forming nearly pure stands on over 80 percent of the sites. Occasional associates include aspen and mountain hemlock. The lodgepole pine forest generally has little understory. This vegetation community occupies approximately 2 percent of the Upper Mokelumne River Watershed.

Red Fir. The red fir forest generally occupies wetter areas downslope of the lodgepole pine zone, beginning at elevations of about 6,000 feet, depending upon aspect. Red fir dominates north slopes and higher elevations, where conditions are colder and wetter. Mature stands are generally monotypic, with very few other species in any layer. High fuel loads are common. This vegetation community occupies approximately 10 percent of the Upper Mokelumne River Watershed.

White Fir. White fir vegetation has historically been considered a phase of the mixed conifer type. It is characterized by a nearly monotypic, even-aged overstory. It sometimes associates with sugar pine, incense cedar, and red fir. The understory is usually sparse, with high levels of downed wood. It grows downslope of the mixed red fir zone, beginning at about 5,500 feet. It may be intermixed with the red fir vegetation species at the boundary between these two zones. White fir forests occupy approximately 15 percent of the Upper Mokelumne River Watershed.

Mixed Conifer. The mixed conifer forests are a mixture of ponderosa pine, sugar pine, white fir, incense cedar, Douglas fir, and black oak. Ceanothus and manzanita grow in openings. The mixed conifer vegetative species occupy areas downslope of the white fir, beginning at elevations of about 4,000 feet, depending on aspect. Mixed conifer forests occur on approximately 25 percent of the Upper Mokelumne Watershed.

Ponderosa Pine. The ponderosa pine vegetation includes ponderosa pine, sugar pine, and incense cedar. Canyon live oak, black oak, and manzanita are also common. Ponderosa pine species grow downslope of the mixed conifer zone, beginning at about 2,000 feet. They are often near, or intermixed with, chaparral or oak woodland. Ponderosa pine vegetation communities occupy approximately 14 percent of the Upper Mokelumne River Watershed.

Montane Hardwood and Montane Harwood Conifer. These low to mid-elevation vegetative species contain the highest biodiversity of the Sierra Nevada. Common species include blue oak, interior live oak, canyon live oak, and valley oak. At higher elevations they include California buckeye, digger pine, ponderosa pine, and black oak. Willows, California sycamore, cottonwoods, and white alder grow in riparian areas. Non-native annual grasses have largely replaced native perennial grasses and herbaceous species. These vegetative species occupy approximately 6 percent of the Upper Mokelumne River Watershed.

Chaparral. Chaparrel is a diverse vegetation community dominated by shrubs. It occurs in a wide variety of ecological conditions but generally on dryer slopes, where it may border or be intermixed with the black oak, ponderosa pine, or mixed conifer zones. Evidence indicates that its occurrence is strongly correlated with fire regimes. This vegetation community occupies approximately 8 percent of the Upper Mokelumne River Watershed.

Grasslands. Grasslands, dominated by annual grasses, occupy approximately 2 percent of the Upper Mokelumne River Watershed generally on the lowest elevations. Lands surrounding the Pardee Reservoir are predominantly grasslands as shown in Figure 3-2.

Wildlife

The Eldorado National Forest provides habitat for 340 species of wildlife. This total includes 202 bird species, 79 mammal species, 20 fish species, 24 reptile species, and 15 amphibian species. The Stanislaus National Forest provides habitat for 343 wildlife species. Reptiles, amphibians, birds, fish and mammals of all size ranges are located in the aquatic and upland communities of the Upper Mokelumne River Watershed. Some of the larger mammals include the mountain lion, black-tailed deer, and black bear. Smaller mammals include the western grey squirrel, racoon, muskrat and brush rabbit. More details regarding these mammals and other wildlife are provided in *Section 5 - Potential Contaminant Sources.*

As documented in the watershed assessment conducted by Sierra-Pacific, 33 wildlife species -- 7 amphibian and reptile species, 13 bird species, 1 fish species, 5 mammal species, and 7 invertebrate species -- of special status and/or concern potentially occur in the Upper Mokelumne River Watershed. The principal sources consulted for the description of target species -- special status species -- included the California Natural Diversity Database (CNDD), California Wildlife Habitat Relationships, publications by California Native Plant Society, reports on Status of Sierra Nevada and other relevant references. Of the 33 wildlife species potentially occurring in Upper Mokelumne River Watershed, 10 species were listed as federal and/or state endangered or threatened species. These endangered or threatened species include the following: California red-legged frog, bald eagle, great gray owl, willow flycatcher Lahontan cutthroat trout, Sierra Nevada red fox, California wolverine, vernal pool fairy shrimp (2 sub-species), and valley elderberry longhorn beetle. Based on vertebrate species

distribution information, the California red-legged frog, bald eagle, great gray owl, willow flycatcher, and Sierra Nevada red fox are species of special status to be considered for habitat management and/or distribution minimization.

Drainage Basins

Above Pardee Dam, the watershed encompasses an area of approximately 578 square miles. It is approximately 60 miles long and ranges from a mile and a half in width at its narrowest point to 17 miles at its widest. In addition to the Mainstem of the Mokelumne River which drains into Pardee Reservoir, three major forks (tributaries) comprise the upper reaches of the Mokelumne River -- North, Middle, and South Forks.

The North Fork is the major tributary flowing some 55 miles from its source at the crest of the Sierras to its confluence with the South Fork near West Point. Elevations within the North Fork sub-watershed range from 10,430 feet at Round Top Peak to 900 feet at the confluence with the Middle Fork of the Mokelumne River. Major tributaries to the North Fork include: Blue Creek which is fed by Upper and Lower Blue Lakes (elevation 8,000 ft) and by Twin Lake; Meadow Creek which flows from Meadow Lake (elevation 7,800 ft); Summit Creek; the Bear River which flows through Upper Bear (elevation 5,900 ft) and Lower Bear (elevation 5,820 ft) reservoirs; and Tiger Creek. Flow in the North Fork is regulated by Pacific Gas and Electric's (PG&E) Mokelumne River Project which is located upstream of Pardee Dam.

The Middle Fork of the Mokelumne River flows about 22 miles from its headwaters in Stanislaus National Forest at elevation 7,200 feet near Baily Ridge to join the South Fork about one mile upstream of its confluence with the North Fork. The elevation of the Middle Fork sub-watershed ranges from 7,380 feet on the eastern boundary to 900 feet at the confluence with the North Fork of the Mokelumne River. The major tributaries are Forest Creek, which enters the Middle Fork about 2.5 miles east of Wilseyville, and Bear Creek, which flows into the Middle Fork about 1 mile east of Wilseyville. Schaads Reservoir (1,800 acre-foot capacity) partially regulates streamflow on the Middle Fork.

The South Fork flows about 24 miles from its headwaters in Stanislaus National Forest near elevation 7,000 feet between Summit Level Ridge and Bailey Ridge to its confluence with the North Fork. The elevation range within the South Fork sub-watershed varies from approximately 7,000 feet on the top of the ridge at the eastern border to about 1,200 feet at the confluence with the Middle Fork. Licking Fork is the major tributary and joins the South Fork about one mile southeast of Wilseyville or four miles upstream of its confluence with the Middle Fork.

The Mainstem of the Mokelumne River begins 17 miles upstream of Pardee Dam at the confluence of the North and South Forks. It flows southwest through the foothills in a narrow valley, passes PG&E's Electra Powerhouse, flows under Highway 49 near the community of Mokelumne Hill, and enters Pardee Reservoir about two miles downstream of the Highway 49 bridge. Elevations within the Mainstem sub-watershed range from 3,012 feet near Alabama Hill on the east border of the basin to 570 feet at Pardee Reservoir. There are no significant tributaries within the Mainstem sub-watershed. The only other inflows to Pardee Reservoir are from overland flow or ephemeral streams. Pardee Reservoir has a gross storage capacity of about 197,950 ac-ft at its maximum pool elevation of 568 feet.

Precipitation and Evaporation

Annual precipitation -- rainfall and snowfall -- and thus streamflow in the Mokelumne River is extremely variable both from month-to-month and from year-to-year. Table C-4 in Appendix C provides a summary of 18 representative climatological stations within the Upper Mokelumne River Watershed or Mokelumne River Watershed. Figure 3-3 depicts 60-year average precipitation isohyets for the Upper Mokelumne River Watershed. Precipitation is highest in the areas furthest from Pardee Reservoir. The District collects monthly precipitation (rainfall) and evaporation data at Pardee Reservoir. Figures 3-4 and 3-5 depict average monthly rainfall and evaporation, respectively, for Pardee Reservoir. As these figures show, most of the rainfall occurs between October and May and, correspondingly, most of the evaporation occurs between April and September. While the amount of precipitation varies from year to year. Between 1974 and 1999, the annual rainfall ranged between 7.1 and 45.0 inches with an average rainfall of 22.9 inches at Pardee Reservoir. The rainfall probability distribution based on that 25-year period indicates that a 50 percent probability is approximately 19 inches for Pardee Reservoir.

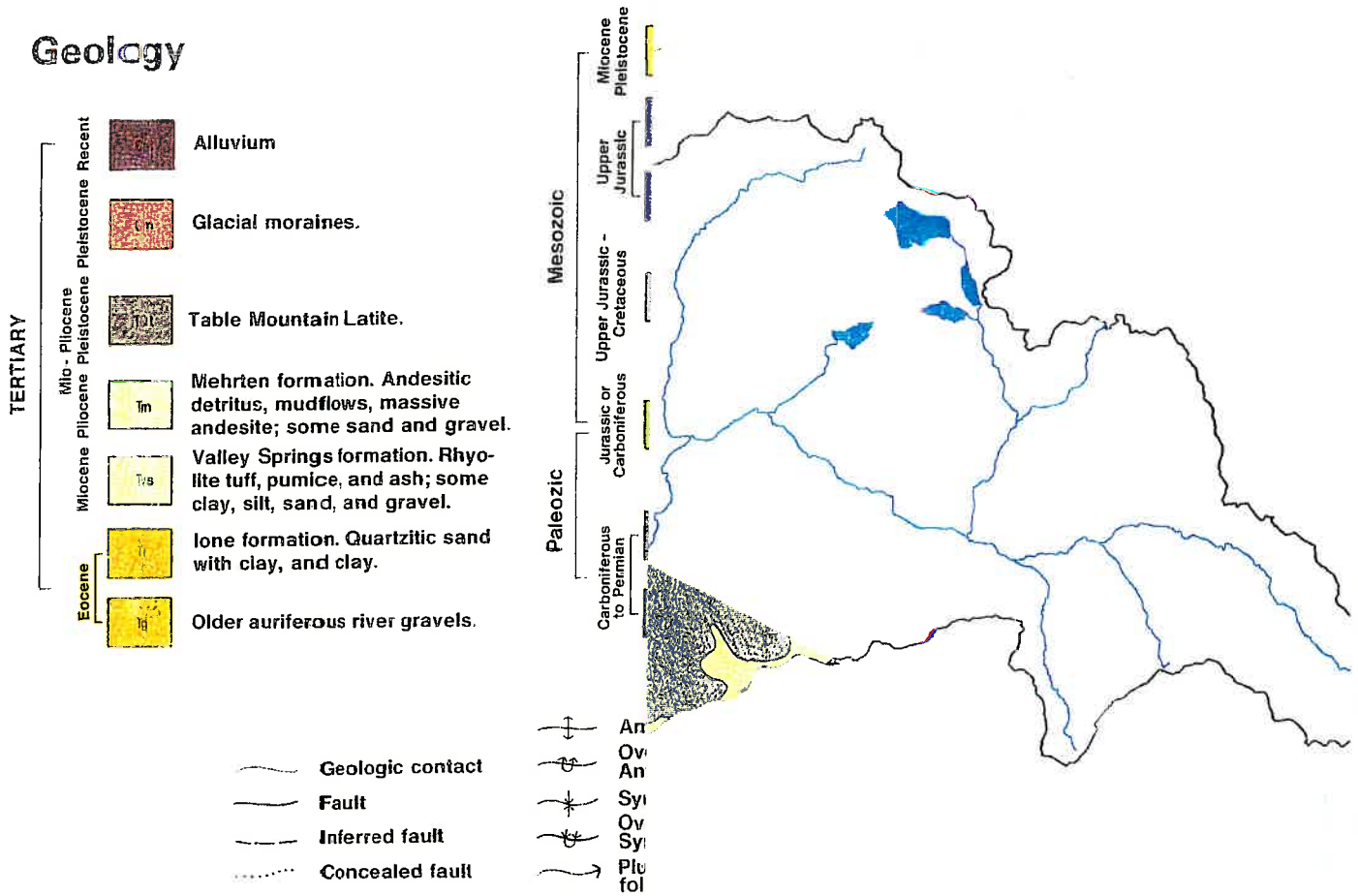
Evaporation is less variable than rainfall, ranging from 52.2 inches to 72.4 inches with an average annual evaporation of 61.8 inches at Pardee Reservoir. As a complement to these figures, Table C-5 in Appendix C provides a summary of the monthly and annual temperature and precipitation data for climatological stations within the watershed.

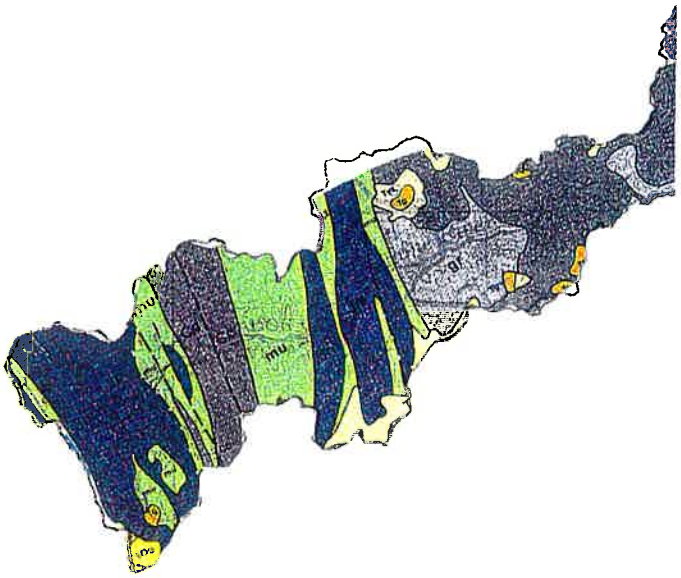
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Upper Mokelumne

FIGURE 3-1

Geology





Upper Mokelumne Watershed

FIGURE 3-1

Geolcgy

TERTIARY

Recent — Pleistocene

- Qal — Alluvium
- Qm — Glacial moraines.

Mio - Pliocene — Pleistocene

- Tmt — Table Mountain Latite.

Miocene — Pliocene

- Tm — Mehrten formation. Andesitic detritus, mudflows, massive andesite; some sand and gravel.
- Tvs — Valley Springs formation. Rhyolite tuff, pumice, and ash; some clay, silt, sand, and gravel.

Eocene

- Tl — Ione formation. Quartzitic sand with clay, and clay.
- Tg — Older auriferous river gravels.

Mesozoic

Miocene — Pleistocene

- TQg — Gravels containing gold in places.

Upper Jurassic

- sm — Mariposa formation. Dark slate; some phyllite and schist.
- sp — Ultra-mafic rocks. Serpentine; smaller amounts of pyroxenite, gabbro, silica-carbonate rock, and mariposite-ankerite rock.

Upper Jurassic - Cretaceous

- gr — Granite rocks. Granite and granodiorite; small amounts of quartz diorite, diorite, diorite gneiss, and gabbro.

Paleozic

Jurassic or Carboniferous

- mu — Metamorphic rocks undifferentiated. Amphibolite schist, green schist, greenstone, quartz and feldspar porphyry; includes greenstone, phyllite, and schist of Amador group.

Carboniferous to Permian

- Cc — Calaveras formation. Lenses of recrystallized limestone and dolomite.
- Ccr — Calaveras formation. Quartz-mica schist, graphitic schist, metachert, quartzite, and slate.

- Geologic contact
- Fault
- Inferred fault
- Concealed fault
- Anticline
- Overturned Anticline
- Syncline
- Overturned Syncline
- Plunge of fold axis

NO DATA AVAILABLE

Upper Mokelumne Watershed

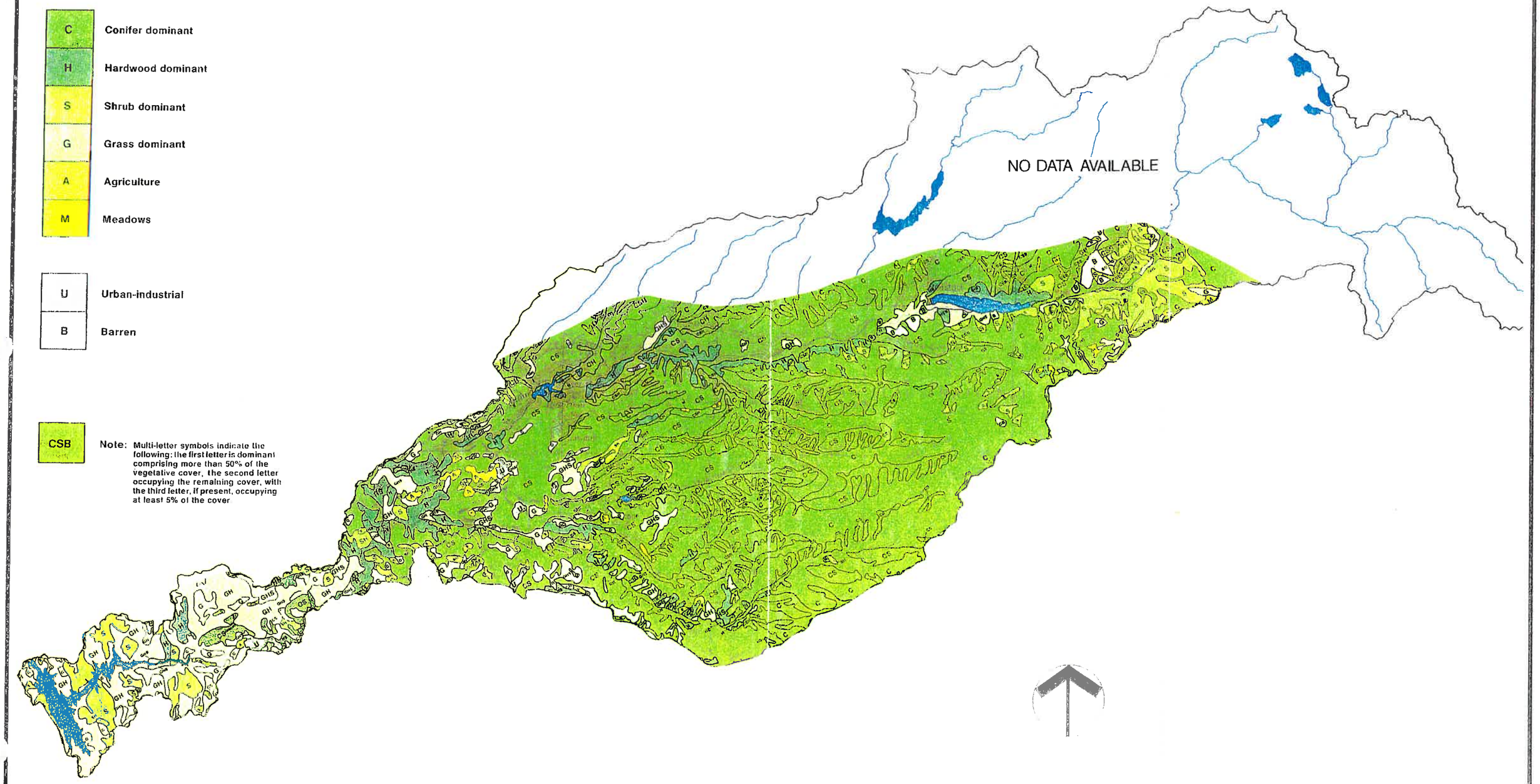
FIGURE 3-2

Vegetative Communities

- C — Conifer dominant
- H — Hardwood dominant
- S — Shrub dominant
- G — Grass dominant
- A — Agriculture
- M — Meadows
- U — Urban-industrial
- B — Barren

CSB

Note: Multi-letter symbols indicate the following: the first letter is dominant comprising more than 50% of the vegetative cover, the second letter occupying the remaining cover, with the third letter, if present, occupying at least 5% of the cover



Upper Mokelumne Watershed

FIGURE 3-3

60 Year Avarage Precipitation, Flow Gauging & Climatological Stations

- 18.0 inches
- 22.5 inches
- 27.5 inches
- 35.0 inches
- 45.0 inches
- 55.0 inches
- 65.0 inches

Climate Stations

Water Flow Gauge

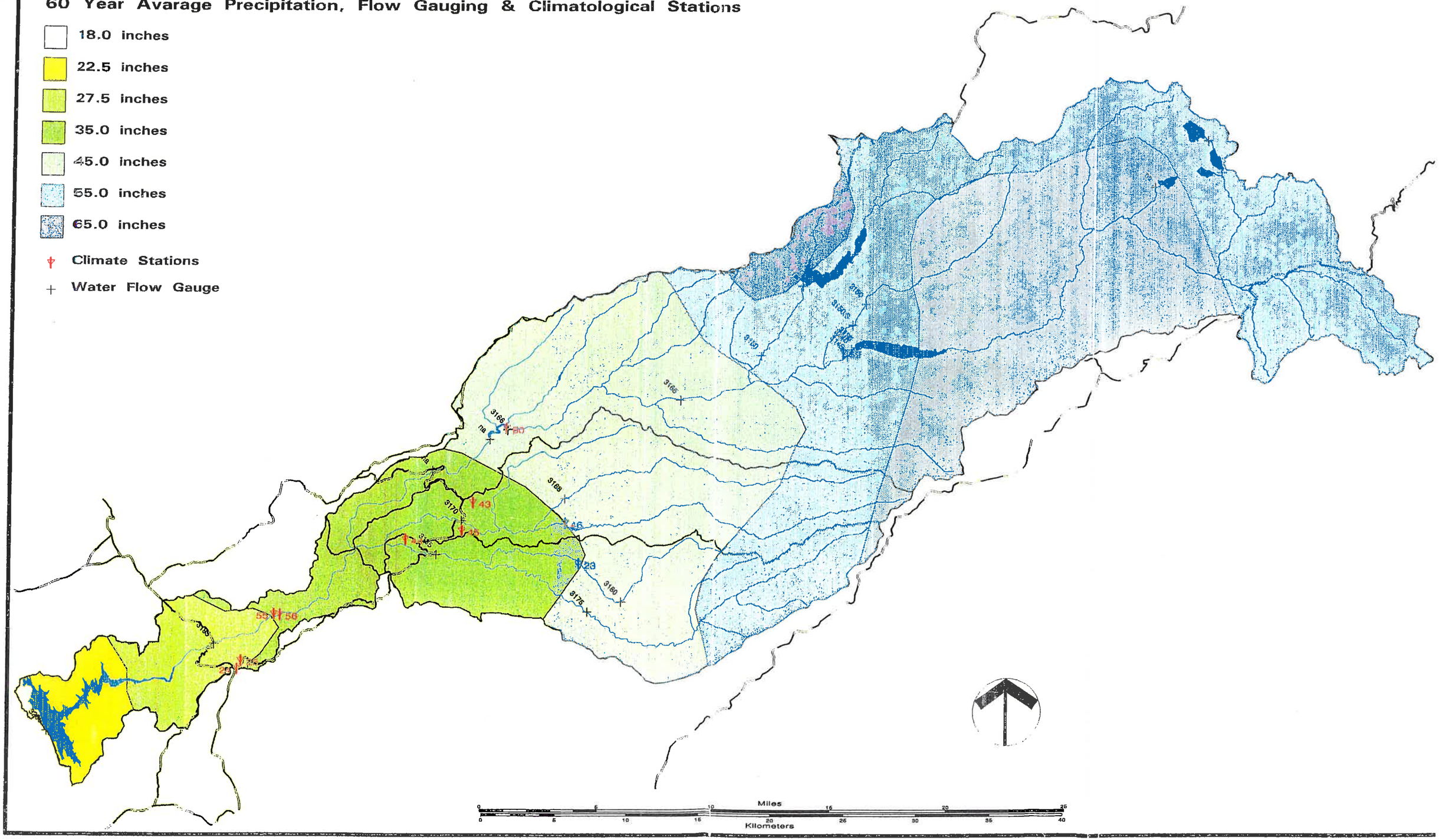
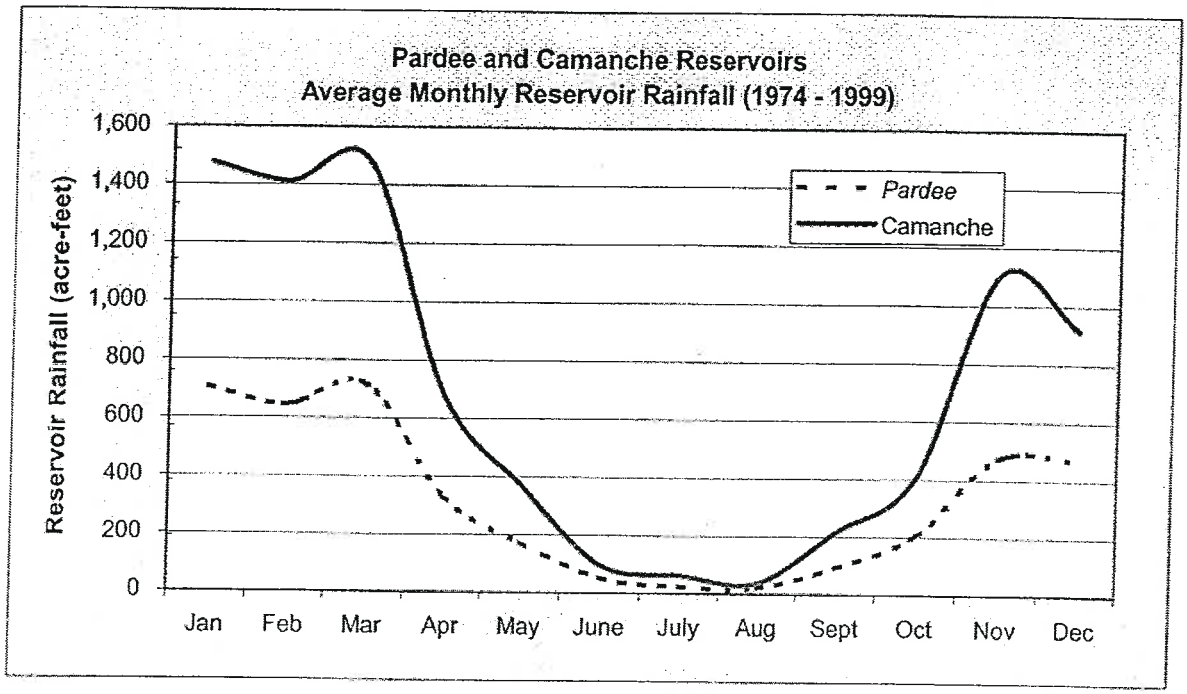


FIGURE 3-4 Pardee and Camanche Reservoirs



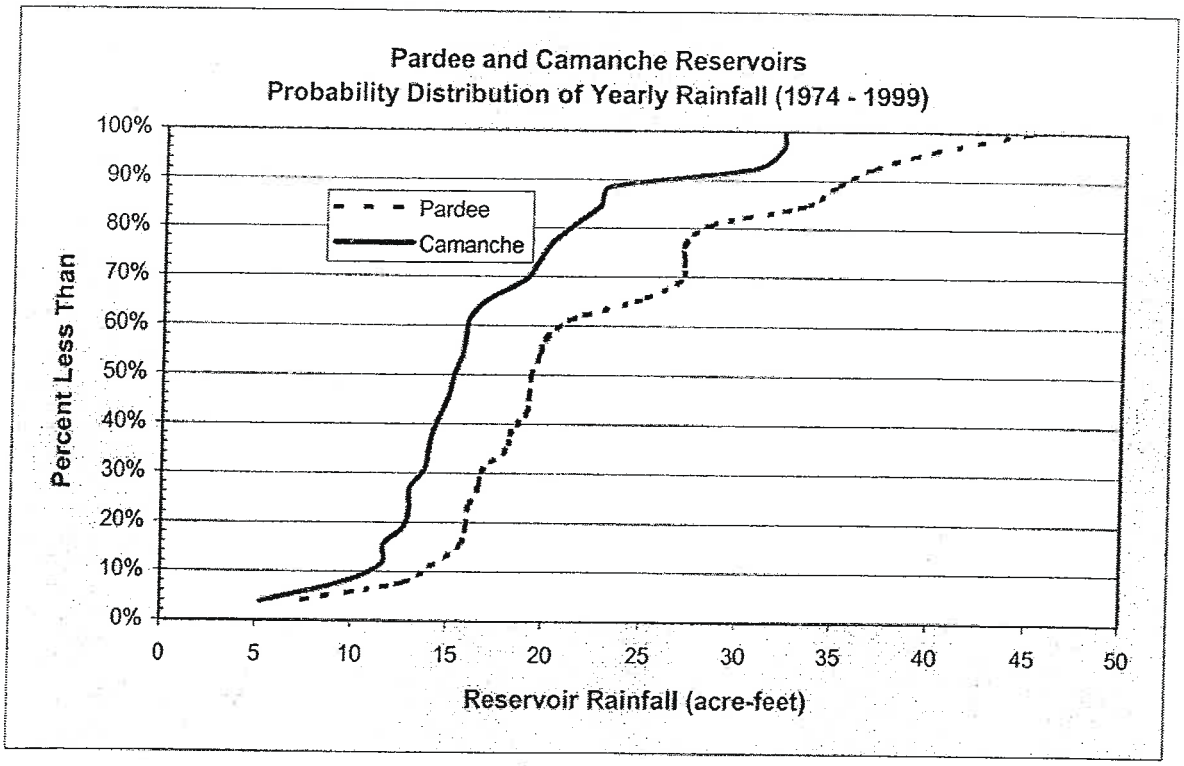
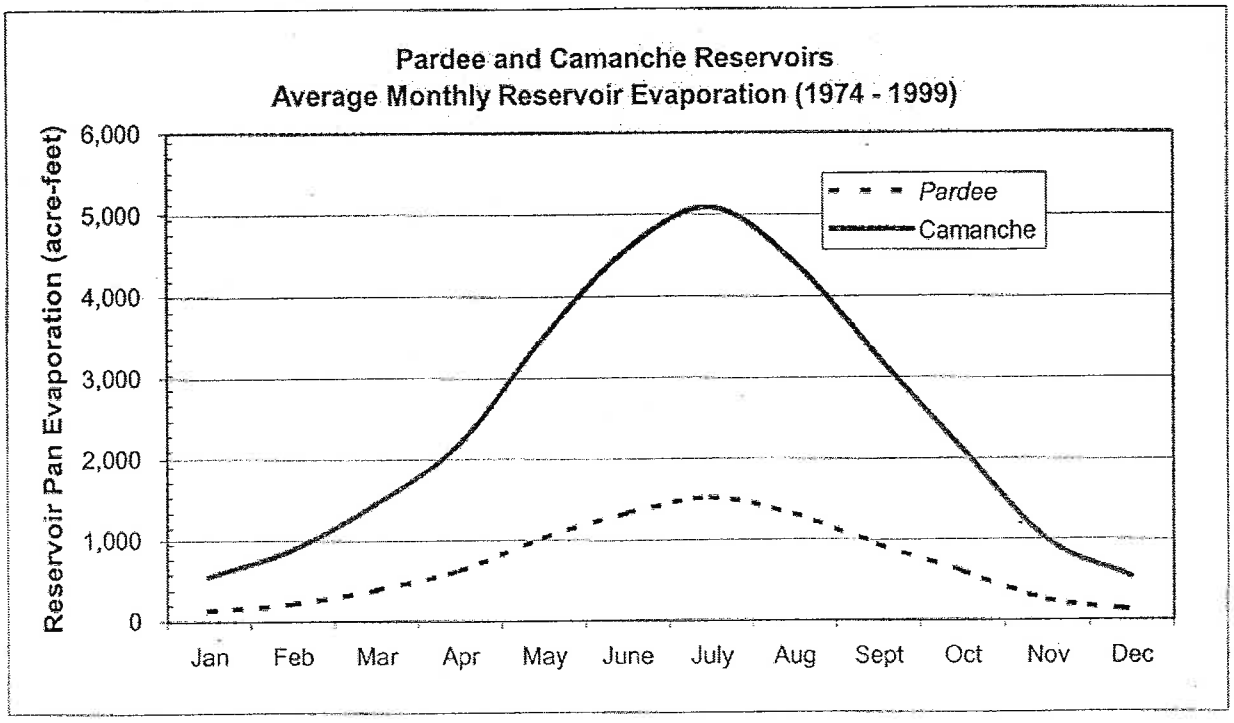
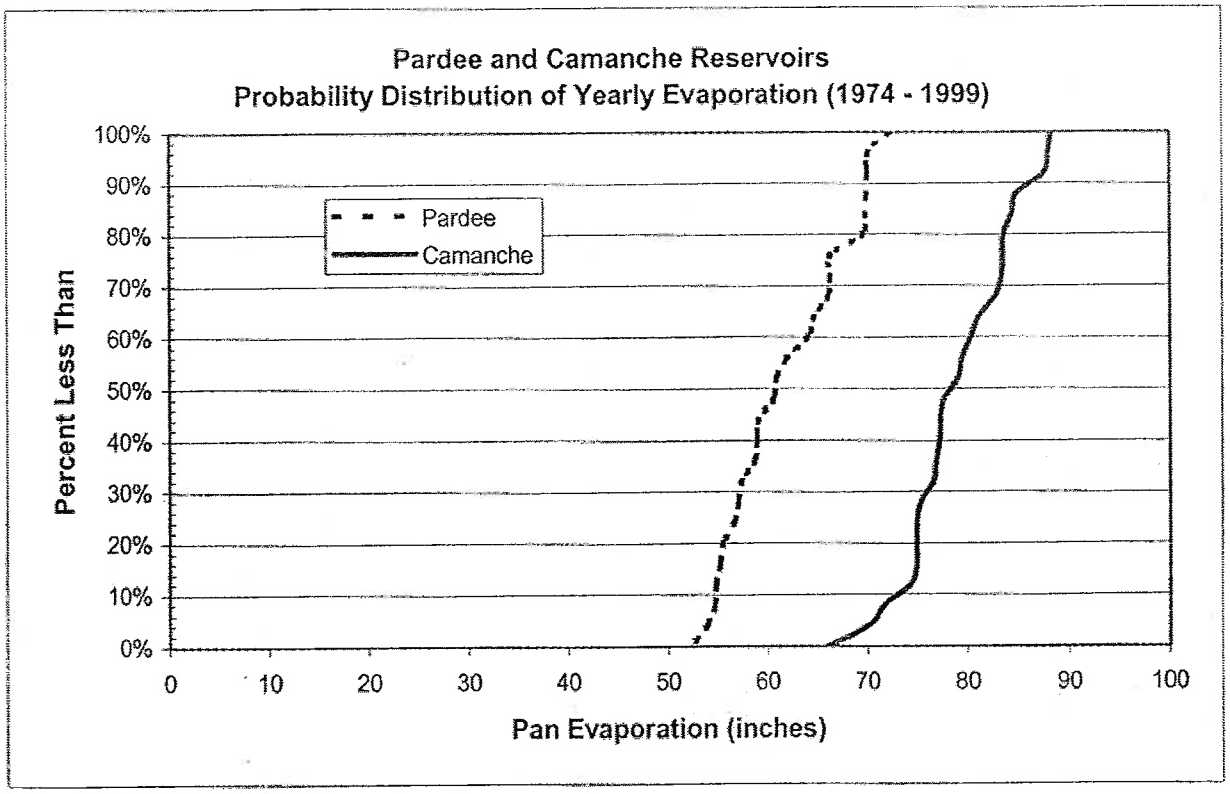


FIGURE 3-5 - Pardee and Camanche Reservoirs





Climatic conditions at the higher elevations are more continental, typified by mild, dry summers, and cool to cold wet winters. The Mediterranean-type climate of the lower elevations is characterized by wet, mild to cool winters, and hot, dry summers. Temperature varies with elevation with the warmest historical temperature (114°F) recorded at Electra Powerhouse elevation 715 feet and the coolest temperature (- 26°F) recorded at Caples Lake elevation 7,900 feet. Caples Lake is the closest climatological station in the higher elevation portion of the Mokelumne River area; although, it is outside the watershed.

Winds in the upper atmosphere flow from the west and northwest during most of the year. South winds occur during the approach of winter storms and east winds during the presence of high-pressure systems over the Great Basin area. The distinctive wet and dry seasons are caused by movements of the semi-permanent high-pressure system, which deflects storms to the north during the dry summer. The high pressure system migrates to the south late in the fall allowing winter storms originating from the Northern Pacific (in the vicinity of the Aleutian Islands) to track more southerly courses, thus encountering the watershed from the northwest. However, winter storms producing the most extreme amounts of precipitation typically approach the coast from the southwest, causing heavy rains and high elevation snowfall. Major storms normally last from 2 to 4 days.

Winter precipitation above 5,000 feet elevation usually occurs as snow, while at lower elevations precipitation may occur as snow, but more commonly as rain or sleet. Cumulative seasonal snowfalls above 6,000 feet typically approach 400 inches, with compacted snow depths attaining 100 inches or more at densities varying from 35 to 50 percent water. Table C-6 in Appendix C lists the snow courses and aerial snow depth markers within the Upper Mokelumne River Watershed. Table 3-1 summarizes the time distribution of the snowpack by elevation. Snow generally accumulates until about the first of April; then snowmelt rates begin to exceed new snowfall accumulations. Table 3-2 lists the distribution of annual normal snowpack water content and precipitation by elevation.

North Fork Sub-Watershed. Tiger Creek Powerhouse and Salt Springs Powerhouse are in the upper North Fork sub-watershed of which the climatic conditions at Caples Lake are representative. Temperatures in the lower North Fork sub-watershed near Tiger Creek powerhouse average 41°F in January and 74°F degrees F in July (Table C-5, Appendix C). The upper elevations are approximately 20 degrees cooler. The lowest expected January temperatures at the highest elevation approach minus 26°F, as recorded at Caples Lake and the highest temperatures are near 90 °F. Mean annual precipitation for the Tiger Creek and Salt Springs monitoring is approximately 44 inches at these elevations. The Caples Lake monitoring station while outside the watershed is used to represent the higher elevations where precipitation averages 47 in/yr. Mean monthly evaporation at Salt Springs Powerhouse is 5.6 inches. The January average is 2.0 inches and the July average is 10.5 inches.

Middle Fork and South Fork Sub-Watersheds. Mean temperature and precipitation data for selected sites within these sub-watersheds were presented in Table C-5, Appendix C. Since most of the area in these sub-watersheds lies below 5,000 feet elevation, precipitation occurs primarily as rain and the snowpack can be depleted by rain-on-snow events.

Mainstem Sub-Watershed. Mean temperature and precipitation data for Camp Pardee and Electra Powerhouse are 62 and 61°F and 20 and 30 inches, respectively. Mean monthly evaporation at Camp Pardee is 5.0 inches. The January average is 0.7 inches and the July average is 11.5 inches. These data typify the low elevation Mediterranean-type climate. Temperatures remain relatively warm in the sub-watershed with average maximum July temperatures at Electra Powerhouse near 98°F. The highest recorded temperature at Electra was 114 °F while the lowest was 16°F. Winter temperature average 48°F and the mean daily winter minimum is 36°F. Average annual precipitation is approximately 30 inches at Electra Powerhouse. Almost all of the precipitation occurs in the form of rain at the lowest elevations (500 to 800 feet).

Localized thunderstorms may occur on five to ten days per year in the sub-watershed. The storms are usually brief but have occurred during every month of the year. Heavy rain and snow, strong winds and hail are indicative of rare severe storms; however, no tornadoes have been recorded in any of the sub-watershed areas.

Table 3-1: Time Distribution of Snowpack by Elevation for Upper Mokelumne River Watershed

	Snowpack (inches of water)[1]				
Elevation Range (ft)	Nov	Dec[2]	Jan/Feb	Mar	Apr
3,500 - 4,500	1.0	1.8	3.0	3.2	4.8
4,500 - 5,500	4.4	7.8	13.0	13.7	20.7
5,500 - 6,500	8.2	14.5	24.0	25.3	38.2
6,500 - 7,500	11.6	20.5	34.0	35.9	54.2
7,500 - 8,500	15.3	27.1	45.0	47.5	71.7
8,500 - 9,500	19.0	33.7	56.0	59.1	89.2
9,500 - 10,500	22.8	40.3	67.0	70.7	106.8

NOTES:

[1]Recorded maximum values.

[2]Interpolated from November and January Records

Source: Amador County, August 1978.

Table 3-2: Distribution of Water Content and Annual Normal Precipitation in Snowpack Elevation Ranges

	Sub-Watershed Area				
Elevation Range (ft)	North Fork (sq mi)	Middle Fork (sq mi)	South Fork (sq mi)	Water Content (inches)	Annual Normal Precipitation (inches)
3,000 - 4,000	33	20	19	3	49
4,000 - 5,000	46	23	16	13	55
5,000 - 6,000	48	14	20	24	59
6,000 - 7,000	59	4	2	34	63
7,000 - 8,000	95			45	64
8,000 - 9,000	73			56	64
9,000 - 10,000	7			67	65

Source: EBMUD, August 1993

Local Runoff and Diversions

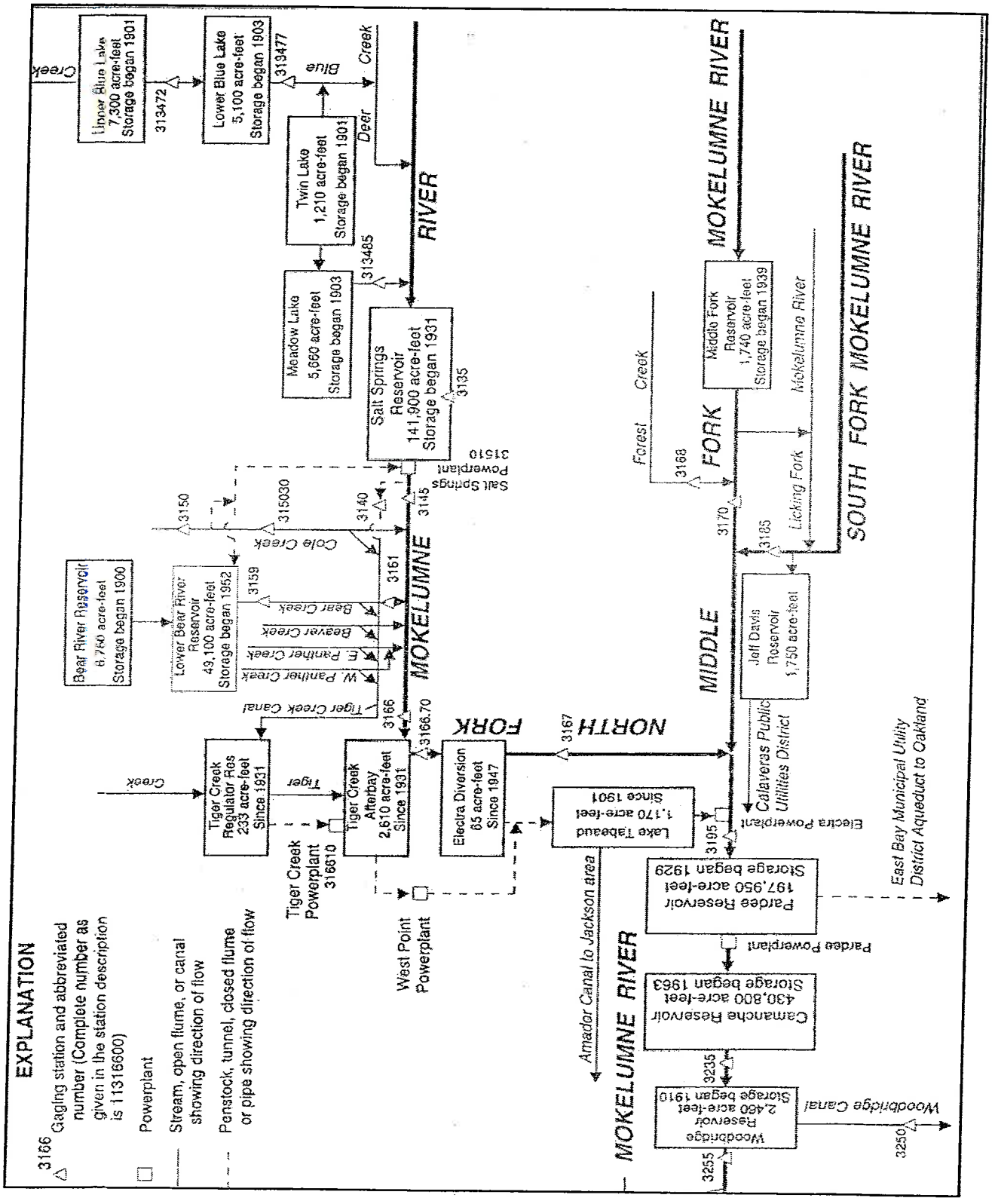
Streamflow in the Mokelumne River is modified by upstream diversions and regulated by reservoir storage operations for hydroelectric power generation and water supply as discussed in Section Two. PG&E operates a network of storage reservoirs and diversion facilities on the North Fork. The Amador Water Agency diverts Mokelumne River water through the Amador Canal and from the Tiger Creek Afterbay to its Central Amador Water Project. Jackson Valley Irrigation District receives water from the Amador Canal and from Pardee Reservoir. Calaveras Public Utility District owns and operates Schaads Reservoir on the Middle Fork and diverts water into Jeff Davis Reservoir -- 1,750 ac-ft capacity of off-stream storage -- for treatment and distribution to customers. Figure 3-6 depicts the diversions and storage of Mokelumne River water in the Upper Mokelumne River Watershed.

Peak runoff in the Upper Mokelumne Watershed normally occurs during the spring snowmelt season from March through June and then tapers off during the summer to minimum flows in late summer or fall. The U.S. Geological Survey (USGS) maintains flow records for numerous gauging stations in the Upper Mokelumne Watershed as summarized in Table C-7, Appendix C. Locations of the USGS flow recording stations are shown in Figure 3-3.

North Fork Sub-Watershed. The North Fork sub-watershed contains nearly all of the major impoundments and diversion systems located in the Upper Mokelumne River Watershed above Pardee Reservoir. Water storage in the reservoirs tends to reduce and retard peak flows and raise minimum flows downstream. Substantial flows may be diverted from Cole Creek, Bear River, Beaver Creek, and East and West Panther Creeks into the Tiger Creek conduit and Canal before being released back into the North Fork. Minimum flow releases required by the Upper Mokelumne Project FERC license range from natural stream-flow (which is highly variable depending on the season) to 10 cfs. Natural flow from Beaver Creek may be less than 1 cfs as noted by the U.S. Forest Service.

Flow rates in the lower portion of the North Fork sub-watershed are governed by release rates from Salt Springs Reservoir. The largest flows occur during April, May, and June during a typical year, when the reservoirs are unable to contain snowmelt from the upper reaches of the sub-watershed.

FIGURE 3-6 - Mokelumne River Releases, Diversions, and Losses



Middle Fork Sub-Watershed. Figure 3-8 depicts the annual variation in discharge for the Middle Fork of the Mokelumne River at West Point (USGS Station 11317000). Flows from the upstream tributaries, Forest Creek and Bear Creek, are also included at this station. This figure represents a 70-year duration from 1930 through 1999. Monthly flows ranged from a low of 4 acre-feet in August to 42,670 acre-feet in February. The highest monthly flows in the Middle Fork of the Mokelumne River typically occurred during the months of January through May. The probability of exceeding 10,000 cfs occurred approximately 10 percent of the time.

Schaad's Reservoir (Middle Fork Reservoir) operated by Calaveras County Water District is the only significant storage reservoir on the Middle Fork. According to Tudor Engineering Company (September 1983), usable storage is estimated at 1,300 acre-feet and its effect on monthly flows in the Middle Fork is negligible.

South Fork Sub-Watershed. Figure 3-9 depicts the minimum, maximum, and mean monthly variation in discharge for the South Fork Mokelumne River near West Point (USGS Station 11318500). This figure represents a 70-year duration from 1930 through 1999. Monthly flows ranged from a low of 2 acre-feet in August to 55,810 acre-feet in January. The highest monthly flows in the South Fork of the Mokelumne River typically occurred during the months of January through April. The probability of exceeding 10,000 cfs occurred approximately 15 percent of the time.

Mainstem Sub-Watershed. Flows from all forks of the Mokelumne River reach the gauging station at Mokelumne Hill (USGS Station 11319500) before entering Pardee Reservoir. Figure 3-10 depicts monthly combined flows -- minimum, maximum, mean -- at Mokelumne Hill for the 70-year duration from 1930 through 1999. This figure represents a 70-year duration from 1930 through 1999. Monthly flows ranged from a low of 552 acre-feet in October to 371,500 acre-feet in June. The highest monthly flows in the Mokelumne River typically occurred during the months of May and June with a probability of exceeding 100,000 cfs occurring less than 20 percent of the time. Flows into Pardee are regulated by all of the upstream reservoirs and four hydroelectric power plants. Figure 3-11 compares the annual variation of true natural flow with regulated flow after upstream diversions, regulation, and re-regulation by PG&E projects. The upstream diversions attenuate the maximum and minimum true natural flow fluctuations.

Major storms within the watershed normally last a shorter period of time in the Mainstem sub-watershed (less than 2 to 4 days). Major flooding occurs when large amounts of precipitation are combined with large amounts of snowmelt runoff resulting from warm temperatures at higher elevations. Large floods can cause both erosion and sediment deposition. Increased upstream river levels induced by floods have historically caused some inundation of existing powerhouses.

FIGURE 3-8 - Mean Monthly Flow Middle Fork Mokelumne River at West Point

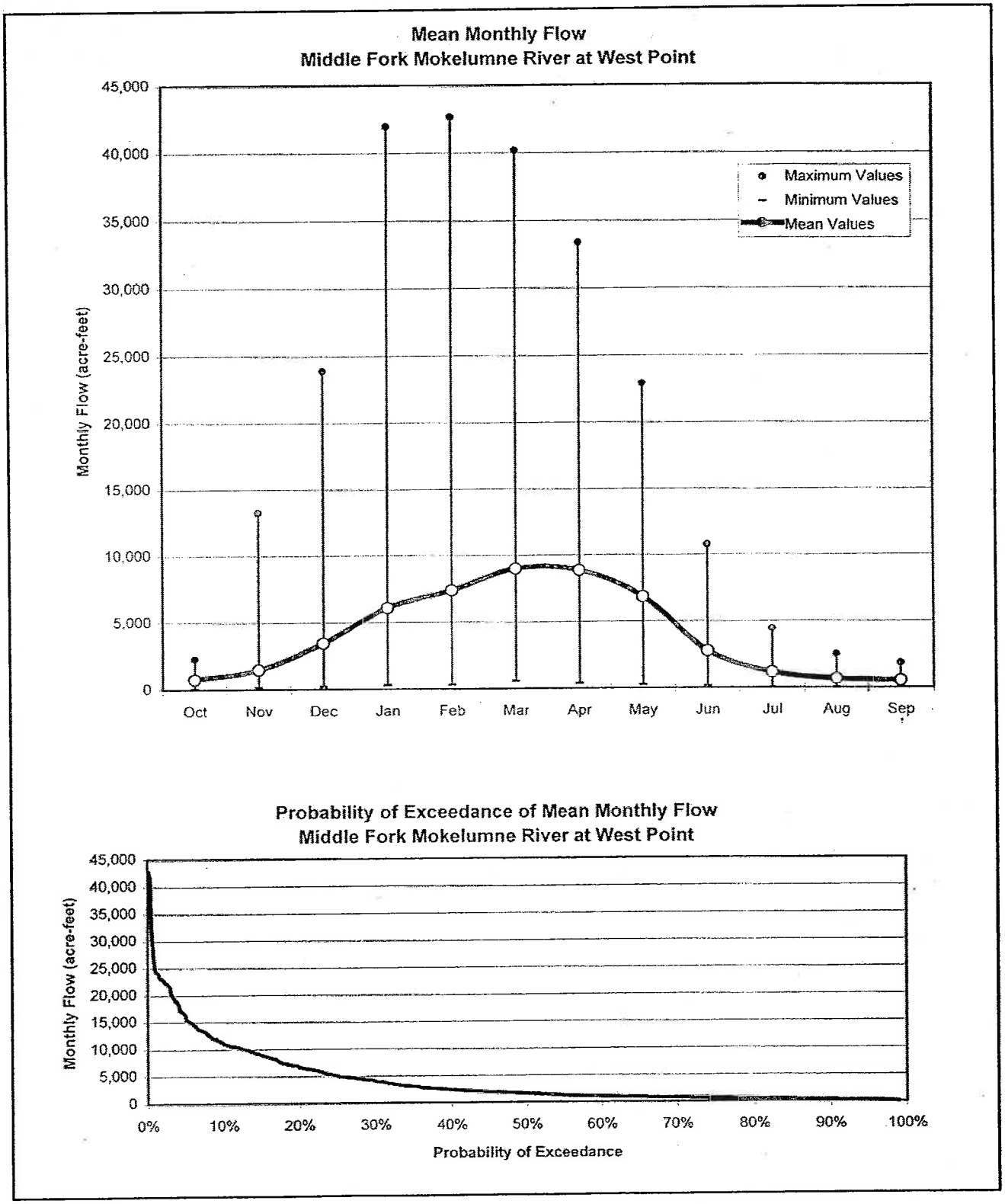


FIGURE 3-9 - Mean Monthly Flow South Fork Mokelumne River Near West Point

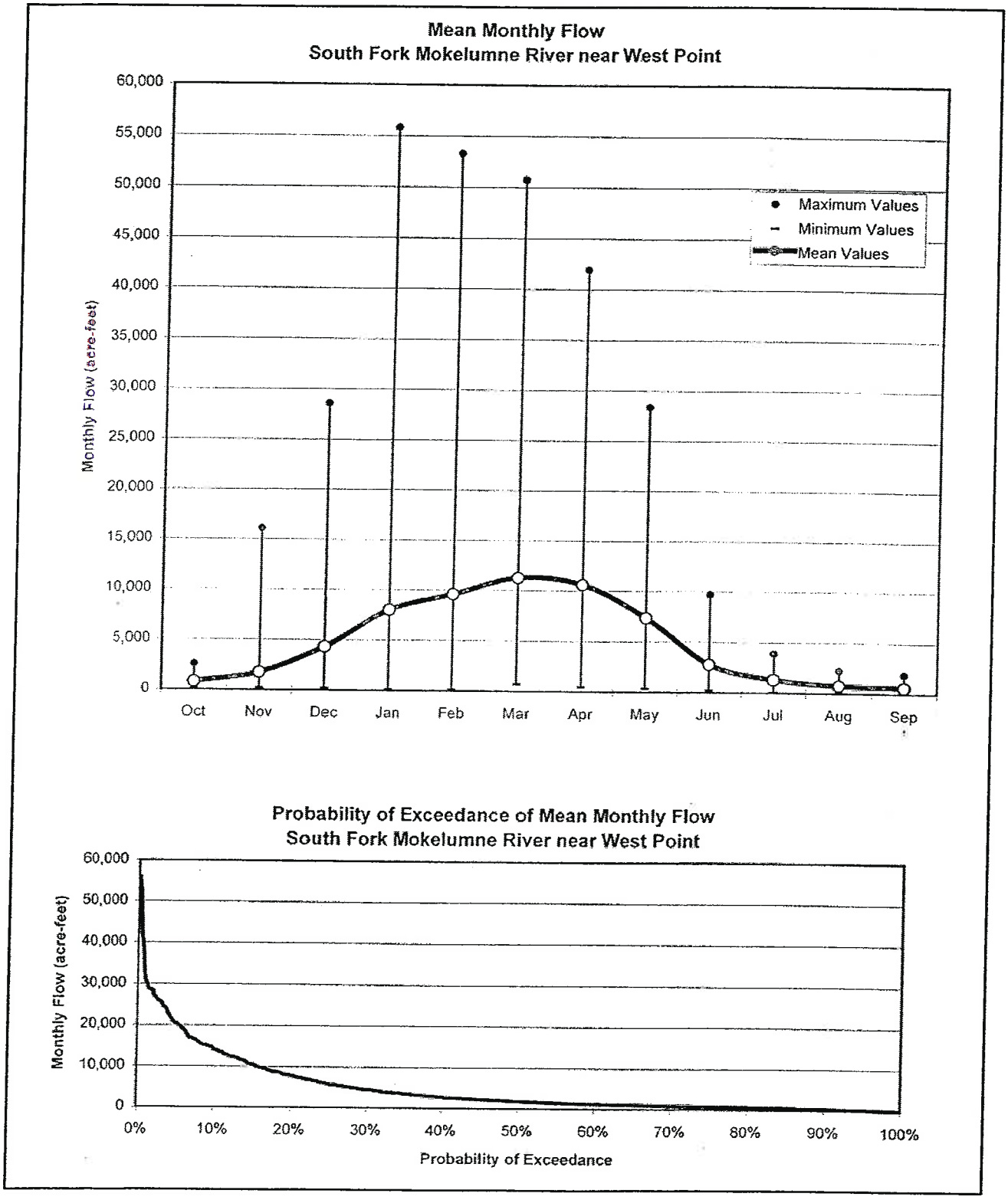


FIGURE 3-10 - Mean Monthly Flow Mainstem Mokelumne River at Mokelumne Hill

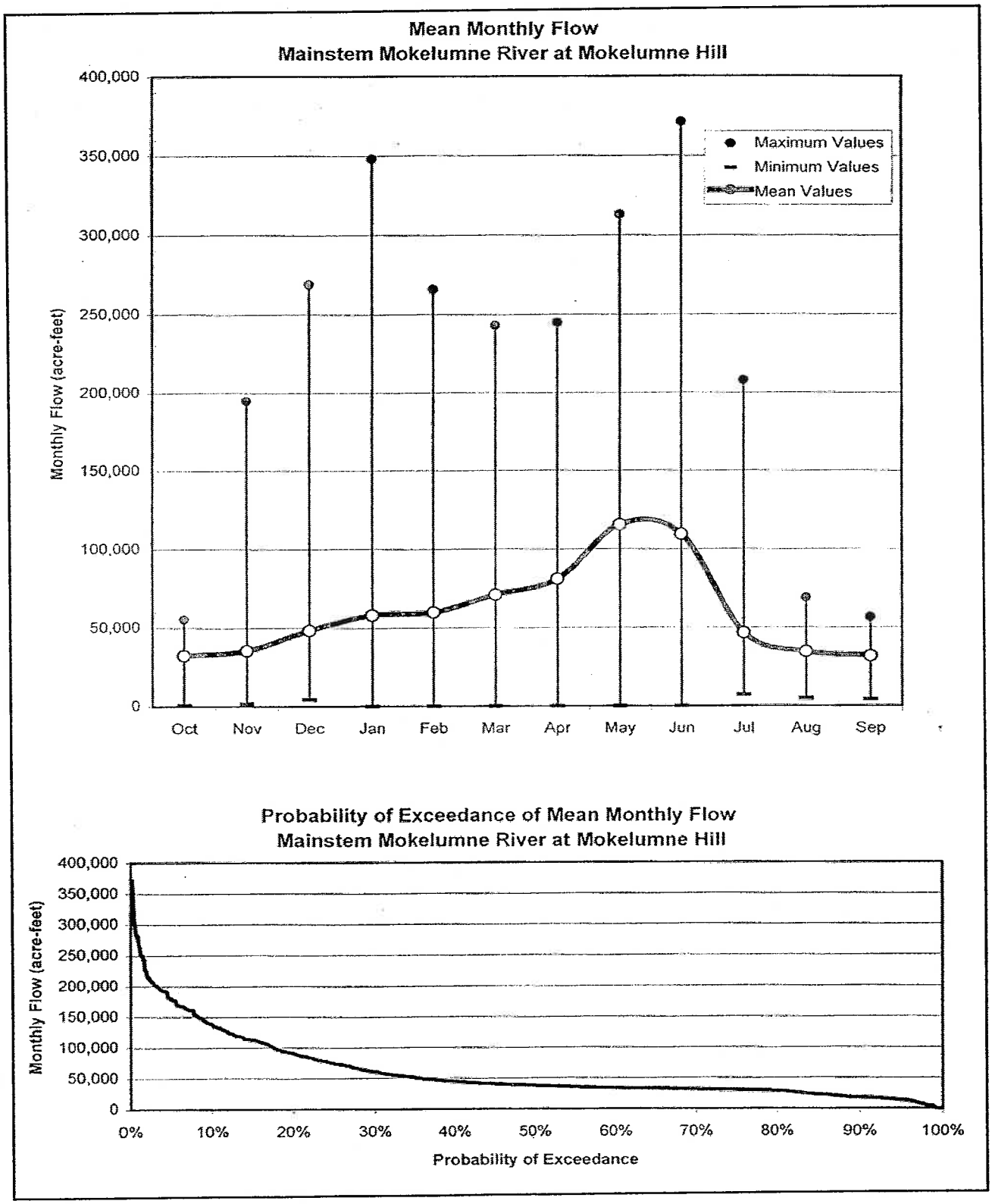
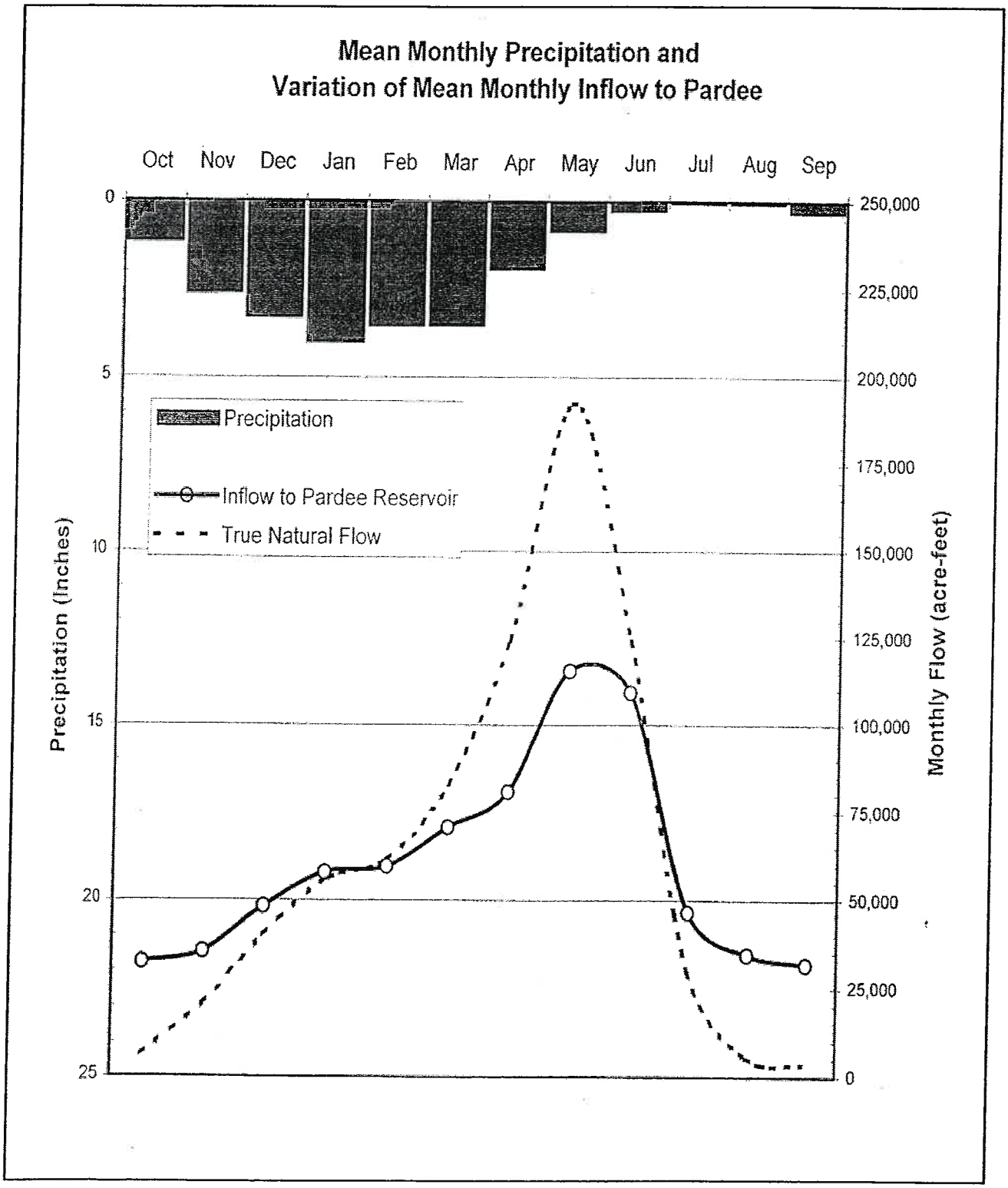


FIGURE 3-11 - Mean Monthly Precipitation and Inflow to Pardee Reservoir



Land Uses

The Upper Mokelumne River Watershed comprises approximately 370,000 acres (578 square miles). The vast majority of this upper watershed consists of open-space and forestland with large tracts of designated wilderness and small concentrations of residential development. There are only very small amounts of agriculture -- mainly orchards and vineyards -- and a few areas dedicated to recreational development. There are very few areas devoted to industrial or commercial use. Table 3-3 summarizes the predominant land uses identified within Upper Mokelumne River Watershed. Figure 3-12 complements Table 3-3 by depicting the predominant land uses identified.

Table 3-3: Land Use in the Upper Mokelumne River Watershed

LAND USE	ACRES	PERCENT
Open Space[1]	241,350	65.58
Production Forests	121,000	32.88
Residential[2]	2,600	00.71
Large Lot Residential[3]	1,500	00.41
Agriculture[4]	800	00.22
Recreation	400	00.11
Industrial	220	00.03
Commercial	130	00.03
Total	368,000	100.00

NOTES:

[1]Open space: Wilderness areas managed upper watershed, grazing land.
[2]Residential: Building lots less than 5 acres.
[3]Large lot residential: Building lots 5 to 40 acres.
[4]Does not include grazing.

Most of the intensively developed areas within the Upper Mokelumne River Watershed are residential communities. As shown in Figure 3-12, the majority of these areas are located in the lower elevations of the sub-watershed areas of the Middle Fork, South Fork, and Mainstem of the Mokelumne River. Table 3-4 summarizes the intensively developed areas by name and acreage for each sub-watershed. These intensively developed areas are continuing to grow due to population growth. As noted in the 1995 MRWSS, the foothill and mountain counties of California have experienced an unexpectedly rapid population growth surge. The counties of Upper Mokelumne River Watershed -- Alpine, Amador, and Calaveras -- are no exception. Table 3-5 summarizes both historical and projected watershed populations by county for the decades from 1980 through 2020. As a compliment to this table, Figures C-3 and C-4 in Appendix C depict existing community populations and areal population densities, and existing housing densities, respectively.

Table 3-4: Intensively Developing Areas within the Upper Mokelumne River Watershed[1]

Sub-Watershed	Development	Land Area (Acres)
North Fork	1. Silver Lake Pines	307
	2. Roden Estates	11
	3. Blue Creek	31
	4. Robb Park Estates	212[2]
	Subtotal	349
Middle Fork	1. Lily Valley Estates	104
	2. West Point Community	251
	3. Lynn Park Acres	266
	4. Wilseyville Subdivision	32
	Subtotal	653
South Fork	1. Glencoe	26
	2. Railroad Flat	168
	Subtotal	194
Mainstem	1. Pine Acres	114
	2. Ponderosa Hills	22
	3. Butte-Mountain Estates	51
	4. Paloma Community	67
	5. Mokelumne Hill Community	460
	6. Boston Yale Subdivision	34
	Subtotal	748
	Watershed Total	2,156

[1]Supporting data, including landowner maps, were developed by C.S. Young Engineers and Teale GIS Technology Center.

[2]Estimated from number of parcels estimated at 1 acre each.

Estimated populations within the Upper Mokelumne River Watershed and each of the sub-watersheds are compiled in Table 3-6. As reported in the 1995 MRWSS, the totals for the watershed are estimated at 5,923 persons living in 3,475 homes.

Table 3-5: Population Projections by Decade for Each Upper Mokelumne River Watershed County

County	1980	1990	2000	2010	2020
Alpine	1,100	1,200	1,400	1,700	2,000
Amador	19,300	30,600	42,500	56,100	70,500
Calaveras	21,000	32,500	54,400	78,200	102,200

Table 3-6: Estimated Populations and Number of Homes Within the Upper Mokelumne River Watershed

Sub-watershed	Population	Number of Homes
North Fork	1,825	1,320
Middle Fork	1,686	924
South Fork	855	499
Mainstem	1,557	732
TOTAL	5,923	3,475

Landownership and Jurisdictional Authority

Including the District, six major institutional landowners and 81 private landowners have been identified in the Upper Mokelumne River Watershed. The major landowners are listed in Table 3-7. Of these landowners, Sierra Pacific Industries owns approximately 23 percent of the land, Bureau of Land Management approximately 4 percent, PG&E approximately 1 percent, Eldorado National Forest and Stanislaus National Forest approximately 52 percent, and others approximately 20 percent. The District is included in the others category of ownership.

The names of the 81 private landowners within the Upper Mokelumne River Watershed with more than 160-acre holdings are listed in Table C-8, Appendix C. In addition to these landowners, there are three counties -- Alpine, Amador, and Calaveras -- and four utilities -- Amador County Water Agency, Calaveras County Public Utility District, Calaveras County Water District, and Jackson Valley Irrigation District -- with major jurisdictional authority. Figures C-5 and C-6 provide background information regarding the water service areas within both Amador and Calaveras counties, respectively. Jurisdictional authority is important to the District in managing watershed lands, particularly with the lands, which are not owned by the District. Land use controls for water quality protection are an important management technique, which are discussed in Section 6.

Table 3-7: Major Landowners in the Upper Mokelumne River Watershed

Sub-Basin	Major Landowners
North Fork	BLM, PG&E, SPI, ENF, SNF
Middle Fork	BLM, SNF, SPI
South Fork	BLM, SNF, SPI
Mainstem	EBMUD, BLM, PG&E

KEY:

BLM: Bureau of Land Management
EBMUD: East Bay Municipal Utility District
ENF: Eldorado National Forest
SPI: Sierra-Pacific Industries
PG&E: Pacific Gas and Electric Company
SNF: Stanislaus National Forest

Natural Resources of the Camanche Watershed

Camanche Watershed is composed of the lands above Camanche Dam and below Pardee Dam, which drain toward Camanche Reservoir. The natural resources of the watershed described herein include geology, soils, vegetation and wildlife, and hydrology. General land use, ownership, and jurisdictional authority are also discussed.

Location

The Camanche Watershed is approximately 42 square miles, draining lands to the north and south of the lower Mokelumne River and immediately to the west of Pardee Reservoir. It is bounded on the west by Camanche Dam.

Geology and Soils

The topography of the watershed varies from the gently sloping plain of the eastern San Joaquin Valley to the gentle and moderately rolling hills and ridges of the western-most Sierra Nevada foothills. Elevations range from 235 feet above Mean Sea Level (MSL) to about 700 feet MSL on the ridge-crests adjacent to Pardee Dam. The most noticeable outcroppings are comprised of Mehrten Formation lahar deposits. This formation generally overlies older sediments. Mehrten Formation generally consists of an upper, soft volcanoclastic layer with interbedded sediments; middle, resistant volcanoclastic unit and a lower unit of light-colored ashy tuff.

Major soil groups in the watershed include well-drained stony clays to stony silt loams, well-drained gravelly to cobbly loams, well-drained clays occupying moderate slopes, relatively young overlying soil deposits consisting of well-developed alluvia with resistant hardpans, and unconsolidated to slightly-consolidated alluvia. Small, valley-side deposits consist of alluvial fans, landslides, and very recent in-channel deposits. All exposed sedimentary rocks and soils are subject to erosion and transport into the reservoir, largely as a function of slope. The presence of vegetation is a major factor in the prevention of erosion. Local sediments are the primary source of inorganic turbidity.

Vegetation and Wildlife

The dominant vegetation in the watershed is the common herbaceous annual, mostly non-native, grassland (with forbs), which is used extensively for cattle grazing. Primary plant types include the brome grasses, filaree, wild oats, star thistle, Italian rye grass and clovers. Above 300 to 400 feet MSL, the grasslands give way to oak-savannah depending upon ground water levels (shallow), soils, and land use constraints. The dominant tree species include the blue oak, interior live oak, and valley oak.

Information pertaining to wildlife is not documented; however, species similar to those found in the lower elevations of the Upper Mokelumne River Watershed are expected to occur in the Camanche Watershed. Birds, mammals, fish, reptiles, and amphibians are expected to be among the wildlife species present in the watershed. Based on the listing for Upper Mokelumne River Watershed, ground squirrels, brush rabbits, and gophers are some of the smaller mammals likely to inhabit the watershed. Larger mammals present in the watershed may include coyote, red fox, and muskrat.

Drainage Basins

The hydrologic drainage pattern of Camanche Watershed is depicted in Figure 2-6. All local streams -- except Mokelumne -- are ephemeral, and the only named streams in clockwise order from Camanche Dam are Rabbit Creek and Camanche Creek. Unnamed streams occupy China Gulch, a draw that passes through the community of Campo Seco, and Chile Camp Gulch.

Precipitation and Evaporation

EBMUD collects monthly precipitation (rainfall) and evaporation data at the District's Camanche North Weather Station. Camanche Watershed has a Mediterranean climate with moist, mild to cool winters and long, hot, and dry summers. Atmospheric flows are predominantly from the west and northwest, except during the approach of winter storms when winds shift to the south. Easterly winds are rare and limited to those periods of higher atmospheric pressures over Nevada and the rest of the Great Basin. Average monthly rainfall and evaporation are depicted in Figures 3-4 and 3-5, respectively. The amount of precipitation varies from year to year. Between 1974 and 1999 annual rainfall ranged between 5.3 inches and 32.2 inches with an average annual rainfall of 17.3 inches of Camanche Reservoir. Evaporation is less variable than rainfall, ranging from 66.0 inches to 88.2 inches, as shown in Figure 3-5. The mean annual evaporation is 79.0.

Almost 90 percent of the precipitation occurs as rainfall during the months of November through April. Snowfall is extremely rare. Precipitation events that produce runoff are typically induced by the passage of pacific cold fronts and associated unstable air masses that last from several hours to several days. Rainfall is generally moderate to light or showery. It it heavy only rarely -- usually in the presence of atypical thunderstorms that may be associated with tropical depressions, rapidly moving cold fronts with strong temperature gradients, extremely unstable air masses, or the westward drifting of cells that formed over the adjacent High Sierra crest.

Sustained heavy to moderately heavy rains capable of producing major flood events like the 1986 February flood -- the most intense local flood event of record -- are extremely rare, with a return probability of only once every seventy years. Similar or lesser great floods can be expected during winter periods when major climatic determinants such as the Pacific El Nino/Southern Oscillation induce sustained collisions of Aleutian and tropical air masses along tracks aimed by the jet stream at the coast of central California.

Local Runoff and Diversions

As previously mentioned the local streams are ephemeral and; therefore, do not carry flows during most of the year. High flows occur only during periods of significant runoff produced by major frontal storms. Total annual runoff volumes are relatively small and are not individually quantified -- only aggregate volumes are estimated for the watershed. Based on studies of similar intermittent foothill streams, which are proximate geographically, instantaneous peak flows are expected to be of relatively short duration and approximately two orders of magnitude larger than their mean flows.

The creek beds within the watershed were completely dry during the previous field surveys, as expected during the summer and fall. No storage reservoirs or natural impoundments other than Camanche Reservoir are present in the watershed except in the northeast corner of the basin. Ten small but permanent ponds and impoundments and at least one ephemeral pond are present in this quadrant. Some of these are connected to the natural drainage courses and some are confined to natural or quarried depressions. Most of these depressions appear to be the products of historical mining and quarrying activities.

Releases from Pardee Dam are the primary inflow into Camanche Reservoir. These releases averaged 565,780 acre-feet per year from 1974 through 1999. Local runoff for the Camanche Watershed is computed based on natural runoff, rainfall on the reservoir, and unaccounted for water between Pardee and Camanche dams. This runoff averaged 53,450 acre-feet per year between 1974 and 1999. Groundwater resources are adequate within Camanche Watershed and are used as a source for drinking water at the Camanche North Shore Recreation Area.

Land Uses

Camanche Reservoir and the District's Camanche North Shore and South Shore Recreation Areas comprises the majority land use within Camanche Watershed (Figure 2-6). The remaining area is comprised of open-space, agricultural areas and localized urban areas adjacent to the District's recreational facilities. The major transportation corridors include Highway 12 and the secondary roads leading to Camanche North Shore and Camanche South Shore Recreation Areas.

Landownership and Jurisdictional Authority

Including Camanche Reservoir and Camanche North Shore and South Shore Recreation Areas, the District owns approximately 47% of the lands within the Camanche Watershed. The majority of the remaining land (open-space) is owned by the Bureau of Land Management. The watershed basin encompasses portions of three counties – Amador, Calaveras and San Joaquin.

SECTION 4

SECTION 4
ANALYSIS OF WATERSHED - WATER QUALITY CONDITIONS

Introduction

In an effort to develop an overview of the water quality conditions in the Upper Mokelumne River Watershed, the 1995 Mokelumne River Watershed Sanitary Survey (1995 MRWSS) included data that represented the District's monitoring programs and those of the Amador Water Agency, Calaveras County Water District, and Calaveras Public Utility District. The 1995 MRWSS was a combined effort between these four agencies with the District assuming the lead role. As a result of this effort a baseline of water quality data was developed for the overall watershed.

The focus of the MRWSS Update 2000 is directed toward those lands and programs that are managed by the District. This enables the District to address in more depth a broader spectrum of water quality parameters. In addition, a District-oriented focus is also more effective with regards to developing relationships between water quality and watershed management.

The MRWSS Update 2000 also identifies lands and programs that are not managed by the District. Potential water quality concerns associated with activities on these lands may be addressed through a collaborative effort among watershed stakeholders.

This section begins with an updated review of relevant drinking water regulations that apply to the District's system. Monitoring programs were reviewed and documented. Raw water quality data and trends over time were evaluated. As part of the evaluation of the District's source water, raw water quality parameters were compared to the drinking water standards. The results of this type of evaluation indicate which water quality parameters require removal through treatment. Finally, a general evaluation of seven of the District's WTPs was conducted with regards to the SWTR and Interim Enhanced Surface Water Treatment Rule (IESWTR) performance standards, monitoring requirements, and operating criteria. Four of the WTPs serve small systems (less than 10,000 people served) and three WTPs serve large systems (greater than 10,000 people served). The four small system WTPs include: Pardee Center, Pardee Recreation, Camanche South Shore, and Camanche North Shore. The three large system WTPs are the Walnut Creek, Lafayette, and Orinda WTPs in the East Bay which treat imported Mokelumne River water from Pardee Reservoir. While the SWTR and IESWTR were written for large systems, the small systems discussed in this report are also evaluated based on the content of these two regulations. In particular, the ESWTR

requirements which address small systems are being developed under the Long Term - Stage 1 ESWTR.

Summary of Drinking Water Regulations

The Safe Drinking Water Act (SDWA) of 1974 gave EPA the authority to set standards for water quality parameters in drinking water supplies. 1999 marks the twenty-fifth anniversary of the SDWA. The EPA was required to establish primary regulations for the control of parameters which affect public health and secondary regulations for parameters which affect the aesthetics, such as taste and odor, of drinking water. Under the provisions of the SDWA, DHS has the primary enforcement responsibility. Title 22 of the California Administrative Code establishes DHS authority, and stipulates drinking water quality and monitoring standards.

Existing Regulations

In the 1986 Amendments to the SDWA, Congress gave EPA three years to establish Maximum Contaminant Levels (MCLs) or treatment techniques for 83 water quality parameters, and required EPA to establish MCLs and MCL Goals (MCLG) for an additional 25 parameters every three years thereafter. Given the enormity of this regulatory setting schedule and the need for broader scientific involvement and public comment, the U.S. House of Representatives passed legislation in February 1995 establishing a regulatory moratorium until December 31, 1995 or until a law was enacted to require risk analysis and cost/benefit analysis in federal rulemaking. The 1996 SDWA Amendments addressed these concerns. Through these amendments, Congress gave EPA 18 months to develop a target list of candidate contaminants to be considered for future regulation through MCLs or treatment technique. A drinking water candidate contaminant list (DWCCL) was to be developed by 1998 with an update every five years thereafter. The list(s) cannot contain any contaminants already being considered for regulation.

The most significant regulations finalized to date as a result of the SDWA, the National Interim Primary Drinking Water Regulations, the 1986 SDWA Amendments, and the 1996 SDWA Amendments are presented in Table 4-1.

Table 4-1: Existing Drinking Water Regulations

Regulation	Targeted Contaminants
Phase I, II, and V Regulations	VOCs, SOCs, and IOCs
Radioactivity	Radionuclides
Trihalomethane	Trihalomethanes
Surface Water Treatment Rule	Microbes and Turbidity
Total Coliform Rule	Microbes
Lead and Copper Rule	Corrosion By-Products
Information Collection Rule	Microbes and D/DBPs
Stage 1 - Disinfectant/Disinfection By-Product Rule	Disinfectants Disinfection By-Products
Interim Enhanced Surface Water Treatment Rule	Microbes and Turbidity
Methyl Tertiary-Butyl Ether (DHS)	MTBE

Since the publication of the 1995 EBWSS report several regulations were finalized and added to the list in Table 4-1. These regulations include: Information Collection Rule (ICR), Stage 1 - Disinfectant/Disinfection By-Product Rule (Stage 1 D/DBP Rule), and the Interim Enhanced Surface Water Treatment Rule (IESWTR). Brief descriptions of each of these new regulations are provided below.

Information Collection Rule. The ICR was proposed in February 1994, promulgated in May 1996, and monitoring began in July 1997. Monitoring was conducted over an 18-month duration. The purpose of the ICR was to collect microbial data, and for systems serving over 100,000 people, water quality and disinfection by-products data, that are critical to the development of the ESWTR and the long-term (Stage II) D/DBP Rule. As the ESWTR has been divided into the LT1 ESWTR and the LT2 ESWTR, the results of the ICR are pertinent to the development of each of these regulations.

Disinfectant/Disinfection By-Products Rule. The Stage I - D/DBP Rule was promulgated in December 1998 and effective as of February 1999. This regulation includes MCLs and MCLGs for the following three DBPs and chlorite:

	MCL (mg/L)	MCLG (mg/L)
Total Trihalomethanes (TTHMs)	0.080	
Chloroform		0
Bromodichloromethane		0
Dibromochloromethane		0.06
Bromoform		0
Haloacetic Acids (HAAs)	0.060	
Dichloroacetic acid		0
Trichloroacetic acid		0.3
Bromate (an ozonation by-product)	0.010	
Chlorite	1.0	

Also, maximum residual disinfectant levels (MRDLs) and MRDL goals (MRDLGs) for chlorine, chloramines, and chlorine dioxide were established.

	MCL (mg/L)	MCLG (mg/L)
Chlorine as Cl_2	4.0	4.0
Chloramine as Cl_2	4.0	4.0
Chlorine Dioxide as ClO_2	0.8	0.8

In addition, treatment goals for total organic carbon (TOC) removal[1] were also defined in the Stage 1 - D/DBP Rule for all water systems that rely upon surface water or ground water under direct influence (GWUDI) of surface water and implement conventional treatment. These removals will be achieved through either enhanced coagulation or enhanced softening unless the water system meets alternative criteria stipulated by the regulation.

[1] A water treatment plant satisfies the requirements enhanced coagulation if its annual average source water TOC or its annual average treated water TOC is less than 2.0 mg/L.

Required TOC Removal

Source Water TOC (mg/L as C)	Source Water Alkalinity (mg/L as $CaCO_3$)		
	0 - 60	> 60 - 120	> 120
> 2.0 to 4.0	35%	25%	15%
> 4.0 to 8.0	45%	35%	25%
>8.0	50%	40%	30%

Interim Enhanced Surface Water Treatment Rule. The IESWTR was promulgated in December 1998 and effective as of February 1999. Under the IESWTR, utilities are required to provide a 2-log reduction in *Cryptosporidium parvum* (*Cryptosporidium*). The rule also includes a series of more stringent requirements regarding turbidity removal. The requirements that pertain to all surface water or GWUDI systems that use conventional treatment or direct filtration, serve 10,000 or more people, and are required to filter are highlighted herein. For these systems, the turbidity of the combined filtered water at each treatment plant must be less than or equal to 0.3 NTU, 95 percent of the time each month. In addition, the combined filtered water turbidity must never exceed 1 NTU. Compliance monitoring for these requirements must be conducted at 4-hour intervals. Individual filter requirements are also stipulated in this regulation but are not highlighted in this document. In final, requirements for microbial disinfection benchmarking or profiling, sanitary surveys, and covering of treated water reservoirs are included in the regulation.

Methyl Tertiary-Butyl Ether. EPA issued a health advisory for MTBE in drinking water in 1998. MTBE is a synthetic compound used in the blending of gasoline to boost octane and reduce emissions of air pollutants from automobile engines. Since the early 1990s, MTBE has been used in gasoline to meet the federal Clean Air Act requirements. Since the introduction of MTBE-enhanced gasoline, MTBE has been detected in both surface and ground water supplies. For ground water sources this contamination generally has resulted from leaking underground pipelines and fuel storage tanks. For surface water sources such as reservoirs, this contamination has been linked to the use of motorized boats and personal watercraft.

In 1998, EPA issued a health advisory of 20 to 40 µg/L for MTBE in drinking water. This health advisory level provides guidance to prevent taste and odor problems. Newly developed information regarding health effects associated with MTBE is being used by EPA to set a secondary MCL (SMCL) for MTBE. An EPA SMCL is anticipated for promulgation in 2001. Since 1991, the DHS has had an interim action level for MTBE of 35 µg/L to protect against adverse health effects. In February 1997, DHS included MTBE as an unregulated chemical for which monitoring is required, to be incorporated into a system's existing raw water monitoring program. DHS established a SMCL of 5 µg/L in 1998 and a primary MCL of 13 µg/L in 1999 for MTBE.

Regulations Summary. Table 4-2 presents both EPA and DHS standards for the targeted contaminants listed in Table 4-1. For the EPA drinking water standards, MCLG, MCL, and secondary MCL (SMCL) are shown. Similarly, MCL and SMCL for the California drinking water standards are shown.

The 1986 SDWA Amendments led to the SWTR which includes a recommendation for all surface water systems to develop watershed control plans. As the primacy agency for the implementation of the SWTR, the DHS required WSS be conducted by January 1996 for all surface supplies with updates every five years thereafter. The contents of this report constitute the first five-year update.

In the SWTR, EPA targeted the control of *Giardia lamblia* (*Giardia*), viruses, heterotrophic bacteria, *Legionella*, and turbidity. DHS determined that all surface waters in California are subjected to potential contamination from *Giardia lamblia* and viruses. As previously mentioned in Section 1, there are several species of *Giardia* with *Giardia lamblia* being of most importance from a human health perspective. The SWTR includes the following general requirements in order to minimize human exposure to microbial contaminants in drinking water. The IESWTR added controls of Cryptosporidium to the watershed protection requirements.

1. Utilities are required to achieve at least 99.9 percent (3-log) removal and/or inactivation of *Giardia lamblia* cysts and a minimum 99.99 (4-log) removal and/or inactivation of viruses.

2. Utilities are required to achieve at least 99 percent (2-log) removal and/or inactivation of *Cryptosporidium*

3. The disinfectant residual entering the distribution system must not fall below 0.2 mg/L for more than 4 hours during any 24-hour period.

4. A disinfectant residual must be detectable in 95 percent of distribution system samples. The presence of heterotrophic plate count bacteria at concentrations less than or equal to 500 colony forming units per milliliter is considered equivalent to a detectable disinfectant residual.

Table 4-2: Drinking Water Standards

			EPA			California DHS(2)	
Water Quality Parameters	Regulation	Best Available Technology (1)	MCLG mg/L	MCL mg/L	SMCL mg/L	MCL mg/L	SMCL mg/L
GENERAL PHYSICAL							
Color (units)					15		15
Odor Threshold (TON)					3		3
Specific conductance							900
Total dissolved solids					500		500
Turbidity (NTU)	IESWTR	C-F, SSF, DEF, DF, D		0.3		0.3	
pH					6.5-8.5		6.5-8.5
Corrosivity					non-corrosive		non-corrosive
Foaming Agents (MBAS)					0.5		0.5
MICROBIOLOGICAL							
Cryptosporidium	IESWTR	C-F, SSF, DEF, DF, D	0	TT			
E coli	TCR	D	0	(4)		(4)	
Fecal coliforms	TCR	D	0	(4)		(4)	
Giardia lamblia	SWTR	C-F, SSF, DEF, DF, D	0	TT		TT	
Heterotrophic bacteria(3)	SWTR	C-F, SSF, DEF, DF, D	0	TT		TT	
Legionella (3)	SWTR	C-F, SSF, DEF, DF, D	0	TT		TT	
Total Coliform	TCR	D	0	(5)		(5)	

Table 4-2: Drinking Water Standards - continued

			EPA			California DHS(2)	
Water Quality Parameters	Regulation	Best Available Technology (1)	MCLG mg/L	MCL mg/L	SMCL mg/L	MCL mg/L	SMCL mg/L
Viruses (3)	SWTR	C-F, SSF, DEF, DF, D	0	TT		TT	
RADIONUCLIDES							
Beta particle and photon emitters (mrem)	Interim Radionuclides	C-F, IX, RO	0	4		4	
Gross Alpha (pCi/L)	Interim Radionuclides	C-F, RO	0	15		15	
Radium-226 + Radium 228 (pCi/L)	Interim Radionuclides			5		5	
Radium-226 (pCi/L)	Radionuclides	LS, (2) IX, RO	0	20			
Radium-228 (pCi/L)	Radionuclides	LS, (2) IX, RO	0	20			
Radon (pCi/L)	Radionuclides	AR	0	300			
Tritium (pCi/L)	Radionuclides					20,000	
Strontium-90 (pCi/L)	Radionuclides					8	
Uranium (pCi/L)	Radionuclides	C-F, (2) LS, (2) AX	0	20		20	
INORGANIC CHEMICALS							
Aluminum					0.05-0.2	1	0.2
Antimony	Phase V	C-F(2) RO	0.005	0.006		0.006	
Arsenic	Interim Arsenic	NA	NA	0.05		0.05	
Asbestos > 10µm (MFL)	Phase II	C-F(2), DF, DEF, CC	7	7		7	
Barium	Phase II	IX, RO, LS(2)	2	2		1	
Beryllium	Phase V	IX, RO, C-F(2), LS(2), AA, IX	0	0.004		0.004	
Bromate	Stage 1 D/DBP	DC	0	0.01			

Table 4-2: Drinking Water Standards - continued

			EPA			California DHS(2)	
Water Quality Parameters	Regulation	Best Available Technology (1)	MCLG mg/L	MCL mg/L	SMCL mg/L	MCL mg/L	SMCL mg/L
Cadmium	Phase II	C-F(2),LS (2), IX, RO	0.005	0.005		0.005	
Chloride	Stage 1				250		250
Chlorite	D/DBP	DC	0.8	1			
Chromium (total)	Phase II	C-F(2), LS, (Cr III)(2), IX, RO	0.1	0.1		0.05	
Copper	LCR	CC, SWT	1.3	TT			1
Cyanide	Phase V	IX, RO, C12	0.2	0.2		0.2	
Fluoride	Fluoride	AA, RO	4	4	2	1.4-2.4	
Iron					0.3		0.3
Lead	LCR	CC, PE, SWT, LSLR	0	TT			
Manganese					0.05		0.05
Mercury	Phase II	C-F (influent 10µg/L)	0.002	0.002		0.002	
		(2)LS, (2)GAC, RO					
Nickel	Phase V	LS, (2) IX, RO	0.1	0.1		0.1	
Nitrate (as N)	Phase II	IX, RO, ED	10	10		10	
Nitrite (as N)	Phase II	IX, RO		1		1	
Nitrate + nitrite (both as N)	Phase II	IX, RO	10	10		10	
Selenium	Phase II	C-F (Se IV) (2), LS(2),	0.05	0.05		0.05	
		AA, RO, ED					
Silver					0.1		0.1
Sulfate	Sulfate	RO, IX, ED	500	500	250		250-500
Thallium	Phase V	IX,AA	0.0005	0.002		0.002	
Zinc					5		5

Table 4-2: Drinking Water Standards - continued

			EPA			California DHS(2)	
Water Quality Parameters	Regulation	Best Available Technology (1)	MCLG mg/L	MCL mg/L	SMCL mg/L	MCL mg/L	SMCL mg/L
ORGANIC CHEMICALS							
Acrylamide	Phase II	PAP	0	TT			
Alachlor	Phase II	GAC	0	0.002		0.002	
Aldicarb	Phase II	GAC	0.001	0.003			
Aldicarb sulfone	Phase II	GAC	0.001	0.002			
Aldicarb sulfoxide	Phase II	GAC	0.001	0.004			
Atrazine	Phase II	GAC	0.003	0.003		0.003	
Bentazon						0.018	
Benzene	Phase I	GAC, PTA	0	0.005		0.001	
Benzo(a)pyrene	Phase V	GAC	0	0.0002		0.0002	
Bromodichloro-methane	Stage 1 D/DBP	EC	0	NA			
Bromoform	Stage 1 D/DBP	EC	0	NA			
Carbofuran	Phase II	GAC	0.04	0.04		0.018	
Carbon tetrachloride	Phase I	GAC, PTA	0	0.005		0.0005	
Chlordane	Phase II	GAC	0	0.002		0.0001	
Chloroform	Stage 1 D/DBP	EC	0	NA			
2,4-D	Phase II	GAC	0.07	0.07		0.07	
Dalapon	Phase V	GAC	0.2	0.2		0.2	
Di(2-ethylhexyl) adipate	Phase V	GAC, PTA	0.4	0.4		0.4	
Di(2-ethylhexyl) phthalate	Phase V	GAC	0	0.006		0.004	
Dibromochloro-methane	Stage 1 D/DBP	EC	0.06	NA			
Dibromochloro-propane (DBCP)	Phase II	GAC, PTA	0	0.0002		0.0002	
Dichloroacetic acid	Stage 1 D/DBP	EC	0	NA			
p-Dichlorobenzene	Phase I	GAC, PTA	0.075	0.075		0.005	

Table 4-2: Drinking Water Standards - continued

			EPA			California DHS(2)	
Water Quality Parameters	Regulation	Best Available Technology (1)	MCLG mg/L	MCL mg/L	SMCL mg/L	MCL mg/L	SMCL mg/L
o-Dichlorobenzene	Phase II	GAC, PTA	0.6	0.6		0.6	
1,1-Dichloroethane		GAC, PTA				0.005	
1,2-Dichloroethane	Phase I	GAC, PTA	0	0.005		0.0005	
1,1-Dichloroethylene	Phase I	GAC, PTA	0.007	0.007		0.006	
cis-1,2-Dichloroethylene	Phase II	GAC, PTA	0.07	0.07		0.006	
trans-1, 2-Dichloroethylene	Phase II	GAC, PTA	0.1	0.1		0.01	
Dichloromethane (methylene chloride)	Phase V	PTA	0	0.005		0.005	
1, 2-Dichloropropane	Phase II	GAC, PTA	0	0.005		0.005	
Dinoseb	Phase V	GAC	0.007	0.007		0.007	
Diquat	Phase V	GAC	0.02	0.02		0.02	
Endothall	Phase V	GAC	0.1	0.1		0.1	
Endrin	Phase V	GAC	0.002	0.002		0.002	
Epichlorohydrin	Phase II	PAP	0	TT			
Ethylbenzene	Phase II	GAC, PTA	0.7	0.7		0.7	
Ethylene dibromide (EDB)	Phase II	GAC, PTA	0	0.00005		0.00005	
Glyphosate	Phase V	OX	0.7	0.7		0.7	
Haloacetic acids (sum of 5; HAA)	Stage 1 D/DBP	EC		0.06			
Heptachlor	Phase II	GAC	0	0.0004		0.00001	
Heptachlor epoxide	Phase II	GAC	0	0.0002		0.00001	
Hexachlorobenzene	Phase V	GAC	0	0.001		0.001	
Hexachlorocyclopentadiene	Phase V	GAC, PTA	0.05	0.05		0.05	
Lindane	Phase II	GAC	0.0002	0.0002		0.0002	
Methoxychlor	Phase II	GAC	0.04	0.04		0.04	
Methyl Tertiary-Butyl Ether	MTBE					0.005	0.013
Molinate						0.02	

Table 4-2: Drinking Water Standards - continued

			EPA			California DHS(2)	
Water Quality Parameters	Regulation	Best Available Technology (1)	MCLG mg/L	MCL mg/L	SMCL mg/L	MCL mg/L	SMCL mg/L
Monochlorobenzene	Phase II	GAC, PTA	0.1	0.1		0.07	
Oxamyl (vydate)	Phase V	GAC	0.2	0.2		0.2	
Pentachlorophenol	Phase II	GAC	0	0.001		0.001	
Picloram	Phase V	GAC	0.5	0.5		0.5	
Polychlorinated byphenyls (PCBs)	Phase II	GAC	0	0.0005		0.0005	
Simazine	Phase V	GAC	0.004	0.004		0.004	
Styrene	Phase II	GAC, PTA	0.1	0.1		0.1	
2,3,7,8 TCDD (dioxin)	Phase V	GAC	0	3 x 10 -8		3 x 10 -8	
1,1,2,2-Tetrachloro-ethane		GAC				0.001	
Tetrachloroethylene	Phase II	GAC, PTA	0	0.005		0.005	
Thiobencarb		GAC, PTA				0.07	0.001
Toluene	Phase II	GAC, PTA	1	1		0.15	
Toxaphene	Phase II	GAC	0	0.003		0.003	
2,4,5 TP (silvex)	Phase II	GAC	0.05	0.05		0.05	
Trichloroacetic acid	Stage 1 D/DBP	EC	0.3	NA			
1,2,4-Trichlorobenzene	Phase V	GAC, PTA	0.07	0.07		0.07	
1,1,1-Trichloroethane	Phase I	GAC, PTA	0.2	0.2		0.2	
1,1,2-Trichloroethane	Phase V	GAC, PTA	0.003	0.005		0.005	
Trichloroethylene	Phase I	GAC, PTA	0	0.005		0.005	
Trichlorofluoromethane		GAC, PTA				0.15	
1,1,2-Trichloro-1,2,2-Trifluoroethane		GAC, PTA				1.2	
Trihalomethanes (sum of 4; THMs)	Stage 1 D/DBP	AD, PR, SPC, EC	NA	0.080		0.080	

Table 4-2: Drinking Water Standards - continued

			EPA			California DHS(2)	
Water Quality Parameters	Regulation	Best Available Technology (1)	MCLG mg/L	MCL mg/L	SMCL mg/L	MCL mg/L	SMCL mg/L
Vinyl chloride	Phase I	PTA	0	0.002		0.0005	
Xylenes (total)	Phase II	GAC + PTA	10	10		1.75	

NOTES: (1) *AA-activated alumina, AD—altemative disinfectants, AR—aeration, AX—anion exchange. CC—corrosion control, C-F—coagulation and filtration, Cl2—chlorination, D—disinfection. DC—disinfection system control, DEF—diatomaceous earth filtration, DF direct filtration, EC—enhanced coagulation, ED electrodialysis, GAC— granular activated carbon, IX—ion exchange, LS—lime softening, LSLR—lead service line replacement, NA—not applicable, OX — oxidation, PAP — polymer addition practices, PE—public education, PR—precursor removal, PS—performance standard, PTA—packed tower aeration, RO—reverse osmosis, SPC—stop pre-chlorination, SSF—slow sand filtration, SWT—source water treatment, TT—treatment technique.

(2) California MCL and SMCL from California Code of Regulations Title 22, Update January, 1995

(3) Coagulation-filtration and lime softening are not BAT for small systems for variances unless treatment is already installed.

(4) Final for systems using surface water, also being considered for groundwater systems

(5) If a repeat total coliform sample is fecal coliform- or E. coli-positive. The system is also in violation of the MCL for total coliforms if a routine sample is a fecal coliform- or E. coli-positive and is followed by a total coliform-positive repeat sample.

(6) No more than 5 percent of the samples per month may be positive. For systems collecting fewer than 40 samples per month, no more than 1 sample per month may be positive.

Anticipated Regulations

As a result of the regulatory activities initiated by the 1996 SDWA Amendments, a number of regulations have been redefined and/or rescheduled for development and promulgation. With an emphasis on strengthening the scientific basis or risk assessment information and approach being used to establish MCLs additional time is required for development and promulgation. In addition, the emphasis on ensuring that the benefits gained from a public health perspective outweigh or balance the costs of treatment is resulting in a more thorough public comment period. Below are the more pertinent regulations which are scheduled for promulgation and are reflected in Table 4-3.

Table 4-3: Status of Anticipated Drinking Water Regulations(1)

Anticipated Regulation	Targeted Contaminants	Status
Ground Water Rule	Viruses	Proposed 3/00 Final 12/01
Arsenic	Arsenic	Proposed 5/00 Final 1/01
Drinking Water Candidate Contaminants List	VOCs, SOCs, IOCs, Microbes	Proposed 3/98 Final 2001 Revised 2003
Radionuclides	Uranium, Radium 226 and 228 Gross beta, Gross alpha	Proposed 7/91 Revised 3/00 Final 11/00
Radon	Radon	Proposed 11/99
Sulfate	Sulfate	DWCCL 2001 Proposal 8/03 Final 2/05
Long Term, Stage 1, Enhanced Surface Water Treatment Rule (LT1 ESWTR)	Microbes and Turbidity	Proposed 3/00 Final 8/00

Anticipated Regulation	Targeted Contaminants	Status
Stage 2 - Disinfectant/ Disinfection By-Product Rule	Disinfectants Disinfection By-Products	Proposal 5/01 Final 5/02
Long Term, Stage 2, Enhanced Surface Water Treatment Rule (LT2 ESWTR)		Proposal 2/01 Final 5/02
MTBE (EPA)	MTBE	Proposal 2001 Final 2002

(1) Anticipated Drinking Water Regulations as of September 2000.

Ground Water Rule. The former ground water disinfection rule was restructured and named the Ground Water Rule (GWR). A proposed version has been available for comment since March 2000. The final rule was scheduled for promulgation in November 2000, but it has been delayed. The GWR establishes multiple barriers to protect public health against bacteria and viruses. A targeted strategy is included to identify those systems which are at high risk for fecal contamination. A 4-log (99.99 %) removal of viruses, sanitary surveys to identify system deficiencies, source water monitoring for undisinfected systems and compliance monitoring for disinfected systems are all delineated in the proposed rule.

Arsenic Rule. The MCL for arsenic is 10 µg/L; with an MCL goal of zero. Compliance with this rule must be achieved by January 2006.

Drinking Water Candidate Contaminant List. A draft list of candidate contaminants was published in 1997 and a final list published in March 1998. The list contains 50 chemical and 10 microbiological contaminants being considered for future regulation. Sulfate is one of the chemical contaminants included in this list. At least five contaminants from the final list must be selected for regulation by August 2001. A revised DWCCL is scheduled to be published by February 2003 and every five years thereafter.

Radionuclides Regulations. The proposed regulations for radionuclides were published in July 1991. Because of the controversy over the proposed radon standard, the promulgation of the final regulations were delayed. Uranium, Radium 226 and 228, Gross alpha, and Gross beta are the radionuclides included in this current proposed regulation.

Radon Regulation. The radon regulation was separated from the remaining radionuclides given that radon in air, and not water, is the key public health concern. A proposed regulation was published in November 1999. This regulation addresses communities which serve greater than 25 people and use ground water or mixed ground water and surface water sources. If the source water radon concentration is less than 300 pCi/L then the water does not need to be treated. Above this concentration, up to 4,000 pCi/L, a system has the option to pursue a multimedia mitigation program (MMM program) given that the DHS has developed such a program.

Sulfate Regulations. The proposed MCL of 500 mg/L for the control of sulfate in drinking water supplies was published in December 1994. Because sulfate is considered a low public health priority, further development of this regulation was postponed. Sulfate is one of the chemical contaminants on the proposed list of drinking water candidate contaminants. If it is selected for regulation by August 2001 under the DWCCL program, then a proposed standard is expected by August 2003 and a final regulation by February 2005.

Stage 2 - Disinfectant/Disinfection By-Product Rule. A proposed Stage 2 - D/DBP Rule is anticipated for publication in February 2001 with a final version being promulgated in May 2002. The agreement in principle, for the Stage 2 Disinfectant/Disinfection By-Product Rule calls for MCLs of 80 mg/L for TTHM and 60 mg/L for HAA (based on an annual average measurement at each compliance monitoring location) and water treatment technique requirements to mitigate for cryptosporidium risks.

Long Term, Stage 1 Enhanced Surface Water Treatment Rule. While the IESWTR applies to systems serving 10,000 or more people, the LT1 ESWTR was proposed in March 2000 and applies to systems serving less than 10,000 people. A final version was scheduled for promulgation in August 2000; however, a delay has pushed this date to November 2000 or possibly later. Like the IESWTR the focus of the LT1 ESWTR emphasizes microbiological

contaminants and turbidity. The LT2 ESWTR, once proposed, is currently scheduled for promulgation in May 2002.

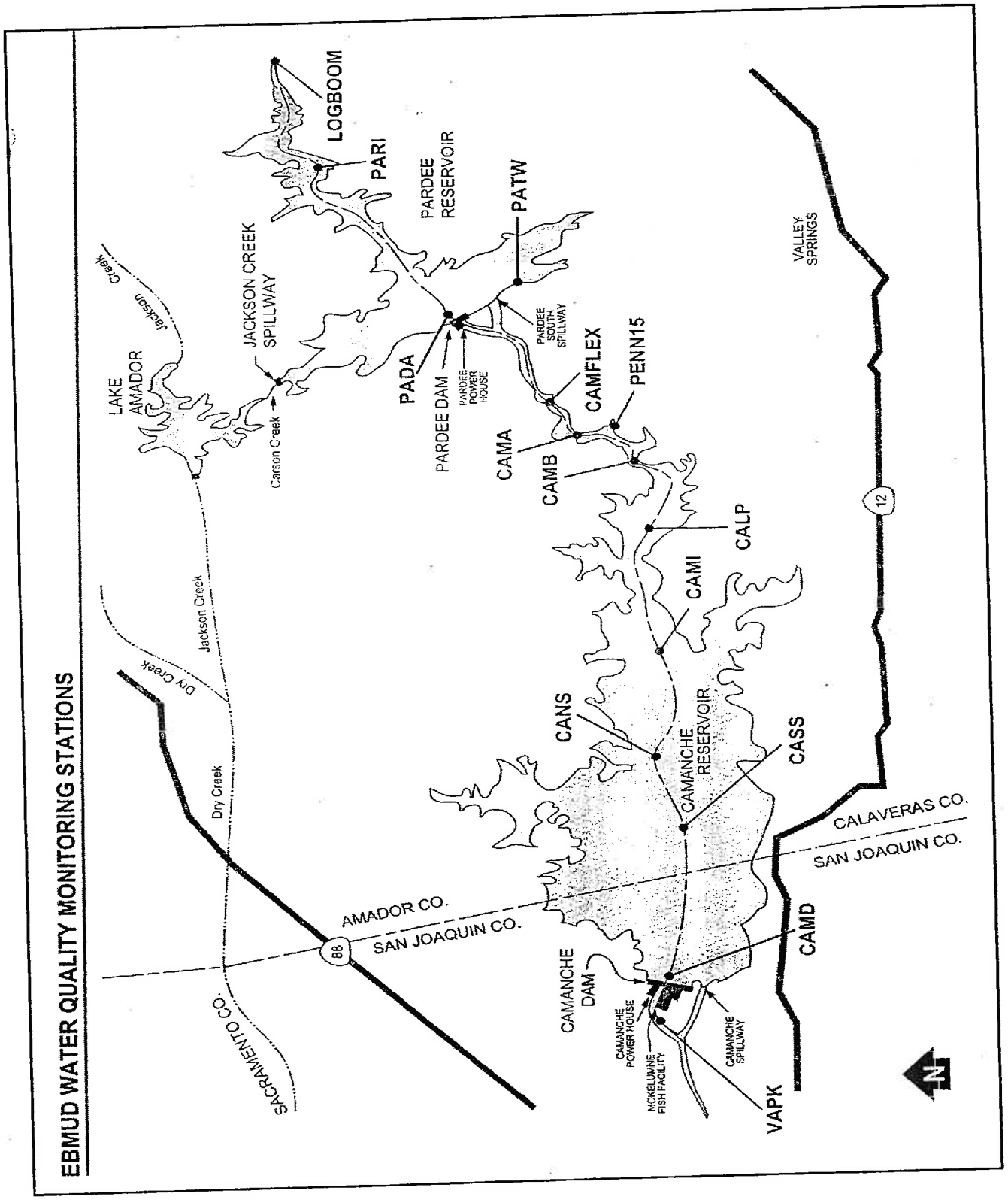
Summary of Available Raw Water Quality Data

The District conducts several water quality monitoring programs on Pardee and Camanche Reservoirs for regulatory compliance, water rights, environmental assessment, and water supply objectives. In addition, EBMUD monitors general water quality parameters throughout the reservoirs to assist staff in managing reservoir operations and water treatment issues. Descriptions of the monitoring programs that pertain to the raw water quality of Pardee and Camanche Reservoirs are presented in the following sections.

General Reservoir Monitoring

EBMUD monitors reservoir water quality conditions on a weekly basis at several locations throughout Pardee and Camanche Reservoirs (Figure 4-1). The water quality parameters – temperature, pH, dissolved oxygen, specific conductance, and oxidation reduction potential – are profiled by depth. Field conditions and turbidity measurements are recorded as well. This information is analyzed and reviewed on a routine basis to assist the District's water supply operations.

FIGURE 4-1 - EBMUD Water Quality Monitoring Stations



Title 22 Monitoring Program

Tables 4-4 through 4-7 contain the District's Title 22 monitoring schedule for Pardee Recreation Area (Table 4-4), Pardee Center (Tables 4-5), Camanche North Shore Recreation Area (Table 4-6), and Camanche South Shore Recreation Area (Table 4-7).

Title 22 from the California Code of Regulations is a compilation of rules and regulations that addresses human health and safety issues. The Environmental Health section includes drinking water standards, reclamation criteria, and hazardous waste. The Domestic Water Quality and Monitoring chapter (which deals with drinking water standards and monitoring requirements) and the Surface Water Filtration and Disinfection Treatment chapter have the most relevance to watershed sanitary survey requirements.

The water quality constituents for Title 22 compliance are addressed by category – volatile organics chemicals; synthetic organic chemicals; fluoride; asbestos; nitrates and nitrites; inorganic chemicals; general mineral and general physical; and radiological. In September 1993, DHS granted the District's request for a reduced monitoring program for certain parameters. Since the 1995 MRWSS, the District has revised the Title 22 Raw Water Monitoring Program to reflect the changes from the Title 22 Emergency rulemaking of September 1994.

In accordance with Title 22 requirements, the District prepares an Annual Water Quality Report that summarizes the water quality conditions being supplied to District consumers. Appendix F contains the Annual Water Quality Reports for 1995-1999 for the District's Pardee Recreation Area, Pardee Center, Camanche North Shore, and Camanche South Shore water supply systems.

Table 4-4: Pardee Recreation Area Title 22 Monitoring Schedule

Chemical	EPA Test Method	FIRST COMPLIANCE CYCLE									SECOND COMPLIANCE CYCLE								
		1st Compliance Period			2nd Compliance Period			3rd Compliance Period			1st Compliance Period			2nd Compliance Period			3rd Compliance Period		
		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Volatile Organics (VOCs)	502.2/524.2	C	C	C	C	C	C	C	C	W	W	W	W	W	W	W	W	W	W
MTBE, TAME, ETBE						C	C	C	C	W	W	W	W	W	W	W	W	W	W
Synthetic Organics (SOCs)																			
2,4-D	515.1	C	W	C	W	C	W	W	C	W	W	W	W	W	W	W	W	W	W
atrazine	507/525.1	C	W	C	W	C	W	W	C	W	W	W	W	W	W	W	W	W	W
simazine	507/525.1	C	W	C	W	C	W	W	C	W	W	W	W	W	W	W	W	W	W
remaining SOCs	various	C	W	C	W	C	W	W	C	W	W	W	W	W	W	W	W	W	W
Fluoride		C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X
Asbestos	TEM			C									X						
Nitrates and Nitrites	300	C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X
Inorganicss (IOCs)																			
aluminum	200.7	C	C	C	C	C	C	W	W	W	W	W	W	W	W	W	W	W	W
arsenic	various	C	C	C	C	C	C	W	W	W	W	W	W	W	W	W	W	W	W
barium	200.7	C	C	C	C	C	C	W	W	W	W	W	W	W	W	W	W	W	W
beryllium	various	C	C	C	C	C	C	W	W	W	W	W	W	W	W	W	W	W	W
cadmium	various	C	C	C	C	C	C	W	W	W	W	W	W	W	W	W	W	W	W
chromium	various	C	C	C	C	C	C	W	W	W	W	W	W	W	W	W	W	W	W
nickel	various	C	C	C	C	C	C	W	W	W	W	W	W	W	W	W	W	W	W
perchlorate											W			R			R		
remaining IOCs	various	C	C	C	C	C	C	W	W	W	W	W	W	W	W	W	W	W	W
General Mineral/Physical																			
thiobencarb		C	C	C	C	W	W	W	W	W	W	W	W	W	W	W	W	W	W
remaining secondary		C	C	C	C	C	C	C	C	W	W	W	W	W	W	W	W	W	W
Radiological																			
natural		C		C				W			W			W					
man-made		C		C				W			W			W					

Notes

C: Monitoring completed
X: Monitoring required
W: Monitoring waived
R: Monitoring waiver renewal required

VOCs: Waiver granted in 1997 and renewed in 1999 for the 1999 - 2001 period.
SOCs: Waiver granted in 1997 and renewed in 1999 for the 1999 - 2001 period.
Asbestos: Waiver granted in 1997 and renewed in 1999 for the 1999 - 2001 period.
nitrate and nitrite: One sample to be collected every year in Pardee reservoir
IOCs: Waiver granted in 1997 and renewed in 1999 for the 1999 - 2001 period.
remaining IOCs: Waiver granted in 1997 and renewed in 1999 for the 1999 - 2001 period.
General Mineral/Physical: Waiver granted in 1997 and renewed in 1999 for the 1999 - 2001 period.
remaining secondary: Remaining secondary include aluminum, color, copper, corrosivity, foaming agents (MBAS), iron, manganese, odor threshold, silver, turbidity, zinc, TDS, specific conductance, chloride, sulfate, bicarbonate, carbonate, and hydroxide alkalinity, calcium, magnesium, sodium and total hardness
Radiological: Waiver granted in 1997 and renewed in 1999 for the 1999 - 2001 period.

Table 4-5: Pardee Center Title 22 Monitoring Schedule

Chemical	EPA Test Method	FIRST COMPLIANCE CYCLE									SECOND COMPLIANCE CYCLE								
		1st Compliance Period			2nd Compliance Period			3rd Compliance Period			1st Compliance Period			2nd Compliance Period			3rd Compliance Period		
		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Volatile Organics (VOCs)	502.2/524.2	C	C	C	C	C	C	C	C			X						X	
MTBE, TAME, ETBE						C	C	C	C			X						X	
Synthetic Organics (SOCs)																			
2,4-D	515.1	C	W	C	W	C	C	W	C	W	W	W	W	W	W	W	W	W	W
atrazine	507/525.1	C	W	C	W	C	C	W	C	W	W	W	W	W	W	W	W	W	W
simazine	507/525.1	C	W	C	W	C	C	W	C	W	W	W	W	W	W	W	W	W	W
remaining SOCs	various	C	W	C	W	C	C	W	C	W	W	W	W	W	W	W	W	W	W
Fluoride		C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X
Asbestos	TEM			C									X						
Nitrates and Nitrites	300	C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X
Inorganicss (IOCs)																			
aluminum	200.7	C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X
arsenic	various	C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X
barium	200.7	C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X
beryllium	various	C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X
cadmium	various	C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X
chromium	various	C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X
nickel	various	C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X
perchlorate											W			R			R		
remaining IOCs	various	C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X
General Mineral/Physical																			
thiobencarb		C	C	C	C	W	W	W	W	W	R	R	R	R	R	R	R	R	R
remaining secondary		C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X
Radiological																			
natural		C		C				C				W			W				
man-made		C		C				C				W			W				

Notes

C: Monitoring completed
X: Monitoring required
W: Monitoring waived
R: Monitoring waiver renewal required

VOCs: Waiver granted in 1997 and renewed in 1999 for the 1999 - 2091 period.
SOCs. Waiver granted in 1997 and renewed in 1999 for the 1999 - 2001 period.
Asbestos: One sample to be collected at San Ramon Tap No. 2, which is served by asbestos-cemnet pipe in addition to sampling at Pardee Reservoir
nitrate and nitrite: One sample to be collected every year in Pardee reservoir
IOCs: One sample to be collected every year in the treated water effluent of each water treatment plant for compliance purposes in lieu of sampling at Pardee reservoir
remaining IOCs: Remaining IOCs include antimony, cyanide, mercury, selenium, and thallium
General Mineral/Physical: One sample to be collected every year in the treated water effluent of water treatment plant for compliance purposes in lieu of sampling at Pardee reservoir
remaining secondary: Remaining secondary include aluminum, color, copper, corrosivity, foaming agents (MBAS), iron, manganese, odor threshold, silver, turbidity, zinc, TDS, specific conductance, chloride, sulfate, bicarbonate, carbonate, and hydroxide alkalnity, calcium, magnesium, sodium and total hardness
Radiological: Waiver granted in 1997 and renewed in 1999 for the 1999 - 2001 period.

Table 4-6: Camanche North Shore Recreation Area Title 22 Monitoring Schedule

Chemical	EPA Test Method	FIRST COMPLIANCE CYCLE									SECOND COMPLIANCE CYCLE								
		1st Compliance Period			2nd Compliance Period			3rd Compliance Period			1st Compliance Period			2nd Compliance Period			3rd Compliance Period		
		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Volatile Organics (VOCs)	502.2/524.2	C	C	C	C	C			C	X	X	X	X	X	X	X	X	X	X
MTBE, TAME, ETBE						C		C	C	X	X	X	X	X	X	X	X	X	X
Synthetic Organics (SOCs)																			
2,4-D	515.1		C			C			C		R			R			R		
atrazine	505/507/525.1		C			C			C		C			C			C		
simazine	505/507/525.1		C			C			C		C			C			C		
remaining SOCs	various			C		W			W		W			W			W		
Fluoride			C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X
Asbestos	TEM			C									C						
Nitrates and Nitrites	300	C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X
Inorganicss (IOCs)																			
aluminum	200.7	C	C	C	C	C	C	C			X			X			X		
arsenic	various	C	C	C	C	C	C	C			X			X			X		
barium	200.7	C	C	C	C	C	C	C			X			X			X		
beryllium	various	C	C	C	C	C	C	C			X			X			X		
cadmium	various	C	C	C	C	C	C	C			X			X			X		
chromium	various	C	C	C	C	C	C	C			X			X			X		
nickel	various	C	C	C	C	C	C	C			X			X			X		
perchlorate											X			R			R		
remaining IOCs	various	C	C	C	C	C	C	C			X			X			X		
General Mineral/Physical																			
thiobencarb		C	C	C	C	W	W	W	W	W	W	W	W	W	W	W	W	W	W
remaining secondary		C	C	C	C	C	C	C	C		X			X			X		
Radiological																			
natural		CC	CC		CCCC			XXXX						XXXX			XXXX		
man-made		C			W			W						W			W		

Notes

C: monitoring completed
X: monitoring required
W: monitoring waived
R: monitoring waiver renewal required

VOCs: Annual monitoring at Well #4 due to recent VOC hits. Every third year for other wells.
SOCs: All well supplies required sampling for Atrazine/Simazine every third year. Two samples collected for 2,4-D at Well #2 only.
Asbestos: One sample to be collected at each source water. If asbestos-cement pipe (ACP) is used, a distribution tap will be sampled representing the area served by the ACP.
nitrate and nitrite: One sample to be collected every year at each well supply.
IOCs: One sample to be collected every third year at every well supply.
remaining IOCs: Remaining IOCs include antimony, cyanide, mercury, selenium, and thallium
General Mineral/Physical: One sample to be collected every third year at every well supply. One sample to be collected every third year in the treated water effluent.
remaining secondary: Remaining secondary include aluminum, color, copper, corrosivity, foaming agents (MBAS), iron, manganese, odor threshold, silver, turbidity, zinc, TDS, specific conductance, chloride, sulfate, bicarbonate, carbonate, and hydroxide alkalinity, calcium, magnesium, sodium and total hardness
Radiological: Four consecutive quarterly samples to be collected every four years

Table 4-7: Camanche South Shore Recreation Area Title 22 Monitoring Schedule

Chemical	EPA Test Method	FIRST COMPLIANCE CYCLE									SECOND COMPLIANCE CYCLE								
		1st Compliance Period			2nd Compliance Period			3rd Compliance Period			1st Compliance Period			2nd Compliance Period			3rd Compliance Period		
		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Volatile Organics (VOCs)	502.2/524.2	C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X
MTBE, TAME, ETBE						C	C	C	C	X	X	X	X	X	X	X	X	X	X
Synthetic Organics (SOCs)																			
2,4-D	515.1		C			C	W	W	W	W	W	W	W	W	W	W	W	W	W
alrazine	505/507/525.1		C			C	W	W	W	W	W	W	W	W	W	W	W	W	W
simazine	505/507/525.1		C			C	W	W	W	W	W	W	W	W	W	W	W	W	W
remaining SOCs	various		C			W	W	W	W	W	W	W	W	W	W	W	W	W	W
Fluoride			C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X
Asbestos	TEM			C									X						
Nitrates and Nitrites	300	C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X
Inorganicss (IOCs)																			
aluminum	200.7	C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X
arsenic	various	C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X
barium	200.7	C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X
beryllium	various	C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X
cadmium	various	C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X
chromium	various	C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X
nickel	various	C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X
perchlorate											X			R			R		
remaining IOCs	various	C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X
General Mineral/Physical																			
thiobencarb		C	C	C	C	W	W	W	W	W	W	W	W	W	W	W	W	W	W
remaining secondary		C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X
Radiological																			
natural		CCCC			CCCC			XXXX						XXXX			XXXX		
man-made		C			W			W						W			W		

Notes

C: monitoring completed
X: monitoring required
W: monitoring waived
R: monitoring waiver renewal required

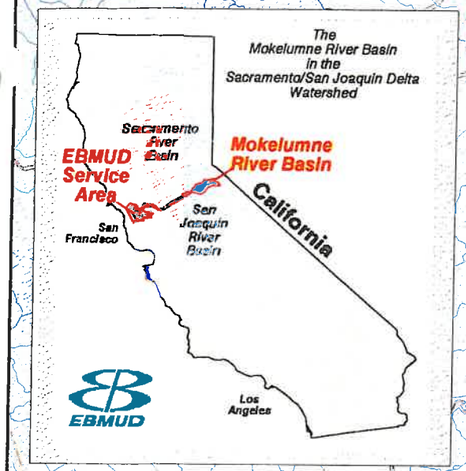
VOCs: Quarterly monitoring required till 3rd quarter of 2001 due to recent VOC hits.
SOCs: Waiver granted for all SOCs in 1997 and renewed in 1999 for 1999 - 2001.
Asbestos: One sample to be collected at the source water. If asbestos-cement pipe (ACP) is used, a distribution tap will be sampled representing the area served by the ACP.
nitrate and nitrite: One sample to be collected every year at the source water.
IOCs: One sample to be collected every year at the source water.
remaining IOCs: Remaining IOCs include antimony, cyanide, mercury, selenium, and thallium
General Mineral/Physical: One sample to be collected every year in the treated water effluent of the water treatment plant for compliance purposes in lieu of sampling at Camanche Reservoir
remaining secondary: Remaining secondary include aluminum, color, copper, corrosivity, foaming agents (MBAS), iron, manganese, odor threshold, silver, turbidity, zinc, TDS, specific conductance, chloride, sulfate, bicarbonate, carbonate, and hydroxide alklanity, calcium, magnesium, sodium and total hardness
Radiological: Four consecutive quarterly samples to be collected every four years

Mokelumne River and Tributary Monitoring

The District monitors water quality on a monthly basis at eight locations along the Mokelumne River and its main tributaries upstream of Pardee Reservoir (Table 4-8). The purpose of this monitoring program is to develop a long-term record of water quality conditions to establish a baseline and to monitor long-term trends. The monthly grab samples are analyzed for total coliform, fecal coliform, E.coli, and turbidity. A flow estimate is recorded as well. Figure 4-2 depicts the locations of these sampling sites in the Upper Mokelumne Watershed.

Table 4-8: Mokelumne River and Tributary Monitoring Stations

Station	Description
MRHW49	Mokelumne River at Highway 49 crossing
MRPH	Mokelumne River approx. half mile downstream of Electra Powerhouse at PG&E day-use recreation area
MRWG	Wilson Gulch approx. quarter mile downstream of Highway 49 crossing
MRHW26	South Fork Mokelumne River at Highway 26 crossing
MRLF	South Fork Mokelumne River at Railroad Flat Road crossing, approx. quarter mile upstream of Licking Fork confluence
MRPW	Middle Fork Mokelumne River upstream of Wilseyville (CCWD) pump station, approx. 1 mile upstream of Highway 26 crossing
MRWP	Middle Fork Mokelumne River at West Point (Highway 26 crossing)
MRTC	North Fork Mokelumne River below Tiger Creek Powerhouse afterbay.



El Dorado County

North Fork Sub-Basin

Alpine County

Middle Fork Sub-Basin

Tuolumme County

Amador County

Main Stem Sub-Basin

South Fork Sub-Basin

Calaveras County

Camanche Sub-Basin

San Joaquin County

Kirkwood

Jackson

Mokelumne Hill

San Andreas

Big Trees

Hwy 88

Hwy 49

Hwy 26

Hwy 4

Hwy 12

Hwy 104

Hwy 16

Hwy 124

Hwy 88

Hwy 29

MRTC

MRWP

MRPW

MRLF

MRWW 29

MRPH

MRWG

MRIW 49

PATW

Figure 4-2
Mokelumne River Water Quality Sampling and Recreation Sites

☆ *Water Quality Monitoring Site*

○ *Recreation Site*

EBMUD

0 4 8

MILES

Giardia Monitoring

Sampling for *Giardia* was initiated in 1991 at the influent tap of the Walnut Creek WTP to determine whether *Giardia* was present in water delivered from Pardee Reservoir. This sampling continued on a monthly basis from March to August 1991. Beginning in November 1994, the District initiated a sampling program for *Giardia* at Pardee Reservoir and the Walnut Creek WTP influent two to three times monthly. From mid-1995 through 1998, *Giardia* sampling occurred on a monthly basis. In 1999, based on consistent low levels of *Giardia*, this sampling was reduced to semi-annual collection.

Cryptosporidium Monitoring

Cryptosporidium samples were collected from the Walnut Creek WTP influent tap from March to August 1991 to monitor for the presence of *Cryptosporidium* in the water delivered from Pardee Reservoir. The results of this sampling indicated that *Cryptosporidium* was present in the water. Additionally, a sampling program was initiated for *Cryptosporidium* and enteric viruses in September 1994 in anticipation of the ICR. The results were documented in the 1995 MRWSS. *Cryptosporidium* has been sampled on a monthly basis from 1995 through 1998. In 1999, the frequency of sampling was reduced to semi-annual collection, based on consistent low levels at or near the detection limit.

Special Studies

A number of special studies are conducted on the raw and treated waters corresponding to the Upper Mokelumne River Watershed. An overview of these special studies are provided below.

Penn Mine. Penn Mine is an abandoned copper/zinc mine located adjacent to the District's Camanche Watershed property, along its upper reaches. The mine was opened in 1861, and periods of major mining activity occurred from 1899 through 1919 and during World War II. Heavy metals in stormwater runoff from the mine were linked to fish losses. Even after the mine was closed in the 1950s, problems persisted. Although the mine was not on District property, the District has worked for many years with the Regional Water Quality Control Board (RWQCB) to resolve the pollution problems and protect Camanche Reservoir and the Lower Mokelumne River. In February 1993, the District and RWQCB built an in-line treatment system to treat the acid rock drainage and

avoid untreated discharges during high storm events over the spillway of Mine Run Dam. The EPA approved these efforts and continues to provide regulatory oversight on water quality compliance. In February 1997, the District and the RWQCB – Central Valley Region, completed environmental documentation that identified a long-term solution to the acid rock drainage from the Penn Mine site. The solution included construction of a landfill onsite, excavation of mine waste and placement of the waste in the landfill, and the restoration and revegetation of the Penn Mine site. The Penn Mine Environmental Restoration Project was initiated in summer 1997 and completed in November 1999. Water quality monitoring was conducted throughout the restoration project. Post-restoration monitoring is ongoing. Receiving water samples are collected in Camanche Reservoir at designated locations.

Methyl Tertiary-Butyl Ether. Methyl tertiary-butyl ether (MTBE) is a SOC used in the blending of gasoline to boost octane and reduce emissions of air pollutants from automobile engines. Since the early 1990's, MTBE has been used in gasoline to meet federal Clean Air Act requirements. Since the introduction of MTBE-enhanced gasoline, MTBE has been detected in both surface and ground water supplies. For surface water sources such as reservoirs, this contamination has been linked to the use of motorized watercraft. Motorized watercraft are permitted for recreational purposes on Pardee and Camanche Reservoirs.

Potential health concerns regarding MTBE detection in surface waters became a primary concern in the drinking water industry the mid-1990s. The District began monitoring for MTBE on a monthly basis at Pardee and Camanche Reservoirs in 1995. Subsequent monitoring at both Pardee and Camanche Reservoirs detected MTBE. MTBE was not detected in any of the District's reservoirs where recreational motorized boating is prohibited. By early 1998, the District had developed an Action Plan that was intended to reduce or eliminate MTBE contamination in its drinking water reservoirs. The District's plan focused on source prevention: expanded monitoring, restriction of high emission outboard engines, and public outreach.

MTBE concentrations occur in Pardee and Camanche Reservoirs beginning in April and continuing through September as a consequence of increased motorized boating. These concentrations are at their maximum levels during the major holidays - Memorial Day, Fourth of July and Labor Day. MTBE concentrations then diminish to non-detect levels during November through January when motorized boating ceases at these

reservoirs. In 1998, all District-owned and concessionaire-owned 2-stroke high emission engines were replaced with 4-stroke low emission engines. Following replacement of these engines, average reservoir MTBE levels decreased slightly.

DHS established a secondary drinking water standard of 5 µg/L for MTBE in 1998 and a primary drinking water standard of 13 µg/L in 1999. EPA has established a recommended Drinking Water Advisory Level for MTBE of 20 to 40 µg/L and is in the process of developing a secondary drinking water standard.

Mokelumne River Watershed Area - Water Quality Conditions

This section summarizes water quality in the Upper Mokelumne River Watershed area -- Mokelumne River tributaries, Pardee Reservoir, and Camanche Reservoir. Raw and treated water quality monitoring data are compared with corresponding treated water quality regulatory standards, described previously in the *Summary of Drinking Water Regulations*. Data sources for the raw water quality data are listed in the section entitled *Summary of Available Raw Water Quality Data*.

Mokelumne River and Tributary Monitoring – Evaluation of Water Quality

The District monitors water quality on a monthly basis at eight locations along the Mokelumne River and its main tributaries upstream of Pardee Reservoir (refer to Figure 4-2). The purpose of this monitoring program is to develop a long-term record of water quality conditions (total coliform, fecal coliform, E.coli, and turbidity) to establish a baseline and to monitor long-term trends.

Figures 4-3 through 4-10 depict the seasonal fluctuations observed for total coliform and turbidity from 1985 through 1999, and for E.coli and fecal coliform from 1995 through 1999 for the Mokelumne River and Tributary Monitoring stations:

- (Figure 4-3) MRTC - North Fork Mokelumne River below Tiger Creek Powerhouse afterbay,
- (Figure 4-4) MRWP - Middle Fork Mokelumne River at West Point (Highway 26 crossing),
- (Figure 4-5) MRLF - South Fork Mokelumne River at Railroad Flat Road crossing, approx. quarter mile upstream of Licking Fork confluence,

- (Figure 4-6) MRPW - Middle Fork Mokelumne River upstream of Wilseyville (CCWD) pump station, approx. 1 mile upstream of Highway 26 crossing,
- (Figure 4-7) MRHW26 - South Fork Mokelumne River at Highway 26 crossing,
- (Figure 4-8) MRPH - Mokelumne River approx. half mile downstream of Electra Powerhouse at PG&E day-use recreation area,
- (Figure 4-9) MRWG - Wilson Gulch approx. quarter mile downstream of Highway 49 crossing,
- (Figure 4-10) MRHW49 - Mokelumne River at Highway 49 crossing

FIGURE 4-3 - Mokelumne River Tributary Sampling – Tiger Creek (MRTC)

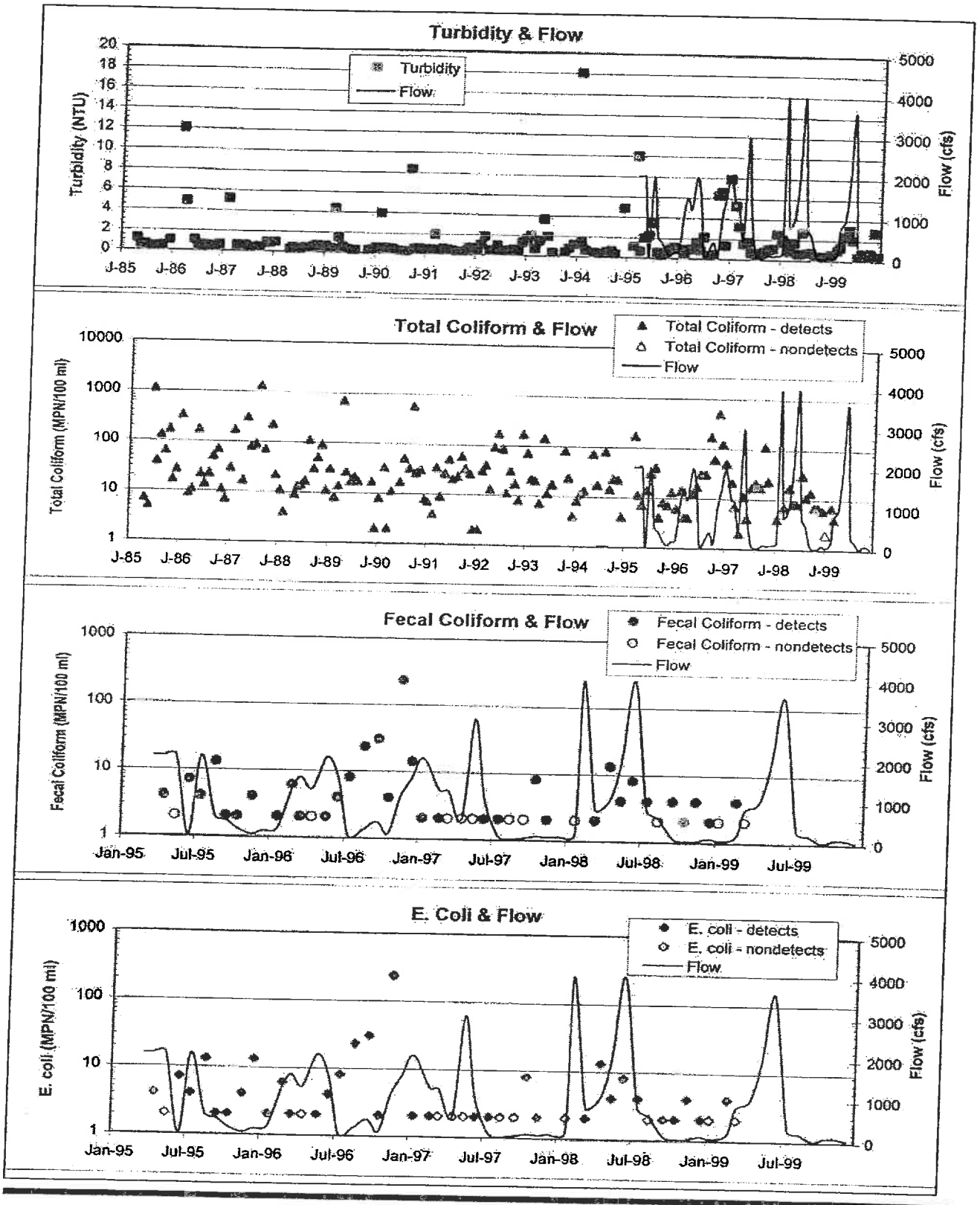


FIGURE 4-4 - Mokelumne River Tributary Sampling – West Point (MRWP)

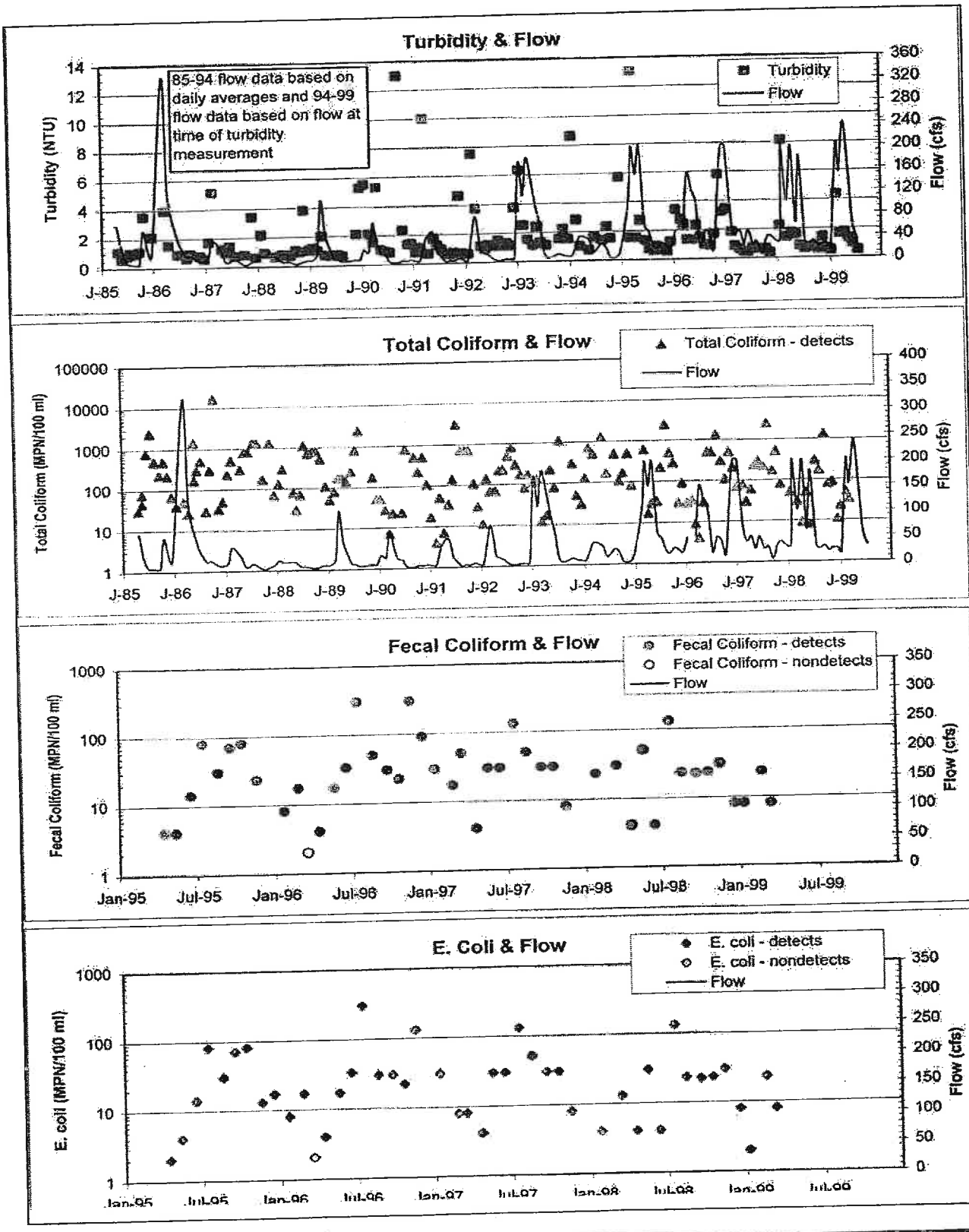


FIGURE 4-5 - Mokelumne River Tributary Sampling – Licking Fork (MRLF)

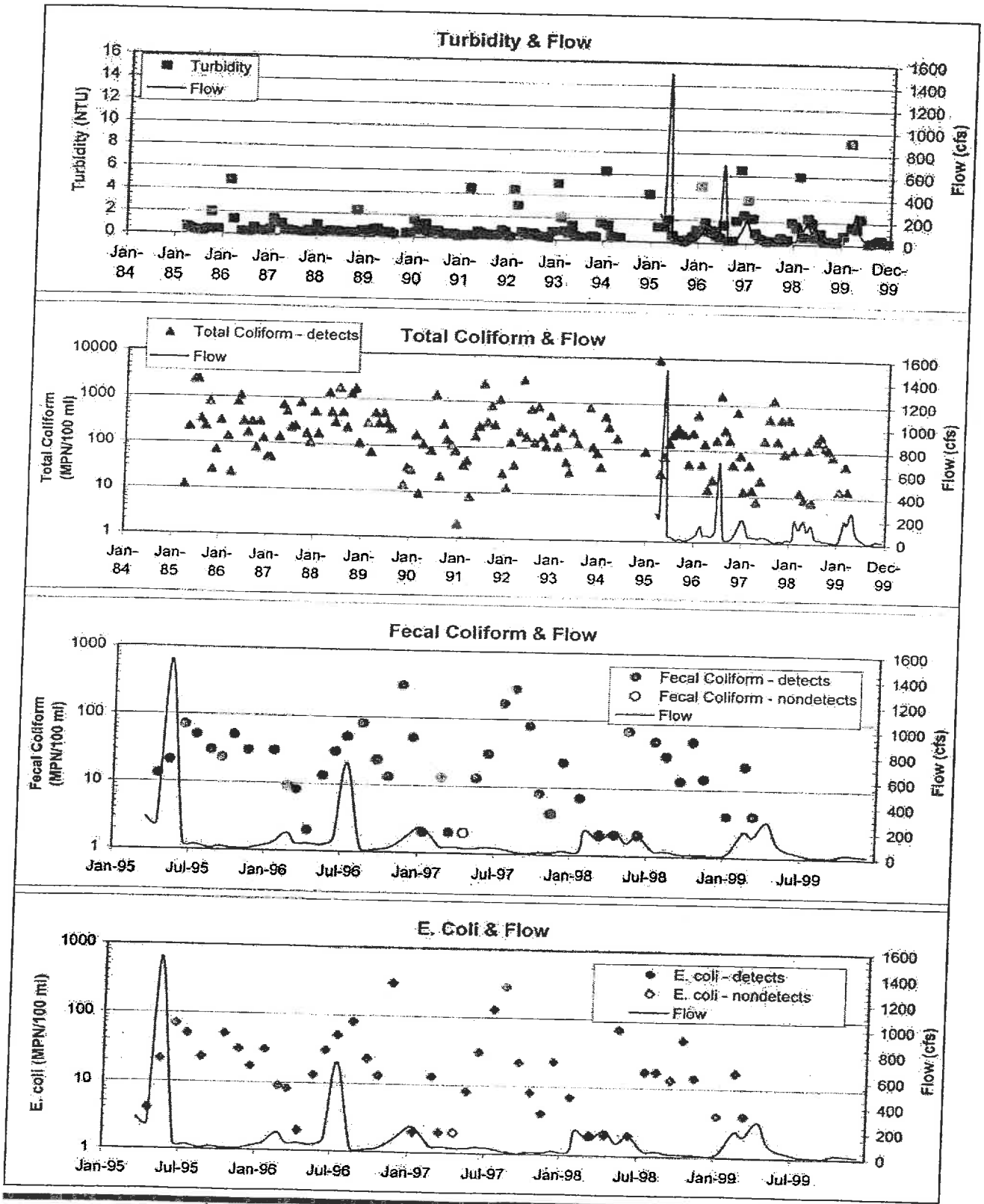


FIGURE 4-6 - Mokelumne River Tributary Sampling –Ponderosa Way (MRPW)

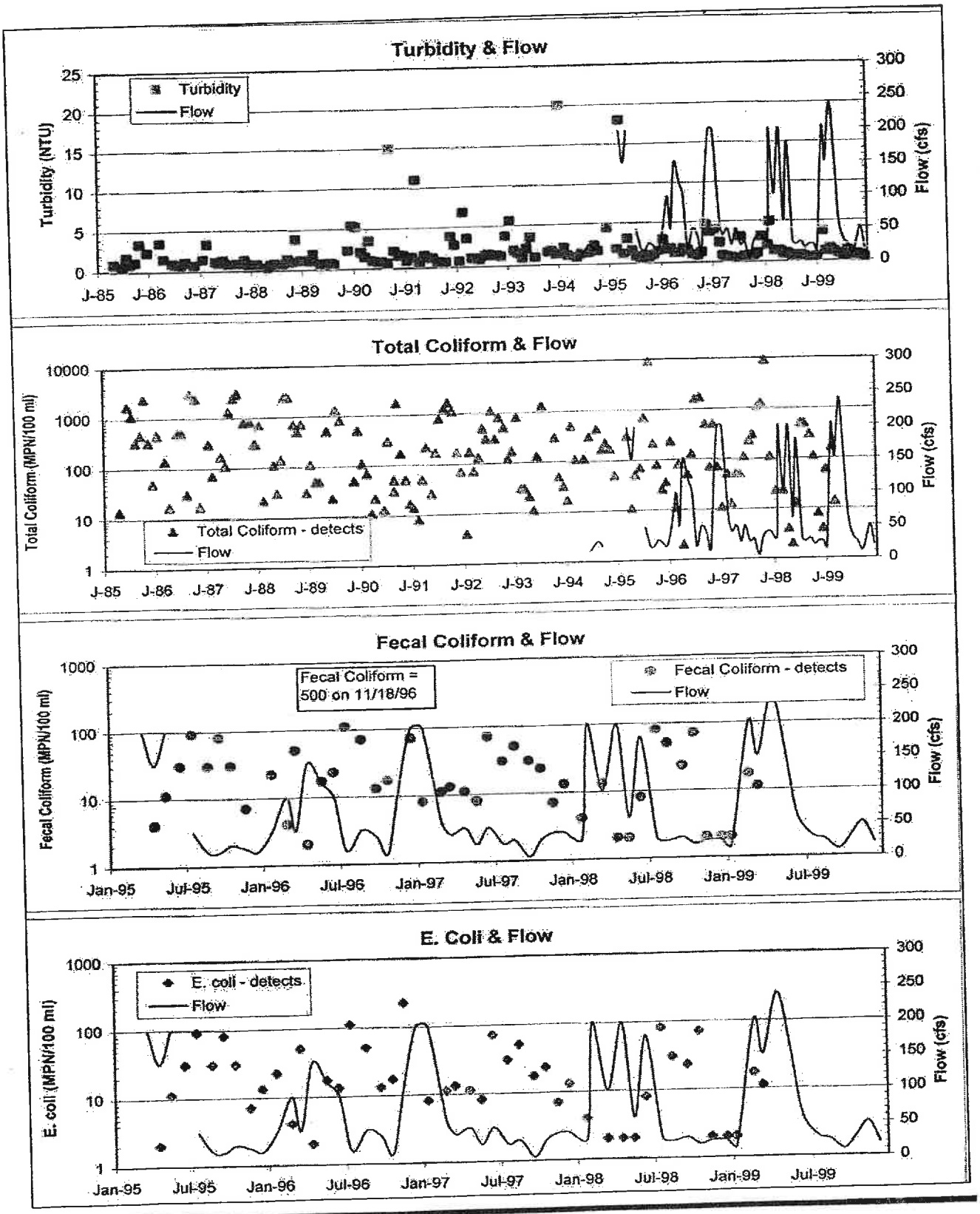


FIGURE 4-7 - Mokelumne River Tributary Sampling – Highway 26 (MRHW26)

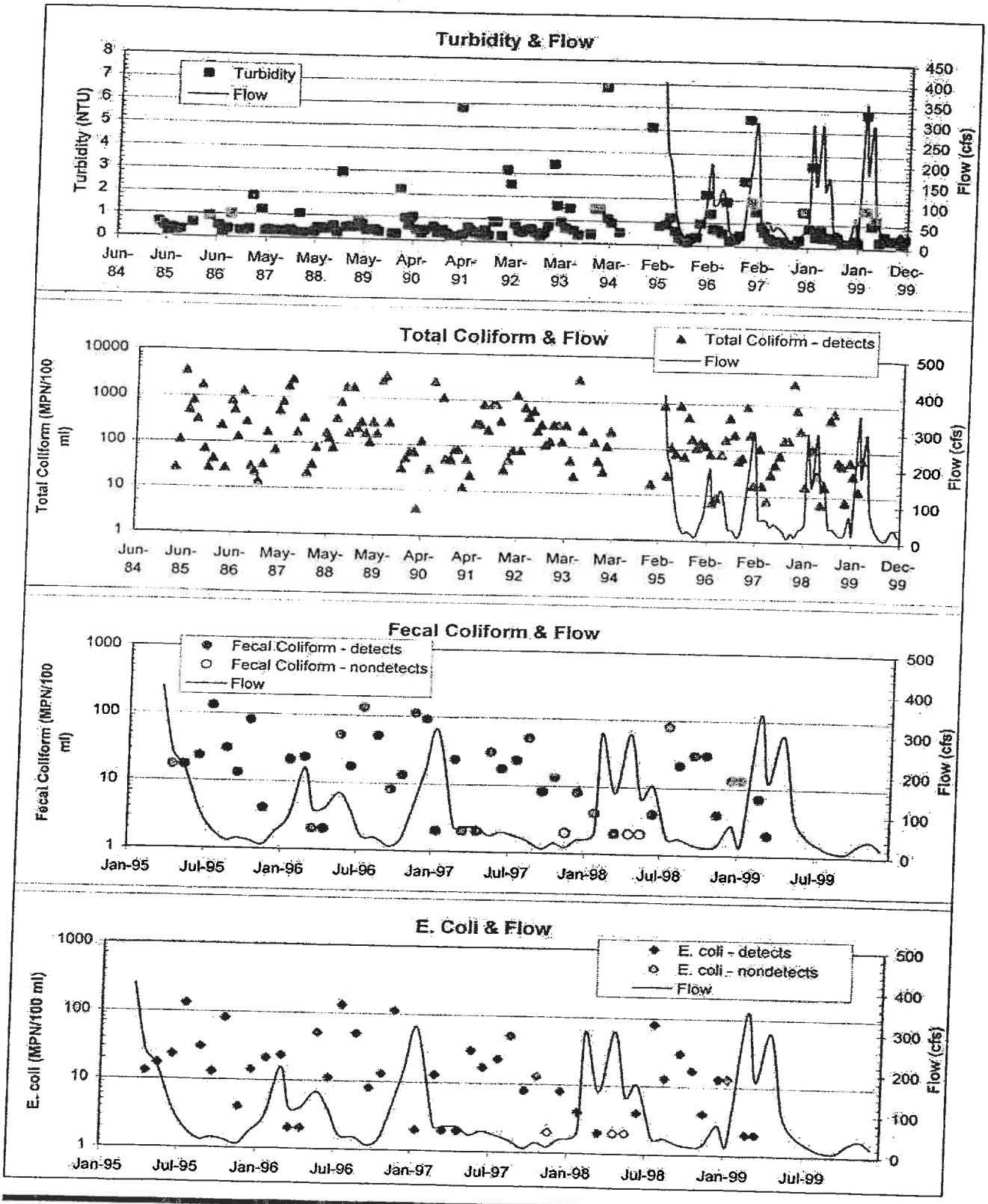


FIGURE 4-8 - Mokelumne River Tributary Sampling – Electra Powerhouse (MRPH)

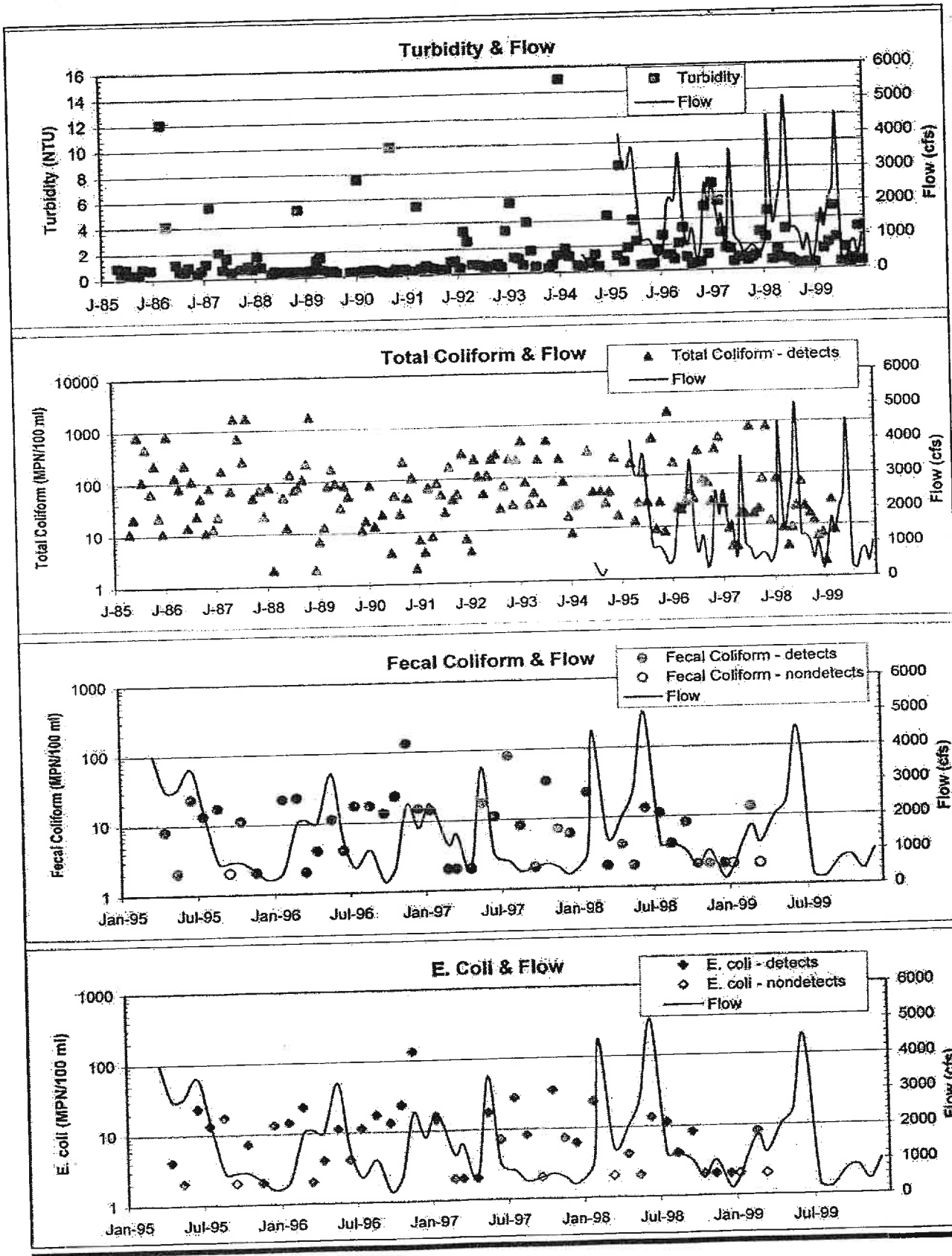


FIGURE 4-9 - Mokelumne River Tributary Sampling – Wilson Gulch (MRWG)

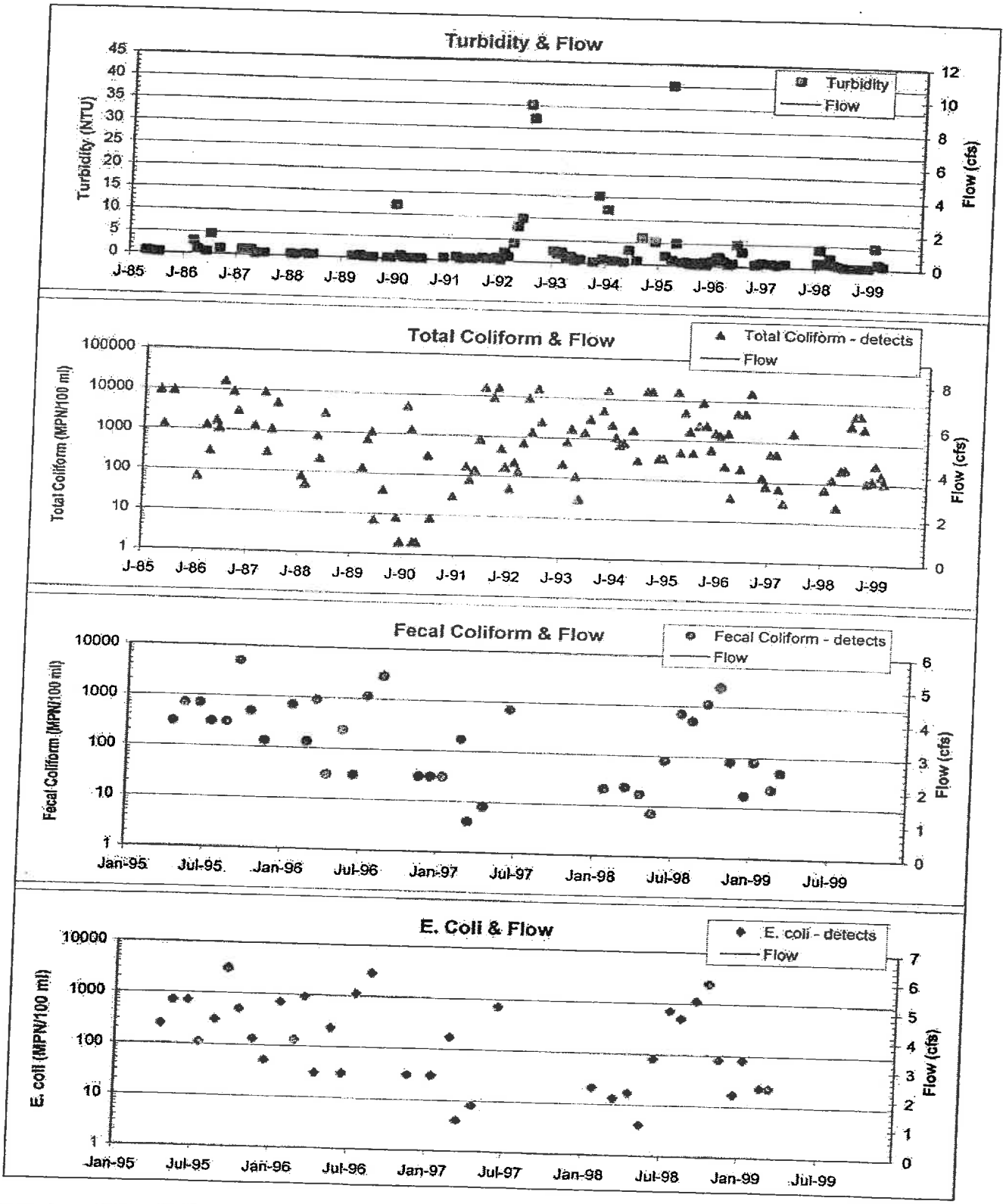
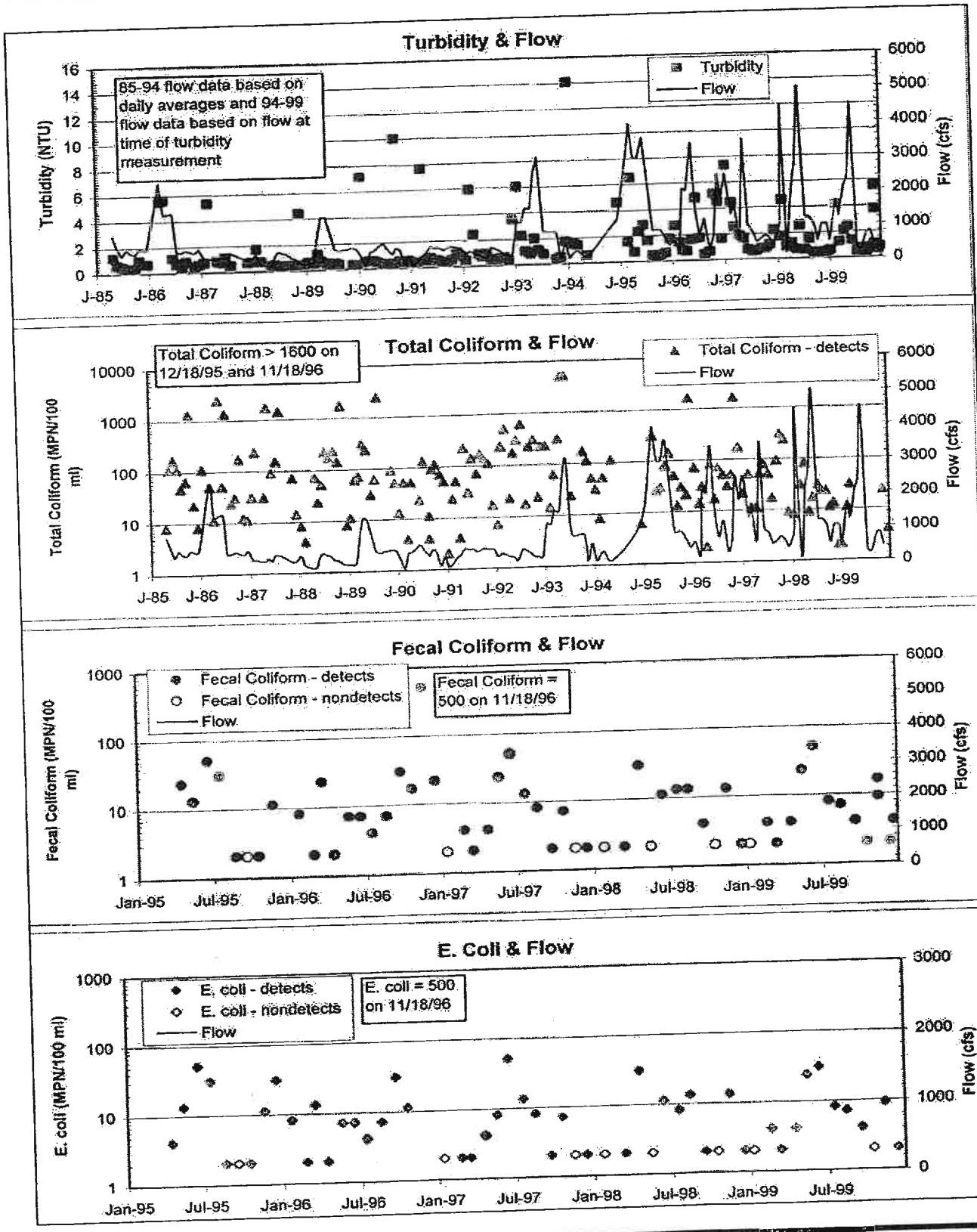


FIGURE 4-10 - Mokelumne River Tributary Sampling –Highway 49 (MRH49)



An analysis of Figures 4-3 through 4-10 results in a number of observations relating to watershed conditions and activities. It is important to note that the flow depicted in each figure reflects the observed flow in the river which represents the impacts due to precipitation and due to diversions and releases associated with the extensive hydroelectric facilities along the Mokelumne River.

With regards to precipitation impacts, seasonal fluctuations in turbidity are depicted in most figures with elevated turbidities generally occurring during the winter months of January through March due to precipitation and runoff. For those stations that capture conditions in the vicinity below hydroelectric facilities, elevated turbidities occurring in the summer months may have been caused by releases associated with the upstream hydroelectric facilities. The District has determined that more detailed monitoring should be implemented to document the relationship between releases associated with hydroelectric facilities and observed turbidities and has raised the issue to the Federal Energy Regulatory Commission and the California Public Utilities Commission.

In general, as tributary flow decreases total coliform, fecal coliform, and E. coli measurements increase. Figures 4-3 (Tiger Creek, MRTC), 4-4 (West Point, MRWP), and 4-9 (Wilson Gulch, MRWG) reflect this observation. Of these three figures, Figure 4-3 – the Tiger Creek sampling location -- depicts the highest flows and the lowest microbiological measurements. Figure 4-9 -- Wilson Gulch -- depicts the lowest flows and the highest microbiological measurements. This suggests that at the tributary locations with higher flows, dilution effects may be influencing the concentrations of these microbiological parameters. The elevated concentrations (above background fluctuations) for these parameters could be due to a natural source such as wildlife or human induced source such as septic systems.

Based on the monthly tributary monitoring data, the strongest correlation between a watershed activity or potential contaminant source and observed water quality conditions is depicted in Figure 4-9 – the Wilson Gulch sampling location. The Wilson Gulch sampling location has the highest total coliform, fecal coliform, and E. coli measurements when compared to the other eight sampling locations. Immediately above the Wilson Gulch sampling location is the Mokelumne Hill wastewater treatment plant and spray field which may be the source of the high background concentrations of these three microbiological parameters. Elevated concentrations of

these microbiological parameters have been noted in the past when effluent problems at the wastewater facility occurred.

As watershed activities change and watershed management practices are modified, the monthly sampling the District conducts at the eight tributary locations will continue to be a valuable water quality information tool. More detailed and specific sampling can be conducted to further understand the relationships between watershed activities and water quality as well as compliment this ongoing background monitoring.

Pardee Reservoir - Evaluation of Water Quality

In the following sections, existing Pardee raw water quality for all Title 22 parameters, other pertinent water quality parameters, apparent trends, and a comparison of raw and treated water to the drinking water standards are discussed.

Existing Raw Water Quality. Table 4-9 is a statistical summary of the raw water quality data required by Title 22 for Pardee Reservoir. The period of time reflected by the summary table is from 1994 through 1999. Maximum contaminant levels (MCLs) and minimum/maximum detection levels (MDLs) are documented for each parameter along with minimum, medium, and maximum statistics. In general, Pardee Reservoir water is considered a very soft water with a total hardness ranging from 7.2 to 43 mg/L as $CaCO_3$. Waters with total hardness below 75 mg/L as $CaCO_3$ are considered soft, from 75 to 150 mg/L as $CaCO_3$ are considered moderately hard, and above 150 mg/L as $CaCO_3$ are considered hard. pH which measures the relative acidity or basic nature of water ranged from 6.8 to 8.3 with a median value of 7.4 indicating the water is moderately basic. The color of the water was below the detection limit for reporting (DLR) of 5 CU indicating a water with very low color.

Table 4-9: Pardee Reservoir Raw Water Quality Monitoring – 1994 thru 1999

Water Quality Parameters	MCL	Units	No. of Samples	Median	Minimum	Maximum	Minimum DLR		Maximum DLR
Microbiological Constituents									
Cryptosporidium oocysts	NA	#/100 L	26	ND	ND	3	0.32	-	4.5
Giardia cysts	NA	cysts/100	26	ND	ND	5	0.32	-	4.5
E coli	NA	MPN/100 mL	235	ND	ND	50		2	
Fecal Coliforms	NA	MPN/100 mL	381	ND	ND	140		2	
Total Coliforms	NA	MPN/100 mL	381	4	ND	900		2	
Primary Standards (Health Related) - Inorganic Chemicals									
Aluminum (Al)	1000	ug/L	79	30	7.5	1100	7.28	-	62.4
Antimony (Sb)	6	ug/L	2	ND	ND	0.07	0.07	-	0.4
Arsenic (As)	50	ug/L	1	0.2	0.2	0.2		0.1	
Asbestos	7	MFL	1	ND	ND	ND		0.027	
Barium (Ba)	1000	ug/L	59	6.49	5.84	23	0.104	-	
Beryllium (Be)	4	ug/L	59	2	0.08	2.2	0.1	-	2.2
Cadmium (Cd)	5	ug/L	2	ND	ND	ND	0.05	-	0.09
Chromium (Cr)	50	ug/L	1	ND	ND	ND		0.3	
Cyanide (CN)	200	ug/L	2	ND	ND	ND	0.004	-	0.01
Fluoride (F-)	2000	ug/L	2	ND	ND	40	30	-	40
Mercury (Hg)	2	ug/L	1	0.08	0.08	0.08		0.04	
Nickel (Ni)	100	ug/L	2	ND	ND	ND	1	-	2
Nitrate (as NO3)	22500	ug/L	139	ND	ND	450	13.5	-	45
Nitrate+Nitrite as N	10000	ug/L	2	ND	ND	102			
Nitrite (as N)	1000	ug/L	2	ND	ND	ND		4	
Selenium (Se)	50	ug/L	2	ND	ND	ND	0.1	-	0.3
Thallium (Tl)	2	ug/L	2	ND	ND	ND	0.05	-	0.1
Primary Standards (Health Related) - Non-volatile Organic Chemicals (SOCs)									
1,2-Dibromo-3-chloropropane (DBCP)	0.2	ug/L	260	ND	ND	ND	0.01	-	0.47
2,3,7,8-TCDD (Dioxin)	0.00003	ug/L	2	ND	ND	ND		0.000005	
2,4,5-TP (Silvex)	50	ug/L	2	ND	ND	ND	0.065	-	0.2
2,4-D	70	ug/L	2	ND	ND	ND	0.12	-	0.43
Alachlor (Alanex)	2	ug/L	4	ND	ND	ND	0.054	-	1.5
Atrazine (Aatrex)	3	ug/L	2	ND	ND	ND	0.032	-	0.32
Bentazon (Basagran)	18	ug/L	2	ND	ND	ND	0.26	-	1
Benzo(a)pyrene	0.2	ug/L	2	ND	ND	ND	0.29	-	0.03
Carbofuran (Furadan)	18	ug/L	1	ND	ND	ND		1	
Chlordane	0.1	ug/L	3	ND	ND	ND		0.0579	
Dalapon	200	ug/L	1	ND	ND	ND		2.7	
Di(2-ethylhexyl)adipate	400	ug/L							
Di(2-ethylhexyl)phthalate (DEHP)	4	ug/L	2	ND	ND	1.3	0.03	-	0.029
Dinoseb (DNBP)	7	ug/L	4	ND	ND	ND	0.18	-	0.24
Diquat	20	ug/L							
Endothall	100	ug/L	1	ND	ND	ND		1	
Endrin	2	ug/L	1	ND	ND	ND		0.005	
Ethylene dibromide (EDB)	0.05	ug/L	2	ND	ND	ND		0.01	
Glyphosate	700	ug/L	2	ND	ND	ND	3.5	-	10
Heptachlor	0.01	ug/L	1	ND	ND	ND		0.0074	
Heptachlor epoxide	0.01	ug/L	1	ND	ND	ND		0.002	
Hexachlorobenzene	1	ug/L	2	ND	ND	ND	0.0014	-	0.029
Hexachlorocyclopentadiene	50	ug/L	2	ND	ND	ND	0.039	-	0.04
Lindane (gamma-BHC)	0.2	ug/L	1	ND	ND	ND		0.0032	
Methoxychlor (Lannate)	40	ug/L	1	ND	ND	ND		0.0082	
Molinate (Ordam)	20	ug/L	4	ND	ND	ND	0.16	-	0.98
Methyl-tert-butyl ether (MTBE)	13	ug/L	254	ND	ND	6.1	0.5	-	1.0
Oxamyl (Vydate)	200	ug/L	1	ND	ND	ND		1	
Pentachlorophenol (PCP)	1	ug/L	2	ND	ND	ND	0.38	-	0.16
Picloram	500	ug/L	2	ND	ND	ND		0.19	
Polychlorinated biphenyls (PCBs)	0.5	ug/L							
Simazine (Princep)	4	ug/L	2	ND	ND	ND	0.072	-	0.95
Thiobencarb (Bolero)	70	ug/L	2	ND	ND	ND	0.021	-	0.26
Toxaphene	3	ug/L	1	ND	ND	ND		0.397	
Primary Standards (Health Related) - Radioactivity									
Combined Radium-226 and Radium-228	5	pCi/L	No Data						
Gross Alpha	15	pCi/L	7	ND	ND	2		1	
Gross Beta	50	pCi/L	2		3	6		2	
Strontium	8	pCi/L	No Data						
Tritium	20000	pCi/L	1	170	170	170			
Uranium	20	pCi/L	3	0.2	0	0.6			
Primary Standards (Health Related) - Total Trihalomethanes									
Bromodichloromethane (Dichlorobromomethane)	NA	ug/L	259	ND	ND	ND		0.04	
Bromoform (Tribromomethane)	NA	ug/L	259	ND	ND	ND		0.1	

Table 4-9: Pardee Reservoir Raw Water Quality Monitoring – 1994-1999 – (cont.)

Water Quality Parameters	MCL	Units	No. of Samples	Median	Minimum	Maximum	Minimum DLR	DLR	Maximum DLR
Chlorodibromomethane (Dibromochloromethane)	NA	ug/L	259	ND	ND	ND		0.06	
Chloroform (Trichlormethane)	NA	ug/L	259	ND	ND	0.33		0.07	
Trihalomethanes	100	ug/L	259	ND	ND	0.33		0.27	
Primary Standards (Health Related) - Volatile Organic Chemicals (VOCs)									
1,1,1-Trichloroethane (1,1,1-TCA)	0.2	ug/L	259	ND	ND	ND		0.03	
1,1,2,2-Tetrachloroethane	1	ug/L	259	ND	ND	ND		0.11	
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	1200	ug/L	259	ND	ND	ND		0.1	
1,1,2-Trichloroethane (1,1,2-TCA)	5	ug/L	259	ND	ND	ND	0.05	-	0.15
1,1-Dichloroethane (1,1-DCA)	5	ug/L	259	ND	ND	ND		0.07	
1,1-Dichloroethylene (1,1-DCE)	6	ug/L	259	ND	ND	ND		0.05	
1,2,4-Trichlorobenzene (Unsym-Trichlorobenzene)	70	ug/L	259	ND	ND	ND		0.11	
1,2-Dichlorobenzene (o-DCB)	600	ug/L	259	ND	ND	ND		0.05	
1,2-Dichloroethane (1,2-DCA)	0.5	ug/L	259	ND	ND	ND		0.06	
1,2-Dichloropropane (Propulene dichloride)	5	ug/L	259	ND	ND	ND		0.12	
1,3-Dichloropropene	0.5	ug/L	259	ND	ND	ND		0.07	
1,4-Dichlorobenzene (p-DCB)	5	ug/L	259	ND	ND	ND		0.04	
Benzene	1	ug/L	259	ND	ND	ND		0.05	
Carbon Tetrachloride	0.5	ug/L	259	ND	ND	ND		0.14	
cis-1,2-Dichlorethylene (c-1,2-DCE)	6	ug/L	259	ND	ND	ND		0.05	
Dichloromethane (Methylene chloride)	5	ug/L	259	ND	ND	ND		0.07	
Ethylbenzene (Phenylethane)	700	ug/L	259	ND	ND	ND		0.08	
Monochlorobenzene (Chlorobenzene)	70	ug/L	259	ND	ND	ND		0.05	
Styrene (Vinylbenzene)	100	ug/L	259	ND	ND	ND		0.08	
Tetrachloroethylene (PCE)	5	ug/L	259	ND	ND	ND		0.11	
Toluene (Methylbenzene)	150	ug/L	259	ND	ND	ND		0.07	
trans-1,2-Dichloroethylene (t-1,2-DCE)	10	ug/L	259	ND	ND	ND		0.14	
Trichloroethylene (TCE)	5	ug/L	259	ND	ND	ND		0.05	
Trichlorofluoromethane (Freon 11)	150	ug/L	260	ND	ND	ND		0.15	
Vinyl chloride (VC)	0.5	ug/L	259	ND	ND	ND		0.07	
Xylenes (total)	1750	ug/L	4	ND	ND	ND		0.1	
Lead and Copper Rule (Action Levels)									
Copper (Cu)	1300	ug/L	59	ND	ND	51.08	1.5	-	3.3
Lead (Pb)	15	ug/L	2	ND	ND	ND	1	-	5
Secondary Standards (Aesthetics)									
Aluminum (Al)	200	ug/L	79	30	7.5	1100	7.28	-	62.4
Chloride (Cl)	250-500	mg/L	74	2	0.5	8	0.07	-	1
Color	15	color unit	4	ND	ND	ND		5	
Copper (Cu)	1000	ug/L	59	ND	ND	51.08	1.5	-	3.3
Foaming Agents (MBAs)	500	ug/L	4	ND	ND	ND		0.025	
Iron (Fe)	300	ug/L	59	35	ND	977	2.1	-	11
Manganese (Mn)	50	ug/L	59	3.58	1.04	27.3	0.31	-	1.1
Methyl-tert-butyl ether (MTBE)	5	ug/L	254	ND	ND	6.1	0.5	-	1.0
Odor--Threshold	3	TON							
Silver (Ag)	100	ug/L	3	ND	ND	ND	0.2	-	0.4
Specific Conductance	900 - 1600	umhos/cm							
Sulfate	250 - 500	mg/L	99	1.1	0.69	2	0.02	-	0.06
Thiobencarb (Bolero)	1	ug/L	4	ND	ND	ND	0.021	-	0.26
Total Dissolved Solids (TDS)	500 - 1000	mg/L	7	30	20	470		6	
Turbidity (Grab Samples)+C51	5	NTU	107	0.62	0.14	11		0.01	
Zinc (Zn)	5	ug/L	76	4.81	0.75	32.6	1.5	-	5.2
Unregulated Organic Chemicals - List A									
1,1,1,2-Tetrachloroethane	NA	ug/L	259	ND	ND	ND		0.03	
1,1-Dichloropropene	NA	ug/L	259	ND	ND	ND		0.07	
1,2,3-Trichloropropane (Allyl trichloride)	NA	ug/L	20	ND	ND	ND		0.18	
1,3-Dichlorobenzene (m-DCB)	NA	ug/L	259	ND	ND	ND		0.16	
1,3-Dichloropropane	NA	ug/L	259	ND	ND	ND		0.07	
2,2-Dichloropropane	NA	ug/L				No Data			
2-Chlorotoluene (o-Chlorotoluene)	NA	ug/L	259	ND	ND	ND		0.12	
4-Chlorotoluene (p-Chlorotoluene)	NA	ug/L	259	ND	ND	ND		0.08	
Bromobenzene (Monobromobenzene)	NA	ug/L	259	ND	ND	ND		0.08	
Bromodichloromethane (Dichlorobromomethane)	NA	ug/L	259	ND	ND	ND		0.04	
Bromoform (Tribromomethane)	NA	ug/L	259	ND	ND	ND		0.1	
Bromomethane (Methyl bromide)	NA	ug/L	259	ND	ND	ND		0.21	
Chlorodibromomethane (Dibromochloromethane)	NA	ug/L	259	ND	ND	ND		0.04	
Chloroethane (Ethyl chloride)	NA	ug/L	259	ND	ND	0.037		0.19	
Chloroform (Trichlormethane)	NA	ug/L						0.07	
Chloromethane (Methyl chloride)	NA	ug/L	259	ND	ND	ND		0.09	
Dibromomethane (Methyl bromide)	NA	ug/L	259	ND	ND	ND		0.09	
Dichlorodifluoromethane (Difluorodichloromethane	NA	ug/L							

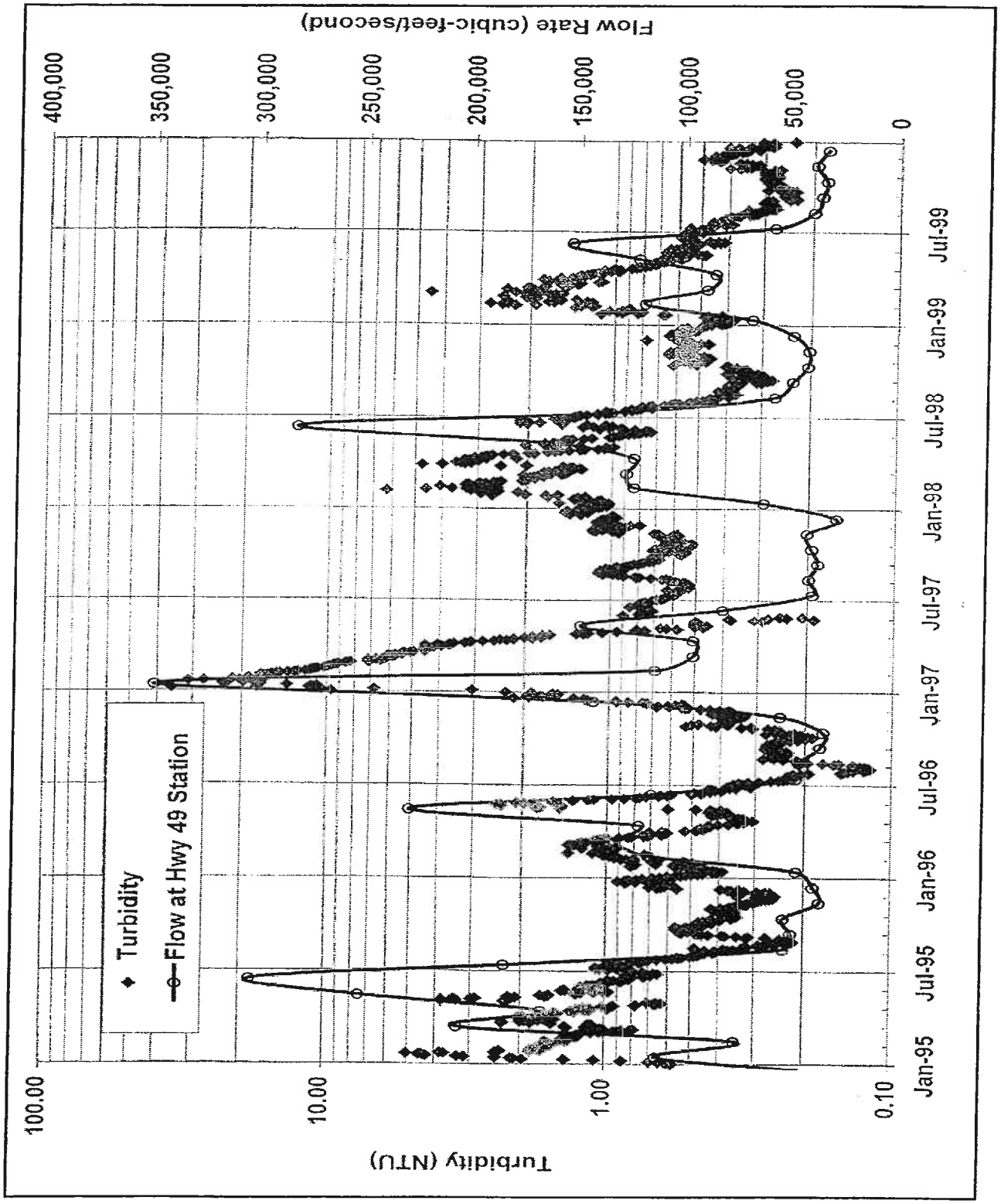
Table 4-9: Pardee Reservoir Raw Water Quality Monitoring – 1994-1999 – (cont.)

Water Quality Parameters	MCL	Units	No. of Samples	Median	Minimum	Maximum	Minimum DLR	DLR	Maximum DLR
Unregulated Organic Chemicals - List B									
1,2,3-Trichlorobenzene (vis-Trichlorobenzene)	NA	ug/L	259	ND	ND	ND		0.11	
1,2,4-Trimethylbenzene (Pseudocumene)	NA	ug/L	259	ND	ND	0.65		0.35	
1,3,5-Trimethylbenzene (Mesitylene)	NA	ug/L	259	ND	ND	ND		0.18	
1-Propylpropane (n-Propylbenzene)	NA	ug/L	259	ND	ND	ND		0.1	
Bromacil (Hyvar X, Hyvar XL)	NA	ug/L	2	ND	ND	ND	0.14	-	1.8
Bromochloromethane (Chlorobromomethane)	NA	ug/L	259	ND	ND	ND		0.14	
Chlorothalonil (Bravo, Daconil)	NA	ug/L	3	ND	ND	ND		0.0089	
Dimethoate (Cygon)	NA	ug/L	2	ND	ND	ND	0.29	-	0.3
Diuron (Karmex, Krovar)	NA	ug/L	3	ND	ND	ND		1	
Ethyl tertiary butyl ether (ETBE)	NA	ug/L	259	ND	ND	ND		0.5	
Hexachlorobutadiene (Perchlorobutadiene)	NA	ug/L	259	ND	ND	ND		0.12	
Isopropylbenzene (Cumene)	NA	ug/L	259	ND	ND	ND		0.09	
Naphthalene (Naphthalin)	NA	ug/L	259	ND	ND	ND		0.1	
n-Butylbenzene (1-Butylpropane)	NA	ug/L	259	ND	ND	ND		0.09	
p-Isopropyltoluene (p-Cymene)	NA	ug/L	259	ND	ND	ND		0.08	
Prometryn (Caparol)	NA	ug/L	4	ND	ND	ND	0.032	-	0.32
sec-Butylbenzene (2-Phenylbutane)	NA	ug/L	310	ND	ND	ND		0.1	
tert-Butylbenzene (2-Methyl-2-phenylpropane)	NA	ug/L	309	ND	ND	ND		0.08	
Tertiary-amyl methyl ether (TAME)	NA	ug/L	291	ND	ND	ND		0.5	
Unregulated Organic Chemicals - List C									
3-Hydroxycarbofuran	NA	ug/L	1	ND	ND	ND		1	
Aldicarb (Temik)	NA	ug/L	2	ND	ND	ND		1	
Aldicarb Sulfone	NA	ug/L	2	ND	ND	ND		1	
Aldicarb Sulfoxide	NA	ug/L	2	ND	ND	ND		1	
Aldrin	NA	ug/L	3	ND	ND	ND		0.0013	
Butachlor (Butanex, Lambast, Machete)	NA	ug/L	2	ND	ND	ND	0.043	-	0.38
Carbaryl (Sevin)	NA	ug/L	3	ND	ND	ND		1	
Dicamba (Banax, Banvel, Dianat)	NA	ug/L	4	ND	ND	ND	0.18	-	0.51
Dieldrin	NA	ug/L	1	ND	ND	ND		0.0024	
Methoxychlor (Lannate)	NA	ug/L	1	ND	ND	ND		0.0082	
Metolachlor (Metelilachlor)	NA	ug/L	2	ND	ND	ND	0.073	-	0.75
Metribuzin (Lexone, Sencor, Sencoral)	NA	ug/L	2	ND	ND	ND	0.064	-	0.15
Propachlor (Albrass,Ramrod)	NA	ug/L	2	ND	ND	ND	0.026	-	0.66
Other Parameters									
Alkalinity (CO3)	NA	ug/L	2	ND	ND	ND		1000	
Alkalinity (HCO3)	NA	ug/L	3	13000	13000	20000		1000	
Alkalinity, Total	NA	ug/L	62	14000	10000	23000		5000	
Bromide	NA	ug/L	57	ND	ND	60	2	-	50
Calcium (Ca)	NA	ug/L	82	3450	1730	4413	5	-	11
Hardness	NA	ug/L	72	11	7.2	43		2	
Hydroxide Alkalinity	NA	ug/L	2	ND	ND	ND		1000	
Magnesium (Mg)	NA	ug/L	83	1070	416	1840	20	-	44
pH	NA	ug/L	23	-	6.8	8.3		7.4	
Total Phoshpate as N	NA	ug/L	127	8	ND	130		5	
Sodium (Na)	NA	ug/L	83	1980	83	2530	10	-	72.8
TTHM Formation Potential	NA	ug/L	130	64	41	120	0.45	-	0.5
Total Organic Carbon (TOC)	NA	mg/L	131	1.4	0.92	2.9	0.02	-	0.09

Turbidity. The turbidity data collected at the Pardee Outlet Tower ranged from 0.14 to 11 NTU with a median value of 0.62 NTU. These data indicate that Pardee Reservoir is generally a very low turbidity water with occasional spikes of moderate turbidity. Additional turbidity data collected in the Mokelumne Aqueduct at the Campo Seco monitoring station are depicted in Figure 4-11. The daily average turbidity reflected by this figure was collected by an on-line analyzer and extracted from the District's SCADA system. A maximum turbidity of 35 NTU with a median value of 0.65 NTU were analyzed at this station. While the maximum turbidity was higher than that detected at the Pardee Outlet Tower, the median values at both sample sites were approximately equivalent.

The turbidity measured at the Campo Seco station was less than 2.3 NTU, 95 percent of the time which further supports Pardee Reservoir water is a high quality, low turbidity water. However, even for low turbidity waters, extended durations of elevated turbidity can affect WTPs. For example, during the 1996 to 1997 winter season, Pardee Reservoir turbidity exceeded 5 NTU for an extended period which caused treatment operation problems for the District's Walnut Creek in-line Water Treatment Plant. Water from Briones Reservoir was diverted to supply the Walnut Creek WTP to avoid treating this high turbidity water. At the Pardee Recreation Area, the old water treatment plant was placed back in service to pre-filter the water before being processed by the current membrane filtration treatment plant. During this period, the membrane filtration system at Pardee Center was able to adequately treat the high turbidity water due, in part, to the low demand placed on the water treatment plant.

FIGURE 4-11 - Mokelumne Aqueduct Turbidity at Campo Seco



Microbiological. As previously mentioned, the SWTR is primarily concerned with providing adequate inactivation and/or removal of *Giardia* and enteric viruses, and the IESWTR is focused on removal requirements for *Cryptosporidium*. To determine the removal capabilities of the District's WTPs, both small systems and large systems, the District monitors several microbiological parameters in the raw water of the Pardee Reservoir including: total coliforms, fecal coliforms, E. coli, *Giardia*, and *Cryptosporidium*. Figure 4-12, depicts raw water total coliform count versus time for the monitoring period of January 1995 to December 1999. The cumulative distribution for this data set is depicted in Figure 4-13. The data indicate that Pardee Reservoir had a total coliform count below 110 MPN/100 ml, 95 percent of the time, with a median value of 4 MPN/100 ml. Median values for fecal coliforms and E. coli were non-detect for both with maximum values of 140 MPN/100 ml and 50 MPN/100 ml, respectively.

FIGURE 4-12 - Pardee Reservoir Total Coliform Monitoring

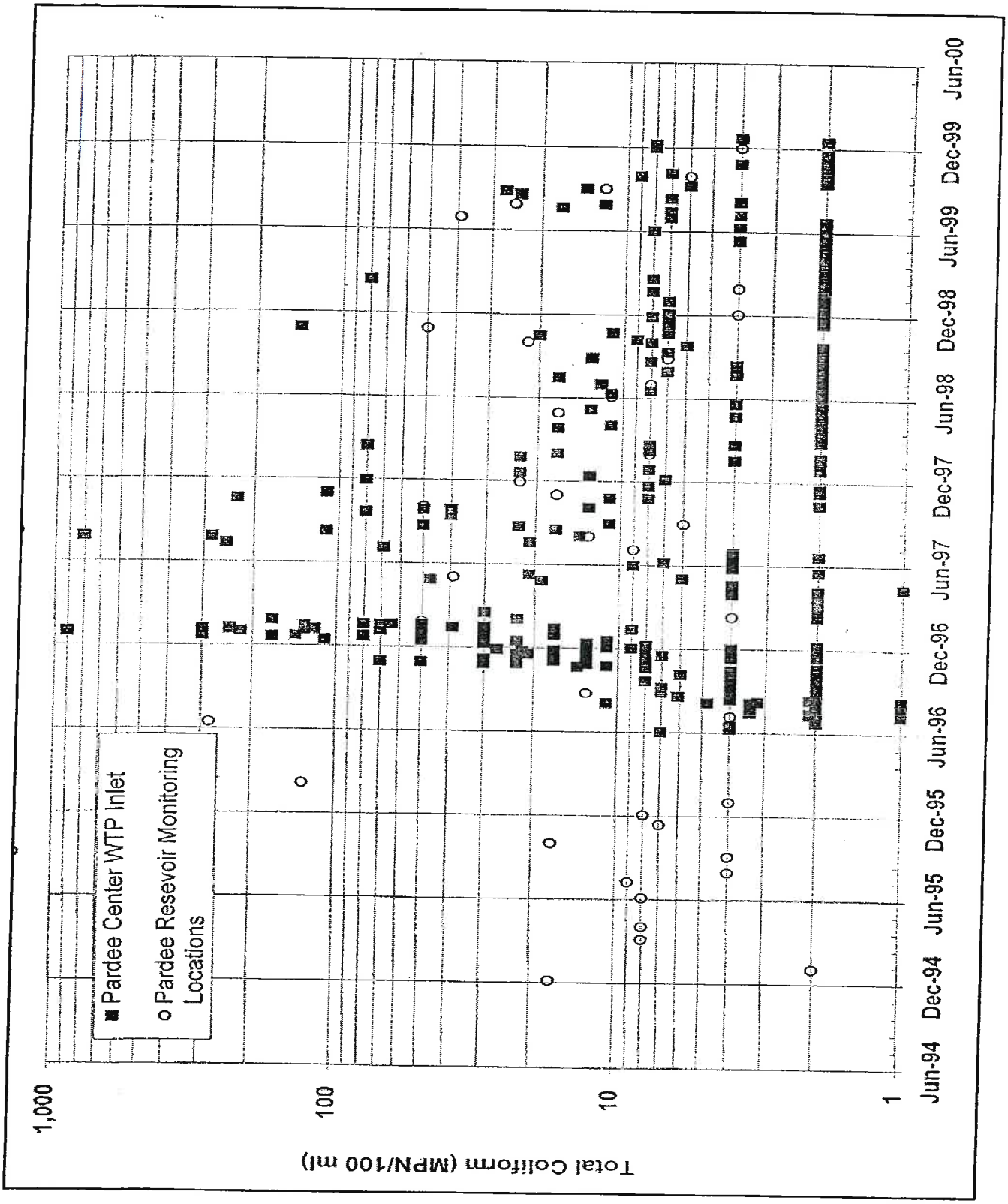
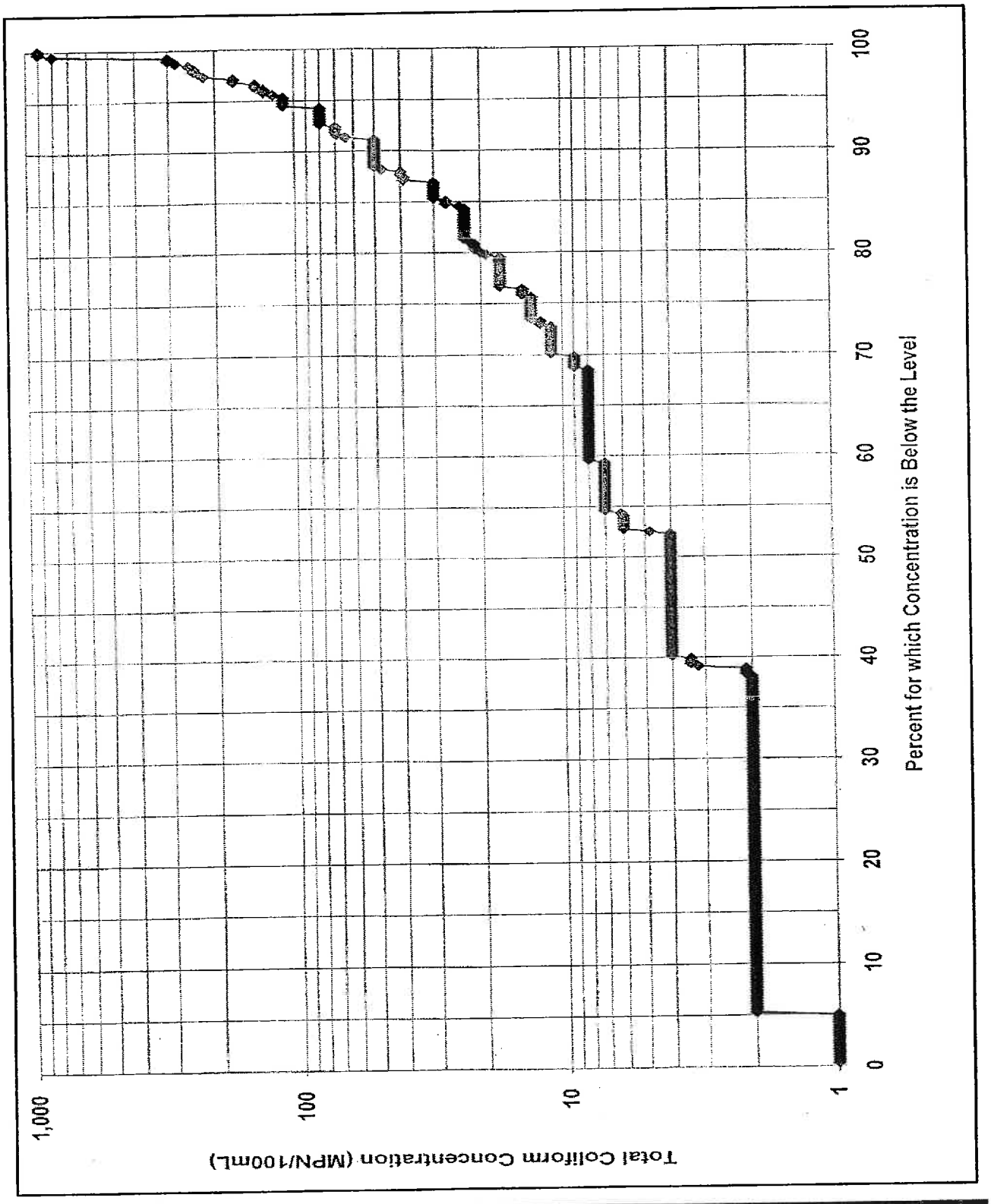
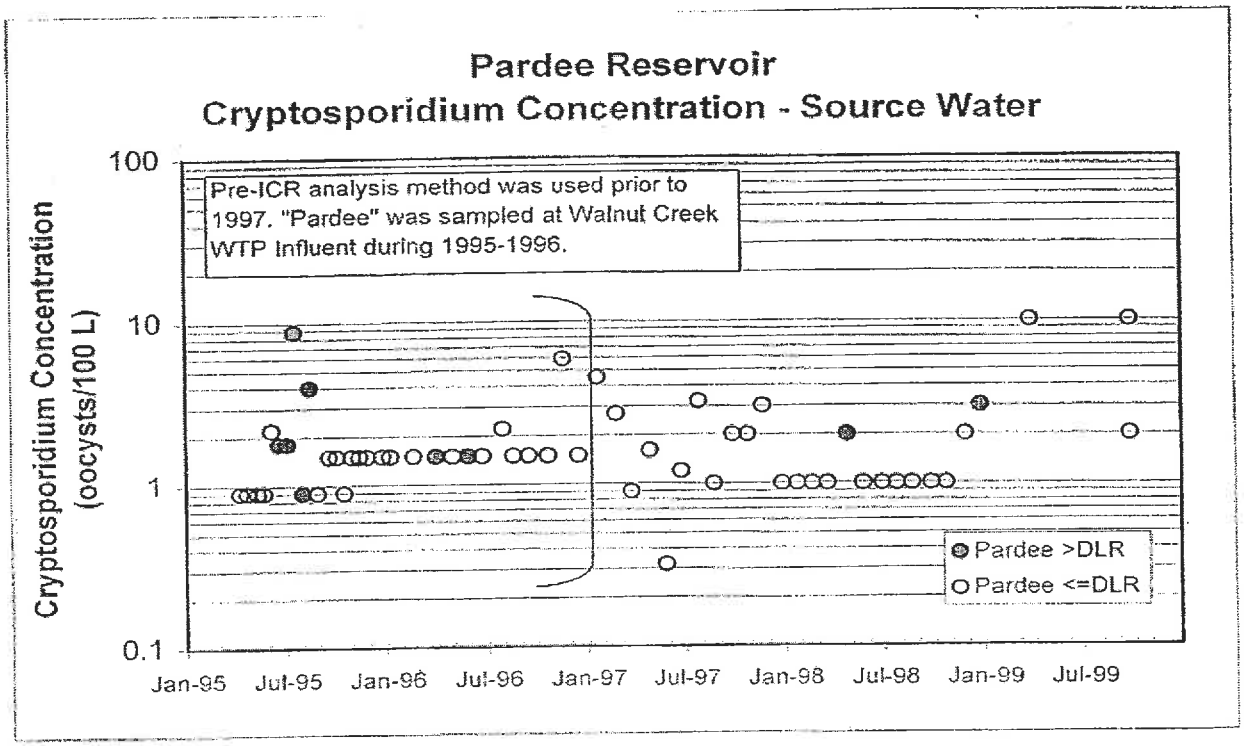


FIGURE 4-13 - Pardee Reservoir Total Coliform Monitoring - Cumulative Distribution



Based on the data presented in Figure 4-14 and supported by Table 4-10, Pardee Reservoir contains very low levels of *Giardia* and *Cryptosporidium*. The highest cyst concentrations have been 5 cysts per 100 L for *Giardia* and 3 oocysts per 100 L for *Cryptosporidium*. Forty-two percent of the samples collected from January 1997 through September 1999 were positive for *Giardia* and 8 percent of the samples were positive for *Cryptosporidium*. For the samples detected positive the median concentrations for *Giardia* and *Cryptosporidium* were 1 cyst per 100 L and 2.5 oocysts per 100 L, respectively. The low microbiological counts for total coliforms, fecal coliforms, E. coli, *Giardia*, and *Cryptosporidium* indicate that Pardee Reservoir stores a high quality water.

FIGURE 4-14 - Pardee Reservoir Cryptosporidium and Giardia Monitoring



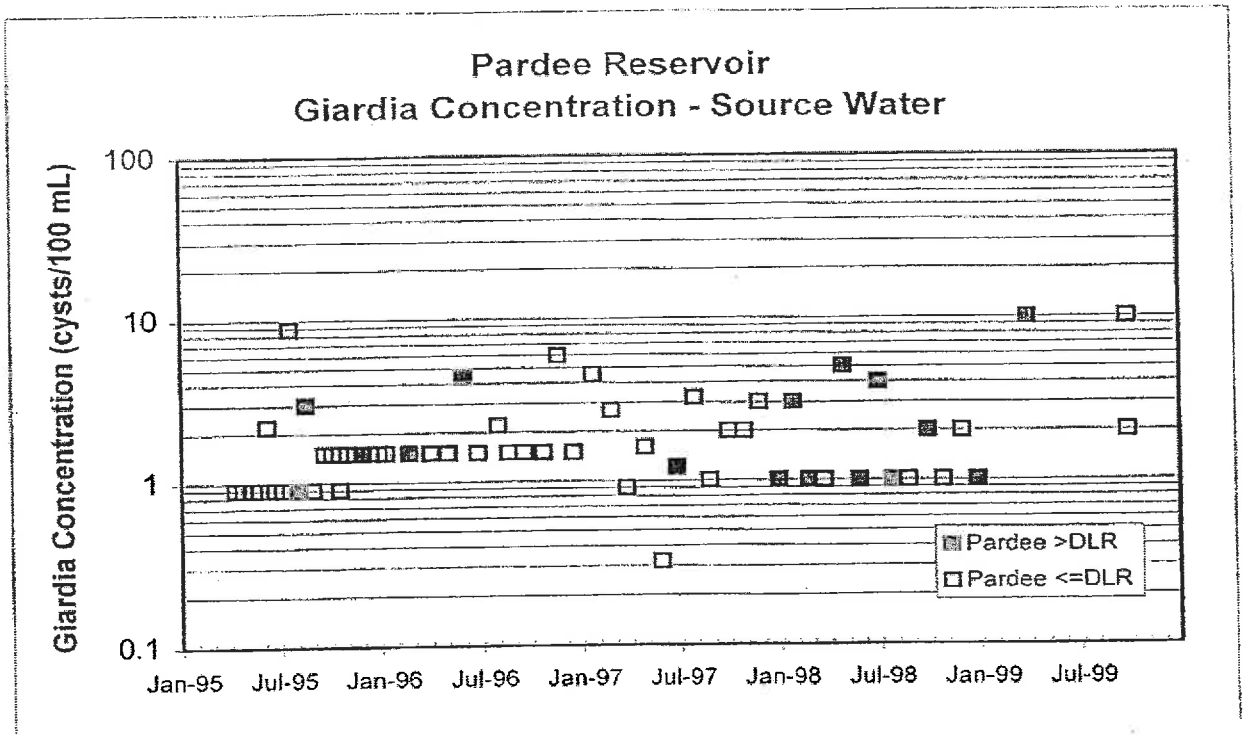


Table 4-10: Pardee Reservoir Cryptosporidium and Giardia Monitoring

Site	Locator	Collect Date	Login Number	Giardia	Crypto	Detection Limit
FP PARDEE CNTR	INF	21-Jan-97	L40326-1	<4.5	<4.5	4.5
FP PARDEE CNTR	INF	24-Feb-97	L41780-1	<2.7	<2.7	2.7
FP PARDEE CNTR	INF	24-Mar-97	L43055-1	<0.9	<0.9	0.9
FP PARDEE CNTR	INF	28-Apr-97	L44598-1	<1.6	<1.6	1.6
FP PARDEE CNTR	INF	28-May-97	45829-1	<0.32	<0.32	0.32
FP_PARDEE CNTR	INF	25-Jun-97	L46978-1	1.2	<1.2	1.2
FP_PARDEE CNTR	INF	28-Jul-97	L48466-1	<3.2	<3.2	3.2
FP_PARDEE CNTR	INF	25-Aug-97	L49647-1	<1	<1	1
FP_PARDEE CNTR	INF	29-Sep-97	L50970-1	<2	<2	2
FP_PARDEE CNTR	INF	27-Oct-97	L52033-1	<2	<2	2
FP_PARDEE CNTR	INF	24-Nov-97	L53204-1	<3	<3	3
FP_PARDEE CNTR	INF	29-Dec-97	L54686-1	0.9	<0.9	0.9
FP_PARDEE CNTR	INF	27-Jan-98	L55676-1	3	<1	1
FP_PARDEE CNTR	INF	23-Feb-98	L56758-1	1	<1	1
FP_PARDEE CNTR	INF	23-Mar-98	L57703-1	<1	<1	1
FP_PARDEE CNTR	INF	27-Apr-98	L59529-1	5	2	1
FP_PARDEE CNTR	INF	26-May-98	L60500-1	1	<1	1
FP_PARDEE CNTR	INF	29-Jun-98	L61960-1	4	<1	1
FP_PARDEE CNTR	INF	27-Jul-98	L63247-1	1	<1	1
FP_PARDEE CNTR	INF	24-Aug-98	L64519-1	<1	<1	1
FP_PARDEE CNTR	INF	29-Sep-98	L65585-1	2	<1	1
FP_PARDEE CNTR	INF	26-Oct-98	L67231-1	<1	<1	1
FP_PARDEE CNTR	INF	30-Nov-98	L68519-1	<2	<2	2
FP_PARDEE CNTR	INF	28-Dec-98	L69555-1	1	3	1
FP_PARDEE CNTR	INF	29-Mar-99	L72198-1	1	<1	1
FP_PARDEE CNTR	INF	28-Sep-99	L76496-1	<2	<2	2

# of samples	**26**	**26**	
# of positives	**11**	**2**	
% positives	**42**	**8**	
Min	**0.9**	**2**	**0.32**
Max	**5**	**3**	**4.5**
Median	**1**	**2.5**	

General Minerals and Inorganics. The general minerals and inorganic chemicals present in the Pardee Reservoir are very low. For example, as Table 4-9 highlights, the median concentration of total dissolved solids (TDS) is only 30 mg/L and total alkalinity is 14 mg/L. As a reference, the recommended secondary drinking water MCL for TDS is from 500 mg/L to 1,000 mg/L. Waters with high concentrations of TDS are less palatable to consumers.

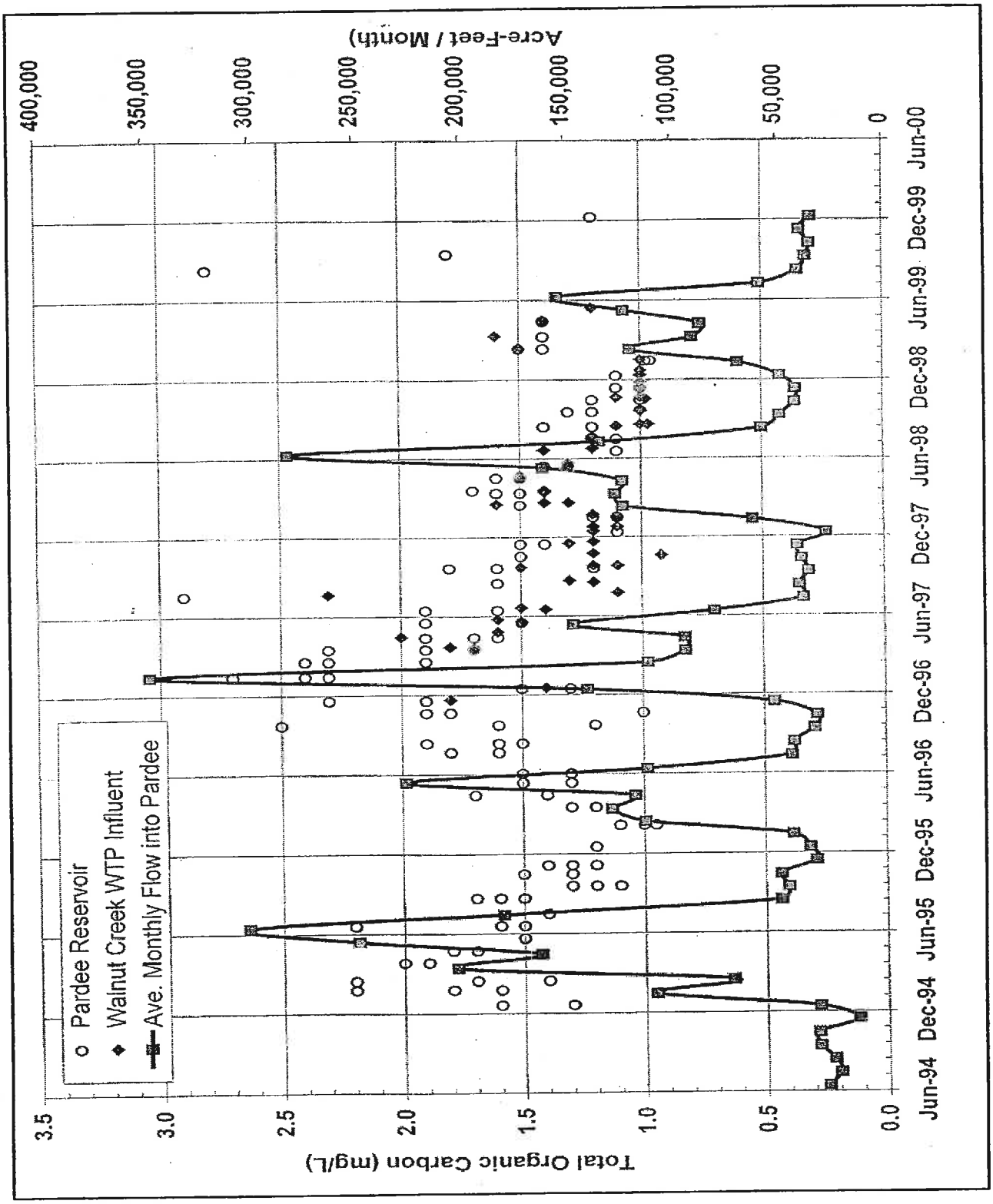
Since the original 1995 MRWSS, the five-years of water quality monitoring indicate that the median concentrations of the inorganic primary and secondary drinking water contaminants have been non-detect or well below the EPA and DHS MCLs. Raw water aluminum had a maximum value of 1.1 mg/L, just slightly over the primary drinking water MCL of 1 mg/L. However, the median raw water concentration for aluminum was only 0.03 mg/L. In addition, the raw water maximum value for iron was 0.977 mg/L, well above the secondary drinking water MCL of 0.3 mg/L. However, similar to aluminum, the median value for iron was quite low at 0.035 mg/L suggesting the maximum value reflects an infrequent excursion. It is important to remember that MCLs apply to treated water quality. The raw water quality is being evaluated using treated water MCLs as a benchmark and potential guide for treatment operations only.

Regulated and Unregulated Organics. Natural organic matter present in water is likely to originate from decaying plant material. Organic matter may color the water, add tastes or odors, deplete oxygen, interfere with water treatment processes, or form halogenated compounds when disinfected. Synthetic organic chemicals in the raw water are usually due to various activities within the watershed. SOCs encompass both non-volatile organics and volatile organics (VOCs). As Table 4-9 indicates, since 1994 the maximum concentrations of all the regulated SOCs monitored in Pardee Reservoir water were non-detect or well below drinking water MCLs. For the past five years, the maximum levels of all the regulated organic contaminant at Pardee Only two SOCs, DEHP and MTBE were at very low detectable levels with maximum concentrations of 1.3 µg/L and 4 µg/L, respectively. MTBE is discussed further in the section entitled *Other Water Quality Parameters*.

For the same five-year period, the maximum concentrations of the unregulated SOCs have been non-detect with the exception of chloroform and 1,2,4-trimethylbenzene. The maximum concentrations of these contaminants were 0.037 µg/L and 0.65 µg/L, respectively. The median concentrations for these parameters were non-detect. In addition, the median concentrations for all regulated and unregulated SOCs were non-detect, indicating that Pardee Reservoir stores high quality raw water.

Total Organic Carbon. TOC is another important surrogate of the natural organic content of water and is highlighted in the Stage 1 - D/DBP Rule. In this regulation, TOC is used as a surrogate parameter for indicating the potential for disinfection by-product formation when water is treated or disinfected. Percent removal requirements for WTPs are dependent on the annual average TOC of the influent raw water to the plant. Figure 4-15 depicts TOC monitoring data from December 1996 through August 1999 for both Pardee Reservoir and the Walnut Creek WTP. As the data reflects both the raw and treated water TOC concentrations are below 2 mg/L, suggesting that TOC removal through enhanced coagulation is not required at the water treatment plants. The five years of raw water TOC data summarized in Table 4-9, indicate a range of 0.92 to 2.9 mg/L with a median value of 1.4 mg/L occurred in Pardee Reservoir.

FIGURE 4-15 - Pardee Reservoir Total Organic Carbon Monitoring



Taste & Odor. No taste and odor problems associated with Pardee Reservoir water was documented during the past five years. Results of algae sampling at Pardee Reservoir from June 1994 through December 1999 are summarized in Table 4-11. This table highlights those algae whose counts were greater than 1,000 colonies or cells per 100 ml. A number of the algae summarized in Table 4-11 is associated with filter clogging problems at WTPs and T&O incidences. While it varies between algal species, to produce odorous metabolites of a high enough concentration to result in a noticeable T&O incident, algal counts of 10,000 to well over 100,000 cells per 100 ml would have to occur. To result in filter clogging problems, depending upon algal species, lower counts of 1,000s to 10,000s cells per 100 ml may be all that is required. Fortunately, Pardee Reservoir water is not noted as causing filter clogging problems or T&O incidences.

Table 4-11: Algal Species Detected in Pardee and Camanche Reservoirs

ALGAE CLASS	WATER QUALITY OR TREATMENT CONCERN	RESERVOIR	
		PARDEE	CAMANCHE
Bacillariophyceae (Diatoms)			
Asterionella	filter-clogging, odor	•	•
Attheya	--		•
Cyclotella	filter-clogging, odor	•	•
Cymbella	filter-clogging	•	
Fragilaria	filter-clogging, odor	•	•
Melosira	filter-clogging, odor	•	•
Navicula	filter-clogging	•	•
Nitzschia	--	•	•
Rhizosolenia	--	•	•
Stephanodiscus	filter-clogging, odor	•	•
Synedra	filter-clogging, odor	•	•
Tabellaria	taste, odor	•	
Chlorophyceae			
Ankistrodemus	--	•	•
Ankistrodesmus	odor	•	•
Botryococcus	--	•	
Coelastrum	--		•
Cosmarium	odor	•	
Crucigenia	--		•
Elakatothrix	odor	•	•
Gloeocystis	odor	•	
Golenkinia	--		•
Hormidium	--	•	
Oocystis	--	•	•
Pachycladon	--	•	•
Palmella	filter-clogging	•	•
Pediastrum	odor		•
Scenedesmus	odor	•	•
Schroederia	--	•	•
Sphaerocystis	--	•	•
Spondylosium	--	•	•
Staurastrum	odor		•
Tetraedron	--	•	•
Ulothrix	odor	•	•
Chrysophyceae			
Dinobryon	odor	•	•
Mallomonas	taste, odor	•	•

Table 4-11: Algal Species Detected in Pardee and Camanche Reservoirs – (cont.)

ALGAE CLASS	WATER QUALITY OR TREATMENT CONCERN	RESERVOIR	
		PARDEE	CAMANCHE
Cyanophyceae (Myxophycae)			
Agmenellum	--	•	•
Anabaena	filter-clogging, odor	•	•
Anacystis	taste, odor	•	•
Aphanizomenon	taste, odor	•	•
Coccochloris	--	•	•
Oscillatoria	filter-clogging, odor	•	•
Dinophyceae			
Ceratium	taste, odor		•
Codomonas	--	•	
Gymnodinium	--		•
Peridinium	odor	•	•
Euglenophyceae			
Euglenoid	odor	•	
Trachelomonas	--	•	•
Zooflagellates			
Aulomonas	--	•	•
Cladomonas	--		•
Domatomonas	--	•	•
Stelexomonas	--	•	

Sources: EBMUD, 2000.

AWWA. Lyonnaise Des Eaux. *Identification and Treatment of Tastes and Odors in Drinking Water.* 1987.

APHA, AWWA, WEF, *Standard Methods for the Examination of Water and Wastewater*, 1998.

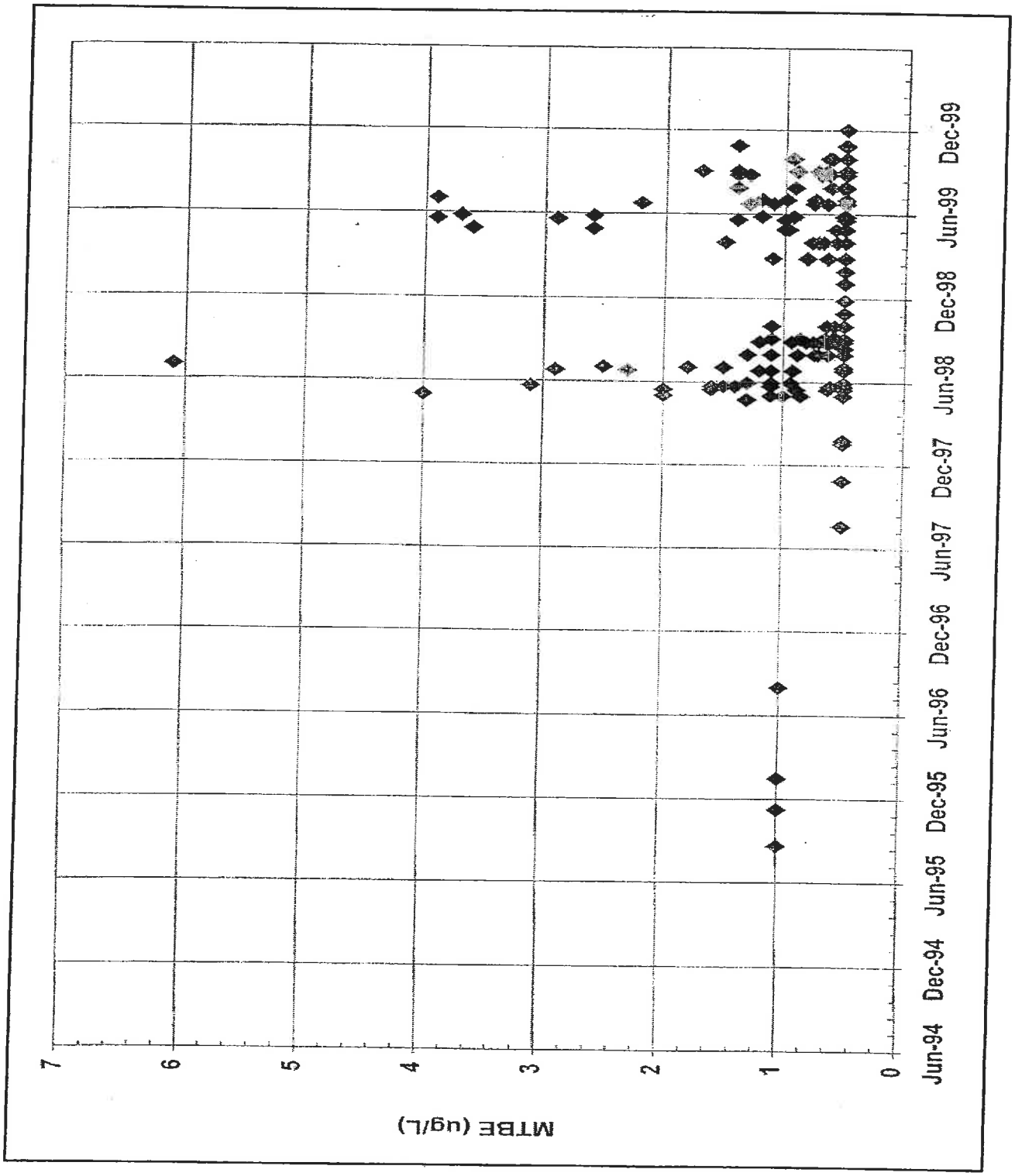
NOTES: Algae listed are samples collected from June 1994 to December 1999, which measured more than 1,000 colonies or cells per 100 ml.

Other Water Quality Parameters. Several other parameters for which the District monitors and are pertinent to the discussion herein include arsenic, bromate/bromide, and MTBE. Given that the arsenic MCL is expected to be reduced to a concentration between 2 and 20 µg/L by EPA, the District began monitoring for this parameter. The median arsenic level at Pardee Reservoir was 0.2 µg/L during the 1994 through 1999 monitoring program.

As part of the Stage 1 - D/DBP Rule, an MCL for bromate -- a disinfection by-product created when bromide is ozonated -- was promulgated at 10 µg/L. The bromide concentration in Pardee Reservoir over the five-year monitoring program ranged from non-detect to 0.06 mg/L with a median concentration of non-detect. This low maximum bromide concentration, combined with the fact that ozonation is not applied to treat Mokelumne River water, suggests that bromate is not an issue of concern.

MTBE is one of a group of chemicals known as fuel oxygenates required by EPA as a gasoline additive since 1996 for air pollution control regulation. Since is introduction as a gasoline additive, MTBE has been detected in drinking-water supplies as a result of gasoline spills, leaking underground storage tanks and pipes, street runoff and motorboat outboard engine emissions. As previously discussed in the regulatory section, DHS adopted a secondary MCL of 5 µg/L in 1999 and a primary MCL of 13 µg/L in 2000 for MTBE. Based on monitoring initiated in 1995, the District has infrequently detected MTBE in Pardee Reservoir (Figure 4-16). MTBE has ranged from non-detect to 6.1 µg/L with a median value of non-detect. The high concentrations reflect samples collected near the marina.

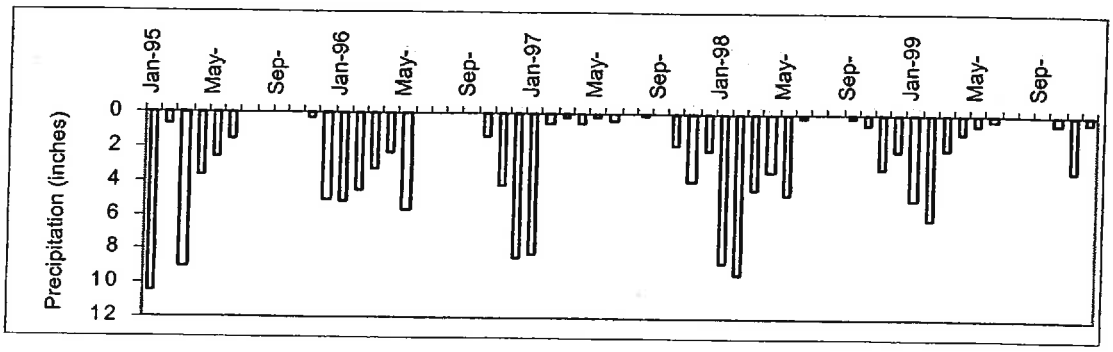
FIGURE 4-16 - Pardee Reservoir MTBE Monitoring



Trends in Water Quality. To investigate whether potential trends or relationships between watershed conditions and water quality can be extracted from current water quality monitoring programs, monthly precipitation and turbidity data were plotted for Pardee Center WTP (Figure 4-17) and Pardee Recreation Area WTP (Figure 4-18). As shown in these figures, a correlation is suggested between rainfall events and elevated (raw water) turbidity at the Pardee Reservoir. However, the data depicts the treatment performance of the Pardee Center and Pardee Recreation Area WTPs as shown by the relatively consistent treated water turbidity that is produced whether or not there is a raw water turbidity spike caused by a rainfall event. For the District's Walnut Creek, Lafayette, and Orinda in-line water treatment plants that treat Mokelumne River water diverted from Pardee Reservoir, high turbidity events pose operational difficulties. Operational procedures have been developed to mitigate the impact of turbidity spikes on treatment plant operations at these WTPs.

Pardee Reservoir data does not reflect distinct fluctuations in total coliform levels, as were detected in the Mokelumne River tributaries to Pardee Reservoir. Continued monitoring of the tributaries is important to the overall monitoring database for Pardee Reservoir. However, the current lack of an integrated monitoring program prohibits conclusions from being drawn regarding the upper watershed.

FIGURE 4-17 - Precipitation, Raw Water Turbidity, and Pardee Center WTP Treated Water Turbidity



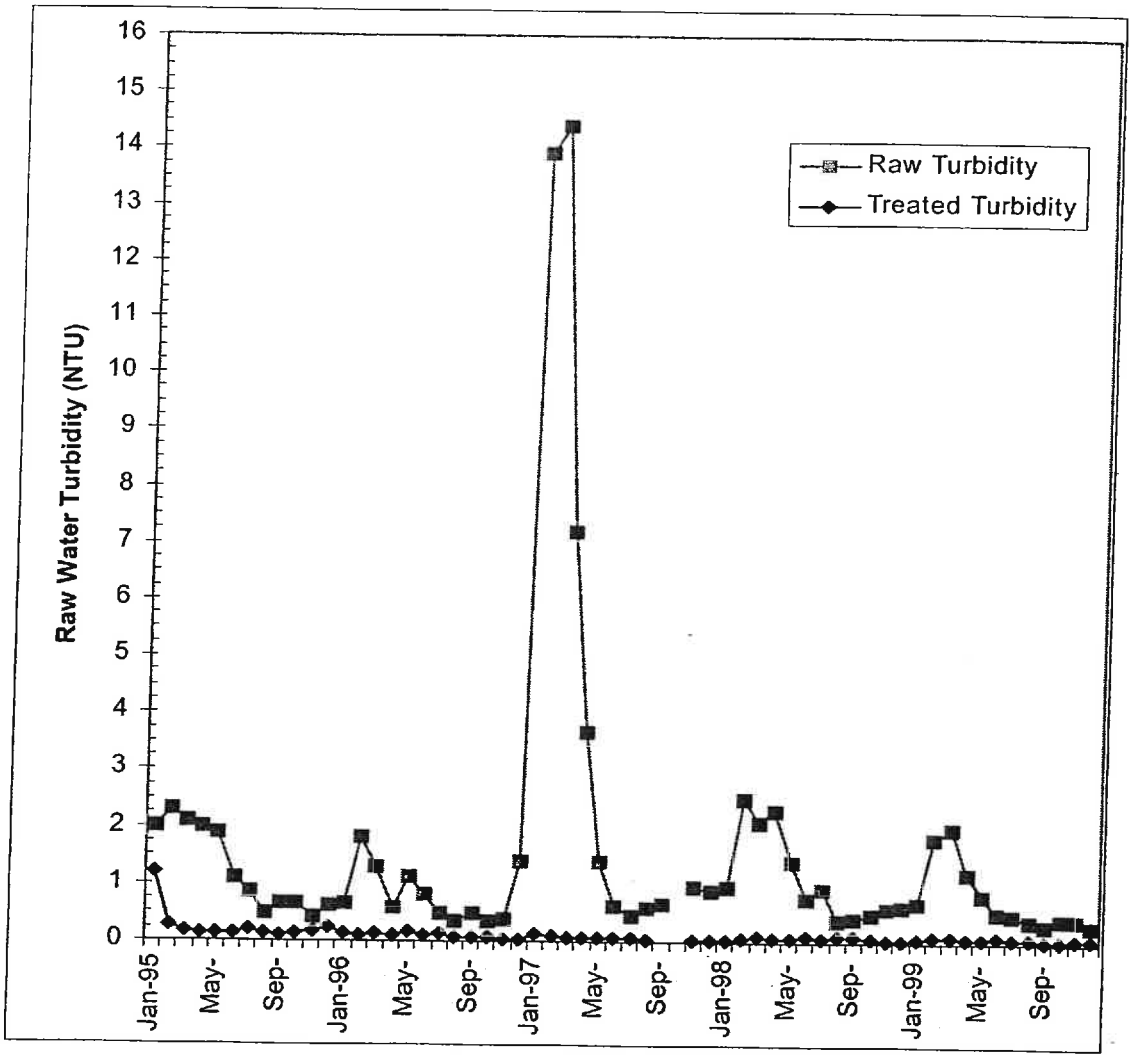
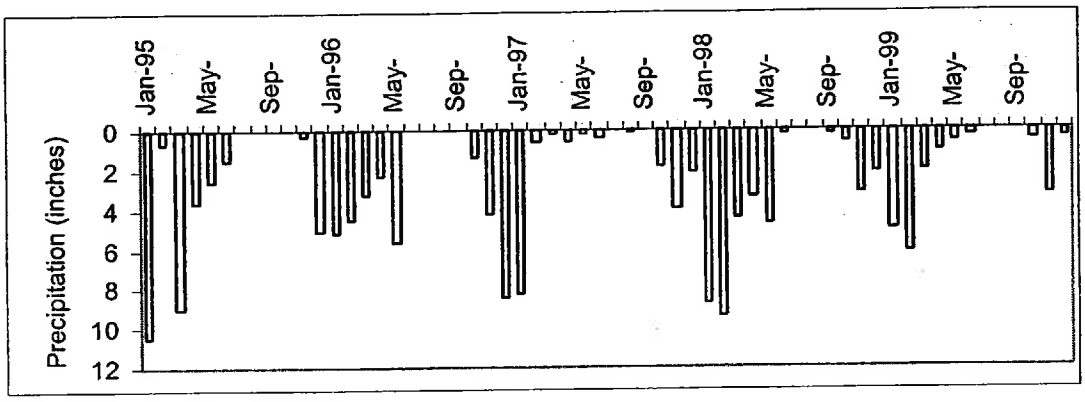
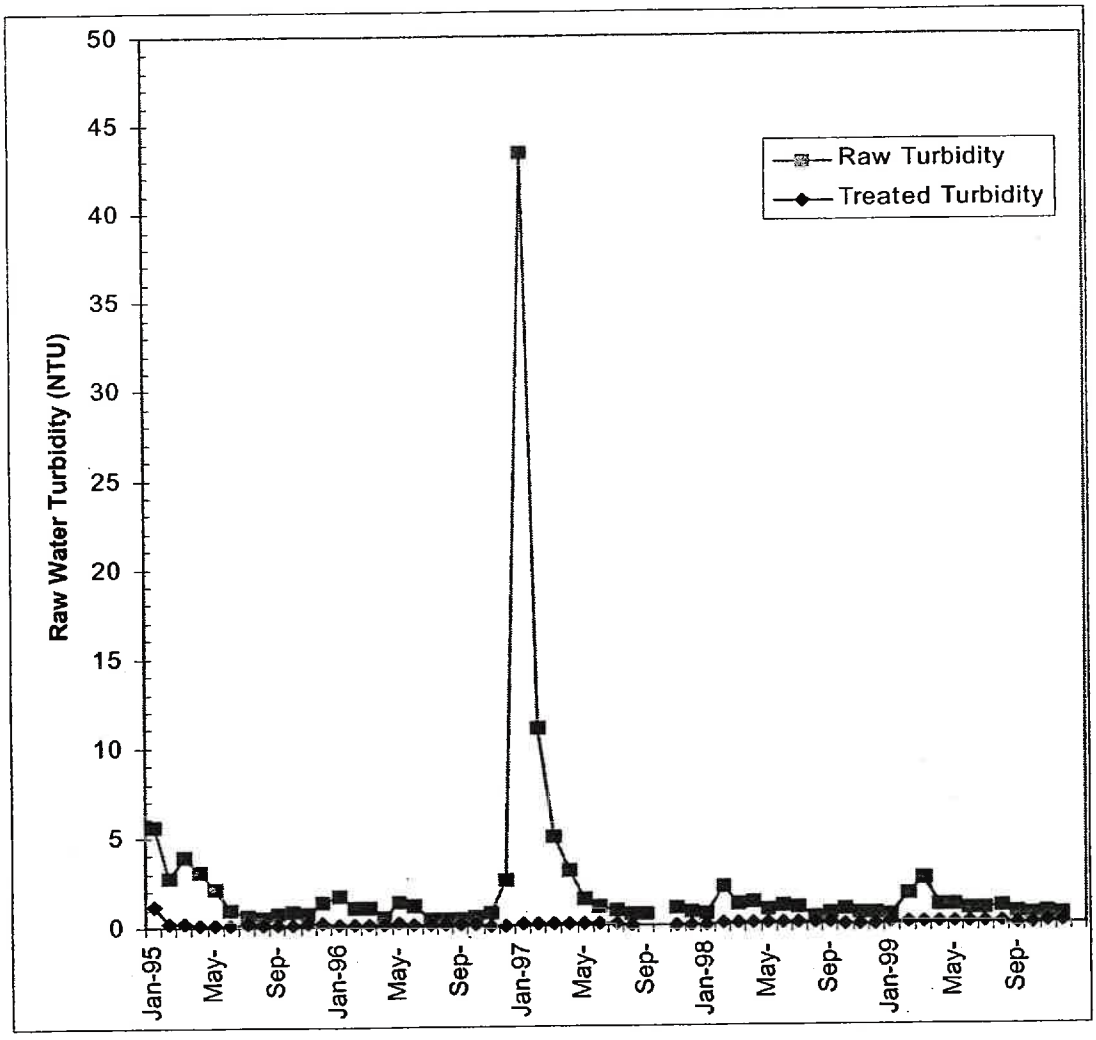


FIGURE 4-18 - Precipitation, Raw Water Turbidity, and Pardee Recreation Area WTP Treated Water Turbidity





Comparison of Raw/Treated Water to Standards. As previously noted, the District's annual reports for the large systems -- Walnut Creek, Lafayette, and Orinda WTPs -- present treated water distribution system-wide averages for many of the regulated parameters discussed herein. Annual reports for the small water systems -- Pardee Center and Pardee Recreation Area WTPs -- document distribution system-wide averages for a smaller subset of pertinent water quality parameters. The Annual Water Quality and Supply Reports from 1995 through 1999 are provided in Appendix D. Monthly summaries of water treatment plant operations (monthly compliance reports submitted to DHS) were used to evaluate the corresponding treated and finished water qualities.

Raw water in the Pardee Reservoir generally met treated water quality standards, with the exception of three parameters: turbidity, aluminum, and iron. For both aluminum and iron, the median concentrations were well below the respective primary and secondary MCLs for treated water. The maximum concentrations reported for these parameters were above these standards suggesting occasional but infrequent elevated levels occur. Neither of these parameters occurs at concentrations above the primary and secondary standards once treated. As for turbidity, this parameter is removed through the process trains of Pardee Center WTP, Pardee Recreation Area WTP, and the District's in-line WTPs (Walnut Creek, Lafayette, and Orinda WTPs). The monthly and annual water quality reports prepared for DHS indicate that all of the District's water treatment plants that receive Mokelumne River water effectively treat the water, meeting all drinking water standards -- both primary and secondary.

Camanche Reservoir - Evaluation of Water Quality

Camanche Reservoir is predominantly used for flood control and to meet fish flow requirements defined in the District's water rights permit. One small system -- Camanche South Shore WTP -- treats Camanche Reservoir water. Camanche North Shore treats water from three wells located near Camanche Reservoir. Both of these systems are defined as serving mountain communities with populations less than 3,300. Therefore, the raw water quality monitoring requirements as defined under Title 22 for Camanche Reservoir are less extensive than those required for Pardee Reservoir. The results of this monitoring along with other pertinent water quality parameters are discussed below.

Existing Raw Water Quality. Raw water monitoring at Camanche Reservoir is not as extensive as the program conducted at Pardee Reservoir. Table 4-12 provides a statistical summary of the raw water quality of Camanche Reservoir from June 1994 through December 1999. MCLs and minimum/maximum MDLs for reporting are documented for each parameter along with minimum, median, and maximum statistics. As noted in Table 4-12, Camanche Reservoir water is basic in nature with a median pH of 7.1 and a range of 6.5 to 8.4. Total alkalinity was low and relatively constant, ranging from 9 to 28 mg/L as $CaCO_3$. Total hardness ranged from 8 to 23 mg/L as $CaCO_3$ reflecting a very soft water.

Table 4-12: Camanche Reservoir Water Quality Monitoring - 1994 thru 1999

Water Quality Parameters	MCL	Units	No. of Samples	Median	Minimum	Maximum	Minimum DLR		Maximum DLR
Microbiological Constituents									
Cryptosporidium oocysts	NA	#/100 L	No Data						
Giardia cysts	NA	cysts/100	No Data						
E coli	NA	MPN/100 mL	449	ND	ND	2400	2		
Fecal Coliforms	NA	MPN/100 mL	458	ND	ND	3000	2		
Total Coliforms	NA	MPN/100 mL	463	23	ND	16000	2		
Primary Standards (Health Related) - Inorganic Chemicals									
Aluminum (Al)	1000	ug/L	1212	493	ND	3140	3.5	-	60
Antimony (Sb)	6	ug/L	1418	ND	ND	103	15	-	33
Arsenic (As)	50	ug/L	308	0.55	ND	5	0.05	-	0.5
Asbestos	7	MFL	No Data						
Barium (Ba)	1000	ug/L	1472	17.8	6.5	56.8	0.05	-	3.5
Beryllium (Be)	4	ug/L	783	ND	ND	2.63	0.03	-	2.2
Cadmium (Cd)	5	ug/L	611	ND	ND	0.7	0.1	-	4
Chromium (Cr)	50	ug/L	179	ND	ND	33.6	1.5	-	4.5
Cyanide (CN)	200	ug/L	No Data						
Fluoride (F-)	1.4	ug/L	24	0.04	ND	0.61	0.03		
Mercury (Hg)	2	ug/L	104	0.105	ND	0.77	0.05		
Nickel (Ni)	100	ug/L	464	1.04	ND	16	0.4	-	20
Nitrate (as NO3)	22500	ug/L	1302	62	ND	1012	3	-	100
Nitrate+Nitrite as N	10000	ug/L	921	14.3	ND	229			
Nitrite (as N)	1000	ug/L	921	ND	ND	ND	1	-	27
Selenium (Se)	50	ug/L	1717	ND	ND	829	0.5	-	50
Thallium (Tl)	2	ug/L	419	ND	ND	0.5	0.05	-	1
Primary Standards (Health Related) - Non-volatile Organic Chemicals (SOCs)									
1,2-Dibromo-3-chloropropane (DBCP)	0.2	ug/L	No Data						
2,3,7,8-TCDD (Dioxin)	0.00003	ug/L	No Data						
2,4,5-TP (Silvex)	50	ug/L	No Data						
2,4-D	70	ug/L	No Data						
Alachlor (Alanex)	2	ug/L	No Data						
Atrazine (Aatrex)	3	ug/L	No Data						
Bentazon (Basagran)	18	ug/L	No Data						
Benzo(a)pyrene	0.2	ug/L	No Data						
Carbofuran (Furadan)	18	ug/L	No Data						
Chlordane	0.1	ug/L	No Data						
Dalapon	200	ug/L	No Data						
Di(2-ethylhexyl)adipate	400	ug/L	No Data						
Di(2-ethylhexyl)phthalate (DEHP)	4	ug/L	No Data						
Dinoseb (DNBP)	7	ug/L	No Data						
Diquat	20	ug/L	No Data						
Endothall	100	ug/L	No Data						
Endrin	2	ug/L	No Data						
Ethylene dibromide (EDB)	0.05	ug/L	No Data						
Glyphosate	700	ug/L	No Data						
Heptachlor	0.01	ug/L	No Data						
Heptachlor epoxide	0.01	ug/L	No Data						
Hexachlorobenzene	1	ug/L	No Data						
Hexachlorocyclopentadiene	50	ug/L	No Data						
Lindane (gamma-BHC)	0.2	ug/L	No Data						
Methoxychlor (Lannate)	40	ug/L	No Data						
Molinate (Ordam)	20	ug/L	No Data						
Methyl-tert-butyl ether (MTBE)	5	ug/L	265	1.1	ND	12	0.5		
Oxamyl (Vydate)	200	ug/L	No Data						
Pentachlorophenol (PCP)	1	ug/L	No Data						
Picloram	500	ug/L	No Data						
Polychlorinated biphenyls (PCBs)	0.5	ug/L	No Data						
Simazine (Princep)	4	ug/L	No Data						
Thiobencarb (Bolero)	70	ug/L	No Data						
Toxaphene	3	ug/L	No Data						
Primary Standards (Health Related) - Radioactivity									
Combined Radium-226 and Radium-228	5	pCi/L	No Data						
Gross Alpha	15	pCi/L	No Data						
Gross Beta	50	pCi/L	No Data						

Table 4-12: Camanche Reservoir Water Quality Monitoring – 1994-1999 – (cont.)

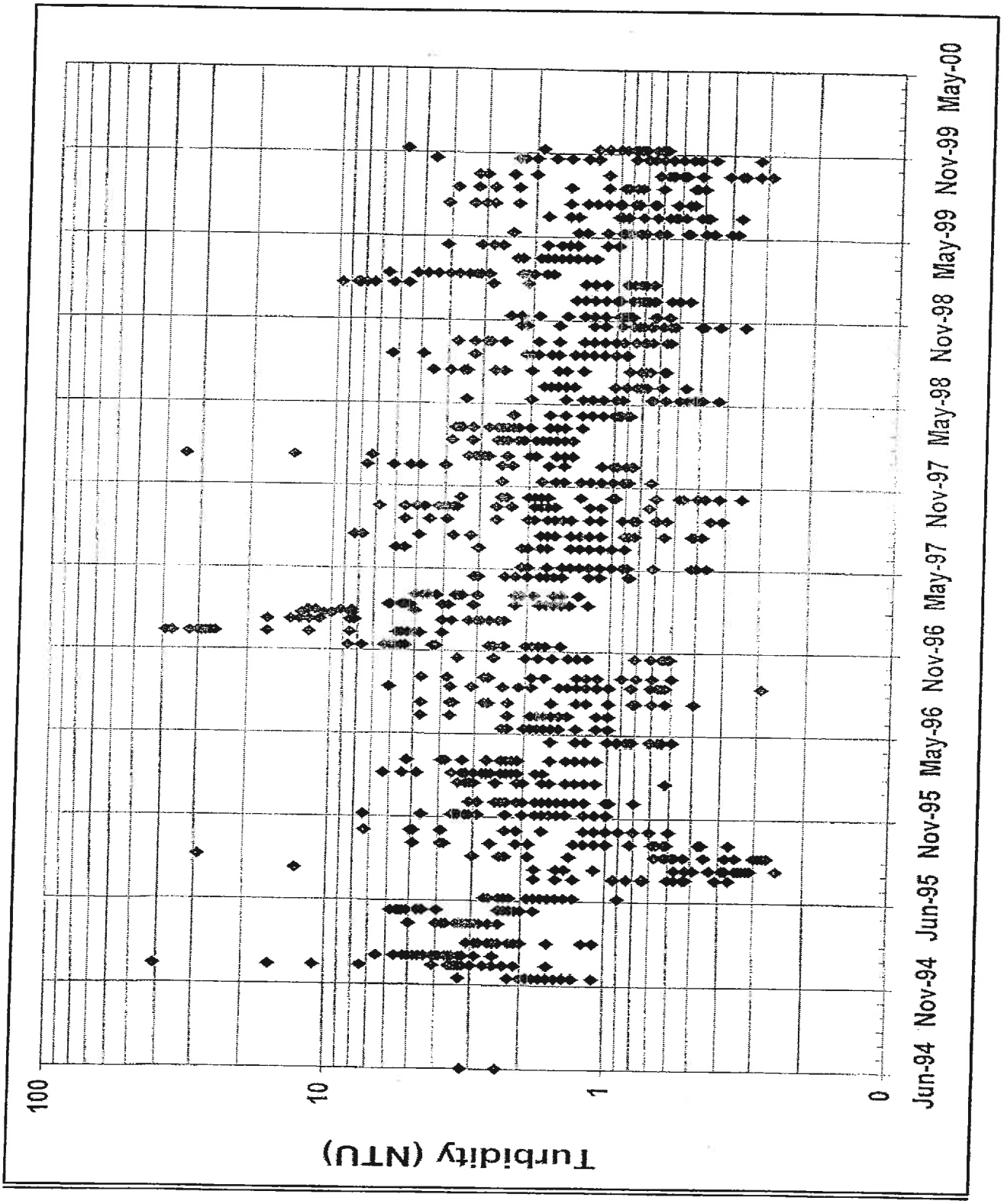
Water Quality Parameters	MCL	Units	No. of Samples	Median	Minimum	Maximum	Minimum DLR		Maximum DLR
Radium 226	NA	pCi/L	No Data						
Radium 228	NA	pCi/L	No Data						
Strontium	8	pCi/L	No Data						
Tritium	20000	pCi/L	No Data						
Uranium	20	pCi/L	No Data						
Primary Standards (Health Related) - Total Trihalomethanes									
Bromodichloromethane (Dichlorobromomethan	NA	ug/L	265	ND	ND	ND	0.04		
Bromoform (Tribromomethane)	NA	ug/L	265	ND	ND	ND	0.1		
Chlorodibromomethane (Dibromochloromethan	NA	ug/L	265	ND	ND	ND	0.06		
Chloroform (Trichlormethane)	NA	ug/L	265	ND	ND	ND	0.07		
Primary Standards (Health Related) - Volatile Organic Chemicals (VOCs)									
1,1,1-Trichloroethane (1,1,1-TCA)	0.2	ug/L	265	ND	ND	ND	0.08		
1,1,2,2-Tetrachloroethane	1	ug/L	265	ND	ND	ND	0.11		
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 11	1200	ug/L	265	ND	ND	ND	0.03		
1,1,2-Trichloroethane (1,1,2-TCA)	5	ug/L	265	ND	ND	ND	0.03		
1,1-Dichloroethane (1,1-DCA)	5	ug/L	265	ND	ND	ND	0.07		
1,1-Dichloroethylene (1,1-DCE)	6	ug/L	265	ND	ND	ND	0.05		
1,2,4-Trichlorobenzene (Unsym-Trichlorobenze	70	ug/L	265	ND	ND	ND	0.11		
1,2-Dichlorobenzene (o-DCB)	600	ug/L	265	ND	ND	ND	0.05		
1,2-Dichloroethane (1,2-DCA)	0.5	ug/L	265	ND	ND	ND	0.06		
1,2-Dichloropropane (Propulene dichloride)	5	ug/L	265	ND	ND	ND	0.12		
1,3-Dichloropropene	0.5	ug/L	265	ND	ND	ND	0.07		
1,4-Dichlorobenzene (p-DCB)	5	ug/L	265	ND	ND	ND	0.04		
Benzene	1	ug/L	265	ND	ND	ND	0.05		
Carbon Tetrachloride	0.5	ug/L	265	ND	ND	ND	0.14		
cis-1,2-Dichlorethylene (c-1,2-DCE)	6	ug/L	265	ND	ND	ND	0.05		
Dichloromethane (Methylene chloride)	5	ug/L	265	ND	ND	ND	0.07		
Ethylbenzene (Phenylethane)	700	ug/L	265	ND	ND	0.28	0.08		
Monochlorobenzene (Chlorobenzene)	70	ug/L	265	ND	ND	ND	0.05		
Styrene (Vinylbenzene)	100	ug/L	265	ND	ND	ND	0.08		
Tetrachloroethylene (PCE)	5	ug/L	265	ND	ND	ND	0.11		
Toluene (Methylbenzene)	150	ug/L	265	ND	ND	7.8	0.07		
trans-1,2-Dichloroethylene (t-1,2-DCE)	10	ug/L	265	ND	ND	ND	0.14		
Trichloroethylene (TCE)	5	ug/L	265	ND	ND	ND	0.05		
Trichlorofluoromethane (Freon 11)	150	ug/L	265	ND	ND	ND	0.15		
Vinyl chloride (VC)	0.5	ug/L	265	ND	ND	ND	0.07		
Xylenes (total)	1750	ug/L	265	ND	ND	1.4	0.33		
Lead and Copper Rule (Action Levels									
Copper (Cu)	1300	ug/L	1371	1.61	0.5	80.6	1	-	3.3
Lead (Pb)	15	ug/L	525	ND	ND	30	0.2	-	60
Secondary Standards (Aesthetics)									
Aluminum (Al)	200	ug/L	1212	493	ND	3140	3.5	-	60
Chloride (Cl)	250-500	mg/L	24	1.6	0.92	300	0.07	-	7
Color	15	color unit	No Data						
Copper (Cu)	1000	ug/L	1371	1.61	0.5	80.6	1	-	3.3
Foaming Agents (MBAs)	500	ug/L	NA						
Iron (Fe)	300	ug/L	1082	81.12	5	2810	1	-	11
Manganese (Mn)	50	ug/L	1376	11.1	1.5	1760	0.15	-	1.1
Methyl-tert-butyl ether (MTBE)	5	ug/L	265	1.1	ND	12	0.5		
Odor--Threshold	3	TON	No Data						
Silver (Ag)	100	ug/L	381	ND	ND	ND	0.15	-	5
Specific Conductance	900 - 1600	umhos/cm	1487	44	24	80			
Sulfate	250 - 500	mg/L	1297	1.7	0.7	12	0.03	-	0.5
Thiobencarb (Bolero)	1	ug/L	No Data						
Total Dissolved Solids (TDS)	500 - 1000	mg/L	124	34	12	590	6		
Turbidity (Grab Samples)	5	NTU	1227	1.6	0.25	40	0.01	-	4
Zinc (Zn)	5	ug/L	1207	11.9	1.5	238	1	-	5
Unregulated Organic Chemicals - List A									
1,1,1,2-Tetrachloroethane	NA	ug/L	328	ND	ND	ND	0.03		
1,1-Dichloropropene	NA	ug/L	328	ND	ND	ND	0.07		
1,2,3-Trichloropropane (Allyl trichloride)	NA	ug/L	307	ND	ND	ND	0.08		
1,3-Dichlorobenzene (m-DCB)	NA	ug/L	328	ND	ND	ND	0.06		
1,3-Dichloropropane	NA	ug/L	328	ND	ND	ND	0.07		

Table 4-12: Camanche Reservoir Water Quality Monitoring - 1994-1999 – (cont.)

Water Quality Parameters	MCL	Units	No. of Samples	Median	Minimum	Maximum	Minimum DLR	DLR	Maximum DLR
2,2-Dichloropropane	NA	ug/L	No Data						
2-Chlorotoluene (o-Chlorotoluene)	NA	ug/L	328	ND	ND	ND		0.12	
4-Chlorotoluene (p-Chlorotoluene)	NA	ug/L	328	ND	ND	ND		0.08	
Bromobenzene (Monobromobenzene)	NA	ug/L	328	ND	ND	ND		0.08	
Bromodichloromethane (Dichlorobromomethan	NA	ug/L	328	ND	ND	ND		0.04	
Bromoform (Tribromomethane)	NA	ug/L	328	ND	ND	ND		0.1	
Bromomethane (Methyl bromide)	NA	ug/L	328	ND	ND	ND		0.21	
Chlorodibromomethane (Dibromochloromethan	NA	ug/L	328	ND	ND	ND		0.06	
Chloroethane (Ethyl chloride)	NA	ug/L	328	ND	ND	ND		0.19	
Chloroform (Trichlormethane)	NA	ug/L	328	ND	ND	ND		0.07	
Chloromethane (Methyl chloride)	NA	ug/L	328	ND	ND	ND		0.1	
Dibromomethane (Methyl bromide)	NA	ug/L	328	ND	ND	ND		0.09	
Dichlorodifluoromethane (Difluorodichlorometha	NA	ug/L	328	ND	ND	ND		0.09	
Unregulated Organic Chemicals - List B									
1,2,3-Trichlorobenzene (vis-Trichlorobenzene)	NA	ug/L	265	ND	ND	ND		0.11	
1,2,4-Trimethylbenzene (Pseudocumene)	NA	ug/L	265	ND	ND	ND		0.35	
1,3,5-Trimethylbenzene (Mesitylene)	NA	ug/L	265	ND	ND	ND		0.18	
1-Propylpropane (n-Propylbenzene)	NA	ug/L	265	ND	ND	ND		0.09	
Bromacil (Hyvar X, Hyvar XL)	NA	ug/L	No Data						
Bromochloromethane (Chlorobromomethane)	NA	ug/L	265	ND	ND	ND		0.14	
Chlorothalonil (Bravo, Daconil)	NA	ug/L	No Data						
Dimethoate (Cygon)	NA	ug/L	No Data						
Diuron (Karmex, Krovar)	NA	ug/L	No Data						
Ethyl tertiary butyl ether (ETBE)	NA	ug/L	265	ND	ND	ND		0.5	
Hexachlorobutadiene (Perchlorobutadiene)	NA	ug/L	265	ND	ND	ND		0.12	
Isopropylbenzene (Cumene)	NA	ug/L	265	ND	ND	ND		0.11	
Naphthalene (Naphthalin)	NA	ug/L	265	ND	ND	ND		0.1	
n-Butylbenzene (1-Butylpropane)	NA	ug/L	265	ND	ND	ND		0.09	
p-isopropyltoluene (p-Cymene)	NA	ug/L	265	ND	ND	ND		0.08	
Prometryn (Caparol)	NA	ug/L	No Data						
sec-Butylbenzene (2-Phenylbutane)	NA	ug/L	No Data						
tert-Butylbenzene (2-Methyl-2-phenylpropane)	NA	ug/L	265	ND	ND	ND		0.08	
Tertiary amyl methyl ether (TAME)	NA	ug/L	265	ND	ND	ND		0.5	
Unregulated Organic Chemicals - List C									
3-Hydroxycarbofuran	NA	ug/L	No Data						
Aldicarb (Temik)	NA	ug/L	No Data						
Aldicarb Sulfone	NA	ug/L	No Data						
Aldicarb Sulfoxide	NA	ug/L	No Data						
Aldrin	NA	ug/L	No Data						
Butachlor (Butanex, Lambast, Machete)	NA	ug/L	No Data						
Carbaryl (Sevin)	NA	ug/L	No Data						
Dicamba (Banax, Banvel, Dianat)	NA	ug/L	No Data						
Dieldrin	NA	ug/L	No Data						
Methoxychlor (Lannate)	NA	ug/L	No Data						
Metolachlor (Metelilachlor)	NA	ug/L	No Data						
Metribuzin (Lexone, Sencor, Sencoral)	NA	ug/L	No Data						
Propachlor (Albrass,Ramrod)	NA	ug/L	No Data						
Other Parameters									
Alkalinity, Total	NA	ug/L	879	17	9	28		5	
Total Phosphate as P	NA	ug/L	906	17	ND	1100	5	-	1100
Bromide	NA	ug/L	24	ND	ND	16		10	
Calcium (Ca)	NA	ug/L	489	9870	2260	31000	3	-	5
Geosmin	NA	ug/L	No Data						
Hardness	NA	ug/L	983	14	8	23		2	
Hydroxide Alkalinity	NA	ug/L	No Data						
Total Organic Carbon (TOC)	NA	mg/L	1	2.3	2.3	2.3		0.02	
TTHM Formation Potential	NA	ug/L	No Data						
Magnesium (Mg)	NA	ug/L	586	1270	842	12900	0.35	-	20
MIB	NA	ug/L	No Data						
pH	NA	ug/L	176	7.1	6.6	8.4			
Sodium (Na)	NA	ug/L	1602	2040	1060	217000	5	-	35

Turbidity. Figure 4-19 depicts the monthly turbidity from 1994 through 1999 at Camanche Reservoir. While the maximum turbidity was 41 NTU, the median value was 1.6 NTU during this five-year period. In addition, ninety-five percent of the turbidity data were below 6.3 NTU. One of the highest turbidity events occurred in the winter of late 1996 - early 1997, following very heavy rainfall in the Mokelumne Watershed. The effects of this heavy rainfall were also detected in the Pardee Reservoir by elevated turbidity measurements.

FIGURE 4-19 - Camanche Reservoir Turbidity Monitoring



Microbiological. Given that Camanche Reservoir is predominantly used for flood control and fish flows and secondarily as a source for one small system, monitoring for *Giardia* and *Cryptosporidium* have yet to be conducted at Camanche. The District monitors total coliforms, fecal coliforms, E. coli, and turbidity at Camanche South Shore WTP. Figure 4-20 highlights the raw water total coliform count versus time for 1994 through 1999. Samples collected directly from the reservoir and at the influent to Camanche South Shore WTP are included in this data set. The highest concentrations of total coliforms occurred at the beach area at Handicap Boat Ramp during June and July, suggesting that these elevated counts correspond to higher visitor or recreational use of Camanche Reservoir. The cumulative distribution for this data set is presented in Figure 4-21. As Figure 4-21 depicts, Camanche Reservoir is of good quality with total coliform counts below 1,900 MPN/100 ml, 95 percent of the time. The median total coliform count was 23 MPN/100 ml with a range of non-detect to 16,000 MPN/100 ml.

FIGURE 4-20 - Camanche Reservoir Total Coliform Monitoring

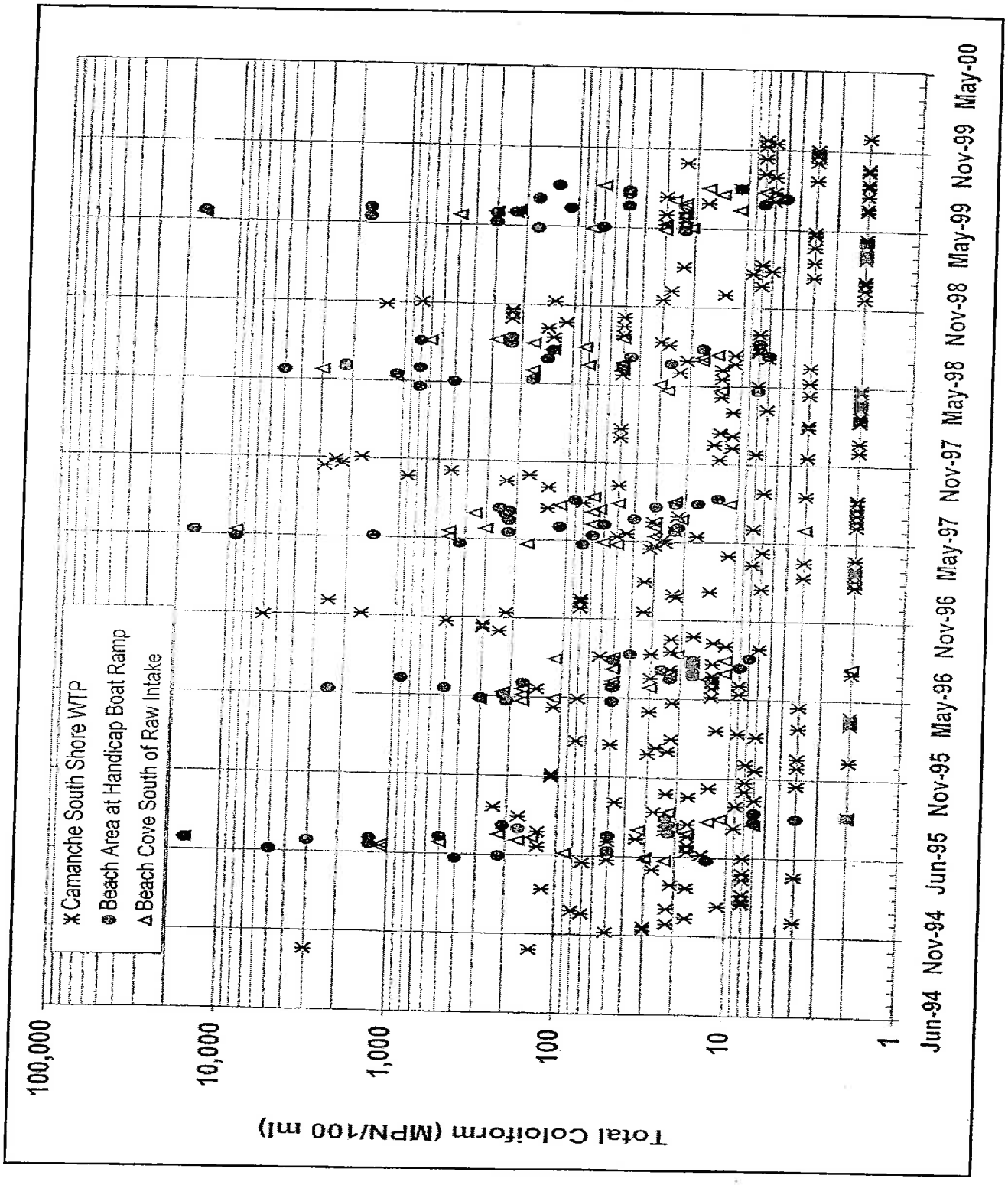
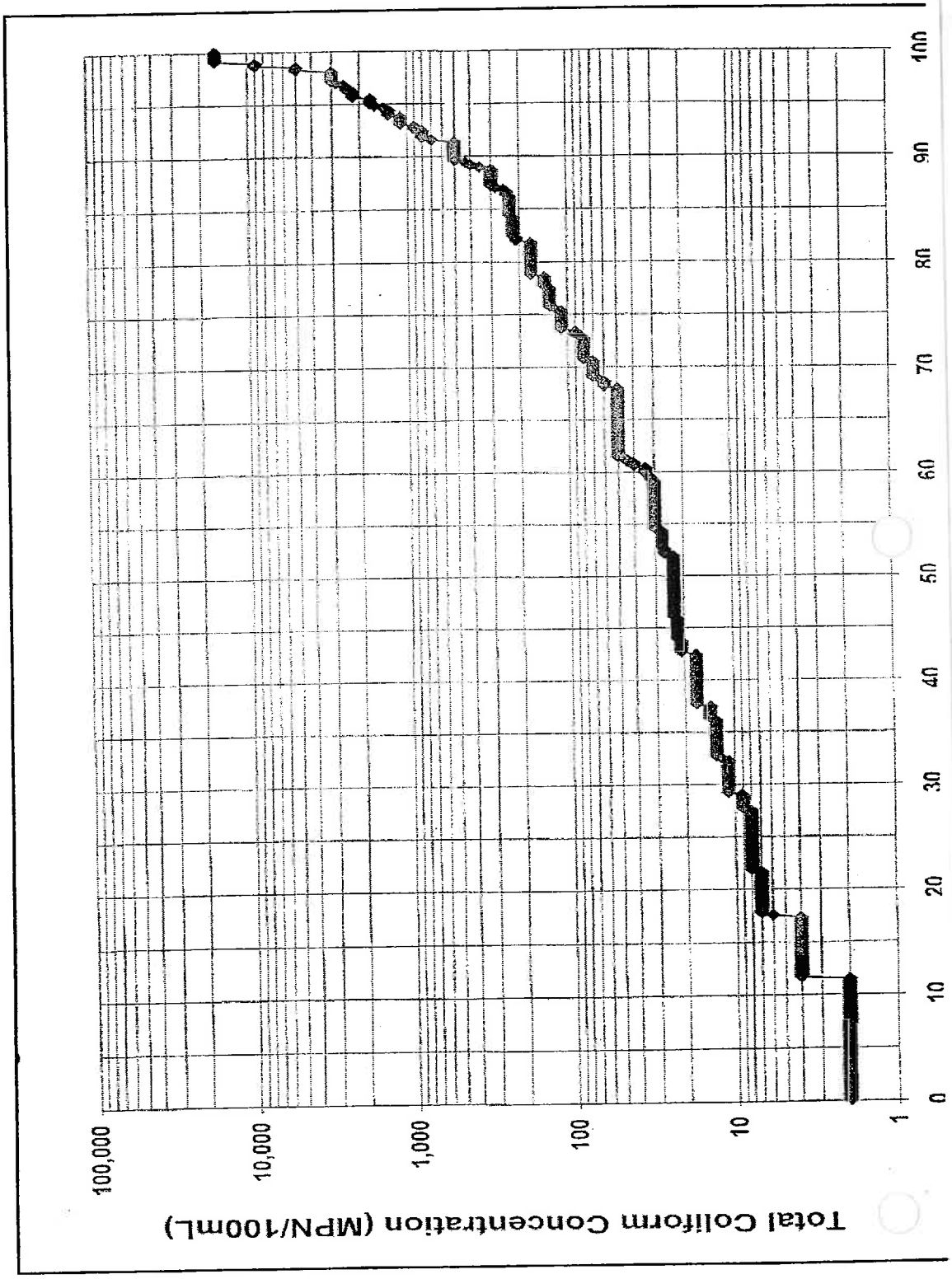


FIGURE 4-21 - Camanche Reservoir Total Coliform Monitoring - Cumulative Distribution



Figures 4-22 and 4-23 depict fecal coliform and E. coli monitoring at Camanche Reservoir, respectively. These two figures further support the total coliform results depicted in Figure 4-20 -- highest counts were detected during June and July when annual recreational use of Camanche Reservoir is highest. Generally, low fecal coliform and E. coli counts were detected during the five-year monitoring program, with median counts of non-detect for both parameters and maximum values of 3,000 and 2,400 MPN/100 ml, respectively.

FIGURE 4-22 - Camanche Reservoir Fecal Coliform Monitoring

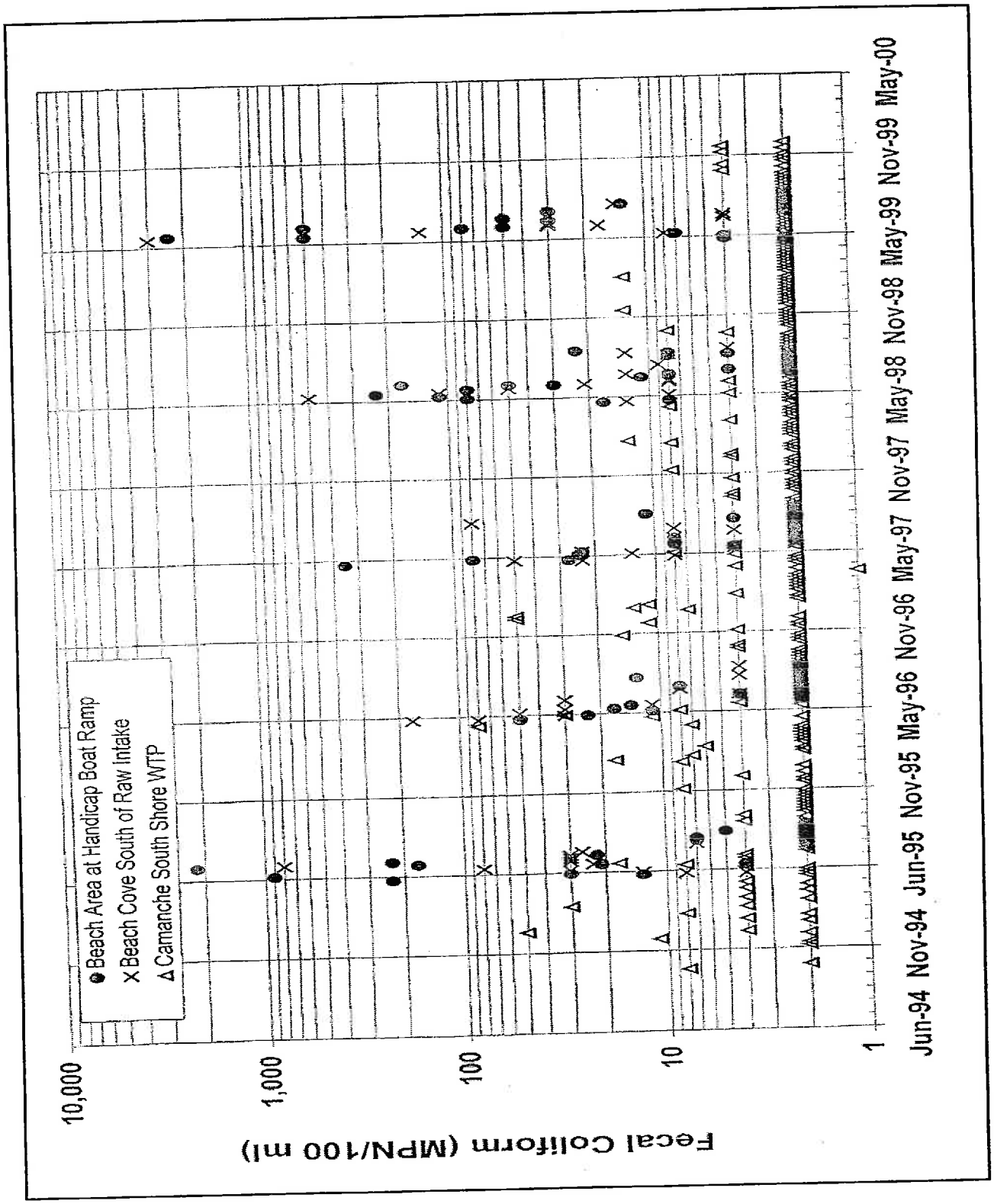
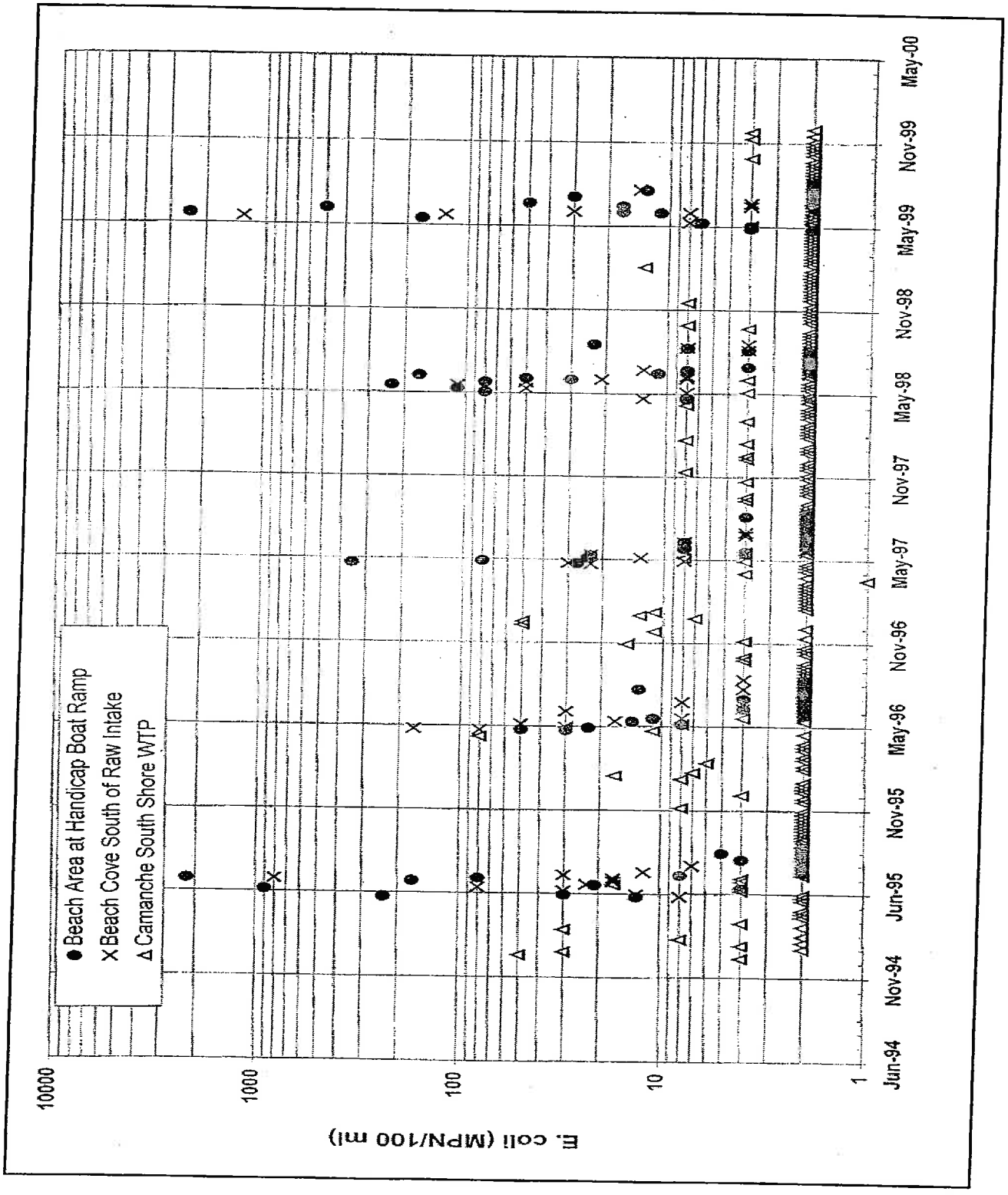


FIGURE 4-23 - Camanche Reservoir E. Coli Monitoring



General Minerals and Inorganic Chemicals. The general minerals and inorganic chemicals present in Camanche Reservoir were detected at very low to moderate concentrations with the exception of aluminum and zinc. As highlighted previously and summarized in Table 4-12, the median concentrations for total alkalinity and total dissolved solids were very low at 17 mg/L and 34 mg/L, respectively. As a reference, the recommended secondary drinking water MCL for TDS ranges from 500 to 1,000 mg/L depending upon source waters. Waters with high concentrations of TDS are less palatable to consumers.

For the past five years, with the exception of aluminum, the median concentrations for general minerals and inorganic chemicals in Camanche Reservoir have been non-detect or below the EPA and DHS primary and secondary drinking water MCLs. Aluminum was detected at a maximum concentration of 3.14 mg/L with a median value of 0.493 mg/L. The DHS primary MCL for aluminum is 1.0 mg/L. While the median raw water concentrations for iron was below the treated water secondary MCL of 0.3 mg/L, the maximum level detected -- 2.51 mg/L -- was well above this MCL. The source for these contaminants may be attributable to runoff from the Penn Mine area. Recent completion of the Penn Mine Environmental Restoration Project (addressed in Section 5) is expected to resolve these occurrences. Continued monitoring will ascertain the performance of this project.

Regulated and Unregulated Organic Chemicals. Table 4-12 summarizes the SOC monitoring results for the period from 1994 through 1999. During this five-year period, the District collected samples for the regulated VOCs. As Table 4-12 indicates, the maximum concentrations of all the regulated VOCs were non-detect with the exception of ethylbenzene, toluene, and total xylenes. While detectable, the maximum raw water concentrations for these contaminants were well below the primary drinking water MCLs. DHS approved a monitoring waiver for the regulated non-volatile SOCs. For the unregulated SOCs monitored during this five-year period, all maximum concentrations were non-detect. These results indicate that Camanche Reservoir water is of high quality.

Total Organic Carbon. Total Organic Carbon (TOC) is highlighted in the Stage 1 - D/DBP Rule as a surrogate parameter which indicates the potential for disinfection by-product formation when water is treated or disinfected. Percent TOC removal requirements for WTPs are dependent on the annual average TOC concentration of the raw water influent to the plant. In general, the percent of TOC-removal requirements increase when the annual average TOC is above 2 mg/L, above 4 mg/L, and above 8 mg/L. The TOC monitoring results summarized in Table 4-12 reflects one sample collected during the last five years with a concentration of 2.3 mg/L. Given that only one data point exists, it is difficult to assess the impact of the Stage 1 - D/DBP Rule on TOC removal at Camanche North Shore and Camanche South Shore WTPs. It is anticipated that the treatment processes at these WTPs provide adequate reductions in raw water TOC such that modifications to existing processes are unwarranted.

Taste & Odor. During the past five years, there have been no T&O events associated with Camanche Reservoir. Because consumer complaints have been non-existent, T&O related sampling was not included in the Camanche monitoring program. Therefore, data for threshold odor number (TON), geosmin and MIB are not reported in Table 4-12.

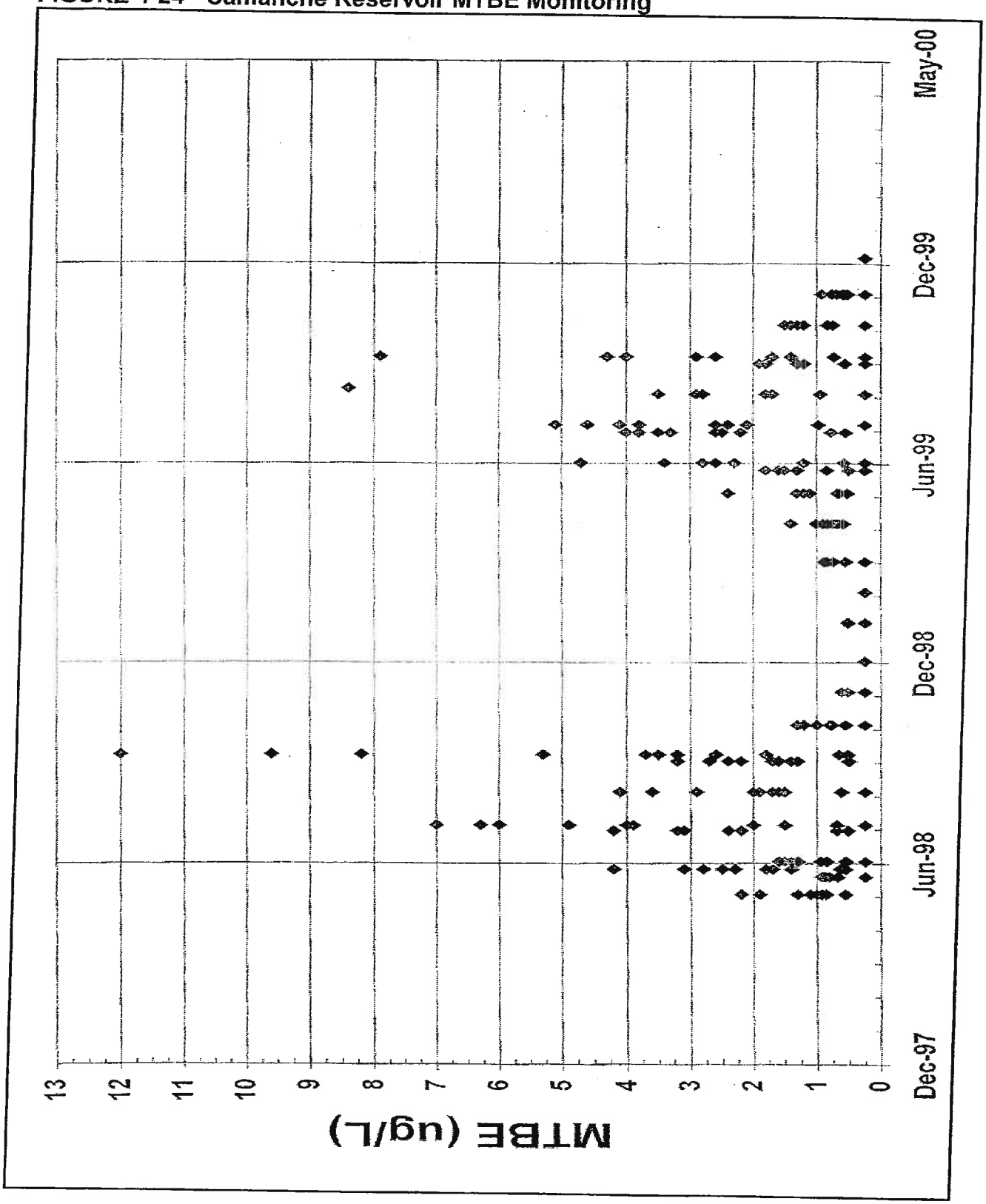
While specific T&O related monitoring was not conducted at Camanche Reservoir, the District collected algal data as part of the water quality-sampling program to support reservoir operations. Table 4-11 summarizes the results of this sampling by documenting those algal species, which were detected at concentrations greater than 1,000 colonies or cells per 100 ml. A number of algal species were prevalent in Camanche Reservoir at concentrations greater than 1,000 colonies or cells per 100 ml. Of these algal species approximately 50 percent are identified as potentially causing filter clogging, tastes and/or odor events. Fortunately none of these events impacted the performance of the Camanche South Shore WTP.

Other Water Quality Parameters. Three other parameters for which the District monitors and are pertinent to the discussion herein include arsenic, bromate/bromide, and MTBE. Arsenic monitoring in Camanche Reservoir from 1994 through 1999 reflects a median concentration of 0.55 µg/L and a range of non-detect to 5 µg/L.

As part of the Stage 1 - D/DBP Rule, an MCL for bromate -- a disinfection by-product created when bromide is ozonated -- was promulgated at 10 µg/L. The bromide concentration in Camanche Reservoir over the five-year monitoring program ranged from non-detect to 16 µg/L with a median concentration of non-detect. With a median concentration of non-detect and a very low maximum bromide concentration, it is not expected that elevated levels of bromate would be formed through treatment.

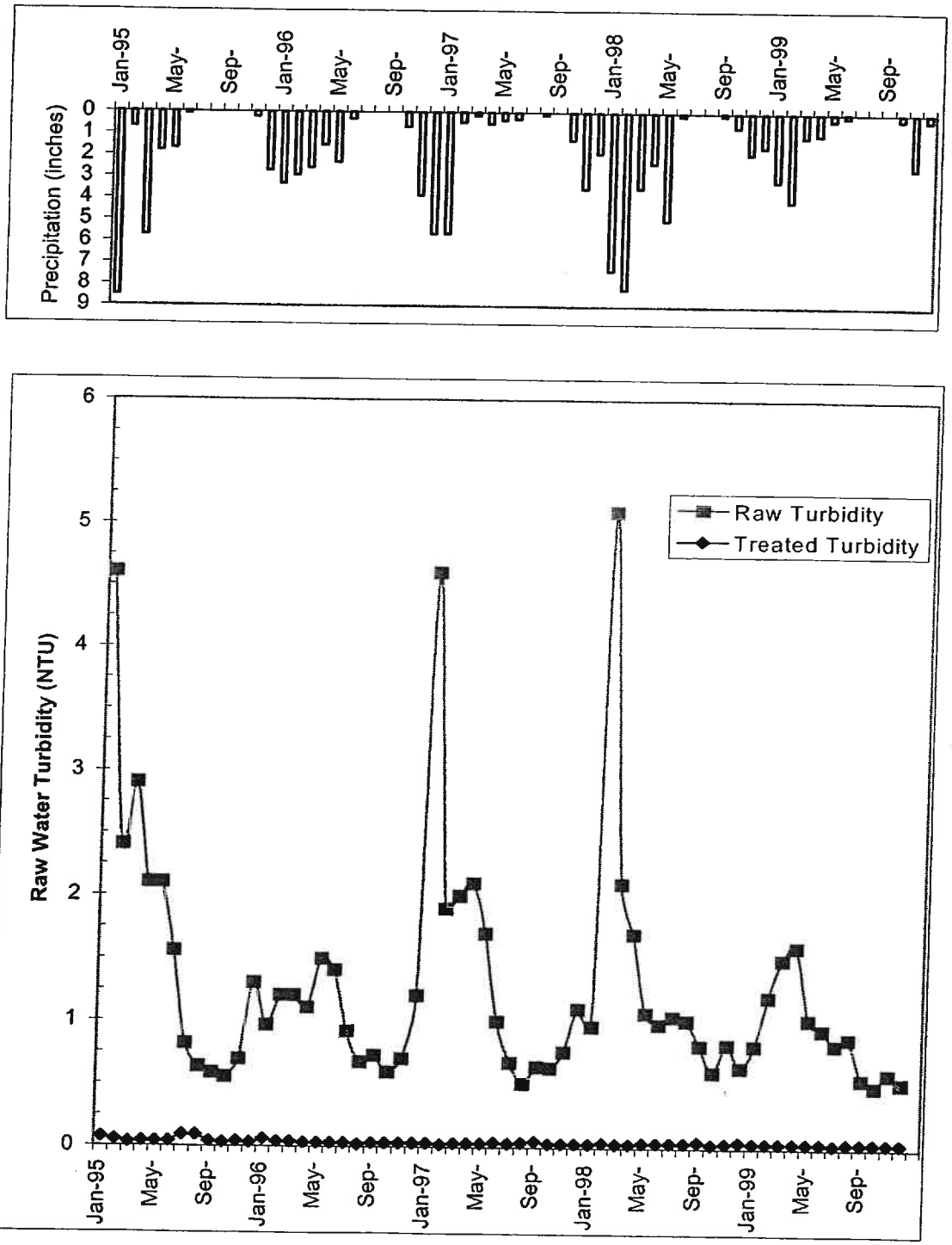
Since the 1996 MRWSS, MTBE -- a fuel oxygenate required for air pollution control since 1996 -- has been detected in drinking-water supplies. DHS adopted a secondary MCL of 5 µg/L in 1999 and a primary MCL of 13 µg/L in 2000 for MTBE. Based on monitoring initiated in 1998, the District has frequently detected MTBE in Camanche Reservoir. Figure 4-24 depicts the results of this MTBE sampling program with a maximum concentration of 12 µg/L occurring in the summer of 1998 near the marina at Camanche South Shore Recreation Area. The median MTBE concentration for the past two years of monitoring was 1.1 µg/L, and MTBE levels continue to decline.

FIGURE 4-24 - Camanche Reservoir MTBE Monitoring



Trends in Water Quality. To understand if potential trends or relationships between watershed conditions and water quality can be extracted from current water quality monitoring programs, monthly precipitation and turbidity are plotted in Figure 4-25. As shown in this figure, a correlation is suggested between rainfall events and elevated turbidity for the Camanche Reservoir. However, the treated water turbidities at Camanche South Shore WTP indicate that relatively consistent turbidity is produced whether or not there is a raw water turbidity spike caused by a rainfall event.

FIGURE 4-25 - Precipitation, Raw Water Turbidity, and Camanche South Shore Treated Water Turbidity



In addition to turbidity, the total coliform, fecal coliform, and E. coli data discussed previously suggest a direct correlation between maximum raw water microbiological counts and highest annual recreational use of Camanche Reservoir. Also, monitoring of MTBE has enabled the District to identify a direct correlation between elevated concentrations and increased motorboat and personal watercraft activities. This resulted in the District developing a proactive watershed management approach, which helped mitigate raw water MTBE concentrations. These microbiological and MTBE trends emphasize the importance of understanding the relationships between watershed activities and water quality whenever possible. In turn, watershed management practices can be modified if deemed necessary.

Comparison of Raw/Treated Water to Standards. WTP monthly water quality and annual inspection reports prepared for DHS were used to evaluate the treated or finished water for the two Camanche WTPs.

Raw water in the Camanche Reservoir generally met treated water quality standards, with the exception of four parameters: aluminum, iron, manganese, and turbidity. For aluminum, the median raw water concentration was below the primary MCL but above the secondary MCL. The maximum aluminum concentration was above both the primary and secondary MCLs. For both iron and manganese, the median raw water concentrations were below their respective secondary MCL but the maximum concentrations were well above their respective secondary MCL. These results suggest occasional but infrequent elevated levels occur. None of these parameters occur at concentrations above the primary and secondary standards once treated.

Turbidity is removed through the treatment process train at the Camanche South Shore WTP. The monthly and annual water quality reports prepared for DHS indicate Camanche South Shore WTP effectively treats Camanche Reservoir water, meeting all drinking water standards -- both primary and secondary. In addition, Camanche North Shore WTP that treats ground water also meets all drinking water standards -- both primary and secondary.

Evaluation of EBMUD Compliance with the SWTR and IESWTR

This section is intended to be an update of the evaluation contained in the 1995 MRWSS. At the time the 1995 MRWSS was prepared, EPA had targeted microbial contaminants in the SWTR. In Chapter 17 of Title 22 of the California Code of Regulations, DHS further interpreted the federal rule, and established specific requirements for removal or inactivation of viruses, *Giardia lamblia,* heterotrophic plate count (HPC) bacteria, *Legionellae,* and turbidity. With the recent promulgation of the IESWTR, inactivation requirements have been defined for *Cryptosporidium* and further removals for turbidity. The District must be able to meet these new treatment requirements by mid-2001.

Regulatory Requirements

A multibarrier treatment must be provided for approved surface waters and reliably achieve the following regulatory requirements:

SWTR

- A total of 99.9 percent (three log) reduction of *Giardia* cysts through filtration and disinfection,
- A total of 99.99 percent (four log) reduction of viruses through filtration and disinfection
- The turbidity of a system's combined filtered waters at a WTP must be less than or equal to 0.5 NTU, 95 percent of the time each month, and
- The turbidity of a system's combined filtered waters at a WTP must at no time exceed 1 NTU.

IESWTR

- A total of 99 percent (two log) reduction of *Cryptosporidium* through filtration,
- The turbidity of a system's combined filtered waters at a WTP must be less than or equal to 0.3 NTU, 95 percent of the time each month, and
- The turbidity of a system's combined filtered waters at a WTP must at no time exceed 1 NTU.

The performance standards, monitoring requirements, and operating criteria detailed in Chapter 17 of Title 22 of the California Code of Regulations are summarized in Table 4-13 and remain relatively unchanged since the 1995 MRWSS.

Table 4-13: SWTR Compliance Summary - Performance, Monitoring, and Operations

Performance Standards

- The turbidity of filtered water shall be less than or equal to 0.5 NTU in 95 percent of the samples analyzed each month.
- Turbidity of filtered water shall not exceed 5.0 NTU at any time.
- For grab sampling, turbidity levels of the filtered water shall not exceed 1.0 NTU in more than two consecutive samples while the plant is in operation.
- For continuous sampling, turbidity levels of the filtered water shall not exceed 1.0 NTU for more than eight consecutive hours while the plant is in operation.
- Water delivered to the distribution system shall not contain a disinfectant residual of less than 0.2 mg/L for more than four hours in any 24-hour period.
- The residual disinfectant concentrations of samples collected from the distribution system shall be detectable in at least 95 percent of the samples taken each month.
- At any point in the distribution system, the presence of HPC bacteria at less than or equal to 500 cfu/ml shall be considered equivalent to a detectable disinfectant residual.

Monitoring Requirements

- Raw waters of approved surface water sources shall be monitored for daily turbidity grab samples.
- The combined filter effluent shall be monitored for turbidity levels at least once every four hours that the system is in operation to determine compliance with performance standards.
- Continuous turbidity measurements may be substituted for grab sampling, provided the accuracy of the measurements is verified on a weekly basis.
- A monitoring program shall be developed and conducted to measure the parameters affecting the performance of the disinfection process:

  1) temperature of the disinfected water
  2) pH of the disinfected water if chlorine is used as a disinfectant
  3) disinfectant contact time
  4) residual disinfectant concentration before or at the first customer.

Monitoring program shall be in the operations plan.

- Disinfectant residual concentration of the water being delivered to the distribution system shall be monitored and recorded continuously.
- The residual disinfectant concentration must be measured at least at the same points in the distribution system and at the same time the total coliforms are sampled.

Operation

- Treatment plant operators shall be certified in accordance with applicable Health and Safety Codes.
- Conventional and direct filtration plants shall be operated at flow rates not to exceed:

  1) 3.0 gpm/sq. ft. for single media filters, and
  2) 6.0 gpm/sq. ft. for deep bed, dual, or mixed media filters under gravity flow conditions.

- Filtration rates shall be increased gradually when placing filters back into service following any interruption in operation of the filter.
- When an individual filter is placed back in service, the filtered water turbidity of the effluent shall not exceed:

  1) 2.0 NTU
  2) 1.0 NTU in at least 90 percent of the interruption events during any consecutive 12-month period.
  3) 0.5 NTU after the filter has been in operation for 4 hours.

- Coagulation and flocculation unit processes shall be in use at all times during which conventional and direct filtration plants are in operation.
- The effectiveness of coagulation and flocculation unit processes shall be demonstrated by at least an 80 percent reduction through the filters of the monthly average raw water turbidity.
- The filtered water turbidity shall be monitored with a continuous turbidity meter and recorder, or with an approved grab sampling program.
- If a filter unit is not meeting the operating criteria, the filter shall be taken out of service, deficiencies corrected, and its operations tested to demonstrate that it is meeting the criteria.
- Disinfection facilities shall maintain a reserve supply of chemical necessary to provide continuous operation of disinfection facilities.
- Disinfection facilities shall develop an emergency plant for implementation in the event of a disinfection failure. Delivery of undisinfected or inadequately disinfected water to the distribution system shall be prevented.
- Operations plan shall include:

  1) performance monitoring program
  2) unit process equipment maintenance program
  3) operating personnel, including number of staff, certification level, and responsibilities
  4) how and when each unit process is operated
  5) laboratory procedures
  6) procedures used to determine chemical dose rates
  7) records
  8) response to plant and watershed emergencies
  9) reliability features.

Records

- Operations records shall include:

  1) all monitoring results.
  2) dates on which filter maintenance and inspection were performed and the results of any inspections.
  3) quantity of water produced, plant flow rates, filtration rates, hours of operation, and backwash rates.
  4) dates and descriptions of major equipment and process failures, and corrective actions taken.

- Treatment plant records shall be retained for not less than two years.

Source: California Code of Regulations, Title 22, Chapter 17.

EBMUD Compliance with SWTR and IESWTR

Water quality monitoring and operation of the water treatment processes at each of the District's water treatment plants is conducted in accordance with the respective Water Supply Permits. The District's *SWTR Operations Plan 2000* contains the current operational criteria for compliance with the SWTR for the Walnut Creek, Lafayette, and Orinda Water Treatment Plants. Operational criteria for the Pardee Center, Pardee Recreation Area, Camanche North Shore Recreation Area, and Camanche South Shore Recreation Area Water Treatment Plants are followed in accordance with the respective Water Supply Permits, in coordination with DHS.

In compliance with the SWTR requirements, EBMUD routinely submits a monthly water quality report to DHS for each of the District's Water Treatment Plants. This report typically contains the following, and is supplemented with other information as deemed necessary:

- Distribution System Bacteriological Test Results Report - percentage of distribution samples with detectable residuals.
- Monthly SWTR Summary of Monitoring - highlight of backwash data by exception.
- Organics/Inorganics Exception Report - exceedances of primary or secondary MCLs.

- Monthly Fluoride Report.
- Water Quality Complaints Summary.

Based on the results presented in these reports, the treated water from Walnut Creek, Lafayette, and Orinda Water Treatment Plants met the turbidity requirement (less than 0.2 NTU, 95 percent of the time) each month they were in operation. This requirement, defined by DHS for the District's water supply permit, is more stringent than the turbidity removal defined by the IESWTR. The District's water treatment plants surpassed the operating criteria of 80 percent turbidity removal of the monthly average raw water turbidity, and all operating criteria were met when filters were returned to service. In addition, the performance standard of maintaining a disinfection residual not less the 0.2 mg/L for more than four hours in any 24-hour period was achieved for all water treatment plants. Finally, based on a partial review of filtered water turbidities and the more stringent DHS removal requirement, it is expected that the District's Walnut Creek, Lafayette, and Orinda WTPs will easily meet the IESWTR turbidity requirement of less than 0.3 NTU, 95 percent of the time.

Water quality monitoring for Pardee Center, Pardee Recreation Area, Camanche North Shore Recreation Area, and Camanche South Shore Recreation Area WTPs is conducted in accordance with provisions of the individual Water Supply Permits, as directed by DHS. The results of the small water systems' monitoring programs indicate that each of the four WTPs met the filtered water turbidity requirement of the IESWTR -- less than 0.3 NTU, 95 percent of the time -- each month of operation. Similar to the large systems, the small WTPs filters surpassed the operating criteria of 80 percent turbidity removal of the monthly average raw water turbidity, and all operating criteria were met when filters were returned to service. Finally, the performance standard of maintaining a disinfection residual not less the 0.2 mg/L for more than four hours in any 24-hour period was achieved at each of the water treatment plant.

Conclusions

Pardee and Camanche Reservoirs exhibit excellent raw water quality characteristics. The raw waters met the primary treated water MCLs for all general physical (excluding turbidity), general mineral (excluding aluminum), inorganics, organics and radionuclide parameters. The raw water turbidity and total coliform levels were above the treated water MCLs that is expected. For Pardee Reservoir iron was detected at concentrations above the secondary standard. For Camanche Reservoir, both iron and manganese were detected in the raw water at concentrations above the corresponding secondary standards. Secondary standards are primarily concerned with taste or appearance of water rather than public health concerns.

There were no SOCs detected at concentrations above primary treated water MCLs in either of these two reservoirs. In Pardee and Camanche Reservoirs, the water quality monitoring data indicates that MTBE concentrations declined after the District initiated a program that required all District-owned and concessionaire-owned 2-stroke high emission engines be replaced with 4-stroke low emission engines. As further monitoring is conducted, a more stringent program may be warranted that defines engine restrictions for private launches at these reservoirs.

The District's Water Treatment Plants -- Pardee Center, Pardee Recreation Area, Camanche North Shore, Camanche South Shore, Walnut Creek, Lafayette, and Orinda WTPs -- are very effective and reliable at removing particulates and microorganisms. The monthly WTP reports, annual water quality reports, and annual inspection reports submitted to DHS indicate that the treated or finished waters from these WTPs met all treated water quality regulations. In addition, disinfection residual and microbiological data from the District's distribution systems (as stated in the monthly WTP reports) showed that the District had no problems meeting the detectable disinfectant residual criteria of the SWTR. It is expected that the District will be able to meet the recently promulgated *Cryptosporidium* inactivation requirements as defined in the IESWTR. With regards to the recently promulgated Stage 1 - D/DBP Rule, the source water TOC concentrations in both Pardee and Camanche Reservoirs (median TOC values of 1.4 mg/L and 2.3 mg/L, respectively) indicate that the District will not be required to pursue enhanced coagulation at any of the water treatment plants treating these source waters.

SECTION 5

SECTION 5
POTENTIAL CONTAMINANT SOURCES WITHIN WATERSHEDS

Introduction

This section documents the identification of potential contaminant sources – both human-induced sources and natural sources – that correspond to the Pardee and Camanche Watersheds. Information contained in the 1995 Mokelumne River Watershed Sanitary Survey (1995 MRWSS) and documents pertaining to the Camanche Watershed, PG&E facilities, Sierra Pacific Industries' *Watershed Assessment of the Upper Mokelumne River* report, and information gathered during field inspections formed the basis of this section.

Of particular interest, the Sierra Pacific watershed assessment included a susceptibility assessment of the planning watersheds owned by Sierra Pacific. Of the 44 CalWater planning watersheds in the Upper Mokelumne River Watershed, 26 are owned by Sierra Pacific. Water quality, water quantity, and the potential to affect stream channels were the key issues addressed in this synthesis. Erosion associated with timber harvesting, road crossings, and erodible soil types was the key factor considered when determining susceptibility. Thirteen of the 26 Sierra Pacific properties were found to have a high susceptibility and 13 properties had a low susceptibility to erosion. The location of specific activities within each planning watershed that affect the susceptibility were not identified. However, these rankings further highlight the importance of identifying potential contaminant sources so that effective watershed management practices can be focused. In addition, it highlights the importance of working with other stakeholders and jurisdictional agencies to develop integrated and effective watershed management programs.

To this end, a review of the various land uses and activities within the watersheds as potential contaminant sources and their corresponding threats to water quality are provided. An initial discussion regarding water quality parameters of concern is provided as a basis for understanding the impacts of the potential contaminant sources identified. The significance of the potential contaminant sources is discussed at the end of this section.

Water Treatment Plant Facilities and Operations

Water quality parameters of concern from a drinking water perspective are generally classified in the following five groups: general physical, microorganisms, radionuclides, inorganics and organics. Below is a summary of some of the parameters which are included in these five groups.

- General Physical - color, odor, taste, temperature, pH, turbidity, algae
- Microorganisms - coliform, Heterotrophic Plate Counts (HPC), viruses, *Giardia lamblia*, *Cryptosporidium parvum*
- Radionuclides - radon, uranium, tritium, strontium, radium, gross alpha, gross beta
- Inorganics - general mineral and metals
- Organics - Total Organic Carbon (TOC) (Disinfectant/ Disinfection By-Products precursors); SOCs (including Volatile Organic Chemicals (VOCs), pesticides, and herbicides); surfactants (MBAS); oil and grease, and other hydrocarbons (such as MTBE)

In total, over 100 water quality parameters are regulated for drinking water purposes. A summary of these existing and pending regulations and the District's compliance with these regulations is provided in Section 4.

Table 5-1 provides an overview of the relationships between the five parameter groups and three water quality concerns - aesthetics, public health, and treatment. The objective of this table is to provide a basic understanding of the issues or concerns associated with water quality parameters and, in turn, understanding the rationale for identifying and controlling potential contaminant sources.

Table 5-1: Water Quality Parameters and Corresponding Concerns

WATER QUALITY PARAMETERS	WATER QUALITY CONCERNS		
	Aesthetics	Public Health	Treatment
General Physical			
Turbidity	•	•	•
Algae/Taste and Odor	•		•
pH			•
Microorganisms		•	•
Radionuclides		•	•
Inorganics			
General Mineral	•	•	•
Metals	•	•	•
Organics			
Total Organic Carbon (TOC)	•	• (1)	•
SOCs; VOCs, Pesticides, Herbicides		•	•
Oil & Grease, Other Hydrocarbons (MTBE)	•	•	•

(1) Indirectly, only when combined with disinfectants.

General Physical

Turbidity and algae have been specifically identified as two important general physical parameters. Although turbidity (particulates) is not a specified public health concern, other water quality parameters that are public health concerns such as microorganisms, inorganics, and organics can adhere or adsorb onto the surfaces or into the pores of the particulates. Microorganisms, in particular, have been known to survive disinfection during treatment by essentially hiding within the pores of particulate matter. Therefore, the removal of turbidity through treatment can reduce other water quality concerns. While effective removal of turbidity is generally achieved through various combinations of water treatment processes, it is identified in Table 5-1 as a treatment concern because it is one of the easiest parameters to track for operational and regulatory purposes.

Algae are often a treatment concern because of its ability to clog treatment plant filters. The District's in-line water treatment plants can not remove the algae prior to filtration (no sedimentation in the in-line treatment process train). Certain types of algae can form a thick mat on top of the filter media thereby shortening filter runs. Water quality is not impacted; however, plant production is reduced if this occurs.

Microorganisms

Microorganisms include both bacteria (total coliform, HPCs) and pathogens (viruses, *Giardia*, *Cryptosporidium*), and pose both public health and treatment related concerns. Microorganisms, particularly *Giardia* and *Cryptosporidium*, are the water quality parameters of greatest concern from a watershed sanitary survey perspective.

There are a number of species of both *Giardia* and *Cryptosporidium, which* can be carried by mammals, reptiles, and birds. In general, the species carried by mammals - *Giardia lamblia* and *Cryptosporidium parvum* - have been shown to be infectious to humans while those carried by reptiles and birds have not. *Giardia lamblia* is a protozoan parasite that infects humans and causes giardiasis - a gastrointestinal disease. *Giardia* cysts are commonly

found in the feces of wild animals, although, both wild and domestic animals can serve as hosts. *Cryptosporidium parvum* is also a protozoan parasite that infects humans. The gastrointestinal disease induced by the organism is cryptosporidiosis. *Cryptosporidium* oocysts are often found in the feces of domestic and wild animals and are persistent in the environment. The terms *Giardia* and *Cryptosporidium* are used herein as abbreviations for *Giardia lamblia* and *Cryptosporidium parvum*.

Historically microorganisms such as total coliforms, HPCs, and viruses have been relatively easily controlled through treatment, particularly filtration and disinfection. The use of chlorine as a disinfectant has been very effective for microbiological control. However, microorganisms such as *Giardia* and *Cryptosporidium* are more difficult to eliminate with chlorine as the conventional disinfectant applied. Other disinfectants such as ozone may provide more viable treatment options. Also, the effective removal of these microorganisms through filtration places more emphasis on the need for effective coagulation, flocculation, proper filter media design and effective filter operations.

A further treatment challenge associated with the control of microorganisms through additional disinfection is the recognition that organics may pose public health concerns during disinfection in the forming of disinfection by-products (DBPs). Treatment operations must therefore be balanced to meet the competing regulatory requirements for limiting microorganisms and DBP formation control.

Radionuclides

Radionuclides are found in both surface and ground waters with the highest concentrations being found in ground waters. Radionuclides are the products of radioactive decay from subsurface rocks, which are either igneous or metamorphic in origin or from human activities such as medical and industrial uses. When in solution radionuclides are very volatile; radionuclides can be readily dispersed through aeration, both natural and mechanical turbulence, or easily adsorbed onto particulates. The most likely introduction of radionuclides into the District's water bodies would be through adsorption onto particulates which, in turn, are ultimately transported by runoff into the water bodies. In addition, radioactive rocks or soils that come in contact with water can impart radioactivity to the water.

Radionuclides pose both public health and treatment related concerns. From a public health perspective, all radionuclides are defined as known human carcinogens - cancer causing compounds. With regards to treatment, radionuclides can be removed through a number of processes depending upon whether they are in solution or adsorbed onto a particle. Radionuclides in solution can be readily treated through aeration or by adsorption onto granular activated carbon. If already adsorbed onto particulates in water, radionuclides can be removed through coagulation/sedimentation and filtration. Besides possibly requiring the addition of a new treatment process specifically designed to remove radionuclides in solution, the difficulty of disposing of a "radioactive" waste is very costly. Fortunately, radionuclides do not pose a water quality concern for the District.

Inorganics

Inorganics include a wide variety of parameters, which are classified as either general minerals or metals. General minerals include alkalinity, asbestos, sodium, chloride, nitrogen, phosphorus, and total dissolved solids. Metals include copper, lead, mercury, iron, manganese, arsenic, and aluminum.

Some of these parameters are regulated for aesthetic reasons and others for public health concerns. In general the aesthetic reasons are associated with T&O, water discoloration which can stain clothing and other materials, and deposits on piping and mechanical equipment which can result in operational problems. According to The National Research Council Publication, *Drinking Water and Health*, the public health concerns range from beneficial effects, no known effects, mild to acute toxicity, and suspected carcinogenicity, mutagenicity and teratogenicity. Mild to acute toxicity can result in gastrointestinal problems, inhalation-related disorders, and organ dysfunction or failure. As described above, carcinogens are defined as cancer causing compounds. Mutagens are compounds, which are capable of producing a heritable change in genetic material. Teratogens are compounds, which act during pregnancy to produce a physical or functional defect in developing offspring.

From a treatment-related perspective, inorganics can be readily removed through coagulation/sedimentation, lime softening and filtration. In some cases, depending upon the specific compound and corresponding concentration, processes such as using granular activated carbon reverse osmosis, or ion exchange may be required. Fortunately the current raw water qualities of the District's Mokelumne River source do not warrant the need for specialized treatment.

Organics

Organics, in general, are associated with aesthetic, public health and treatment related concerns. From a regulatory perspective, organics represent the largest group of water quality parameters currently regulated and slated for further regulatory development.

TOC is identified as an aesthetic concern because of its impact on T&O and color. Organic carbon imparts T&O as well as color depending upon the composition and age of the organic matter. As the organic carbon content of raw water increases and ages, both T&O and color tend to increase.

The public health concern associated with TOC is related to the potential by-products, which may form when organic carbon comes into contact with a disinfectant. Many DBPs are suspected carcinogens (cancer causing compounds). The treatment concern associated with TOC is related to the potential that a utility may or may not have to modify their treatment processes and/or operations to achieve acceptable DBP levels. The Stage 1 - D/DBP Rule specifies that, depending upon the annual average raw water concentration of TOC, a utility may have to achieve 15 to 50 percent TOC removal prior to the disinfection process. This requirement may potentially require water treatment process modifications for the District's water treatment plants.

The aesthetic concern associated with oil and grease and other hydrocarbons is T&O related. Oil and grease, as well as other hydrocarbons, can impart tastes and odors to water depending upon concentrations present. In addition, if oil and grease, or other hydrocarbon odors are masked by separate odors such as earthy/musty or marshy/ septic, then the hydrocarbon odors may not be detected until the final treatment steps. At this point the hydrocarbons are already through the treatment plant and it may not be possible to treat them. The masking of the hydrocarbon

odors can sometimes occur in surface water supplies, according to the American Water Works Association manual *Identification and Treatment of Tastes and Odors in Drinking Water* (1987). Thus, as with TOC, elevated concentrations of oil and grease can result in increases in T&O complaints.

Within the last five years, a fuel oxygenate -- methyl tertiary butyl ether (MTBE) -- has been detected in both Pardee and Camanche Reservoirs at levels which may impart objectionable T&O to sensitive individuals. Fortunately, the levels of MTBE detected in both reservoirs were significantly below the levels for health concern. From a public health perspective, the regulated organics (including MTBE) are identified as being or are suspected of being carcinogens, mutagens, or teratogens. Most organics, however, have yet to be classified as a known carcinogen, mutagen, or teratogen. They are currently only suspected and additional scientific information is necessary before they can be properly classified. Fortunately for the District, all raw water organic concentrations are either non-detected or have been detected at concentrations near the method detection limits, most of which are below the corresponding MCLs.

The treatment concerns associated with these organics pertain to the potential for requiring additional treatment processes. In general, soluble organics are removed either through airstrippers, granular activated carbon filters, or post-filter absorbers. Particulate organic matter or organic matter adsorbed onto particulates is removed through coagulation/sedimentation and filtration.

Table 5-2 provides an overview of the relationships between the typical water quality parameters discussed above and potential contaminant sources found in general watersheds.

Table 5-2: Typical Potential Contaminant Sources and Water Quality Parameters Relationship in General Watersheds

POTENTIAL CONTAMINANT SOURCES: LAND USES & ACTIVITIES	GENERAL PHYSICAL		MICRO-ORGANISMS	RADIO-NUCLIDES	INORGANICS		ORGANICS		
	Turbidity	Algae/ T&O			General Mineral	Metals	TOC	Pesticides & Herbicides	SOCs, VOCS Oil & Grease, Other Hydrocarbons
Sanitation Facilities		•	•			•	•	•	•
Urban Area Runoff	•	•	•		•	•	•	•	•
Rural Area Runoff	•	•	•		•	•	•	•	•
Utilities	•	•		•	•	•	•	•	•
Transportation Corridors	•	•			•	•	•	•	•
Agriculture	•	•			•		•	•	
Wildlife and Livestock	•	•	•				•		
Recreation/Public Access	•	•	•		•	•	•	•	•
Mines and Quarries	•			•	•	•			•
Geologic Hazards	•	•		•	•	•	•		
Fires & Fire Management	•	•			•		•	•	
Logging	•	•			•		•	•	

Upper Mokelumne River Watershed

Almost all land uses and activities have the potential for impacting surface water supplies depending upon the corresponding circumstances - such as proximity to the waterbody, water quality parameter concentration, watershed characteristics (slope, length of slope, soil type and depth, vegetation type and abundance, etc.), and transport mechanism. As Table 5-2 summarizes, these land uses and activities in turn become the potential water quality contaminant sources.

This section documents the land uses and activities within the Upper Mokelumne River Watershed Area as potential contaminant sources. Table 5-3 summarizes the potential contaminant sources (land uses and activities) and corresponding water quality concerns specific to the Upper Mokelumne River Watershed. The list of potential contaminant sources that are included in these tables and have the greatest potential for impacting water quality include:

- EBMUD Facilities
- Water Resources Development
- Sanitation Facilities
- Urban Area Runoff
- Rural Area Runoff
- Utilities - Hydroelectric Power
- Transportation Corridors
- Agriculture
- Wildlife and Livestock
- Recreation/Public Access
- Mines
- Geologic Hazards
- Fires and Fire Management
- Logging
- Unauthorized Activities

Recreation as shown in Table 5-3 pertains to those recreational activities occurring on EBMUD, National Forest, and private lands. In general, the potential water quality concerns associated with the various combinations of recreational activities may be similar regardless of land ownership; however, the degree of concern will vary depending upon the concentration of facilities, types of activities, management practices implemented, and proximity to waterbodies.

Table 5-3: Upper Mokelumne River Watershed –Potential Contaminant Sources and Water Quality Parameters Relationship

POTENTIAL CONTAMINANT SOURCES: LAND USES & ACTIVITIES	GENERAL PHYSICAL		MICRO-ORGANISMS	RADIO-NUCLIDES	INORGANICS		ORGANICS		
	Turbidity	Algae/ T&O (Temp)			General Mineral	Metals	TOC	Pesticides & Herbicides	SOCs, VOCs, Oil & Grease, Other Hydrocarbons
Sanitation Facilities		•	•			•	•	•	•
Urban Area Runoff - Residential/Commercial	•	•	•		•	•	•	•	•
Rural Area Runoff - Residential	•	•	•		•	•	•	•	•
Utilities - Hydroelectric Power	•	•			•		•	•	•
EBMUD Facilities (Except Recreation)	•	•	•		•	•	•		•
Transportation Corridors	•	•			•	•	•	•	•
Agriculture	•	•			•		•	•	
Wildlife and Livestock	•	•	•		•		•		
Recreation/Public Access	•	•	•		•	•	•		•
Mines	•			•	•	•			•
Geologic Hazards	•	•		•	•	•	•		
Fires & Fire Management	•	•			•		•	•	
Logging	•	•			•		•	•	•
Unauthorized Activities	•	•	•		•	•	•	•	•

EBMUD Facilities

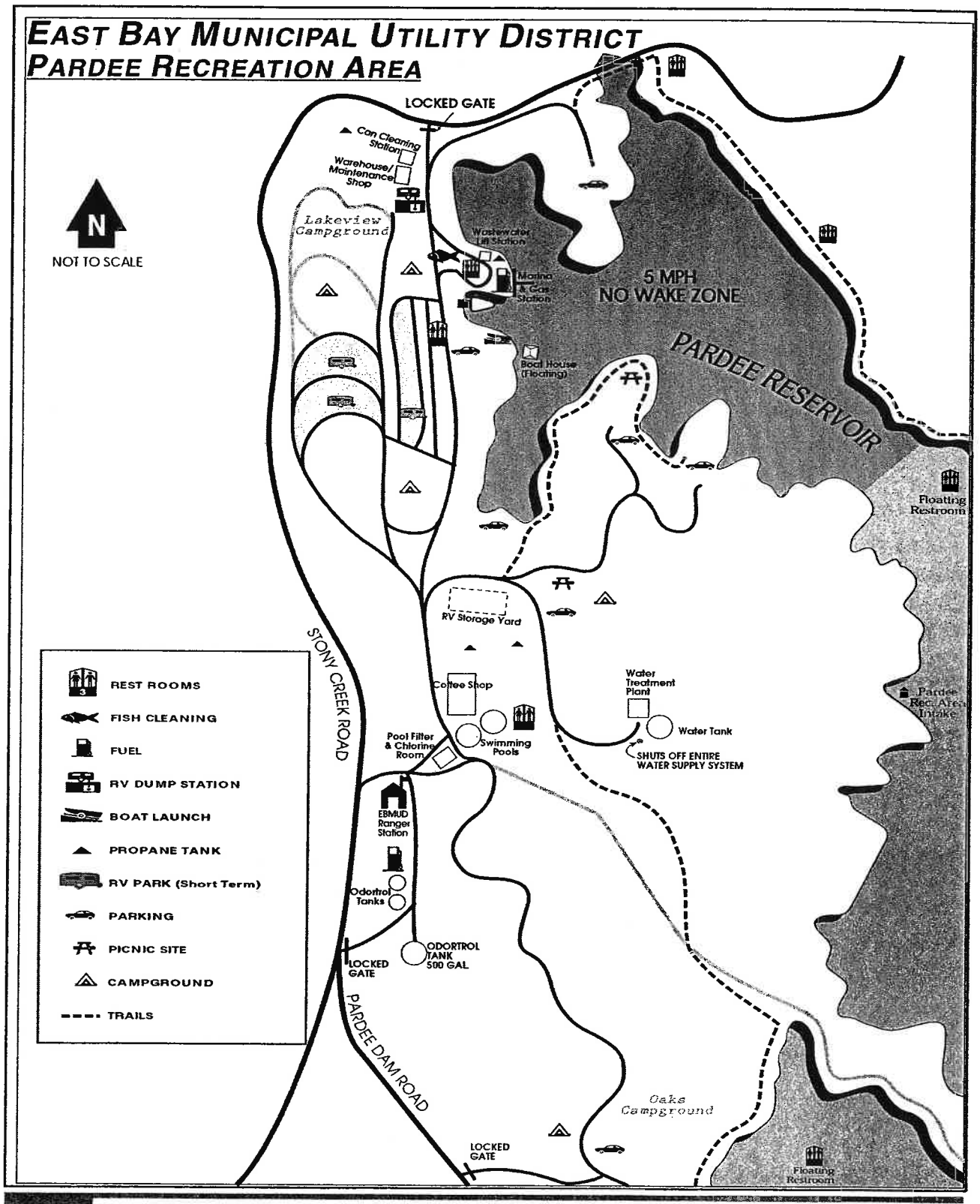
District facilities within the Upper Mokelumne River Watershed include the Pardee Reservoir (Pardee Dam and outlet tower), Pardee Recreation Area, and the District's Administration facilities located at Pardee Center (see Figure 2-3). Each of these facilities is discussed below with respect to potential contaminant sources.

Pardee Reservoir. Recreation at Pardee Reservoir is strictly controlled by the District in accordance with the provisions of the District's Water Supply Permits and the licensing requirements from the Federal Energy Regulatory Commission (FERC). Although boating is allowed at the reservoir, body contact with the water is not allowed. It is estimated that approximately 75,000 recreation visitor days per year occur at Pardee Reservoir, with the only body contact being accidental or incidental, deliberate non-compliance. The reservoir is patrolled regularly to limit incidents of non-compliance.

A public health issue of potential concern is the provision of adequate sanitation facilities for boaters utilizing Pardee Reservoir. The District has addressed the problem by maintaining a combination of floating and shoreline toilets to meet visitor use demands. The District pumps out the toilets regularly and disposes the effluent to its Pardee Recreation wastewater treatment facility. The facilities are maintained and inspected on a regular basis, and the District submits an annual summary inspection report for each facility to the State Department of Health Services (DHS).

Pardee Recreation Area. The Pardee Recreation Area is located in a rural area on the north shore of Pardee Reservoir at 4900 Stony Creek Road in Ione, Amador County (Figure 5-1). The main roads into the area are Stoney Creek Road and Pardee Dam Road. There are no major businesses, care facilities, highways, hospitals, or schools in the immediate area. Predominantly undeveloped watershed and agricultural land surround the facility.

FIGURE 5-1 - Pardee Recreation Area



The Pardee Recreation Area encompasses approximately 245 acres. A portion of the parcel is developed and includes a marina with fueling and boat cleaning facilities, paved boat launch, a fish cleaning station, a coffee shop, public restrooms, day-use picnic sites, campgrounds, short-term and seasonal recreational vehicle areas with full hook-ups, laundry facilities, two swimming pools, a water treatment plant, a wastewater treatment plant, a warehouse/maintenance shop, and several large parking areas. Table 5-4 summarizes the facilities at the Pardee Recreation Area. The remaining acreage is undeveloped watershed. Except for the water treatment plant, which is maintained and operated by the District, the facilities are maintained and operated by the concessionaire, Lake Pardee Marina, Inc.

Table 5-4: Pardee Reservoir Recreation Facilities

FACILITY	PARDEE RECREATION AREA Existing Size/Quantity
Tent Campsites	94
RV Campsites (short term)	12
RV Campsites (seasonal)	87
Picnic Tables	118
Roads (paved)	3 mi
Roads (unpaved)	1.5 mi
Hiking Trails	1.75 mi
Total Day Use Parking Spaces	314
Vehicle w/ Boat/Trailer or RV Parking Stalls	137
Drinking Fountains	37
Hydrants	18
Swimming Pools	2
Fish Cleaning Facilities	1
Above Ground Fuel Tanks	3
RV Dump Stations	2
Restrooms (portable)	45
TOTAL BUILDINGS	**12**
Restroom/Shower Buildings	**4**
Toilets	11
Urinals	4
Sinks	14
Heads	10
Laundry (Locations)	**1**
Dryers	2
Washers	2
Marina	**1**
Slips	70
Park Headquarters	1
Entrance Kiosk	1
Pool Building	1
Coffee Shop	1
Pump House	1
Sanitary Can Cleaning Station	1
Maintenance Shop	1
EBMUD Boat House	1
RV/Boat Storage Area	101 spaces
Boat Launch Ramps	**2 Locations**
Main - Elevation (540-572)	10 lanes
Low Water - Elevation (495-535)	2 lanes
Public Telephones	**3**

Recreation. Recreation is restricted to camping, fishing and boating. No body contact activities are allowed. In 1999, the Pardee Recreation Area served an average of 249 visitors per day. In 1999, an average of 27 boats per day was observed with a peak daily usage of 110 boats (May 1, 1999).Table 5-5 summarizes the record of visitor use at Pardee Recreation Area for the period 1995-1999.

Table 5-5: Visitor Use of Pardee Recreation Area (1995-1999)

Month	1995	1996	1997	1998	1999
January	10,648	9,696	8,090	8,171	9,108
February	17,669	14,102	13,126	8,376	10,162
March	15,074	17,072	19,203	11,412	12,604
April	23,078	20,940	17,274	17,144	18,623
May	22,664	17,927	24,293	16,416	20,089
June	24,527	26,242	22,444	22,228	22,391
July	28,485	26,239	24,752	28,675	29,341
August	31,044	29,504	26,817	24,386	27,373
September	18,904	13,044	12,353	12,050	14,173
October	11,431	9,092	9,221	9,513	11,691
November	13,190	10,104	9,358	8,753	9,757
December	9,623	6,964	7,337	7,501	8,462
Total	226,337	200,926	194,268	174,625	193,774

Water Supply. Pardee Reservoir serves as the source of supply for the Pardee Recreation Area water system. As discussed in Section 2, the WTP intake is suspended approximately 40 feet below the surface of the reservoir about 2,000 feet south of the marina. The water used in the treatment plant is fed through a 6-inch pipeline by two 100 GPM pumps on a floating platform. The intake depth is adjustable from the floating platform. A buoy line has been installed around the intake to restrict recreation in proximity to the intake.

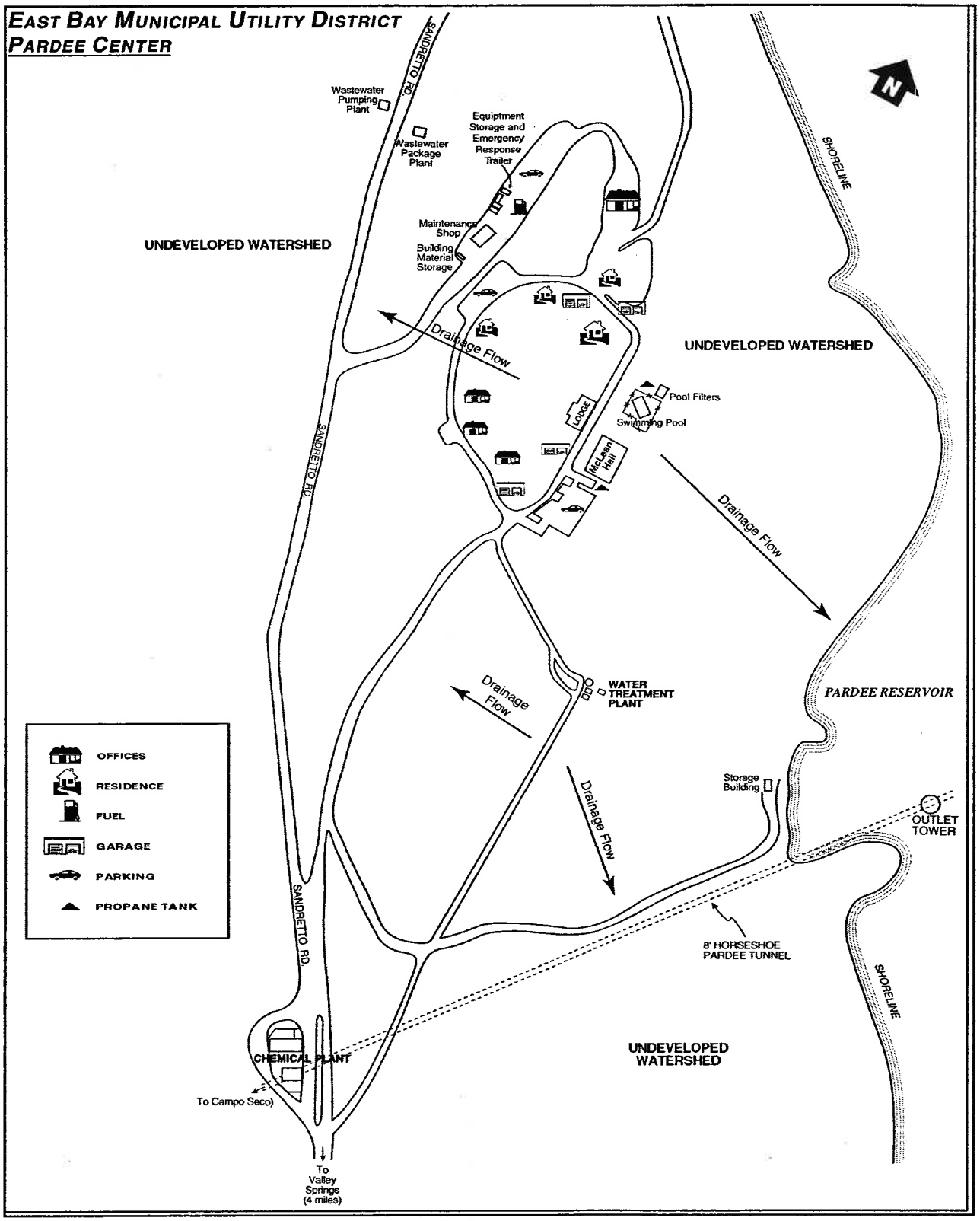
The water treatment plant for the Pardee Reservoir Recreation Area employs membrane filtration and uses sodium hypochlorite for disinfection. The hypochlorite is stored in 7-gallon containers with spill containment. Any spills are contained locally in the water treatment plant building.

Sanitation Facilities. Operation of the District's Pardee Recreation Area wastewater treatment plant is conducted under permit with the Regional Water Quality Control Board (RWQCB). The wastewater treatment plant has two ponds that are currently operated to dispose of the effluent by evaporation and percolation. Construction is scheduled to be completed in the spring of 2001 to stop percolation and to allow spray irrigation above the pond drainage area. Any pond overflow would drain to another watershed, Carson Creek, which supplies Lake Amador. However, recent improvements have been constructed at the wastewater ponds to prevent future overflows to Carson Creek. Table D-1 provides an overview of the monitoring program for the Pardee Recreation Area wastewater ponds.

In August 1997, three underground storage tanks were removed from above the marina store at Pardee Recreation Area. A grab groundwater sample from the excavation indicated that groundwater was impacted by hydrocarbon constituents. In November 1999, a soil boring was drilled to a depth of 50 feet and a groundwater sample was taken which indicates that hydrocarbon contamination is present. A groundwater monitoring well was installed on site in August 2000 and routine quarterly sampling will be conducted for four quarters, and the remaining volume of product in place will be calculated pending the groundwater monitoring results. Amador County and the RWQCB have approved all removal and monitoring work.

Pardee Center. Pardee Center is located in a rural area on the west shore of Pardee Reservoir, primarily in Calaveras County (Figure 5-2). The main roads into the area are Pardee Dam Road and Sandretto Road. There are no major businesses, care facilities, highways, hospitals, or schools in the immediate area. Undeveloped watershed and agricultural land surround the facility. Pardee Center is a District facility consisting of administrative offices, a chemical plant, equipment storage areas, a fuel dispensing station, maintenance shops, a swimming pool, two residences, a water treatment plant, a wastewater treatment plant, and two small parking areas.

FIGURE 5-2 - Pardee Center



Water Supply. Pardee Reservoir serves as the source of supply for the Pardee Center water treatment system. The water treatment plant intake is located about 75 feet north of the Pardee outlet tower. The water is conveyed through two 18 gpm submersible pumps to the water treatment plant. Two other submersible pumps with 270 and 190 gpm capacities provide water to the irrigation or fire emergency system and also serve as a backup system for the water treatment plant. The intake depth is adjustable from the floating platform but is currently fixed at 40 feet of depth. A buoy line has been installed around the intake location to restrict recreation in proximity to the intake.

The water treatment plant for the Pardee Center employs membrane filtration and uses sodium hypochlorite. Sodium hypochlorite is stored diluted to a one- percent solution in a 7.5-gallon container. Soda ash is used for corrosion control and is mixed in a 12-gallon container. Any spills are contained locally in the treatment building.

Sanitation Facilities. The Pardee Center wastewater treatment plant is operated under permit with the RWQCB. It consists of gravity sewers that drain to an extended aeration package plant with a 3,000-gallon per day capacity. Effluent from the wastewater plant is conveyed to a holding/settling tank with a capacity of about 1,500 to 2,000 gallons for additional treatment. The effluent from the tank is routed to a 2,500 gallon holding tank before spray irrigation or disposal to an evaporation pond. Any drainage from overflows (none have occurred in the past) would flow to the Pardee Spillway, which drains to Camanche Reservoir. Table D-2 summarizes the waste discharge requirements for the Pardee Center wastewater treatment plant.

Three underground storage tanks were removed from the Pardee Center site in 1989. No soil contamination was detected and; therefore, no further action was required.

Potential Recreation Use at Middle Bar. In response to public request, District officials have met with the State Lands Commission and State Attorney General officials to discuss recreational use in the Middle Bar area of the Mokelumne River. To date, recreation has not been approved for this area. However, discussions are pending. Given that effective watershed management can be achieved through sound watershed controls, providing specific but limited recreational access in the Middle Bar area is a likely future occurrence.

Water Resources Development

Ongoing water resources development along the Mokelumne River has been primarily confined to the North Fork and Mainstem sub-watersheds since the major flows occur along these stretches of the Mokelumne River. The existing PG&E power generation network consists of a complex system of hydroelectric facilities, tunnels, reservoirs, forebays, and afterbays which are described in Section 2. With the recent restructuring and deregulation of the electrical power industry in California, PG&E initiated an auction of all its hydropower facilities in California. PG&E's Project 137 encompasses all the PG&E facilities in the Upper Mokelumne River Watershed mainly along the North Fork and Mainstem of the Upper Mokelumne River. These facilities and the associated potential contaminant sources are discussed in the section entitled *Utilities - Hydroelectric Power.*

Future water development in the watershed warrants concern by the District and other water purveyors because it may decrease the yield of the watershed, either as a result of direct export, or because of increased evaporative and seepage losses from reservoirs and flumes. This can exacerbate water quality problems because of the reduced volume of water available for dilution. Modified water temperatures can directly affect aquatic life and can increase the potential for eutrophication in downstream reservoirs and canals, causing algal blooms and related water quality problems. Temporarily, adverse water quality impacts such as increased turbidity can be anticipated due to construction if they are not fully ameliorated by mitigation measures.

Two water resources projects are described below. These are the Lower Bear River Reservoir Enlargement Project (North Fork) and the Middle Bar Project (Mainstem). The Lower Bear River Reservoir Enlargement Project is part of PG&E's Project 137. No new water resources projects are currently targeted along either the Middle Fork or South Fork of the Mokelumne River, although other projects have been considered in the past.

Lower Bear River Reservoir Enlargement Project. PG&E filed an application with FERC to enlarge the Lower Bear River Reservoir from 52,000 acre-feet to 78,000-acre feet in order to increase the operational flexibility of PG&E's hydroelectric facilities (the Mokelumne River Project - Project 137), and potentially to develop an additional water supply for use within Amador County. As shown in Figure 5-3, the reservoir is located on the Bear River, a tributary of the North Fork of the Mokelumne River above Pardee Reservoir, just to the north of Salt Springs Reservoir. The FERC application was filed in 1981; but no approval action was taken and PG&E have subsequently dropped the project. However, the County is interested in taking over the project and discussions have been held between the Amador County Water Agency and the Board of Supervisors.

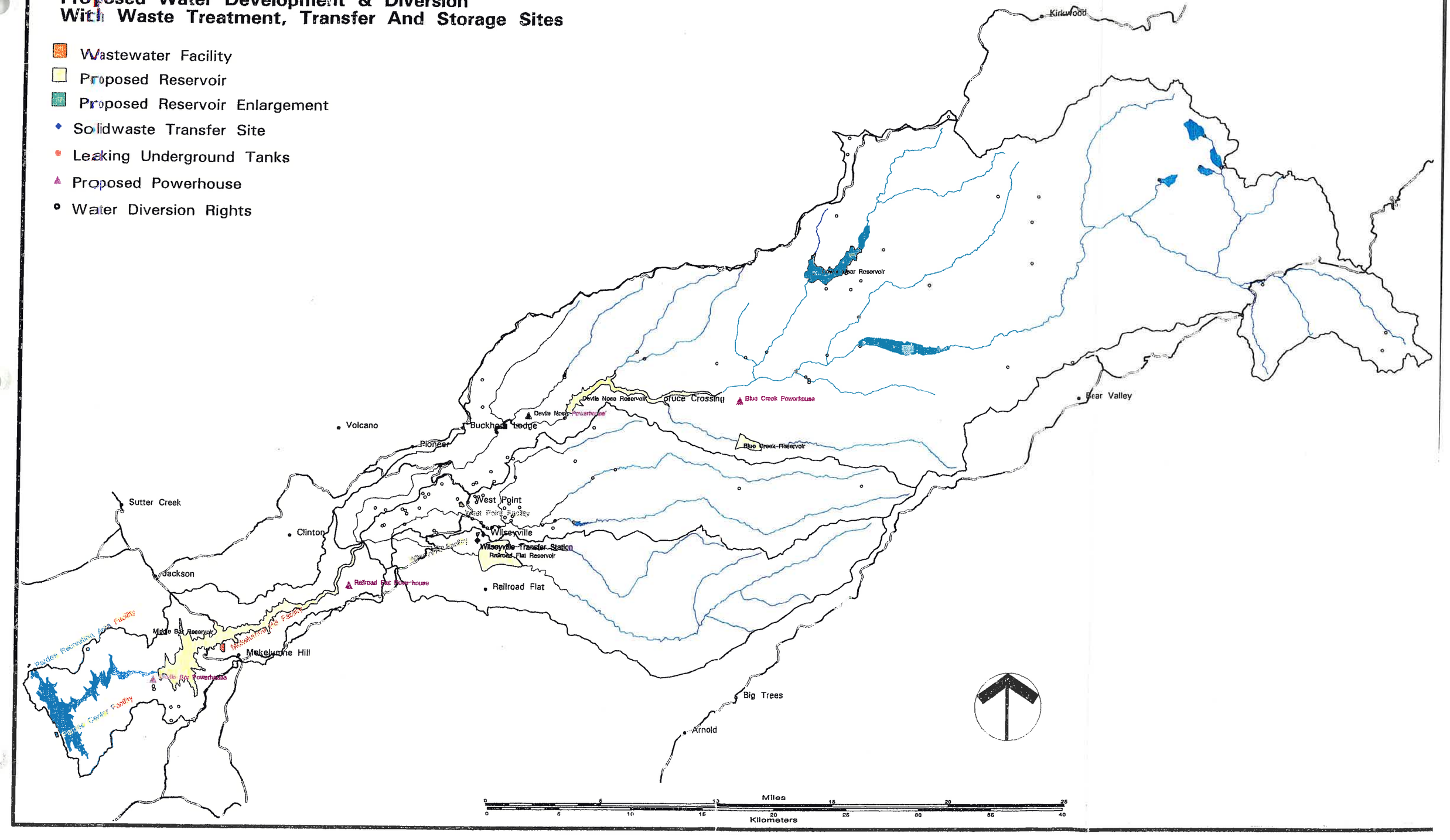
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Upper Mokelumne Watershed

FIGURE 5-3

Proposed Water Development & Diversion With Waste Treatment, Transfer And Storage Sites

- Wastewater Facility
- Proposed Reservoir
- Proposed Reservoir Enlargement
- Solidwaste Transfer Site
- Leaking Underground Tanks
- Proposed Powerhouse
- Water Diversion Rights



The Lodi Decree is a collection of court judgments (1938-1940) which define the relative rights of the District, the City of Lodi, and PG&E to domestic water from PG&E's Mokelumne River facilities. Under the Lodi Decree, PG&E is bound by a set of operating rules governed by storage and precipitation. The District is required to supply the City of Lodi with up to 3,600 ac-ft/yr if the groundwater level falls below sea level in Lodi for two consecutive Januarys.

Middle Bar Project. The Middle Bar project is a proposed 40,000 acre-foot capacity reservoir located on the Mokelumne River adjacent to, and constructed in the river arm of, Pardee Reservoir. The Mokelumne River Water and Power Authority has filed water rights applications and an application for a preliminary FERC Permit for the project, which is in the early planning stages.

The Middle Bar dam and reservoir site is located three miles west of Mokelumne Hill, near the upstream end of Pardee Reservoir. Figure 5-1 shows the proposed project location. The project would include a 190-foot-high dam and a 31-megawatt capacity powerhouse.

Sanitation Facilities

The sanitation facilities in the Upper Mokelumne River Watershed include septic systems and sanitary sewers. Sanitation facilities collect, treat, and dispose of human waste. Failure of these systems may result in the introduction of disease-causing microorganisms to the raw water supplies, as well as, increase the nutrient loading, particularly nitrogen, to the reservoir. Sewered areas typically are not considered a contaminant source, and present little risk to public water supplies. In the event of a system failure (leak, pump station failure, or pipe break) near a waterbody, however, such releases of raw sewage can be considered a significant contaminant source. Elevated nutrients may trigger or intensify an algal bloom, which in turn may compound the difficulties of treatment. In households with septic systems, improper disposal of household chemicals including substances containing metals, pesticides or herbicides can lead to contamination from the leach fields.

Chemical toilets are provided and serviced by EBMUD, PG&E, and the U.S. Forest Service in conjunction with trails and recreational uses. There are three ways in which chemical toilets may result in degradation of source water: leaking units; damage from vandalism; and sanitation truck mishaps along transportation corridors. The likelihood of spills from any of the preceding scenarios has been minimized through best management practices.

Wastewater Collection Systems. Wastewater collection systems constitute potential sources of contamination by microbiological constituents. The systems may be vulnerable to spillage in the event of pipe failures, accidental breaches due to adjacent construction activities, or overflows induced by wet weather infiltration. Figure 5-3 shows the locations of existing and proposed wastewater treatment facilities and their associated collection systems in the Upper Mokelumne River Watershed. While there are no existing wastewater collection systems in the North Fork sub-watershed, one is proposed for the Buckhorn area. As depicted in Figure 5-3, two wastewater collection and treatment systems are located in the Middle Fork sub-watershed -- West Point and Wilseyville -- shown in detail in Appendix D, Figures D-1 and D-2, respectively. In the South Fork sub-watershed there are no community wastewater collection and treatment systems. Instead, all residences are serviced by septic tanks. Two of the three wastewater collection and treatment systems located in the Mainstem sub-watershed are owned and operated by the District. One system is at Pardee Center and the second system is at Pardee Recreation Area -- shown in detail in Appendix D, Figures D-3 and D-4, respectively. The third collection and treatment system in the Mainstem sub-watershed corresponds to the community of Mokelumne Hill, shown in Appendix D, Figure D-5.

Sewage Overflows. Sewage overflows can result from excessive flows beyond the capacity of the collection system, and breaks or ruptures in the collection systems. As noted in the 1995 MRWSS document, there is record of one overflow incident from the collection system of the Mokelumne Hill facility. Although it lasted several weeks, it was confined to a small area and contained.

Stormwater Drainage Overflows. There are no areas from which significant quantities of urban runoff directly enter the Mokelumne River system. The Counties of Alpine, Amador, and Calaveras have each stated that there are no engineered municipal stormwater collection systems within the upper Mokelumne River watershed. Communities and developing areas in the watershed utilize ditches and intermittent natural stream channels as conveyance courses for their minor quantities of stormwater drainage.

Wastewater Treatment Plant Disposal. There are five small community wastewater systems in the Upper Mokelumne River Watershed that discharge to land; they are described by sub-watershed in Table 5-6. Treatment plant effluent restrictions for each wastewater treatment facility also are listed in the table.

No direct discharges occur to any surface waters of the watershed. The West Point, Wilseyville, Mokelumne Hill, and Pardee Center facilities each utilize spray disposal fields on land in order to prevent treated effluents from reaching surface water bodies. The Pardee Recreation Area facility relies on evaporation, percolation, and spray disposal of any excess effluent from its oxidation ponds. The excess effluent from the recreation area is spray irrigated onto lands outside the watershed, from which any surface runoff drains into the Lake Amador watershed (Carson Creek).

Table 5-6. Upper Mokelumne River Watershed Non-Discharging Small Community Wastewater Systems

Sub-Watershed	Service Area	Location (USGS, MDB&M)	Operating Agency	Type of Development	Wastewater Facilities	Design Capacity (gpd)	Avg. Flow (gpd)
Middle Fork	West Point	SEC 10, T6N, R13N	Calaveras County Water District	120-acre community (about 170 connections)[1]	Forced storage septic tanks with effluent sprayed on site	58,000	23,000
EFFLUENT RESTRICTIONS: Monthly Mean - 40 mg/L BOD5, 0.2 mL/L/hr settleable solids, 23 MPN/100 ml total coliform. Daily Max: 0.5 mL/L/hr settleable solids, 230 MPN/100 ml total coliform							
South Fork	Wilseyville	SEC 14 T6N, R13E	Calaveras County Water District	27 homes and a general store	Aerated lagoon and 10-acre spray disposal field	9,000	6,000
	Mokelumne Hill	SEC 12, T6N, R12E	Mokelumne Hill Sanitary District	Community of Mokelumne Hill (about 300 connections)[1]	Two aerated lagoons, chlorination tank, storage pond, and spray disposal field	150,000	60,000
EFFLUENT RESTRICTIONS: Monthly Mean - 40 mg/L BOD5, 0.5 mL/L/hr settleable solids. Daily Max: 80 mg/L BOD5, 1.0 mL/L/hr settleable solids							
Mainstem	Pardee Center	SEC 35, T5N, R10E	EBMUD	Residential, office, shop and recreational facilities for EBMUD employees	Package plant with one-half-acre spray irrigation field outside watershed	3,000	3,000
EFFLUENT RESTRICTIONS: Monthly Mean - 40 mg/L BOD5, 40 mg/L suspended solids, 0.5 mL/L/hr settleable solids. Daily Max: 80 mg/L suspended solids, 80 mg/L BOD5, 1.0 mL/L/hr settleable solids							
	Pardee Reservoir Recreation Area	SEC 15, T5N, R10E	EBMUD	80 recreational vehicle units and a recreational center including restaurant	Oxidation pond system and spray irrigation field are outside watershed[2]	38,100	15,000

[1] The populations served can be estimated by assuming approximately 2.5 persons per connection.

[2] Surface water at treatment site drains to the Lake Amador watershed via Carson Creek.

Sources: Central Valley Regional Water Quality Control Board
Amador County, Calaveras County, Alpine County.

Upgrades to the Calaveras County Water District West Point wastewater treatment plant began in the spring of 1994 and were completed in 1997. A new treatment and disposal system for CCWD's West Point sewer customers was the focus of this construction effort. The leach field disposal site was abandoned. The sewage is pumped an additional two miles south to a new facility, where it is treated to a secondary quality, disinfected, and disposed of by on-site irrigation. Each of the wastewater disposal systems has a non-discharging system permit from the Central Valley Regional Water Quality Control Board. The RWQCB also has primary responsibility for monitoring, inspection, and enforcement proceedings for each of the five systems. Consistent monitoring is needed to avoid potential contamination of surface or surfacing waters by microbiological constituents of potential public health concern.

A new wastewater treatment facility is planned within the North Fork sub-watershed to treat wastewaters collected from the Buckhorn area. This facility will be located north of Tiger Creek Reservoir, approximately one-half mile from Route 88, and it will treat wastewaters collected from about ten different connections. The treatment process will utilize an aeration pond and underground leach field.

The risk of sewage overflows from wastewater treatment and disposal facilities is associated primarily with overuse of these existing land disposal sites. If the assimilative capacity of the land disposal site is exceeded, and there are no alternative backup sites available to utilize for at least temporary relief, wastewaters either flow overland or migrate through the ground water until they surface, or reach a groundwater body connected with a stream or drainage course. From here, wastewater constituents can enter the primary water supply source. Historically, this is believed to have happened in the Mokelumne River watershed, primarily from the Mokelumne Hill wastewater treatment plant; however, this was not confirmed by the RWQCB. The only evidence of incidents consisted of increased coliform bacteria counts at various locations in the river, adjacent to Wilson Gulch.

Factors that could have contributed to the overflows and consequent downstream contamination include: proximity to the river, proximity to Pardee Reservoir, steepness of the terrain between the points of disposal by spray irrigation and the river, excessive application of effluent beyond the ability of the soil to absorb it, overflow of holding ponds, failure of the pretreatment septic tanks, and/or failure of the oxidation ponds.

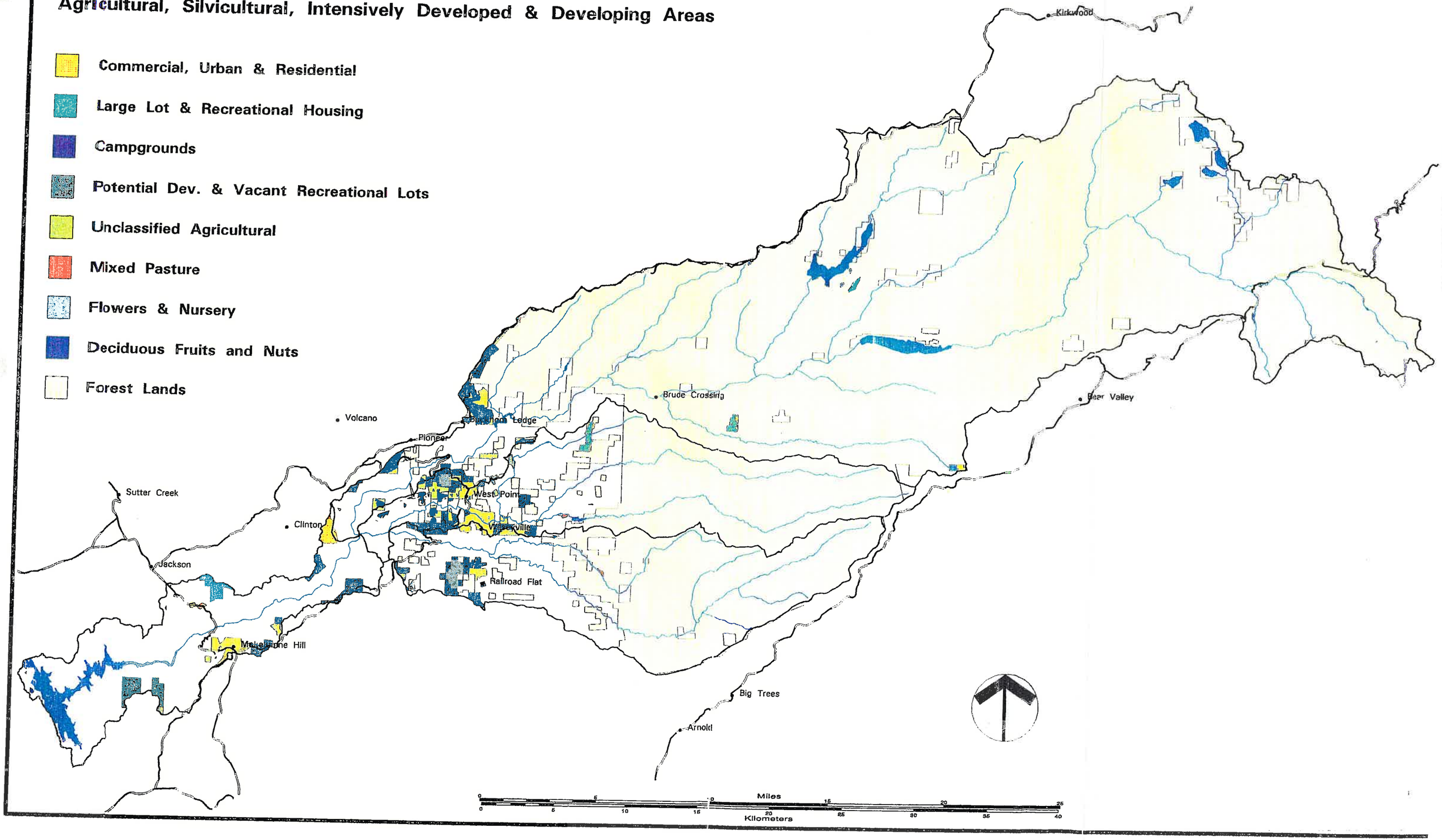
Septic Tank Drainage. Most of the developed area of the Mokelumne River watershed is unsewered and dependent upon individual sewage treatment systems. Figure 5-4 shows the significantly developed areas of the watershed as those with population densities greater than ten persons/acre (commercial, urban & residential, and recreational housing). Numbers of persons and numbers of households presently being served by septic tank systems were estimated using the Geographic Information System. Populations and households in the sewered communities were subtracted from the total sub-watershed estimates to produce the estimated totals of 5,376 persons in 3,205 households that rely on septic tanks for sewage disposal in the entire upper watershed.

Upper Mokelumne Watershed

FIGURE 5-4

Agricultural, Silvicultural, Intensively Developed & Developing Areas

- Commercial, Urban & Residential
- Large Lot & Recreational Housing
- Campgrounds
- Potential Dev. & Vacant Recreational Lots
- Unclassified Agricultural
- Mixed Pasture
- Flowers & Nursery
- Deciduous Fruits and Nuts
- Forest Lands

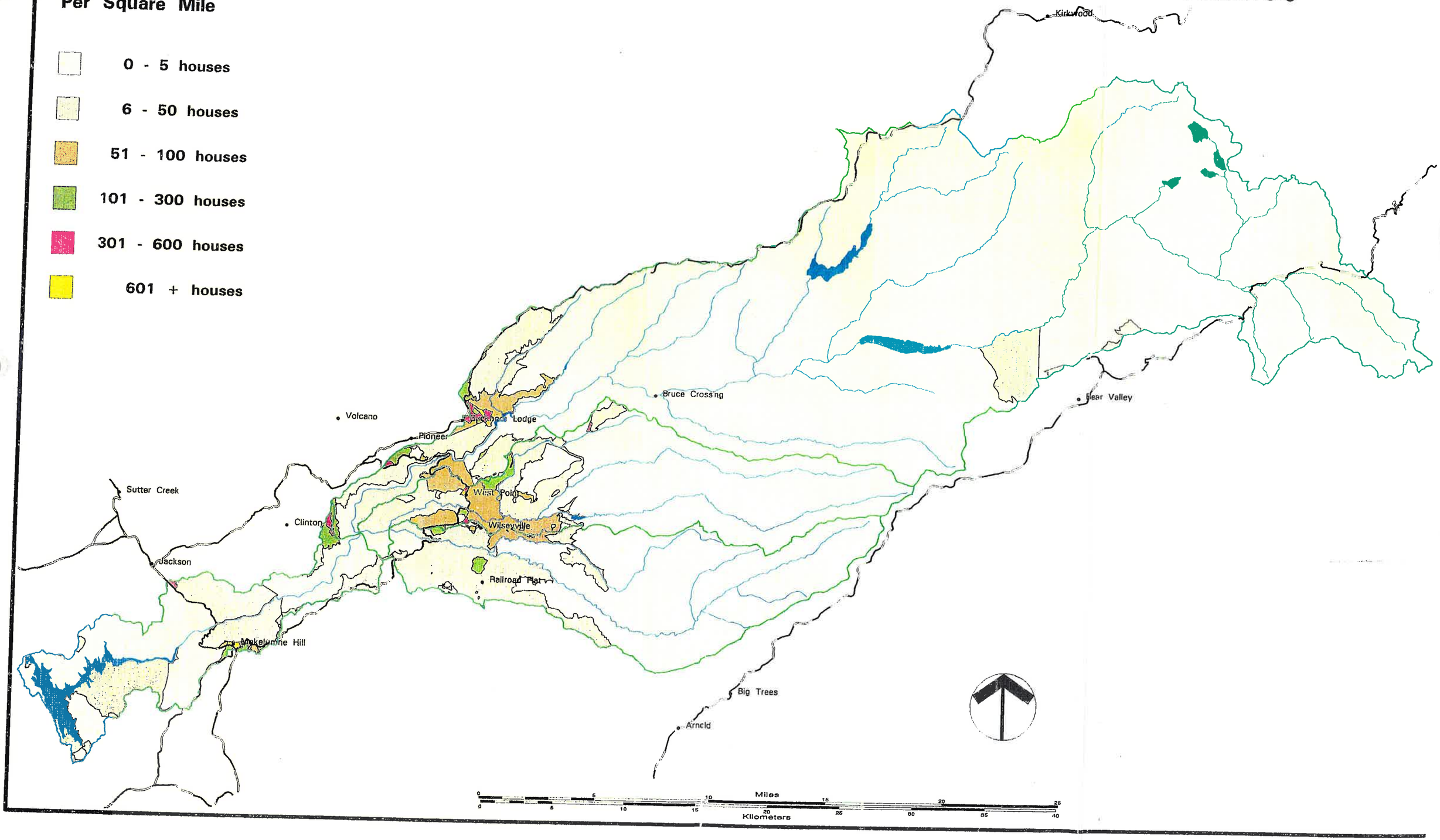


Upper Mokelumne Watershed

Demography -- Housing Density Per Square Mile

FIGURE 5-5

- 0 - 5 houses
- 6 - 50 houses
- 51 - 100 houses
- 101 - 300 houses
- 301 - 600 houses
- 601 + houses



Not all of the systems are situated on private land. Approximately 45 recreational residences are permitted on Eldorado National Forestlands. These residences are owned on lands leased through special permits from the U.S. Forest Service and none are sewered. They are almost exclusively summer cabins. They are all located on the Bear River Reservoir Tract on lots that average 100 x 150 feet in size.

Some residences served by septic tanks are also situated on Stanislaus National Forestlands in the vicinity of Bear Valley, and between Bear Valley and Salt Springs Reservoir. However, most of the residences in the resort area of Mt. Reba-Bear Valley and a large part of the ski area development are located outside the watershed boundaries

Middle Fork. Most of the septic tank-served residential areas of the Middle Fork sub-watershed are situated around the outskirts of the sewered communities of West Point and Wilseyville. The GIS analysis yielded an estimate of 1,522 persons in 856 households on septic systems.

South Fork. Most of the unsewered development in the South Fork sub-watershed is concentrated in the lower half of the basin. The most dense concentration of homes is in the Railroad Flat area, with 101 to 300 houses per square mile. Except for the area just to the south of Wilseyville, the remaining developed areas have densities from 6 to 50 houses per square mile. The GIS analysis yielded an estimate of 825 persons in 484 households on septic systems.

Mainstem. Most of the unsewered area of the lower sub-watershed is concentrated in the Clinton area, where home densities exceed 300 houses per square mile in places, but are more typically in the 100 to 300 homes per square mile range. Other developed areas occur along Route 26, to the north of Mokelumne Hill, and to the southeast of Pardee Reservoir. The GIS analysis yielded an estimate of 1,204 persons in 545 households on septic systems.

Solid Waste Disposal Sites. The State Solid Waste Management Board has the overall responsibility for regulation and management of solid wastes within the watershed. There are no solid waste landfills nor transfer stations located within the North Fork, Middle Fork, or Mainstem sub-watersheds of the Mokelumne River. The only solid waste-handling site located within the Upper Mokelumne River Watershed is the Wilseyville Transfer Station, in the South Fork sub-watershed, about one-third mile south of Wilseyville. Its

location is shown in Figure 5-3. This transfer station operates four days a week: Friday, Saturday, Sunday, and Monday. About ten tons of municipal solid waste is transferred each operating day. The transfer station is too small to warrant a wastewater treatment facility. There have never been any complaints of odor or other problems at this facility, and it is not judged to be a contaminant source of concern to public health.

Hazardous Materials Storage

Factors that increase the risk of spillages of hazardous materials, fuels, and chemicals include traffic and highway characteristics and the density of industrial or commercial storage facilities. Types of materials stored or transported, and the security of their containment tanks, are of major importance. Increasingly strict regulations, intensive monitoring, and clean-up/abatement orders from regulatory agencies have had major effects in reducing the risk of spills and leaks and reducing the migration of harmful water quality constituents from areas of soil and groundwater contamination.

Past spillages of fuels and chemicals in urban and rural areas have received prompt attention from the authorities and from agencies charged with pollution control responsibilities. Storage facilities must now meet stringent requirements for safety and for secondary containment in the event of uncontrolled leakage, accidental spills, or catastrophic failures. For these reasons, the risk of contamination from accidental spillage on urban highways and from leakage in developed areas is judged to be low, overall. Increasing risks caused by increasing volumes of transported fuels, coupled with increased traffic congestion, can be expected to continue to be counterbalanced by improved restrictions, inspections, and enforcement measures.

Fuels. Table 5-7 contains the current list of documented leaking underground storage tanks in the Upper Mokelumne River Watershed, as reported by the RWQCB. Figure 5-3 illustrates their locations. Amador, Calaveras, and Alpine counties state that the majority of storage tanks within the watershed area contain fuel and other petroleum products including gasoline, diesel fuel, and liquefied petroleum gas (propane). Figure 5-3 also shows the location of other known underground storage tanks in the watershed.

Table 5-7: Upper Mokelumne River Watershed – Leaking Underground Storage Tanks

Sub-watershed	Facility	Street Address	City	County	Substance	Contamination	Status Of Cleanup, or Date Closed
North Fork	Bear Valley Cross Country	1 Bear Valley Rd	Bear Valley	Alpine	Gasoline	Aquifer	Leak Being Confirmed
	Bear Valley - Grizzly Bowl #7	Mt Reba Rd	Bear Valley	Alpine	Diesel	Soil	10/7/97
	Bear Valley - Maintenance Fac.	Mt Reba Rd	Bear Valley	Alpine	Diesel	Soil	12/4/98
	Bear Valley - Supercub #9	Mt Reba Rd	Bear Valley	Alpine	Gasoline	Soil	10/7/97
	Bear Valley - Kodiak #8	Mt Reba Rd	Bear Valley	Alpine	Gasoline	Soil	10/7/97
	Bear Valley - Office Area #6	Mt Reba Rd	Bear Valley	Alpine	Gasoline	Aquifer	12/28/97
	Pioneer Stage Stop	24140 Hwy 88	Pioneer	Amador	Gasoline	Aquifer	11/24/98
	Bob's Chevron	24444 Hwy 88	Pioneer	Amador	Gasoline	Soil	10/7/92
	Pioneer Elementary School	24625 Hwy 88	Pioneer	Amador	Diesel	Soil	2/3/94
	P & M Cedar	25270 Hwy 88	Pioneer	Amador	Gasoline	Ground Water	3/30/95
	Cook's Station	31950 Hwy 88	Pioneer	Amador	Gasoline	Soil	6/19/97
	Ham's Station	34950 Hwy 88	Pioneer	Amador	Gasoline	Aquifer	Preliminary Site Assessment Underway
	Bear River Lake Resort	40800 Hwy 88	Pioneer	Amador	Diesel	Undefined	Preliminary Site Assessment Underway
	Peddler Hill Maintenance Stn	41951 Hwy 88	Pioneer	Amador	Waste Oil	Soil	Leak Being Confirmed
	Iron Mt Ski Area	Hwy 88 & Iron Mt Rd	Pioneer	El Dorado	Diesel	Well	Leak Being Confirmed
	Kay's Silver Lake Resort	48400 Kay's Rd	Pioneer	Amador	Gasoline	Aquifer	Preliminary Site Assessment Underway
Middle Fork	Westpoint Maintenance Station	22412 Hwy 26	West Point	Calaveras	Gasoline	Soil	11/26/97
	West Point Forest Fire Station	22670 Hwy 26	West Point	Calaveras	Gasoline	Soil	Leak Being Confirmed
	Gas Star	25545 Hwy 26	West Point	Calaveras	Gasoline	Undefined	Leak Being Confirmed
	West Point Exxon	347 Main St	West Point	Calaveras	Gasoline	Aquifer	Leak Being Confirmed
	Martin Fisher Logging	1165 Skull Flat Rd	West Point	Calaveras	Gasoline	Undefined	Preliminary Site Assessment Workplan
	Sharp's Gas & Grocery	22623 West Point--Pioneer Rd	West Point	Calaveras	Gasoline	Soil	Leak Being Confirmed
	Wilseyville Food & Gas	3961 Blizzard Mine Rd	Wilseyville	Calaveras	Gasoline	Aquifer	Leak Being Confirmed
South Fork	Railroad Flat General Store	313 Railroad Flat Rd	Railroad Flat	Calaveras	Gasoline	Soil	Leak Being Confirmed
	Reed's Fix It Shop	675 Ridge Rd	Railroad Flat	Calaveras	Gasoline	Soil	8/29/95
Mainstem	Helen & Don Messick	8345 Main St	Mokelumne Hill	Calaveras	Gasoline	Soil	1/8/92

Source: State Regional Water Quality Control Board, Leaking Underground Storage Tank Information System, December 2000.

In the North Fork sub-watershed, as summarized in Table 5-7, most of the leaking underground tanks are located in the Pioneer area on Highway 88. There are six documented leaking tanks in Bear Valley. Other tanks that could be prone to leakage are located in small communities, such as Buckhorn, primarily along Highway 88. With regards to the Middle Fork sub-watershed, there are six leaking underground tanks that have been documented in the community of West Point, and one reported in Wilseyville. For the South Fork sub-watershed, two leaking underground tanks have been noted in the community of Railroad Flat. There has been one reported leaking underground tank in Mokelumne Hill for the Mainstem sub-watershed.

Leaking underground service station tanks located near transportation corridors and urban areas are deemed to be low risk due to their very low density and generally sufficient distance from the river. Moreover, surface leaks and resultant flows that could reach the river are generally detected within short time frames. While underground leaks to groundwater are more difficult to find than surface leaks, they are usually detected and remediated before contaminated groundwater flows can reach waterways.

Other Hazardous Chemicals. As previously reported, PG&E has replaced the polychlorinated biphenyl (PCB) transformers in its powerhouses with mineral oil-filled distribution transformers, thus greatly reducing the risk of hazardous PCB explosions and spills.

The Calaveras County Fire Department reports that there have been several cases of methamphetamine drug lab seizures in the communities of West Point, Paloma, and Railroad Flat. Chemicals subject to illegal disposal at these sites include hydrogen chloride, liquid hydrochloric acid, trichloro-fluoro-ethane, methylamine, and red phosphorous. If illegally dumped into storm drains or ditches, such chemicals could drain into water supply sources with potentially serious consequences, dependent upon the quantities dumped, transport time, and amount of dilution.

Fertilizer storage is also of concern in the watershed. As documented in the 1995 MRWSS, a large spill occurred in the North Fork Mokelumne River sub-watershed adjacent to the Amador Canal. It quickly neutralized the chlorine residual at the Tanner Treatment Plant, rendering its disinfection process useless. Upon detection, response by the Amador Water Agency was immediate, resulting in the successful tracking and remediation of

the spill. Continued vigilance is necessary to ensure adequate and timely responses throughout vulnerable areas of the watershed.

Urban Area Runoff

This section describes potential contaminant sources from urban areas within the Upper Mokelumne River Watershed. Urban land uses include single-family residential, multi-family residential, and commercial and public facilities (excluding parks and recreational facilities such as golf courses). The only significant urban areas present are located Mokelumne Hill, West Point, Wilseyville, Pine Grove, and portions of Jackson.

Single-Family Residential Sources. Stormwater Control Programs developed throughout California have similar goals in many ways to this watershed sanitary survey. Information developed by stormwater control programs was used to help identify potential urban area contaminant sources. The residential activities identified through these programs as possible sources of stormwater pollution are described below and prioritized in relative order of increased risk.

- **Pesticides and Fertilizers.** Diazinon and other organo-phosphate pesticides, Roundup (glyphosate), and 2,4,-D are chemicals commonly used by both commercial applicators and homeowners. Commercial applicators are required to record the amounts and types of pesticides used. Homeowner use of pesticides and fertilizers is essentially unregulated; therefore, control or enforcement capabilities are limited. Certain home and garden pesticides contain up to 50 percent active copper. Other heavy metals typically found in pesticides include cadmium, chromium, copper, lead, mercury, and zinc. Pesticides (including herbicides and fungicides) from yard and garden applications could enter the stormwater, particularly when lawns are over-watered. In addition, the use of pesticides can lead to inadvertent contamination of nearby streams and storm drains by overuse, misapplication, or storm activities occurring shortly after application. Excess fertilizer usage can result in the release of nitrogen and phosphate compounds, which cause algal blooms in the reservoirs.

- **Paints.** Environmental and public education has encouraged the use of latex paint, instead of oil based paint, for residential homes. A study of latex paint found that it contains low levels of cadmium, chromium, copper, and mercury, and moderate levels

(100 to 1,000 mg/L) of zinc. The main pathway for these paints to enter stormwater catch basins has been identified to be through illegal dumping and improper cleanup practices.

- **Wood Preservatives.** In residential areas, wood preservatives are used to treat wooden patios and fence posts. Heavy metals such as copper, cadmium, chromium, and nickel are present in variable amounts. Wood preservatives can also contain creosote or pentachlorophenol dissolved in a petroleum-based solvent, copper naphthate or inorganic arsenicals such as chromated copper arsenate dissolved in water. Potential sources of stormwater contamination include spills from around the application area, drippings from treated wood, equipment leaks, and spills from the unloading and use of wood preservatives.

- **Streets and Driveways.** Streets and driveways are significant contributors to stormwater pollution in residential areas. More than 70 percent of zinc and copper found in residential runoff comes from streets, and driveways contribute about 20 percent of the loading for the same contaminants. (Santa Clara Valley Nonpoint Source Pollution Control Programs - Source Identification and Control Study, December 1992) These results indicate that automobiles in residential areas contribute significantly to metals in stormwater pollution.

  Drips and leaks of oil, grease, transmission fluid, coolant, and brake fluid, and the wearing down of brake linings are also potential sources of organic and polynuclear aromatic hydrocarbon contaminants. Car washing and cleaning activities is sources of detergents and solvents.

- **Sediments from New Developments and Redevelopments.** New developments or redevelopments often result in the disturbance and erosion of soil. Construction-related erosion is a significant source of solids and siltation. Heavy equipment used during construction also contributes significantly to erosion of the developing area. A study in the Santa Clara Valley indicated that chromium and nickel in urban runoff are primarily associated with erosion.

  Concrete waste products are also potential contaminants. Sources of these contaminants include washing of waste concrete from trucks, forms, equipment and the general work area, and water from the curing of concrete products. Besides

the basic ingredients for making concrete products, chemicals used in the curing of concrete and the removal of forms may end up in stormwater.

- **Roofing Materials.** A significant quantity of zinc is used in the production of galvanized roofing materials. Zinc is leached into storm drains through contact with rainwater. Runoff from residential roofs with galvanized gutters has been found to contain significantly higher levels of zinc than runoff from roofs with aluminum gutters.

- **Household Products.** Residues from household products of potential concern such as cleaners, polishes, and paint from brush cleaning are often disposed of via the septic or sanitary sewer system, or storm drains. However, containers stored outside or improperly disposed of could also become sources of metals, solvents, and organic materials.

- **Domestic Animal Waste.** Domestic pet waste that is not collected and disposed of as part of the solid waste stream can be a source of coliform bacteria, pathogens, and nutrients.

Multi-family Residential Areas. Multi-family residential buildings (e.g. apartments and condominiums) generate proportionately larger amounts (on an aerial basis) of SOC contaminants than single-family residences because of the larger numbers of vehicle parking, vehicle washing and oil changing, and garbage containers present. Stormwater from multi-family parking lots would therefore contain higher concentrations of oil and grease, suspended particulates, and metals. It would also contain the organic by-products of engine combustion. These conditions are exacerbated depending upon the extent to which car owners wash their cars and change their own oil. Estimates have been made that as much as 60 percent of owner changed oil may be improperly disposed. Pesticide and fertilizer loads would be lower for multi-family areas than single family areas.

Commercial and Public Areas. The primary concern associated with commercial areas is automotive related activities, including individual, commercial, and public transportation, plus businesses which own, operate and maintain or repair vehicle fleets, including buses, truck freight services, and renting and/or leasing of cars, trucks, and trailers. Parking lots and roadways, restaurants and mobile cleaning services are other potential sources of stormwater contamination.

- **Automotive-related Industries.** Both solid and liquid wastes are produced by the automotive industry. Waste materials generated include: used oils, oil filters, antifreeze, solvents, brake fluid, batteries (sulfuric acid, battery acid sludges), empty contaminated containers, and soiled rags. Vehicle maintenance and repair operations generate waste solvents, degreasers, and acid solutions with chromium, zinc, copper, lead and cadmium, brake fluids, and machine chips with residual machining oil. Improper disposal or illegal dumping of such wastes pose a threat to water quality and aquatic life. In addition, spillage of gasoline and diesel fuel occurs from pumps and during transfer from tanker to underground storage tanks.

  Other automotive related businesses may maintain, wash, and fuel their own vehicles on-site and therefore possess many of the characteristics of general service gas stations or repair shops. Washing may take place in enclosed and fully automated systems like commercial vehicle washers, or by hand in the parking area. Truck and bus engines and engine parts is often steam cleaned. Some fleet owners may store retired vehicles on site to be stripped for parts - a common practice with taxi fleets - which may result in the spilling of engine fluids, or in rusting of metal. Wastewater from cleaning activities contains significant quantities of oil and grease, suspended solids, heavy metals, organics and contaminants from the detergents. Oil/water separators tend to be ineffective because the surfactant in the detergents chemically stabilize free and dispersed oil.

- **Impervious Surface Runoff.** Accumulation and runoff of contaminants from road surfaces such as parking lots, gas stations and freeways are sources of stormwater pollution. These contaminants typically result from fluid leaks, fuel combustion, and brake and tire wear as described above.

- **Restaurants.** Restaurants, particularly fast food restaurants, which can experience high consumer traffic are potential sources of contaminants. The two most important, corresponding potential sources of stormwater contamination are the parking lots and garbage dumpsters exposed to precipitation. The cleaning of cooling vent filters in the parking lot can also result in the discharge of cooking grease to the storm drains.

- **Cleaning Services.** Mobile carpet and upholstery cleaning services catering to residential areas are a potential source of stormwater pollution if the cleaning water is allowed to drain to the storm sewer.

New urban development can be a significant problem in a constricted watershed with significant population accommodation pressures such as the Upper Mokelumne River Watershed. Figure 5-3 depicts those areas that are considered particularly susceptible to urban and high-density residential development within the watershed. The areas shown were identified as such by the California Department of Water Resources in its statewide planning studies to determine local water needs. Short of controversial anti-growth measures, there is little that can be done to forestall reasonable rates of development. Inappropriate development can, of course, be controlled through restrictions imposed by the General Plans and enforced by the County Planning Commissions.

New developments can have a variety of effects on the watershed with water quality implications including: increased urban runoff, increased wastewater flows, losses of vegetation, and increased erosion (especially during construction activity and when levels of road and culvert maintenance are inadequate). Consequently, the encroachment of developments upon watershed lands should be carefully monitored and assessed.

Rural Area Runoff

For this discussion, rural area runoff is focused on potential contaminant sources associated with rural residences. Rural residences are generally dispersed over large areas, often on large parcels of land (such as one house per 100 acres).

In general, the potential contaminant sources and corresponding water quality concerns associated with rural area runoff are similar to those associated with urban area runoff. However, the magnitude of the rural area water quality concerns is reduced, excluding microbiological parameters, when compared to urban area runoff. This is particularly true herein because the residential component of rural area is considered to produce the most significant impact under the rural area runoff classification. In addition, rural areas are sparsely populated with residences dispersed over large areas. In final, agriculture, wildlife, and

livestock are potential contaminant sources associated with rural areas; however, they are being addressed separately and independently herein.

With regards to the microbiological parameters, potential contaminant sources, which are associated with rural versus urban areas, are the many septic systems associated with rural residences. Failure of septic systems close to waterbodies can result in significant microbiological water quality concerns. Urban areas, on the other hand, are sewered and, in general, do not pose the same microbiological water quality threat given that sewer overflows are avoided. Because microbiological parameters, specifically pathogens such as *Giardia* and *Cryptosporidium*, pose acute health concerns, potential contaminant sources such as rural septic systems must be effectively maintained.

The presence of homes in remote locations within the watershed represents an increased level of risk for fire and vandalism. Residential activities may generate a number of contaminants, which could migrate into the surface and/or ground waters. If on-site waste disposal systems (septic systems and leach fields) fail, nutrients, pathogenic microorganisms, and hazardous materials may be discharged. Erosion could be caused by construction, lack of proper maintenance, gardening, or improper watering practices. Residents may apply pesticides, herbicides, and fertilizers to lawns and gardens. Pet wastes may carry disease-causing agents transmitted by water. Vehicles used for transportation may leak fluids or fuel onto road and parking area surfaces. Runoff during storms may transport vehicle-related contaminants into the reservoir. Care and repair of automobiles, trucks, and other gasoline-powered engines (lawn mowers, tractors, motorcycles, etc.) may generate vehicle-related contaminants, including oil, grease, and various hydrocarbons, metals, solvents, as well as detergents from washing.

Utilities - Hydropower Generation

Utilities or utility corridors of potential concern for watersheds in general are those that would contain pipelines for petroleum and petroleum products and high voltage overhead electrical power transmission lines. Petroleum pipelines are not a concern for the Upper Mokelumne River Watershed; however, hydroelectric facilities and the corresponding power lines traversing the watershed are of critical importance. FERC Project 137 encompasses PG&E's hydroelectric facilities and related reservoirs, tunnels, and power plants in the Upper Mokelumne River Watershed. Table 5-8 provides an overview of these facilities. Project 137, which includes the Tiger Creek Hydro Service Center, is in Alpine, Amador, and Calaveras counties near the towns of West Point and Jackson. About 85 percent of the project area is in the Eldorado National Forest and PG&E and Sierra Pacific Industries own the other 15 percent.

Where possible, PG&E facilities make use of natural watercourses to convey water. However, where necessary, water is also conveyed through canals, flumes, tunnels, siphons, penstocks, tailraces, and spillways. Water is stored in a variety of reservoirs, forebays upstream of powerhouses, and afterbays downstream of the powerhouses. Most of the reservoirs and bays have been created with man-made dams. Structures for power generation typically include the powerhouses, step-up transformers, and the power lines linking the powerhouses with the switchyards. The major facilities related to transmission and distribution include power lines carried on towers and poles. Administrative facilities, switching centers, and service centers may be located at or away from the powerhouses. These centralized facilities generally include office space, vehicle equipment storage, and repair and maintenance shops. Appurtenant facilities include small staging areas, valve houses, air valve housing for siphons, remote platforms for storing cloud-seeding equipment, and helicopter pads. In addition to the many roads -- both paved and unpaved -- and vehicular traffic associated with PG&E facilities, occasionally helicopters and boats are used.

As the land uses associated with PG&E operations reflect the myriad of facilities required for hydropower generation, the corresponding potential sources of contamination are also diverse. Potential sources of contamination from PG&E facilities include herbicides used for vegetation management, erosion and loss of soil particles from unpaved access roads, contaminants from vehicles on the access roads, leaching of preservatives from wooden utility poles, galvanized metal pipes, PCBs in older transformers, water removed from underground transformer vaults, contaminants from staging areas and maintenance facilities, and changes to water temperatures due to hydroelectric power generation. In addition, any waste materials generated during maintenance activities stored outside the hydroelectric facilities or substations rather than being removed immediately for disposal would provide a potential contaminant source. The water quality concerns associated with these potential contaminant sources are summarized in Table 5-21 which lists many of the activities that take place on PG&E lands -- hydropower, transportation, recreation, agriculture, and logging.

Table 5-8 - Upper Mokelumne River Watershed – PG&E Hydroelectric Facilities

Reservoirs	Year Completed	Gross Storage Capacity (acre-feet)	Elevation of Dam (feet)	Generating Capacity (MW)	Flow Capacity (cfs)
Old Reservoirs					
Upper Bear	1900	6,756	5876		
Upper Blue Lake	1881	7,300	8138		
Lower Bear Lake	1885	5,091	8053		
Twin Lakes	1898	1,207	8145		
Meadow Lake	1903	5,656	7774		
New Reservoirs					
Salt Springs	1931	141,817	3959		
Lower Bear	1952	52,025	5818		
Powerhouses					
Salt Springs				44	
Unit 1					600
Unit 2					225
Tiger Creek				58	750
West Point				14.5	725
Electra				98	1,130
Tunnels and Canals					
Tiger Creek Canal					550
Tiger Creek Regulator Conduit					625
West Point Tunnel					675
Electra Tunnel					875
Totals		219,852		215.0	

Source: EBMUD, Response to PG&E Environmental Assessment, Mokelumne River Project, FERC License No. 137, 1996.

Hydropower. Hydroelectric operation of PG&E's reservoirs may impact streamflow and water quality characteristics downstream of its facilities. Variations in streamflow due to power generation and/or reservoir release practices may impact streambank erosion, sediment transport, and water quality.

Recreation. Recreational facilities include rest stops, parking areas, boat launching ramps and docks, picnic areas, camping areas, and RV hookups. Table 5-9 summarizes these facilities by location, type, and visits. While PG&E staff does not create heavy vehicular traffic, public use of the recreation facilities can create large seasonal increases in traffic at some facilities. In addition, boating is permitted on many of the PG&E reservoirs.

Table 5-9 - PG&E and Mokelumne River Project Recreation Facilities

Facility	Type	Number of Units	All on PG&E Property? (if no, list other owner)	Visits in 1996	Comments
Lower Blue Lake	Campground	16	Yes	4,708	
Middle Creek	Campground	5	Yes	1,344	
Upper Dam Site	Campground	10	Yes	2,460	
Upper Blue Dam Expansion	Campground	25	Yes	2,392	
Upper Blue Lake	Campground	32	Yes	4,832	
Blue Lakes Overflow	Campground	25	Yes	1,068	
Salt Springs	Day use, fishing access	4	Yes	1,090	
Tiger Creek Powerhouse	Day use, fishing access	N/A	Yes	No information	
Tiger Creek Afterbay	Day use, fishing access, and 10 picnic tables	10	No, U.S. Bureau of Land Management	994	Entirely on BLM lands
Lake Tabeaud	Day use, fishing access, and 10 picnic tables	10	Yes	3,276	
Electra	Day use, fishing access, and 7 picnic tables	7	Yes	6,300	
Dispersed Use	Access areas	N/A	Yes	8,316	

Source: *PG&E Hydroelectric Asset Bundling Information, April 2000.*

Agriculture. PG&E does not conduct agricultural activities itself, but has entered into leases and other agreements that allow agricultural activities on PG&E lands. These activities include Christmas tree farming and grazing. In addition, PG&E have contracts under which it provides water for irrigation to support agricultural land uses. Typically these leases or agreements have terms of three to five years.

Logging. PG&E maintain an active timber management program that is managed by a staff of registered professional foresters. As part of the timber management program, there are ongoing timber harvest plans on many of the properties proposed for ownership transfer under Project 137. As required by state regulation, PG&E have filed timber harvest plans with the California Department of Forestry for the specific timber areas. The last of the plans will expire at the end of the year 2002.

Vegetation Management. The PG&E Weed Control Manual describes the several methods used by the utility for weed control around their power lines and other facilities: non-native species weed control, mechanical weed control, mulches, fire, biological weed control such as grazing, and chemical weed control such as the use of Roundup or other herbicides.

Weed control work is at least partly contracted out and chemical weed control methods are emphasized in the manual. Ultimate responsibility lies with the applicator. When used, pre-emergents are applied in the fall shortly before the rains (late October). On sites where conditions promote more rapid herbicide decomposition or where resistant weed species are present, one or two return treatments may be necessary between February and May to control known late growth. Post-emergent treatments are also used when required. Pre- and post-emergents pertain to the herbicides which are applied at the onset of, and after vegetation growth, respectively. Monthly Summary Pesticide Use Reports are required by the California Department of Food and Agriculture to be prepared and submitted to the County Agricultural Commissioner.

Canal Maintenance. PG&E occasionally encounters problems in the removal of attached algae from its extensive canal and flume system. Left unchecked, the attached algae would quickly become sufficiently dense to impede flow through the canal system and clog the turbines and penstocks. This situation indicates the magnitude of the problem of biostimulation from the input of nutrients, and the growth-enhancing effects of changes in water temperatures

attained in the canals and flumes. PG&E's maintenance process consists of draining the canals and running a truck-mounted water jet, with high velocity nozzles directed to blast the algae loose. Most of the nutrients are removed as part of the biomass when algae is blown out of the canal; however, some remain in the canal to be flushed upon refilling, and thus remain in the system. Of additional concern are elevated water temperatures, which may have stimulated the algal growth in the first place. These increased temperatures can impact downstream fish populations, aquatic habitats, and potentially Pardee Reservoir water quality. Elevated temperatures are known to stimulate algal growth, which can cause T&O events, and elevated organic carbon concentrations, which become problems for drinking water utilities.

Transportation Corridors

Figure 2-1 provides an overview of the major transportation corridors within the Upper Mokelumne River Watershed. The primary concerns associated with transportation corridors are the automotive related contaminants in surface runoff from roads and parking areas. Contaminants may result from (1) runoff during storms from road surfaces and parking areas; (2) erosion due to rapid runoff and inadequate or failed stormwater collection systems and from construction and maintenance activities; (3) herbicides applied during road maintenance; (4) atmospheric contribution of heavy metals and particulate matter; (5) risks due to increased public access - fire, hazardous materials spills, illegal dumping, and vandalism.

Erosion is the greatest concern associated with unpaved surfaces such as fire access roads, logging roads, and trails and unpaved parking areas. During erosion many substances sorb onto particulates: pathogens, metals, herbicides, and other organics. During the water treatment process, high levels of turbidity may interfere with disinfection processes. Also, sediment will impede/accumulate in storm drainage systems or in terminal reservoirs, reducing storage capacity and adding nutrients into the reservoirs.

- **Surface Runoff** - Contaminants in surface runoff from roads and parking areas include: oil, grease, fluids (antifreeze, lubricants, battery acid, etc.) hydrocarbons, and metals. Stormwater can be contaminated by fuels and oil spilled on exposed paved surfaces. Stormwater contaminated by fuels

and oils may contain significant concentrations of dissolved organics that cannot be removed by an oil/water separator. The major class of constituents found in automotive contaminants is oil and grease, total suspended solids, heavy metals, polynuclear aromatic hydrocarbons (PAHs), and petroleum hydrocarbons.

Antifreeze and motor oil are major stormwater contaminants. The two main pathways identified for oil and antifreeze to enter the stormwater are illegal dumping and leaks from cars. Motor oil contains moderate levels of lead, copper, nickel, and high concentrations of zinc. In addition, motor oil is a source of PAH contamination. Antifreeze contains low levels of lead, copper, nickel, and zinc. It is estimated that approximately 25 percent of the antifreeze sold is disposed of by being poured on the ground or sent to a landfill.

Studies have shown that most of the wear from tires settles on or near the roadway (Santa Clara Valley Nonpoint Source Pollution Control Program, 1992). Rubber used to make tires and brake linings contain lead, chromium, copper, nickel, and zinc. As is the case with tires, most of the wear from brake linings is available for stormwater contact.

- **Erosion** - Erosion from areas adjacent to roadways can result in structural deterioration of the roadbed and appurtenant structures. Road construction or maintenance activities also affect erosion rates. Vegetation provides a protective cover which absorbs the impact of precipitation droplets, traps soil particles from further downslope movement, absorbs moisture, and allows percolation to ground water.

- **Herbicides** - Spraying of herbicides along transportation corridors by the County or Caltrans controls nuisance vegetations. However, these herbicides can contaminate public water supplies, are toxic to aquatic organisms. The environmental fate of herbicides varies greatly. Microbial action, soil adsorption, chemical decay, volatilization, photochemical decomposition, and plant uptake are some of the processes, which affect degradation rates.

- **Atmospheric Contaminants** - Motor-vehicle exhaust and emissions from stationary point sources have been identified as the two major sources of contaminants that could contribute to nonpoint source contamination. Contaminants of concern

include heavy metals and particulate matter. Limited information is available on the extent and type of contaminants expected from atmospheric deposition. The major constituents of atmospheric aerosols are sulfates, nitrates, carbonaceous compounds, water, ammonium ions and materials originating from the Earth's crust. Average compositions vary with particle size, by location and season. Pollutant transport can carry materials out of the watershed or to pervious open space areas where they may be deposited and retained.

- **Risks due to Public Access** - Public use of roads through sensitive watershed area increases the risk of hazardous materials spills from tankers, or vehicle accidents and failures resulting in fuel or fluid releases. Fire may be ignited by discarded cigarettes, matches, catalytic converters, exhaust systems, or from auto accidents. After land has been burned, the amount of sediment and organic matter transported into the reservoir increases. Vandalism and illegal dumping may also occur along remote roads - including disposal of household wastes, appliances, hazardous wastes, and explosive by-products from illegal drug labs.

Surface Runoff. In addition to the general contaminants identified above for surface runoff, salt and cinder are additional contaminants used by Caltrans on the upper sections of Highway 88 that receive winter snows to maintain traction and clear ice and snow.

Erosion. A major activity of concern from the erosion and sedimentation -- and consequently, water quality -- standpoint is the construction and maintenance of unpaved roads, landings, and skid trails in the watershed. Such construction, and the ongoing usage of existing logging roads, are major sources of sediment. These sediment burdens, with their associated loads of nutrients and total coliform bacteria, are a prime reason for high turbidities, nutrients and total coliforms in the streams following rainfall and snowmelt events.

With regards to paved roads, there is very little activity on paved road construction and reconstruction, aside from some limited road widening projects, mainly on Highway 88. Such projects are usually constructed during the dry season and repaved before prolonged wet weather sets in, and must meet fairly stringent state and/or federal mitigation requirements. Erosion associated with paved roads is insignificant when compared to unpaved roads. However, surface runoff is of a greater concern with paved roads.

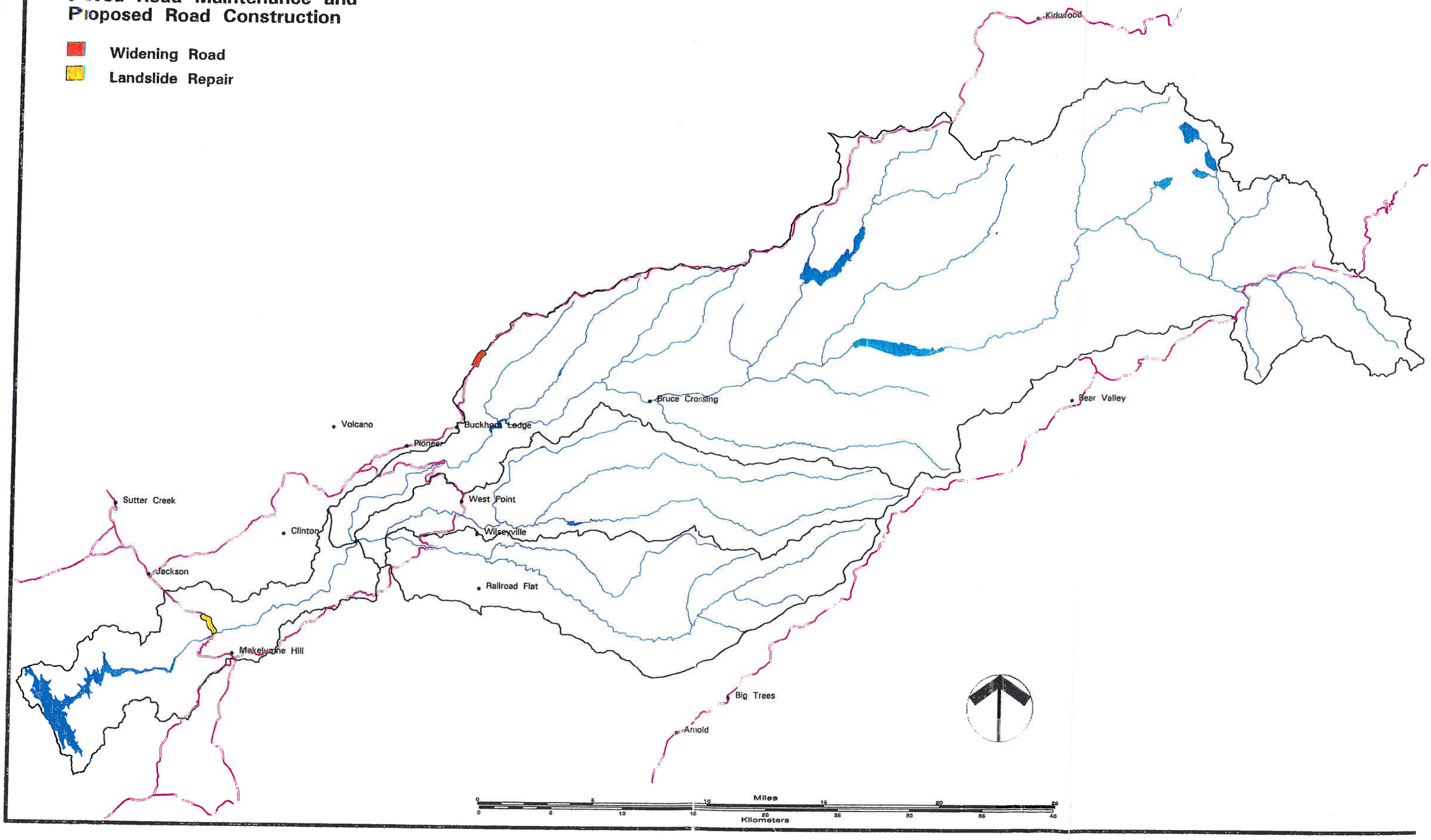
In 2000, Caltrans completed construction to widen a 0.8 mile section of Route 88 in the Amador County portion of the North Fork sub-watershed. The widening project is located between Amador 88 post miles 35.1 and 35.9. (shown in Figure 5-7). Caltrans also reports the repair of small soil and rockslides at various locations along Highways 88 and 4 during, and after, rainstorms.

Upper Mokelumne Watershed

FIGURE 5-7

Paved Road Maintenance and Proposed Road Construction

- Widening Road
- Landslide Repair



The Counties of Amador, Calaveras, and Alpine have indicated that, at present, there are no construction projects planned for any County-maintained roads within their portions of the sub-watershed areas. In the Mainstem sub-watershed, there is a continuing slide problem at the Highway 49 crossing of the Mokelumne River that results in the transport and deposition of sediment into the river. Each winter, slides ranging from 1 to 200 cubic yards are reported on the north side of the river. Figure 5-8 shows the location of these slides. Caltrans also conducts routine cleanup and repair of small soil and rock slides at locations during and after storm events.

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Upper Mokelumne Watershed

Landslides & Major Gully Erosion

FIGURE 5-8

EXISTING

Major gully erosion –

initiated by man

debris with avalanche scar

POTENTIAL – susceptibility to erosion if vegetation is removed or disturbed

L Low

M Moderate

H High

NO DATA AVAILABLE

Herbicides. As part of a vegetation management program, Caltrans applies herbicides along the major roadways of the Upper Mokelumne River Watershed for weed abatement and fire control. The dirt shoulders of paved highways in both directions are sprayed in bands of 4 feet to 8 feet with herbicides by Caltrans. As reported in the 1995 MRWSS, herbicides similar to those applied in the District's East Bay watersheds, are applied within the Upper Mokelumne River Watershed by Caltrans. The herbicides applied include: Surflan, Goal, Roundup and Garlon. Table 5-10 is a summary of the herbicides applied, season of application, and type of control desired. Figure 5-9 depicts those roadways, which are treated with herbicides by Caltrans. In addition, Tables D-3 contains a summary of the U.S. Forest Service application of herbicides in the North Fork sub-watershed. Tables D-4 through D-7 in Appendix D, summarize the herbicide application programs by Caltrans for the North Fork, Middle Fork, South Fork, and Mainstem sub-watersheds, respectively.

Table 5-10: Upper Mokelumne River Watershed – CalTrans Vegetation Control Program

Herbicide Type	Spray Season	Type of Control
Surflan, Goal (pre-emergent herbicides), and Roundup (post-emergent herbicide)	Fall and Winter (November until March)	Pre- and Post-emergent weed control.
Garlon (post-emergent herbicide)	September until November	Brush control.
Garlon	All year when temperatures are below 80 degrees F.	Tree and shrub cut. Stump treatment.
Roundup (post-emergent herbicide)	Spring and Summer (as needed)	Post-emergent weed control.

Active ingredients of each herbicide are shown below:
Garlon 4-#: "Triclopyr"
Goal: "Oxyfluorfen
Roundup/Accord: "Glyphosate"
Surflan: AS - 40/40% 3,5-Dinitro-N,N-Dipropylsulfanilamide

Source: Caltrans District 10, Stockton, October 1993

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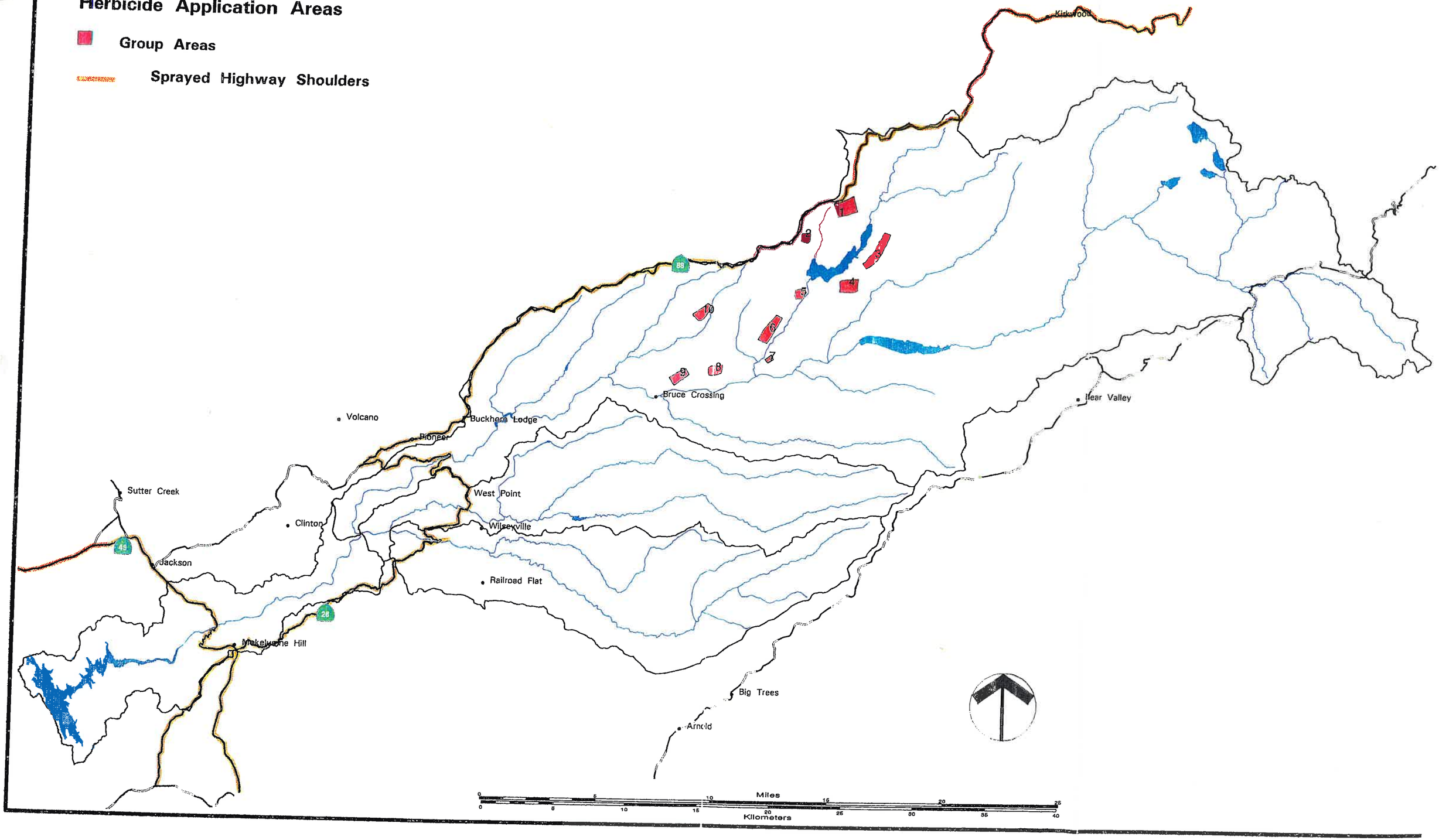
Upper Mokelumne Watershed

FIGURE 5-9

Herbicide Application Areas

Group Areas

Sprayed Highway Shoulders



Atmospheric Contaminants. No major air pollution sources have been permitted within the Upper Mokelumne River Watershed area. Smoke from fireplaces, road dust, and motor vehicle emissions are the major general sources that affect the air quality of the study area. Based on a reconnaissance level report published by the Army Corps of Engineers (June 1991), poor air quality in much of the San Joaquin Valley airshed (in which the Upper Mokelumne River Watershed lies) causes crop damage, reduces visibility, and degrades public health and the environment. Air quality standards are not being met in the San Joaquin Valley for ozone, fine particulates, or carbon monoxide. The primary factor causing increases in air pollutant emissions is population growth. The California Air Resources Board predicts that the San Joaquin Valley will soon have one of the worst air quality problems in the nation as a result of burgeoning population densities (especially Bay Area commuters) in an essentially closed air basin that is subject to poor atmospheric circulation. While the burgeoning population densities in the Bay Area have yet to occur in the Upper Mokelumne River Watershed, the air quality impacts of these densities are likely to be detected in the Upper Mokelumne River Watershed given it is located within the same airshed as the Bay Area. Therefore, air pollution sources should remain on the list of potential contaminant sources so they are part of ongoing watershed management programs.

Risks Due To Public Access. There is very little activity involving the transport of hazardous materials in the Upper Mokelumne River Watershed. No railroads, and only two major highways, traverse the watershed, and they are used only rarely to transport dangerous substances -- mainly for local use. Due to their lower summit elevations, wider rights-of-way, and less serpentine (winding) routes, Interstate 80 and Highway 50 to the north are the preferred trans-Sierra and interstate routes versus Highways 88 and 4. Interstate 5 and Highway 99 are the preferred north-south routes compared to Highway 49 for similar reasons.

As depicted in Figure 2-1, within the North Fork sub-watershed, the alignment of Highway 88 follows the ridgeline between the Mokelumne and Cosumnes River/South Fork American River drainages until it passes out of the sub-watershed. Because of the ridgeline alignment, a wide buffer zone of one to two miles occurs between the highway and the Mokelumne River. This buffer zone is wide enough to disperse and assimilate foreseeable spillages of hazardous materials. Only in a few locations directly at the heads of small drainages is the buffer zone much narrower. Highway 4, which traverses the most remote upper reaches of the North Fork

sub-watershed near Ebbetts Pass, is not at all likely to be selected as a hazardous material transport route because it is even more constricted and torturous than Highway 88, and has very steep grades.

In the South Fork and Middle Fork sub-watersheds, only local access roads exist, there are no major highways or throughways. The frequency of transporting hazardous materials over these local roads is considered to be extremely low; therefore, the risk of contamination of the South and/or Middle Forks is minimal.

With regards to the Mainstem sub-watershed, because it is a very narrow sub-watershed, only a very small portion of Highway 49 right-of-way drains into the Mokelumne River. No accidents involving significant spillages of hazardous materials have been recorded along this section of highway.

As discussed above, the risk of highway accidents or public access in the sub-watersheds resulting in hazardous materials contamination of Pardee Reservoir is considered very low. Nonetheless, the potential consequences of a disastrous spill in the Mokelumne River and ultimately Pardee Reservoir, warrant future vigilance by Caltrans and the California Highway Patrol regarding hazardous materials transport policies in the watershed to make sure that the risk of contamination remains acceptably low.

Potential secondary risks of hazardous materials contamination originate from more routine releases such as leaking or overheated radiators and spillages at refueling stations. However, the chances of residues from such minor spills reaching the Pardee Reservoir in any detectable quantities are exceedingly low due to the generally adequate distances between the highways and the Mokelumne River and its tributary streams.

Agriculture

Depending upon the type of agricultural activity, potential contributions of particulates, pesticides, herbicides, and/or general minerals and metals from fertilizers could be found entering water supplies through runoff from agricultural properties. However, the agricultural lands within the Upper Mokelumne River Watershed are small in size and extent, and generally so far removed from the major tributaries, that the hazard is minimal. Those residues that do drift or migrate beyond the lands on which they are applied, would be absorbed or assimilated rapidly.

As noted in the 1995 MRWSS, only a limited amount of agriculture occurs in the Upper Mokelumne River Watershed due to the lack of arable lands or dedication to other land uses such as forest production. Agricultural production is primarily limited to deciduous orchards and vineyards. The orchards are predominantly planted with walnut and apple trees. Figure 5-4 shows the extent of these agricultural lands. Areas cultivated in flowers and nursery crops are also shown but designated by the separate category of horticultural lands.

Figure 5-4 also delineates those lands that are suitable for agricultural production in the future as potential agricultural lands. However it is important to realize that among these potential agricultural lands, many thousands of acres are more likely to be dedicated to other purposes, due to federal ownership by the U.S. Forest Service, Bureau of Land Management, or U.S. Army Corps of Engineers.

Wildlife and Livestock

Wildlife and livestock activities can affect public water supplies in a number of significant ways: (1) introduce and transmit disease-causing microorganisms into raw drinking water supplies; (2) elevate nutrient loads; (3) increase erosion; (4) compact soils and thereby decrease ground water recharge, and (5) disturb riparian corridors and tributary stream banks by animals gaining access to water supplies. Some of these impacts occur proximate to tributary water supplies unless reservoirs are out-fenced above the high water line.

Wildlife. Habitat must meet requirements for food, water, and cover for wildlife species to survive. Depending on specific requirements, a species may use several habitats or a single one. Larger wildlife species are often more mobile, frequently moving between several habitats; smaller species are more likely to remain in a single habitat.

The Eldorado National Forest provides habitat for 340 species of wildlife. This total includes 202 bird species, 79 mammal species, 20 fish species, 24 reptile species, and 15 amphibian species. The Stanislaus National Forest provides habitat for 343 wildlife species. Reptiles, amphibians, birds, fish and mammals of all size ranges are located in the aquatic and upland communities of the Upper Mokelumne River Watershed.

Below is a listing of the mammals, which inhabit the Upper Mokelumne River Watershed in significant numbers. Because all mammals are potentially capable of carrying *Giardia* organisms, they warrant the most attention. The mammals most vulnerable to infection and; therefore, of primary concern from a public health standpoint, include beaver, deer, bear and muskrat. In addition, birds are capable of contaminating water supplies with fecal coliforms.

Rodents:	Carnivores:	Herbivores:
Beechey ground squirrel	Coyote	Badger
Western grey squirrel	Mountain lion	Skunk
Botta's pocket gopher	Bobcat	Opossum
	Ringtail cat	Beaver
	Long-tailed weasel	Black-tailed deer
	Grey fox	Mule deer
	Red fox	Muskrat
	Black bear	Black-tailed jackrabbit
	Raccoon	Brush rabbit
		Cotton-tailed rabbit

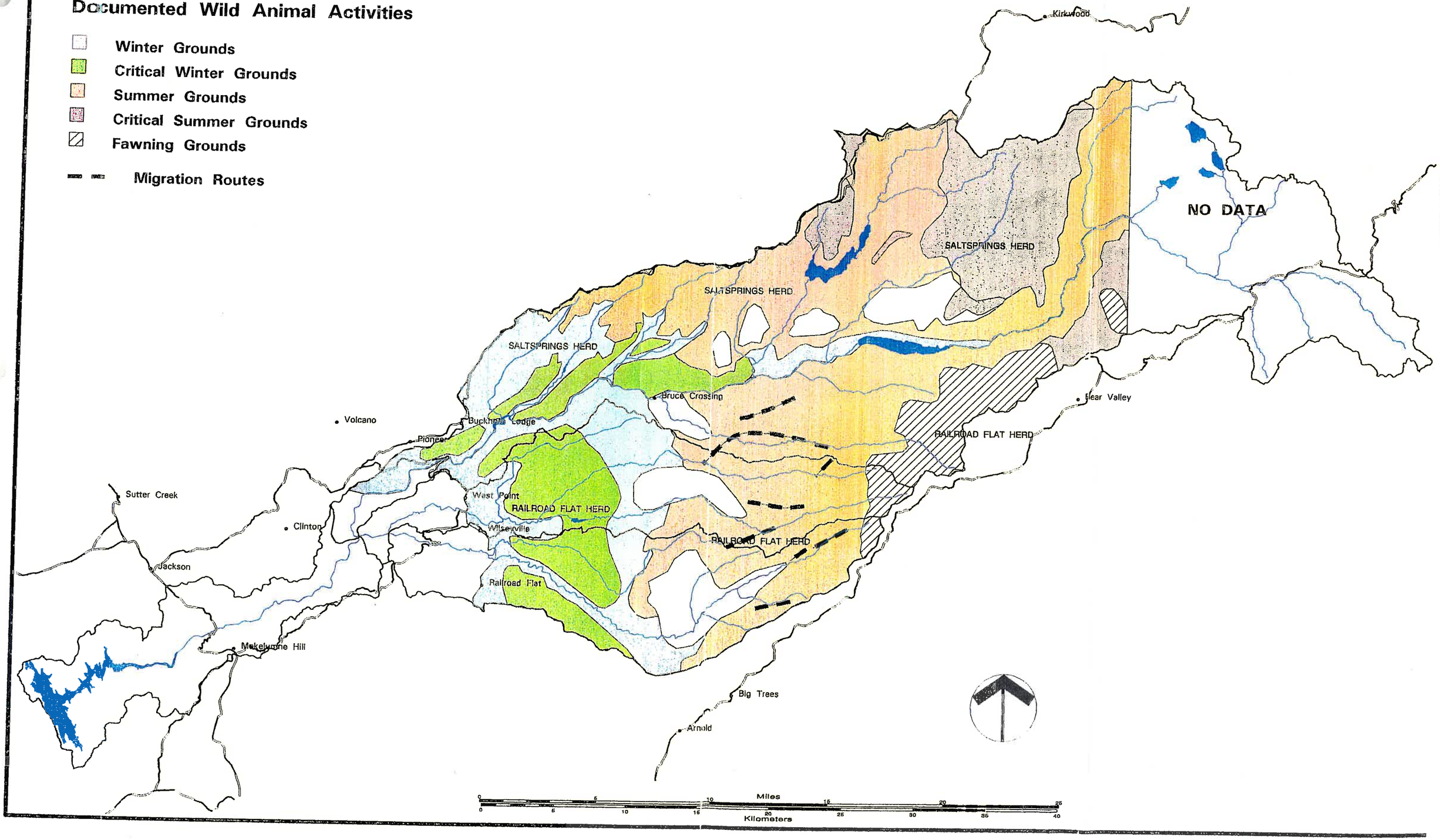
Deer herd migration and seasonal habitat maps, based on those published by the California Department of Fish and Game, are shown in Figure 5-10. As the figure depicts, deer travel through, or reside in, almost all parts of the Upper Mokelumne River Watershed at one or more times of the year.

Upper Mokelumne Watershed

FIGURE 5-10

Documented Wild Animal Activities

- Winter Grounds
- Critical Winter Grounds
- Summer Grounds
- Critical Summer Grounds
- Fawning Grounds
- Migration Routes



The spatial occurrence of other mammal species is not documented, therefore no comparable maps can be generated at this time. However, birds are known to congregate in significant numbers on Pardee Reservoir, and beaver can be expected to reside in any of the mid to upper elevation streams and creeks that support aspen and alder.

North Fork. Wildlife found in the North Fork sub-watershed include all the species documented above that characterize the fauna of the Sierra Nevada Mountains and their lower foothills. The availability of surface water in proximity to dense vegetation along river edges, especially in the canyon bottoms, provides habitat for species that require a permanent water source and dense flora for food, escape, and cover. These river canyons also serve as migration corridors for movement and interchange among wildlife populations in adjoining areas.

Large numbers of deer are found in the upper mountain chaparral and Jeffrey pine regrowth. This cover type is characterized by snowbrush and young conifer regrowth, forming dense, nearly closed stands. Deer access these areas along well-used trails, ridgelines, and roads.

Black bear and mule deer are the two most common big game species in the study area. The resident Salt Springs deer herd can be found on north-facing slopes during the summer and south-facing slopes during the winter. The Railroad Flat deer herd uses the North Fork sub-watershed during the winter.

While not a concern from a potential contaminant source, the North Fork sub-watershed supports a number of fish species. The streambed of the North Fork is dominated by large expanses of bedrock and boulders. This type of streambed creates deep pools, rock crevices, and eddies that provide cover for many species and age classes of fish. Rainbow trout and brown trout are the most common species. Other fish species include Golden Shiner, Roach, Squawfish, Sacramento Suckers, and in some tributaries, Eastern Brook trout. Spawning fish have been observed migrating to the upper reaches in both spring and fall. The primary limiting factor for fish populations appears to be flow. No certification is provided on the relative abundance, species, diversity, or age class differences that may exist.

Middle Fork. The wildlife found in the Middle Fork sub-watershed are typical of those found throughout the Stanislaus National Forest and are not expected to differ significantly from those of the North Fork sub-watershed. The Railroad Flat deer herd (estimated at 6,000 head) occupies the lowest elevations of the sub-watershed during the winter and migrates to the upper elevations during the summer. Some may migrate as far as the North Fork sub-watershed. In addition, documented resident fish do not appear to be significantly different from those of the North Fork sub-watershed.

South Fork. Wildlife found in the South Fork sub-watershed are typical of those found throughout the North Fork and Middle Fork sub-watersheds. Extensive blackberry thickets also provide cover and forage for wildlife in this sub-watershed. As found in the Middle Fork sub-watershed, Railroad Flat deer occupy the lowest elevations of the sub-watershed during the winter and migrate to the upper elevations during the summer. Some may migrate as far as the North Fork sub-watershed. As found in the Middle Fork sub-watershed, documented resident fish do not appear to be significantly different from those of the North and Middle Fork sub-watersheds.

Mainstem. The wildlife found in the Mainstem sub-watershed include a substantial number of species that characterize the foothills of the Sierra Nevada Mountains. Numerous reptiles, amphibians, birds, and mammals of all size ranges inhabit the riparian and upland communities of the Mokelumne River Canyon. Surface waters in proximity to dense vegetation along the river edges and in the canyon bottoms provide vital habitat for species that require a perennial water source and dense flora for escape, cover, and feeding. For example, extensive blackberry thickets provide valuable cover and forage for wildlife. The river canyon itself serves as a migration corridor for the movement and exchange of individuals and groups among population centers. Badgers may forage and breed in open habitats associated with Pardee Reservoir. The oak woodland and riparian habitats also may contain large numbers of badgers. With regards to fish species, the resident fish documented in the Mainstem include: Sacramento suckers, squawfish, hardhead, brown trout, rainbow trout, largemouth and smallmouth black bass, and Kokanee salmon. Spawning fish include trout, channel catfish, carp, and Kokanee salmon. Kokanee salmon have been observed migrating to the upper river reaches near Electra Powerhouse in the fall to

spawn. While species have been documented, no certification is provided on the relative abundance, diversity, or age class differences that may exist.

Livestock. Livestock grazing is an important potential contaminant source because livestock are attracted to watercourses and riparian lands where the vegetation is the most lush and food sources are abundant. Once attracted to these sensitive waterside lands the animals are likely to remain until food supplies are exhausted or they are herded away. As previously mentioned, water quality parameters associated with livestock activities include: *Giardia*, *Cryptosporidium*, fecal coliform, viruses, and nutrients. Livestock are also inclined to physically enter the water for extended periods, and to collapse and trample the banks. These activities introduce unfiltered, undiluted and undegraded wastes directly into the water, and cause the erosion and sloughing of soil materials from damaged banks into downstream water bodies. The most significant potential contaminant concerns related to livestock grazing relate to those activities which occur in riparian zones.

Livestock grazing, primarily cattle, occurs throughout the Upper Mokelumne River Watershed. Both the Eldorado and Stanislaus National Forests are used extensively as open rangeland subject to federal leasing agreements. Sierra-Pacific also permits grazing on its lands subject to U.S. Forest Service lease agreements. The maximum number of cattle permitted is determined annually by the U.S. Forest Service when the leases are negotiated. Numerous private landowners manage ranches dedicated to horses, cattle, and sheep. A small percentage of the pastures are irrigated where water supplies permit, and the rest are utilized as dry pasturage. No significant penning or product processing areas was identified on the watershed, and the calving/lambing and transport loading areas were judged to have no special overall significance due to their extremely small areal extent.

There are 12 permitted grazing allotments within the Upper Mokelumne River Watershed that are managed by the Eldorado and Stanislaus National Forests. As depicted in Figure 5-11, the allotments located on the north side of the North Fork Mokelumne River are permitted by the Eldorado National Forest, while those on the south side are permitted by the Stanislaus National Forest.

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Upper Mokelumne Watershed

FIGURE 5-11

Grazing Allotments
Number of existing cows

- 0
- 1 - 100
- 101 - 200
- 201 - 300
- > 300

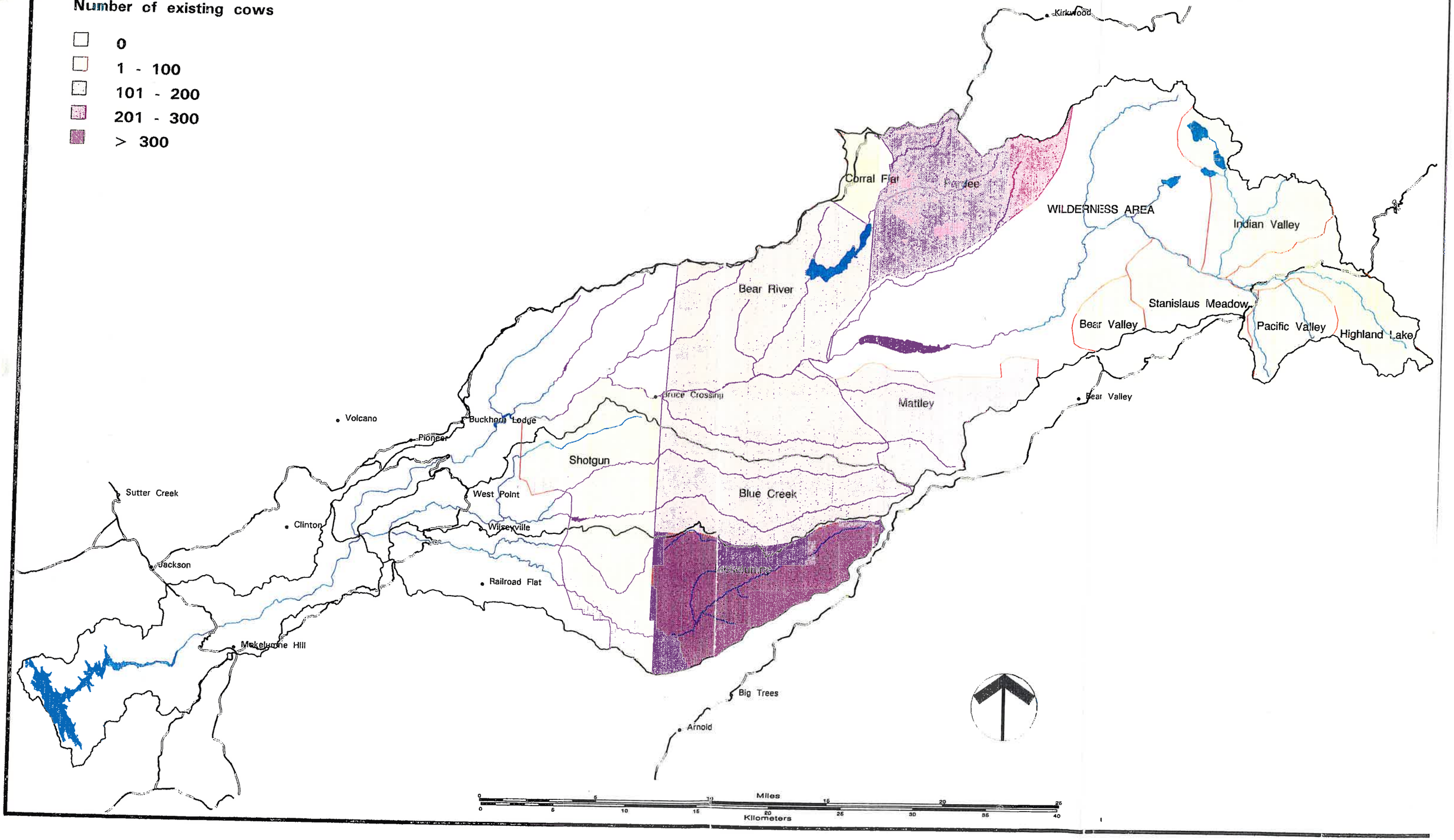


Table 5-11 shows the total permitted numbers of livestock (cows and calves) grazed on each allotment. It also shows the estimated numbers of livestock being grazed on those portions of each allotment that lie within each sub-watershed. These estimates were based on a GIS analysis that included the assumption that the numbers of livestock grazed on each allotment in the watershed were proportional to the percentage of the area of the allotment lying within the watershed. The table shows that cattle grazing is fairly evenly distributed throughout the sub-watersheds.

Table 5-11: Upper Mokelumne River Watershed - Livestock Grazing Allotments

Permitted Allotment Name	Permitted Number	Estimated Number of Calves/Cows	Permitted Period	Animal Unit Months of Forage[1]
North Fork				
Bear River	168	168	06/15 - 09/30	588
Corral Flat	24	24	07/11 - 09/30	60
Pardee	224	224	07/16 - 10/10	672
Shotgun	271	30		
Lower Blue	338	150		
Mattley	171	171		
Bear Valley	145	40		
Stanislaus Meadow	100	60		
Pacific Valley	230	40		
Highland Lakes	215	100		
Subtotal	1,886	1,007		
Middle Fork				
Lower Blue	338	185		
Shotgun	271	120		
Subtotal	609	305		
South Fork				
Mokelumne	328	328		
Shotgun	271	100		
Subtotal	599	428		
Main Fork				
EBMUD managed		750	Oct-May	7,675
Subtotal		750		7,675

[1]Annual unit months of forage = Animal units/month x number of months.

Source: *EBMUD, November 2000*
U.S. Forest Service, Pacific Southwest Region, 1994

The District permits limited grazing leases on its land adjacent to Pardee and Camanche Reservoirs. At this time, there are ten grazing leases in the Mainstem sub-watershed, covering 12,093 acres. The leases allow for the utilization of 7,675 animal unit months of forage.

Beyond District lands in the Mainstem sub-watershed, no presently used allotments were identified. Since permits are not required to raise livestock on privately owned land, County or State agencies do not keep records on the number of livestock raised on these private lands. There are no major feedlots within the Upper Mokelumne River Watershed nor is there any agency, outside of the RWQCB, that has the authority to oversee livestock waste management.

Recreation

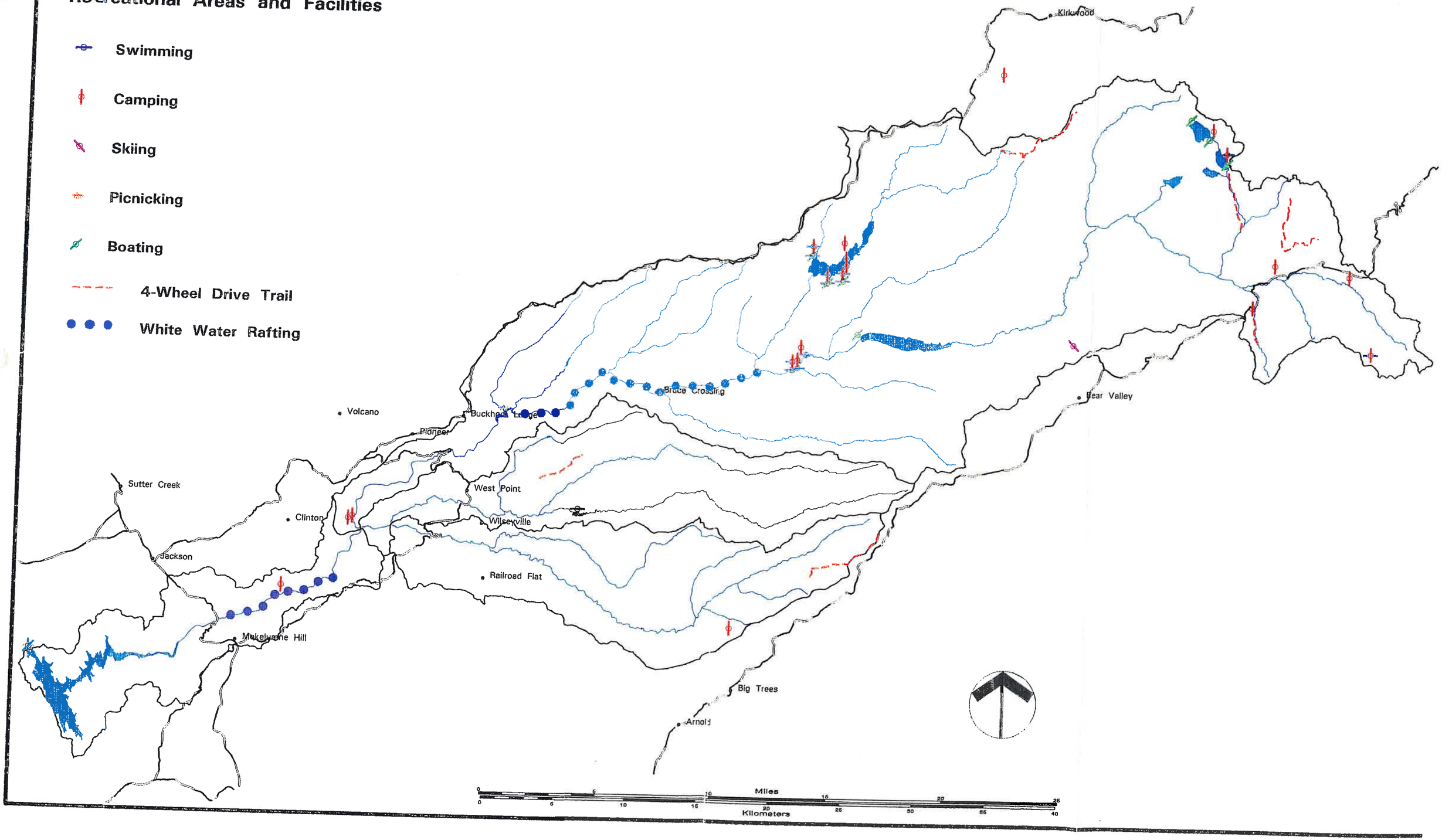
Numerous activities are included under the heading of recreation, as depicted by Figure 5-12 for the Pardee Watershed - camping, equestrian activity, boating, fishing, day-use activities, hiking, bicycling, picnicking, skiing, swimming, white water rafting, and off-road vehicle use. Recreation associated with the District's facilities within the Pardee Watershed is addressed under the section entitled *EBMUD Facilities*.

Upper Mokelumne Watershed

FIGURE 5-12

Recreational Areas and Facilities

- Swimming
- Camping
- Skiing
- Picnicking
- Boating
- 4-Wheel Drive Trail
- White Water Rafting



Hiking, off-road bicycling, off-road vehicle use, and equestrian riding generate particulates from erosion, especially off trails or on steep, unstable slopes. Public access to remote areas of the watershed increases the risk of fire, as well as vandalism. Potential impacts from sanitation facilities were discussed in the *Sanitation* section. Inappropriate disposal of human waste may result in the transmission of disease-causing microorganisms, and increase nutrient loading to adjacent waterbodies. The impacts of equestrian facilities and uses correspond to wildlife and livestock impacts described previously. In general, equestrian facilities and uses are potential contaminant sources for microbiological parameters, nutrients, and particulates.

Body-Contact Recreation. All known body-contact water recreation sites within the watershed are contained in the North Fork and Mainstem sub-watersheds. Body-contact water recreation sites within the North Fork sub-watershed, are depicted in Figure 5-12 and summarized in Table D-8 of Appendix D. The most prominent body-contact recreation along the North Fork occurs at the Bear River Resort and group facilities, while Blue Lakes and Bear River South Shore rank next highest in use, respectively. Moore Creek and White Azalea also receive significant levels of public usage. White water recreation opportunities exist from the Bear River confluence down to Tiger Creek Afterbay. The first run (Class III-V) which extends from Bear River to Devil's Nose, is suitable for intermediate to advanced kayakers and rafters, depending on the volume of flow. The second run (Class V), which continues from Devil's Nose to Tiger Creek, is suitable only for expert boaters. These runs receive minimal use since access is very difficult, over poorly maintained logging roads, and there are no facilities.

The body-contact water recreation sites within the Mainstem sub-watershed are depicted in Figure 5-12 and documented in Table D-8 of Appendix D. Potential body-contact recreation in this sub-watershed is limited to three PG&E picnic sites with a total of 27 picnic tables. These facilities are provided with vault toilets that are maintained by PG&E. PG&E does not keep records of day use.

White-water recreation opportunities are present on the Mainstem from the confluence of the North, Middle, and South Forks downstream to Highway 49. The first run (Class III), which begins at Ponderosa Run, two miles below Tiger Creek Afterbay, and extends to the Electra Picnic area, is intermediate in difficulty, and just beyond the capability of open canoes. The Electra Run, from Electra Picnic Area to State Route 49, is the most heavily used

stretch on the Mokelumne River. It is used by rafters, canoeists, inner tubers, and kayakers. There have been a number of requests and prior discussions about the possibility of extending white-water recreation opportunities downstream to Middle Bar Bridge. No consistent records or detailed estimates of numbers of white-water recreationists are kept on any of the river reaches. Rough estimates from the Amador County Sheriff's Department indicate that on a typical summer weekend day approximately 30 kayakers, inner-tubers, canoeists and other river floaters utilize the river.

Non-Body-Contact Recreation. Primary non-body-contact recreational activities in the watershed consist of fishing, camping, hunting, boating, alpine skiing, cross-country skiing, hiking/backpacking, snowmobiling, wildlife observation, nature photography and mountaineering. Most of the activities occur on public lands or at public recreation facilities above 2,000 feet in elevation, in the snowbelt, and where summertime temperatures are cooler. Recreation on Sierra-Pacific Industries 81,000 acres has been reduced since the company began restricting access to its logging road system.

Recreation on U.S. Bureau of Land Management lands is not managed and there are no recreational facilities. Recreational use consists primarily of hiking, hunting, fishing and wildlife viewing along, and near, unpaved roads throughout its 171,700 acres of owned lands.

Figure 5-12 illustrates the location and type of significant watershed recreation sites. As can be seen, all but one are located in the North Fork and Mainstem sub-watersheds. The location of hiking trails, off-road vehicle roads, and river boating runs are also shown. The greatest amount of watershed recreation occurs in the North Fork sub-watershed, on the U.S. Forest Service National Forest lands. These lands include both those of the Stanislaus and Eldorado National Forests. Table 5-12 shows Forest Service recreational facilities in this sub-watershed, and the activities they support. Body-contact recreational activities and facilities were reported in the previous section.

Table 5-12 - Upper Mokelumne River Watershed - U.S. Forest Service Recreational Activities (1995 MRWSS)

Recreation Sites	Elev. (ft)	Months of Use	Family Camp Units	Group Camp Units	Picnic Units (day use only)	Store Within 5 miles	Toilets Flush/ Valve	Stream or Lake Water	Forest Service Campground	Group Campground	Picnic Areas	Picnic Area other than Forest Service	Hiking	Observation Point	Fee	Boating	Boat Ramp	Fishing	Swimming	Drinking Water	Rec. Vehicle
El Dorado National Forest																					
Bear Creek	3,200	5/01-10/01			3	NO	V	YES			X										
Bear River Group	6,000	6/15-10/15		3		YES	V	NO		X			X		X	X	X	X	X	X	
Lumberyard	6,500	6/01-10/31	8			YES	V	NO	X									X		X	X
Mokelumne	3,200	5/01-11/15	8			NO	V	YES	X									X	X		
Peddler Hill	6,800	6/01-11/15				NO		NO						X							
Salt Springs	3,900	5/01-11/15			4	NO	V	NO			X					X		X			
Shot Rock	7,500	6/15-11/15			3	NO	V	NO			X			X							
South Shore	5,900	6/01-11/15	22			YES	V	NO	X				X	X	X	X	X	X	X	X	X
Tragedy Springs	7,900	6/15-10/15			3	YES	V	NO	X											X	
White Azalea	3,500	5/01-11/15	6			NO	V	YES	X									X	X		
Stanislaus National Forest																					
Bloomfield	8,000		10				V											X	X		X
Moore Creek	3,200	5/01-11/15	8			NO	V	YES	X									X	X		X
Hermit Valley	7,500		6				V											X	X		X

Pollution controls within National Forest lands are primarily the responsibility of the U.S. Forest Service. The controls are implemented through the standards, policies and guidelines established in the Land and Resources Management Plans of each National Forest. The controls are enforced by the Forest Supervisors' and the individual Rangers' offices in accordance with their individually established procedures.

Schaad's Reservoir is the only significant recreational site located in the Middle Fork sub-watershed. It is a private facility of very limited size which allows only camping and fishing. It is difficult to judge how well these facilities are maintained due to lack of access authorization. Some water quality monitoring downstream from the facility is needed to confirm that there are no adverse impacts on water quality originating from this source.

There are no significant recreational facilities located in the South Fork sub-watershed. With the exception of recreation areas below Electra Powerhouse, all recreational facilities located within the Mainstem sub-watershed occur on District lands and are addressed under the section entitled *EBMUD Facilities.*

The intensity of body-contact and non-body-contact recreation and use is indicated by the number of recreational sites and visitor days reported by Eldorado and Stanislaus National Forests, PG&E, and the District. All of the recreational areas and facilities that were inspected were found to be in generally excellent hygienic condition with minimal litter and garbage residues. For the most part, hiking trails did not appear to be subject to excessively heavy use, and no areas of abuse or litter were found. Restroom facilities were generally clean and well maintained.

This is not to say that problems are not likely to occur in the future. As recreational pressures increase due to increasing populations and increasing needs of the populace to periodically escape from urban congestion, it is probable that existing facilities will be overtaxed unless expanded. Thus adequate monitoring of water quality in the streams and sanitary conditions at the recreational sites will be needed to forestall problems before they become significant.

Off-Road Vehicle Use. Off-road vehicle use has been a widespread and severely damaging human activity within the Upper Mokelumne River Watershed. Extraordinary efforts have been required in some cases to curtail damage to unsurfaced roads on privately controlled and patrolled lands. Public and minimally patrolled lands are especially vulnerable to damage. The locations of some of the off-road vehicle roads are indicated on Figure 5-12.

Runoff from unsurfaced roads, landings, and skid trails has been shown to be a major source of sediments and associated water quality constituents or contaminants. Erosion from such roads increases when they are subjected to use during wet weather. Unsurfaced roads on Sierra-Pacific lands have been closed in recent years to control erosion at the onset of wet weather, however it has proved difficult to impose controls upon private off-road vehicle owners. Because of the undue amounts of road damage, and highly visible associated erosion/sedimentation, Sierra-Pacific found it necessary to test and implement various methods of limiting access to vulnerable roads.

One of the first methods to be attempted was the installation of earthen berms at access points; however, these were soon bypassed or circumvented. Eventually, Sierra-Pacific was forced to install locked steel gates at most points of access to its logging road network. Although many of the gates were protested and, in some cases, vandalized or broken through, there was an overall, dramatic reduction in the known illegal usage of the logging road network, and associated damage and erosion. Such methods are much more difficult to implement or are completely impractical on publicly owned lands due to the concept of public freedoms on national public lands, and the expense of maintaining physical constraints on protected U.S. Forest Service lands.

Although not substantiated in the field, in the North Fork sub-watershed, only two major erosion problem areas of off-road vehicle use damage were reported by the U.S. Forest Service. The first area is in the Eldorado National Forest portion of the North Fork sub-watershed, just downstream from Salt Springs Reservoir, immediately adjacent to the river. Damages included destruction of waterbars, campground facilities and culverts. The second area is along a segment of the Old Carson to Big Trees Wagon trail, in the vicinity of Deer Creek and Deer Valley Road. Similar damage was recorded in this area. Control measures which included reconstruction, signing, and intensified enforcement of off-road vehicle regulations have been fairly effective.

Within the Middle Fork, South Fork, and Mainstem sub-watersheds, access control has been somewhat effective at keeping off-road vehicles off vulnerable earthen roads. Despite local evidences of damage, the Upper Mokelumne River Watershed appears to be in generally good condition. Sierra-Pacific has taken significant steps toward controlling and repairing off-road vehicle damages on its lands. Other private landowners are increasingly turning to fencing and gating to prevent damaging intrusions of off-road vehicles but it remains unchecked at this time. This leaves the 171,000 acres of U.S. Forest Service non-wilderness lands as the major area of concern with respect to off-road vehicles in the watershed.

Increased vigilance and more intensive control programs may be needed now and in the future to adequately protect the watershed in the face of intensifying development and recreational use pressures. The problem is potentially serious and could cause future water quality problems in Pardee and Camanche Reservoirs, the lower Mokelumne River and the tributary streams of the watershed.

Mines

Mines and quarries have the potential for being identified as contaminant sources for turbidity, radionuclides, general minerals, metals, oil, grease and hydrocarbons depending upon type of materials being processed and the size of operation. Three permitted mines are identified as being active in the Upper Mokelumne River Watershed -- one in the North Fork sub-watershed and two in the Middle Fork sub-watershed. Table 5-13 summarizes information pertaining to these mines and Figure 5-13 highlights the location of each mine. These privately owned, permitted mines are believed to be operated one or two days a week. As of the 1995 MRWSS, State and local agencies report that water quality concerns associated with drainage waters were non-existent.

Table 5-13: Mines in the Upper Mokelumne River Watershed

Sub-Watershed	Number	Location Name	USGS Coordinate	Product
North Fork	67	Yellow Aster Mine West Point 7.5	38.398, 120.574	Lode Gold
Middle Fork	58	WR Mine West Point 7.5	38.388, 120.568	Lode Gold
	64	Blackstone Mine West Point 7.5	38.386, 120.575	Lode Gold
South Fork	None	--	--	--
Mainstem	None	--	--	--

Source: California Department of Conservation, Division of Mines & Geology,"Mines and Mineral Producers Active in California," Special Publication No. 103, 1988-1989, 1990.

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Upper Mokelumne Watershed

FIGURE 5-13

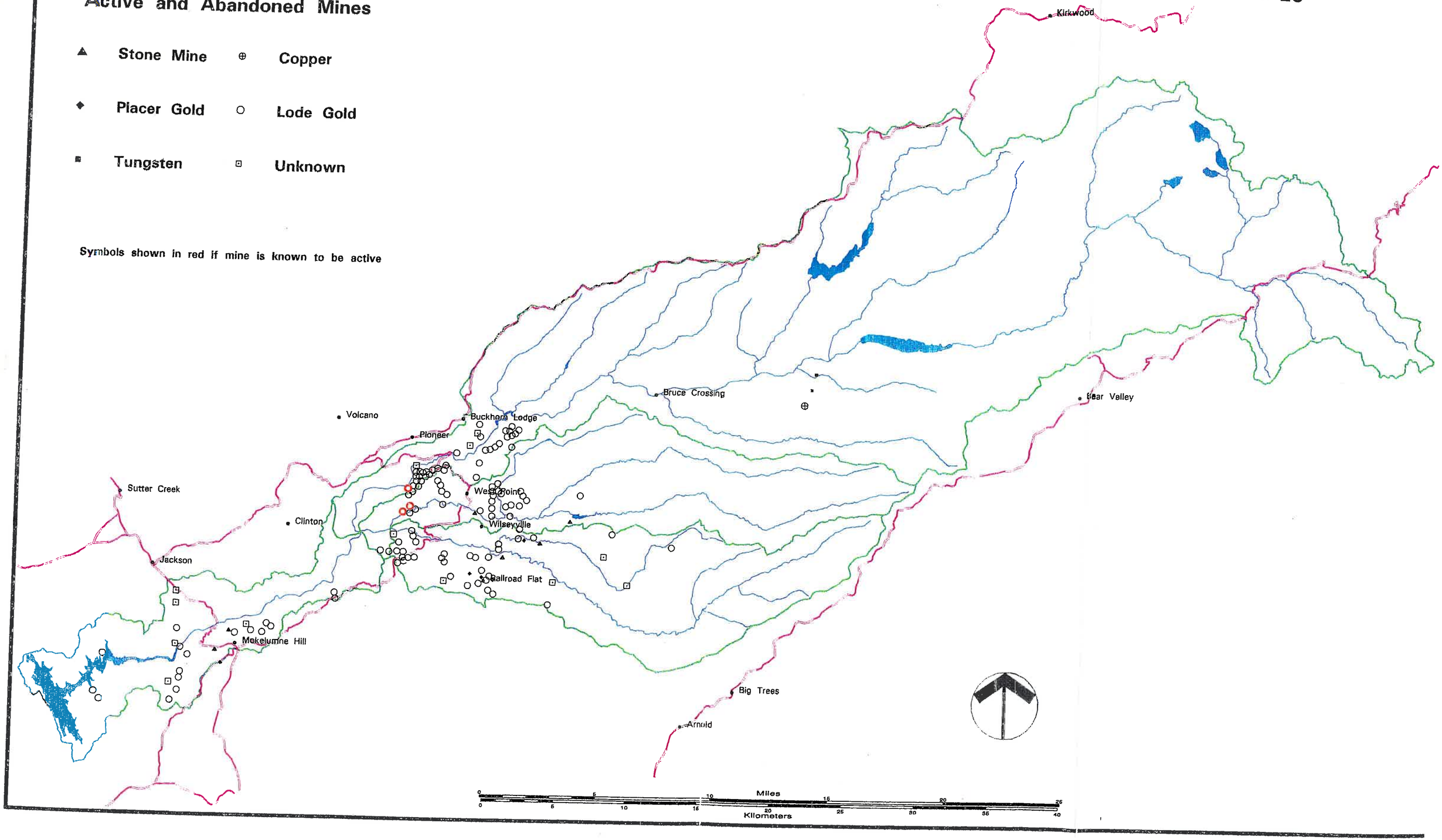
Active and Abandoned Mines

▲ Stone Mine ⊕ Copper

◆ Placer Gold ○ Lode Gold

▪ Tungsten ⊡ Unknown

Symbols shown in red if mine is known to be active



With regards to Gwin Mine, an unpermitted mine, the District received notice from its owner in 1997, that emergency remediation measures were being implemented to control an hydraulic discharge at the main shaft caused by the heavy rains of 1997. Gwin Mine is a gold mine located adjacent to an intermittent stream that empties into the Mainstem of the Mokelumne River at the headwaters of Pardee Reservoir. The owner had been conducting water quality sampling as the first step toward receiving approval from the RWQCB to dewater the mine. They found that due to the storm events in 1997 that surface waters were mixing with mine water and being discharged at the main shaft of the mine into a stream. Elevated levels of arsenic and sulphur concentrations were found to exist in these waters and as the water exited the mine sulphur and dolomite precipitated along the streambed for 200 yards. After this distance, the mine water was diluted by the surface waters and precipitates no longer occurred. Three emergency efforts were pursued by the owner -- sealing the entrance points where surface waters entered the mine, interim onsite treatment of discharge from the main shaft for arsenic and sulphur, and placement of a geochemical barrier downstream to neutralize any potential acidity.

The locations of abandoned mines, tailings, and ore processing areas are also depicted in Figure 5-13. Although none are known to be causing any significant water quality degradation problems, their cumulative effect could be significant, especially in the case of mines that historically undertook considerable on-site ore processing.

Geologic Hazards

Soil erosion is the primary geologic hazard in the Upper Mokelumne River Watershed. Suspended sediment in a water supply reservoir can cause turbidity problems. Phosphorus and nitrogen, which associate with sediments, promotes algae blooms and reservoir increases in biological oxygen demand during the summer. Sediment is transported to reservoirs either directly or in tributary creeks especially after heavy rainfall.

The risk to a water supply is greatest when erosion occurs near the reservoir itself, since small rainfall events can transport sediment over a short distance. Large storms can transport sediment from throughout the watershed. Erosion is most likely to occur where the land has been disturbed, exposing bare soil. Road cuts on

steep slopes are a major source of sediment erosion. Landslides, fires, or disturbances by animals are other modes by which the erosion risk increases. While heavy rainfall is the primary cause of landslides in the Upper Mokelumne River Watershed, earthquakes can also trigger landslides.

The Upper Mokelumne River Watershed has been a very active area for erosion and landslide activity. Unstable geologic formations and erosion-prone soils combined with steep, sparsely vegetated slopes that are prone to flash floods and avalanches, produce chutes, gulleys and side canyons that are extremely prone to rockfall and landslides. Figure 5-8 illustrates the results of a previous analysis of erodibility of watershed soils along with the historic occurrence of landslides and/or major gulley erosion in the river canyons up until 1974. As can be seen, all of the documented major earth movements in the watershed up until that time, occurred in the North Fork and Mainstem sub-watersheds.

The major landslide area to the southwest of Mount Reba has been, and continues to be, the most active site. No measurements have been made of mass or volume, however, it appears to be the largest single source of landslide-derived rock and soil debris to the riverbed within the entire watershed. Although only anecdotal information is available, major turbidity events in the river and at the District's water treatment plant influents have been traced upstream to this source.

Fire and Fire Management

Enhanced by topography, climate, vegetation type, and land use, fire risk is a serious erosion threat in the Upper Mokelumne River Watershed. Naturally and human-caused wildfires are a common historical occurrence in the Sierra Nevada mountains, especially in the 3,000 to 7,000 foot elevation range. Lightning has been a consistent cause, while the ever-increasing pressure of human activities has caused a steady overall increase in the historical incidence of human-caused fires. Fire created by activities along the roadside or trails, such as discarded smoking materials, catalytic converters, or vehicle fires, could have significant negative impacts on the water quality of Pardee Reservoir resulting from the increased erosion during rainfall events. In addition, slash burning following logging which is a common practice should be documented since it is known to be a significant source of nutrients.

Annual herbaceous vegetation produces large quantities of fire fuel. A fire would result in a loss of vegetation thus exposing the soils to the direct impact of rainfall, which then reduces the infiltration capacity and increases runoff. With the loss of vegetation, rainfall does not collect and flow along established depressions, but is dissipated rapidly as sheet flow. Another condition resulting from fires that would contribute to increased erosion is the creation of hydrophobic soils. The increased erosion that would follow a wildfire is one of the greatest potential contaminant sources in the Upper Mokelumne River Watershed as it would increase the amount of sediments, nutrients, and organic material in the tributaries and reservoir.

Not only are fires a contaminant threat, but management measures such as pesticide (herbicide) applications and maintenance of fire roads to reduce fire risk may impact reservoir water quality as well. In addition, mechanical means of vegetation management tend to crush or chop the vegetation and may cause soil disturbance but leave the vegetation matter in place, thus not reducing the fire load except when the vegetation is forced into the soil allowing it to decompose. Grazing can effectively decrease the likelihood of a wildfire by reducing the volume of fuel available. Nevertheless, fire management practices typically decrease the potential for water quality contaminants in the receiving water bodies by decreasing the likelihood of a wild fire. Site visits are important when determining the type of fire management controls that should be taken. The site assessment is based on application objectives, vegetation type, recent and anticipated rainfall, adjacent land uses, and products available to accomplish the management needs.

Although there have been some disastrous fires in the recent history of the Sierra Nevada, the Upper Mokelumne River and Camanche Watersheds has been spared for the most part. In general, most of the fires have been very minor in extent. However, the 1992 Cleveland fire on 25,000 acres of the South Fork American River watershed bears testament to the potential for, and impacts of, a large and intense conflagration. Under drought conditions, the dense, uniform-age timber of this previously clear-cut site, produced an extremely hot fire that left nothing behind but a loose, powdery mixture of scorched, inorganic earth and ash. This surface mixture is now highly prone to rapid erosion when there is runoff, and to mudslides when the ground becomes saturated.

With regards to the Upper Mokelumne River Watershed, only one major fire was recorded in the North Fork sub-watershed during the past 30 years. This fire occurred in the Eldorado National Forest above the Bear River Reservoir during the 1960s and consumed approximately 10,000 acres. Little is known about the general conditions and rates of erosion that resulted from this fire. However, any significant amount of sedimentation that resulted from erosion in the burned area would have been contained within the Bear River Reservoir during the first 10 years following the fire. Since 1995, The U.S. Forest Service has initiated a process of compiling historical data regarding documented fires.

The Stanislaus National Forest includes the south bank of the North Fork sub-watershed, as well as the Middle Fork and South Fork sub-watersheds. Table 5-14 summarizes the fire occurrences that have been recorded for the Stanislaus National Forest lands within the Upper Mokelumne River Watershed for the period 1989-1999. The data does not cover the Mainstem sub-watershed and watershed lands that are within the California Department of Forestry and Fire Protection fire fighting jurisdiction. Fire data for the Eldorado National Forest is shown in Table 5-15 for the period 1994-1999.

Table 5-14. History of Stanislaus National Forest Fires (1989-1999)

Year	Number			Acres		
	Human-Caused	Lightning	Total	Human-Caused	Lightning	Total
1989	4	4	8	0.4	1.8	2.2
1990	2	9	11	3.5	1	4.5
1991	4	7	11	104.6	1.6	106.2
1992	3	2	5	6.1	0.2	6.3
1993	4	0	4	0.4	0	0.4
1994	1	2	3	0.1	0.2	0.3
1995	1	1	2	0.1	0.1	0.2
1996	2	2	4	0.6	0.2	0.8
1997	5	3	8	1.3	0.6	1.9
1998	1	1	2	8	0.1	8.1
1999	0	7	7	0	728.3	728.3

Source: U.S. Forest Service, Stanislaus National Forest, November 2000.

Table 5-15. History of Eldorado National Forest Fires (1994-1999)

Year	Number			Acres		
	Human-Caused	Lightning	Total	Human-Caused	Lightning	Total
1994	9	4	13	20.8	2.3	23.1
1995	0	1	1	0	1	1
1996	1	4	5	1	41.2	42.2
1997	2	2	4	0.2	7.1	7.3
1998	2	9	11	0.2	0.9	1.1
1999	5	9	14	0.5	3.7	4.2

Source: U.S. Forest Service, Eldorado National Forest, December 2000.

Figure 5-14 shows the areas within the watershed that is known to be highly prone to fire danger. Numbers of fires were documented for each sub-area. Also, indices were calculated to indicate the rapidity with which each fire spread (spreading index) and the relative intensity of "hotness" of each fire.

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Upper Mokelumne Watershed

FIGURE 5-14

Fire-Prone Areas

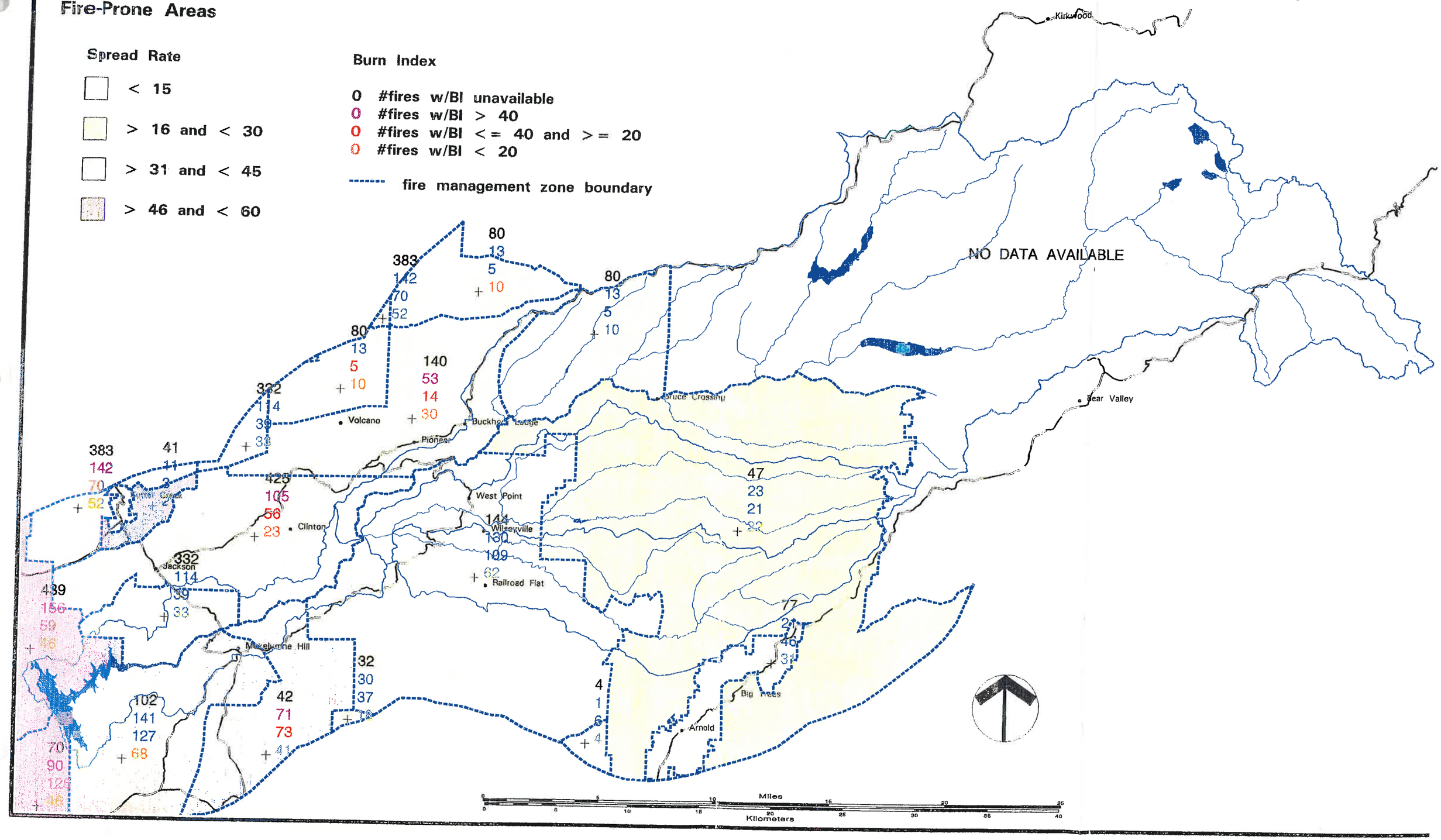
Spread Rate

- < 15
- > 16 and < 30
- > 31 and < 45
- > 46 and < 60

Burn Index

- 0 #fires w/BI unavailable
- 0 #fires w/BI > 40
- 0 #fires w/BI <= 40 and >= 20
- 0 #fires w/BI < 20

fire management zone boundary



Data regarding the wildfires that have been recorded in the Mokelumne River watershed indicated that they have caused very few long-term effects on turbidities, sedimentation, or other water quality-related parameters measured in the watershed. Most of the seriously burned acreages have now been reforested.

Potential future fires give more cause for concern. The impact of a catastrophic fire would be significant, its magnitude depending on size, location and distance from the river or tributaries. The cumulative watershed effect of many small wildfires is largely unknown, but probably slight, due to the high assimilative capacity of the surrounding unburned lands.

Fire danger is greatest on lands that are not managed to reduce fuel supplies, provide fire breaks, or afford ready access by fire fighters and their equipment. This is most extreme in remote canyons and on the steep, densely vegetated canyon walls. Clear and select cut timber harvesting serves to temporarily lower fire danger by reducing fuel supplies, increasing the spacing between fuels, and ensuring for the routine presence of short response-time work crews within the forested areas. Most fires are discovered and extinguished during their early, manageable stages by on-site logging personnel, backed up by on-call California Department of Forestry and Fire Protection, and U.S. Forest Service fire fighters.

Official fire management and control responsibility in the National Forests belongs to the U.S. Forest Service. Responsibility on private lands is shared by the California Department of Forestry and Fire Protection, local fire districts, and private landowners. Prescribed burns are frequently conducted, especially on federal lands, to prevent or eliminate excessive accumulations of fuel and to open up firebreaks. This measure is being implemented to reduce the probability of catastrophic fires in the future.

Logging

Logging is the major land use activity in all of the sub-watersheds except for the Mainstem of the Mokelumne River. Logging causes soil disruption and can contribute to erosion, landslides and the associated sedimentation and nutrient releases as a contaminant source. Figure 5-15 shows logging activities in the watershed approved by the State of California, based on the record of approved state timber harvest plans (THPs). The figure does not show logging approved by the U.S. Forest Service, which totaled 72 million board feet from 1988 through 1994. On National Forest lands, the U.S. Forest Service is primarily responsible for approval of logging and for the control of erosion and other potential sources of pollution. Together, the Eldorado and Stanislaus National Forests combined include 171,699 acres of land in the watershed.

On private lands, the California Department of Forestry and Fire Protection is responsible for enforcing the regulations of the California Forest Practice Act. The regulations require submittal and advance approval of Timber Harvest Plans (THPs) for all significant harvesting efforts for each three-year time segment. Sierra Pacific Industries is the largest current private landowner (owns approximately 23 percent of lands) and timber harvester, operating on both its own, U.S. Forest Service lands, and other private lands in the Upper Mokelumne River Watershed. Timber harvesting volumes are estimated at 50 to 65 million board feet per year.

Timber harvesting activities are believed to be responsible for the release of several constituents of concern including sediments, nutrients and total coliform bacteria. While the impacts of individual THPs may not be significant, the cumulative impacts of numerous operations throughout the watershed are considered significant.

In a recent watershed assessment conducted by Sierra Pacific, a susceptibility assessment of the properties (planning watersheds) owned by Sierra Pacific was conducted. Of the 44 CalWater planning watersheds in the Upper Mokelumne River Watershed, 26 are owned by Sierra Pacific. Water quality, water quantity, and the potential to affect stream channels were the key issues addressed in this synthesis. Erosion associated with timber harvesting, road crossings, and erodible soil types was the key factor considered when determining susceptibility. Thirteen of the 26 Sierra Pacific

properties were found to have a high susceptibility and 13 properties had a low susceptibility to erosion. The specific locations of activities within each planning watershed, which affect the susceptibility, were not identified. However, the ecological consequences associated with the following activities were identified as part of this process -- gold mining, gravel mining, dams, hydroelectric generation, timber harvesting, urbanization, and grazing. This process is similar to the identification of potential contaminant sources documented herein as part of this MRWSS Update 2000. As a result of this assessment, Sierra Pacific developed integrated management recommendations pertaining to new timber harvests, forest practices, restoration strategies, landscape management, and monitoring and adaptive management.

Herbicides. The U.S. Forest Service is one of three major applicators of herbicides in the Upper Mokelumne River Watershed. The major applicators are Caltrans (as discussed under the section entitled *Transportation*) and Sierra Pacific Industries. The U.S. Forest Service program consists of selective pesticide applications to reduce the growth of scrub vegetation and promote the growth of production timber. Figure 5-9 highlights 10 areas, representing 330 acres, in the North Fork sub-watershed where the U.S. Forest Service sprays herbicides. Garlon, Accord, and Pronone are the three herbicides used on these 330 acres. Some solutions are applied in the spring others during the fall or winter. Table D-3 in Appendix D summarizes the pesticides used on these 330 acres. No pesticides are stored on Eldorado and Stanislaus National Forestlands within the Upper Mokelumne River Watershed. Pesticides are transported via road as necessary to reach stands that are to be treated, with the exception that no transport is allowed across the dam on Bear River Reservoir.

Table 5-16 contains pesticide use information by Sierra Pacific Industries as reported to the Amador and Calaveras Agricultural Commissioner's Offices for the period 1997 (partial) to 1999. Records show that even-aged management (clearcutting) practices have been applied to Sierra Pacific lands to a greater extent than previous owners (Georgia-Pacific). Even-aged management practices often rely more heavily on chemical control of competing vegetation than selective harvesting.

Table 5-16: Pesticide Use on Mokelumne River Watershed Land Owned by Sierra Pacific Industries (1997-1999)

Pesticide	EPA Registration	Amount of Pesticide Applied (gallons, undiluted) 1997 (partial records)	1998	1999
Attrex 4L (Atrizine)	100-497	0	110	46
Esteron 99 C (2,4-D)	62719-9-264	119	122	66
Garlon 4 (Triclopyr)	464-1	4	0	0
Pronone 10G (Granular hexazinone)	33560-21	3000 lbs	2200 lbs	175 lbs
R-11 (Spreader, activator)	2935-50142	59	100	46
Roundup (Glyphosate)	various	108	231	135
Velpar L (Liquid hexazinone)	352-392	954	1422	1366

Source: Sierra Pacific Industries Pesticide Use Reports as filed with Amador and Calaveras County Agricultural Commissioner's Offices, December 1999.

Erosion. Improper harvesting and poor construction of landings, skid trails and roads, as well as poor culvert design and installation techniques, can have major effects on the runoff water quality from harvested areas. The impacts on downstream public water supplies are both long lasting and difficult to correct. Increased turbidity levels and sediment transport can increase treatment costs and reduce the effectiveness and reliability of the disinfection process for bacterial, protozoan, and viral contaminants. Nutrients released as a result of the leaching of denuded or eroded soils following logging can cause eutrophication of streams and lakes and lead to increased algae growth and dissolved oxygen depletion. Potential consequences of excessive eutrophication can include formation of toxic amounts of hydrogen sulfide, taste and odor problems, and the formation of humic compounds. The increased presence of humic compounds can increase the formation potential for trihalomethanes and other disinfection byproducts, which are a major concern for domestic water suppliers in the water disinfection process.

Cumulative Impacts. A significant issue with respect to logging in the Upper Mokelumne River Watershed is the lack of adequate consideration of cumulative watershed impacts from multiple timber harvesting operations on both public and private lands. Cumulative impacts tend to be greater than the sum of the individual impacts. For example, the erosive power of runoff is amplified when there is insufficient undisturbed land surrounding logged areas to absorb the increased runoff and reduce downslope flows to other downstream logging sites to background levels. Moreover, inadequate consideration of cumulative watershed impacts by the U.S. Forest Service and the California Department of Forestry and Fire Protection can lead to the approval of more timber sales and timber harvesting plans than may be advisable from the standpoint of full watershed protection.

Publications documenting mathematical modeling evidence, combined with empirical evidence, that water yields, especially from the South and Middle Fork sub-watersheds, have increased as much as 20 percent historically, primarily as a result of reduced evapotranspiration from the forest canopy in logged areas. Such increases also increase the magnitude and duration of peak flows resulting in the mobilization of more sediments which were eroded from skid trails, landings and timber harvesting roads and then deposited in stream channels. In addition to the physical impacts, the sediments would carry increased quantities of nutrients into the streams and reservoirs.

A study of cumulative impacts of logging in the Middle Fork sub-watershed over several-year duration was conducted. This study indicated that increased erosion and stream sedimentation might occur during a wet year. However, the study was limited by the occurrence of the drought. The relatively low peak flows over the eight years covered by the study were not found to be effective at mobilizing and transporting sediments. Additional studies under more normal hydrologic years are needed to assess and quantify the impacts.

Unauthorized Activities

Unauthorized activities within the Upper Mokelumne River Watershed can contribute to a myriad of contaminants entering the Mokelumne River and ultimately Pardee Reservoir. Roadways leading into or through the watersheds, increase the potential for unauthorized activities such as illegal dumping. Illegal dumping and trespassing may impact reservoir water quality by introducing contaminants from materials dropped into creeks or the Mokelumne River leading directly into the reservoir. The illegal dumping of household wastes and appliances is a common ongoing problem within watersheds. In addition, occurrences of commercial dumping (e.g. concrete blocks, creosote logs, tires) has also occurred. Illegal dumping will likely increase as the population increases and as landfill and garbage disposal rates rise. Given the size of the watershed it is expected to be difficult to minimize the increase, except on those lands directly owned and managed by the District.

Camanche Watershed

This section addresses land uses and activities within the Camanche Watershed for the identification of potential contaminant sources. Many of the details pertaining to the relationships between the potential contaminant sources (land uses and activities) and the five water quality parameter groups have been thoroughly addressed in the Upper Mokelumne River Watershed section. Therefore, they will not be addressed to the same level of detail in this section on the Camanche Watershed.

As previously discussed, almost all land uses and activities have the potential for impacting surface water supplies (reservoirs and tributaries) depending upon the corresponding circumstances -- such as proximity to waterbody, water quality parameter concentration, watershed characteristics (slope, soils, vegetation, etc.) and transport mechanism (runoff and direct discharge). As Table 5-2 summarized, these land uses and activities in turn become the potential water quality contaminant sources for a specific waterbody. Table 5-17 summarizes the potential contaminant sources and corresponding water quality concerns specific to Camanche Watershed. Below is the list of potential contaminant sources reflected in this table which have the greatest potential for impacting water quality.

- EBMUD Facilities
- Water Resources Development
- Sanitation Facilities
- Urban Area Runoff
- Rural Area Runoff
- Utilities
- Transportation Corridors
- Hydroelectric Power
- Agriculture
- Wildlife and Livestock
- Recreation
- Mines
- Geologic Hazards
- Fires and Fire Management
- Logging
- Unauthorized Activities

Table 5-17: Camanche Watershed - Potential Contaminant Sources and Water Quality Parameters Relationship

POTENTIAL CONTAMINANT SOURCES: LAND USES & ACTIVITIES	GENERAL PHYSICAL		MICRO-ORGANISMS	RADIO-NUCLIDES	INORGANICS		ORGANICS		
	Turbidity	Algae/ T&O (Temp)			General Mineral	Metals	TOC	Pesticides & Herbicides	SOCs, VOCs, Oil & Grease, Other Hydrocarbons
Sanitation Facilities		•	•			•	•	•	•
Urban Area Runoff - Residential/Commercial	•	•	•		•	•	•	•	•
Rural Area Runoff - Residential	•	•	•		•	•	•	•	•
Utilities - Hydroelectric Power	•	•			•		•	•	•
EBMUD Facilities (Except Recreation)	•	•	•		•	•	•		•
Transportation Corridors	•	•			•	•	•	•	•
Wildlife and Livestock	•	•	•		•		•		
Recreation/Public Access	•	•	•		•	•	•		•
Mines	•			•	•	•			•
Geologic Hazards	•	•		•	•	•	•		
Fires & Fire Management	•	•			•		•	•	
Logging	•	•			•		•	•	•
Unauthorized Activities	•	•	•		•	•	•	•	•

Most facilities and corresponding activities within the Camanche Watershed are associated with the District facilities. Therefore, most of the potential contaminant sources identified for Camanche Watershed will be documented under the category of *EBMUD Facilities*. Sanitation facilities, urban area runoff, rural area runoff, utilities - hydroelectric power, and recreation are included under the category of *EBMUD Facilities*.

EBMUD Facilities

District facilities within the Camanche Watershed include the Camanche Dam and dike system, Camanche hydroelectric facilities, Camanche South Shore Recreation Area, Camanche North Shore Recreation Area, Pardee Reservoir afterbay and spillway, and the District's Watershed Headquarters Administration Building and Maintenance Yard.

Camanche South Shore Recreation Area. The Camanche South Shore Recreation Area is located in a rural area on the south shore of Camanche Reservoir in Calaveras County (Figure 5-16). The only road to the facility is Wade Lane and there are no major businesses, care facilities, highways, hospitals, or schools in the immediate area. The facility is surrounded by the reservoir on three sides and the area to the east is a residential area.

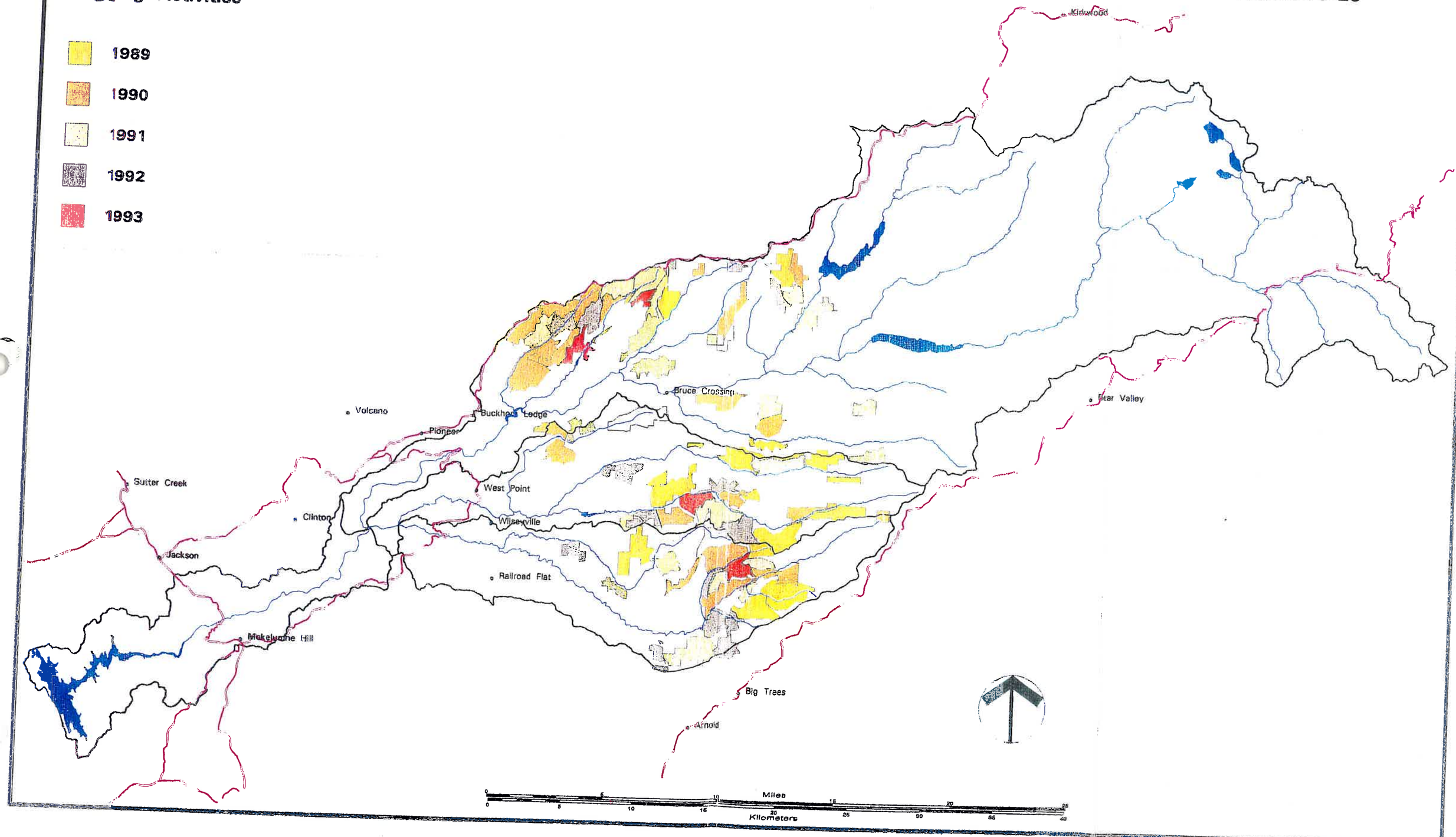
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Upper Mokelumne Watershed

FIGURE 5-15

Logging Activities

- 1989
- 1990
- 1991
- 1992
- 1993



The Camanche South Shore Recreation Area encompasses approximately 1,740 acres. Approximately 140 acres are developed which include a marina with fueling and boat cleaning facilities, paved boat launch, a fish cleaning station, a general store, snack bars, public restrooms, day-use picnic areas, campgrounds, short-term and seasonal recreational vehicle sites with full hook-ups, rental cottages, laundry facilities, a mobile home park, a water treatment plant, a wastewater treatment plant, a ranger station, a maintenance yard, an amphitheater, Recreation Hall, tennis and basketball courts, volleyball and horseshoe pits, and several large parking areas. Table 5-18 summarizes the recreation facilities located in this recreation area. The remaining acreage is undeveloped watershed. Except for the water and wastewater treatment plants, ranger station, and maintenance yard, which are maintained and operated by the District, the facilities are maintained and operated by the concessionaire, the Camanche Recreation Company.

Table 5-18: Camanche North Shore And South Shore Recreation Area Facilities

FACILITY	SOUTH SHORE Existing Size/Quantity	NORTH SHORE Existing Size/Quantity
Tent Campsites	323*	199
Group Campsites	0	4**
RV Campsites (short term)	119	0
RV Campsites (seasonal)	88	0
Picnic Sites	48	18
Roads (paved)	11 mi	9 mi
Total Day Use Parking Spaces	465	217
Paved Parking Spaces	141	167
Fishing Docks	1	0
Fishing Ponds	3	0
Amphitheater	1	0
Drinking Fountains	72	51
Trail Staging Areas	1 accessing 7.25 mi of trail	1 accessing 5.1 mi of trail
Volleyball Courts	1	0
Basketball Courts	1	1
Playgrounds	1	1
Fish Cleaning Facilities	1	1
RV Dump Stations	2	1
Restrooms (portable)	19	29
TOTAL BUILDINGS	95(70 private)	158(130 private)
Restroom Buildings	8	4
Toilets	51	28
Urinals	18	6
Sinks	56	30
Showers (Locations)	5	2
Heads	25	16
Laundry (Locations)	2	3
Dryers	4	4
Washers	4	4
Park Offices	1	1
Ranger Station	1	0
Entrance Kiosks	1	1
Restaurant/Cafe	0	1
Recreation Hall	1	0
Utility Building (former stables)	0	1
Projection Buildings	1	0
General Store	1	1
Service Stations (land)	1	1
Marina	1	1
Service Stations (on water)	0	42
Open berths	38	50
Covered berths	11	17
Rental Boats	2	2
Courtesy Docks	4 Locations	2 Locations
Boat Launch Ramps	8 lanes	8 lanes
SS Main - Lake Elevation (235-205)		4 lanes
NS Main - Lake Elevation (235-200)		2 lanes
NS Main - Lake Elevation (200-197)		2 lanes
NS Main - Lake Elevation (197-194)		
NS Low Water - Lake Elevation (194-175)	2 lanes	
SS Low Water 1 Lake Elevation (225-185)	2 lanes	
SS Low Water 2 Lake Elevation (185 -160)	1 lane	
SS Low Water 3 Lake Elevation (160-125)	1	3
Mobile Home Parks	70	144
Mobile Home Lots Total	70	131
Private Mobile Homes		4
Monthly Rentals (#15, 34, 230, Stables)	7	10
Rental Cottages Buildings		4 BLDG
Triplexs (220, 223, 224, 225) 4 BLDG		4
"A Unit" Motel Rooms (King Size Beds)		4
"B Unit"4 Person Housekeeping		4
C Unit" 6 Person Housekeeping	7	4 BLDG
Cottages/13 BLDG MHP1, MHP3, CSS		4
Motel Room (Twin Size Beds)/ 1 BLDG	7	9
4 Person Housekeeping/ 12 BLDG		25
TOTAL TRIPLEX AND COTTAGE UNITS		1
Maintenance Facilities	1	3
Shop Buildings	1	1
Storage Buildings	2	
Fenced Yards		3
Sewage Treatment Facilities	6	6
Sewer Lift Stations	3	1
Sewer Treatment Ponds	0	
Sewer Spray Fields		1
Water Treatment Facilities	1	4
Water Tanks	1	0
Wells	1	2
Raw Water Pumping Platforms	0	1
Backwash Ponds	1	1
Telemetry Buildings	1	3
Treatment Plant Buildings	0	130
Dry Storage Yards	10 (in maintenance yard)	6
Spaces	3	
Public Telephones		

** Work is in progress to modify the campgrounds at Camanche South Shore Recreation Area. Accordingly, the number of available campgrounds is expected to change as the redevelopment is completed.*

*** Capacities of 12, 24, 72 and 72 persons per site.*

Recreation. Recreational activities include boating, fishing, picnicking, camping, and hiking. In 1999, the Camanche South Shore Recreation Area served 70 permanent residences, 10 permanent travel trailers and an average of 531 visitors per day. In 1999, an average of 25 boats per day was observed with a peak daily usage of 189 boats (July 3, 1999). On May 30, 1999 the total number of campers and visitors peaked at 999 and 1,578, respectively. Table 5-19 presents the record of visitor use at Camanche South Shore Recreation Area for the period 1995-1999.

Table 5-19: Visitor Use of Camanche South Shore Recreation Area (1995-1999)

Month	1995	1996	1997	1998	1999
January	10,648	9,696	8,090	8,171	9,108
February	17,669	14,102	13,126	8,376	10,162
March	15,074	17,072	19,203	11,412	12,604
April	23,078	20,940	17,274	17,144	18,623
May	22,664	17,927	24,293	16,416	20,089
June	24,527	26,242	22,444	22,228	22,391
July	28,485	26,239	24,752	28,675	29,341
August	31,044	29,504	26,817	24,386	27,373
September	18,904	13,044	12,353	12,050	14,173
October	11,431	9,092	9,221	9,513	11,691
November	13,190	10,104	9,358	8,753	9,757
December	9,623	6,964	7,337	7,501	8,462
Total	226,337	200,926	194,268	174,625	193,774

Water Supply. Drinking water for the residents and visitors is provided by the District's Camanche South Shore WTP that draws its supply from Camanche Reservoir. The WTP intake is located about 1,200 feet from the shore at the north side of the recreation area. The water is pumped to the water treatment plant by two 250 GPM floating pumps that are suspended approximately 30 feet below the surface of the water. A buoy line has been installed around the intake to restrict recreation in proximity to the intake. The shoreline is fenced for 1,000 feet in the area of closest access to the raw water intake. In addition, this area is posted with warning signs for potential trespassers, including swimmers, water skiers, jet skiers and fishing boats.

The WTP for the Camanche South Shore Recreation Area uses polymer, and calcium hypochlorite to treat the water prior to distribution. Polymer is stored in the delivered 55-gallon containers with spill containment for each container. Any spills are contained locally in the WTP building.

A total of eight underground storage tanks were removed from Camanche South Shore Recreation area in 1989 and 1990. Diesel contamination was present in the soil samples from the excavation of one of the underground storage tanks. The stockpiled soil was remediated on site in 1991. In January 1998, Calaveras County submitted a closure letter to the District indicating that no further action was required at this time.

Sanitation Facilities. Wastewater disposal and treatment services are provided by a sewer collection system and wastewater treatment facilities which include three ponds; two for aeration, and one for final disposal by evaporation and percolation. The final pond is located approximately 4,000 feet from the intake of the reservoir. No overflows have occurred within the past five years. Chemical toilets are used at Camanche South Shore Recreation Area to augment the sanitation facilities during the peak visitor season. An abandoned solids disposal site is located adjacent to the wastewater treatment ponds. Table D-9 in Appendix D provides a summary of the compliance monitoring required for these facilities.

The Camanche South Shore Solid Waste Facility is located on the South Shore of Camanche Reservoir in Calaveras County. The waste facility is currently owned by the District and was operated between 1967 and 1984. It accepted household waste (cans, bottles, plastics, paper, and wood) and green waste (tree trimmings, weeds, and grasses) from the South Shore Recreation Area. The waste facility ceased operations and closure activities began in 1984. In July 1987, the RWQCB issued a Waste Discharge Requirement for facility closure, groundwater monitoring, and reporting on closure activities.

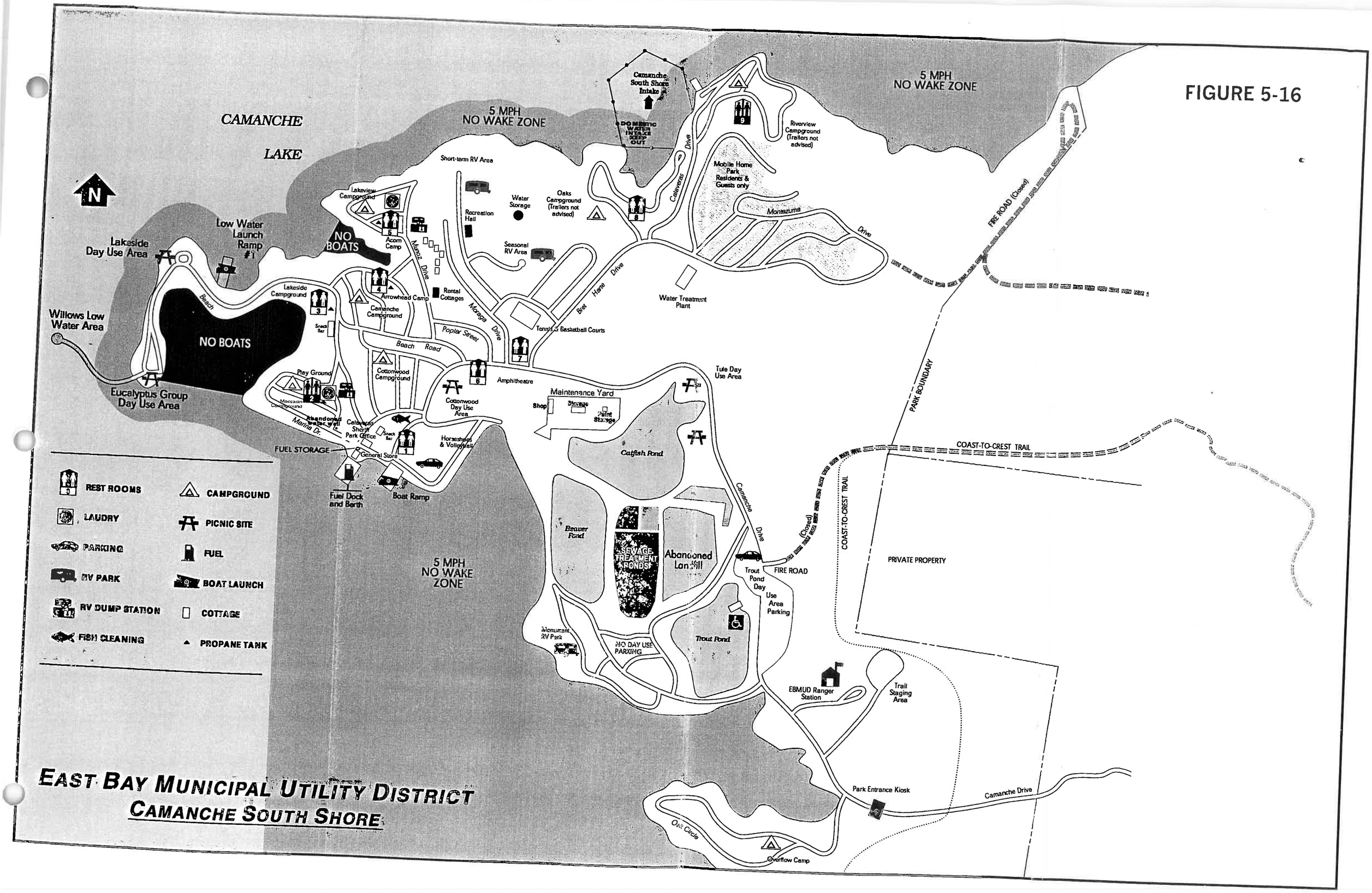
The facility contains an estimated 30,000 cubic yards of waste and soil mixed together. The vertical extent of waste is estimated to range from 7 to 15 feet below ground surface. Ground water levels range from 3 to 38 feet below ground surface. Ground water discharge from the facility is through the underflow to the trout pond near the eastern boundary of a seasonal pond. The ground water parameters that have been measured indicate generally good

quality water. The RWQCB rescinded the discharge requirement in February 1997. The RWQCB indicated that closure was complete and monitoring indicated that no significant threat to water quality remained. Land use was restricted to open space and no further action is required at this site.

Camanche North Shore Recreation Area – The Camanche North Shore Recreation Area is located in a rural area on the north shore of Camanche Reservoir in Amador County (Figure 5-17). The only road into the area is Camanche North Parkway and there are no major businesses, care facilities, highways, hospitals, or schools in the immediate area other than a few stores and restaurants at Lake Camanche Village three miles away. The area to the north is a residential area. The area to the west and east is predominantly undeveloped watershed and agricultural land.

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FIGURE 5-16


CAMANCHE
LAKE
N
5 MPH
NO WAKE ZONE
5 MPH
NO WAKE ZONE
Camanche South Shore Intake
DOMESTIC WATER INTAKE KEEP OUT
Short-term RV Area
Lakeview Campground
Water Storage
Oaks Campground (Trailers not advised)
Recreation Hall
Seasonal RV Area
Acorn Camp
Muroz Drive
Low Water Launch Ramp #1
Lakeside Day Use Area
NO BOATS
Lakeside Campground
Arrowhead Camp
Camanche Campground
Rental Cottages
Malaga Drive
Bret Harte Drive
Water Treatment Plant
Tennis & Basketball Courts
Poplar Street
Beach Road
Beach
Willows Low Water Area
NO BOATS
Play Ground
Cottonwood Campground
Amphitheatre
Maintenance Yard
Shop
Storage
Paint Storage
Tule Day Use Area
Eucalyptus Group Day Use Area
Moccasin Campground
Abandoned Boat Dock
Marina Dr.
Calaveras Sherin Park Office
Snack Bar
Cottonwood Day Use Area
Horseshoes & Volleyball
FUEL STORAGE
General Store
Fuel Dock and Berth
Boat Ramp
Catfish Pond
Riverview Campground (Trailers not advised)
Mobile Home Park Residents & Guests only
Calaveras Drive
Montezuma Drive
FIRE ROAD (Closed)
PARK BOUNDARY
COAST-TO-CREST TRAIL
COAST-TO-CREST TRAIL
PRIVATE PROPERTY
Camanche Drive
Beaver Pond
SEWAGE TREATMENT PONDS
Abandoned Landfill
Trout Pond Day Use Area Parking
FIRE ROAD (Closed)
Monument RV Park
NO DAY USE PARKING
Trout Pond
EBMUD Ranger Station
Trail Staging Area
Park Entrance Kiosk
Camanche Drive
Oak Circle
Overflow Camp
5 MPH
NO WAKE
ZONE
REST ROOMS
LAUNDRY
PARKING
RV PARK
RV DUMP STATION
FISH CLEANING
CAMPGROUND
PICNIC SITE
FUEL
BOAT LAUNCH
COTTAGE
PROPANE TANK
EAST BAY MUNICIPAL UTILITY DISTRICT
CAMANCHE SOUTH SHORE

The Camanche North Shore Recreation Area encompasses approximately 535 acres. Approximately 100 acres of the parcel is developed and includes a marina with fueling and boat cleaning facilities, paved boat launch, fish cleaning stations, a restaurant, general store, snack bars, public restrooms, day-use picnic areas, campgrounds, recreational vehicle (RV) sites with full hook-ups, laundry facilities, two mobile home parks, a water treatment plant, a wastewater treatment plant, a ranger station, a park office, an Amador County Sheriff office, a maintenance yard, and several large parking areas. Table 5-18 summarizes the recreation facilities that can be found in the Camanche North Shore Recreation Area. The remaining acreage is undeveloped watershed. Except for the water and wastewater treatment plants, ranger and sheriff stations, and maintenance yard, which are maintained and operated by EBMUD, the facilities are maintained and operated by the concessionaire, the Camanche Recreation Company.

Recreation. Recreational activities include boating, fishing, picnicking, camping, and hiking. In 1999, the Camanche North Shore Recreation Area served 131 permanent residences and an average of 466 visitors per day. In 1999, an average of 37 boats per day was observed with a peak daily usage of 276 boats (July 10, 1999). On May 30, 1999, total number of campers and visitors peaked at 1,101 and 456, respectively. Table 5-20 presents the record of visitor use at Camanche North Shore Recreation Area for the period 1995 to 1999.

Table 5-20: Visitor Use of Camanche North Shore Recreation Area (1995-1999)

Month	1995	1996	1997	1998	1999
January	7,222	6,800	6,624	5,979	7,202
February	12,592	8,598	9,882	6,815	7,781
March	12,068	13,109	15,408	10,979	10,631
April	20,368	16,240	13,962	11,727	14,013
May	19,055	18,228	20,634	14,515	18,797
June	24,078	25,456	22,201	20,706	22,882
July	32,849	28,535	26,760	28,386	29,362
August	24,522	25,428	23,668	26,889	23,527
September	16,350	14,200	12,131	13,804	13,899
October	10,386	8,259	8,409	7,467	9,188
November	8,205	7,264	6,614	6,154	6,671
December	6,572	6,299	5,527	6,440	6,238
Total	194,267	178,416	171,820	159,861	170,191

Urban/Rural Runoff. Three wells provide potable and non-potable water to the Camanche North Shore Recreation Area facilities. The District's potable water treatment facilities provide drinking water to 211 service connections (155 general and residents, 56 seasonal). Manganese greensand filters and chlorination are used to reduce the iron and manganese in the raw water supplies. Calcium hypochlorite is stored in dry 50-pound pails and potassium permanganate used during treatment is stored in 200-gallon double-walled containers. The drains for the spill containment lead to the wastewater collection system.

In April 1997, four underground storage tanks were removed from the Camanche North Shore Recreation Area Marina Store. During the removal activities, hydrocarbon contamination was discovered in the old piping run to the North Shore Marina. Subsequent soil excavation took place, along with confirmation sampling, which indicated that some contaminated soil was left in place. In November 1999, two groundwater monitoring wells were installed at the site. The wells are at a depth of 10 and 15 feet. Groundwater

samples were collected after the wells were installed. Results indicate that hydrocarbon contamination remains in the wells. MTBE was detected in the wells. Additional sampling of the wells occurred in August 2000 and soil sampling to further characterize the extent of soil contamination occurred in the fall of 2000. A conservative estimate of 200 gallons of product remain in the soil. Routine quarterly sampling will be conducted for four quarters.

Sanitation Facilities. Wastewater treatment and disposal services are provided by a combination of a sewer collection system, septic system and spray fields, and wastewater treatment plant which consists of six ponds: two for aeration, one for extended aeration, two for overflows and one for polishing. Table D-10 in Appendix D provides an overview of compliance monitoring required for these wastewater facilities. After treatment, spray irrigation is practiced over a five-acre area. The spray area is contained from runoff, with diversion back into the polishing pond. The wastewater treatment plant typically treats about 30,000 gallons per day. Chemical toilets are used at Camanche North Shore Recreation Area to augment the sanitation facilities during the peak visitor season.

Watershed Headquarters and Maintenance Yard – In addition to the Ranger Stations located at the Camanche South Shore and North Shore Recreation Areas, the District operates an office building that serves as the headquarters for operations of the District's Mokelumne Watershed and Recreation Division. Wastewater treatment and disposal is provided on-site by a septic system and spray field. The District also operates a maintenance yard that house equipment and supplies for the District's Pardee and Camanche facilities.

Water Resources Development

At this writing, there are no water resources development projects identified for the Camanche Watershed. All the current development projects are targeted for the Upper Mokelumne River Watershed. In particular, is the proposed transfer of ownership and re-operation under deregulation of the PG&E hydroelectric facilities (Project 137) which are associated with Upper Mokelumne River Watershed. Integrated watershed management between the Pardee and Camanche watersheds will be critical to insure any negative impacts detected at Camanche Reservoir are minimized.

Sanitation Facilities

As discussed in the Upper Mokelumne River Watershed section, sanitation facilities collect, treat, and dispose of human waste. Failure of these systems may result in the introduction of disease-causing microorganisms to the raw water supplies. In addition, inadequately treated waste could increase the nutrient loading, particularly nitrogen, to the reservoir. Sanitation facilities within the Camanche Watershed are associated with the District's facilities and are discussed above.

Urban Area Runoff

Urban land uses include residential, commercial, and public facilities. The potential contaminants in the runoff from these facilities include metals, solvents, oil, grease, hydrocarbons, and pesticides from landscaping activities, coliform bacteria, and sediments from construction. Urban area runoff within Camanche Watershed is associated with the District's facilities as discussed above.

Rural Area Runoff

For the purposes of this study, rural area runoff is focused on potential contaminant sources associated with rural residences. Rural residences are generally dispersed over large areas, often on large parcels of land -- one house per 100 acres. The potential water quality issues associated with rural residences are similar to those for urban residential areas. One difference for the rural residences is the use of septic systems instead of sewers for waste collection and treatment. Rural area runoff within Camanche Watershed is associated with the District's facilities as discussed above.

Utilities - Hydroelectric Power

Hydroelectric power generation occurs at Camanche Dam and is part of the District's facilities as mentioned above.

Transportation Corridors

The primary concerns associated with transportation corridors are the automotive related contaminants in surface runoff from roads and parking areas and herbicide application. While no major transportation corridors traverse Camanche Watershed, several secondary roads exist which primarily service the District's Camanche South Shore and Camanche North Shore recreation facilities. These roads are highlighted under the *EBMUD Facilities* section above.

Agriculture

No agricultural activities are currently present within the Camanche Watershed.

Wildlife and Livestock

As discussed in the *Upper Mokelumne River Watershed* section, wildlife and livestock activities can affect public water supplies in a number of significant ways: (1) introduce and transmit disease-causing microorganisms into raw drinking water supplies; (2) elevate nutrient loads; (3) increase erosion; (4) compact soils and thereby decrease ground water recharge, and (5) disturb riparian corridors and tributary stream banks by animals gaining access to water supplies. Some of these impacts occur proximate to tributary water supplies unless reservoirs are out-fenced above the high water line.

Wildlife. Habitat must meet requirements for food, water, and cover for wildlife species to survive. Depending on specific requirements, a species may use several habitats or a single one. Larger wildlife species are often more mobile, frequently moving between several habitats; smaller species are more likely to remain in a single habitat.

All mammals are potentially capable of carrying *Giardia* organisms, therefore they warrant the most attention. The mammals most vulnerable to infection and; therefore, of primary concern from a public health standpoint, include beaver, deer, bear and muskrat. In addition, birds are capable of contaminating water supplies with fecal coliforms. While specific wildlife species identification work has not been documented for the Camanche Watershed, the wildlife documented for the Upper Mokelumne River Watershed which exist at lower elevations are likely to occur in the Camanche Watershed. For example, coyote, the western ground squirrel, deer, raccoon, and bush rabbit are some of the mammals, which are likely to occur on the watershed, include

Livestock. Cattle grazing occurs throughout the Camanche Watershed basin and is permitted on portions of the District-owned lands surrounding Camanche Reservoir. Livestock grazing is an important potential contaminant source because livestock are attracted to watercourses and riparian lands where the vegetation is the most lush and food sources are abundant. Once attracted to these sensitive waterside lands the animals are likely to remain until food supplies are exhausted or they are herded away. As previously mentioned, water quality parameters associated with livestock activities include: *Giardia*, *Cryptosporidium*, fecal coliform, viruses, and nutrients. Livestock are also inclined to physically enter the water for extended periods, and to collapse and trample the banks. These activities introduce unfiltered, undiluted and undegraded wastes directly into the water, and cause the erosion and sloughing of soil materials from damaged banks into downstream water bodies. The most significant potential contaminant concerns related to livestock grazing relate to those activities which occur in riparian zones.

Recreation

Recreation activities occur within the Camanche Watershed and are associated with the District's facilities at Camanche South Shore and Camanche North Shore Recreation Areas. As discussed previously, numerous activities are included under the heading of recreation. As Table 5-17 depicts, a variety of water quality concerns are associated with recreation and vary depending upon the specific activity.

Mines

As noted in the Upper Mokelumne River Watershed discussion, mines and quarries have the potential for being identified as contaminant sources for turbidity, radionuclides, general minerals, metals, oil, grease, and hydrocarbons depending upon type of materials being processed and the size of the operation. Only one abandoned mine, Penn Mine, in the Camanche Watershed has been identified as a potential contaminant source. As other abandoned or closed mines, are located and/or permitted for use, additional mine related water quality concerns might develop. At this writing, only Penn Mine is considered a potential contaminant source, albeit a source with ongoing effective mitigation measures in place.

Penn Mine is an abandoned copper and zinc mine which is located adjacent to the District's property along the upper reaches of the Camanche Reservoir. Although the mine is not on District property, the District has worked for many years with the RWQCB towards resolution of pollution problems relating to historic mining activity. Penn Mine opened in 1861, and periods of major mining activity occurred from 1899 through 1919, and during World War II. Heavy metals in stormwater runoff from the mine were linked to fish losses on the Mokelumne River from the 1930s through 1978. The most severe losses occurred during active mining operation, when seepage was pumped from the mineshafts into the river, killing all aquatic life for 40 miles downstream. Even after the mine was abandoned in the 1950s, problems remained.

The 51-acre site contained approximately 408,000 cubic yards of waste rock, mill tailings, and impacted alluvium in two drainage systems -- Hinkley Run Creek and Mine Run Creek. The waste material contained sulfur in a form that is converted to sulfuric acid in the presence of air and water, which then leached metals from the rock. The acid rock drainage caused significant water quality impacts in the Mokelumne River and in Camanche Reservoir.

In the late 1970s, the District and the RWQCB, with concurrence from other agencies, constructed Mine Run Dam, Mine Run Dam Reservoir, six smaller impoundments in the Mine Run and Hinkley Run drainage systems, and a surface water diversion system to control acid rock drainage from the Penn Mine site. The facilities were designed to contain, recirculate, and evaporate the acid rock

drainage. In February 1993, the District and the RWQCB built an in-line treatment system to treat the acid rock drainage and avoid untreated discharges during high storm events over the spillway of Mine Run Dam. These interim measures resulted in a reduction of metals entering the Mokelumne River system from Penn Mine runoff to less than 1/1,000th of their initial level. Nevertheless, the source of the problem, mine wastes and workings on the Penn Mine property, remained.

Beginning in May 1997, the District and the RWQCB initiated the Penn Mine Environmental Restoration Project to implement site restoration work at Penn Mine. Approximately 408,000 cubic yards of waste material were excavated and placed in a nine-acre landfill. The landfill was constructed with a clay liner and leachate collection system to contain the excavated waste materials. A soil cover was placed over areas disturbed by the waste excavation, which were then revegetated with native grasses. Best management practices were employed during and following construction for erosion control and sediment management. Existing diversion channels were removed and surface water was allowed to flow into restored streambeds which were designed to minimize erosion and restore habitat. Construction activity for the Penn Mine Environmental Restoration Project was completed in December 1999. Currently, monitoring of the Penn Mine facilities is ongoing to ascertain the effectiveness of this environmental restoration project.

Geologic Hazards

Soil erosion is the primary geologic hazard in Camanche Watershed. Suspended sediment in a water supply reservoir can cause turbidity problems. Phosphorus and nitrogen, which associate with sediments, promotes algae blooms and reservoir increases in biological oxygen demand during the summer. Sediment is transported to reservoirs either directly or in tributary creeks especially after heavy rainfall.

While specific geologic hazards are not identified for Camanche Watershed, heavy rainfall can lead to erosion from surface runoff. The risk to the Camanche Reservoir is greatest when erosion occurs near the reservoir itself, since small rainfall events can transport sediment over a short distance. Large storms can transport sediment from throughout the watershed. Erosion is most likely to occur where the land has been disturbed, exposing bare soil. Road cuts on steep slopes are a major source of sediment

erosion. Landslides, fires, or disturbances by animals are other modes by which the erosion risk increases.

Fire and Fire Management

While a major fire has not occurred in Camanche Watershed in the past 20 years or more, a major fire poses a serious erosion threat in the Camanche Watershed. Naturally and human-caused wildfires are a common historical occurrence in the Sierra Nevada mountains. Lightning has been a consistent natural cause of wildfires in the higher elevations -- 3,000 to 7,000 feet -- as these lands are heavily forested. In the lower elevations of Camanche Watershed, human-caused wildfires may pose the more significant threat. Fire created by activities along the roadside or trails, such as discarded smoking materials, catalytic converters, or vehicle fires, could have significant negative impacts on the water quality of Camanche Reservoir resulting from increased erosion during rainfall events.

Logging

Although logging or timber harvesting does not occur within the Camanche Watershed, the effects from the extensive logging activities in the Upper Mokelumne River Watershed are apparent in Camanche Reservoir. For example, improper harvesting and poor construction of landings, skid trails and roads, as well as poor culvert design and installation techniques, can have major effects on the runoff water quality from harvested areas. Erosion from these properties, at the very least, causes increased turbidity levels and sediment transport. Secondarily, nutrients released as a result of the leaching of denuded or eroded soils following logging can cause eutrophication of streams and lakes and lead to increased algae growth and dissolved oxygen depletion. Potential consequences of excessive eutrophication can include formation of toxic amounts of hydrogen sulfide, taste and odor problems, and the formation of humic compounds.

The District has observed the formation of hydrogen sulfide in Camanche Reservoir during summer and fall seasons when the lake is thermally stratified. To offset this impact, the District has installed a hypolimnetic oxygenation system to keep releases from Camanche Reservoir free of hydrogen sulfide. A secondary system was also installed by the District to treat the hatchery influent water and neutralize hydrogen sulfide. This potassium permanganate treatment system is in place and would only be used if the hypolimnetic oxygenation system were to malfunction.

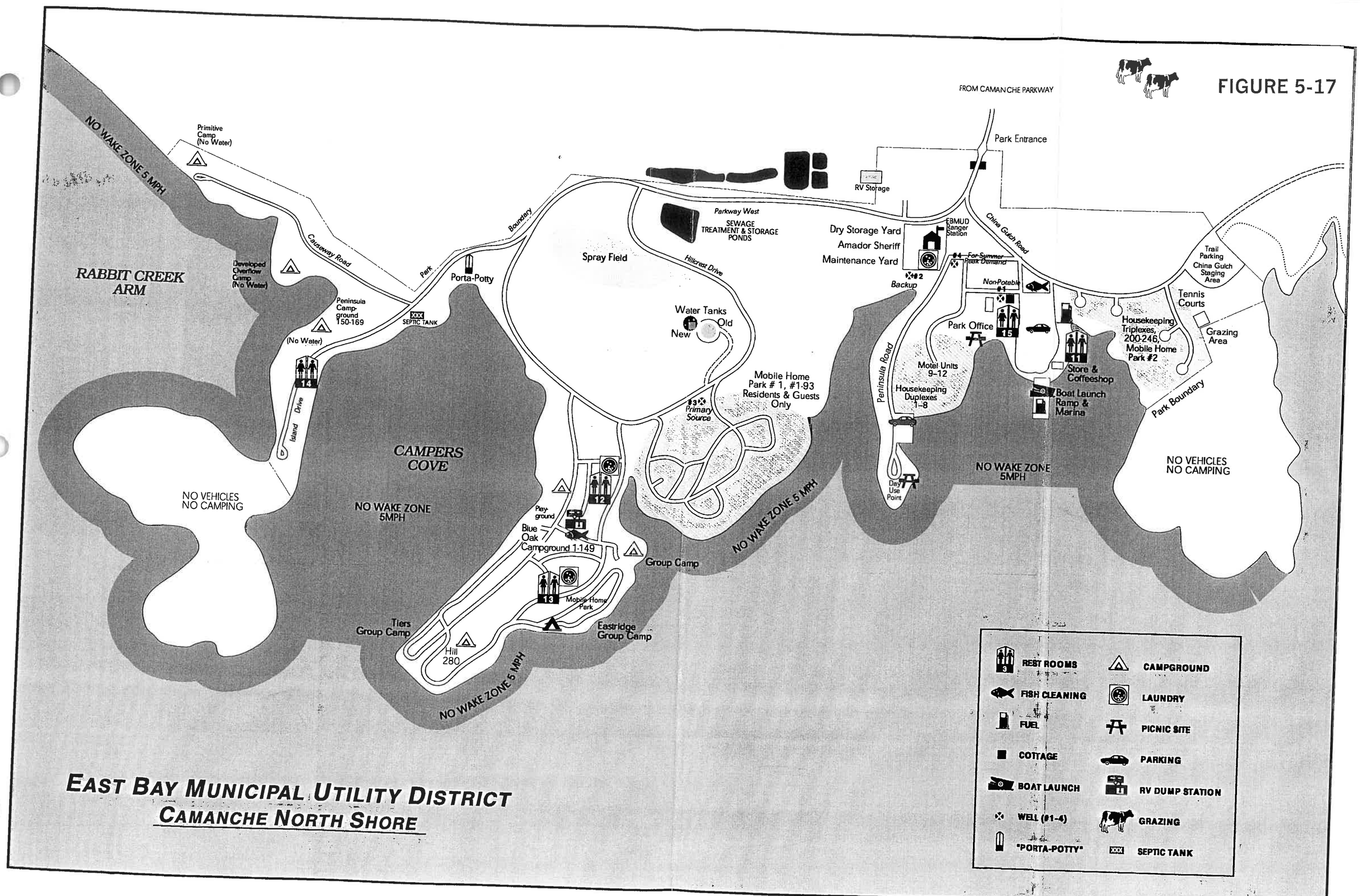
A study regarding the effects of logging practices in the Upper Mokelumne River Watershed on Camanche Reservoir, cited research showing that "various harvesting practices (in New Hampshire) stimulate the loss of dissolved ionic forms of nitrogen, especially nitrate, into stream water. Nitrate loss was commonly attributed to an increase in the activity of autotrophic and possibly heterotrophic nitrifiers". This conclusion was supported by "21 references in internationally referenced scientific journals or texts and represents the considered opinions of most of the workers in this field".

Logging, due to its overwhelming land use position when compared to all other uses, is the only major land use capable of producing the increases in nitrates observed in Camanche Reservoir. While logging is conducted in the Upper Mokelumne River Watershed, the Pardee and Camanche reservoirs are operated in concert, thereby allowing the impacts of logging to be transferred into the Camanche Reservoir. Other land use changes, in either the Pardee or Camanche Watershed, are too restricted in acreage to account for the observed water quality problems. On the other hand, only very small increases in nutrient releases per unit area would be needed from the large acreage of logged lands in Upper Mokelumne River Watershed to explain the increase. A land use analysis indicates that production forest lands in the Upper Mokelumne River Watershed account for 121,000 acres, or 32.9 percent of the 368,000 acres in this watershed. After deducting undisturbed open space (241,350 acres, 65.6 percent), only 1.5 percent of the land is left for all other uses, including residential and commercial.

Unauthorized Activities

Unauthorized activities within the Camanche Watershed can contribute to a myriad of contaminants entering the Mokelumne River and ultimately Camanche Reservoir. Roadways leading into or through the watershed, increases the potential for unauthorized activities such as illegal dumping. Illegal dumping and trespassing may impact reservoir water quality by introducing contaminants from materials dropped into creeks or the Mokelumne River leading directly into the reservoir. The illegal dumping of household wastes and appliances is a common ongoing problem within watersheds. In addition, occurrences of commercial dumping (e.g. concrete blocks, creosote logs, tires) has also occurred. Illegal dumping will likely increase as the population increases in surrounding areas and as landfill and garbage disposal rates rise. While it is difficult to stop unauthorized activities, the District can be successful in minimizing these activities on those lands directly owned and managed by the District.

FIGURE 5-17



EAST BAY MUNICIPAL UTILITY DISTRICT

CAMANCHE NORTH SHORE

Significance of Potential Contaminant Sources

This section summarizes the various contaminant sources identified previously and their potential for water quality degradation for both the Pardee and Camanche Watershed Areas. The potential for each contaminant source to impact water quality is ranked insignificant, low, medium, and high as shown in Table 5-19. These rankings take into account watershed characteristics (size, slopes, soils, vegetation), type of contaminant, distance to waterbodies, and magnitude of source.

In addition, historical records regarding a potential contaminant source may influence a ranking; however, they may be outweighed by the perceived public health risk associated with a water quality parameter. For example, District historical records may not substantiate the potential water quality concerns associated with recreation. However, this does not reduce the potential risk to public health in the event that a recreation-related, water quality contamination event occurs in the future.

In an effort to further highlight the water quality parameters of greatest concern for a specific potential contaminant source, the water quality parameters have been prioritized. This prioritization is based on water quality concerns as they relate to public health and drinking water regulations as well as historical raw water qualities documented in Section Four. The water quality parameter of greatest concern for a specific contaminant source in Table 5-21 is identified in bold type. Below is a general listing of the prioritization assigned to the water quality parameters.

1) Microbiological contaminants with the potential for acute illness;
2) Algae and inorganic compounds which contribute to taste and odor problems;
3) Turbidity (particulates) which provides the transport mechanism for adsorbed contaminants;
4) Total organic carbon which when disinfected, may result in increased DBPs; and
5) Other organic and inorganic compounds which are known or suspected carcinogens, mutagens, or teratogens, or cause acute toxicity.

In determining the potential effects to water quality, microbiological contaminants were considered the highest priority in recognition that they are the parameters targeted by the SWTR watershed sanitary survey requirements and that there may not be currently effective and reliable treatment techniques at the District's WTPs (as they were not designed for this purpose) for controlling *Cryptosporidium*, the most recently identified pathogen for regulatory control. In addition, the future LT1 ESWTR or LT2 ESWTR could potentially impact the level of *Giardia* or *Cryptosporidium* removal requirements. Given these reasons, protecting the raw water sources from microbiological contaminants is crucial.

Second priority is assigned to algae and inorganic compounds, which result in creating T&O incidences. In addition, elevated temperatures from hydroelectric power generation can also impact the growth of algae and ultimately T&O incidences. While T&O is an aesthetic concern and not a public health concern, the main consumer complaint to the District is attributed to T&O incidences.

Third priority is assigned to particulates because of their potential role as a transport mechanism for other adsorbed contaminants.

TOC is designated as the fourth priority since the near-future conversion to chloramines will reduce the threat of DBP formation in the District's finished water.

Fifth, and final, priority was assigned to other organics and inorganics. While serious public health concerns can be associated with many of these parameters, as discussed under *Water Quality Parameters of Concern*, historical raw water quality data documented in Section 4 indicate they are at or below detection limits, and, therefore, do not pose any public health concerns for the District.

Several of the potential contaminant sources listed in Table 5-21 were given ratings of *insignificant, low* or *low to medium* with regards to their potential for affecting water quality. These sources include: agriculture, transportation corridors, and unauthorized activities.

POTENTIAL CONTAMINANT SOURCES WITHIN WATERSHEDS

Below are brief discussions regarding the rationale for assigning the other potential contaminant sources with *low to high*, *medium*, and *medium to high* ratings for impacting water quality. These sources include: sanitation facilities, urban and rural area runoff, EBMUD facilities, utilities - hydroelectric power, wildlife and livestock, recreation, geologic hazards, and fires and fire management.

Table 5-21: Summary of Contaminant Sources and Their Impact on Water Quality

Contaminant Source	Key Contaminants	Potential to Impact Drinking Water Quality
Sanitation Facilities	Algae, Taste and Odor **Microorganisms** TOC	<u>*Low to High*</u> Impacts from leaks and spills are dependent on location of incident, amount and type of material, and response time Failed septic systems have been documented
Urban Area Runoff - Residential Commercial	Turbidity Algae/Taste and Odor **Microorganisms** General minerals and metals TOC **SOCs**, VOCs, **pesticides, herbicides** **Oil and grease, other hydrocarbons**	<u>*Low to High*</u> Urban areas are relatively small in size. Urban areas are the largest contributors of water quality contaminants on a per area unit basis Sewage overflows occur on an infrequent basis Urban development is increasing
Rural Area Runoff - Residential	Turbidity Algae/Taste and Odor **Microorganisms** General minerals and metals TOC SOCs, VOCs, pesticides, herbicides Oil and grease, other hydrocarbons	<u>*Low to High*</u> Rural areas are sparsely populated, but there are less control measures for erosion and sanitation facilities Rural development is increasing

Table 5-21: Summary of Contaminant Sources and Their Impact on Water Quality – (continued)

Contaminant Source	Key Contaminants	Potential to Impact Drinking Water Quality
Utilities - Hydroelectric Power Generation	**Turbidity** **Algae**/Taste and Odor **Temperature** General minerals & metals TOC SOCs, VOCs, herbicides Oil and grease, other hydrocarbons	*Low to High* Extensive hydroelectric facilities occur throughout Pardee and Camanche watersheds. Hydroelectric facilities are integrated into the complex system of reservoirs, canals, and tunnels. Hydroelectric power generation activities represent a high priority for the District concerning potential water quality impacts.
EBMUD Facilities (Excluding recreation)	Microorganisms Turbidity **General minerals** Metals **TOC** Oil and grease, other hydrocarbons	*Low to High* Facilities including septic systems proximate to the reservoirs and tributaries. Impacts from spills can be significant. Maintenance activities can contribute contaminants.
Transportation Corridors	**Turbidity** General minerals and Metals TOC SOCs, VOCs, pesticides, herbicides **Oil and grease, other hydrocarbons**	*Low to Medium* Main thoroughfares proximate to reservoirs. Storm water drains feed directly into the reservoirs. Accidents occur along main thoroughfares. Maintenance activities can contribute contaminants. Logging activities require extensive system of roads throughout watershed lands
Agriculture	Nutrients Turbidity Algae/Taste and Odor General minerals TOC SOCs, VOCs, Pesticides, herbicides	*Insignificant* Agricultural properties are few and small. Some agricultural activities have eliminated the use of pesticides and herbicides.

Table 5-21: Summary of Contaminant Sources and Their Impact on Water Quality – (continued)

Contaminant Source	Key Contaminants	Potential to Impact Drinking Water Quality
Wildlife and Livestock	Turbidity Algae/Taste and Odor **Microorganisms** General minerals and Metals **TOC** **Nutrients**	*Medium to High* The impact of cattle grazing on microorganisms especially *Cryptosporidium* can be significant. The impacts of cattle grazing on erosion and TOC loadings can be significant.
Recreation (EBMUD)	Turbidity Algae/Taste and Odor **Microorganisms** General minerals and metals TOC Oil, grease, other hydrocarbons, MTBE	*Medium to High* Recreation is encouraged at both reservoirs. Recreation is prohibited near the outlet towers. Body contact is permitted in Camanche Reservoir. Cross contamination from privately owned boats can be a significant issue. Fire hazards increase with visitor use.
Recreation (Sierra Pacific, Eldorado & Stanislaus National Forests, Bureau of Land Management, PG&E)	**Turbidity** Algae/Taste and Odor **Microorganisms** General minerals, Metals TOC Oil and grease, other hydrocarbons, MTBE	*Medium to High* Recreational activities occur at reservoir and river locations throughout the watershed.
Mines	**Turbidity** Radionuclides General minerals and metals Oil and grease, other hydrocarbons	*Medium to High* Active and inactive mines exist throughout watersheds. Water quality degradation due to mine discharges has been significant. Mines are proximate to reservoirs and main tributaries.

Table 5-21: Summary of Contaminant Sources and Their Impact on Water Quality – (continued)

Contaminant Source	Key Contaminants	Potential to Impact Drinking Water Quality
Geologic Hazards	**Turbidity** Radionuclides General minerals and Metals TOC Nutrients	*Medium to High* High erosion risk lands within watersheds and in close proximity to waterbodies, waterways, and conveyances. Historically landslides have occurred in close proximity to waterbodies.
Fires and Fire Management	**Turbidity** Algae/Taste and Odor TOC SOCs, VOCs, pesticides, herbicides	*Medium to High* Fires due to lightning strikes are a significant threat. While fires make land vulnerable to erosion, heavy rainfall is necessary to induce major erosion and impact water quality.
Logging	**Nutrients** **Turbidity** **Algae/Taste and Odor** **General minerals** and Metals Microorganisms TOC SOCs, VOCs, herbicides oil and grease, other hydrocarbons	*Medium to High* Extensive logging in Upper Mokelumne River Watershed. Logging roads traverse watersheds and cross tributaries. Herbicides used for vegetation management.

Table 5-21: Summary of Contaminant Sources and Their Impact on Water Quality – (continued)

Contaminant Source	Key Contaminants	Potential to Impact Drinking Water Quality
Unauthorized Activities	Turbidity Algae Microorganisms General minerals and Metals TOC SOCs, VOCs, pesticides, herbicides Oil and grease, other hydrocarbons	*Low to Medium* Disturbance of soil and deposition of contaminants in areas proximate to reservoirs and/or tributaries increases the risk of impacting downstream water quality.

NOTES: Bold indicates contaminants of greatest concern.
Ranking of land uses and activities is based on contaminants of concern, proximity to waterbodies, magnitude of sources, watershed characteristics, and any mitigating factors. Contaminants are prioritized as follows:

1. Microbiological contaminants with the potential for acute illness.
2. Algae and inorganic compounds which contribute to taste and odor problems.
3. Turbidity which also transports adsorbed contaminants.
4. Total organic carbon that is a precursor DBPs.
5. Other organic and inorganic compounds which are at or below detection limits in raw waters.

Sanitation Facilities

The sanitation facilities (including private and District facilities) can have low to high potential for affecting water quality depending upon proximity to water, watershed characteristics, concentrations of contaminants, and precipitation. On a day to day basis their potential contribution to water quality degradation might be minor; however, because of the proximity some facilities have to the reservoirs or their tributaries, a leak or accidental spill has the potential to produce a significant impact. Especially with sanitation facilities, there is a greater likelihood of septic system failure as the system ages.

Urban and Rural Area runoff

Both the Urban (residential/commercial) and Rural (residential) Area Runoff categories have received rankings of low to high for potentially affecting source water quality for a variety of contaminants. In general, the potential contaminant sources and corresponding water quality concerns associated with the runoff from each of these areas are similar. However, the magnitude of the rural area water quality concerns is reduced, excluding microbiological parameters, when compared to urban area runoff. This is particularly true herein because the residential component of the rural area is considered to produce the most significant impacts, however, rural areas are sparsely populated with residences dispersed over large areas.

Of most importance from an urban area runoff standpoint are the microorganisms and organics - SOCs, oil and grease, and other hydrocarbons. The potential contaminant sources for the microorganisms are the occasional accidental sewerage overflows. The potential contaminant sources for the organics are the commercial areas and corresponding parking lots. With regards to rural area runoff, microorganisms are of the most concern because the residences are unsewered, and septic system leakage has been shown to be a problem. When comparing these potential contaminant concerns, the microorganisms are of the most importance because they can result in acute health-effects while organics can result in chronic health-effects from long-term exposure.

EBMUD Facilities

EBMUD facilities (excluding recreation) received a low to high rating. Because these facilities encompass a wide range of land uses and activities, they can potentially contribute a variety of contaminants into the reservoirs. Chemicals are stored onsite, although, containment measures are in place for the treatment related chemicals. Although there are measures to prevent stormwater runoff, leaks, and accidental spills, the risk of water quality impact increases due to the proximity of these facilities to the reservoirs and their tributaries. In addition, watershed activities such as road and trail maintenance can cause significant erosion, which can result in higher raw water turbidities and other adsorbed contaminants.

Utilities - Hydroelectric Power

Utilities, specifically hydroelectric power generation, received a low to high rating due to several factors.

Extensive hydroelectric power generation facilities exist throughout the Upper Mokelumne River Watershed that integrate a complex system of reservoirs, canals, and tunnels that are proximate to the Mokelumne River and main tributaries. Unlike activities that occur on watershed lands, impacts due to the operations of hydroelectric power generation facilities have an immediate impact on water conditions downstream.

Elevated temperatures resulting from hydropower generation may have a significant impact on algal growth, as well as corresponding potential taste and odor events and elevated total organic carbon concentrations. In addition, turbidity and nutrient increases due to erosion related to facility operations may impact water quality.

The District's hydroelectric power facilities at Pardee and Camanche Reservoirs are operated in accordance with guidelines that protect and preserve water quality as a top priority. The hydroelectric power facilities that are upstream of Pardee Reservoir are outside of EBMUD control. These issues, in combination with the proximity of the upstream hydroelectric power facilities tot the District's water supply diversions points, represents an elevated concern to the District regarding potential water quality impacts.

Wildlife and Livestock

Wildlife and livestock received a medium to high rating. The pathogens (*Giardia lamblia* and *Cryptosporidium parvum*) associated with wildlife and livestock are considered significant health risks because of the impending, stringent, future regulations and the current inability to reliably analyze and treat them, particularly *Cryptosporidium*. Also, erosion caused by wildlife and livestock can result in higher raw water turbidities and other adsorbed contaminants. In final, the inorganic compounds (nitrogen and phosphorous) associated with wildlife and livestock may impact algal blooms, some of which can cause undesirable T&O.

Recreation

Recreation within the District lands received a rating of medium to high. Recreation within the Sierra Pacific lands, Eldorado and Stanislaus National Forests, BLM lands, and PG&E lands received a rating of medium to high. Current provisions limit recreation and prohibit body contact in Pardee Reservoir in order to protect the District's raw water quality. However, body contact recreation is permitted on Camanche Reservoir under restricted conditions. Visitors using the non-District related facilities enjoy activities that occur proximate to the waterbodies or take place on the waterbodies. Given the number of visitors and the proximity to water, the potential for degrading water quality increases. Also, the increase in off-road vehicle use during recent years has raised concern for the potential impacts to water quality. The increase in popularity over other ground-based forms of trail recreation (hiking, horseback riding), along with the emphasis on unpaved trails, and the great distances covered make this recreational activity one with the potential to significantly increase erosion control problems.

Geologic Hazards and Fires and Fire Management

Geologic hazards, and fires and fire management received medium to high ratings because of their potential to impact soil erosion. Erosion occurs most often when the soil has been disturbed. Geologic hazards, such as earthquakes and landslides, and fires are significant causes of elevated erosion risk. While earthquakes, landslides, and fires expose the soil and make it vulnerable to erosion, precipitation is necessary to induce erosion and, in turn, increase turbidity in the water supply. Turbidity, in turn, transports other adsorbed contaminants into the waterbodies. In addition, high loads of turbidity transported into the waterbodies by runoff from precipitation can cause significant treatment problems. While geologic hazards and major fires are not common occurrences, their resulting impacts can be catastrophic.

SECTION 6

SECTION 6
WATERSHED CONTROL & MANAGEMENT

Introduction

Section 6 documents the watershed management practices defined by EBMUD and other public and private entities that may have a significant impact on reservoir water quality within the Camanche and Upper Mokelumne River Watershed basins. Watershed control and management practices that were documented in the 1995 Mokelumne River Watershed Sanitary Survey (1995 MRWSS) have been reviewed and modified where necessary. Documenting the practices that are implemented within the watersheds provides a basis for understanding where future modifications can be made.

In addition to the watershed control and management practices, the pertinent organizational structure of the District and jurisdictional authority of outside agencies are identified. Understanding the relationships between the departments within the District, as well as the outside agencies, improves communications and implementation of the watershed management practices.

Organizational Structure

One component of a watershed sanitary survey is to define the "lines of communication" between responsible agencies as well as within the District. A summary of the agencies that have jurisdictional authority within the Camanche and Upper Mokelumne River Watersheds is presented to provide an overview of the agencies involved and a basis of understanding regarding their responsibilities.

The second topic within this section provides an overview of the District's organization and the specific divisions that are responsible for managing the land uses and activities within the watersheds, operations of the reservoirs, monitoring of water quality, and providing water treatment and distribution. Given that several divisions within the District are responsible for water quality - from source water through treatment and distribution - identification of these divisions, their responsibilities, and areas of overlap is important to define for the overall management of source water quality.

Jurisdictional Authority

Table 6-1 summarizes the local/regional, state, and federal agencies and utilities, and their concerns or jurisdictional authority that is relevant to the Camanche and Upper Mokelumne River Watershed lands. Identification of the agencies that have jurisdictional authority within the watersheds as well as their corresponding issues of concern can assist the District in the event that Best Management Practices need to be modified and/or created, and to develop open lines of communication between interested agencies. Each of these agencies has a role in achieving adequate source water protection and their active participation is essential for successful protection.

In light of its concern over the potential threat to water quality posed by the proposed sale of PG&E's hydroelectric facilities and associated lands in the North Fork Mokelumne River basin, the District has participated in the formation of the Upper Mokelumne River Watershed Authority (Authority). The Authority is a joint power authority consisting of the Alpine County Water Agency, Amador Water Agency, Calaveras County Water District, Calaveras Public Utility District, Jackson Valley Irrigation District, and the District. The Authority was formalized by agreement between the participating agencies on August 15, 2000 and was established for the purpose of effectuating the acquisition, operation, and maintenance of PG&E's hydroelectric facilities on the Upper Mokelumne River. A major benefit of Authority ownership of these facilities would be the coordinated use and management of resources within the North Fork Mokelumne River watershed.

Table 6-1: Agencies with Influence Over Source Water Quality

Agency	Jurisdiction or Issues of Concern
Local / Regional Agencies	
EBMUD	Management of water supply, quality, treatment, and distribution. Collection, treatment, and disposal of wastewater
Counties of Alpine, Amador, Calaveras, and San Joaquin	Regulation and monitoring of agricultural pesticide usage. Control of animal and plant pests. Inspection of hazardous materials storage and underground storage tanks. Fire protection, storage of hazardous materials, emergency response. Stormwater collection and disposal. Management of natural resources. Emergency planning and response. General plan/zoning land use changes, use permits, environmental compliance. Construction and maintenance of county roads--vegetation management and erosion control. Transportation planning and traffic control. Development services /building permits. Hazardous materials business plan.
Sierra-Pacific Industries	Collection, treatment and disposal of wastewater, septic system permits. Management of forests – planting and logging. Management of associated facilities -- roads, timber processing plant, administrative & maintenance buildings.
PG&E	Management of hydroelectric facilities. Management of associated facilities -- water transmission, water quality, roads, administrative buildings, recreation sites.
Amador Water Agency	Management of water supply, quality, treatment, and distribution.
Calaveras County Public Utility District	Management of water supply, quality, treatment, and distribution.
Calaveras County Water District	Management of water supply, quality, treatment, and distribution.
Jackson Valley Irrigation District	Management of water supply, quality, treatment, and distribution.
Upper Mokelumne River Watershed Authority	Acquisition, operation and maintenance of PG&E's hydropower facilities on the Upper Mokelumne River system; watershed management, and restoration, water quality protection.

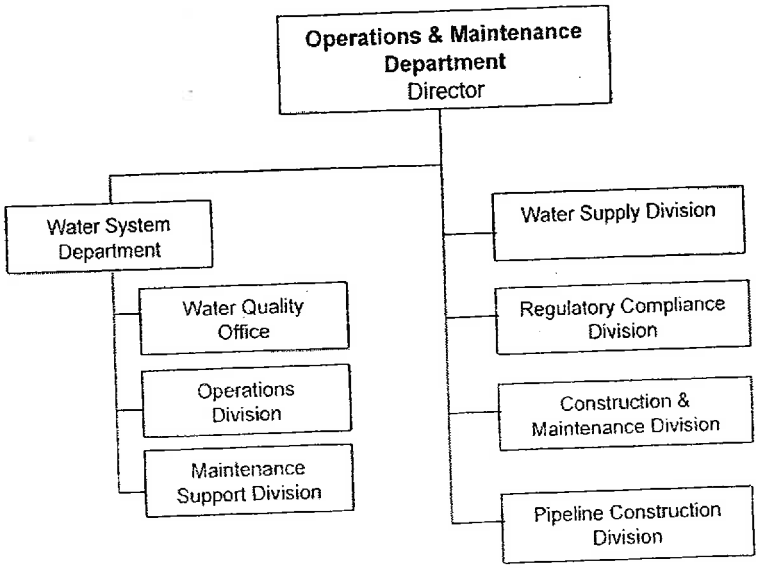
Table 6-1: Agencies with Influence Over Source Water Quality – (continued)

Agency	Jurisdiction or Issues of Concern
State Agencies	
Caltrans - CA Department of Transportation	Construction and maintenance of state and federal roads Stormwater collection along state and federal roads Hazardous materials spill response and maintenance of spill records along state and federal rights-of-way
CA Department of Fish and Game	Protection of state listed species Monitoring of water quality for aquatic species Regulation of alterations to natural state of rivers, streams, or lakes.
CA Department of Forestry and Fire Prevention	Fire prevention and suppression on all state-responsible lands (includes all District-owned watershed lands, except Lafayette Watershed) Regulation of timber harvesting activity on privated lands
CA Department of Health Services	Primacy for setting safe drinking water standards Protection of drinking water supplies Regulation of public water supply, treatment, and distribution systems
CA Department of Toxic Substances Control	Regulation of hazardous waste generation and storage
CA Office of Emergency Services	Coordination of regional emergency response
CA Regional Water Quality Control Board - Central Valley Region	Regulation of waste discharge into surface waters Regulation of stormwater discharge
Federal Agencies	
U.S. Army Corps of Engineers	Regulation of discharge of dredged or fill materials into waters of U.S.
U.S. Department of Agriculture Natural Resources Conservation Service	Resource conservation and soils
U.S. Forest Service	Management of national forests
U.S. Department of Interior Fish and Wildlife Service	Protection of federally listed species
U.S. Bureau of Land Management	Management and permitting of activities on federal lands.
U.S. Environmental Protection Agency	Primacy for setting safe drinking water standards Protection of drinking water supplies Regulation of public water supply, treatment, and distribution systems

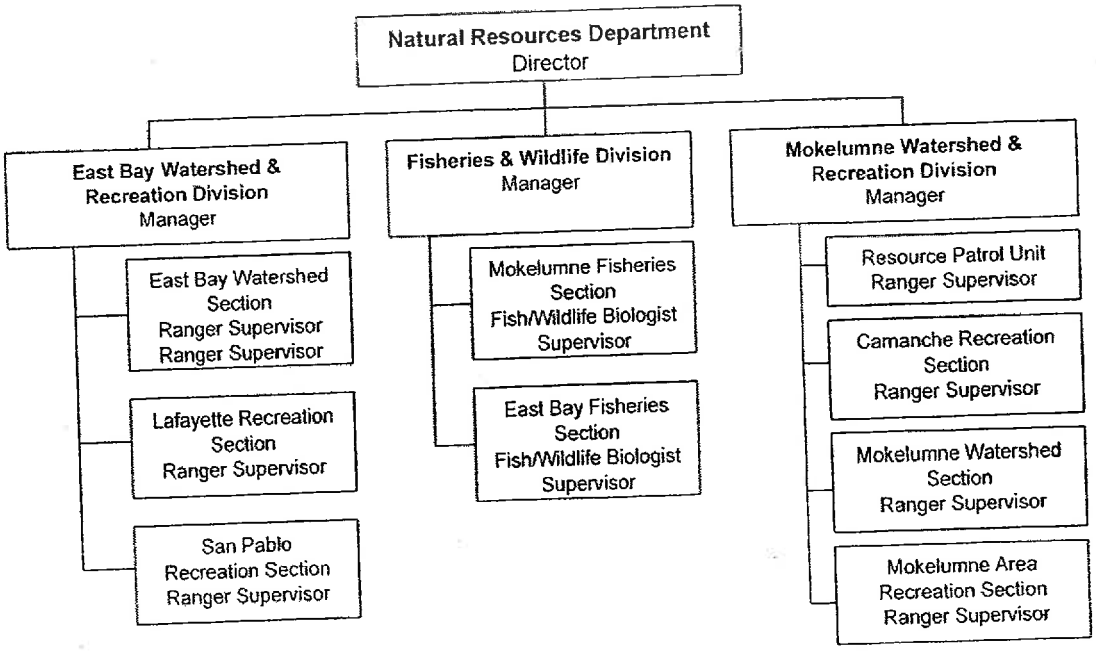
EBMUD Organizational Structure

From a water quality and watershed management perspective, the two most critical departments within EBMUD are the Operations and Maintenance (O&M) Department and the Natural Resources Department. These departments have as part of their primary responsibilities the management of the District-owned lands and facilities surrounding Pardee and Camanche Reservoirs. Figure 6-1 depicts an overview of the organizational structures of both of these departments.

FIGURE 6-1 - Water Operations & Maintenance Department and Natural Resources Department Organization Charts



NOTE: O&M Department Organization is a "Proposed" Organization



The O&M Department, formerly called the Water Operations Department in the 1995 MRWSS, is undergoing further organizational changes and the organization depicted in Figure 6-1 is a proposed structure. The mission of this department is to operate and maintain, manage, and improve the District's water system infrastructure, processes, and assets; provide safe, reliable, and high quality drinking water; engage and educate the District's stakeholders; and reflect sound environmental and financial stewardship.

The Water System Department within the O&M Department includes those groups whose activities impact and/or pertain to the water quality and watershed management of the East Bay water supply facilities. For the Camanche and Pardee water supply facilities, the Pardee Section, under the Water Supply Division, is responsible for the daily operations and maintenance functions for the Camanche and Pardee Reservoir water supply, wastewater, water treatment, and water distribution facilities. These facilities include Pardee and Camanche dams and powerplants, reservoir operations, water supply system outlet towers, treatment plants, distributions systems, wastewater treatment and disposal facilities, and the facilities that monitor water quality and quantity data to support operations.

Figure 6-2 highlights those functional groups within the O&M Department that are of most importance to water quality and watershed management.

FIGURE 6-2 - Watershed Water Quality Responsibilities – Water Operations and Maintenance Department

WATER QUALITY OFFICE

Responsible for all water quality information relating to regulatory compliance and developing strategies and action plans to comply with all current and future regulations.

- Safe Drinking Water Act Compliance
- Water Quality Monitoring and Reporting
- Source Water Quality
- Water Quality Planning, Analysis and Forecasting

OPERATIONS DIVISION

Responsible for raw water storage and treatment and drinking water distribution.

Water Treatment Section

Responsible for operation of water treatment facilities to provide potable water to the East Bay Service area.

- Safe Drinking Water Act Compliance
- Water Quality Monitoring and Reporting
- Finish Water Quality

Water Distribution Section

Responsible for operation of distribution system facilities to provide potable water to the East Bay Service area.

- Safe Drinking Water Act Compliance
- Water Quality Monitoring and Reporting
- Distribution System Water Quality

Strategic Project Coordination Section

Responsible for technical input into programs and projects that impact the ability to effectively operate and maintain the water system.

- Project Coordination
- Source Water Quality
- Drinking Water Regulatory Compliance.

Pardee Section

Responsible for operation and maintenance of water treatment and distribution facilities for Pardee Recreation Area, Pardee Center, Camanche North Shore and Camanche South Shore Recreation Areas.

The Natural Resources Department organization is virtually unchanged since the 1995 MRWSS. The department is divided into three divisions -- East Bay Watershed and Recreation Division, the Fisheries and Wildlife Services Division, and the Mokelumne Watershed and Recreation Division. Figure 6-3 summarizes the responsibilities of the Natural Resources Department's three divisions.

FIGURE 6-3– Watershed Water Quality Responsibilities Natural Resources Department

LOCAL WATERSHED AND RECREATION DIVISION

Responsible for planning, organizing, developing, supervising, and implementing the District's watershed and management program for the local watersheds.

- Range Conservation
- Integrated Pest Management
- Erosion Control
- Maintenance of Recreational Trails
- Maintenance of Fire Access Roads and Watershed Service Roads
- Fire Suppression and Prevention
- Environmental Education

FISHERIES AND WILDLIFE SERVICES DIVISION

Responsible for providing technical support on fisheries and wildlife issues that affect the District's natural resources or water quality.

- District Water Rights
- District's Water System Operating Plans
- Fisheries and Wildlife Monitoring
- District Mokelumne River Fish Hatchery
- Participate in Interagency Fisheries Technical Advisory Committees
- Review of Environmental Documentation and Mitigation Plans

MOKELUMNE WATERSHED AND RECREATION DIVISION

Responsible for planning, organizing, developing, supervising and implementing the District's watershed land management program for the Mokelumne Area.

- Managerial Oversight of Camanche and Pardee Recreation Areas
- Grazing Lease Administration
- Integrated Pest Management
- Erosion Control
- Monitor Wide Variety of Land Use Practices Which Could Impact Water Quality in the Mokelumne Watershed

Watershed Management Practices

The watershed control and management practices include an overview of the District's practices as well as those of other agencies that have potentially significant impacts on source water quality in the Camanche and Upper Mokelumne River Watersheds. The focus of these programs or practices is to prevent future degradation of water quality and enhance water quality. Since watershed management is not an enforceable requirement for water purveyors that provide filtration, the most effective approach to designing a long-term multi-agency watershed stakeholder program is based on consensus building. The goal is to develop best management practices that are economically feasible, politically acceptable and within the legal authority of the water purveyors.

Appendix F contains information pertaining to Best Management Practices (BMPs) used in watersheds throughout the United States. Some of these BMPs may be applicable for incorporation into Camanche and Upper Mokelumne River Watershed management efforts.

The practices documented in this section are summarized by agency and specific management practices. Four agencies are included: EBMUD, U.S. Forest Service, Soil Conservation Service, and Department of Fish and Game. The specific management practices are grouped as follows:

- Land Use Planning
- Access control
- Erosion Control
- Vegetation Management
- Pest Management
- Logging Practices
- Grazing and Livestock Management
- Mineral Exploration and Mining
- Stormwater Management
- Waste Management
- Structures , Dredging, and Fill Management
- Inspection, Surveillance, and Enforcement Procedures
- Emergency Response
- Public Education

EBMUD

The EBMUD Land Use Master Plan (Administrative Policy Statement 12) describes the policies for District-owned watershed lands surrounding Pardee and Camanche Reservoirs and the river reaches immediately upstream from each. A summary of its key elements that directly or indirectly relate to water supply follows.

- **District Lands - General**
  - Own and maintain existing lands and anticipate land requirements sufficient to effectively perform designated District functions and protect the sources of water supply.
  - Own, maintain, acquire, or dispose of District lands in accordance with environmental management principles consistent with the primary District functions of providing potable water within the District service area.
- **Watershed Lands Protection**
  - Maintain a positive program of sanitary control of its watershed lands and cooperate with officials of sanitary districts, federal, state, county and city health departments having jurisdiction over other lands tributary to District storage reservoirs in order to prevent the contamination and pollution of the water supply.
  - Maintain adequate and sufficient controls to minimize erosion and fire damage.
  - Prohibit unauthorized entry to all District watershed lands.
  - Prohibit use of lands not provided with adequate and approved facilities for removal of sewage from the watershed.
- **Multiple Public Utilization of Watershed Lands**
  - Recognize the benefit to the public of multiple use of District lands, giving prime consideration to those uses which will protect and preserve the open space characteristics of the land.

- Recognize that comprehensive land use planning, together with systematic and public review of such planning, is essential to achieve continuing optimum public benefits from multiple use of District lands.

- Coordinate District land use planning with federal, state, and local agencies as required.

- Cooperate with other agencies or public utilities seeking interest in or acquisition of District lands, insofar as such uses are consistent with the Land Use Master Plan and the stated policies. Proposed uses which do not comply with the 1996 EBWMP and policies, or which would result in deterioration of environmental quality, shall be aggressively resisted by the District with all means and methods provided by law.

- Retain fee title and direct control over all lands and reservoirs essential to the security or operation of the utility system and directly perform necessary patrolling of these lands and reservoirs.

- When a public need exists, open reservoir or watershed areas for public recreation, public fishing and educational use in accordance with the applicable provisions of law, provided that the opening and use is consistent with the District's primary purpose and is in accordance with the District's Land Use Master Plan.

- Where it is determined by the Board that District development and operation of recreation and fishing is not in the best interests of the District, recreational development and/or management by qualified public agencies or private concessionaires will be encouraged. Overall supervision and patrolling to protect water quality and sanitation shall be under control of the District at all times.

- Non-District development and/or management of recreation areas must conform to the Land Use Master Plan and meet optimum public benefit criteria including satisfactory regard for environmental quality.

- Effect public information programs to educate the public on the importance of watershed lands and the importance of the proper use of such lands.

Upper Mokelumne River Watershed Authority

As envisioned in its enabling agreement, the Authority would pursue the following activities if successful in acquiring PG&E's facilities and lands in the Pardee Watershed.

- Protection of water quality for member entities and other watershed users;
- Protection and enhancement of riparian ecosystems within the Upper Mokelumne River watershed;
- Use of existing facilities to enhance the water supplies of Alpine, Amador, and Calaveras Counties;
- Provision of future local water supplies;
- Support of continued public access and the enhancement of recreation opportunities; and
- The funding of a variety of watershed projects, including projects for watershed restoration, watershed assessment, acquisition of critical watershed lands public education, wildfire management, water conservation and recreation.

U.S. Forest Service

The U.S. Forest Service (USFS), a division of the U.S. Department of Agriculture, directs the management of the Eldorado and Stanislaus National Forests which together encompass all national forest lands within the watershed. Both entities have approved land and resources management plans for their respective areas of jurisdiction. The plans contain standards and guidelines, as well as specific plans and management area prescriptions. Management goals, activities and guidelines contained in those plans that could improve or affect water quality aspects of public health concerns include the following:

- Provide a wide range of developed and dispersed recreational opportunities, to meet projected demands using the simplest, most natural designs possible, to minimize public use impacts.

- Preserve high quality wilderness lands (Lands with resources and aesthetics valued by man that have not been significantly altered by man) for public use and appreciation of its unique characteristics.

- Manage the wilderness, scenic, and recreational aspects of the rivers to protect their outstanding recreational and aesthetic values.

- Preserve the integrity of the botanical, archaeological, geological, and recreational features for which special interest areas were established.

- Maintain and enhance populations of threatened and endangered wildlife and plant species and maintain viable populations of sensitive species. Provide a diverse habitat for all species, including harvestable game fish and wildlife.

- While permitting current levels of livestock grazing to continue, take steps to control livestock access to sensitive areas and improve ground cover and forage.

- Sustain a long-term timber yield by practicing the most intensive forms of timber management on the most productive sites. Increase yield by application of high utilization standards and scientific silvicultural growth techniques.

- Employ integrated pest management programs to aid in reforestation and timber stand maintenance/improvement by minimizing timber losses from forest pests.

- In areas susceptible to slope instability, develop management activities to avoid initiation or acceleration of slope movement.

- Prevent degradation or groundwater quality and develop groundwater sources to meet domestic, livestock and wildlife needs.

- Conserve or improve the inherent long-term soil productivity through the incorporation of soils information into land management decisions and through soil quality monitoring.

- Protect streams, lakes, wetlands and the riparian vegetation that surrounds them. Establish permanent Streamside Management Zones to furnish shade, ground cover, and natural environmental elements, which serve to maintain high water quality and enhance fish and wildlife habitat. Limit cumulative impacts on watershed lands within the National Forests by basing land and resource use decisions on the results of comprehensive resource management planning and impact assessments.

- Induce moderate increases in water yield by direct watershed improvement projects, meadow rehabilitation and expansion projects, and snowpack manipulation associated with timber harvest practices.

- Manage the National Forests to reduce susceptibility of fuels to fire and provide a sufficient level of fire protection while assuring a continuous flow of adequate outputs and amenities from the Forests.

Virtually all development activity on or requiring access over, or through, lands under the management of the USFS will require one or more "Use" or Authorization Permits. Timber harvesting, mining, and grazing are singled out for "Specific Use" program permits. All other uses are considered "Special Use" and are generally subject to the Rules and Regulations specified in 36 CFR Part 251.50-251.64.

Recreation "special use" authorizations are issued to private parties, groups, other public agencies, public and private institutions, and private businesses that provide accommodations and services on USFS lands. The kinds of recreation activities requiring permits generally fall into one of three categories:

- Private uses, such as recreation residences and the Mt. Reba - Bear Valley ski area, (in this category, permits are not required for non-commercial use or occupancy of the national forests for camping, picnicking, hiking, fishing, hunting, horseback riding, boating, or similar recreational activities).

- Semi-public, non-commercial services, such as fishing tournaments, and other group events.

- Commercial services provided for the benefit of the general public.

Soil Conservation Service (U.S. Department of Agriculture)

The Soil Conservation Service (SCS) is a non-regulatory agency with major responsibilities to develop and disseminate scientific knowledge, understanding and management techniques to be applied to the nation's soil resources. SCS provides technical information and advice on best management practices for agriculture, vegetation management, and soil conservation. SCS publishes county soil maps and technical reports describing the nature and erodibility of soils. The service also participates in scientific studies and offers advisory technical services to individuals, firms, organizations, and interagency cooperative investigations. Public investment in the Service's technical input and participation should produce returns in preventing the release of potentially harmful constituents and turbidity-inducing sediment loads into the raw drinking water supplies, by reducing erosion inputs.

Department of Fish and Game

Lake or Streambed Alteration Agreement. Any person, governmental agency, or public utility proposing any activity that will divert or obstruct the natural flow or change the bed, channel or bank of any river, stream, or lake; or proposing to disturb any material in a streambed, must first notify the State Department of Fish and Game of such proposed activity. Based on the information submitted by the applicant and a possible field inspection, Fish and Game will negotiate a Lake or Streambed Alteration Agreement with the applicant designed to protect and conserve the fish and wildlife resources of the waterway.

The notification requirement applies to any work undertaken within the 100-year flood plain of a body of water or its tributaries, including intermittent streams. As a general rule, it applies to any work undertaken within the annual high-water mark of a stream or lake which contains (or once contained) fish and wildlife, or supports (or once supported) riparian vegetation.

Fish and Game bases its evaluation of a Notification of a proposed Lake or Streambed Alteration on the anticipated impact of the proposed project on fish and wildlife resources. Consequently, Fish and Game will authorize the Lake or Streambed Alteration

Agreement subject to terms and conditions designed to protect and/or compensate for impacts on these resources.

Standard and Special Suction Dredging Permits. Anyone proposing to use suction or vacuum dredging equipment with an intake diameter of 8 inches or less in any river, stream, or lake designated as (open for dredging) must obtain a standard suction dredging permit from the Department of Fish and Game.

The state and regional offices of Fish and Game regulate the use of suction and vacuum dredging equipment to maintain a stable environment for fish and wildlife resources in California's waters. The State also has jurisdiction over waters flowing across federal lands.

The Department of Fish and Game will not issue a suction dredging permit if the proposed dredging activity will harm fish. In addition, Fish and Game will not issue a permit for dredging in any national forest or in any national, state, county, or municipal park if the agency in control of the forest or park has prohibited dredging in its jurisdiction.

Anyone proposing to use suction or vacuum dredge equipment with an intake diameter over 8 inches in any lake, stream, or river in the state must obtain a special suction dredging permit form the Department of Fish and Game. In addition, anyone proposing to use suction or vacuum dredging equipment of any size in the area designated as "closed" by Fish and Game must also obtain a special suction dredging permit.

Land Use Planning

Effective land use planning is critical to the overall protection of source water quality. Depending upon the specific land use, any number of water quality parameters can be effected including turbidity, microbes, organics, and inorganics. Section 5 which addresses potential contaminant sources as they relate to land uses and activities provides specific details regarding the water quality concerns corresponding to the land uses identified. Below is a brief summary of some of the land use planning programs defined by both Calaveras and Amador counties.

County governments have the authority to restrict activities on lands within the counties that are subject to their jurisdiction. This is done primarily through the establishment and enforcement of

land zoning ordinances. Uses of a parcel of land must be consistent with the zoning for that parcel. How a parcel is zoned is determined in part by the General Plan for the county. A General Plan is a long-range policy guide designed to be used by public officials and citizens in the development of land. These General Plans designate specific land uses for each parcel within the counties. For example, the Calaveras General Plan has two general land uses: community development lands and natural resource lands. The community development lands consist of community centers, residential centers, and future single family residential. The natural resource lands include wildlife habitats, botanical areas, timberlands, mineral resource areas, dam inundation areas, and agriculture preserves. Zoning must be consistent with the land uses designated by the County Plan. Zones fall into four general categories: interim zones, resource production zones, residential zones, and commercial/economic zones.

The General Plan and zoning in Amador County is very similar to the General Plan and zoning for Calaveras County. Zones may be consistent with a variety of land uses. For example, in Calaveras County, the timber production zone (a subset of resources production zones) is consistent with all land uses as defined in the County Plan. Most of the land owned by the largest private landowner in the Mokelumne River Watershed, Sierra Pacific Corporation, is zoned for timber production with some parcels zoned unclassified (Calaveras County) or R1A (Amador County).

Access Control

Land Ownership. Landowners can control uses and activities on their land to avoid water supply contamination. Examples of appropriate controls including posting against trespassing, conservation of natural protective features, and adherence to sound waste disposal practices. The major landowners in the upper Mokelumne River Watershed are the Bureau of Land Management (BLM), Eldorado National Forest, Sierra Pacific Industries, Pacific Gas and Electric Company, and Stanislaus National Forest.

Fencing Restricted Watershed Areas/Riparian Lands. Fencing of restricted watershed areas and riparian lands provides access control. It can completely exclude all humans and livestock and thus eliminate any contamination due to these sources.

All Camanche and Upper Mokelumne River watershed lands owned by the District are fenced and posted, with human access strictly controlled. The shorelines of Pardee Reservoir and the Mokelumne River where it passes through District land are also fenced to exclude cattle. Cattle are not excluded from the riparian areas of some subordinate tributaries, but the District has plans to do so in the future.

BLM does not have any riparian areas fenced to control access. Livestock control fences are present but these are designed for livestock management, and not to limit access.

Most of the fencing in Eldorado National Forest is between range allotments and some fencing is present within the allotments to prevent livestock from entering sensitive areas. However no single program exists which is designed to protect sensitive watershed areas and riparian lands. Each USFS District Ranger has the authority to restrict usage if a problem exists.

In Stanislaus National Forest, the Forest Service has recently completed work in campgrounds to restrict vehicles from the riparian zone of Moore Creek, the North Fork of the Mokelumne near Moore Creek, and the North Fork of the Mokelumne near Ebbetts Pass (Bloomfield campground). This was done with fencing and large boulders as part of a recently instituted ecosystem management program, the Coordinated Resource Management Areas (CRMA), to evaluate the current health of the watershed ecology and to evaluate what steps must be taken in the future to improve the ecology of the watershed.

Gating of Roadways. Gating of roadways prevents vehicular access but does not limit livestock access and only partially limits human access. All roadways within EBMUD watershed lands are either gated or fenced along the entire passage through District lands.

A few gated roadways exist on BLM land in the Mokelumne River Watershed. They are generally placed to prevent driving into mining claims or for public safety.

Eldorado National Forest has an extensive system of gating of roadways. Access is restricted on roads for a variety of reasons. For example, some roads are closed except when needed for a particular project; some may be closed due to wildlife issues, and some are closed during winter.

It is estimated that over 80 percent of the roads entering Sierra Pacific land from the Stanislaus National Forest are gated (Greg Napper, Stanislaus National Forest, pers. comm.). Very few roads on lands owned and operated exclusively by the Stanislaus National Forest are gated. However a large number of single purpose (timber harvesting) roads are present which are blocked until they are needed again (in 10 to 20 years). The gates that are present are rarely closed because most of them are in the snowbelt and are closed in winter by snow. However, due in part to the recent drought, the National Forest staff is re-evaluating its road closure policies and may be closing more roads in the future.

Hunting and Fishing Regulations. The California Department of Fish and Game (Fish and Game) issues licenses to regulate all fishing and hunting in the watershed. The seasons and limits on take are imposed by the Fish and Game Code by means of the licenses, and enforced by the Fish and Game wardens. While not designed to control soil and vegetation conservation and consequent water quality impacts per se, the regulations do serve to limit the extent and severity of such impacts by regulating the intensity of use and limiting the number of users to those willing to pay for licenses.

Off-Road Vehicle Use Restrictions. The U.S. Forest Service imposes restrictions on off-road vehicles on the National Forest lands. All designated wilderness areas are off limits by Congressional designation. Other National Forest lands are closed due to the presence of unstable or devegetated soils, unstable roads and drainage systems, and sensitive biota such as spotted owl nesting pairs or rare plants. Closures may be permanent or seasonal; for example, designated areas may be open only to snow travel vehicles during the winter months.

The USFS is not funded to install gates to limit access; so notification is by means of forest orders, signs and maps. Violators are subject to citation by U.S. Forest Service rangers. Convictions can result in stiff penalties of up to $5,000 fine and/or six months in jail.

Wilderness Area Restrictions. Mokelumne wilderness is jointly administered by Eldorado and Stanislaus National Forests. The wilderness is protected by means of restrictions on activities and strict conformance with the wilderness land use designation. Human uses are basically limited to hiking, nature study and photography, horseback riding, backpacking, limited packtrain excursions, fishing, cross county skiing and mountaineering. No

mechanized vehicles, including mountain bikes or snowmobiles, are permitted in the wilderness area.

Control is imposed by means of overnight permit requirements and issuance. At this time no restrictions on the number of permits or persons in each party are in place; however, such limits are being studied. Backpacking without a permit is a violation punishable by fine. Riparian lands, streams and water quality are further protected by means of restrictions on campsites and human waste disposal sites. Camps and latrines must be located at least 100 feet away from trails, lakes and stream courses. Stock animals are subject to further, more stringent restrictions on where they may be tethered, as well as tree and vegetation protection measures.

Rights-of-Way. BLM has many rights-of-way in the Mokelumne River Watershed. However, access is not restricted on any of the rights-of-way present on BLM land. Eldorado National Forest has "cooperative" roads, some of which have restricted access where they cross private land. Stanislaus National Forest has easements on lands owned by Sierra Pacific in two categories: limited and unlimited. Unlimited easements allow complete public access and limited easements allow access only for protection and management of Forest Service lands.

Ski Area Special Use Permits. The Mt. Reba - Bear Valley Ski Resort operates under a special use permit from the Stanislaus National Forest. Activities are limited to recreational skiing and the construction and maintenance of the necessary support facilities. Terms of the permit require any potentially adverse impacts of the development to be minimized or mitigated as fully as possible. An erosion control plan that includes requirements for revegetation/runoff control and slope stabilization is required for ski slopes.

Erosion Control

The water quality concerns associated with erosion control are numerous. Turbidity is the water quality parameter of most importance with respect to an erosion event. Other water quality parameters (organics, inorganics, and microbes) adhere to particulates and are transported into corresponding water bodies. In addition to turbidity, these water quality parameters can cause reservoir and treatment-related concerns; therefore, effective erosion control and soil management is important for adequate source protection.

On National Forest lands, the U.S. Forest Service is primarily responsible for the control of erosion and other potential sources of pollution. Both the Eldorado and Stanislaus National Forests use the national standards and guidelines for these purposes, proposed best management practices developed by the State of California's Department of Forestry and Fire Protection, and their own Land and Resource Management Plans. Included among these regulations are limitations on operations in stream protection zones, on steep or unstable slopes, and during wet weather conditions. Very little quantitative data is available for the National Forest lands.

On private lands, the California Department of Forestry and Fire Protection is responsible for enforcing the regulations of the California Forest Practices Act to control erosion impacts. The regulations require submittal and advance approval of Timber Harvest Plans for all significant harvesting efforts for each three-year time segment.

Vegetation Management

As with many of the management programs, the main water quality concern associated with vegetation management is high turbidities resulting from erosion. In particular, erosion occurring adjacent to water bodies and the use of pesticides along the roadways within proximity to water bodies are of most concern. As previously mentioned, other water quality parameters such as microbes, organics, and inorganics adhere to particulates and can, therefore, be transported into the water bodies when erosion occurs. These water quality parameters, as well as turbidity, in turn can create reservoir and treatment-related concerns.

In addition to the water quality concerns, erosion from areas adjacent to roadways can result in structural deterioration of the roadbed and appurtenant structures. Also, sediment can impede or accumulate in storm drainage systems or in terminal reservoirs, reducing storage capacity and increasing the possibility of flooding. Vegetation can provide a protective cover which minimizes erosion by reducing the impact of precipitation droplets, trapping soil particulates from further downslope movement, absorbing moisture, and allowing percolation to ground water.

The major purpose of the National Forest is the preservation of vegetation, however this purpose produces major secondary benefits for water quality control. The bulk of the National Forest programs are directed toward vegetation management.

The U.S. Bureau of Land Management requires one or more "Use" Authorization Permits for activities that may impact vegetation. Under the BLM forestry program, a contract is required for removal of timber and other vegetation resources for commercial or domestic use. Timber includes saw timber, fuel wood, poles, posts, and any standing trees, downed trees or logs capable of being measured in board feet. Other vegetative resources include Christmas trees, cones, boughs, manzanita, moss, and many other unspecified products which are salable.
Uses and projects, such as new road construction or use of existing roads for commercial hauling of private timber across BLM land, require issuance of right-of-way grants or temporary use permits from BLM. Such uses include access roads, utility lines, communication sites, or any other uses that involve the placement of either temporary or permanent improvements upon BLM lands. In addition, any activity that involves physical disturbance to the land or vegetation requires a permit (e.g., brush removal or test hole drilling). Other long-term occupancy or use of BLM land that could affect vegetation may also be authorized by a lease. Applications must be filed with the local BLM office.

Any person who owns timberlands which are to be devoted to uses other than the growing of timber, or who applies for immediate rezoning from Timberland Production Zone (TPZ) whether timber operations are involved or not, must obtain a Timberland Conversion Permit from the Director of the Department of Forestry and Fire Protection. Examples of activities requiring a Timberland Conversion Permit include development of a ski area or other development of recreational facilities, the construction of a housing development, changing the designation of timberland to grazing land, or applying for immediate rezoning from TPZ.

The Director of the California Department of Forestry and Fire Protection evaluates applications for Timberland Conversion Permits to assure that the proposed timberland conversion meets the requirements of the Forest Practices Act, related Board of Forestry regulations, and provisions, rules, and regulations requiring stocking for continued forest production, or to enable a county to finalize approval of immediate rezoning from TPZ.

Owners proposing a conversion of a timber stand of less than three acres within a single ownership to other uses need not obtain a Timberland Conversion Permit if the conversion conforms to the local general plan and zoning ordinances. Timber owners may not use this exemption more than once for a parcel in a single ownership. Public agencies proposing to convert timberland to construct rights-of-way across public property, and landowners granting easements for constructing and maintaining utility transmission lines need not obtain a Timberland Conversion Permit. Additionally, landowners who have satisfied all local CEQA requirements for a subdivision development are exempt from Timberland Conversion Permit requirements.

Pest Management

Pest management typically includes management practices for nuisance vegetation control, mosquito control, rodent control, or pesticide spraying for agricultural needs. These practices rely quite heavily on the use of pesticides and herbicides. The water quality concerns associated with pesticide and herbicide uses were discussed in Section 5. Because agricultural lands constitute a small area of the watershed lands, any associated pesticide spraying is not of significant concern. There are no active programs within the watershed lands for mosquito or rodent abatement, nor areal pesticide spraying.

Any property owner or operator who wishes to use a pesticide designated as a "Restricted Material" on a specific crop or site must first obtain a Restricted Materials Permit from the county agricultural commissioner. A list of restricted materials is found in Title 3, California Code of Regulations, Section 6400. Restricted materials are those pesticides which the Director of the California Environmental Protection Agency finds to be a potential hazard to public health, pesticide applicators, field workers, domestic animals, crops, or to wildlife and the environment in general, as determined by the Department of Pesticide Regulation. The County Agricultural Commissioner enforces pesticide laws and regulations at the local level. Prior to issuing a permit to possess or use a restricted material, each County Agricultural Commissioner shall determine if a significant adverse environmental impact may result from the use of the pesticide.

There are two types of permits an applicant may obtain. The first is an agricultural permit that is to be used for agricultural purposes such as the production of food, feed and fiber; or the maintenance of golf courses, parks, cemeteries, or right-of-ways. The second type of permit is for non-agricultural uses, which include industrial and institutional uses.

Logging Practices

National Forest timber which includes trees, portions of trees, and other forest products on National Forest System lands, may be disposed of for administrative use by sale or without a charge, as may be most advantageous to the United States. Most of the wood products that may be disposed of for administrative use are in the form of personal wood fuels; permits are subject to a maximum quantity set for each National Forest.

The USFS will insure that each permit for timber use is consistent with applicable land and resource management plans and environmental quality standards. The key factors include:

- Fire protection and suppression.
- Minimizing additional soil erosion.
- Insuring favorable conditions of water flow and quality.
- Protection of residual timber.
- Regeneration of timber.

The Code of Federal Regulations prescribes the manner in, and extent to which, timber sales and uses will be conducted, and specifies the conditions of the sale or use and/or the cancellation of same.

Timber owners or operators who propose to cut and remove solid-wood forest products of designated live commercial forest trees from non-federal timber lands must first submit a timber harvesting plan to the California Department of Forestry and Fire Protection for approval. Timber owners include persons who own timber or timber rights on lands owned by another party. Solid-wood forest products include sawlogs, veneer logs, poles, pilings, timbers, posts, tanbark, chips, fuel woods, split products, root-crown burls, and pulp-logs. Timberland is non-federally owned land capable of bearing designated commercial forest tree species. Designated commercial forest tree species vary between regions. Timber operators or owners should contact regional offices of the California

Department of Forestry and Fire Protection in the area of the proposed timber operations to determine what lands are designated as timberlands.

The California Department of Forestry and Fire Protection approves timber-harvesting plans to assure that timber operators carry out their activities in keeping with the goal of maximum, sustained timber production while considering maintenance of recreational opportunities, watershed quality, wildlife, range, forage, and fisheries.

Grazing and Livestock Management

All grazing and livestock use on National Forest System Lands, and on other lands under Forest Service control, must be authorized by a Grazing or Livestock Uses Permit. The Code of Federal Regulations (CFR) sets the rules under which livestock operations will be conducted in order to meet the multiple-use, sustained yield, economic, and other needs and objectives for the lands involved. Allotment Management Plans prescribe the manner in, and extent to which, these operations will be carried out on a site-specific basis, to minimize environmental and water quality impacts. The use of Bureau of Land Management lands for grazing or any livestock use requires the issuance of a grazing lease.

Mineral Exploration and Mining

Title 36, Section 228 of the CFR sets the rules and procedures through which the surface of National Forest System Land may be used in conjunction with operations authorized by the United States Mining and Mineral leasing laws, and the sale of mineral materials. Hard rock mineral leasing on National Forest System administered lands is subject to 43 CFR 3500.

The mineral authorities are grouped into three broad categories: locatable, salable, and leasable. Locatable minerals are those like gold, silver, copper, and other minerals of rare occurrence or specialized value that are available for exploration and development by mining claims under the Mining Law of 1872. Salable minerals are the common varieties of sand, gravel, stone, and cinders and other minerals of widespread occurrence, which are available under a contract sale or permit from the USFS. The leasable minerals are oil and gas, geothermal steam, potash,

phosphate, sodium, and similar minerals, and are available through a lease from the United States Department of the Interior. The USFS regulates the surface uses associated with these leases.

Mineral development on, or requiring access across, lands under the management of BLM will require one or more "use" authorization permits issued by the BLM. Categories of permits include locatable minerals, leasable minerals, salable minerals (which include oil and gas, and geothermal).

Locatable Minerals. When locating a mining claim on any open federal lands (BLM/U.S. Forest Service) in California, notification must be provided by recording the location notice with the BLM. Surface disturbing activities require the submission of a "plan" or "notice" to BLM or U.S. Forest Service for their review and issuance of a permit (43 CFR 3802 or 3809).

Leasable Minerals. Coal, phosphate, sodium compounds, potash (potassium) compounds or public lands or "hardrock" minerals on acquired lands are available by lease (43 CFR 3400 and 3500).

Salable Minerals. Permits for sand, gravel, fill, decorative stone, and construction aggregate extraction are issued for fair market value under contract from BLM (43 CFR 3600) except that municipalities may receive such materials free of charge. Oil and Gas and geothermal leases are also available through BLM.

The procedural requirements generally provide that a Notice or Plan be filed with the Forest Service District Ranger by any person proposing to conduct operations which might cause disturbance of the surface resources. For locatable (mining claim) operations, a Notice of Intent should include enough information about the proposed activity to allow the District Ranger to identify the area involved, the nature of the proposed operations, the route of access to the area, and the method of transport. If the District Ranger determines that such operations will likely cause significant disturbance of surface resources, the operator will be required to supply a more detailed Plan of Operations, which must include: the type of operations proposed and how the operations will be conducted; a description of the type and standard of the existing or proposed roads or access routes; identification of the means of transportation to be used in connection with the operations; the time period during which the activity will take place; and the measures to be taken to meet the requirements for protection of air quality, water quality, scenic values, solid wastes, fisheries and wildlife habitat, roads, and for reclamation of the site.

Proponents for operations under the salable mineral laws must submit an Operating Plan to the District Ranger for prior approval. The Plan must include, as a minimum, a map and explanation of nature of the access, a description of the anticipated activity and surface disturbance, and the intended reclamation including the removal or retention of structures and facilities.

Activities on the National Forests for the exploration and development of leases from the Department of the Interior must be initiated with the Department of Interior. The Forest Supervisor will review proposed operating plans from the U.S. Department of Interior, and shall advise the Department of the terms and conditions required for the protection of surface resources. The Forest Supervisor will also monitor those approved operations for compliance with stipulations.

All uses of National Forest System lands, improvements, and resources, except those provided for in Sections 222, 223, and 228, are designated "Special Uses", and must be approved by an authorizing officer.

Stormwater Management

The water quality concerns associated with stormwater are detailed in Section 5. In general, the concerns identified with urban stormwater include organics, inorganics, microbes, and occasionally turbidity. The first storms of the rainy season have the potential for transporting unusually high concentrations of numerous water quality parameters. These elevated concentrations in turn create both reservoir and treatment-related concerns. Given that several urban areas are within the watersheds, well-defined and maintained stormwater management programs are critical to the overall success of source water protection.

Discharges composed entirely of industrial stormwater runoff may be eligible for coverage under a General Industrial Stormwater Permit issued by SWRCB rather than an individual permit issued by the Regional Board. Eligible activities include:

- Facilities subject to stormwater effluent guidelines (40 CFR subchapter N).

- Manufacturing facilities.
- Mining facilities.
- Hazardous waste treatment, storage, or disposal facilities.
- Landfills, land application sites, and open dumps that receive industrial waste.
- Recycling facilities such as metal scrap yards, battery reclamation sites, salvage yards, and automobile yards.
- Transportation facilities.
- Sewage treatment plants.
- Certain stormwater discharge facilities.

The SWRCB has also developed a General Construction Activity Stormwater Permit for stormwater runoff associated with any construction activity including clearing, grading, excavation, reconstruction, and dredge and fill activities that result in the disturbance of at least five acres of total area.

Waste Management

Discharge Requirements. The owner or operator of any facility or activity which discharges or will discharge waste that may affect groundwater quality, or from which waste may be discharged in a diffused manner (e.g., erosion from soil disturbance) must first obtain waste discharge requirements from the Central Valley Regional Water Quality Control Board (Regional Board).

The Regional Board issues NPDES permits and adopts waste discharge requirements to protect the waters of the state for all designated beneficial uses in the watershed. The State Water Resources Control Board (SWRCB) and Regional Board seek to attain the highest possible water quality in the state. Examples of activities that may require an NPDES permit include:

- Feedlots for cattle, swine, sheep, goats, horses, turkeys, chickens, and ducks.
- Sewage treatment plants.
- Stormwater runoff discharges (municipal, industrial, and construction).
- Dredge spoils discharges.
- Mining activities.
- Groundwater discharge operations.

Examples of the types of wastes that may require waste discharge requirements are:

- Drainage from agricultural operations.
- Drainage from waste materials in landfills.
- Flow or seepage containing debris or eroded earth from logging operations.
- Drainage from inoperative and abandoned mines.
- Waste from construction or dredging operations.
- Food production and processing wastes.
- Waste from manufacturing and refining operations.
- Municipal and industrial wastes, if percolation or injection to groundwater are the disposal methods to be utilized.

The discharge of waste into a municipal sewer system is not usually subject to waste discharge requirements. However, EPA, SWRCB, the Regional Board, and the local wastewater management agency may require some industries to pretreat hazardous wastes prior to discharge to the municipal sewer system. The local wastewater management agency will notify the industry of the requirements. Waste disposal by injection well also may be subject to a Federal Underground Injection Control Program Permit issued by EPA.

The Regional Board evaluates the "Report of Waste Discharge" to determine whether the proposed discharge is consistent with the Regional Board's adopted water quality standards, the Areawide Waste Treatment Management ("208") Plan, the Water Quality Control Plan (Basin Plan) for the area in which the proposed activity is located, and the "Chapter 15" regulations, if applicable.

When adopting waste discharge requirements, the Regional Board sets pollutant limits (effluent limitations) on each discharge as a condition of approval. Monitoring compliance with the limitations ensures that the discharge will not harm beneficial uses, such as

public water supplies, agricultural and industrial water uses, wildlife habitats, or any water-related activities.

Septic Tank Regulations. Only approximately 1 percent of the land use in the Mokelumne River Watershed is residential. Because of the close proximity of many residential areas to creeks and other waterways, poorly functioning or situated septic systems present a major potential source of contamination to the Mokelumne River system and Pardee Reservoir.
In Calaveras County, individual septic tanks fall under the jurisdiction of the Building Department, On-Site Sewage Division. The regulations for septic systems in Calaveras County pertain only to the installation of new systems. No regulations or management of existing systems are present, although the County is aware that maintenance regulations are needed and are working to that end (Jim Steinsiek, Calaveras County Building Department, On-Site Sewage Division). Prior to installation of a septic system, the On-site Sewage Division conducts an initial analysis of the soil to determine if it is suitable for a standard system. If the soil is not suitable for a standard system, an appropriate system must be designed by a registered engineer, environmental health specialist, or engineering geologist. For all systems, the On-Site Sewage Division specifies the type of system to be used depending on soil depth, soil permeability, depth to the ground water, slope, and available area.

In Amador County, the County Health Department regulates the siting, design, construction and performance of septic systems. In Alpine County, an extensive set of guidelines and procedures are present to obtain a permit to construct, alter or repair a septic system in accordance with Alpine County Health Department Regulations. These regulations cover siting, construction, and performance standards.

Underground Tanks and Chemical/Fuel Storage. The underground tank law established state regulations requiring permits to be issued by the Regional Water Quality Control Board to underground tank owners. A developer-applicant will need this permit if they own, operate, or intend to construct an underground storage tank containing a hazardous substance.

All new underground storage tanks must provide primary and secondary containment for the hazardous substances stored. The primary container must be product-tight under all circumstances (i.e., impervious to the substance it contains). Secondary containment must be constructed to prevent structural weakening

as a result of contact with any released hazardous substances, and also shall be capable of storing the hazardous substances for the maximum anticipated period of time necessary for the recovery of any released hazardous substance. An access casing is required in the secondary container for installation of the monitoring system to detect unauthorized releases and provide a conduit for removal of the hazardous substance.

To protect water quality statewide standards have been established for monitoring underground storage tanks that store hazardous substances. The objective of the monitoring program is to detect any unauthorized release from any portion of the underground storage tank system at the earliest possible opportunity. If the monitoring detects an apparent unauthorized release, the actions to be taken will be governed by the provisions of Chapter 16 of Division 3, Title 23, California Code of Regulations (CCR), which regulates underground tanks. Specific procedures are required for reporting unauthorized releases. All unauthorized releases must be reported to local agencies by underground storage tank owners or operators.

A non-pressurized underground motor vehicle fuel storage tank may be repaired once by the operator. The tank owner must demonstrate to the local agency that all of the problems have been identified and that the proposed repair will correct them. A test or inspection must then be performed to determine if the underground storage tank is structurally sound. Repairs are required to be performed, using accepted engineering practices, with materials that are compatible with the underground storage tank and with the hazardous substance(s) being stored. All repaired tanks must be retrofitted with cathodic protection and overspill prevention. Following the repair, the underground storage tank owner must demonstrate that the repair was successful and that the underground storage tank will meet the applicable containment.

Certain specific actions and evaluations must be completed by the underground storage tank owner when the underground storage tank is either temporarily or permanently taken out of service. Temporary closure allows an underground storage tank to be taken out of service for up to one year without implementing permanent closure. Leaking underground storage tanks must be repaired or permanently closed.

Land Disposal Regulations. Many of the larger communities in Calaveras County utilize wastewater treatment systems, which collect sewage from septic tanks and transport the effluent to community treatment facilities. After treatment, wastewater is disposed of on land. Land disposal of treated wastewater in Calaveras County is regulated by the Central Valley Regional Water Quality Control Board. Information on the existing regulations was provided by the Regional Board (Ethan Heilman, pers. comm.). Discharge requirements are specific to individual sanitary districts, but the Regional Board is attempting to update and standardize all discharge requirements. An example of a sanitary district with updated discharge requirements is Mokelumne Hill Sanitary District. The discharge requirements for the Mokelumne Hill Sanitary District are as follows:

- Effluent Limitations - Spray Irrigation Field:
  - The discharge of an effluent in excess of the following limits is prohibited:

Constituents	Monthly Averages	Daily Maximum
20°C BOD_5	40 mg/L	80 mg/L
Settleable Matter	0.5 ml/L	1.0 ml/L
Flow	0.15 mgd	

- **Discharge Prohibitions:**
  - Discharge of wastes to surface waters or surface drainage courses is prohibited.
  - By-pass or overflow of untreated or partially treated waste is prohibited.
- **Discharge Specifications:**
  - Neither the treatment nor the discharge shall cause a nuisance or condition of pollution as defined by the California Water Code, Section 13050.
  - The discharge shall not cause degradation of any water supply.
  - The discharge shall remain within the designated disposal area at all times.

- Collected screenings, sludges, and other solids removed from liquid wastes shall be disposed of in a manner approved by the Executive Officer.

- A 2.0-foot freeboard shall be maintained in all ponds at all times.

- Reclaimed wastewater shall meet the criteria contained in Title 22, Division 4, CCR (Section 60301, et seq.).

- The discharge of waste containing any carcinogen or reproductive toxin listed by the Governor pursuant to Health and Safety Code Sections 25249.5 through 25249.13, the Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65), where such chemical passes or probably will pass into any source of drinking water, is prohibited.

- The dissolved oxygen content of holding ponds shall not be less than 1.0 mg/l for 16 hours in any 24-hour period.

Compliance with these requirements is insured by monitoring and periodic visits (typically annually) from the Regional Board staff. Monitoring is required weekly for pond freeboard, monthly (when spraying occurs) for 20°C BOD_5 and settleable matter, yearly for standard minerals, and continuously for flow. Quarterly monitoring reports and a yearly summary report are required to be submitted to the Regional Board.

No facilities that use land disposal of wastewater are present in the Amador and Alpine County portion of the Mokelumne River Watershed. No National Pollutant Discharge Elimination System (NPDES) permits have been issued for Amador, Alpine, or Calaveras Counties because there are no permitted waste water discharges to surface waters of the State at present.

Structures, Dredging and Fill Management

Any person or public agency proposing to locate a structure, excavate, or discharge dredged or fill material into waters of the United States must obtain a Section 404 Dredged Material Discharge or Fill Material Placement Permit from the U.S. Army Corps of Engineers' (COE). Typical activities requiring permits include the construction or installation of artificial canals, artificial islands, boat ramps, breakwaters, bulkheads, dams, dikes, weirs, groins and jetties, intake pipes, levees, mooring buoys, outfall

pipes, overhead power crossings, pipes and cables, piers and wharves, riprap, road fills, signs, and tunnels; or activities that result in dredging or filling, or the discharge of sand, gravel, dirt, clay, and stone.

The Federal Rivers and Harbors Act of 1899, and Section 404 of the Clean Water Act grant the COE jurisdiction over all navigable waters within the United States. Recent legislation and court decisions have expanded the legal definition of navigable waters to include marshes, swamps, and diked lands, even though they may not, in fact, be navigable.

The decision whether to grant or deny a permit is based on a public interest review of the probable impacts of the proposed activity and its intended use. Benefits and detriments are balanced by considering effects on such concerns as: conservation, economics, wetlands, fish and wildlife values, flood hazards, navigation, water quality and the needs and welfare of the people. In addition, projects involving discharge or dredge or fill material must comply with the Section 404(b)(1) guidelines prepared by the Environmental Protection Agency. The guidelines restrict discharges into aquatic areas when there are less environmentally damaging, practicable alternatives. Reasonable and practicable mitigation of unavoidable impacts also will be required. A permit will be granted unless the project is found to be contrary to the public interest or fails to comply with the guidelines.

The COE is required by federal law to consult with state and federal wildlife agencies regarding any impacts of a project on aquatic habitats.

Inspection, Surveillance, and Enforcement Procedures

The rangers in the District's watersheds and recreation division patrol the watershed lands to protect water quality and natural resources. Each weekday, one person is assigned to inspect the District owned lands and facilities in both the Pardee and Camanche watersheds

Emergency Response

Depending upon the type of emergency, any number of water quality contaminants may impact source water quality including turbidity, microbes, organics, and inorganics. Of particular concern are emergency scenarios that could result in contaminants being introduced within close proximity to a reservoir outlet tower. The District's Emergency Operations Plan describes the overall District emergency management program through a phased approach: preparedness, alert and warning, activation of emergency operations plan, District notification, partial and full response, and recovery. The Basic Plan responds to a broad range of emergency scenarios. Three standard emergency ratings classify the magnitude and scope of emergency response required by the event:

- Level I: Minor Emergency (e.g. aqueduct failure or local freeze)
- Level II: Major Emergency (e.g. moderate earthquake (like 1989 Loma Prieta), or widespread and long-term power outage)
- Level III: Catastrophic Emergency (e.g. major earthquake, fire, flooding)

The emergency response plan summarizes potential hazards facing the District: earthquake, aqueduct or levee failure, dam failure, hazardous materials spill or leak, major fires, severe storm or flood, civil disturbance, contamination of water supplies, sewage spill, widespread power outage, and national security emergency. The plan establishes the emergency response structure - systems are laid out, and specific responses and activities are outlined.

The District rangers are classified by the state as "wildland firefighters" and have the responsibility for initial response and mop-up of all fires on District-owned lands. In addition, they have the responsibility for fire road grading and maintenance, and fire prevention activities in accordance with the Annual Fire Plan.

During a major disaster, the District operates as part of the Statewide Emergency Management System. Local cities, special districts, counties, mutual aid regions, and state agencies participate in this response. During disaster response, the District reverts into Emergency Management Organization, (based on an Incident Command System) to provide clear communication, coordination, and direction during emergencies. In addition, each

division or department develops and updates an emergency plan with details on response priorities, staff assignments, and emergency resources. These department/division plans are updated on an annual basis.

The Regional Water Quality Control Board, Department of Fish and Game, Caltrans, and Department of Health Services have responsibilities to mobilize personnel to oversee responses and cleanup following any spillages or releases of hazardous materials. If the situation should become a major crisis, the State Office of Emergency Services may step in to coordinate the overall emergency response, public notification and evaluation, and cleanup and abatement efforts.

Public Education

The Environmental Health Department of Amador County advises businesses individually on managing their hazardous waste and controlling pollutants. The County maintains three household hazardous waste disposal sites and has developed a brochure on this topic. Residents can dispose of latex paints, used oil and depleted batteries at these sites. County public schools have presented students with information on appropriate recycling and recycling practices, groundwater contamination prevention, and composting. Proper construction specifications and maintenance are reviewed with residential septic system applicants by County personnel. Radio station KNGT-FM in Amador County broadcasts a weekly segment on recycling developed by the Solid Waste Department. Appropriate recycling practices are presented (e.g., don't dump oil down storm drains) as well as the proper use and disposal of toxic household products.

The Amador County Farm Bureau co-sponsors workshops with the County Agricultural Commissioner in English and Spanish on the proper use and disposal/discharge of pesticides. An "Ag" Clean Up Day was conducted in March 1993 to dispose of disallowed and excess chemicals. Both Amador and Calaveras counties participated; and an independent agency was hired to collect and dispose of the chemicals by incineration.

Alpine County has no specific program for public education. They do produce a newsletter, the "Alpiner" which covers a variety of topics including recycling.

Calaveras County has not implemented any public education activities, but the Health Department hopes to develop materials in the future. Neither the County Farm Bureau nor the U.C. Extension Farm Advisor has conducted any public education efforts.

The District has recognized since the early 1970's that water suppliers have an obligation, as managers of an essential natural resource, to educate the public to conserve and protect that resource. Environmental education is a key component of the District's Public Information Division and for their Natural Resources Department. The District is a leader in providing curricular materials to schools on the subjects of protecting and conserving the water supply. In addition, the District provides ranger-naturalists to visit classrooms or to lead field trips to District reservoirs and watershed lands.
The Stanislaus National Forest has begun erecting informational signs to help restrict access to riparian areas. They have placed signs and provided other educational material for the public informing them of the need to prevent livestock access to areas with steep slopes, fragile vegetation and sensitive riparian areas.
The Eldorado National Forest has maps and other information to instruct the public about sensitive resources and designated trails.

BLM has no formal public education program. They do have a program ("Outreach") whereby specialists are available to talk to schools when requested. BLM also participates in County fairs to answer questions from the public.

SECTION 7

SECTION 7
POTENTIAL CORRECTIVE ACTIONS

Introduction

Section 7 documents potential corrective actions relating to each of the major components of the watershed sanitary survey. Based on the information contained in the 1995 Mokelumne River Watershed Sanitary Survey (1995 MRWSS), the East Bay Watershed Sanitary Survey Update 2000 (EBWSS Update 2000), and within this update document, corrective actions as they pertain to water quality monitoring, potential contaminant source management, and other watershed management practices are presented for the District's consideration and possible future implementation. The minimization of water quality degradation is the focus of the corrective actions listed in this section. The issues and recommendations that were highlighted in the 1995 MRWSS have been incorporated and updated within this discussion.

The commitment of other jurisdictional agencies within the Camanche and Upper Mokelumne River Watershed to implement applicable corrective actions is essential for the protection of source water quality. These agencies include the major landowners (Sierra Pacific Industries, Eldorado National Forest, Stanislaus National Forest, PG&E, and Bureau of Land Management), other major jurisdictional agencies, (Alpine, Amador, Calaveras, and San Joaquin counties), and other water supply utilities (Amador County Water Agency, Calaveras County Public Utility District, Calaveras County Water District, and Jackson Valley Irrigation District). Many, if not all of these agencies, implement management practices, which can impact source water quality. For example, Sierra Pacific Industries recently completed a watershed assessment of the Upper Mokelumne River Watershed which identified soil erosion, water quality, and water quantity as the major issues in the assessment. These three issues require an integrated watershed management approach to address. As water quality is a key issue for the District, working in concert with agencies such as Sierra Pacific to implement corrective actions is a step in the direction towards improved watershed management.

In light of its concern over the potential threat to water quality posed by the proposed sale of PG&E's hydroelectric facilities and associated lands in the North Fork Mokelumne River basin, the District has participated in the formation of the Upper Mokelumne River Watershed Authority (Authority). The Authority is a joint power authority consisting of the Alpine County Water Agency, Amador Water Agency, Calaveras County Water District, Calaveras Public Utility District, Jackson Valley Irrigation District and the

District. The Authority was formalized by agreement between the participating agencies on August 15, 2000 and was established for the purpose of effectuating the acquisition, operation, and maintenance of PG&E's hydroelectric facilities on the Upper Mokelumne River. A major benefit of Authority ownership of these facilities would be the coordinated use and management of resources within the North Fork Mokelumne River watershed.

Potential Corrective Actions

The potential corrective actions contained in this section were developed to strengthen source protection for the District's watersheds. Although Pardee and Camanche Reservoirs store high quality Mokelumne River water, it is important to continue to be vigilant about source protection. Controlling the water quality impacts resulting from watershed activities through sound watershed management is critical to a successful source protection program.

By elevating the importance and strengthening source protection, the potential impacts on water treatment will be reduced. The District's water treatment plants -- both small systems and large systems -- are effective at removing some water quality parameters and meeting all federal and state drinking water regulations; however, the potential always exists that unexpected mechanical or operational interruptions may occur which may ultimately impact the finished water quality. As the water industry's technical knowledge increases regarding water quality parameters and related health effects, the importance of controlling treatment-related by-products increases. Therefore, by source water quality, concerns associated with the treatment processes such as potential process interruptions and by-product formation are reduced.

The potential corrective actions are grouped according to the following subjects: water quality, watershed control and management practices, inter-jurisdictional coordination, and public education. These potential corrective actions were developed based on the 1995 MRWSS, the EBWSS Update 2000, updated information documented in previous sections of this report, and information gathered from recent documents developed by other agencies. The District and other agencies within the watershed will consider these potential corrective actions when additional land uses or changes to existing land uses within the watersheds are proposed. The majority of the listed potential corrective actions were developed during the preparation of the MRWSS Update

2000 document. Annotations are included to indicate which of the potential corrective action items originate from the 1995 MRWSS report.

To improve overall watershed protection and maintain the best possible source water quality, the potential corrective actions are prioritized into low, medium, and high priority categories as shown in Table 7-1. These rankings are subjective; however, they take into account watershed characteristics (slope, soils, etc.), type and magnitude of potential contaminants, distance to waterbodies, current and future drinking water regulations, and reservoir status (water supply or flood control).

Table 7-1: Summary of Potential Corrective Actions

Watershed Management Categories	High Priority Corrective Actions	Medium Priority Corrective Actions	Low Priority Corrective Actions
Water Quality Monitoring	Monitoring Related to Specific Land Use and Activities	Organic Contaminants Follow-up Procedure	Urban Stormwater Monitoring
	Reservoir Temperature Monitoring	Penn Mine Monitoring	Storm-Related Turbidity Monitoring
	TOC Monitoring	Septic Tank Monitoring	Bathymetric Surveys
	MTBE Monitoring		Runoff from Historic Mines
	Herbicide Monitoring		Raw and Finished Water Sampling
	Land Disposal Monitoring		
Watershed Control and Management Practices	Forest Practices and Logging	On-site Waste Management Programs	Equestrian Use Policy
	Grazing Practices	Seismic Evaluation	Concentrated Animal Facilities (Low to Medium)
	Access Control Programs	Off-Road Vehicle Usage	

Table 7-1: Summary of Potential Corrective Actions – (continued)

Watershed Management Categories	High Priority Corrective Actions	Medium Priority Corrective Actions	Low Priority Corrective Actions
Watershed Control and Management Practices – *cont.*	In-Reservoir Recreation	Road and Landing Construction and Maintenance (Medium to High)	
	Recreation - Body Contact	Fire Roads and Hiking Trails - Construction, Maintenance, and Use (Medium to High)	
		Hazardous Materials Storage and Transfer Facilities (Medium)	
		Runoff from Parking Lots and Roads (Medium)	
		Reservoir Shoreline (Medium)	
		Protection of Riparian Corridors (Medium)	
Inter-jurisdictional Coordination	Upper Mokelumne River Water Quality Coordination Committee	Stormwater Runoff	Fire Suppression - Chemical Usage
	Emergency Response	Erosion Control (Medium)	
	Future Development		
Public Education		Residential and Commercial Neighbors (Medium to High)	Volunteer Organization
		Transportation Corridors	
		Recreational Trail Users	
		Community Outreach	

Table 7-2 contains a summary of the potential corrective actions that were designated as a "Medium to High Priority" or a "High Priority." Many of the identified actions have been recognized and

are currently being implemented by the District. The current status of these items is indicated in the table.

Table 7-2: Summary of High Priority Recommendations

Watershed Management Categories	Recommended Activity	Actions	Status
Water Quality Monitoring	Monitoring Related to Land Use and Activities	Determine contributions from various contaminants associated with FERC Project 137 and grazing practices.	Ongoing*
	Reservoir Temperature Monitoring	Evaluate reservoir thermal stratification and the impacts to water temperatures due to upstream hydroelectric powerplant operations.	Ongoing*
	TOC Monitoring	Continue monitoring of TOC in Pardee and Camanche Reservoirs.	Ongoing
	MTBE Monitoring	Conduct monitoring of Pardee and Camanche Reservoirs to determine if further control measures are needed.	Ongoing
	Herbicide Monitoring	Monitoring herbicide applications within Pardee and Camanche watersheds.	Ongoing
	Land Disposal Monitoring	Request that increased inspection of and surveillance of wastewater collection and disposal systems that are external to EBMUD-owned lands are conducted by RWQCB.	Initiate Discussions
Watershed Control and Management Practices	Forest Practices and Logging	Support efforts to develop protection measures for forest resources and associated vegetation, wildlife, and aquatic resources.	Ongoing
	Grazing Practices	Develop Grazing Plan for District lands, which incorporates appropriate consideration of water quality preservation.	Complete
	Access Control Programs	Continue programs which control human access and protect riparian and sensitive watershed land within Pardee and Camanche watersheds.	Ongoing

*Ongoing within Pardee and Camanche watershed lands owned by EBMUD. EBMUD requested that the Federal Energy Regulatory Commission require monitoring by PG&E within lands owned by PG&E.

Table 7-2: Summary of High Priority Recommendations - continued

Watershed Management Categories	Recommended Activity	Actions	Status
Watershed Control and Management Practices - *cont.*	In-Reservoir Recreation	Promote inspection of recreational watercraft to prevent introduction of exotic species.	Ongoing
	Recreation – Body Contact	Continue to prohibit body-contact recreation in Pardee Reservoir to reduce the risk of pathogen contamination.	Ongoing
	Road and Landing Construction & Maintenance	Develop management guidelines to address soil erosion and sediment delivery mechanisms from road construction and maintenance activities within EBMUD-owned lands.	Ongoing
	Fire Roads and Hiking Trails	Review and identify policies for fire road and hiking trail construction and maintenance to minimize impacts to water quality within EBMUD-owned lands.	Ongoing
	Reservoir Shoreline	Assess measures to restore and protect eroded reservoir shorelines.	Completed
	Protection of Riparian Corridors	Promote protection of riparian corridors and encourage the implementation of effective BMPs for protecting riparian zones.	Ongoing
Inter-jurisdictional Coordination	Upper Mokelumne River Water Quality Coordination Committee	Form a multi-agency committee of stakeholder agencies to discuss and resolve potential watershed water quality problems.	Ongoing
	Emergency Response	Coordinate with other agencies whose activities or jurisdiction may impact water quality to define and prioritize actions and responses in case of emergencies.	Under Consideration
	Future Development	Review all proposed development plans, provide comments based on water quality impacts, and develop strategies to cope with increasing urban pressure on watershed lands.	Under Consideration

Table 7-2: Summary of High Priority Recommendations - continued

Watershed Management Categories	Recommended Activity	Actions	Status
Public Education	Residential and Commercial Neighbors	Develop public information campaign for residents and neighbors regarding source water protection.	Under Consideration

Water Quality

Watershed water quality monitoring programs are critical to identifying contaminant sources and quantifying the concentrations of undesirable water quality parameters entering the reservoirs. Monitoring programs should be developed to assess long-term trends, and if possible, the loadings generated by runoff - particulates, microorganisms, heavy metals, disinfection by-product (DBP) precursors, nutrients, and synthetic organic compounds (including volatile organic chemical (VOCs), pesticides, and herbicides). Below are a number of potential monitoring programs for consideration by the District and other agencies where applicable.

- **Urban Stormwater Monitoring.** Currently, a limited amount of monitoring data is available that documents the concentrations and loadings of constituents in urban stormwater. As development within the Pardee and Camanche watersheds increases it will be important to assess the potential impacts of urban stormwater. (Low Priority)

- **Monitoring Related to Specific Land Use and Activities.** Monitoring programs for the following land uses and activities should be developed to determine the contribution of particular water quality contaminants of concern and to work with the adjacent landowners in reducing contributions of contaminants. The monitoring programs must be developed specific to each land use.

- Mokelumne River Project No. 137 (FERC Project 137) - Dissolved oxygen, pH, sediment, temperature, inorganic chemicals, nutrients, organic chemicals, total organic carbon, microorganisms (High Priority)

  Status 2000 *- The District has initiated a water quality-monitoring program to compile a dataset that documents the characteristics of Mokelumne River water entering and flowing through the District's Pardee and Camanche Reservoirs.*

- Grazing - Microorganisms (High Priority)

  Status 2000 *– Refer to discussion under "Grazing Practices" for status of District efforts.*

- PG&E Substations - PCBs (Medium Priority)
- Transportation Corridor - Metals, oil and grease, and other hydrocarbons (Low Priority)
- Equestrian Facilities – (Low priority)

- **Reservoir Temperature Monitoring.** Continue collecting temperature data of Pardee and Camanche Reservoirs. In order to fully evaluate the effect of FERC Project 137 on the District's beneficial uses, detailed information on reservoir thermal stratification and changes in water temperatures due to PG&E hydroelectric powerplant operations is necessary. Increased water temperatures could adversely affect the District's ability to manage the hypolimnion (coldwater pool) in Pardee and Camanche Reservoirs with resultant impacts on raw water quality and the anadromous fishery in the lower Mokelumne River. (High Priority)

  Status 2000 *- The District monitors reservoir conditions at several locations on a weekly basis. Water quality sampling efforts collect temperature, pH, dissolved oxygen, specific conductance, and oxygen reduction potential throughout the water column at designated locations.*

- **TOC Monitoring**. Continue monitoring total organic carbon (TOC) levels entering and residing within Pardee Reservoir. Expand monitoring to upstream tributaries, when warranted. TOC is a parameter that is targeted in the regulatory process as a surrogate for the presence of all other organics, particularly DBP precursors. (High Priority)

Status 2000 *– The District continues to monitor TOC at designated locations within Pardee Reservoir.*

- **MTBE Monitoring**. Monitor Pardee and Camanche Reservoirs for MTBE to determine if control measures are warranted, particularly during the peak recreation season. (High Priority)

  Status 2000 *- The District conducted a monitoring program at both Pardee and Camanche Reservoirs. Based on the results of this program, in 1998 all District and concessionaire-owned 2 stroke high emission engines were replaced with 4-stroke low emission engines. Continued monitoring for MTBE is being conducted to determine if further actions are warranted.*

- **Herbicide Monitoring.** Request the adequate monitoring of herbicide applications within the watershed as well as the buildup of residuals or the runoff of any residues into watershed water bodies, courses, and streams. Prompt action should be demanded of the enforcement agencies if any potentially adverse concentrations are detected at any point in the watershed. (High Priority)

  Status 2000 *– The District continues to monitor pesticide and herbicide levels entering into Pardee Reservoir to detect potential water quality concerns relating to these parameters.*

- **Land Disposal Monitoring.** Increased inspection and surveillance of wastewater collection and land disposal systems by the Central Valley RWQCB should be requested. Although the Mokelumne Hill Sanitary District has ample pond capacity and land disposal area coliform levels in the Wilson Gulch adjacent to Mokelumne Hill are elevated relative to the rest of the river. Further studies should be conducted to determine the source of the contamination. (High Priority)

  Status 2000 *– The District continues to collect bacteriological data at designated sampling locations throughout the lower regions of the Upper Mokelumne River and tributaries to further develop a dataset of bacteriological conditions.*

- **Organic Contaminants.** Establish a follow-up procedure for the organic contaminants detected in the raw and finished waters to determine possible source of contaminants or to determine false-positive results. (Medium Priority)

***Status 2000** - Shortly after the 1995 MRWSS was published, a follow-up procedure was established for organic compounds detected in either raw or treated waters to notify DHS and the District's sampling staff so that repeat sampling would be conducted. Two electronic backup systems are also in place to notify the District by e-mail in the event detectable levels for purposes of reporting (DLRs) are analyzed for organic compounds.*

- **Storm-Related Turbidity Monitoring.** The District should monitor rainfall at Pardee inflow to evaluate the possible trends between raw water turbidity and rainfall, and other contaminants including TOC, pesticides and herbicides, and other organic contaminants. (Low Priority)

- **Bathymetric Surveys.** Bathymetric studies provide useful information for reservoir and watershed management. Historical records exist and erosion and sedimentation rates have been estimated. Bathymetric surveys would aid in the assessment of evaluating contributions from tributary streams, and with management and restoration efforts. Sediment cores may provide information on the origin of the deposited material as well as nutrient, pathogen and organic loads and budgets for the reservoirs. (Medium Priority)

- **Runoff from Historic Mines.** Develop a watershed-wide map that locates historic mines, particularly those in proximity to tributaries and those that continue to be active. Coordinate map with RWQCB to maintain a record of those mines that have historical drainage pollution problems or potentially developing a drainage problem. (Low Priority)

- **Penn Mine Monitoring.** Continue ongoing compliance monitoring of the Penn Mine Environmental Restoration Project. (Medium Priority)

  ***Status 2000** - The District initiated this compliance-monitoring program in 1998 and will continue until all phases of the environmental restoration project are completed -- mine waste removal, landfill construction, restoration and revegetation.*

- **Raw and Finished Water Sampling.** When sampling raw waters, collect and archive a corresponding sample of finished water prior to entering the distribution system. The archived samples can be analyzed at some later time if the raw water analyses measure any parameters in excess of the drinking

water standards. In this way, the District will be able to document the effectiveness of the treatment processes in meeting drinking water standards. (Low Priority)

Status 2000 *- The District continues to collect water quality data for raw and treated water, and throughout the distribution systems in compliance with all appropriate regulations. The data is archived in the District's Laboratory Information Management System for future analysis.*

- **Septic Tank Monitoring (1995 MRWSS).** Improved monitoring, water quality assessment, and enforcement of septic tank regulations by the counties to help assure proper maintenance of existing systems should be implemented. Possible seepage from septic tanks near the river in the South Fork sub-watershed should be investigated. Pit toilets and vault toilets in campgrounds should be inspected, and old or malfunctioning ones replaced. For example, the Moore Creek Campground has aging vault toilets, which may allow some seepage into the ground water. (Medium Priority)

Watershed Control and Management Practices

Land uses and activities within the watershed have the potential for impacting reservoir water quality. Tailoring management and control efforts within the watershed is required to minimize risks associated with specific land uses and activities. The following potential corrective actions may be considered in implementing changes to the existing or providing input for future land uses and activities within the watersheds.

- **On-site Waste Management Programs.** Develop on-site waste management programs for septic systems and leach fields within the watershed basins. Encourage the public works and the land use planning departments with jurisdictional controls to adopt, implement, and enforce these management strategies. The program could include the following components: identify and locate all on-site waste disposal systems; regularly inspect each system for integrity and adequacy; review pumping records; require upgrades to bring existing systems into compliance with current codes; establish minimum setbacks from tributary streams; establish on-going septic tank pumping requirements; develop funding alternatives for low-income property owners; evaluate retrofit of existing systems with leak

alarms; conduct on-going monitoring programs in surface waters (and groundwater, if possible) to identify failed or inadequate systems; and establish enforcement schedules and penalties. (Medium Priority)

- **Seismic Evaluation.** Perform a seismic evaluation for facilities within the watershed, including pipelines and conveyances, dams, intake structures, and other facilities critical for maintaining water service during emergencies to minimize fire damage and resulting water quality impacts. (Medium Priority)

  Status 2000 *- The District's Materials Engineering Section is responsible for conducting routine evaluations regarding the structural integrity of the District's water supply and distribution facilities including dams, pipelines and conveyances, intake structures, and related facilities. They are in direct contact with the State of California's Dam Safety and Design Department.*

- **Forest Practices and Logging (1995 MRWSS)**. Continue to insure adequate CEQA and Board of Forestry protection measures to protect forest resources and associated vegetation, wildlife, and aquatic resources. Educational programs should focus on the need to understand the nutrient release process that is accelerated by overly ambitious timber harvesting plans and operations. More data should be collected and research programs funded by those responsible for, and beneficiary to, the benefits of timber harvesting to document this phenomenon and its effects on watershed streams, lakes, and reservoirs and associated zoological and botanical species. (High Priority)

- **Grazing Practices.** The District has developed a Rangeland Management Plan for their East Bay watersheds, which focuses on best management practices for grazing to prevent degradation of water quality. Wherever applicable, these BMPs should be implemented by EBMUD, private, and public entities that allow grazing on their properties. Specifically, the District should recommend the inclusion of provisions in grazing permits which insure that grazing livestock are kept out of riparian corridors to avoid damage to sensitive streamside riparian vegetation, streambanks and streambeds, as well as the water column itself. The District should encourage and promote the installation of fences as the only sure means of accomplishing this goal; however, the responsibility for this improvement lies solely with those private and public entities allowing the land use. As another example, cattle use should be minimized on

lands with high erosion risk when the soil is saturated. (High Priority)

Status 2000 *- The District has used applicable portions from the Rangeland Management Plan developed for the East Bay watersheds for the watershed management program in the Pardee and Camanche watersheds. Many of the management practices implemented are directed toward a more effective use of the available acreage and, wherever necessary, protecting riparian corridors, tributaries, and reservoirs from livestock.*

- **Access Control Programs**. Continue watershed management programs that control human access and continue to fence riparian and sensitive watershed land particularly on grazing lands. Encourage the implementation of similar programs already in existence (CRMA in Stanislaus National Forest) and the formation of similar programs by other large landowners. Encourage Sierra Pacific Industries to continue its access control program and promote adoption of the same approach by the U.S. Forest Service. (High Priority)

  Status 2000 *- Protection of reservoir shorelines is a high priority for the District, particularly in those areas near the intake structures. During a recent field inspection, it was noted that he shoreline areas are quite clean. In addition, the District conducts patrolling of the watersheds. Similar programs, if not already implemented, should be initiated by other utilities at their respective facilities.*

- **Equestrian Use.** Develop integrated policies with regard to equestrian use of watershed lands. Conduct census on number of horses stabled or pastured within watersheds, and annual use of equestrian facilities. Because of the potential for transmission of pathogens, horses are prohibited from access to reservoirs. This affords the maximum advantage of the filtering capacity of the soil. (Low Priority)

- **Off-Road Vehicle Usage**. Encourage Sierra-Pacific and the National Forests to continue their programs to curtail and control the damage caused by indiscriminate and irresponsible four-wheel drive vehicle operators. Holders of other lands subject to the same type of damage should be encouraged to take similar steps. (Medium Priority)

- **Concentrated Animal Facilities.** BMPs should be developed for concentrated animal facilities such as stables, corrals, paddocks, riding arenas, and equestrian camping facilities. Recommendations should be developed, tailored to each site. (Low to Medium Priority)

- **In-Reservoir Recreation**. Privately owned boats that can introduce various contaminants from different recreational waterbodies is a serious issue for the District to consider. All boats (with the exception of the rental fleet) should be inspected prior to entering the waterbody. Boats with unsealed bilge should be kept out of the reservoir and boats should be checked for exotic species such as zebra mussels and hydrilla. (High Priority)

  Status 2000 *– Boating policies are enforced at the District's recreation facilities to prevent the introduction of exotic species to Pardee and Camanche Reservoirs.*

- **Recreation – Body Contact**. The District currently does not allow body contact recreational activities in Pardee Reservoir; and allows restricted body contact recreation in Camanche Reservoir. To reduce the risk of pathogenic contamination, the prohibition of body-contact activities in Pardee Reservoir and promotion of public awareness concerning the protection of source water quality must be continued. (High Priority)

  Status 2000 *– The District continues its policy to prohibit body-contact recreation at Pardee Recreation Area and restrict body-contact recreation at Camanche North Shore and South Shore Recreation Areas.*

- **Road and Landing Construction and Maintenance**. Develop site-specific management guidelines addressing soil erosion and sediment delivery potential from roads near streams, roads crossing streams, roads crossing unstable slopes, and roads crossing erodible soils. Prevent severe surface erosion events caused by road building that directly impacts any stream. Maintenance of existing roads and landings after timber operations will be improved. (Medium to High Priority)

- **Fire Roads and Hiking Trails.** Review and identify BMPs and standards for fire road and hiking trail construction, maintenance, and use. Prohibit trail uses that would increase erosion above current levels. The District is developing a

comprehensive plan for fire roads within its jurisdiction. Protection of water quality and supply impacts of this plan should be considered as a high priority issue. (Medium to High Priority)

- **Hazardous Materials Storage and Transfer Facilities.** Conduct site visits of hazardous materials storage and transfer facilities within the watersheds which may be owned by the District, public works departments, Sierra Pacific, PG&E, golf courses, industries, etc. Collaborate with other responsible agencies in the training of personnel and inspectors on how to identify risks to drinking water and choosing effective protective measures. (Medium)

- **Runoff from Parking Lots and Roads.** Review stormwater collection systems from parking lots and roads serving watershed facilities. Consider pretreatment options or rerouting discharge away from reservoirs. (Medium)

- **Reservoir Shoreline.** Assess measures to restore and protect eroded reservoir shorelines. Public access for fishing could be restricted to piers. In addition, establishing a narrow margin of plants or rocks would protect the shoreline from erosive wave action particularly in reservoirs that allow boating. (Medium)

  Status 2000 *– Boating policies are enforced at the recreation areas of Pardee and Camanche Reservoirs to restrict speeds for public safety and environmental protection.*

- **Protection of Riparian Corridors.** Promote protection of riparian corridors through the establishment of setbacks. Review various approaches and encourage the implementation of effective BMPs for protecting riparian zones. (Medium)

  Status 2000 *– EBMUD guidelines for all District-owned lands focus on implementing and maintaining best management practices to protect natural resources that include the riparian zones under District jurisdiction.*

Interjurisdictional Coordination

The District has several outreach activities to establish proactive lines of communication with neighboring agencies and those with overlapping jurisdictions. This is important in responding rapidly and efficiently to emergencies, as well as instilling the value of water quality protection within the watersheds.

- **Water Quality Technical Coordination Forum (1995 MRWSS).** A technical coordination forum, consisting of key stakeholders in the watershed should be formed that share the common interest of resolving impending or potential watershed water quality problems. It would be mutually beneficial for participating members in addressing watershed issues that require multiple agency commitment to enact. (High Priority)

- **Emergency Response (1995 MRWSS).** Emergency response procedures for various scenarios that can affect raw water quality must be identified and coordinated with local, state, and federal agencies. On-going coordination with agencies or entities such as Alpine, Amador, and Calaveras counties, Amador County Water Agency, Calaveras County Public Utility District, Calaveras County Water District, Jackson Valley Irrigation District, Sierra Pacific, PG&E, BLM, and Eldorado and Stanislaus National Forests in advance of any emergencies to clearly define and prioritize the most critical actions and responses is essential and should be maintained. (High Priority)

  To ensure that the District staff will have adequate time to take appropriate actions during emergencies, the notification procedures from other agencies such as Caltrans, Office of Emergency Services, California Highway Patrol, County Health Departments, County Agricultural Commissions, California Department of Fish and Game, and Regional Water Quality Control Board, need to be reviewed. (High Priority)

- **Future Development.** Foster cooperation from landowners, developers and managers by further opening good lines of communication, and by providing educational information on the impacts certain development practices may have on the watershed. As new developments are being planned the District should assume a proactive role in commenting on the proposed plans and emphasizing the potential impacts on water quality. Specifically, sanitation facilities need to be reviewed and parcels

which are key to water quality protection should be identified. (High Priority)

Status 2000 - *The District has participated in the formation of the Upper Mokelumne River Watershed Authority (Authority). The Authority is a joint powers authority consisting of the Alpine County Water Agency, Amador Water Agency, Calaveras County Water District, Calaveras Public Utility District, Jackson Valley Irrigation District, and the District. The Authority was formalized by agreement between the participating agencies on August 15, 2000 and was established for the purpose of effectuating the acquisition, operation and maintenance of PG&E's hydroelectric facilities on the Upper Mokelumne River. A major benefit of Authority ownership of these facilities would be the coordinated use and management of resources within the North Fork Mokelumne River watershed.*

As envisioned in its enabling agreement, the Authority would pursue the following activities if successful in acquiring PG&E's facilities and lands in the Pardee Watershed.

- *Protection of water quality for member entities and other watershed users;*
- *Protection and enhancement of riparian ecosystems within the Upper Mokelumne River watershed;*
- *Use of existing facilities to enhance the water supplies of Alpine, Amador, and Calaveras Counties;*
- *Provision of future local water supplies;*
- *Support of continued public access and the enhancement of recreation opportunities; and*
- *The funding of a variety of watershed projects, including projects for watershed restoration, watershed assessment, acquisition of critical watershed lands public education, wildfire management, water conservation and recreation.*

This type of approach is supported by the watershed-based regulations developed for drinking water sources.

- **Stormwater Runoff.** Review stormwater collection systems on county roads adjacent to the reservoirs. Rank reaches of roads by risk and consequence of potential impacts. For highest priority roads, evaluate the alternatives to minimize contaminants identified in road runoff from entering the water supply, including treatment alternatives in the reservoir or at the water treatment plants. Consider the development of spill

containment basins to sequester any hazardous substances prior to entering reservoirs. (Medium Priority)

- **Erosion Control.** Continue efforts to require landowners and those with legal control authority to restrict or control road building, which initiates or accelerates soil erosion. Emphasis should be placed on private and National Forest areas, which do not have successful erosion control plans in effect. Known problem areas should continue to be the focus of land remediation efforts supported by adequate funding from private and public agencies responsible for the impacts. All of the entities with activity control authority should be encouraged to continue meeting and working together to share the benefits of resource and problem area inventories, and to share or exchange ideas on control strategies. (Medium)

- **Fire Suppression Chemical Usage.** Review chemicals used during fire suppression and assess potential impacts on water quality. (Low Priority)

Public Education

Materials for public education on the importance of water supplies and activities that affect water quality and potential protection measures should be developed and distributed. These public education materials can either be targeted to District owned and managed facilities and/or to the entire watershed lands. For lands outside District jurisdiction, coordination with other agencies is essential. A number of public education components are recommended each targeting a specific audience.

- **Residential and Commercial Neighbors.** Develop an aggressive public information campaign for residents and neighbors on the unique advantages and responsibilities of living on watershed lands. Provide materials regarding the water quality and supply impacts of the following activities: lawn and gardening practices (e.g. erosion control, fertilizer and pesticide application, etc.); use of hazardous materials; local facilities for hazardous materials disposal (e.g.. neighborhood drop-off points, semi-annual neighborhood collection programs, etc.); construction and renovations; appropriate disposal of pet wastes; and vehicle maintenance and leak prevention. An emergency telephone number should be established for reporting spills, illegal dumping, and indiscriminate usage of pesticides and fertilizers. (Medium to High Priority)

- **Transportation Corridors.** Launch a public awareness and education campaign using signs along transportation corridors in watersheds. The signs should alert travelers to the risks and impacts on water quality from fire, vehicle accidents, and other spills. Post emergency contact number for reporting spills, accidents, and illegal dumping. (Medium Priority)

- **Recreational Trail Users.** Trail users of District, Sierra-Pacific, Eldorado and Stanislaus National Forests, and PG&E watershed lands must be educated through pamphlets and signage on the importance of protecting their drinking water supplies, activities that may threaten water quality, and measures to minimize risk (e.g. appropriate methods of human sanitation in areas not equipped with toilets, minimizing erosion by staying on trails, cleaning up after dogs, etc.) (Medium Priority)

  Status 2000 – *Source water protection and water quality awareness pamphlets have been developed by the District and are available at the District's recreation facilities to the public.*

- **Community Outreach (1995 MRWSS).** The District in concert with other agencies may want to consider developing community outreach efforts through public school education programs. A number of water quality concerns should be embraced by neighborhood coalitions for action: erosion, deteriorating metals, and inadequate septic systems. Enlisting residents to participate in the Friends of the Watershed (see below) may also raise awareness and stimulate action on these problems. (Medium Priority)

- **Volunteer Organizations.** The District in concert with other agencies may want to initiate a Friends of the Watershed organization. This would be a volunteer organization consisting of residents, neighbors, and other friends. The purpose would be to nurture local commitment to protection of water quality and supply, and foster an appreciation of the watersheds' biological resources. A program such as this may also result in increasing pressure to share decision-making. (Low Priority)

APPENDIX A

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APPENDIX B

ABBREVIATIONS

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ABBREVIATIONS

To conserve space and improve readability, the following standard abbreviations have been used in this report.

ac-ft/yr	acre-feet per year
AWA	Amador Water Agency
Authority	Upper Mokelumne River Watershed Authority
BMPs	Best Management Practices
BOD5	5-Day biochemical oxygen demand
CaCO3	Calcium Carbonate
Caltrans	California Department of Transportation
CCCWP	Contra Costa Clean Water Program
CCWD	Calaveras County Water District
CDF	California Department of Forestry & Fire Protection
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
COE	U.S. Corps of Engineers
CPUC	California Public Utilities Commission
CPUD	Calaveras Public Utility District
D/DBP	Disinfection/Disinfection By-Product
DBPs	Disinfection By-Products
DEHP	Di(2-ethylhexyl)phthalate
DHS	California Department of Health Services
District	East Bay Municipal Utility District
DO	Dissolved oxygen
DWCCL	Drinking Water Candidate Contaminant List
DWPL	Drinking Water Priority List
EBMUD	East Bay Municipal Utility District
EBWSS	East Bay Watershed Sanitary Survey
EPA	U.S. Environmental Protection Agency
ESWTR	Enhanced Surface Water Treatment Rule
FERC	Federal Energy Regulatory Commission
FPA	Flavor Profile Analysis
GAC	Granular Activated Carbon
GIS	Global Information System
Gpd	gallons per day

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ABBREVIATIONS

Gpd/ft	gallons per day per foot
Gpm	gallons per minute
Gpm/sf	gallons per minute per square foot
GWDR	Groundwater Disinfection Rule
GWR	Ground Water Rule
GWUDI	Ground water under direct influence
HAAs	Haloacetic Acids
HOS	Hypolimnetic Oxygenation System
HPC	Heterotrophic Plate Count
ICR	Information Collection Rule
IESWTR	Interim Enhanced Surface Water Treatment Rule
IMP	Integrated Pest Management
IOC	Inorganic Chemicals
JVID	Jackson Valley Irrigation District
LIMS	Laboratory Information Management System
MBAS	Methylene Blue Active Substance
MCL	Maximum Contaminant Level – enforceable standard
MCLG	Maximum Contaminant Level Goal – health goal, non-enforceable
mg/L	milligram per liter, equivalent to 1 part per million
mgd	millions gallons per day
MGD	Million gallons per day
ml	milliliters
MPN	Most Probable Number
MRDL	Maximum residual disinfectant level
MRDLG	Maximum residual disinfectant level goal
MSL	Mean sea level
MTBE	Methyl Teriary-Butyl Ether
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Unit (standard turbidity measurement)
OCC	Operation Control Center
PACl	Polyaluminum Chloride
PAH	Polynuclear aromatic hydrocarbons
PCB	Polychlorinated biphenyl
pCi/L	Pico Curies per liter

APPENDIX B

ABBREVIATIONS

PG&E	Pacific Gas and Electric Company
ppm	parts per million
RWQCB	Regional Water Quality Control Board
SCADA	Supervisory Control and Data Acquisition
SCS	Soil Conservation Service
SDWA	Safe Drinking Water Act of 1974
SMCL	Secondary Maximum Contaminant Levels
SOC	Synthetic Organic Chemicals
SWTR	Surface Water Treatment Rule
T&O	Taste and Odor
TAF	Thousand Acre-Feet
TCA	Trichloroethane
TDS	Total Dissolved Solids
THM	Trihalomethane
TIP	Treatment Improvements Project
TOC	Total Organic Carbon
TON	Threshold Odor Number
ug/L	micrograms per liter, equivalent to 1 part per billion
umho/cm	micro ohms per centimeter
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
USL	Upper San Leandro
VOCs	Volatile Organic Chemicals
WSS	Watershed Sanitary Survey
WTP	Water Treatment Plant

APPENDIX C

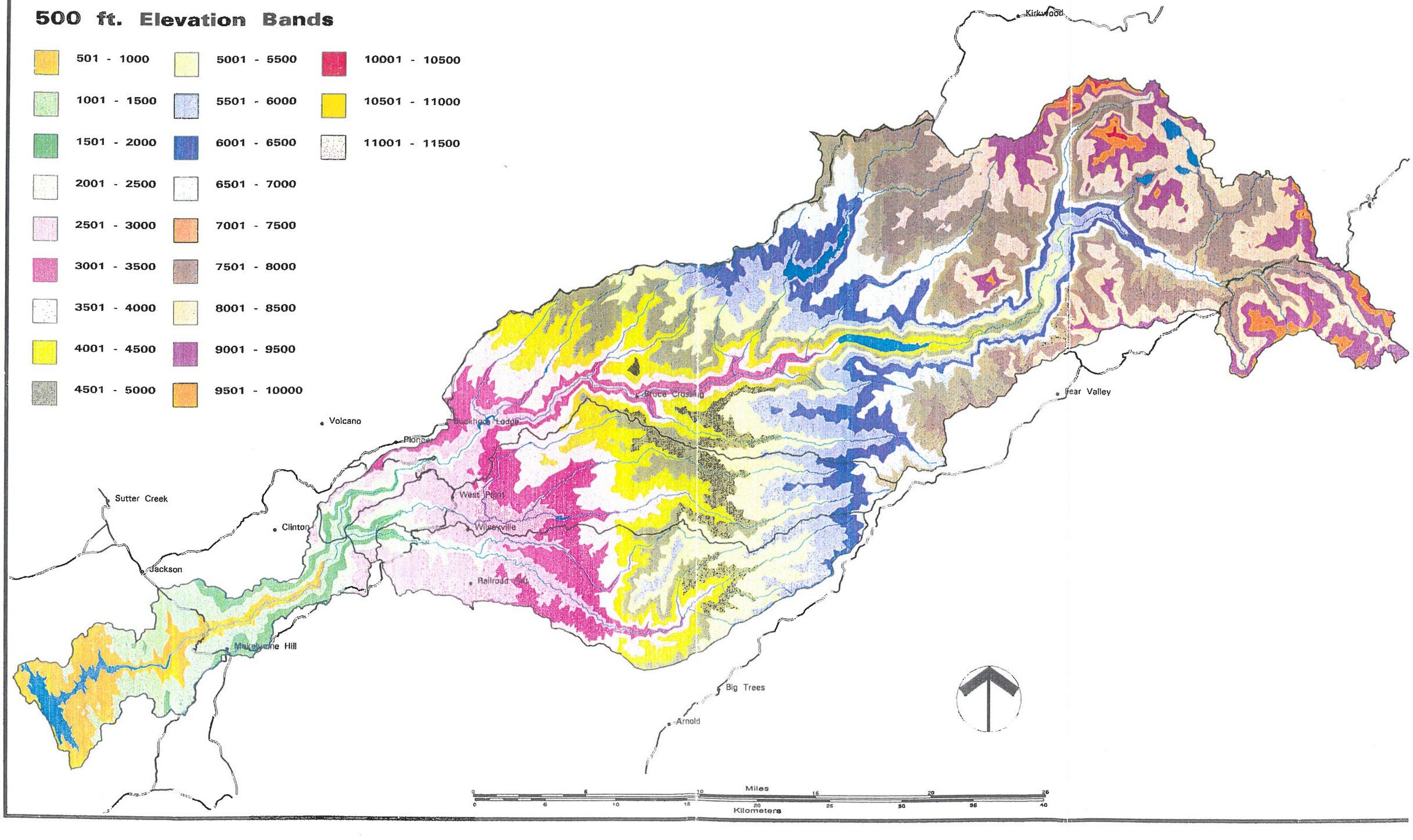
SUPPORTING DOCUMENTATION FOR SECTION 3

Upper Mokelumne Watershed

FIGURE C-1

500 ft. Elevation Bands

501 - 1000	5001 - 5500	10001 - 10500
1001 - 1500	5501 - 6000	10501 - 11000
1501 - 2000	6001 - 6500	11001 - 11500
2001 - 2500	6501 - 7000	
2501 - 3000	7001 - 7500	
3001 - 3500	7501 - 8000	
3501 - 4000	8001 - 8500	
4001 - 4500	9001 - 9500	
4501 - 5000	9501 - 10000	

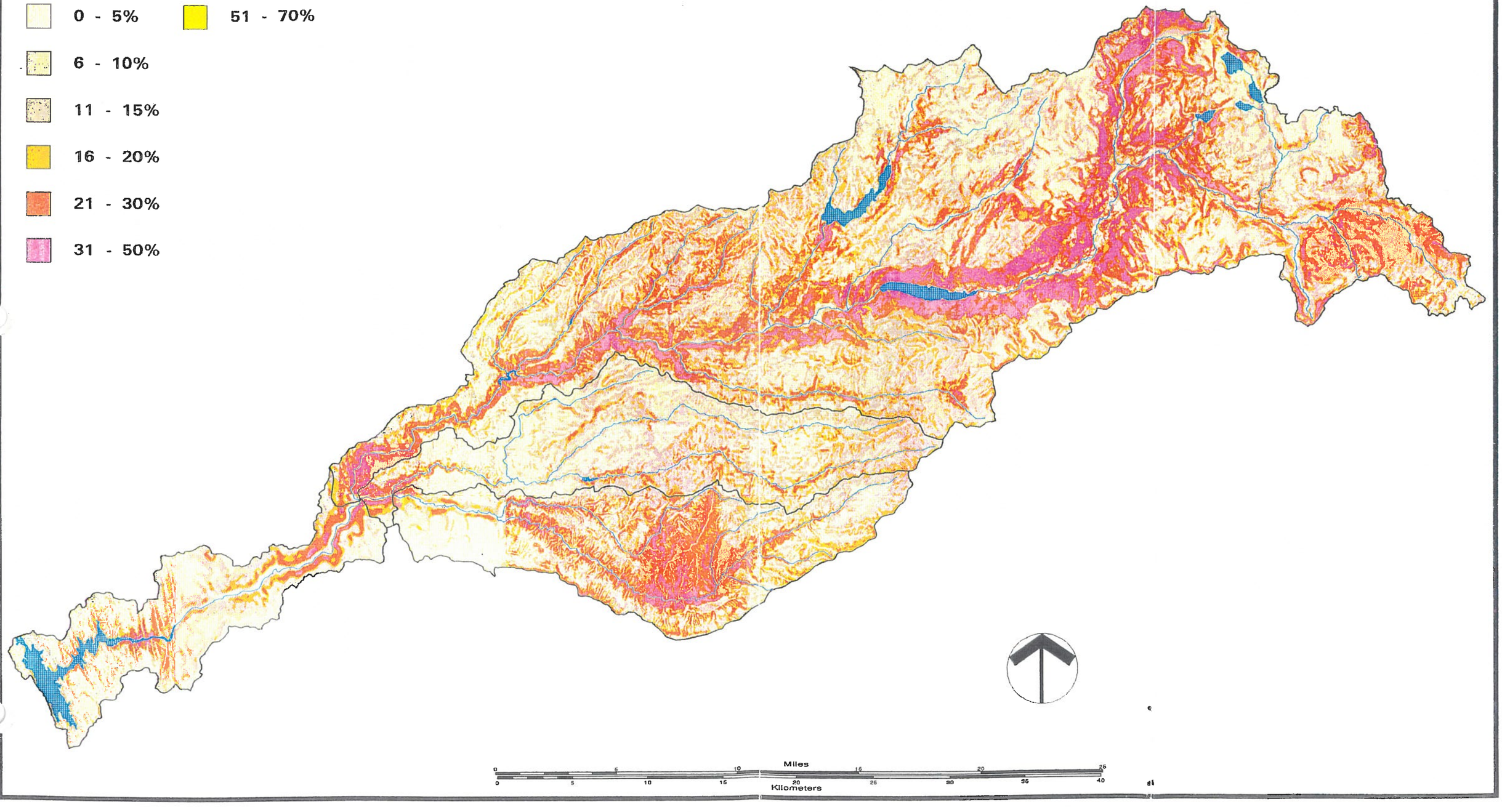


Upper Mokelumne Watershed

FIGURE C-2

Topographic Slopes

- 0 - 5%
- 6 - 10%
- 11 - 15%
- 16 - 20%
- 21 - 30%
- 31 - 50%
- 51 - 70%

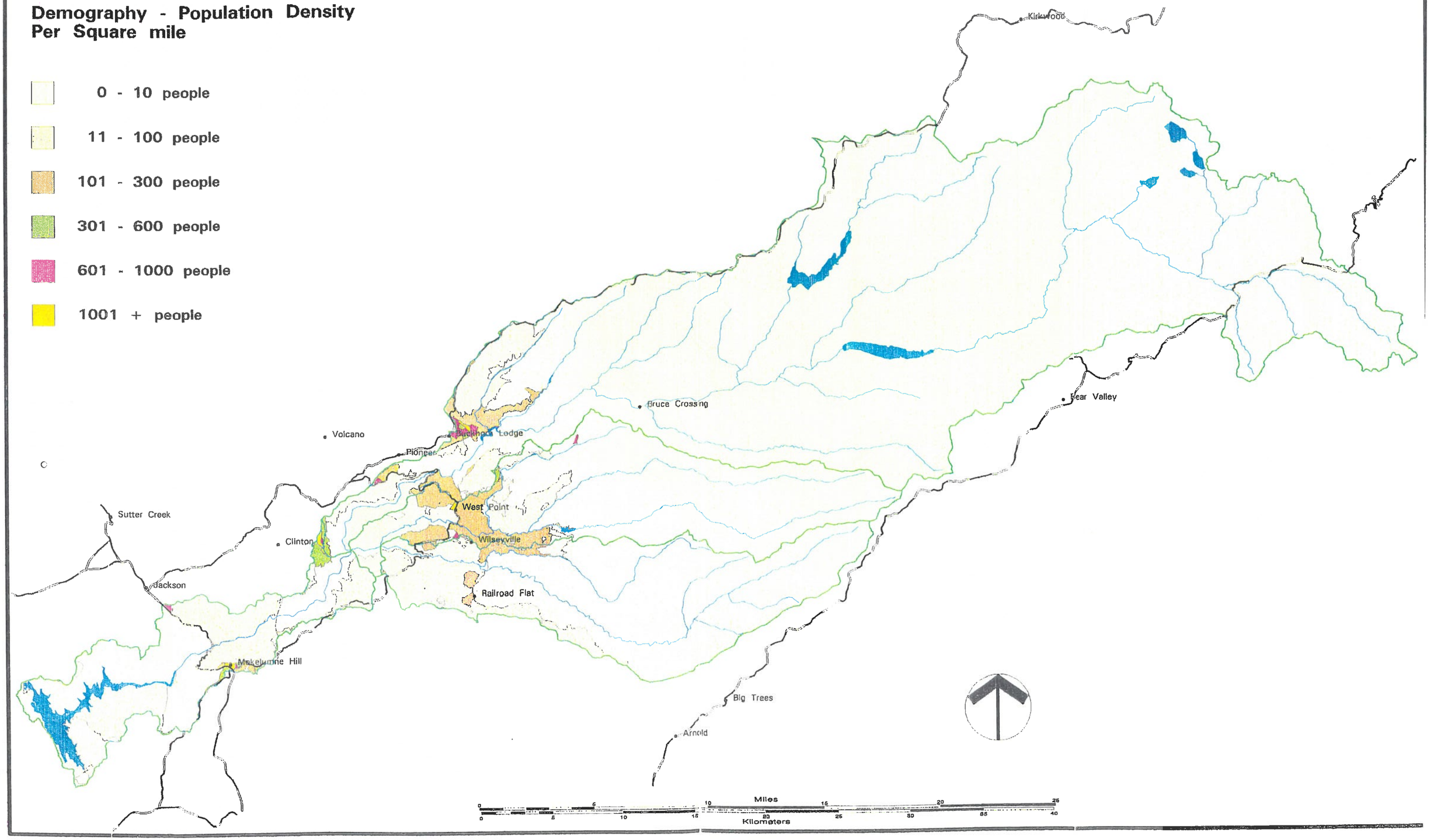


Upper Mokelumne Watershed

FIGURE C-3

Demography - Population Density
Per Square mile

- 0 - 10 people
- 11 - 100 people
- 101 - 300 people
- 301 - 600 people
- 601 - 1000 people
- 1001 + people



APPENDIX D

SUPPORTING DOCUMENTATION FOR SECTION 5

Table D-1. Pardee Recreation Area Pond Monitoring

Influent Monitoring

Constituent	Units	Type of Sample	Sampling Frequency	Reporting Frequency	Discharge Limit
Flow	mgd	Cumulative	Continuous	Monthly	38,100 gpd average

Pond Monitoring

BOTH Ponds are to be monitored for:

Constituent	Units	Type of Sample	Sampling Frequency	Reporting Frequency	Discharge Limit
Dissolved Oxygen	mg/l	Grab	Monthly	Monthly	not < 1.0 mg/l
Freeboard	feet and inches	Observation	Monthly	Monthly	not < 2 Feet
pH	pH units	Grab	Monthly	Monthly	between 6.5 and 8.5

Additional Monitoring of the **SECOND** pond:

Constituent	Units	Type of Sample	Sampling Frequency	Reporting Frequency	Discharge Limit
20degC BOD5	mg/l	Grab	Monthly	Monthly	NA
TSS	mg/l	Grab	Monthly	Monthly	NA
Total Coliform	MPN/100	Grab	Monthly	Monthly	NA
Formaldehyde	mg/l	Grab	Monthly, **May-Sept**	Monthly, **May-Sept**	NA NA
Zinc	mg/l	Grab	Monthly, **May-Sept**	Monthly, **May-Sept**	NA
Phenol	mg/l	Grab	Monthly, **May-Sept**	Monthly, **May-Sept**	NA
Ammonia-N	mg/l	Grab	Monthly, **May-Sept**	Monthly, **May-Sept**	NA
Nitrate-N	mg/l	Grab	Monthly, **May-Sept**	Monthly, **May-Sept**	NA

Lysimeter Monitoring

Constituent	Units	Type of Sample	Sampling Frequency	Reporting Frequency	Discharge Limit
pH	pH units	Grab	Quarterly	Quarterly	NA
Nitrate-N	mg/l	Grab	Quarterly	Quarterly	NA
Total Coliform	MPN/100	Grab	Quarterly	Quarterly	NA

Table D-2
Pardee Center Wastewater Treatment Plant
Waste Discharge Requirement No. 88-165

Effluent Monitoring Samples to be collected just prior to discharge to spray irrigation					
Constituents	Units	Discharge Limits Daily Maximum	Monthly Mean	Type of Sample	Sampling Frequency
20°C BOD	mg/l	80	40	Grab	Monthly
Settleable Solids	mg/l	1.0	0.5	Grab	Monthly
Suspended Solids	mg/l	80	40	Grab	Monthly
Flow	gallons	30 day average daily dry weather discharge flow not to exceed 3,000 gallons			Daily volumes discharged to plant and disposal sites

Effluent Reservoir Monitoring			
Constituents	Units	Limits	Sampling Frequency
Dissolved Oxygen	mg/l	Not less than 1.0 mg/l for 16 hours in any 24 hour period	Monthly
Freeboard	feet	Not less than 2 feet	Weekly
Reservoir Conditions	Weekly log kept on reservoirs condition, noting: floating or suspended matter, discoloration, bottom deposits, aquatic life, odors, erosion, seeps in dikes		Weekly

Discharge Prohibitions

1. No direct discharge of wastes to surface waters or drainage courses.
2. No by-pass or overflow of untreated or partially treated waste.

Discharge Specifications

1. Maintain fenced spray disposal area and 100 foot setback, or 200 feet in open terrain.
2. No spraying during rain or within 24 hours afterwards.
3. No degradation of any water supply.

Reporting Requirements

Report is due the 15th of each month.
Reports are signed by Rob Alcott.
Submit lab analyses, flows, pond conditions, and freeboard measurements monthly.
Annual report to be submitted January 30 that provides summary of monitoring data obtained the previous year, and any discussion of corrective actions taken or planned to keep discharge in compliance.

Term of Permit

No expiration date

Table D-3

U.S. Forest Service Application of Herbicides in the North Fork Sub-Watershed

Group Area No.	Acreages	Spring Spray				Fall Spray
		TRI	GLY	GLY/TRI	Sub-total	HEX
1	122	52	25	13	90	33
2	21	0	0	0	0	21
3	51	0	32	4	36	25
4	32	0	18	4	22	10
5	31	0	0	31	31	10
6	25	0	0	25	25	0
7	2	0	2	0	2	0
8	28	0	0	28	28	0
9	14	0	0	14	14	0
10	4	0	0	4	4	0
Total	330	52	77	123	252	99

Notes: (1) Please refer to Figure III-9 for the location of each group area.

(2) The composition and general application of each solution is shown below:

TRI = 1.5% Garlon 4, sprayed to wet

GLY = 2.0% Accord, sprayed to wet

GLY/TRI = 1.5% Accord +0.75% Garlon 4, sprayed to wet

HEX = Pronone 10G, 30 pounds per acre

Detailed information about each compound is contained in the Appendix

Source: Caltrans District 10, Stockton, October 1993.

Table D-4

Caltrans Applications of Herbicides in the North Fork Sub-Watershed

Material	Frequency (per year)	Application Times	Area (acres)	Rate (gal/acre)	Amount (gal/year)	Purpose
Route 88 (approx. 35 miles)						
Garlon 4-E	1	All Year	0.4	1.0	0.4	Treat Cut Stumps
Surflan AS	1	Nov-March	18.7	1.0	18.7	Preemergent Shoulders
Goal	1	Nov-March	18.7	0.5	9.4	Preemergent Shoulders
Roundup	1	Nov-March	18.7	0.5	9.4	Postemergent Shoulders
Garlon 4-E	1	Sep-Nov	1.2	1.0	1.2	Brush Control
Roundup	2	As Needed	2.3	1.0	4.6	Perennials Spot Spray
Surfactant	1	As Needed	9.3	1.0	9.3	Surfactant
		Subotal	69.3		53.0	
Route 26 (approx. 8 miles)						
Surflan AS	1	Nov-March	14.9	1.0	14.9	Preemergent Shoulders
Goal	1	Nov-March	14.9	0.5	7.5	Preemergent Shoulders
Roundup	1	Nov-March	14.9	0.5	7.5	Postemergent Shoulders
Garlon 4-E	1	Sep-Nov	1.5	1.0	1.5	Brush Control
Roundup	2	As Needed	3.0	1.0	6.0	Perennials Spot Spray
Surfactant	1	As Needed	5.2	2.0	10.4	Surfactant
Garlon 4-E	1	All Year	3.7	1.0	3.7	Treat Cut Stumps
		Subtotal	58.1		51.5	
		Total	127.4		104.5	

Note: (1) Detailed information about each herbicide is contained in the Appendix
(2) More than one herbicide may be sprayed on a given area

Source: Caltrans District 10, Stockton, October 1993.

Table D-5

Caltrans Applications of Herbicides in the Middle Fork Sub-Watershed

Material	Frequency (per year)	Application Times	Area (acres)	Rate (gal/acre)	Amount (gal/year)	Purpose
Route 26 (approx. 4 miles)						
Surflan AS	1	Nov-March	7.5	1.0	7.5	Preemergent Shoulders
Goal	1	Nov-March	7.5	0.5	3.8	Preemergent Shoulders
Roundup	1	Nov-March	7.5	0.5	3.8	Postemergent Shoulders
Garlon 4-E	1	Sep-Nov	0.5	1.0	0.5	Brush Control
Roundup	2	As Needed	0.9	1.0	1.8	Perennials Spot Spray
Surfactant	1	As Needed	2.3	2.0	4.6	Surfactant
Garlon 4-E	1	All Year	0.3	1.0	0.3	Treat Cut Stumps
		Total			22.3	

Note: (1) Detailed information about each herbicide is contained in the Appendix
(2) More than one herbicide may be sprayed on a given area

Source: Caltrans District 10, Stockton, October 1993.

Table D-6

Caltrans Applications of Herbicides in the South Fork Sub-Watershed

Material	Frequency (per year)	Application Times	Area (acres)	Rate (gal/acre)	Amount (gal/year)	Purpose
Route 26 (approx. 3 miles)						
Surflan AS	1	Nov-March	6.0	1.0	6.0	Preemergent Shoulders
Goal	1	Nov-March	6.0	0.5	3.0	Preemergent Shoulders
Roundup	2	Nov-March	6.0	0.5	6.0	Postemergent Shoulders
Garlon 4-E	1	Sep-Nov	0.4	1.0	0.4	Brush Control
Roundup	1	As Needed	0.7	1.0	0.7	Perennials Spot Spray
Surfactant	1	As Needed	1.9	2.0	3.8	Surfactant
Garlon 4-E	1	All Year	0.3	1.0	0.3	Treat Cut Stumps
		Total			20.2	

Note: (1) Detailed information about each herbicide is contained in the Appendix
(2) More than one herbicide may be sprayed on a given area

Source: Caltrans District 10, Stockton, October 1993.

Table D-7

Caltrans Applications of Herbicides in the Mainstem Mokelumne River Sub-Watershed

Material	Frequency (per year)	Application Times	Area (acres)	Rate (gal/acre)	Amount (gal/year)	Purpose
Route 26 (approx. 6 miles)						
Surflan AS	1	Nov-March	11.9	1.0	11.9	Preemergent Shoulders
Goal	1	Nov-March	11.9	0.5	6.0	Preemergent Shoulders
Roundup	1	Nov-March	11.9	0.5	6.0	Postemergent Shoulders
Garlon 4-E	1	Sep-Nov	0.8	1.0	0.8	Brush Control
Roundup	2	As Needed	1.5	1.0	3.0	Perennials Spot Spray
Surfactant	1	As Needed	3.7	1.0	3.7	Surfactant
Garlon 4-E	1	All Year	0.5	1.0	0.5	Treat Cut Stumps
		Subtotal			31.9	
Route 49 (approx. 7 miles)						
Surflan AS	1	Nov-March	13.0	1.0	13.0	Preemergent Shoulders
Goal	1	Nov-March	13.0	0.5	6.5	Preemergent Shoulders
Roundup	1	Nov-March	13.0	0.5	6.5	Postemergent Shoulders
Garlon 4-E	1	Sep-Nov	0.8	1.0	0.8	Brush Control
Roundup	2	As Needed	2.0	1.0	4.0	Perennials Spot Spray
Surfactant	1	As Needed	6.1	2.0	12.2	Surfactant
		Subtotal	47.9		43.0	
		TOTAL			74.9	

Note: (1) Detailed information about each herbicide is contained in the Appendix
(2) More than one herbicide may be sprayed on a given area

Source: Caltrans District 10, Stockton, October 1993.

Table D-8

North Fork and Mainstem Mokelumne River Sub-Watersheds - Body Contact Recreation Sites

Recreation Facility	Units or Group Size	Toilet Type	Boating	Swimming	Recreation Visitor Days		Operating Agency
					1991	1992	
North Fork Sub-watershed							
Bear River Group	20	Vault	X	X	4,000	6,100	Eldorado National Forest
Bear River Resort	125	Vault	X	X	7,000	11,500	Eldorado National Forest
Lower Blue Lake	16	Vault	X		5,476	5,688	Pacific Gas & Electric
Middle Creek	5	Vault	X		1,660	1,828	Pacific Gas & Electric
Mokelumne	8	Vault		X	5,700	4,200	Eldorado National Forest
Moore Creek	8	Vault		X	6,300	5,200	Eldorado National Forest
Salt Springs	4	Vault	X		200	400	Eldorado National Forest
South Shore	22	Vault	X	X	3,900	7,700	Eldorado National Forest
Upper Blue Lake	32	Vault	X		6,116	7,048	Pacific Gas & Electric
White Azalea	6	Vault		X	3,500	3,600	Eldorado National Forest
Mainstem Mokelumne Sub-Watershed							
Electra	7	Vault	X	X	1	1	Pacific Gas & Electric
Tiger Creek Afterbay	10	Vault	X		1	1	Pacific Gas & Electric

[1]No information available. PG&E keeps no records of day-use.
Source: U.S. Forest Service. Visitor days were provided by operating agencies.

Table D-9
Camanche South Shore Wastewater Treatment Plant
Waste Discharge Requirement No. 86-155

Discharge Monitoring and Reporting Requirements		
Item	Limit	Record keeping
30 Day Average Daily Dry Weather Flow	Not to exceed 82,160 gallons/day	--
Pond Levees and Contents	--	Semi Weekly Records Of: 1. Vertical Freeboard 2. Odor 3. Evidence of Dike Erosion 4. Dike Leakage

Discharge Prohibitions

1. No direct discharge of wastes to surface waters or drainage courses.
2. No by-pass or overflow of untreated or partially treated waste.

Discharge Specifications

1. No spraying during rain or within 24 hours afterwards.
2. No degradation of any water supply.

Reporting Requirements

Annual report due January 30 that provides summary of monitoring data obtained the previous year, and any discussion of corrective actions taken or planned to keep discharge in compliance. Submit inspection reports monthly to Environemental Compliance.
Reports are signed by Rob Alcott

Term of Permit

No expiration date

Table D-10
Camanche North Shore Wastewater Treatment Plant
Waste Discharge Requirement No. 95-175
No expiration date

Effluent Monitoring

Samples from pond 6 shall not exceed the following:

Constituents	Units	Discharge Limits Daily Maximum	Monthly Mean	Type of Sample	Sampling Frequency
20°C BOD	mg/l	80	40	Grab	Monthly
Settleable Solids	mg/l	0.5	0.2	Grab	Monthly
Suspended Solids	mg/l	80	40	Grab	Monthly

Report the days each month that irrigation took place and the volume of effluent discharged to the irrigation fields.

Ponds Monitoring

Constituents	Units	Type of Sample	Limits	Sampling Frequency
Flow	mgd	Cumulative	Not to exceed 0.1 mgd/day	Daily
Freeboard	feet	--	Not less than 2 feet	Weekly
Dissolved Oxygen	mg/l	Grab	Not less than 1.0	Monthly

Discharge Prohibitions

1. No direct discharge of wastes to surface waters or drainage courses.
2. No by-pass or overflow of untreated or partially treated waste.

Discharge Specifications

1. Treatment facilities shall be designed, constructed, operated, and maintained to prevent inundation or washout due to floods with a 100-year return frequency.
2. Ponds shall have sufficient capacity to accommodate allowable wastewater flow and design seasonal precipitation and ancillary inflow and infiltration during the nonirrigation season. Design seasonal precipitation shall be based on total annual precipitation using a return period of 25 years, distributed monthly in accordance with historical rainfall patterns. Freeboard shall never be less than two feet (measured vertically to the lowest point of overflow).
3. No spraying during rain or within 24 hours afterwards, or when winds exceed 30 mph..
4. No standing water in the disposal area 24 hours after wastewater is applied.
5. No public contact with wastewater.
6. Maintain a 100-foot buffer around the spray field and between any watercourse and the wetted area during spraying.
7. Keep spray confined to the reclamation area and from drinking water facilities.
8. Spray water shall be managed to minimize erosion, runoff, and movement of aerosols from the disposal area.
9. No ground water degradation.

Reporting Requirements

Report is due the 20th of January, April, July, and October.
Submit lab analyses, flows, pond conditions, and freeboard measurements quarterly.
Annual report to be submitted January 30 that provides summary of monitoring data obtained the previous year, and any discussion of corrective actions taken or planned to keep discharge in compliance.
Reports are signed by Rob Alcott.

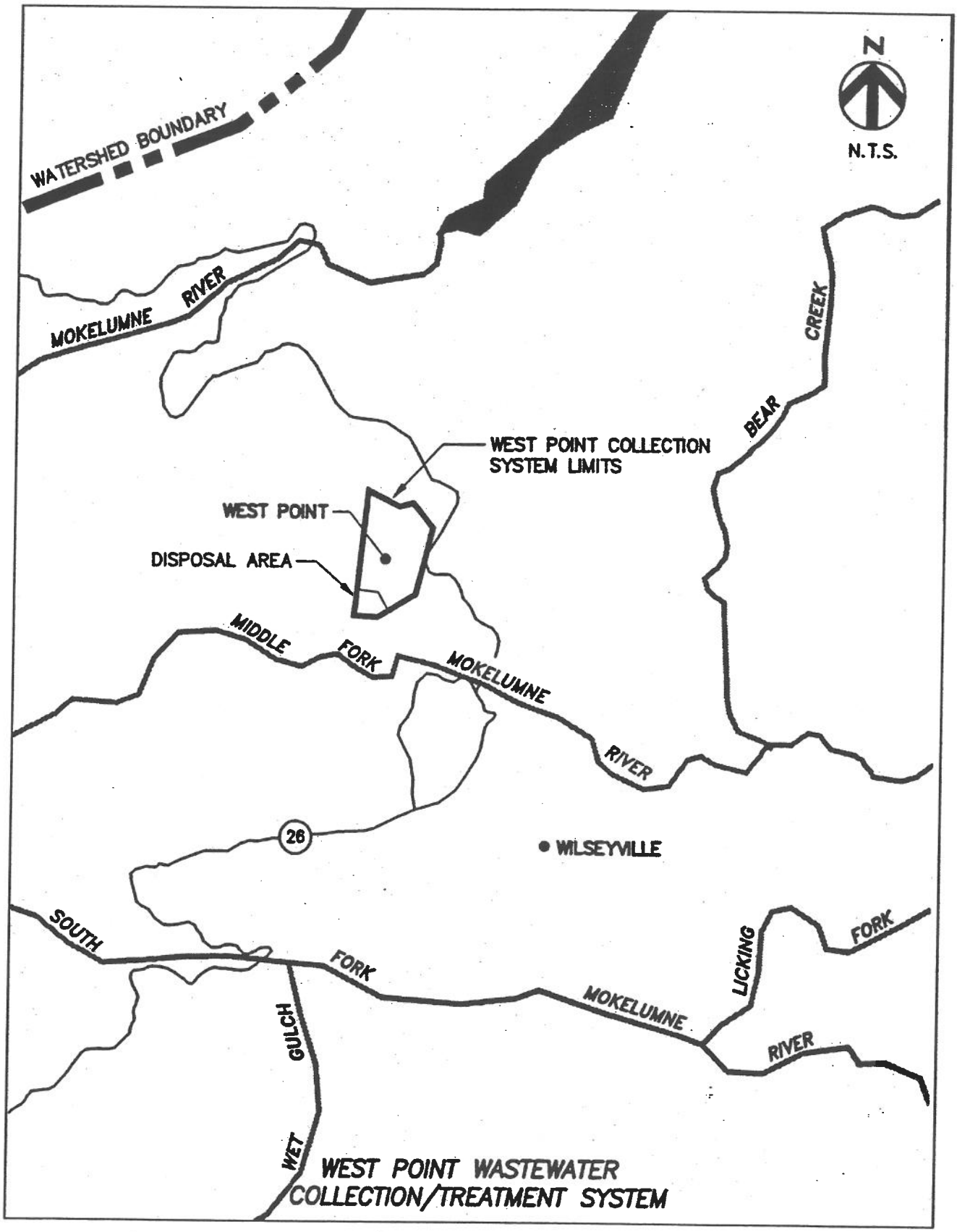
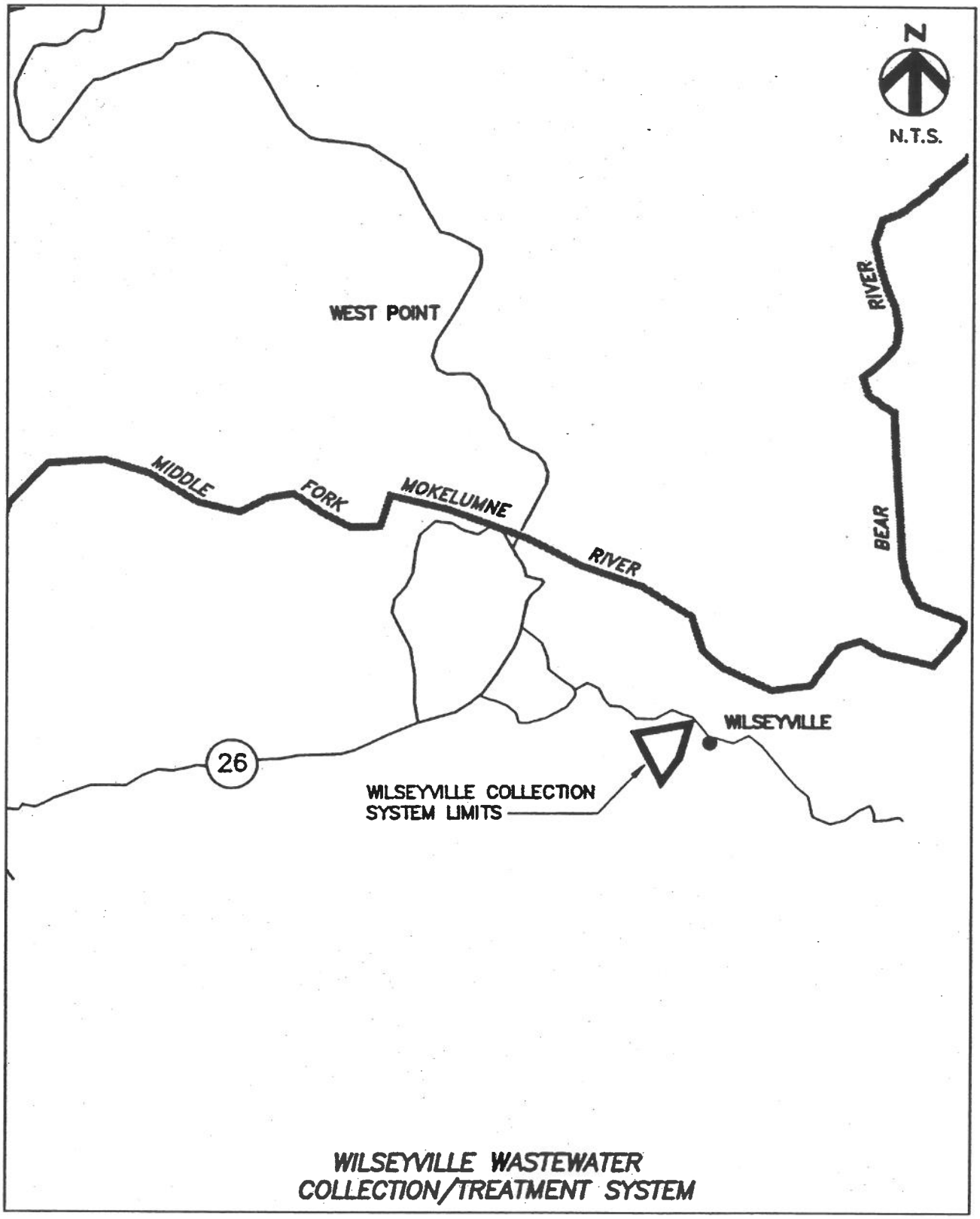

WATERSHED BOUNDARY
N
N.T.S.
MOKELUMNE RIVER
BEAR CREEK
WEST POINT COLLECTION SYSTEM LIMITS
WEST POINT
DISPOSAL AREA
MIDDLE FORK MOKELUMNE RIVER
26
WILSEYVILLE
SOUTH FORK MOKELUMNE RIVER
LICKING FORK
WET GULCH
WEST POINT WASTEWATER COLLECTION/TREATMENT SYSTEM

FIGURE D-1



WILSEYVILLE WASTEWATER
COLLECTION/TREATMENT SYSTEM

FIGURE D-2

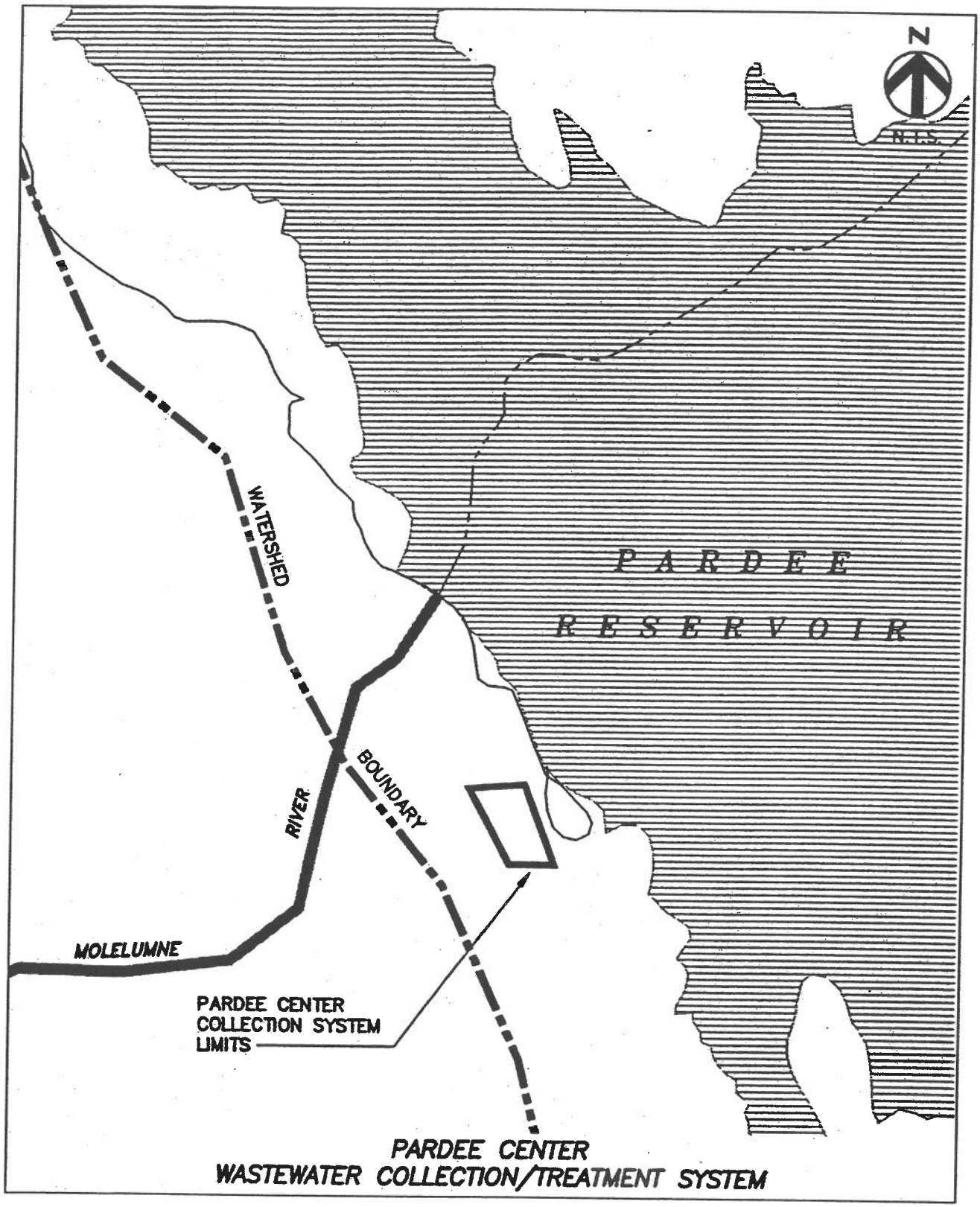

N
N.T.S.
PARDEE
RESERVOIR
WATERSHED
BOUNDARY
RIVER
MOLELUMNE
PARDEE CENTER
COLLECTION SYSTEM
LIMITS
PARDEE CENTER
WASTEWATER COLLECTION/TREATMENT SYSTEM

FIGURE D-3

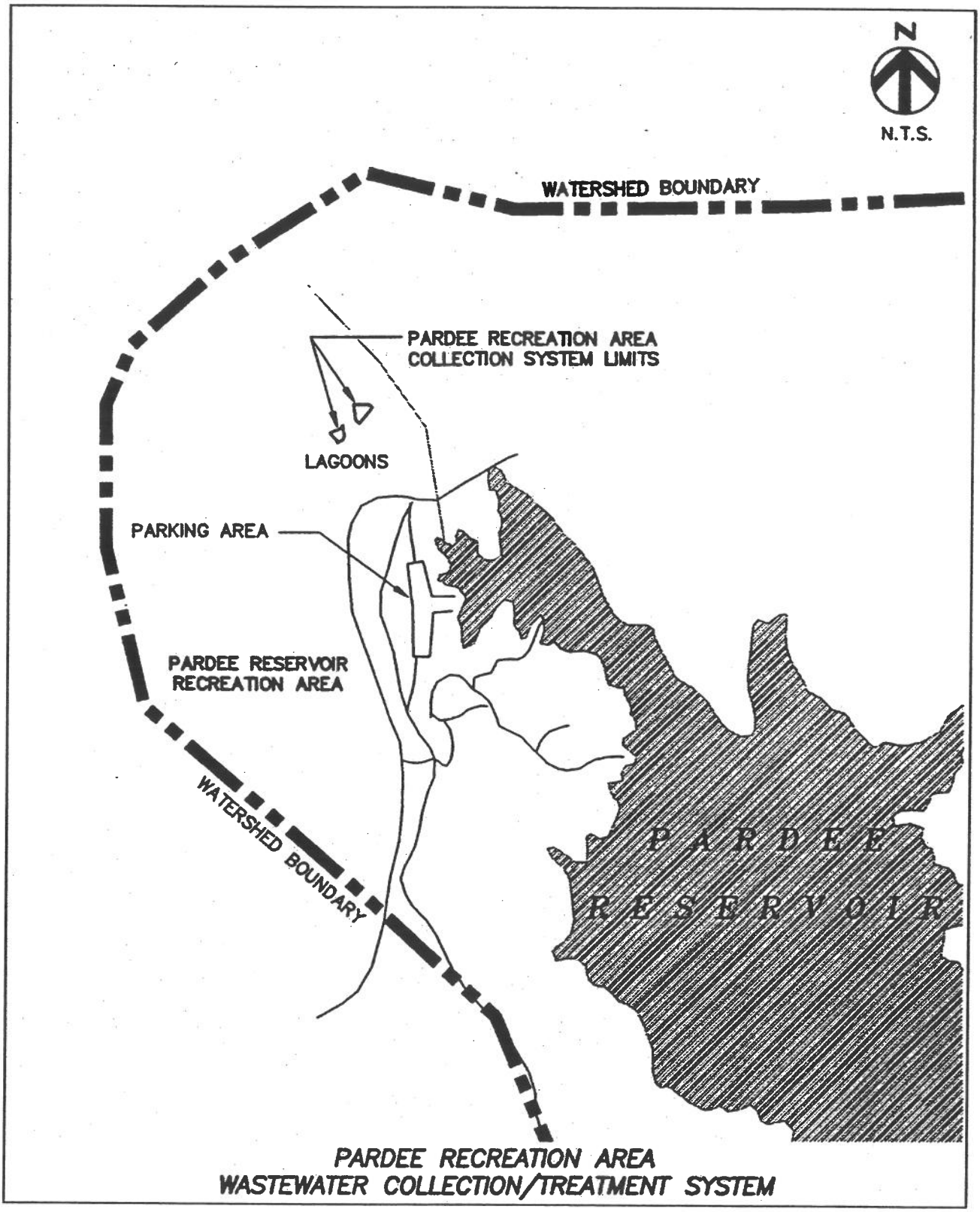

N
N.T.S.
WATERSHED BOUNDARY
PARDEE RECREATION AREA
COLLECTION SYSTEM LIMITS
LAGOONS
PARKING AREA
PARDEE RESERVOIR
RECREATION AREA
WATERSHED BOUNDARY
PARDEE
RESERVOIR
PARDEE RECREATION AREA
WASTEWATER COLLECTION/TREATMENT SYSTEM

FIGURE D-4

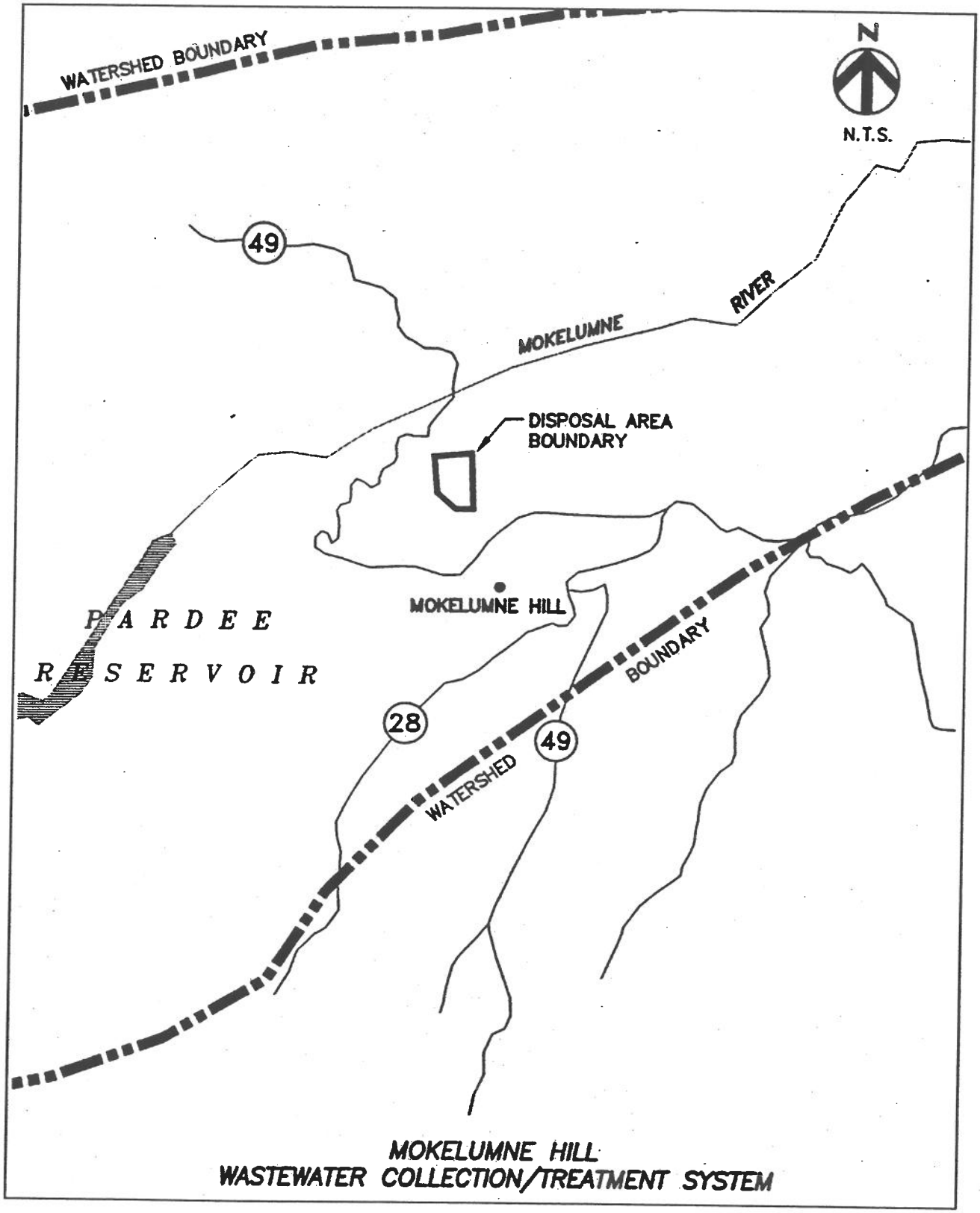

WATERSHED BOUNDARY
N
N.T.S.
49
MOKELUMNE RIVER
DISPOSAL AREA BOUNDARY
MOKELUMNE HILL
PARDEE RESERVOIR
28
49
WATERSHED BOUNDARY
MOKELUMNE HILL
WASTEWATER COLLECTION/TREATMENT SYSTEM

FIGURE D-5

APPENDIX E

BEST MANAGEMENT PRACTICES

APPENDIX E

BEST MANAGEMENT PRACTICES

Land-use control and structural measures implemented by water utilities and other agencies with jurisdiction in the watershed can comprise the building blocks of a watershed protection program. This section reviews and describes some of the successful protection measures, called best management practices (BMPs) with potential applicability in the Mokelumne River watershed, that relate to those activities identified in the 1995 MRWSS that have the greatest potential to degrade water quality constituents of public health concern.

The description of protection measures is divided into five key categories: (1) general watershed protection measures common to a variety of land uses, (2) agricultural and grazing management practices, (3) silvicultural best management practices, (4) wastewater management and (5) recreational off-road vehicle (ORV) use. The contents of this section were drawn partly from a recent report by the American Water Works Association Research Foundation 1991 report entitled "Effective Watershed Management for Surface Water Supplies."

The protection measures include both structural and non-structural controls. Structural controls are specific capital improvements designed to filter, detain, or reroute contaminants carried in surface runoff. Nonstructural controls utilize land-use planning, land-use regulations, and land ownership tools to eliminate or minimize sources of contamination in a watershed.

General Watershed Protection Measures

Land Use Control and Land Acquisition. A high risk for contamination of water supplies occurs with certain land uses. Other land uses, while not inherently high risk, can produce contamination of the water supply if not carefully controlled. Thus the best way to prevent contamination of the water supply is to control the land use in the watershed.

The most effective way to guarantee protection of surface water supplies is for the utilities to acquire most or all of the land in the watershed. Although public agencies can often apply their power of eminent domain to condemn private property, purchase of large tracts is no longer feasible in most instances because of political opposition and the high capital costs of land.

Access Control. Controlling human and livestock access to a watershed prevents contamination of the water supply by their activities. Best management practices to control access to a watershed include fencing of restricted watershed areas and riparian lands, gating of roadways, hunting and fishing regulations, off-road vehicle use restrictions, wilderness area restrictions and controlling access on rights-of-way.

Buffer Zone Protection. The most sensitive portions of water supply watersheds are those areas immediately adjacent to streams and reservoirs. Development activity within and adjacent to watercourses can degrade water quality by increasing the availability and transport of pollutants. Retention of vegetated, undisturbed buffers along watercourses is one of the most effective practices used to protect water supplies.
Buffer zones are commonly created in two ways: (1) the utility, municipality, or other cooperating jurisdictions acquire the buffer area, or (2) development or other land management activities within the buffer zone are restricted.

Monitoring and experience have shown that even small, intermittent, and ephemeral streams have a significant effect on downstream water quality. In addition, poorly treated stormwater discharges often bypass, or "short-circuit," vegetative buffers, particularly when runoff is routed directly to receiving waters through storm sewers, culverts, and other confined drainage courses.

Reservoir Use Restrictions. Reservoir-use restrictions can be considered part of a watershed protection program because policies for recreational use of public water supplies are frequently connected with land-use controls in the rest of the watershed. With the exception of water supplies drawn from multipurpose impoundments managed by agencies such as the Corps of Engineers and Bureau of Reclamation, reservoir-use restrictions are one of the few control measures usually within the jurisdiction of water utilities.

Cause-and-effect relationships between recreational use and water quality contamination in surface water sources are difficult to establish because of the difficulty in maintaining adequate sampling controls. Without conclusive monitoring studies of recreational impacts, it is recommended that water utilities continue to impose reasonable and prudent restrictions on recreational use of public

water supplies to minimize the risks of biological contamination and hazardous spills.

Sign Posting. Signs have been widely used by water utilities and their cooperative jurisdictions as a notification tool for protecting water supplies. Their most common use is for posting watershed property against trespass. Signs can be posted along legal property boundaries, physical drainage boundaries, or along travel routes such as roads and trails.

Signs are also helpful for communicating special regulations for watershed lands that are open to the public but subject to restrictions. They can be used to alert the public or road maintenance crews about special regulations that pertain to a watershed, or simply carry a general message about the need to protect water supplies. In regions where extensive use of road salt is a water quality concern, signs can be used to alert state and municipal road crews that alternative-deicing methods should be employed. Pesticide spraying restrictions along state highway right-of-ways also can be indicated with "spray" "no-spray" zoning signs.

Written Agreements. Written agreements with public and private landowners in the watershed can provide formal, legal bases for specific watershed controls that is not otherwise provided through existing land-use regulations or land ownership. EPA has placed an increased emphasis on written agreements by explicitly including them among the criteria in the Surface Water Treatment Rule for determining whether public surface water systems may be allowed to remain unfiltered. The final rule states that in order for an unfiltered system to avoid the requirements for mandatory filtration, it "must demonstrate through ownership or written agreements with landowners in the watershed, or a combination of both, that it controls all human activities which may have an adverse effect on the microbiological quality of the source water".

Plan Review. For lands outside the direct control of water utilities, one of the most effective ways to protect water supplies is for the utility to participate directly in the process of reviewing land-use activities that could potentially degrade water quality. This is accomplished by reviewing permits, plans, designs, or other documents that are required by regulations and policies. In watersheds threatened by urban development such as the Mokelumne, this could involve review of plans and permits for activities such as residential development, structural BMPs, water and sewer services, and septic system construction.

Watershed Inspection Programs. An important component of any effective watershed protection program is field inspections. Frequent, routine inspections of the watershed are needed to identify sources of contamination and determine the effectiveness of control measures. Ideally, watershed inspections should be coupled with sampling programs in order to document water quality impacts and help quantify the effectiveness of structural and nonstructural controls.

Legal Action. When local governments have exhausted the police powers available under existing regulations, an option for protecting water supplies is to pursue legal action. Threats to water quality can be addressed either through administrative or legal actions. Administrative actions involve protests or similar actions taken through government channels when existing regulations are not properly enforced or do not provide sufficient protection. Court suits can be used if a government agency, landowner, or other party continues to ignore regulations, or when land-use actions endanger public water supplies. Although legal actions are not always successful, they can increase public scrutiny and help to focus attention on the need to protect water supplies.

Public Education and Participation. Public education and community involvement programs may play valuable roles in a watershed protection program. Citizens and property owners need to understand the objectives of the watershed protection program, the benefits to the community and to themselves, and ways in which they can participate. Public awareness affects the acceptability of mandatory controls, the effectiveness of voluntary measures, and the level of support provided by elected officials. A public education campaign can improve the feasibility of a plan and is often critical for successful implementation of an effective watershed protection program.

Agricultural and Grazing Management Practices

Agricultural nonpoint sources of pollution include both irrigated and non-irrigated crop production, pasture grazing, feedlots, and animal-waste management areas. Surface water supplies that drain from agricultural areas may be degraded by erosive tillage practices, alteration of riparian areas, fertilizer and pesticide applications, or poor waste management practices. The approach taken by the Federal Water Pollution Control Act (PL 92-500) and amending legislation called for source management, rather than collection and treatment of pollutants, as the preferred method for controlling agricultural nonpoint pollution. Agricultural best management practices have been developed to address this need, and they include a variety of structural and nonstructural methods designed to protect soil and water resources.

Conservation Tillage. Conservation tillage systems are farming practices that retain crop residues (stalks, stems, and roots) on the surface of cultivated croplands after harvest. They protect the soil surface from erosion, help to maintain good soil structure, reduce soils compaction, and improve soil properties such as porosity to air and water.

Contour Farming. Where feasible, contour farming is a method of tillage, planting, and cultivation on the contour that can reduce sheet and rill erosion. The practice is most applicable on land with a 2 percent to 8 percent slope, where its effectiveness for controlling nutrient (phosphorus) and sediment export is rated as fair and good, respectively. Contour strip-cropping is similar to contour farming but differs in that strips of close-growing vegetation (such as meadow grasses) are planted between strips of production row crops. The sediment-trapping characteristics of contour strip-cropping allow it to be used on slopes approaching 15 percent. On steeper slopes, its effectiveness is similar to or slightly better than that of contour farming. Both methods must be practiced each year to maintain their effectiveness.

Terraces. Terraces may be used on long slopes of up to 12 percent. They may consist of small earth embankments, channels, or combinations of ridges and channels constructed on the contour. The ridge of the terrace is designed to guide surface water to a controlled outlet. The outlet may be either a grassed waterway or an underground drain that carries water to a ditch or creek. Terraces reduce slope length by breaking the slope into near-horizontal slopes and are used to reduce sheet and rill erosion and prevent development of gullies. Terraces are used where neither contouring, contour strip-cropping, nor conservation tillage alone can provide sufficient soil protection.

Grassed Waterways. A grassed waterway is a natural or artificially constructed broad, shallow drainage channel that is planted with erosion-resistant grasses. Waterways can be designed to handle both large and small drainage areas where concentrated flows are a problem. The depth and width requirements of a waterway are functions of the slope and size of the drainage area. Grass waterways are a fairly inexpensive solution to concentrated flow problems on agricultural croplands. They are effective in reducing ephemeral gully erosion and can result in 60 to 80 percent reductions of sediment exports (EPA 1987a). Their primary disadvantage to farmers is that they take cropland out of production by dedicating it to grass. In some cases, gully erosion that occurs at the outlet of grassed waterways may result in a high annual maintenance cost. In these instances, grade stabilization structures may be used to stabilize the outlet.

Conservation Structures. Agricultural soil conservation structures include a variety of nonvegetative techniques used to control erosion and sedimentation. Two of the most common types of conservation structures are sediment control basins and grade stabilization structures. Sediment control basins are useful to control sediment loss due to surface runoff by acting as a settling basin for sediment. They are generally most effective in small drainage areas. In larger drainage areas, the size of the dam and pipe required for the facility may make it uneconomical for farmers and cost-sharing agencies.

Grade stabilization structures are used to control gully development by armoring and modifying the longitudinal slope of drainage ways. One example is a block chute, which employs rectangular blocks laid over a bed of fine rock and geotextile fabric. The advantages of block chutes are that they tend to be less expensive than other conservation structures and can be used in situations in which

there is a large amount of overfall (distance from the top of the structure to the flow line of the ditch or creek). The primary limitations of block chutes are that they require considerable amounts of hand labor to construct.

Grazing Practices. The objective of range and pasture management is to prevent overgrazing due to concentrations of grazing populations in confined or limited areas. Management practices include irrigation to promote regrowth, rotating animals between pastures, spreading mineral supplements, improving feed and water distribution, and allowing animals to graze only when a particular plant food is growing rapidly (EPA 1988b).

Animal-Waste Management. Animal-waste management facilities such as manure bunkers and lagoons are BMP facilities where animal wastes are held temporarily until they can be utilized more efficiently or safely discharged. Wastes can be stored in earthen ponds or constructed holding facilities. These measures can reduce a major source of bacteria, pathogenic organisms, and nutrient loading upon downstream water supplies. In cases where waste storage facilities are not used, farmers usually are required to distribute manure on adjacent fields daily. During the dormant season, there is less opportunity for the biological processing of animal wastes to occur. Facilities such as lagoons or manure bunkers allow farmers to store wastes until field conditions are more suitable for land application. They also can lessen dependence on chemical fertilizers for crop production.

Silvicultural Best Management Practices

Surface water supplies located in forested watersheds are widely considered to produce the best raw water quality. Poor silvicultural practices in such areas can produce a variety of nonpoint water quality problems, including increases in sediment, turbidity, nutrients, temperature, natural organics (e.g. tannin and lignin), and dissolved oxygen. Controlling nonpoint source pollution from timber harvesting and other forest management activities is an essential part of a protection program for watersheds that include commercial forestlands.

In addition to identifying the need for controlling nonpoint source pollution from agricultural activities, the federal Water Pollution Control Act Amendments of 1972 (PL92-500) specifically identified silvicultural activities as potential sources of nonpoint pollution. The act required California to develop methods to control pollutants emanating from such sources. As with agricultural lands, EPA has adopted the concept of BMPs to control potential nonpoint pollution from forested lands. EPA did not provide specific procedures for accomplishing these objectives in the 1972 Act or the Clean Water Act of 1977 (PL 95-217). However, federal land management agencies such as the U.S. Forest Service developed documents that describe silvicultural BMPs. California also has passed a Forest Practices Act to fulfill the state's requirements for establishing programs for the control of nonpoint source pollution from silvicultural activities. The state must specify the relationship between water quality standards and BMPs. To this end the state has pursued written agreements to establish that federal agency requirements for silvicultural BMPs will enable compliance with water quality objectives.

Control strategies or BMPs used to prevent or minimize adverse impacts from forest management activity include buffer strips; design and construction of haul roads, skid trails, and landings; postdisturbance erosion control; seasonal operating restrictions; and slash disposal procedures. Protection of vegetated buffer strips is a control measure common to nearly all land uses discussed earlier. Evaluation of the effectiveness of individual BMPs is often difficult because logging operations typically involve the use of several BMPs applied jointly. However, the disproportionate erosion impacts produced by roads and skid trails indicate that BMPs for these features should receive close attention in the planning, implementation, and monitoring phases of forestry operations.

Design and Construction of Haul Roads, Skid Trails, and Landings. The transportation network on commercial forestlands consists of haul roads, skid trails, and landings. Related BMP guidelines normally call for avoiding disturbance to sensitive areas such as unstable terrain and riparian areas, and for minimizing their total area or percentage of coverage within the basin. When possible, roads should use nongeometric horizontal and vertical alignments and conform as closely as possible to natural ground contours. For ground-based logging systems that require skid trails, the recommended BMP is to predesignate their locations

within the logging unit and restrict machinery from operating outside the approved routes.

Postdisturbance Erosion Control. Erosion can be controlled from previously disturbed surfaces by the application of various natural or artificial ground coverings. Materials include straw/asphalt, wood chips, straw, erosion mats and hydromulch. A comparison of erosion reduction by the five different methods reviewed by Burroughs and King (1989) showed that straw applied with an asphalt tackifier generally provided the greatest reduction in surface erosion. With the exception of hydromulch, comparable reductions in erosion were obtained with application rates sufficient to obtain at least 90 percent coverage of exposed areas. Seeding alone has done little to control surface erosion until germination and growth of new plants, and then only if the seed has not been washed from the slope.

Erosion control for skid trails, landings, and temporary haul roads also may involve removal of culverts and construction of earth berms, or "water bars," to prevent runoff from creating rill and gully erosion.

Seasonal Operating Restrictions. Seasonal operating restrictions can involve prohibitions on logging during certain calendar periods or weather conditions. Logging operations are normally suspended during the winter season to avoid soil erosion and long-term damage to the soils. Seasonal restrictions may also be established for extremely dry periods to reduce wildfire ignition potential.

Slash Disposal. Most forest management programs involve procedures for reducing the amounts of nonsalable woody residue, or slash that remain on the harvest units following log removal operations. Slash is disposed of through mechanical chipping, piling, or burning, to improve the efficiency of reforestation efforts and reduce the amount of combustible woody material. BMPs for management of woody debris in riparian areas differ regionally and should be tailored to the situation. In some cases, the presence of large woody debris has helped prevent channel scour and streambank erosion in steep gradient streams (Swanson et al., 1976; Swanson and Lienkaemper, 1978; Bilby and Likens, 1980) and it is an acknowledged necessity to enhance fisheries. Few studies however, offer guidance on how to distinguish stable versus unstable debris accumulations in stream channels, or assess the risk of damaging downstream drainage structures such as bridges and culverts when the debris impounds and then releases flows.

APPENDIX E

BEST MANAGEMENT PRACTICES

Wastewater Management

Land Disposal of Wastewaters. Best management practices to prevent contamination from land disposal of wastewater fall into two major categories: design and operation.

Design best management practices include the following measures:

- Treatment plants must be designed to treat the wastewater to acceptable levels prior to land disposal.
- Storage ponds must be of adequate capacity to prevent overflow, particularly during rainy periods.
- The land area used for disposal must be sufficiently large in size, with a soil composition that will insure adequate percolation.
- The land disposal area must be sufficiently distant from creeks, streams or other bodies of water.

Operational best management practices include the following measures:

- The application rates of wastewaters must be limited in order to prevent runoff.
- Wastewater application must be further restricted during periods of rain.
- Regular monitoring should be conducted by the facility to insure compliance with regulations.
- Land disposal systems must be inspected and monitored by the RWQCB.

Septic Tanks. On-site septic systems are the most common type of sewage disposal method used in rural watersheds. If septic systems are poorly sited constructed, or maintained, they can pose significant threats to the water quality of both surface and groundwater supplies. Generally, conventional septic systems should not be allowed in areas where soil type, subsurface conditions, groundwater conditions, or proximity to surface water could cause contamination of water supplies. Minimum requirements for the design, installation, operation, and maintenance of septic tanks and other on-site sewage disposal systems are established by state and local public health codes. Although water utilities rarely have enforcement authority over septic systems, they should coordinate closely with local jurisdictions to ensure proper enforcement of septic system regulations in public water supply watersheds.

Municipal and county health departments normally have responsibility for administering septic system regulations. In unsewered rural areas, lot-size restrictions are often established on the basis of the minimum area necessary to support septic systems. A minimum lot size of at least one-acre is usually required by local health departments for construction of conventional septic systems. However, it is not uncommon to require a minimum lot size of 2 to 5 acres for development with on-site septic systems. Where site conditions are not favorable for conventional septic tanks, state and local regulations may permit alternative designs such as low-pressure pipe systems and mound systems. Water utilities can reduce the risk of contamination from septic systems by coordinating closely with local jurisdictions on review of, and approval for, proposed systems and by monitoring existing systems.

Best management practices to prevent groundwater and stream contamination from septic tanks also fall into design and operation categories.

Design best management practices include the following measures:

- Ensure appropriate soil depth, soil permeability, depth to the groundwater, depth to bedrock, slope, and available area.
- Limit the number of systems per unit area in accordance with site limitations.
- Reduce nitrogen levels prior to disposal (for example with a sand filter).
- Require that shallower and wider leaching trenches be constructed in areas with high water tables.
- Require set-aside of areas large enough to accommodate backup systems in case of primary system failure.

Operational best management practices include the following measures:

- Provide appropriate frequency of pumpage and haulage of sludge to prevent overflow/discharge and clogging.
- Maintain drainage field piping to avoid clogging.
- Enforcement of septic tank regulations by counties to help assure proper maintenance of existing systems.

Recreational Off-Road Vehicle Use

Measures to prevent adverse impacts and resultant erosion of road and lands subject to use by off-road vehicles have already been discussed at some length. The most successful restriction method employed so far appears to be that used by Sierra Pacific Corporation, complete restriction of access. Through the use of gates, with explanatory signs, Sierra Pacific has been able to effectively exclude four-wheelers and completely avoid further damage to private dirt road systems and vulnerable land areas. Although there has been adverse criticism, and occasional vandalism, the measures have proved to be far more successful that its predecessor, which entailed the installation of massive earth barriers at known points of entry. Although the barriers were built high enough to preclude entry by four-wheel drive vehicles, they were quickly torn down or bypassed by misguided recreationists or vandals.

The National Forest Program of map-posting, forest rules issuance, posting and the imposition of stiff penalties combined with enforcement, has proved to be moderately successful. Both of the above-described measures have been accompanied by repair and eradication of previously caused damage.

APPENDIX F

EBMUD ANNUAL WATER QUALITY REPORTS (1995-1999)

EBMUD

EAST BAY MUNICIPAL UTILITY DISTRICT

PARDEE CENTER
1999 WATER QUALITY ANNUAL REPORT



Water System Information

This report includes information such as the source of water, its water quality and comparisons to State and Federal drinking water standards. This information is provided because informed customers are our best allies. For more information, please call Harold Roberson, Water Treatment/Distribution System Supervisor at 209-772-8368.

Source of Water

Pardee Reservoir is the source of water for Pardee Center. Water conservation is an integral part of water supply at Pardee Center. Pardee Center has a dual water distribution system. The non-potable system serves the fire hydrants, irrigation system, and various other uses throughout Pardee Center.

The water from Pardee Reservoir is treated with state-of-the-art nanofiltration resulting in particle removal as small as 0.001 micron to protect you from microbial contaminants. This is equivalent to 70,000 times smaller than the diameter of a human hair. We also added a new 13,900-gallon distribution reservoir. Treatment includes filtration, chlorination, and corrosion control. Compliance with regulations requires an extensive monitoring program in both the source and treated waters approved by the California Department of Health Services (Department). Water quality regulations were met in all water quality aspects in 1999.

This report describes the results from sampling water for potential contaminants and gives you information on water related activities. In order to ensure that the water is safe to drink, the Department prescribes regulations which limit the amount of certain contaminants in water provided by public water systems. We treat the water according to the Department's regulations. The Department's regulations also establish limits for contaminants in bottled water that provide the same protection for public health.

Definitions

Maximum Contaminant Level (MCL): The highest level of a contaminant that is allowed in drinking water. Primary MCLs are set as close to the Public or Maximum Contaminant Level Goals as is economically and technologically feasible. Secondary MCLs are set to protect the odor, taste, and appearance of drinking water.

Maximum Contaminant Level Goal (MCLG): The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs are set by the U.S. Environmental Protection Agency (USEPA).

Public Health Goal (PHG): The level of a contaminant in drinking water below which there is no known or expected risk to health. PHGs are set by the California Environmental Protection Agency.

Primary Drinking Water Standard (PDWS): MCLs for contaminants that affect health along with their monitoring and reporting requirements, and water treatment requirements.

Regulatory Action Level (AL): The concentration of a contaminant which, if exceeded, triggers treatment or other requirements which a water system must follow.

Treatment Technique (TT): A required process intended to reduce the level of a contaminant in drinking water.

Educational Information

Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the EPA's Safe Drinking Water Hotline (1-800-426-4791).

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers.

The sources of drinking water (both tap water and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs, and wells. As water travels over the surface of the land or through the ground, it dissolves naturally-occurring minerals and, in some cases, radioactive material, and can pick up substances resulting from the presence of animals or from human activity.

Cryptosporidium is a microbial pathogen found in surface water throughout the U.S. Although filtration removes cryptosporidium, the most commonly used filtration methods cannot guarantee 100 percent removal. Current test methods do not allow us to determine if the organisms are dead or if they are capable of causing disease. Ingestion of cryptosporidium may cause cryptosporidiosis, an abdominal infection. Symptoms of infection include

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nausea, diarrhea, and abdominal cramps. Most healthy individuals can overcome the disease within a few weeks. However, immuno-compromised people are at greater risk of developing life threatening illness. We encourage immuno-compromised individuals to consult their doctor regarding appropriate precautions to take to avoid infection. Cryptosporidium must be ingested to cause disease, and it may be spread through means other than drinking water. Guidelines on appropriate means to lessen the risk of infection by cryptosporidium and other microbial contaminants are available by calling the USEPA Safe Drinking Water Hotline (1-800-426-4791).

Primary Drinking Water Standards

Contaminants that may be present in the source water include:

Microbiological Contaminants, such as viruses and bacteria, which may come from sewage treatment plants, septic systems, agricultural livestock operations and wildlife. Treatment Techniques (TT) are used to ensure disinfection and inactivation of coliforms and waterborne pathogens. These include: turbidity removal and sufficient disinfectant residual concentrations and time of contact. We found no coliforms in our system in 1999.

Inorganic Contaminants, such as salts and metals, which can be naturally-occurring or result from urban stormwater runoff, industrial or domestic wastewater discharges, oil and gas production, mining or farming.

Sampling for all inorganic chemicals is required once every 12 months, except asbestos (required once every 9 years) and cyanide (requirement waived by the Department).

Lead and copper were last monitored in 1998 at consumer taps, as required by the Lead & Copper Rule. Private plumbing and fixtures may add lead or copper levels above the level delivered by the District. Hot water systems can contain elevated levels of lead and copper so it is not advisable to drink from hot water faucets. Selection of faucets and plumbing materials should be based on the use of approved materials for potable consumption and installed according to local building codes.

Radiological Contaminants, which are naturally occurring. The most recent radiological sampling of Camanche South Shore was performed in 1997.

Synthetic Organic Contaminants or Synthetic Organic Chemicals (SOCs) including pesticides and herbicides, which may come from a variety of sources such as agricultural and residential uses. The Department has waived monitoring of SOCs for Pardee Center.

Volatile Organic Contaminants or Volatile Organic Chemicals (VOCs) are by-products of industrial processes and petroleum production, and can also come from gas stations, urban stormwater runoff and septic systems. The latest monitoring in 1999 showed no detection of VOCs except Toluene.

Secondary Parameters include aesthetic qualities such as taste and odor and appearance. The clarity of the water can be measured by color, turbidity and aluminum content. Monitoring of parameters with secondary standards is not required by the Department.

Other Parameters include unregulated contaminants and general minerals and chemicals. Unregulated contaminant monitoring helps the EPA and the Department to determine where certain contaminants occur and whether the contaminants need to be regulated. General minerals and chemicals are monitored once a year as required by the Department.

Pardee Center 1999 Water Quality Data

The table below lists all the drinking water contaminants that we detected during the 1999 calendar year. The presence of thes e contaminants in the water does not necessarily indicate that the water poses a health risk. Unless otherwise noted, the data presented in this table is from test ing done January 1, through December 31, 1999. The Department requires us to monitor certain contaminants less than once per year because the concentration of these contamina nts are not expected to vary significantly from year to year. Some of the data, though representative of the water quality, is more than one year old.

PRIAMARY CONTAMINANTS	MCL	PHG (MCLG)	LEVEL FOUND	RANGE	SAMPLE DATE	TYPICAL SOURCES
Turbidity (NTU)	TT = 5 NTU	NS	0.25	N/A		Soil erosion
	TT=percentage of samples <0.5 NTU	NS	100%	N/A		
*Turbidity is a measure of the cloudiness of water. We monitor it because it is a good indicator of water quality. High turbidity can hinder the effectiveness of disinfectants.						
ORGANIC CONTAMINANTS						
Toluene	150	150	.85	0.8 – 0.93		Petroleum chemicals
COPPER AND LEAD						
Copper (mg/L)	AL = 1.3	0.17	90th percentile = 0.23	No sites above the AL out of 5 sites sampled	1998	Corrosion of household plumbing
Lead (µg/L)	AL = 15	2	90th percentile = 1.6	No sites above the AL out of 5 sites sampled	1998	Corrosion of household plumbing

SECONDARY PARAMETERS	MCL	AVERAGE	RANGE	TYPICAL SOURCES
Color (units)	15	5		Naturally occurring organic materials
Corrosivity	Non-corrosive	Non-corrosive		Natural or industrially-influenced balance of hydrogen, carbon and oxygen in the water; affected by temperature and other factors
Odor—Threshold (TON)	3	2		Naturally occurring organic materials
Total Dissolved Solids (mg/L)	1000	25		Runoff/leaching from natural deposits
Specific Conductance (µmho/cm)	1600	50	45 – 54	Substances that form ions when in water; seawater influence
Chloride (mg/L)	250	2.4		Runoff/leaching from natural deposits; seawater influence
Sulfate (mg/L)	500	1		Runoff/leaching from natural deposits; industrial wastes

UNREGULATED CONTAMINANTS	MCLG	AVERAGE	RANGE	TYPICAL SOURCES
Bromodichloromethane (µg/L)	0	1.8	1.7 – 2	By-product of drinking water chlorination
Chloroform (µg/L)	0	78	73 – 84	By-product of drinking water chlorination

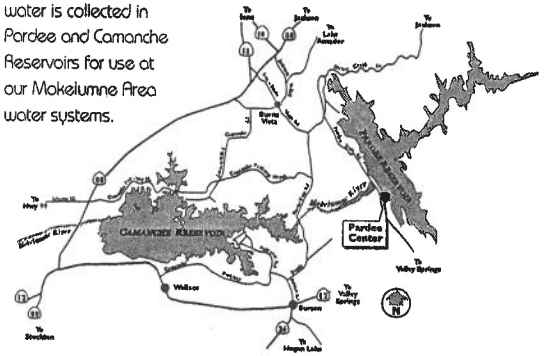
OTHER PARAMETERS	AVERAGE	RANGE	OTHER PARAMETERS	AVERAGE	RANGE
Alkalinity, bicarbonate (mg/L)	18		Magnesium (mg/L)	0.8	0.77 – 0.84
Calcium (mg/L)	3.9	3.8 – 4	Potassium (mg/L)	0.47	0.42 – 0.51
Hardness (mg/L)	12	12 – 13	Sodium (mg/L)	3.7	2.9 – 4.5

KEY

AL = Regulatory Action Level
MCL = Maximum Contaminant Level
MCLG = Maximum Contaminant Level Goal
mg/L = milligrams per liter, or parts per million (ppm)
N/A = Not Applicable
ND = Not Detected.
NS = No Standards
NTU = Nephelometric Turbidity Units
pCi/L = picoCuries per liter (a measure of radioactivity)
PHG = Public Health Goal
TON = Threshold Odor Number
TT = Treatment Technique
µmhos/cm = micro mhos per centimeter, measure of conductivity
µg/L = micrograms per liter, or parts per billion (ppb)
90th Percentile = 90% of samples had lower values than indicated

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High quality has always been the hallmark of EBMUD drinking water. It comes from snowmelt that flows from Alpine County high in the Sierra Nevada. Carried by the Mokelumne River, EBMUD water is collected in Pardee and Camanche Reservoirs for use at our Mokelumne Area water systems.



Water Supply

PardeeReservoir is the water source for Pardee Center. Water conservation is an integral part of water supply at Pardee Center. Pardee Center has a dual water distribution system. The non potable system serves the fire hydrants, irrigation system, and various other uses throughout Pardee Center. Average daily potable water use declined in 1998 to 3,669 gallons per day (gpd) from 5,817 gpd in 1997. Average daily potable water use in the spring and summer months of 1993 was 27,000 gpd (prior to the dual water distribution).

Water Quality

Compliance with state and federal regulations is determined through an extensive monitoring program in both the untreated water sources and in the treated water delivered to consumers. This ensures that EBMUD is consistently providing safe, high-quality drinking water. Water quality standards continue to be met with the exception of odor. Water quality data is listed in the attached table. Terms for understanding the tables include:

Primary Standards - These are the chemicals or characteristics of concern by state and federal regulations based on public health protection.

Secondary Standards - These are the chemicals or characteristics of concern by state and federal regulations based on aesthetics such as taste, odor, and color.

MTBE

Methl tertiary butyl ether (MTBE) is one of a group of chemicals known as fuel oxygenates required in gasoline by federal and state regulations. Drinking-water reservoirs can be contaminated by MTBE from leaking gas storage tanks and pipes, street runoff and motorboat outboard engines.

In 1998, the District initiated a program that replaced the high emission outboard engines used on its operational and rental boats, expanded its water quality monitoring for MTBE, participated in national and state efforts to control MTBE and other components in its drinking water and kept the public informed of these efforts through its outreach program. The program will be continued in 1999.

The expanded monitoring program detected MTBE in San Pablo, Pardee and Camanche Reservoirs. Average MTBE levels in San Pablo Reservoir were usually below 0.002 parts per million (ppm), and were about half the levels measured in 1997. Average levels in Pardee Reservoir were always under 0.0015 ppm, while average levels at Camanche Reservoir were all below 0.0035 ppm. When MTBE was detected in the treated drinking water delivered to customers from the San Pablo, Pardee and Camanche Reservoirs it was at levels almost 10 times lower than the 0.005 ppm secondary drinking water standard adopted by DOHS in January 1999 to avoid sensitive individuals from experiencing objectionable taste and odor. The MTBE levels in the treated drinking water were over 30 times lower than the primary drinking water standard DOHS is expected to adopt in 1999 to protect the health of drinking water consumers.

Water System Improvements

The corrosion control treatment process was placed in service in December, 1997 in order to comply with the lead and copper rule. The process uses soda ash for pH adjustment in the treated water. Lead and copper sample results have been in compliance since the system went on line. Planning is underway to replace the current water treatment facility that utilizes pressure filters with a state of the art membrane filter plant. A new water distribution reservoir will be part of this project. Please call Harold Roberson, Water Treatment/Distribution System Supervisor (209) 772-8368 for questions or comments about this water quality report.

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WATER QUALITY CONSTITUENT	UNITS	STATE MCLs	PHGs	RAW WATER MIN	RAW WATER MAX	TREATED WATER AVE	TREATED WATER MIN	TREATED WATER MAX
PRIMARY PARAMETERS								
Health-related Standards								
● Include primary MCLs, specific treatment techniques adopted in lieu of primary MCLs, and monitoring and reporting requirements for MCLs that are specified in regulation.								
● Coliforms are harmless bacteria common in the environment. Turbidity is considered a concern for bacteriological quality since particles in the water may hinder disinfection of organisms. Total coliforms were not detected in the water system in 1998.								
BACTERIOLOGICAL								
Turbidity	NTU	NS	NS	0.31	38	0.15	0.06	0.25
● "Average" for turbidity uses the highest 5% of the month.								
INORGANIC CHEMICALS								
● The following Inorganic Chemicals were monitored in 1998 and were not detected in any of the water samples: Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Cyanide, Lead, Mercury, Nickel, Nitrate, Nitrite, Selenium and Thallium. Sampling for all Inorganic Chemicals are required annually except nitrite (every 3 years) and asbestos (every 9 years). See "Waivers granted by Dept. of Health Services" below.[1]								
Fluoride	mg/L	2	1.4	NR	NR	ND	ND	ND
RADIOLOGICAL PARAMETERS								
● Radiological parameters were last monitored in 1995 and the following were not detected: Alpha activity and Uranium. DOHS has waived monitoring for radionuclides.								
VOLATILE ORGANIC CHEMICALS								
● Volatile Organic Chemicals (from gasoline, diesel, cleaning solvents, etc.) are monitored to determine sources of industrial, commercial and residential contamination. Their presence can pose a health threat since some are known or probable carcinogens. No detectable levels of VOCs were found in 1998, including methyl-tert-butyl-ether (MTBE). A Secondary Standard was established for MTBE in January 1999 with the MCL at 0.005 mg/L.								
SYNTHETIC ORGANIC CHEMICALS								
● Synthetic Organic Chemicals (pesticides, herbicides, etc.) are monitored to determine sources of industrial and agricultural contamination and none were detected in our waters. The following Synthetic Organic Chemicals were monitored in 1998 and were not detected in the water sources: Alachlor, Atrazine, Bentazon, Benzo(a) pyrene, 2,4-D, Dalapon, Di(2-ethylhexyl)adipate, Di(2-ethylhexyl)phthalate, Dinoseb, Glyphosate, Molinate, Pentachlorophenol, Picloram, Simazine, Thiobencarb, and 2,4,5-TP (Silvex). DOHS waived monitoring for all SOCs. See "Waivers granted by Dept. of Health Services" below.[1]								
SECONDARY PARAMETERS								
Aesthetic Standards								
● Secondary parameters include aesthetic qualities such as tastes and odors. The clarity of the water can be measured by color, turbidity and aluminum content. Copper[2], iron, manganese and zinc levels can affect the color of the water. High odor levels were attributed to high chlorine residuals. Without chlorine odors, they were well within the allowable level. Carbonate, hydroxide alkalinity, copper[2] and silver were not detected in 1998. See "Volatile Organic Chemicals" above for MTBE.								
Alkalinity, bicarbonate (HCO_3^- as $CaCO_3$)	mg/L	NS	NS	13	13	22	18	26
Boron	mg/L	NS	NS	NR	NR	7	5	8
Calcium (Ca)	mg/L	NS	NS	3	3	5	4	6
Chloride (Cl)	mg/L	250	NS	1	3	3	3	3
Color	units	15	NS	NR	NR	3	3	3
Foaming Agents (MBAs)	mg/L	0.5	NS	ND	ND	0.05	0.03	0.07
Hardness	mg/L	NS	NS	10	30	12	12	12
Iron (Fe)	mg/L	0.3	NS	NR	NR	0.03	0.02	0.03
Magnesium (Mg)	mg/L	NS	NS	1	1	11.6	7.4	15.8
Manganese (Mn)	mg/L	0.05	NS	NR	NR	0.001	0.001	0.001
Odor—Threshold	TON	3	NS	NR	NR	6	3	9
Potassium	mg/L	NS	NS	NR	NR	0.7	0.5	0.8
pH	pH units	NS	NS	7.1	7.6	7.6	7.6	7.6
Silica	mg/L	NS	NS	NR	NR	10.5	7.9	13.1
Sodium (Na)	mg/L	NS	NS	1	1	NR	NR	NR
Specific Conductance	µmho/cm	1600	NS	NR	NR	53	48	57
Sulfate	mg/L	500	NS	1	2	1	1	1
Total Dissolved Solids (TDS)	mg/L	1000	NS	21	21	70	70	70
Turbidity[3]	NTU	5	NS	0.31	38	0.07	ND	0.30
Zinc (Zn)	mg/L	5	NS	NR	NR	0.020	0.020	0.020

FOOTNOTES AND ABBREVIATIONS

[1] The California Department of Health Services (DOHS) waived sampling requirements for some Inorganic and most Synthetic Organic Chemicals (SOCs). DOHS' waiver process recognizes that water supply sources vary in sanitary conditions and vulnerability to contaminants. DOHS may grant waivers for water supply sources based on past analytical results, usage of particular contaminants on the watershed and vulnerability to contaminants on the watershed.

[2] The Lead and Copper Rule requires samples taken at customer taps and has no MCLs but "Action Levels" applied to the highest ten percent of the Lead and Copper results. Results completed in 1998 complied with the Lead and Copper Action Levels of 0.015 and 1.30 mg/L, respectively. State MCL for Copper is based on Secondary Standards.

Private plumbing and fixtures may add lead or copper levels above the level delivered by the District. Hot water systems can contain elevated levels of lead and copper so consuming from hot water faucets is not advisable. Selection of faucets and plumbing materials should be based on the use of approved materials for potable consumption and installed according to local building codes.

[3] Turbidity for Secondary Standards use all sample results, not only the highest 5 percent levels that are used for the Primary Standards.

DLR = Detection Levels for the purpose of Reporting. The minimum concentration at which a constituent in water can be found to be present as determined by the State Department of Health Services.

MCL = Maximum Contaminant Level is the highest level of a contaminant allowable for drinking water. MCLs are set as close to the PHGs and MCLGs as is economically and technologically feasible.

MCLG = Maximum Contaminant Level Goal is the level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs are set by the U.S. Environmental Protection Agency (USEPA).

mg/L = milligrams per liter or parts per million (to convert to parts per billion or micrograms per liter, multiply the value in milligrams per liter by 1,000).

ND = This means not detected.

NR = Not required for monitoring. See "DOHS' Waiver Process" above.

NS = No detection limit for reporting (DLR) or established state or federal standard (MCL).

NTU = Nepholometric Turbidity Unit, a measure of water clarity.

pCi/L = picoCuries per liter

PHG = Public Health Goal, which the State has determined as levels of contaminants in drinking water, based on human health risk assessments, that are protective of public health. PHGs may be determined without consideration of feasibility and detection limit. In those cases where the PHGs are less than the DLR, this report will give results in relation to the DLR, since the DLR is the feasible limit of measuring the contaminant.

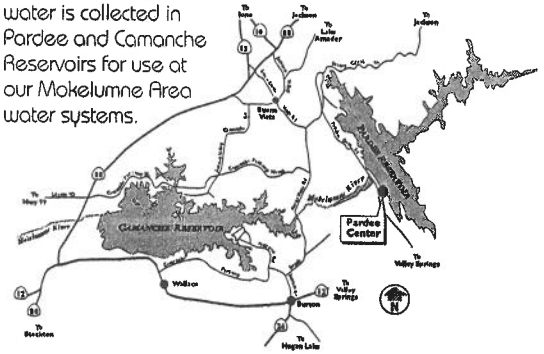
TON = Threshold Odor Number

µmho/cm = micro mhos per centimeter

EAST BAY MUNICIPAL UTILITY DISTRICT

PARDEE CENTER
1997 WATER QUALITY ANNUAL REPORT

High quality has always been the hallmark of EBMUD drinking water. It comes from snowmelt that flows from Alpine County high in the Sierra Nevada. Carried by the Mokelumne River, EBMUD water is collected in Pardee and Camanche Reservoirs for use at our Mokelumne Area water systems.



Water Supply

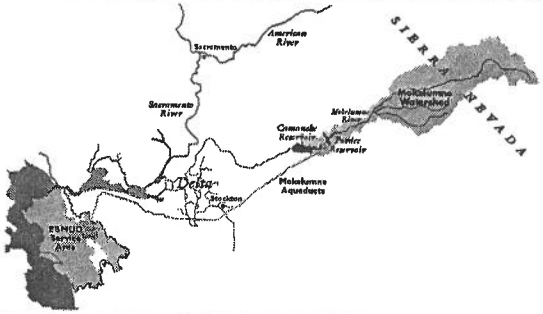
Pardee Reservoir is the water source for Pardee Center. Pardee Center has a dual water distribution system. The non potable system serves the fire hydrants, irrigation system, and various other uses throughout Pardee Center. Treated water use has declined dramatically since the new potable system was installed in 1994. The average daily treated water use for 1997 was 6,000 gallons per day (gpd). The average daily treated water use in the spring and summer months in 1993 was 27,000 gpd.

Water Quality

EBMUD Water Treatment Specialists operate the water system on a daily basis. The attached water quality report lists parameters that were monitored in 1997. Water quality standards continue to be met with the exception of odor due to chlorine in the water. Chlorine is used for disinfection. Chlorine residual in the water ranges from 0.5 mg/L to 1.0 mg/L. Please call the Pardee Water Quality Unit (209) 772-8266 with questions or comments about this water quality report.

Water System Improvements

A corrosion control study was completed in 1997. Soda ash was recommended to increase the pH of the treated water at Pardee Center. The new soda ash treatment system was placed in service in December 1997. A new state-of-the-art calcium hypochlorite disinfection system was tested at Pardee Center. This new system will be permanently installed in 1998.



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PARDEE CENTER
1997 ANNUAL WATER QUALITY REPORT

EBMUD

WATER QUALITY CONSTITUENT	UNITS	STATE MCLs	RAW WATER MIN	RAW WATER MAX	TREATED WATER AVE	TREATED WATER MIN	TREATED WATER MAX
PRIMARY PARAMETERS Health-related Standards							
BACTERIOLOGICAL							
• Coliforms are harmless bacteria common in the environment used as an indicator of possible contamination from human or animal wastes.							
• Turbidity is considered a concern for bacteriological quality since particles in the water may hinder disinfection of organisms.							
• Total coliforms were not detected in the water system in 1997.							
Turbidity	NTU	NS	0.31	38	0.15	0.06	0.25
• "Average" for turbidity uses the highest 5% of the month. NTU = Nephelometric Turbidity Units, a measure of clarity."							
INORGANIC CHEMICALS[a]							
• The following Inorganic chemicals were monitored in 1997 and were not detected in any of the water sources. Aluminum, Antimony, Barium, Beryllium, Cadmium, Chromium, Nickel, Nitrate, Nitrite and Thallium. Lead, Mercury and Selenium were last monitored in 1996. Sampling for all Inorganic Chemicals is required annually except nitrite (every 3 years), asbestos (every 9 years) and cyanide (waived until further notice by DOHS). See "Waivers granted by Dept. of Health Services" below.							
Fluoride (Fl)	mg/L	1.4	0.04	0.04	NR	NR	NR
RADIOLOGICAL PARAMETERS							
• Radiological parameters were last monitored in 1995 and the following were not detected: Alpha activity and Uranium.							
VOLATILE ORGANIC CHEMICALS							
• Volatile organic chemicals (from gasoline, diesel fuel, cleaning solvents, etc.) are monitored to determine sources of industrial, commercial and residential contamination. Their presence can pose a health threat since some are known or probable carcinogens. No detectable levels of VOCs were found in 1997, including methyl-tert-butyl-ether (MTBE). See "MTBE" below.							
SYNTHETIC ORGANIC CHEMICALS							
• Synthetic organic chemicals (pesticide, herbicides, etc.) are monitored to determine sources of industrial and agricultural contamination and none were detected in our waters. The following synthetic organic chemicals were monitored in 1997 and were not detected in any of the water sources: Alachlor, Atrazine, Bentazon, Benzo(a)pyrene, 2,4-D, Di(2-ethylhexyl)adipate, Di(2-ethylhexyl)phthalate, Dinoseb, Glyphosate, Molinate, Pentachlorophenol, Picloram, Simazine, Thiobencarb, and 2,4,5-TP (Silvex). DOHS waived monitoring for all above and the following SOCs, which were last monitored in 1995: Carbofuran, Chlordane, Dalapon, Dibromochloropropane, Diquat, Endothall, Endrin, Ethylene dibromide, Heptachlor, Heptachlor epoxide, Hexachlorobenzene, Hexachlorocyclopentadiene, Lindane, Methoxychlor, Oxamyl, Polychlorinated biphenyls (PCBs), 2,3,7,8-TCDD (Dioxin) and Toxaphene. See "Waivers granted by Dept. of Health Services" below.							
SECONDARY PARAMETERS Aesthetic Standards							
• Secondary parameters include aesthetic qualities such as tastes and odors. The clarity of the water can be measured by color, turbidity and aluminum content. Copper, iron, manganese and zinc levels can affect the color of the water. High odor levels were attributed to high chlorine residuals. Without chlorine odors, they were well within the allowable level. Carbonate, hydroxide alkalinity, copper and silver were not detected in 1997.							
Alkalinity, bicarbonate (as $CaCO_3$)	mg/L	NS	13	18	NR	NR	NR
Boron (B)	mg/L	NS	6.6	13.5	NR	NR	NR
Calcium (Ca)	mg/L	NS	2.8	3.6	4.1	3.2	5.6
Chloride (Cl)	mg/L	250	0.94	2	4.7	2.3	7.0
Color	units	15	NR	NR	NR	NR	NR
Foaming Agents (MBAs)	mg/L	0.5	ND	ND	NR	NR	NR
Hardness	mg/L	NS	9	14	13.8	12	25
Iron (Fe)	mg/L	0.3	ND	1	0.016	0.006	0.080
Magnesium (Mg)	mg/L	NS	0.93	1.4	1.2	1.1	1.3
Manganese (Mn)	mg/L	0.05	0.002	0.023	ND	ND	0.006
Odor – Threshold	TON	3	NR	NR	4	4	4
Potassium (K)	mg/L	NS	ND	ND	ND	ND	1.2
pH	pH units	NS	7.1	7.6	6.9	6.9	6.9
Silica	mg/L	NS	NR	NR	9.7	8.2	10.9
Sodium (Na)	mg/L	NS	15.9	20.1	1.8	1.5	2
Specific Conductance	µmho/cm	1600	NR	NR	50	50	50
Sulfate	mg/L	500	0.87	1.8	1.5	1.5	1.5
Total Dissolved Solids (TDS)	mg/L	1000	28	28	42	42	42
Turbidity[b]	NTU	5	0.31	38	0.07	ND	0.30
Zinc (Zn)	mg/L	5	ND	0.01	52	ND	0.26

FOOTNOTES AND ABBREVIATIONS

- Waivers granted by Dept. of Health Services (DOHS): DOHS' waiver process recognizes that water supply sources vary in sanitary conditions and vulnerability to contaminants. DOHS may grant waivers for water supply sources based on: past analytical results, usage of particular contaminants on the watershed and vulnerability for contamination on the watershed.

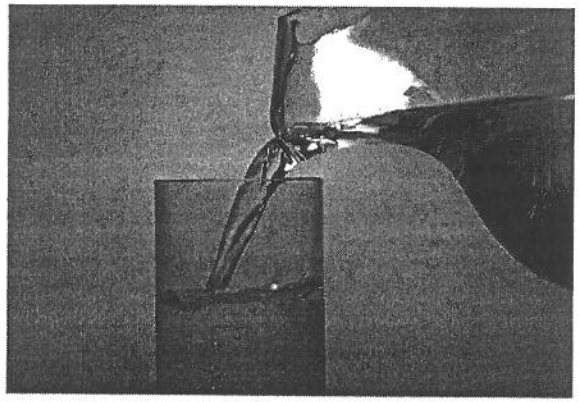
[a] Lead and Copper results shown in the table are from treated water samples. State MCL for Copper is based on Secondary Standards. Samples taken at customer taps as required by the Lead and Copper Rule had no MCLs but "Action Levels" applied to the highest ten percent of the Lead and Copper results. The Lead and Copper "Action Levels" were exceeded in 1996. New corrosion control measures were added in 1997.

[b] Turbidity for Secondary Standards use all results, not only the highest 5 percent levels used for the Primary Standards.

MCL = Maximum Contaminant Level
mg/L = milligrams per liter
ND = Not Detected by laboratory
NR = Not Required
NS = No Standard
NTU = Nephelometric Turbidity Unit(s)
TON = Threshold Odor Number
µg/L = micrograms per liter
µmhos/cm = micro mhos per centimeter

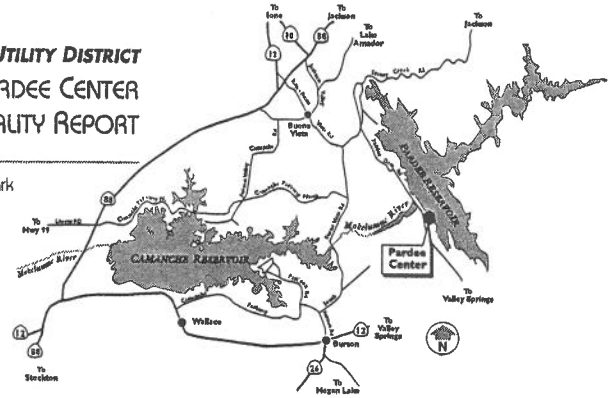
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PARDEE CENTER • VALLEY SPRINGS, CA 95252
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1996 ANNUAL WATER QUALITY REPORT



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High quality has always been the hallmark of EBMUD drinking water. It comes from snowmelt that flows from Alpine County high in the Sierra Nevada. Carried by the Mokelumne River, EBMUD water is collected in Pardee and Camanche Reservoirs for use at our Mokelumne Area water systems.



Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) was created to authorize Federal oversight of public water supply safety in the United States. It gives the U.S. Environmental Protection Agency the authority to establish regulations to ensure safe drinking water. The number of constituents in the water regulated by the SDWA has increased from 18 in 1975 to 84 in 1996. The California Department of Health Services is responsible for implementing the SDWA in California. There are two types of drinking water standards.

Primary Standards are related to the protection of public health against substances in water that may be harmful to humans if consumed for long periods of time.

Secondary Standards are based on aesthetic qualities of water such as taste and odor. These standards specify limits for substances that may influence consumer acceptance of the water.

1996 SDWA Amendments

The SDWA was amended in August, 1996. The regulatory process has been revised to include sound science, costs, benefits, and competing risks. Current regulations for fluoride, volatile organic chemicals, total coliforms, surface water treatment, phase II and phase V synthetic organic and inorganic constituents, and lead and copper remain basically unchanged. New deadlines have been established for the regulation of arsenic, sulfate, radon, disinfectants, and disinfection by-products, enhanced surface water treatment, and groundwater disinfection.

Water Quality

Water quality is monitored by EBMUD's highly skilled, state certified water treatment operators. Water quality standards continue to be met at Pardee Center for all primary and secondary standards with the exception of the lead and copper rule. A consultant has completed a corrosion control study that identifies treatment techniques at the water treatment plant which will make the water less aggressive This study is under review by EBMUD staff. Corrosion control measures should be implemented at the water treatment plant in 1997.

Water Conservation

Water conservation, especially the use of treated water, was greatly enhanced by the dual water distribution system at Pardee Center. A new potable water system was installed in 1994. The old water system became the non potable water system. This distribution system serves the fire hydrants and the irrigation system. Treated water use has declined dramatically. The average treated water use in the spring and summer of 1993 was 27,000 gallons compared with 9,000 gallons of treated water in the same months in 1996. Water treatment costs and water treatment operator time at the plant have been greatly reduced.

Please call the Pardee Water Quality Unit (209) 772-8266 with questions or comments about this report.

PARDEE CENTER
1996 ANNUAL WATER QUALITY REPORT

WATER QUALITY CONSTITUENT	UNITS	STATE MCLs	RAW WATER MIN	RAW WATER MAX	TREATED WATER AVE[a]	TREATED WATER MIN	TREATED WATER MAX
PRIMARY PARAMETERS Health-related Standards							
BACTERIOLOGICAL[c,d]							
Total Coliforms	%presence	1samp/mo[b]	NR	NR	ND	ND	ND
Turbidity	NTU	0.5	0.21	5.6	0.15	ND	0.26
INORGANIC CHEMICALS							
Aluminum (Al)[d]	µg/L	1,000	NR	NR	<65	<62	<66
Antimony (Sb)	µg/L	6	NR	NR	ND	ND	ND
Arsenic (As)	µg/L	50	NR	NR	ND	ND	ND
Asbestos (fibers > 10 microns)[e]	mf/L	7	NR	NR	ND	ND	ND
Barium (Ba)	µg/L	1,000	NR	NR	ND	ND	ND
Beryllium (Be)	µg/L	4	NR	NR	ND	ND	ND
Cadmium (Cd)	µg/L	5	NR	NR	ND	ND	ND
Chromium (Cr)	µg/L	50	NR	NR	ND	ND	ND
Cyanide (CN)	µg/L	200	NR	NR	ND	ND	ND
Lead (Pb)[f]	µg/L	NS	NR	NR	ND	ND	ND
Mercury (Hg)	µg/L	2	NR	NR	ND	ND	ND
Nickel (Ni)	µg/L	100	NR	NR	ND	ND	ND
Nitrate (as NO_3)	mg/L	45	NR	NR	ND	ND	ND
Nitrate+Nitrite as N	mg/L	10	NR	NR	ND	ND	ND
Nitrite (as N)	mg/L	1	NR	NR	ND	ND	ND
Selenium (Se)	µg/L	50	NR	NR	ND	ND	ND
Thallium (Tl)	µg/L	2	NR	NR	ND	ND	ND
Fluoride (F)	mg/L	1.4	NR	NR	NR	NR	NR
RADIOLOGICAL PARAMETERS[g]							
Radium 226 & 228	pCi/L	5	NR	NR	NR	NR	NR
Gross Alpha	pCi/L	15	NR	NR	NR	NR	NR
Tritium	pCi/L	20,000	NR	NR	NR	NR	NR
Strontium	pCi/L	8	NR	NR	NR	NR	NR
Gross Beta	pCi/L	50	NR	NR	NR	NR	NR
Uranium	pCi/L	20	NR	NR	NR	NR	NR
VOLATILE ORGANIC CHEMICALS							
Benzene	µg/L	1	ND	ND	ND	ND	ND
Carbon Tetrachloride	µg/L	0.5	ND	ND	ND	ND	ND
1,2-Dichlorobenzene (o-DCB)	µg/L	600	ND	ND	ND	ND	ND
1,4-Dichlorobenzene (p-DCB)	µg/L	5	ND	ND	ND	ND	ND
1,1-Dichloroethane (1,1-DCA)	µg/L	5	ND	ND	ND	ND	ND
1,2-Dichloroethane (1,2-DCA)	µg/L	0.5	ND	ND	ND	ND	ND
1,1-Dichloroethylene (1,1-DCE)	µg/L	6	ND	ND	ND	ND	ND
cis-1,2-Dichloroethylene (c-1,2-DCE)	µg/L	6	ND	ND	ND	ND	ND
trans-1,2-Dichloroethylene (t-1,2-DCE)	µg/L	10	ND	ND	ND	ND	ND
Dichloromethane (Methylene Chloride)	µg/L	5	ND	ND	ND	ND	ND
1,2-Dichloropropane	µg/L	5	ND	ND	ND	ND	ND
cis-1,3-Dichloropropene	µg/L	0.5	ND	ND	ND	ND	ND
trans-1,3-Dichloropropene	µg/L	0.5	ND	ND	ND	ND	ND
Ethylbenzene	µg/L	700	ND	ND	ND	ND	ND
Monochlorobenzene (Chlorobenzene)	µg/L	70	ND	ND	ND	ND	ND
Styrene	µg/L	100	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	µg/L	1	ND	ND	ND	ND	ND
Tetrachloroethylene (PCE)	µg/L	5	ND	ND	ND	ND	ND
Toluene	µg/L	150	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	µg/L	70	ND	ND	ND	ND	ND
1,1,1-Trichloroethane (1,1,1-TCA)	µg/L	200	ND	ND	ND	ND	ND
1,1,2-Trichloroethane (1,1,2-TCA)	µg/L	5	ND	ND	ND	ND	ND
Trichloroethylene (TCE)	µg/L	5	ND	ND	ND	ND	ND
Trichlorofluoromethane (Freon 11)	µg/L	150	ND	ND	ND	ND	ND
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	µg/L	1,200	ND	ND	ND	ND	ND
Vinyl Chloride (VC)	µg/L	0.5	ND	ND	ND	ND	ND
Xylenes (total)	µg/L	1,750	ND	ND	ND	ND	ND
SYNTHETIC ORGANIC CHEMICALS[h]							
Alachlor (Alanex)	µg/L	2	NR	NR	ND	ND	ND
Atrazine (Aatrex)	µg/L	3	NR	NR	ND	ND	ND
Bentazon (Basagran)	µg/L	18	NR	NR	ND	ND	ND
Benzo(a)pyrene	µg/L	0.2	NR	NR	ND	ND	ND
Carbofuran	µg/L	18	NR	NR	ND	ND	ND
Chlordane	µg/L	0.1	NR	NR	ND	ND	ND
2,4-D	µg/L	70	NR	NR	ND	ND	ND
Dalapon	µg/L	200	NR	NR	ND	ND	ND
1,2-Dibromo-3-chloropropane (DBCP)	µg/L	0.2	NR	NR	ND	ND	ND
Di(2-ethylhexyl)adipate	µg/L	400	NR	NR	ND	ND	ND
Di(2-ethylhexyl)phthalate	µg/L	4	NR	NR	ND	ND	ND
Dinoseb (DNBP)	µg/L	7	NR	NR	ND	ND	ND
Diquat	µg/L	20	NR	NR	ND	ND	ND
Endothall	µg/L	100	NR	NR	ND	ND	ND
Endrin	µg/L	0.2	NR	NR	ND	ND	ND
Ethylene Dibromide (EDB)	µg/L	0.05	NR	NR	ND	ND	ND
Glyphosate	µg/L	700	NR	NR	ND	ND	ND
Heptachlor	µg/L	0.01	NR	NR	ND	ND	ND
Heptachlor Epoxide	µg/L	0.01	NR	NR	ND	ND	ND
Hexachlorobenzene	µg/L	1	NR	NR	ND	ND	ND
Hexachlorocyclopentadiene	µg/L	50	NR	NR	ND	ND	ND
Lindane	µg/L	0.2	NR	NR	ND	ND	ND
Methoxychlor	µg/L	40	NR	NR	ND	ND	ND
Molinate	µg/L	20	NR	NR	ND	ND	ND
Oxamyl (Vydate)	µg/L	200	NR	NR	ND	ND	ND
Pentachlorophenol (PCP)	µg/L	1	NR	NR	ND	ND	ND
Picloram	µg/L	500	NR	NR	ND	ND	ND
Polychlorinated Biphenyls (PCB's)	µg/L	0.5	NR	NR	ND	ND	ND
Simazine	µg/L	4	NR	NR	ND	ND	ND
Thiobencarb	µg/L	70	NR	NR	ND	ND	ND
Toxaphene	µg/L	5	NR	NR	ND	ND	ND
2,3,7,8-TCDD (Dioxin)	pg/L	30	NR	NR	NR	NR	NR
2,4,5-TP (Silvex)	µg/L	50	NR	NR	ND	ND	ND
SECONDARY PARAMETERS Aesthetic Standards							
Alkalinity, bicarbonate (HCO_3^- as $CaCO_3$)	mg/L	NS	NR	NR	14	18	18
Alkalinity, carbonate ($CO_3^=$ as $CaCO_3$)	mg/L	NS	NR	NR	ND	ND	ND
Alkalinity, hydroxide (OH^- as $CaCO_3$)	mg/L	NS	NR	NR	ND	ND	ND
Boron	mg/L	NS	NR	NR	13	10.4	19
Calcium (Ca)	mg/L	NS	NR	NR	3.6	3.6	3.6
Chloride (Cl)	mg/L	250	1	2	4.4	4.4	4.4
Color	units	15	NR	NR	ND	ND	ND
Copper (Cu)[f]	µg/L	1,000	NR	NR	ND	ND	ND
Foaming Agents (MBAs)	mg/L	0.5	NR	NR	ND	ND	ND
Hardness	mg/L	NS	9	13	13	11	14
Iron (Fe)	µg/L	300	NR	NR	ND	ND	ND
Magnesium (Mg)	mg/L	NS	NR	NR	0.92	0.83	1.06
Manganese (Mn)	µg/L	50	NR	NR	ND	ND	ND
Odor---Threshold	TON	3	NR	NR	1	1	1
pH	pH units	NS	NR	NR	NR	NR	NR
Silica	mg/L	NS	NR	NR	8.9	8.3	9.9
Silver (Ag)	µg/L	100	NR	NR	ND	ND	ND
Sodium (Na)	mg/L	NS	NR	NR	1.7	1.6	1.8
Specific Conductance	µmho/cm	1,600	NR	NR	52	52	52
Sulfate	mg/L	500	NR	NR	1.4	1.4	1.4
Total Dissolved Solids (TDS)	mg/L	1,000	NR	NR	38	38	38
Turbidity[k]	NTU	5	0.21	5.6	0.10	ND	0.35
Zinc (Zn)	µg/L	5,000	NR	NR	0.16	0.03	182

NOTES AND ABBREVIATIONS

[a] Arithmetic average if sampled more than once annually.

[b] Greater than one positive sample per month for Total Coliforms would exceed MCLs on monthly reporting basis.

[c] Total Coliforms and Turbidity were reported from monthly averages of weekly and bi-hourly monitoring results, respectively. Turbidity (clarity) Primary Standard is based on the highest five percent of treated water samples. Thus, Turbidity in the "Average" is actually the highest five percent level. The maximum Turbidity value is based on highest treated level observed.

[d] Aluminum and Turbidity are regulated both with Primary and Secondary Standards.

[e] Asbestos sampled in 1995. Monitoring required once every nine years.

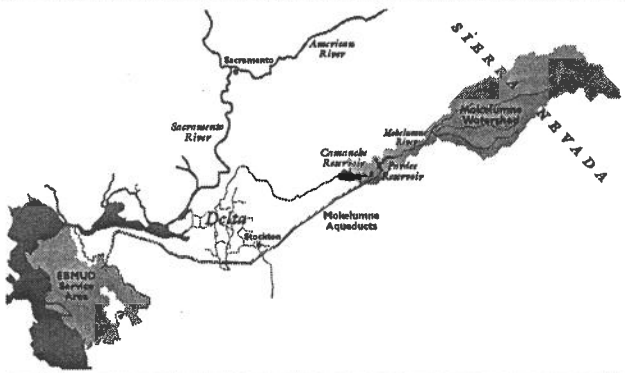
[f] Lead and Copper results shown on table from treated water samples. State MCL for Copper is based on Secondary Standards. Samples taken at customer taps as required by the Lead and Copper Rule had no MCLs but "Action Levels" applied to the highest ten percent of the Lead and Copper results. Results completed in 1996 exceeded the Action Levels for copper, requiring further corrosion treatment studies.

[g] Radiological results from sampling completed in 1994. Monitoring required every four years. Radium 226 & 228 not required if Gross Alpha is less than 5 pCi/L.

[h] Synthetic Organic Chemical results sampled in 1995, except for Alachlor, Atrazine, Molinate, Simazine and Thiobencarb.

[k] Secondary Standard for Turbidity based on maximum levels for treated water only, so Raw Water, Average or Minimum are given for information only.

1samp/mo = one sample per month that coliform organisms are detected.
MCL = Maximum Contaminent Level
NA = Not Analyzed by laboratory
ND = Not Detected by laboratory
NR = Not Required
NS = No Standard
NTU = Nephelometric Turbidity Unit(s)
mf/L = million fibers per liter
mg/L = milligrams per liter
pCi/L = picoCuries per liter
pg/L = picograms per liter
µg/L = micrograms per liter
µmho/cm = micro mhos per centimeter



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PARDEE CENTER
1995 ANNUAL WATER QUALITY REPORT

WATER QUALITY CONSTITUENT	UNITS	FEDERAL MCLs	STATE MCLs	AVE[a]	MIN	MAX
PRIMARY PARAMETERS Health-related Standards						
BACTERIOLOGICAL[c]						
Total Coliforms	%presence	1samp/mo[b]	1samp/mo[b]	ND	ND	ND
Turbidity	NTU	1	0.5	0.25	ND	3
INORGANIC CHEMICALS[d]						
Aluminum (Al)	µg/L	NS	1,000	ND	ND	ND
Antimony (Sb)	µg/L	6	6	ND	ND	ND
Arsenic (As)	µg/L	NS	50	ND	ND	ND
Asbestos (fibers > 10 microns)	mf/L	7	7	ND	ND	ND
Barium (Ba)	µg/L	2,000	1,000	ND	ND	ND
Beryllium (Be)	µg/L	4	4	ND	ND	ND
Cadmium (Cd)	µg/L	5	5	ND	ND	ND
Chromium (Cr)	µg/L	100	50	ND	ND	ND
Cyanide (CN)	µg/L	200	200	ND	ND	ND
Lead (Pb)[g]	µg/L	15	NS	ND	ND	ND
Mercury (Hg)	µg/L	2	2	ND	ND	ND
Nickel (Ni)	µg/L	NS	100	ND	ND	ND
Nitrate (as N)	mg/L	10	10	ND	ND	ND
Nitrate+Nitrite as N	mg/L	10	10	ND	ND	ND
Nitrite (as N)	mg/L	1	1	ND	ND	ND
Selenium (Se)	µg/L	0.05	50	ND	ND	ND
Thallium (Tl)	µg/L	0.002	2	ND	ND	ND
Fluoride (F^-)	mg/L	4	1.4	ND	ND	ND
RADIOLOGICAL PARAMETERS[f]						
Radium 226 & 228	pCi/L	5	5	NR	NR	NR
Gross Alpha	pCi/L	15	15	NR	NR	NR
Tritium	pCi/L	20,000	20,000	NR	NR	NR
Strontium	pCi/L	8	8	NR	NR	NR
Gross Beta	pCi/L	50	50	NR	NR	NR
Uranium	pCi/L	30	20	NR	NR	NR
VOLATILE ORGANIC CHEMICALS[e]						
Benzene	µg/L	5	1	ND	ND	ND
Carbon Tetrachloride	µg/L	5	0.5	ND	ND	ND
1,2-Dichlorobenzene (o-DCB)	µg/L	600	600	ND	ND	ND
1,4-Dichlorobenzene (p-DCB)	µg/L	75	5	ND	ND	ND
1,1-Dichloroethane (1,1-DCA)	µg/L	NS	5	ND	ND	ND
1,2-Dichloroethane (1,2-DCA)	µg/L	5	0.5	ND	ND	ND
1,1-Dichloroethylene (1,1-DCE)	µg/L	7	6	ND	ND	ND
cis-1,2-Dichlorethylene (c-1,2-DCE)	µg/L	7	6	ND	ND	ND
trans-1,2-Dichloroethylene (t-1,2-DCE)	µg/L	10	10	ND	ND	ND
Dichloromethane (Methylene Chloride)	µg/L	5	5	ND	ND	ND
1,2-Dichloropropane	µg/L	5	5	ND	ND	ND
cis-1,3-Dichloropropene	µg/L	NS	0.5	ND	ND	ND
trans-1,3-Dichloropropene	µg/L	700	0.5	ND	ND	ND
Ethylbenzene	µg/L	100	700	ND	ND	ND
Monochlorobenzene (Chlorobenzene)	µg/L	70	70	ND	ND	ND
Styrene	µg/L	100	100	ND	ND	ND
1,1,2,2-Tetrachloroethane	µg/L	1	1	ND	ND	ND
Tetrachloroethylene (PCE)	µg/L	100	5	ND	ND	ND
Toluene	µg/L	150	150	ND	ND	ND
1,2,4-Trichlorobenzene	µg/L	70	70	ND	ND	ND
1,1,1-Trichloroethane (1,1,1-TCA)	µg/L	5	200	ND	ND	ND
1,1,2-Trichloroethane (1,1,2-TCA)	µg/L	5	5	ND	ND	ND
Trichloroethylene (TCE)	µg/L	5	5	ND	ND	ND
Trichlorofluoromethane (Freon 11)	µg/L	150	150	ND	ND	ND
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	µg/L	100	1,200	ND	ND	ND
Vinyl Chloride (VC)	µg/L	2	0.5	ND	ND	ND
Xylenes (total)	µg/L	10,000	1,750	ND	ND	ND
SYNTHETIC ORGANIC CHEMICALS[e]						
Alachlor (Alanex)	µg/L	2	2	ND	ND	ND
Atrazine (Aatrex)	µg/L	3	3	ND	ND	ND
Bentazon (Basagran)	µg/L	NS	18	ND	ND	ND
Benzo(a)pyrene	µg/L	0.2	0.2	ND	ND	ND
Carbofuran	µg/L	40	18	ND	ND	ND
Chlordane	µg/L	2	0.1	ND	ND	ND
2,4-D	µg/L	70	70	ND	ND	ND
Dalapon	µg/L	200	200	ND	ND	ND
1,2-Dibromo-3-chloropropane (DBCP)	µg/L	0.2	0.2	ND	ND	ND
Di(2-ethylhexyl)adipate	µg/L	400	400	ND	ND	ND
Di(2-ethylhexyl)phthalate	µg/L	6	4	ND	ND	ND
Dinoseb (DNBP)	µg/L	7	7	ND	ND	ND
Diquat	µg/L	20	20	ND	ND	ND
Endothall	µg/L	100	100	ND	ND	ND
Endrin	µg/L	2	0.2	ND	ND	ND
Ethylene Dibromide (EDB)	µg/L	0.05	0.05	ND	ND	ND
Glyphosate	µg/L	700	700	ND	ND	ND

Water Quality Constituent	Units	Federal MCLs	State MCLs	Ave[a]	Min	Max
Synthetic Organic Chemicals[e] Continued						
Heptachlor	µg/L	0.4	0.01	ND	ND	ND
Heptachlor Epoxide	µg/L	0.2	0.01	ND	ND	ND
Hexachlorobenzene	µg/L	1	1	ND	ND	ND
Hexachlorocyclopentadiene	µg/L	50	50	ND	ND	ND
Lindane	µg/L	0.2	0.2	ND	ND	ND
Methoxychlor	µg/L	40	40	ND	ND	ND
Molinate	µg/L	20	20	ND	ND	ND
Oxamyl (Vydate)	µg/L	200	200	ND	ND	ND
Pentachlorophenol (PCP)	µg/L	1	1	ND	ND	ND
Picloram	µg/L	500	500	ND	ND	ND
Polychlorinated Biphenyls (PCB's)	µg/L	0.5	0.5	ND	ND	ND
Simazine	µg/L	4	4	ND	ND	ND
Thiobencarb	µg/L	NS	70	ND	ND	ND
Toxaphene	µg/L	3	5	ND	ND	ND
2,3,7,8-TCDD (Dioxin)	µg/L	0.00003	0.00003	NA	NA	NA
2,4,5-TP (Silvex)	µg/L	50	50	ND	ND	ND
Secondary Parameters[d] Aesthetic Standards						
Color	Color units	15	15	ND	ND	ND
Alkalinity (Bicarbonate)	mg/L	NS	NS	18	18	18
Alkalinity (Carbonate)	mg/L	NS	NS	ND	ND	ND
Copper (Cu)	µg/L	1300	1000	ND	ND	ND
Foaming Agents (MBAs)	mg/L	0.5	0.5	ND	ND	ND
Iron (Fe)	µg/L	300	300	ND	ND	ND
Manganese (Mn)	µg/L	50	50	ND	ND	ND
Odor—Threshold	TON	3	3	2	2	2
Silver (Ag)	µg/L	100	100	ND	ND	ND
Turbidity	NTU	1	0.5	0.25	0.16	0.40
Zinc (Zn)	µg/L	5,000	5,000	ND	ND	ND
Total Dissolved Solids (TDS)	mg/L	500	1,000	44	44	44
Specific Conductance	µmho/cm	NS	1,600	54	54	54
Chloride (Cl)	mg/L	NS	250	5.5	5.5	5.5
Sulfate	mg/L	250	500	2.2	2.2	2.2
Hydroxide Alkalinity	mg/L	NS	NS	ND	ND	ND
Calcium (Ca)	mg/L	NS	NS	4.68	4.68	4.68
Magnesium (Mg)	mg/L	NS	NS	1.29	1.29	1.29
Sodium (Na)	mg/L	NS	NS	2.2	2.2	2.2
Hardness	mg/L	NS	NS	18	18	18
Boron	mg/L	NS	NS	0.09	0.09	0.09
Silica	mg/L	NS	NS	10	10	10
pH	units	NS	NS	7.3	7.3	7.3

Pardee Center
1995 Annual Water Quality Report Continued

Footnotes and Abbreviations

[a] Arithmetic average if sampled more than once annually.

[b] Greater than one positive sample per month for Total Coliforms would exceed MCLs on monthly reporting basis.

[c] Total Coliforms and Turbidity reported from monthly averages of weekly and bi-hourly monitoring results, respectively.

[d] Inorganics sampled at treated water in the plant.

[e] Radionuclides, Volatile Organics and Synthetic Organic Chemicals sampled at sources.

[f] Radiological results from sampling completed in 1993. Monitoring required every four years. Radium 226 & 228 not required if Gross Alpha is less than 5 pCi/L.

[g] Lead and Copper samples taken at customer taps on April 6 and September 19, 1995 as required by Federal Lead and Copper Rule. State MCL for Copper based only on Secondary Standards (Aesthetics) in 1995.

MCL = Maximum Contaminant Level
NA = Not Analyzed by laboratory
ND = Not Detected by laboratory
NR = Not Required
NS = No Standard
NTU = Nephelometric Turbidity Unit(s)
mg/L = milligrams per liter
mf/L = million fibers per liter
pCi/L = picoCuries per liter
µg/L = micrograms per liter
µmho/cm = micro mhos per centimeter

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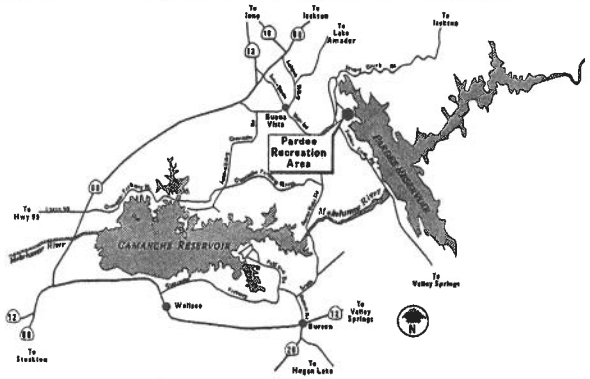
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EAST BAY MUNICIPAL UTILITY DISTRICT

PARDEE RECREATION AREA
1999 WATER QUALITY ANNUAL REPORT



Water System Information

This report includes information such as the source of water, its water quality and comparisons to State and Federal drinking water standards. This information is provided because informed customers are our best allies. For more information, please call Harold Roberson, Water Treatment/Distribution System Supervisor at 209-772-8368.

Source of Water

Pardee Reservoir is the water source for Pardee Recreation Area. The Recreation Area is served by a state-of-the-art ultrafiltration membrane water treatment facility. Ultrafiltration can remove particles as small as 0.01 microns, which is equivalent to 7,000 times smaller than the diameter of a human hair. Treatment includes membrane filtration and chlorination. A new 97,000-gallon tank also replaced the old distribution reservoir. Complying with regulations requires an extensive monitoring program in both the source and treated waters, which is approved by the California Department of Health Services (Department). Water quality regulations were met in 1999.

This report describes the results from sampling water for potential contaminants and gives you information on water related activities. In order to ensure that the water is safe to drink, the Department prescribes regulations which limit the amount of certain contaminants in water provided by public water systems. We treat the water according to the Department's regulations. The Department's regulations also establish limits for contaminants in bottled water that provide the same protection for public health.

Definitions

Maximum Contaminant Level (MCL): The highest level of a contaminant that is allowed in drinking water. Primary MCLs are set as close to the Public or Maximum Contaminant Level Goals as is economically and technologically feasible. Secondary MCLs are set to protect the odor, taste, and appearance of drinking water.

Maximum Contaminant Level Goal (MCLG): The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs are set by the U.S. Environmental Protection Agency (USEPA).

Public Health Goal (PHG): The level of a contaminant in drinking water below which there is no known or expected risk to health. PHGs are set by the California Environmental Protection Agency.

Primary Drinking Water Standard (PDWS): MCLs for contaminants that affect health along with their monitoring and reporting requirements, and water treatment requirements.

Regulatory Action Level (AL): The concentration of a contaminant which, if exceeded, triggers treatment or other requirements which a water system must follow.

Treatment Technique (TT): A required process intended to reduce the level of a contaminant in drinking water.

Educational Information

Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the EPA's Safe Drinking Water Hotline (1-800-426-4791).

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers.

The sources of drinking water (both tap water and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs, and wells. As water travels over the surface of the land or through the ground, it dissolves naturally-occurring minerals and, in some cases, radioactive material, and can pick up substances resulting from the presence of animals or from human activity.

Cryptosporidium is a microbial pathogen found in surface water throughout the U.S. Although filtration removes cryptosporidium, the most commonly used filtration methods cannot guarantee 100 percent removal. Current test methods do not allow us to determine if the organisms are dead or if they are capable of causing disease. Ingestion of cryptosporidium may cause cryptosporidiosis, an abdominal infection. Symptoms of infection include nausea, diarrhea, and abdominal cramps. Most healthy individuals can overcome the disease within a few weeks. However, immuno-compromised people are at greater risk of developing life threatening illness. We encourage immuno-compromised individuals to consult their doctor regarding appropriate precau-

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tions to take to avoid infection. Cryptosporidium must be ingested to cause disease, and it may be spread through means other than drinking water. Guidelines on appropriate means to lessen the risk of infection by cryptosporidium and other microbial contaminants are available by calling the USEPA Safe Drinking Water Hotline (1-800-426-4791).

Primary Drinking Water Standards

Contaminants that may be present in the source water include:

Microbiological Contaminants, such as viruses and bacteria, which may come from sewage treatment plants, septic systems, agricultural livestock operations and wildlife. Treatment Techniques (TT) are used to ensure disinfection and inactivation of coliforms and waterborne pathogens. These include: turbidity removal and sufficient disinfectant residual concentrations and time of contact. We found no coliforms in the system in 1999.

Inorganic Contaminants, such as salts and metals, which can be naturally-occurring or result from urban stormwater runoff, industrial or domestic wastewater discharges, oil and gas production, mining or farming.

Sampling for all inorganic chemicals is waived by the Department except for fluoride (once), nitrate (annually) and nitrite (once every three years).

Lead and copper were last monitored in 1995 at consumer taps, as required by the Lead & Copper Rule. Monitoring was waived by the Department for Lead and Copper at the consumer taps. Private plumbing and fixtures may add lead or copper levels above the level delivered by the District. Hot water systems can contain elevated levels of lead and copper so it is not advisable to drink from hot water faucets. Selection of faucets and plumbing materials should be based on the use of approved materials for potable consumption and installed according to local building codes.

Radiological Contaminants, which are naturally occurring. The Department has waived radiological monitoring for Pardee Recreation Area.

Synthetic Organic Contaminants or Synthetic Organic Chemicals (SOCs) including pesticides and herbicides, which may come from a variety of sources such as agricultural and residential uses. The Department has waived monitoring of SOCs for Pardee Recreation Area.

Volatile Organic Contaminants or Volatile Organic Chemicals (VOCs) are by-products of industrial processes and petroleum production, and can also come from gas stations, urban stormwater runoff and septic systems. The Department has waived monitoring of VOCs for Pardee Recreation Area.

Secondary Parameters include aesthetic qualities such as taste and odor and appearance. The clarity of the water can be measured by color, turbidity and aluminum content. Monitoring of secondary standards is waived by the Department, except Iron and Manganese were monitored once in 1997.

Other Parameters include unregulated contaminants and general minerals and chemicals. Unregulated contaminant monitoring helps the EPA and the Department to determine where certain contaminants occur and whether the contaminants need to be regulated.

Pardee Recreation Area 1999 Water Quality Data

The table below lists all the drinking water contaminants that we detected during the 1999 calendar year. The presence of thes e contaminants in the water does not necessarily indicate that the water poses a health risk. Unless otherwise noted, the data presented in this table is from test ing done January 1, through December 31, 1999. The Department requires us to monitor certain contaminants less than once per year because the concentration of these contamina nts are not expected to vary significantly from year to year. Some of the data, though representative of the water quality, is more than one year old.

PRIMARY CONTAMINANTS	MCL	PHG (MCLG)	LEVEL FOUND	RANGE	SAMPLE DATE	TYPICAL SOURCES
Turbidity (NTU)	TT = 5 NTU	NS	0.06	N/A		Soil erosion
	TT=percentage of samples <0.5 NTU	NS	100%	N/A		

*Turbidity is a measure of the cloudiness of water. We monitor it because it is a good indicator of water quality. High turbidity can hinder the effectiveness of disinfectants.

SECONDARY PARAMETERS	MCL	LEVEL FOUND	SAMPLE DATE	TYPICAL SOURCES
Corrosivity	Non-corrosive	Non-corrosive	February 1997	Natural or industrially-influenced balance of hydrogen, carbon and oxygen in the water; affected by temperature and other factors
Iron (µg/L)	300	9	February 1997	Municipal and industrial waste discharges
Manganese (µg/L)	50	0.6	February 1997	Leaching from natural deposits

UNREGULATED CONTAMINANTS	MCLG	AVERAGE	RANGE	TYPICAL SOURCES
Bromodichloromethane (µg/L)	0	1.8	1.7 – 2	By-product of drinking water chlorination
Chloroform (µg/L)	0	78	73 – 84	By-product of drinking water chlorination

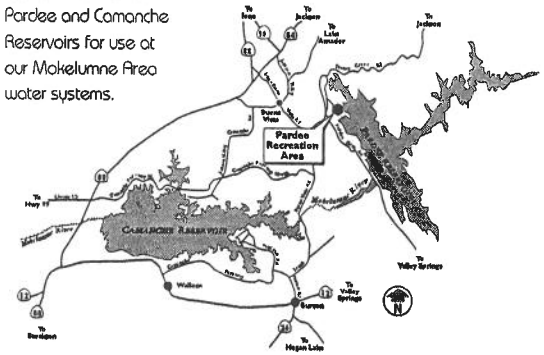
OTHER PARAMETERS	LEVEL FOUND	SAMPLE DATE	OTHER PARAMETERS	LEVEL FOUND	SAMPLE DATE
Alkalinity, bicarbonate (mg/L)	18	February 1997	Magnesium (mg/L)	1.3	February 1997
Calcium (mg/L)	4.1	February 1997	Sodium (mg/L)	5.4	February 1997
Hardness (mg/L)	13	February 1997			

KEY

MCL = Maximum Contaminant Level
MCLG = Maximum Contaminant Level Goal
mg/L = milligrams per liter, or parts per million (ppm)
NS = No Standards
NTU = Nephelometric Turbidity Units
PHG = Public Health Goal
TT = Treatment Technique
µg/L = micrograms per liter, or parts per billion (ppb)

EAST BAY MUNICIPAL UTILITY DISTRICT
PARDEE RECREATION AREA
1998 WATER QUALITY ANNUAL REPORT

High quality has always been the hallmark of EBMUD drinking water. It comes from snowmelt that flows from Alpine County high in the Sierra Nevada. Carried by the Mokelumne River, EBMUD water is collected in Pardee and Camanche Reservoirs for use at our Mokelumne Area water systems.



Water Supply

Pardee Reservoir is the water source for Pardee Recreation Area. The recreation area is served by a state of the art ultrafiltration membrane water treatment facility. Ultrafiltration can remove particles as small as 0.01 microns. This is equivalent to 7,000 times smaller than the diameter of a human hair.

Water Quality

Compliance with state and federal regulations is determined through an extensive monitoring program in both the untreated water sources and in the treated water delivered to consumers. This ensures that EBMUD is consistently providing safe, high-quality drinking water. Water quality standards continue to be met with the exception of odor. Water quality data is listed in the attached table. Terms for understanding the tables include:

Primary Standards - These are the chemicals or characteristics of concern by state and federal regulations based on public health protection.

Secondary Standards - These are the chemicals or characteristics of concern by state and federal regulations based on aesthetics such as taste, odor, and color.

MTBE

Methyl tertiary butyl ether (MTBE) is one of a group of chemicals known as fuel oxygenates required in gasoline by federal and state regulations. Drinking-water reservoirs can be contaminated by MTBE from leaking gas storage tanks and pipes, street runoff and motorboat outboard engines.

In 1998, the District initiated a program that replaced the high emission outboard engines used on its operational and rental boats, expanded its water quality monitoring for MTBE, participated in national and state efforts to control MTBE and other components in its drinking water and kept the public informed of these efforts through its outreach program. The program will be continued in 1999.

The expanded monitoring program detected MTBE in San Pablo, Pardee and Camanche Reservoirs. Average MTBE levels in San Pablo Reservoir were usually below 0.002 parts per million (ppm), and were about half the levels measured in 1997. Average levels in Pardee Reservoir were always under 0.0015 ppm, while average levels at Camanche Reservoir were all below 0.0035 ppm. When MTBE was detected in the treated drinking water delivered to customers from the San Pablo, Pardee and Camanche Reservoirs it was at levels almost 10 times lower than the 0.005 ppm secondary drinking water standard adopted by DOHS in January 1999 to avoid sensitive individuals from experiencing objectionable taste and odor. The MTBE levels in the treated drinking water were over 30 times lower than the primary drinking water standard DOHS is expected to adopt in 1999 to protect the health of drinking water consumers.

Water System Improvements

Plans are underway to construct a new distribution reservoir in 1999. Please call Harold Roberson, Water Treatment/Distribution System Supervisor (209) 772-8368 for questions or comments about this water quality report.

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1998 ANNUAL WATER QUALITY REPORT

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WATER QUALITY CONSTITUENT	UNITS	STATE MCLs	STATE PHGs	RAW WATER MIN	RAW WATER MAX	TREATED WATER AVE	TREATED WATER MIN	TREATED WATER MAX
PRIMARY PARAMETERS Health-related Standards								
● Include primary MCLs, specific treatment techniques adopted in lieu of primary MCLs, and monitoring and reporting requirements for MCLs that are specified in regulation.								
● Coliforms are harmless bacteria common in the environment. Turbidity is considered a concern for bacteriological quality since particles in the water may hinder disinfection of organisms. Total coliforms were not detected in the water system in 1998.								
BACTERIOLOGICAL								
Turbidity	NTU	NS	NS	0.36	3.6	0.03	0.02	0.05
● "Average" for turbidity uses the highest 5% of the month.								
INORGANIC CHEMICALS								
● The following Inorganic Chemicals were monitored in 1998 and were not detected in any of the water sources: Aluminum, Arsenic, Barium, Beryllium, Nitrate and Nitrite. Cadmium, Chromium, Cyanide, Lead, Mercury, Nickel, Selenium and Thallium were last monitored in 1996. Sampling for all Inorganic Chemicals are not required (waived) except nitrate (annually) and nitrite (every 3 years). Asbestos and cyanide were both waived until further notice by DOHS and were not detected when last sampled in 1995. See "Waivers granted by Dept. of Health Services" below.[1]								
Fluoride	mg/L	2	1.4	0.06	0.06	NR	NR	NR
RADIOLOGICAL PARAMETERS								
● Radiological parameters were last monitored in 1995 and following were not detected: Alpha activity and Uranium. DOHS granted waivers for more monitoring. See "Waivers granted by Dept. of Health Services" below.								
VOLATILE ORGANIC CHEMICALS								
● Volatile Organic Chemicals (from gasoline, diesel, cleaning solvents, etc.) are monitored to determine sources of industrial, commercial, recreational and residential contamination. Their presence can pose a health threat since some are known carcinogens (cancer-causing agents). One of 17 raw water samples was found to have detectable amounts of Methylene chloride in 1998. None of the 4 treated water samples had detectable amounts. None of the 21 samples had detectable amounts of MTBE, an unregulated chemical, in 1998. A Secondary Standard was established for MTBE in January 1999 with the MCL at 0.005 mg/L.								
Methylene Chloride	mg/L	0.005	zero*	ND	0.001	ND	ND	ND
* = "zero" for PHGs refer to the MCL Goals set by EPA.								
SYNTHETIC ORGANIC CHEMICALS								
● Synthetic Organic Chemicals (pesticides, herbicides, etc.) are monitored to determine sources of industrial and agricultural contamination and none were detected in our waters. The following Synthetic Organic Chemicals were monitored in 1997 and were not detected in any of the water sources: Benzo(a) pyrene, Di(2-ethylhexyl)adipate, Di(2-ethylhexyl)phthalate. DOHS waived monitoring for all SOCs. See "Waivers granted by Dept. of Health Services" below.[1]								
SECONDARY PARAMETERS Aesthetic Standards								
● Secondary parameters include aesthetic qualities such as tastes and odors. The clarity of the water can be measured by color, turbidity and aluminum content. Copper[2], iron, manganese and zinc levels can affect the color of the water. High odor levels were attributed to high chlorine residuals. Without chlorine odors, they were well within the allowable level. Carbonate and hydroxide alkalinity, copper, potassium, silver, zinc were not detected in 1998. DOHS requires monitoring for Secondary parameters every nine years. See "Volatile Organic Chemicals" above for MTBE.								
Alkalinity, Bicarbonate (HCO_3^- as $CaCO_3$)	mg/L	NS	NS	18	18	NR	NR	NR
Boron	mg/L	NS	NS	0.01	0.01	NR	NR	NR
Calcium (Ca)**	mg/L	NS	NS	NR	NR	4.1	4.1	4.1
Chloride (Cl)**	mg/L	250	NS	NR	NR	2.9	2.9	2.9
Color**	units	15	NS	NR	NR	3	3	3
Foaming Agents (MBAs)**	mg/L	0.5	NS	NR	NR	0.02	0.02	0.02
Iron (Fe)	mg/L	0.3	NS	0.06	0.05	NR	NR	NR
Hardness**	mg/L	NS	NS	NR	NR	13	13	13
Magnesium (Mg)**	mg/L	NS	NS	NR	NR	1.3	1.3	1.3
Manganese (Mn)**	mg/L	0.05	NS	NR	NR	0.001	0.001	0.001
Odor—Threshold**	TON	3	NS	NR	NR	4	4	4
pH**	pH units	NS	NS	NR	NR	7.3	7.3	7.3
Silica**	mg/L	NS	NS	NR	NR	12.4	12.4	12.4
Sodium (Na)**	mg/L	NS	NS	NR	NR	5.4	5.4	5.4
Specific Conductance**	µmho/cm	1600	NS	NR	NR	64	64	64
Sulfate**	mg/L	500	NS	NR	NR	1.7	1.7	1.7
Total Dissolved Solids (TDS)**	mg/L	1000	NS	NR	NR	46	46	46
Turbidity[3]**	NTU	5	NS	NR	NR	0.03	0.02	0.08
** = Results from 1997 sampling.								

FOOTNOTES AND ABBREVIATIONS

[1] The California Department of Health Services (DOHS) waived sampling requirements for some Inorganic and all Synthetic Organic Chemicals (SOCs). DOHS' waiver process recognizes that water supply sources vary in sanitary conditions and vulnerability to contaminants. DOHS may grant waivers for water supply sources based on past analytical results, usage of particular contaminants on the watershed and vulnerability to contaminants on the watershed.

[2] The Lead and Copper Rule requires samples taken at customer taps and has no MCLs but "Action Levels" applied to the highest ten percent of the Lead and Copper results. Results completed in 1995 complied with the Lead and Copper Action Levels of 0.015 and 1.30 mg/L, respectively. State MCL for Copper is based on Secondary Standards.

Private plumbing and fixtures may add lead or copper levels above the level delivered by the District. Hot water systems can contain elevated levels of lead and copper so consuming from hot water faucets is not advisable. Selection of faucets and plumbing materials should be based on the use of approved materials for potable consumption and installed according to local building codes.

[3] Turbidity for Secondary Standards use all sample results, not only the highest 5 percent levels that are used for the Primary Standards.

DLR = Detection Levels for the purpose of Reporting. The minimum concentration at which a constituent in water can be found to be present as determined by the State Department of Health Services.

MCL = Maximum Contaminant Level is the highest level of a contaminant allowable for drinking water. MCLs are set as close to the PHGs and MCLGs as is economically and technologically feasible.

MCLG = Maximum Contaminant Level Goal is the level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs are set by the U.S. Environmental Protection Agency (USEPA).

mg/L = milligrams per liter or parts per million (to convert to parts per billion or micrograms per liter, multiply the value in milligrams per liter by 1,000).

ND = This means not detected.

NR = Not required for monitoring. See "DOHS' Waiver Process" above.

NS = No detection limit for reporting (DLR) or established state or federal standard (MCL).

NTU = Nepholometric Turbidity Unit, a measure of water clarity.

pCi/l = picoCuries per liter

PHG = Public Health Goal, which the State has determined as levels of contaminants in drinking water, based on human health risk assessments, that are protective of public health. PHGs may be determined without consideration of feasibility and detection limit. In those cases where the PHGs are less than the DLR, this report will give results in relation to the DLR, since the DLR is the feasible limit of measuring the contaminant.

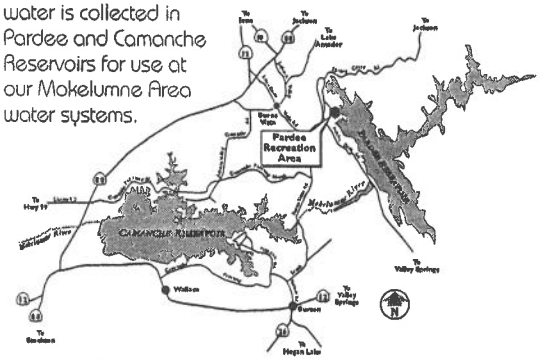
TON = Threshold Odor Number

µmho/cm = micro mhos per centimeter

EAST BAY MUNICIPAL UTILITY DISTRICT

PARDEE RECREATION AREA
1997 WATER QUALITY ANNUAL REPORT

High quality has always been the hallmark of EBMUD drinking water. It comes from snowmelt that flows from Alpine County high in the Sierra Nevada. Carried by the Mokelumne River, EBMUD water is collected in Pardee and Camanche Reservoirs for use at our Mokelumne Area water systems.



Water Supply

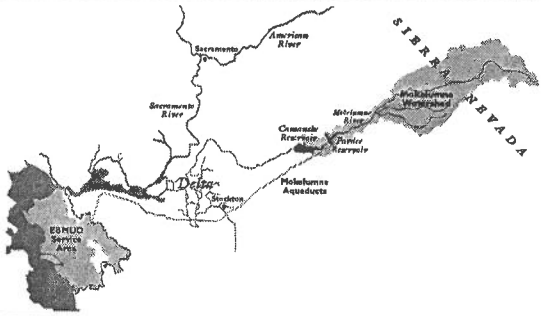
Pardee Reservoir is the water source for Pardee Recreation Area. The park is served by a state-of-the-art, ultrafiltration membrane water treatment plant. Ultrafiltration can remove particles as small as 0.01 microns. This is equivalent to 7,000 times smaller than the diameter of a human hair.

Water Quality

EBMUD Water Treatment Specialists operate the water system on a daily basis. The attached water quality report lists parameters that were monitored in 1997. Water quality standards continue to be met with the exception of odor due to chlorine in the water. Chlorine is used for disinfection. Chlorine residual in the water ranges from 0.5 mg/L to 1.0 mg/L. Please call the Pardee Water Quality Unit (209) 772-8266 with questions or comments about this water quality report.

Water System Improvements

A new floating pumps platform was installed in Pardee Reservoir in 1997. Two pumps are located on the platform which can draw water from depths of 30 feet below the water surface and 40 feet below the water surface.



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PARDEE RECREATION AREA
1997 ANNUAL WATER QUALITY REPORT

EBMUD

WATER QUALITY CONSTITUENT	UNITS	STATE MCLs	RAW WATER MIN	RAW WATER MAX	TREATED WATER AVE	TREATED WATER MIN	TREATED WATER MAX
PRIMARY PARAMETERS Health-related Standards							
BACTERIOLOGICAL							
• Coliforms are harmless bacteria common in the environment used as an indicator of possible contamination from human or animal wastes.							
• Turbidity is considered a concern for bacteriological quality since particles in the water may hinder disinfection of organisms.							
• Total coliforms were not detected in the water system in 1997.							
Turbidity	NTU	NS	0.36	100+	0.05	0.05	0.08
• "Average" for turbidity uses the highest 5% of the month. NTU = Nephelometric Turbidity Units, a measure of clarity.							
INORGANIC CHEMICALS[a]							
• The following Inorganic chemicals were monitored in 1997 and were not detected in any of the water sources: Aluminum, Barium, Beryllium, Nitrate and Nitrite. Cadmium, Chromium, Cyanide, Lead, Mercury Nickel, Selenium and Thallium were last monitored in 1996. Sampling for all Inorganic Chemicals is required annually except nitrite (every 3 years), asbestos (every 9 years) and cyanide (waived until further notice by DOHS). See "Waivers granted by Dept. of Health Services" below.							
RADIOLOGICAL PARAMETERS							
• Radiological parameters were last monitored in 1995 and the following were not detected: Alpha activity and Uranium. DOHS granted waivers for more monitoring. See "Waivers granted by Dept. of Health Services" below.							
VOLTILE ORGANIC CHEMICALS							
• Volatile organic chemicals (from gasoline, diesel fuel, cleaning solvents, etc.) are monitored to determine sources of industrial, commercial and residential contamination. Their presence can pose a health threat since some are known or probable carcinogens. No detectable levels of VOCs were found in 1997, including methyl-tert-butyl-ether (MTBE). See "MTBE" below.							
SYNTHETIC ORGANIC CHEMICALS							
• Synthetic organic chemicals (pesticide, herbicides, etc.) are monitored to determine sources of industrial and agricultural contamination and none were detected in our waters. The following synthetic organic chemicals were monitored in 1997 and were not detected in any of the water sources. Benzo(a) pyrene, Di(2-ethylhexyl)adipate, Di(2-ethylhexyl)phthalate. DOHS waived monitoring for above and Alachlor, Atrazine, Bentazon, 2,4-D, Carbofuran, Chlordane, Dalapon, Dibromochloropropane, Di(2-ethylhexyl)adipate, Di(2-ethylhexyl)phthalate, Dinoseb, Diquat, Endothall, Endrin, Ethylene dibromide, Glyphosate, Heptachlor, Heptachlor epoxide, Hexachlorobenzene, Hexachlorocyclopentadiene, Lindane, Molinate, Methoxychlor, Oxamyl, Pentachlorophenol, Picloram, Polychlorinated biphenyls (PCBs), Simazine, Thiobencarb, Toxaphene and 2,4,5-TP (Silvex). DOHS waived monitoring for all above and Dioxin in 1997. See "Waivers granted by Dept. of Health Services" below. Except Benzo(a) pyrene, Di(2-ethylhexyl)adipate, Di(2-ethylhexyl)phthalate, the above SOCs were last monitored in 1996.							
SECONDARY PARAMETERS Aesthetic Standards							
• Secondary parameters include aesthetic qualities such as tastes and odors. The clarity of the water can be measured by color, turbidity and aluminum content. Copper, iron, manganese and zinc levels can affect the color of the water. High odor levels were attributed to high chlorine residuals. Without chlorine odors, they were well within the allowable level. Carbonate, hydroxide alkalinity, iron, copper, potassium, silver, zinc were not detected in 1997.							
Alkalinity, bicarbonate (as $CaCO_3$)	mg/L	NS	NR	NR	18	18	18
Boron (B)	mg/L	NS	NR	NR	8.6	8.6	8.6
Calcium (Ca)	mg/L	NS	NR	NR	4.1	4.1	4.1
Chloride (Cl)	mg/L	250	NR	NR	2.9	2.9	2.9
Color	units	15	NR	NR	3	3	3
Foaming Agents (MBAs)	mg/L	0.5	NR	NR	0.02	0.02	0.02
Hardness	mg/L	NS	NR	NR	13	13	13
Magnesium (Mg)	mg/L	NS	NR	NR	1.3	1.3	1.3
Manganese (Mn)	mg/L	0.05	NR	NR	0.001	0.001	0.001
Odor – Threshold	TON	3	NR	NR	4	4	4
pH	pH units	NS	NR	NR	7.3	7.3	7.3
Silica	mg/L	NS	NR	NR	12.4	12.4	12.4
Sodium (Na)	mg/L	NS	NR	NR	5.4	5.4	5.4
Specific Conductance	µmho/cm	1600	NR	NR	64	64	64
Sulfate	mg/L	500	NR	NR	1.7	1.7	1.7
Total Dissolved Solids (TDS)	mg/L	1000	NR	NR	46	46	46
Turbidity[b]	NTU	5	NR	NR	0.03	0.02	0.08

FOOTNOTES AND ABBREVIATIONS

- Waivers granted by Dept. of Health Services (DOHS): DOHS' waiver process recognizes that water supply sources vary in sanitary conditions and vulnerability to contaminants. DOHS may grant waivers for water supply sources based on: past analytical results, usage of particular contaminants on the watershed and vulnerability for contamination on the watershed.

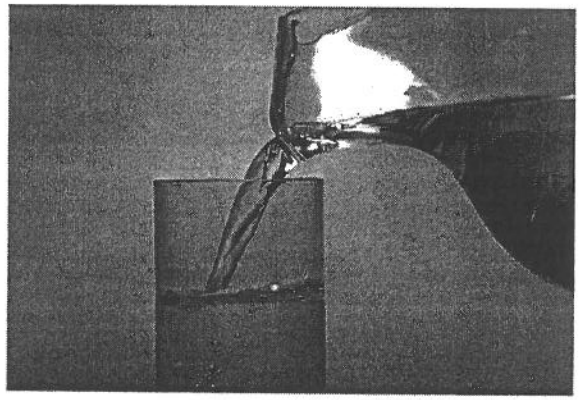
[a] Lead and Copper results shown in the table are from treated water samples. State MCL for Copper is based on Secondary Standards. Samples taken at customer taps as required by the Lead and Copper Rule had no MCLs but "Action Levels" applied to the highest ten percent of the Lead and Copper results. Results completed in 1994 and 1995 complied with the Action Levels.

[b] Turbidity for Secondary Standards use all results, not only the highest 5 percent levels used for the Primary Standards.

MCL = Maximum Contaminant Level
mg/L = milligrams per liter
ND = Not Detected by laboratory
NR = Not Required
NS = No Standard
NTU = Nephelometric Turbidity Unit(s)
TON = Threshold Odor Number
µg/L = micrograms per liter
µmhos/cm = micro mhos per centimeter

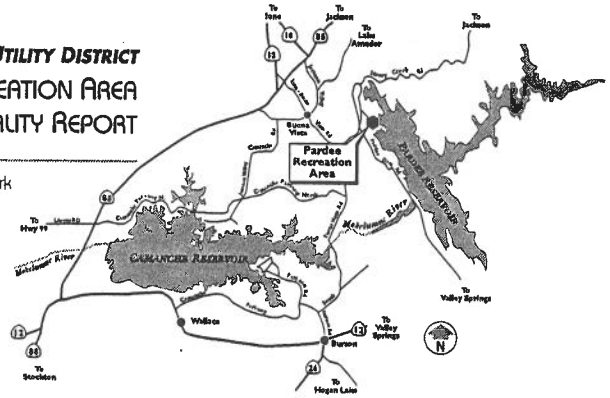
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PARDEE CENTER • VALLEY SPRINGS, CA 95252
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EAST BAY MUNICIPAL UTILITY DISTRICT
PARDEE RECREATION AREA
1996 ANNUAL WATER QUALITY REPORT



EAST BAY MUNICIPAL UTILITY DISTRICT
PARDEE RECREATION AREA
1996 ANNUAL WATER QUALITY REPORT

High quality has always been the hallmark of EBMUD drinking water. It comes from snowmelt that flows from Alpine County high in the Sierra Nevada. Carried by the Mokelumne River, EBMUD water is collected in Pardee and Camanche Reservoirs for use at our Mokelumne Area water systems.



Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) was created to authorize Federal oversight of public water supply safety in the United States. It gives the U.S. Environmental Protection Agency the authority to establish regulations to ensure safe drinking water. The number of constituents in the water regulated by the SDWA has increased from 18 in 1975 to 84 in 1996. The California Department of Health Services is responsible for implementing the SDWA in California. There are two types of drinking water standards.

Primary Standards are related to the protection of public health against substances in water that may be harmful to humans if consumed for long periods of time.

Secondary Standards are based on aesthetic qualities of water such as taste and odor. These standards specify limits for substances that may influence consumer acceptance of the water.

1996 SDWA Amendments

The SDWA was amended in August, 1996. The regulatory process has been revised to include sound science, costs, benefits, and competing risks. Current regulations for fluoride, volatile organic chemicals, total coliforms, surface water treatment, phase II and phase V synthetic organic and inorganic constituents, and lead and copper remain basically unchanged. New deadlines have been established for the regulation of arsenic, sulfate, radon, disinfectants, and disinfection by-products, enhanced surface water treatment, and groundwater disinfection.

Water Quality

The water source of Pardee Recreation Area is Pardee Reservoir. Water quality is monitored by EBMUD's highly skilled, state certified water treatment operators. Water quality standards continue to be met at Pardee Recreation Area for all primary and secondary standards. The park is served by a-state-of-the-art, ultrafiltration membrane water treatment plant. Ultrafiltration can remove particles as small as 0.01 microns. This is equivalent to 7,000 times smaller than the diameter of a human hair.

Water Conservation

Water conservation is extremely important at Pardee Recreation Area especially during the Spring and Summer months. EBMUD works closely with the Concessionaire for the most efficient landscape irrigation schedule for the common areas in the park. Homeowners can do their part by irrigating in the morning or in the evening when the air is still and evaporation is minimal. Water conservation literature and advice is available from the EBMUD water conservation office at (510) 287-0590.

Please call the Pardee Water Quality Unit (209) 772-8266 with questions or comments about this water quality report.

PARDEE RECREATION AREA
1996 ANNUAL WATER QUALITY REPORT

WATER QUALITY CONSTITUENT	UNITS	STATE MCLs	RAW WATER MIN	RAW WATER MAX	TREATED WATER AVE[a]	TREATED WATER MIN	TREATED WATER MAX
PRIMARY PARAMETERS Health-related Standards							
BACTERIOLOGICAL[c,d]							
Total Coliforms	%presence	1samp/mo[b]	NR	NR	ND	ND	ND
Turbidity	NTU	0.5	0.21	5	0.03	ND	0.04
INORGANIC CHEMICALS							
Aluminum (Al)[d]	µg/L	1,000	<62	<62	<66	<66	<66
Antimony (Sb)	µg/L	6	ND	ND	ND	ND	ND
Arsenic (As)	µg/L	50	ND	ND	ND	ND	ND
Asbestos (fibers > 10 microns)[e]	mf/L	7	ND	ND	ND	ND	ND
Barium (Ba)	µg/L	1,000	ND	ND	ND	ND	ND
Beryllium (Be)	µg/L	4	ND	ND	ND	ND	ND
Cadmium (Cd)	µg/L	5	ND	ND	ND	ND	ND
Chromium (Cr)	µg/L	50	ND	ND	ND	ND	ND
Cyanide (CN)	µg/L	200	ND	ND	ND	ND	ND
Lead (Pb)[f]	µg/L	NS	ND	ND	ND	ND	ND
Mercury (Hg)	µg/L	2	ND	ND	ND	ND	ND
Nickel (Ni)	µg/L	100	ND	ND	ND	ND	ND
Nitrate (as NO_3)	mg/L	45	ND	ND	ND	ND	ND
Nitrate+Nitrite as N	mg/L	10	ND	ND	ND	ND	ND
Nitrite (as N)	mg/L	1	ND	ND	ND	ND	ND
Selenium (Se)	µg/L	50	ND	ND	ND	ND	ND
Thallium (Tl)	µg/L	2	ND	ND	ND	ND	ND
Fluoride (F^-)	mg/L	1.4	NR	NR	NR	NR	NR
RADIOLOGICAL PARAMETERS[g]							
Radium 226 & 228	pCi/L	5	NR	NR	NR	NR	NR
Gross Alpha	pCi/L	15	NR	NR	NR	NR	NR
Tritium	pCi/L	20,000	NR	NR	NR	NR	NR
Strontium	pCi/L	8	NR	NR	NR	NR	NR
Gross Beta	pCi/L	50	NR	NR	NR	NR	NR
Uranium	pCi/L	20	NR	NR	NR	NR	NR
VOLATILE ORGANIC CHEMICALS							
Benzene	µg/L	1	ND	ND	ND	ND	ND
Carbon Tetrachloride	µg/L	0.5	ND	ND	ND	ND	ND
1,2-Dichlorobenzene (o-DCB)	µg/L	600	ND	ND	ND	ND	ND
1,4-Dichlorobenzene (p-DCB)	µg/L	5	ND	ND	ND	ND	ND
1,1-Dichloroethane (1,1-DCA)	µg/L	5	ND	ND	ND	ND	ND
1,2-Dichloroethane (1,2-DCA)	µg/L	0.5	ND	ND	ND	ND	ND
1,1-Dichloroethylene (1,1-DCE)	µg/L	6	ND	ND	ND	ND	ND
cis-1,2-Dichlorethylene (c-1,2-DCE)	µg/L	6	ND	ND	ND	ND	ND
trans-1,2-Dichloroethylene (t-1,2-DCE)	µg/L	10	ND	ND	ND	ND	ND
Dichloromethane (Methylene Chloride)	µg/L	5	ND	ND	ND	ND	ND
1,2-Dichloropropane	µg/L	5	ND	ND	ND	ND	ND
cis-1,3-Dichloropropene	µg/L	0.5	ND	ND	ND	ND	ND
trans-1,3-Dichloropropene	µg/L	0.5	ND	ND	ND	ND	ND
Ethylbenzene	µg/L	700	ND	ND	ND	ND	ND
Monochlorobenzene (Chlorobenzene)	µg/L	70	ND	ND	ND	ND	ND
Styrene	µg/L	100	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	µg/L	1	ND	ND	ND	ND	ND
Tetrachloroethylene (PCE)	µg/L	5	ND	ND	ND	ND	ND
Toluene	µg/L	150	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	µg/L	70	ND	ND	ND	ND	ND
1,1,1-Trichloroethane (1,1,1-TCA)	µg/L	200	ND	ND	ND	ND	ND
1,1,2-Trichloroethane (1,1,2-TCA)	µg/L	5	ND	ND	ND	ND	ND
Trichloroethylene (TCE)	µg/L	5	ND	ND	ND	ND	ND
Trichlorofluoromethane (Freon 11)	µg/L	150	ND	ND	ND	ND	ND
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	µg/L	1,200	ND	ND	ND	ND	ND
Vinyl Chloride (VC)	µg/L	0.5	ND	ND	ND	ND	ND
Xylenes (total)	µg/L	1,750	ND	ND	ND	ND	ND

WATER QUALITY CONSTITUENT	UNITS	STATE MCLs	RAW WATER MIN	RAW WATER MAX	TREATED WATER AVE[a]	TREATED WATER MIN	TREATED WATER MAX
SYNTHETIC ORGANIC CHEMICALS[h]							
Alachlor (Alanex)	µg/L	2	NR	NR	ND	ND	ND
Atrazine (Aatrex)	µg/L	3	NR	NR	ND	ND	ND
Bentazon (Basagran)	µg/L	18	NR	NR	ND	ND	ND
Benzo(a)pyrene	µg/L	0.2	NR	NR	ND	ND	ND
Carbofuran	µg/L	18	NR	NR	ND	ND	ND
Chlordane	µg/L	0.1	NR	NR	ND	ND	ND
2,4-D	µg/L	70	NR	NR	ND	ND	ND
Dalapon	µg/L	200	NR	NR	ND	ND	ND
1,2-Dibromo-3-chloropropane (DBCP)	µg/L	0.2	NR	NR	ND	ND	ND
Di(2-ethylhexyl)adipate	µg/L	400	NR	NR	ND	ND	ND
Di(2-ethylhexyl)phthalate	µg/L	4	NR	NR	ND	ND	ND
Dinoseb (DNBP)	µg/L	7	NR	NR	ND	ND	ND
Diquat	µg/L	20	NR	NR	ND	ND	ND
Endothall	µg/L	100	NR	NR	ND	ND	ND
Endrin	µg/L	0.2	NR	NR	ND	ND	ND
Ethylene Dibromide (EDB)	µg/L	0.05	NR	NR	ND	ND	ND
Glyphosate	µg/L	700	NR	NR	ND	ND	ND
Heptachlor	µg/L	0.01	NR	NR	ND	ND	ND
Heptachlor Epoxide	µg/L	0.01	NR	NR	ND	ND	ND
Hexachlorobenzene	µg/L	1	NR	NR	ND	ND	ND
Hexachlorocyclopentadiene	µg/L	50	NR	NR	ND	ND	ND
Lindane	µg/L	0.2	NR	NR	ND	ND	ND
Methoxychlor	µg/L	40	NR	NR	ND	ND	ND
Molinate	µg/L	20	NR	NR	ND	ND	ND
Oxamyl (Vydate)	µg/L	200	NR	NR	ND	ND	ND
Pentachlorophenol (PCP)	µg/L	1	NR	NR	ND	ND	ND
Picloram	µg/L	500	NR	NR	ND	ND	ND
Polychlorinated Biphenyls (PCB's)	µg/L	0.5	NR	NR	ND	ND	ND
Simazine	µg/L	4	NR	NR	ND	ND	ND
Thiobencarb	µg/L	70	NR	NR	ND	ND	ND
Toxaphene	µg/L	5	NR	NR	ND	ND	ND
2,3,7,8-TCDD (Dioxin)	pg/l	30	NR	NR	NR	NR	NR
2,4,5-TP (Silvex)	units	50	NR	NR	ND	ND	ND
SECONDARY PARAMETERS Aesthetic Standards							
Alkalinity, bicarbonate (HCO_3^- as $CaCO_3$)	mg/L	NS	16	16	20	20	20
Alkalinity, carbonate ($CO_3^=$ as $CaCO_3$)	µg/L	NS	ND	ND	ND	ND	ND
Alkalinity, hydroxide (OH^- as $CaCO_3$)	mg/L	NS	ND	ND	ND	ND	ND
Boron	mg/L	NS	10.7	10.7	11	11	11
Calcium (Ca)	mg/L	NS	4.2	4.2	3.8	3.8	3.8
Chloride (Cl)	mg/L	250	1	1	6.4	6.4	6.4
Color	mg/L	15	7	7	ND	ND	ND
Copper (Cu)[f]	mg/L	1,000	ND	ND	ND	ND	ND
Foaming Agents (MBAs)	µg/L	0.5	ND	ND	0.03	0.03	0.03
Hardness	µg/L	NS	15	15	13	13	13
Iron (Fe)	µg/L	300	ND	ND	ND	ND	ND
Magnesium (Mg)	mg/L	NS	1.3	1.3	1.1	1.1	1.1
Manganese (Mn)	µg/L	50	ND	ND	ND	ND	ND
Odor---Threshold	TON	3	1	1	2	2	2
pH	pH units	NS	NR	NR	NS	NS	NS
Silica	mg/L	NS	11.4	11.4	10.6	10.6	10.6
Silver (Ag)	µg/L	100	ND	ND	ND	ND	ND
Sodium (Na)	mg/L	NS	2	2	5.1	5.1	5.1
Specific Conductance	mg/L	1,600	49	49	60	60	60
Sulfate	mg/L	500	1.6	1.6	1.5	1.5	1.5
Total Dissolved Solids (TDS)	µmho/cm	1,000	33	33	43	43	43
Turbidity[k]	NTU	5	0.21	5	0.03	ND	0.23
Zinc (Zn)	mg/L	5,000	ND	ND	ND	ND	ND

FOOTNOTES AND ABBREVIATIONS

[a] Arithmetic average if sampled more than once annually.

[b] Greater than one positive sample per month for Total Coliforms would exceed MCLs on monthly reporting basis.

[c] Total Coliforms and Turbidity were reported from monthly averages of weekly and bi-hourly monitoring results, respectively. Turbidity (clarity) Primary Standard is based on the highest five percent of treated water samples. Thus, Turbidity in the "Average" is actually the highest five percent level. The maximum Turbidity value is based on highest treated level observed.

[d] Aluminum and turbidity are regulated both with Primary and Secondary standards.

[e] Asbestos sampled in 1995. Monitoring required once every nine years.

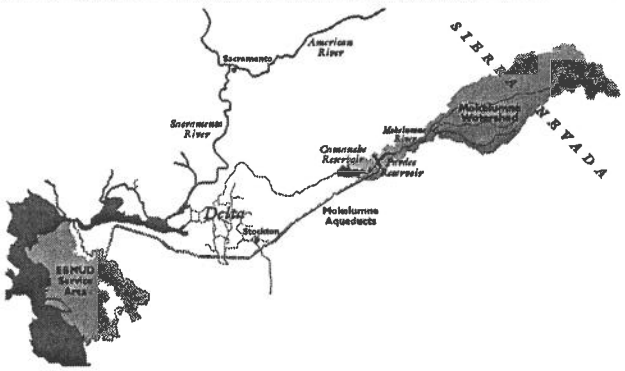
[f] Lead and Copper results shown on table from treated water samples. State MCL for Copper is based on Secondary Standards. Samples taken at customer taps as required by the Lead and Copper Rule had no MCLs but "Action Levels" applied to the highest ten percent of the Lead and Copper results. Results completed in 1994 complied with the Action Levels.

[g] Radiological results from sampling completed in 1994. Monitoring required every four years. Radium 226 & 228 not required if Gross Alpha is less than 5 pCi/L.

[h] Synthetic Organic Chemical results sampled in 1995, except for Alachlor, Atrazine, Molinate, Simazine and Thiobencarb.

[k] Secondary Standard for Turbidity based on maximum levels for treated water only, so Raw Water, Average or Minimum are given for information only.

1samp/mo = one sample per month that coliform organisms are detected.
MCL = Maximum Contaminent Level
NA = Not Analyzed by laboratory
ND = Not Detected by laboratory
NR = Not Required
NS = No Standard
NTU = Nephelometric Turbidity Unit(s)
mf/L = million fibers per liter
mg/L = milligrams per liter
pCi/L = picoCuries per liter
pg/L = picograms per liter
µg/L = micrograms per liter
µmho/cm = micro mhos per centimeter



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PARDEE RECREATION AREA
1995 ANNUAL WATER QUALITY REPORT

WATER QUALITY CONSTITUENT	UNITS	FEDERAL MCLs	STATE MCLs	AVE[a]	MIN	MAX
PRIMARY PARAMETERS Health-related Standards						
BACTERIOLOGICAL[c]						
Total Coliforms	%presence	1samp/mo[b]	1samp/mo[b]	ND	ND	ND
Turbidity	NTU	1	0.5	0.03	ND	0.08
INORGANIC CHEMICALS[d]						
Aluminum (Al)	µg/L	NS	1,000	ND	ND	ND
Antimony (Sb)	µg/L	6	6	ND	ND	ND
Arsenic (As)	µg/L	NS	50	ND	ND	ND
Asbestos (fibers > 10 microns)	mf/L	7	7	ND	ND	ND
Barium (Ba)	µg/L	2,000	1,000	ND	ND	ND
Beryllium (Be)	µg/L	4	4	ND	ND	ND
Cadmium (Cd)	µg/L	5	5	ND	ND	ND
Chromium (Cr)	µg/L	100	50	ND	ND	ND
Cyanide (CN)	µg/L	200	200	ND	ND	ND
Lead (Pb)[g]	µg/L	15	NS	ND	ND	ND
Mercury (Hg)	µg/L	2	2	ND	ND	ND
Nickel (Ni)	µg/L	NS	100	ND	ND	ND
Nitrate (as N)	mg/L	10	10	ND	ND	ND
Nitrate+Nitrite as N	mg/L	10	10	ND	ND	ND
Nitrite (as N)	mg/L	1	1	ND	ND	ND
Selenium (Se)	µg/L	50	50	ND	ND	ND
Thallium (Tl)	µg/L	2	2	ND	ND	ND
Fluoride (F-)	mg/L	4	1.4	ND	ND	ND
RADIOLOGICAL PARAMETERS[f]						
Radium 226 & 228	pCi/L	5	5	NR	NR	NR
Gross Alpha	pCi/L	15	15	NR	NR	NR
Tritium	pCi/L	20,000	20,000	NR	NR	NR
Strontium	pCi/L	8	8	NR	NR	NR
Gross Beta	pCi/L	50	50	NR	NR	NR
Uranium	µg/L	30	20	NR	NR	NR
VOLATILE ORGANIC CHEMICALS[e]						
Benzene	µg/L	5	1	ND	ND	ND
Carbon Tetrachloride	µg/L	5	0.5	ND	ND	ND
1,2-Dichlorobenzene (o-DCB)	µg/L	600	600	ND	ND	ND
1,4-Dichlorobenzene (p-DCB)	µg/L	75	5	ND	ND	ND
1,1-Dichloroethane (1,1-DCA)	µg/L	NS	5	ND	ND	ND
1,2-Dichloroethane (1,2-DCA)	µg/L	5	0.5	ND	ND	ND
1,1-Dichloroethylene (1,1-DCE)	µg/L	7	6	ND	ND	ND

WATER QUALITY CONSTITUENT	UNITS	FEDERAL MCLs	STATE MCLs	AVE[a]	MIN	MAX
VOLATILE ORGANIC CHEMICALS[e] Continued						
cis-1,2-Dichlorethylene (c-1,2-DCE)	µg/L	7	6	ND	ND	ND
trans-1,2-Dichloroethylene (t-1,2-DCE)	µg/L	10	10	ND	ND	ND
Dichloromethane (Methylene Chloride)	µg/L	5	5	ND	ND	ND
1,2-Dichloropropane	µg/L	5	5	ND	ND	ND
cis-1,3-Dichloropropene	µg/L	NS	0.5	ND	ND	ND
trans-1,3-Dichloropropene	µg/L	700	0.5	ND	ND	ND
Ethylbenzene	µg/L	100	700	ND	ND	ND
Monochlorobenzene (Chlorobenzene)	µg/L	70	70	ND	ND	ND
Styrene	µg/L	100	100	ND	ND	ND
1,1,2,2-Tetrachloroethane	µg/L	1	1	ND	ND	ND
Tetrachloroethylene (PCE)	µg/L	100	5	ND	ND	ND
Toluene	µg/L	150	150	ND	ND	ND
1,2,4-Trichlorobenzene	µg/L	70	70	ND	ND	ND
1,1,1-Trichloroethane (1,1,1-TCA)	µg/L	5	200	ND	ND	ND
1,1,2-Trichloroethane (1,1,2-TCA)	µg/L	5	5	ND	ND	ND
Trichloroethylene (TCE)	µg/L	5	5	ND	ND	ND
Trichlorofluoromethane (Freon 11)	µg/L	150	150	ND	ND	ND
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	µg/L	100	1,200	ND	ND	ND
Vinyl Chloride (VC)	µg/L	2	0.5	ND	ND	ND
Xylenes (total)	µg/L	10,000	1,750	ND	ND	ND
SYNTHETIC ORGANIC CHEMICALS[e]						
Alachlor (Alanex)	µg/L	2	2	ND	ND	ND
Atrazine (Aatrex)	µg/L	3	3	ND	ND	ND
Bentazon (Basagran)	µg/L	NS	18	ND	ND	ND
Benzo(a)pyrene	µg/L	0.2	0.2	ND	ND	ND
Carbofuran	µg/L	40	18	ND	ND	ND
Chlordane	µg/L	2	0.1	ND	ND	ND
2,4-D	µg/L	70	70	ND	ND	ND
Dalapon	µg/L	200	200	ND	ND	ND
1,2-Dibromo-3-chloropropane (DBCP)	µg/L	0.2	0.2	ND	ND	ND
Di(2-ethylhexyl)adipate	µg/L	400	400	ND	ND	ND
Di(2-ethylhexyl)phthalate	µg/L	6	4	ND	ND	ND
Dinoseb (DNBP)	µg/L	7	7	ND	ND	ND
Diquat	µg/L	20	20	ND	ND	ND
Endothall	µg/L	100	100	ND	ND	ND
Endrin	µg/L	2	0.2	ND	ND	ND
Ethylene Dibromide (EDB)	µg/L	0.05	0.05	ND	ND	ND
Glyphosate	µg/L	700	700	ND	ND	ND

Water Quality Constituent	Units	Federal MCLs	State MCLs	Ave[a]	Min	Max
Synthetic Organic Chemicals[e] Continued						
Heptachlor	µg/L	0.4	0.01	ND	ND	ND
Heptachlor Epoxide	µg/L	0.2	0.01	ND	ND	ND
Hexachlorobenzene	µg/L	1	1	ND	ND	ND
Hexachlorocyclopentadiene	µg/L	50	50	ND	ND	ND
Lindane	µg/L	0.2	0.2	ND	ND	ND
Methoxychlor	µg/L	40	40	ND	ND	ND
Molinate	µg/L	20	20	ND	ND	ND
Oxamyl (Vydate)	µg/L	200	200	ND	ND	ND
Pentachlorophenol (PCP)	µg/L	1	1	ND	ND	ND
Picloram	µg/L	500	500	ND	ND	ND
Polychlorinated Biphenyls (PCB's)	µg/L	0.5	0.5	ND	ND	ND
Simazine	µg/L	4	4	ND	ND	ND
Thiobencarb	µg/L	NS	70	ND	ND	ND
Toxaphene	µg/L	3	5	ND	ND	ND
2,3,7,8-TCDD (Dioxin)	µg/L	0.00003	0.00003	NR	NR	NR
2,4,5-TP (Silvex)	units	50	50	ND	ND	ND
Secondary Parameters[d] Aesthetic Standards						
Color	Color units	15	15	ND	ND	ND
Alkalinity (Bicarbonate)	mg/L	NS	NS	14	14	14
Alkalinity (Carbonate)	mg/L	NS	NS	ND	ND	ND
Copper (Cu)	µg/L	1,300	1,000	ND	ND	ND
Foaming Agents (MBAs)	mg/L	0.5	0.5	NR	NR	NR
Iron (Fe)	µg/L	300	300	ND	ND	ND
Manganese (Mn)	µg/L	50	50	ND	ND	ND
Odor—Threshold	TON	3	3	2	2	2
Silver (Ag)	µg/L	100	100	ND	ND	ND
Turbidity	NTU	1	0.5	0.03	ND	0.08
Zinc (Zn)	µg/L	5,000	5,000	ND	ND	ND
Total Dissolved Solids (TDS)	mg/L	500	1,000	44	44	44
Specific Conductance	µmho/cm	NS	1,600	52	52	52
Chloride (Cl)	mg/L	NS	250	6.5	6.5	6.5
Sulfate	mg/L	250	500	2.1	2.1	2.1
Hydroxide Alkalinity	mg/L	NS	NS	ND	ND	ND
Calcium (Ca)	mg/L	NS	NS	4.1	4.1	4.1
Magnesium (Mg)	mg/L	NS	NS	1.2	1.2	1.2
Sodium (Na)	mg/L	NS	NS	2.2	2.2	2.2
Hardness	mg/L	NS	NS	16	16	16
Boron	mg/L	NS	NS	0.013	0.013	0.013
Silica	mg/L	NS	NS	10.7	10.7	10.7
pH	units	NS	NS	7.2	7.2	7.2

Pardee Recreation Area
1995 Annual Water Quality Report Continued

Footnotes and Abbreviations

[a] Arithmetic average if sampled more than once annually.

[b] Greater than one positive sample per month for Total Coliforms would exceed MCLs on monthly reporting basis.

[c] Total Coliforms and Turbidity reported from monthly averages of weekly and bi-hourly monitoring results, respectively.

[d] Inorganics sampled at treated water in the plant.

[e] Radionuclides, Volatile Organics and Synthetic Organic Chemicals sampled at sources.

[f] Radiological results from sampling completed in 1993. Monitoring required every four years. Radium 226 & 228 not required if Gross Alpha is less than 5 pCi/L.

[g] Lead and Copper samples taken at customer taps on September 19 and November 28, 1995 as required by Federal Lead and Copper Rule. State MCL for Copper based only on Secondary Standards (Aesthetics) in 1995.

MCL = Maximum Contaminant Level
NA = Not Analyzed by laboratory
ND = Not Detected by laboratory
NR = Not Required
NS = No Standard
NTU = Nephelometric Turbidity Unit(s)
mg/L = milligrams per liter
mf/L = million fibers per liter
pCi/L = picoCuries per liter
µg/L = micrograms per liter
µmho/cm = micro mhos per centimeter

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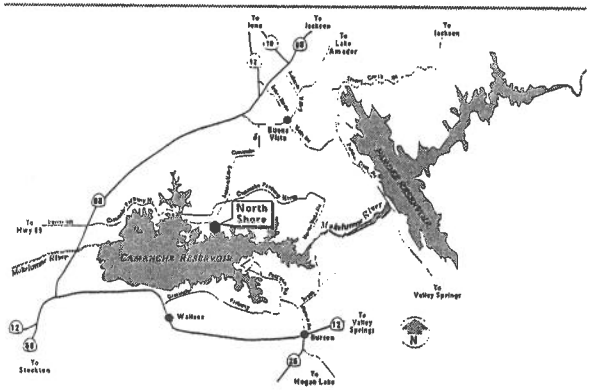
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EAST BAY MUNICIPAL UTILITY DISTRICT

CAMANCHE NORTH SHORE 1999 WATER QUALITY ANNUAL REPORT



Water System Information

This report includes information such as the source of water, its water quality and comparisons to State and Federal drinking water standards. This information is provided because informed customers are our best allies. For more information, please call Harold Roberson, Water Treatment/Distribution System Supervisor at 209-772-8368.

Source of Water

Three deep wells are the water sources for Camanche North Shore Recreation Area. Water is treated at Camanche North Shore Water Treatment Facility. Treatment includes: chlorination, permanganate addition, and filtration. Complying with regulations requires an extensive monitoring program in both the source and treated waters. Water quality regulations were met in 1999, with the exception of one sample for odor.

This report describes the results from sampling water for potential contaminants and gives you information on water related activities. In order to ensure that the water is safe to drink, the California Department of Health Services (Department) prescribes regulations which limit the amount of certain contaminants in water provided by public water systems. We treat the water according to the Department's regulations. The Department's regulations also establish limits for contaminants in bottled water that provide the same protection for public health.

Definitions

Maximum Contaminant Level (MCL): The highest level of a contaminant that is allowed in drinking water. Primary MCLs are set as close to the Public Health Goals (PHGs) or Maximum Contaminant Level Goals (MCLGs) as is economically and technologically feasible. Secondary MCLs are set to protect the odor, taste, and appearance of drinking water.

Maximum Contaminant Level Goal (MCLG): The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs are set by the U.S. Environmental Protection Agency (EPA).

Public Health Goal (PHG): The level of a contaminant in drinking water below which there is no known or expected risk to health. PHGs are set by the California Environmental Protection Agency.

Primary Drinking Water Standard (PDWS): MCLs for contaminants that affect health along with their monitoring and reporting requirements, and water treatment requirements.

Regulatory Action Level (AL): The concentration of a contaminant which, if exceeded, triggers treatment or other requirements which a water system must follow.

Treatment Technique (TT): A required process intended to reduce the level of a contaminant in drinking water.

Educational Information

Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the EPA's Safe Drinking Water Hotline (1-800-426-4791).

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers.

The sources of drinking water (both tap water and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs, and wells. As water travels over the surface of the land or through the ground, it dissolves naturally-occurring minerals and, in some cases, radioactive material, and can pick up substances resulting from the presence of animals or from human activity.

Cryptosporidium is a microbial pathogen found in surface water throughout the U.S. Although filtration removes cryptosporidium, the most commonly used filtration methods cannot guarantee 100 percent removal. Current test methods do not allow us to determine if the organisms are dead or if they are capable of causing disease. Ingestion of cryptosporidium may cause cryptosporidiosis, an abdominal infection. Symptoms of infection include nausea, diarrhea, and abdominal cramps. Most healthy individuals can overcome the disease within a few weeks. However, immuno-compromised people are at greater risk of developing life threatening illness. We encourage immuno-compromised individuals to consult their doctor regarding appropriate precautions to take to avoid infection. Cryptosporidium must be ingested to cause disease, and it may be spread through means other than drinking water.

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Guidelines on appropriate means to lessen the risk of infection by cryptosporidium and other microbial contaminants are available by calling the USEPA Safe Drinking Water Hotline (1-800-426-4791).

Primary Drinking Water Standards

Contaminants that may be present in the source water include:

Microbiological Contaminants, such as viruses and bacteria, which may come from sewage treatment plants, septic systems, agricultural livestock operations and wildlife. Treatment Techniques (TT) are used to ensure disinfection and inactivation of coliforms and waterborne pathogens. These include: turbidity removal and sufficient disinfectant residual concentrations and time of contact. We found no coliforms in our system in 1999.

Inorganic Contaminants, such as salts and metals, which can be naturally-occurring or result from urban stormwater runoff, industrial or domestic wastewater discharges, oil and gas production, mining or farming.

Sampling for all inorganic chemicals is required once every 36 months, except asbestos (required once every 9 years) and cyanide (requirement waived by the Department). Fluoride samples were taken from the source waters.

Lead and copper were last monitored in 1998 at consumer taps, as required by the Lead & Copper Rule. Private plumbing and fixtures may add lead or copper levels above the level delivered by the District. Hot water systems can contain elevated levels of lead and copper so it is not advisable to drink from hot water faucets. Selection of faucets and plumbing materials should be based on the use of approved materials for potable consumption and installed according to local building codes.

Radiological Contaminants, which are naturally occurring. The most recent radiological sampling of source water was performed in 1998.

Synthetic Organic Contaminants or Synthetic Organic Chemicals (SOCs) including pesticides and herbicides which may come from a variety of sources such as agricultural and residential uses. SOCs are monitored to determine sources of industrial and agricultural contamination. Atrazine and Simazine are monitored once every six years and were not detected during the last monitoring in 1999. The Department waived monitoring requirements for the remaining SOCs.

Volatile Organic Contaminants or Volatile Organic Chemicals (VOCs) are by-products of industrial processes and petroleum production, and can also come from gas stations, urban stormwater runoff and septic systems. The latest monitoring occurred in 1998 and no detectable levels of VOCs (including MTBE) were found. The Department requires monitoring of VOCs once every 72 months.

Secondary Parameters include aesthetic qualities such as taste and odor and appearance. The clarity of the water can be measured by color, turbidity and aluminum content. Monitoring of secondary standards is required once every 36 months except Thiobencarb which is waived by the Department. Samples were taken from treated water.

Other Parameters include unregulated contaminants and general minerals and chemicals. Unregulated contaminant monitoring helps the EPA and the Department to determine where certain contaminants occur and whether the contaminants need to be regulated.

Camanche North Shore 1999 Water Quality Data

The table below lists all the drinking water contaminants that we detected during the 1999 calendar year. The presence of thes e contaminants in the water does not necessarily indicate that the water poses a health risk. Unless otherwise noted, the data presented in this table is from test ing done January 1 through December 31, 1999. The Department requires us to monitor certain contaminants less than once per year because the concentration of these contamina nts is not expected to vary significantly from year to year. Some of the data, though representative of the water quality, is more than one year old.

PRIMARY CONTAMINANTS	MCL	PHG (MCLG)	LEVEL FOUND	RANGE	SAMPLE DATE	TYPICAL SOURCES
Turbidity (NTU)	TT = 5 NTU	NS	0.2	N/A		Soil erosion
	TT=percentage of samples <0.5 NTU	NS	100%	N/A		
*Turbidity is a measure of the cloudiness of water. We monitor it because it is a good indicator of water quality. High turbidity can hinder the effectiveness of disinfectants.						
INORGANIC CONTAMINANTS						
Fluoride (mg/L)	2	1	0.13	0.12 – 0.14		Erosion of natural deposits
RADIOLOGICAL CONTAMINANTS						
Alpha activity (pCi/L)	15	(0)	2.4	ND – 8	1998	Erosion of natural deposits
Radium 226 & 228 (pCi/L)	5	(0)	1.5	1–2	1998	Erosion of natural deposits
LEAD						
Lead (µg/L)	AL = 15	2	90th percentile = 4.5	No site above AL out of 5 sites sampled.	1998	Corrosion of household plumbing

SECONDARY PARAMETERS	MCL	AVERAGE	RANGE	SAMPLE DATE	VIOLATION	TYPICAL SOURCES
Color (units)	15	3				Naturally-occurring organic materials
Corrosivity	Non-corrosive	Non-corrosive				Natural or industrially-influenced balance of hydrogen, carbon and oxygen in the water; affected by temperature and other factors
Foaming Agents (MBAS) (µg/L)	500	42				Municipal and industrial waste discharges
Manganese (µg/L)	50	7.9	7.5 – 8.3			Leaching from natural deposits
Odor–Threshold (TON)	3	5	3 – 8	March 23, 1999	YES*	Naturally occurring organic materials
Total Dissolved Solids (mg/L)	1000	290				Runoff/leaching from natural deposits
Specific Conductance (µmho/cm)	1600	374				Substances that form ions when in water; seawater influence
Chloride (mg/L)	250	7				Runoff/leaching from natural deposits; seawater influence
Sulfate (mg/L)	500	33				Runoff/leaching from natural deposits; industrial wastes

*Odor was found at levels that exceeded the secondary MCL of 3 Threshold Number (TON); the odor MCL was set to protect you against unpleasant aesthetic odor and violating this MCL does not pose a risk to public health.

OTHER PARAMETERS*	LEVEL FOUND	OTHER PARAMETERS*	LEVEL FOUND
Alkalinity, bicarbonate (mg/L)	139	Sodium (mg/L)	28.4
Alkalinity, carbonate (mg/L)	1	Hardness (mg/L)	120
Calcium (mg/L)	38.2	Boron (mg/L)	0.1
Magnesium (mg/L)	9.3	Potassium (mg/L)	10.3

*One sample collected during 1999 from treated water.

KEY

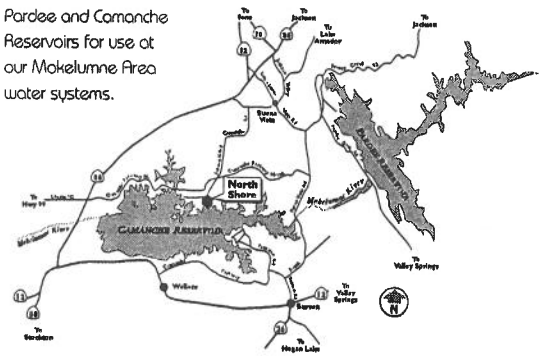
AL = Regulatory Action Level	**ND** = Not Detected.	**TON** = Threshold Odor Number
MCL = Maximum Contaminant Level	**NS** = No Standards	**TT** = Treatment Technique
MCLG = Maximum Contaminant Level Goal	**NTU** = Nephelometric Turbidity Units	**µg/L** = micrograms per liter, or parts per billion (ppb)
mg/L = milligrams per liter, or parts per million (ppm)	**pCi/L** = picoCuries per liter (a measure of radioactivity)	**µmhos/cm** = micro mhos per centimeter (measure of conductivity)
N/A = Not Applicable	**PHG** = Public Health Goal	**90th Percentile** = 90% of samples had lower values than indicated

EAST BAY MUNICIPAL UTILITY DISTRICT

CAMANCHE NORTH SHORE

1998 WATER QUALITY ANNUAL REPORT

High quality has always been the hallmark of EBMUD drinking water. It comes from snowmelt that flows from Alpine County high in the Sierra Nevada. Carried by the Mokelumne River, EBMUD water is collected in Pardee and Camanche Reservoirs for use at our Mokelumne Area water systems.



Water Supply

Well #3 has been the workhorse for Camanche North Shore for the past few years. Well #4, drilled in 1997, received a permit for use from the California Department of Health Services (DOHS) in 1998. Well #4 has been automated and has a well head chlorination system for odor control. This new well should dramatically improve the water supply for Camanche North Shore. Well #2 remains a backup supply. Well #1 is a non potable source that is used for landscape irrigation for the lawn area near the main office. Finally, water conservation continues to be an important part of water supply at Camanche North Shore.

Water Quality

Compliance with state and federal regulations is determined through an extensive monitoring program in both the untreated water sources and in the treated water delivered to consumers. This ensures that EBMUD is consistently providing safe, high-quality drinking water. Water quality standards continue to be met with the exception of odor. Water from well #3 and well #4 has hydrogen sulfide which is typical of groundwater in the Camanche area. Water quality data is listed in the attached table. Terms for understanding the tables include:

Primary Standards - These are the chemicals or characteristics of concern by state and federal regulations based on public health protection.

Secondary Standards - These are the chemicals or characteristics of concern by state and federal regulations based on aesthetics such as taste, odor, and color.

MTBE

Methyl tertiary butyl ether (MTBE) is one of a group of chemicals known as fuel oxygenates required in gasoline by federal and state regulations. Drinking-water reservoirs can be contaminated by MTBE from leaking gas storage tanks and pipes, street runoff and motorboat outboard engines.

In 1998, the District initiated a program that replaced the high emission outboard engines used on its operational and rental boats, expanded its water quality monitoring for MTBE, participated in national and state efforts to control MTBE and other components in its drinking water and kept the public informed of these efforts through its outreach program. The program will be continued in 1999.

The expanded monitoring program detected MTBE in San Pablo, Pardee and Camanche Reservoirs. Average MTBE levels in San Pablo Reservoir were usually below 0.002 parts per million (ppm), and were about half the levels measured in 1997. Average levels in Pardee Reservoir were always under 0.0015 ppm, while average levels at Camanche Reservoir were all below 0.0035 ppm. When MTBE was detected in the treated drinking water delivered to customers from the San Pablo, Pardee and Camanche Reservoirs it was at levels almost 10 times lower than the 0.005 ppm secondary drinking water standard adopted by DOHS in January 1999 to avoid sensitive individuals from experiencing objectionable taste and odor. The MTBE levels in the treated drinking water were over 30 times lower than the primary drinking water standard DOHS is expected to adopt in 1999 to protect the health of drinking water consumers.

Water System Improvements

In addition to automation of well #4, water treatment optimization has improved the odor of the treated water in 1998. Water quality staff will continue to improve the taste and odor of the treated water in 1999. Planning is also underway for a new water distribution reservoir for the system. Please call Harold Roberson, Water Treatment/Distribution System Supervisor (209) 772-8368 for questions or comments about this water quality report.

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CAMANCHE NORTH SHORE
1998 ANNUAL WATER QUALITY REPORT
(INCLUDING WELLS #2, 3 & 4)

WATER QUALITY CONSTITUENT	UNITS	STATE MCLs	STATE PHGs	RAW WATER MIN	RAW WATER MAX	TREATED WATER AVE	TREATED WATER MIN	TREATED WATER MAX
PRIMARY PARAMETERS Health-related Standards								
● Include primary MCLs, specific treatment techniques adopted in lieu of primary MCLs, and monitoring and reporting requirements for MCLs that are specified in regulation.								
BACTERIOLOGICAL								
● Coliforms are harmless bacteria common in the environment. Total coliforms were not detected in the water system in 1998.								
INORGANIC CHEMICALS								
● The following Inorganic Chemicals were monitored in 1998 and were not detected in any of the water sources: Aluminum, Arsenic, Beryllium, Cadmium, Chromium, Mercury, Nickel, Nitrate, Nitrite and Selenium. Antimony, Nickel and Thallium were last monitored in 1997. Sampling for all Inorganic Chemicals are required every three years, except asbestos (every 9 years) and cyanide (waived until further notice by DOHS). See "Waivers granted by Dept. of Health Services" below.[1]								
Barium (Ba)	mg/L	1	NS	0.133	0.133	ND	ND	ND
Fluoride	mg/L	2	1.4	0.14	0.15	0.14	0.14	0.14
RADIOLOGICAL PARAMETERS								
● Radiological parameters were monitored in 1998 and the following were not detected: Uranium.								
Alpha activity	pCi/L	15	NS	0.8	4	NR	NR	NR
Radium 226 & 228	pCi/L	5	NS	ND	2	NR	NR	NR
VOLATILE ORGANIC CHEMICALS								
● Volatile Organic Chemicals (from gasoline, diesel, cleaning solvents, etc.) are monitored to determine sources of industrial, commercial residential contamination. Their presence can pose a health threat since some are known or probable carcinogens. No detectable levels of VOCs were found in 1998. MTBE was monitored at all wells and was not detected. A Secondary Standard for MTBE was established in January 1999 with the MCL at 0.005 mg/L.								
SYNTHETIC ORGANIC CHEMICALS								
● Synthetic Organic Chemicals (pesticides, herbicides, etc.) are monitored to determine sources of industrial and agricultural contamination and none were detected in our waters. The following Synthetic Organic Chemicals were monitored in 1998 and were not detected in any of the water sources: Alachlor, Atrazine, Bentazon, 2,4-D, Dalapon, Dinoseb, Molinate, Pentachlorophenol, Picloram, Simazine, Thiobencarb, and 2,4,5-TP (Silvex). Except Atrazine and Simazine, DOHS waived monitoring for all above and other SOCs. See "Waivers granted by Dept. of Health Services" below.[1]								
SECONDARY PARAMETERS Aesthetic Standards								
● Secondary parameters include aesthetic qualities such as tastes and odors. The clarity of the water can be measured by color, turbidity and aluminum content. Copper[2], iron, manganese and zinc levels can affect the color of the water. High odor levels were attributed to high sulfur odors. Treatment for removal of sulfur has been improved in 1998. Aluminum, Copper, Hydroxide alkalinity, foaming agents (detergents) and Silver were not detected in 1998. DOHS requires monitoring for secondary parameters every three years. See "Volatile Organic Chemicals" above for MTBE.								
Alkalinity, bicarbonate (HCO_3^- as $CaCO_3$)*	mg/L	NS	NS	83	83	169	169	169
Alkalinity, carbonate ($CO_3^=$ as $CaCO_3$)*	mg/L	NS	NS	ND	ND	1	1	1
Boron	mg/L	NS	NS	NR	NR	0.1	0.1	0.1
Calcium (Ca)	mg/L	NS	NS	41.5	41.5	40.9	38.4	43.3
Chloride (Cl)*	mg/L	250	NS	13	13	9.5	5.9	13
Color	units	15	NS	NR	NR	2	2	2
Copper (Cu)[2]	mg/L	1	0.17	ND	ND	ND	ND	ND
Hardness*	mg/L	NS	NS	76	76	150	150	150
Iron (Fe)	mg/L	0.3	NS	0.007	0.007	ND	ND	ND
Magnesium (Mg)	mg/L	NS	NS	9.6	9.6	9.4	9.1	9.6
Manganese (Mn)	mg/L	0.05	NS	0.371	0.371	0.014	0.003	0.024
Odor—Threshold	TON	3	NS	NR	NR	26	1	50
Potassium	mg/L	NS	NS	9.4	9.4	8.5	7.6	9.4
pH*	pH units	NS	NS	7.7	7.7	7.9	7.9	7.9
Silica	mg/L	NS	NS	NR	NR	72.8	72.2	73.3
Sodium (Na)	mg/L	NS	NS	27.4	27.4	27.3	26.8	27.7
Specific Conductance*	µmho/cm	1600	NS	310	310	444	444	444
Sulfate*	mg/L	500	NS	47	47	46	46	46
Total Dissolved Solids (TDS)*	mg/L	1000	NS	240	240	340	340	340
Turbidity[3]	NTU	5	NS	4.3	4.3	0.04	0.04	0.04
Zinc (Zn)	mg/L	5	NS	ND	ND	0.01	0.01	0.01

* = Results from 1997 sampling.

FOOTNOTES AND ABBREVIATIONS

[1] The California Department of Health Services (DOHS) waived sampling requirements for some Inorganic and most Synthetic Organic Chemicals (SOCs). DOHS' waiver process recognizes that water supply sources vary in sanitary conditions and vulnerability to contaminants. DOHS may grant waivers for water supply sources based on past analytical results, usage of particular contaminants on the watershed and vulnerability to contaminants on the watershed.

[2] The Lead and Copper Rule requires samples taken at customer taps and has no MCLs but "Action Levels" applied to the highest ten percent of the Lead and Copper results. Results completed in 1998 complied with the Lead and Copper Action Levels of 0.015 and 1.30 mg/L, respectively. State MCL for Copper is based on Secondary Standards.

Private plumbing and fixtures may add lead or copper levels above the level delivered by the District. Hot water systems can contain elevated levels of lead and copper so consuming from hot water faucets is not advisable. Selection of faucets and plumbing materials should be based on the use of approved materials for potable consumption and installed according to local building codes.

[3] Turbidity for Secondary Standards use all sample results, not only the highest 5 percent levels that are used for the Primary Standards.

DLR = Detection Levels for the purpose of Reporting. The minimum concentration at which a constituent in water can be found to be present as determined by the State Department of Health Services.

MCL = Maximum Contaminant Level is the highest level of a contaminant allowable for drinking water. MCLs are set as close to the PHGs and MCLGs as is economically and technologically feasible.

MCLG = Maximum Contaminant Level Goal is the level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs are set by the U.S. Environmental Protection Agency (USEPA).

mg/L = milligrams per liter or parts per million (to convert to parts per billion or micrograms per liter, multiply the value in milligrams per liter by 1,000).

ND = This means not detected.

NR = Not required for monitoring. See "DOHS' Waiver Process" above.

NS = No detection limit for reporting (DLR) or established state or federal standard (MCL).

NTU = Nepholometric Turbidity Unit, a measure of water clarity.

pCi/L = picoCuries per liter

PHG = Public Health Goal, which the State has determined as levels of contaminants in drinking water, based on human health risk assessments, that are protective of public health. PHGs may be determined without consideration of feasibility and detection limit. In those cases where the PHGs are less than the DLR, this report will give results in relation to the DLR, since the DLR is the feasible limit of measuring the contaminant.

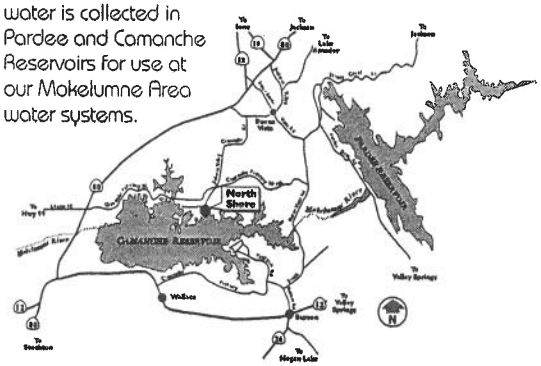
TON = Threshold Odor Number

µmho/cm = micro mhos per centimeter

EAST BAY MUNICIPAL UTILITY DISTRICT

CAMANCHE NORTH SHORE 1997 WATER QUALITY ANNUAL REPORT

High quality has always been the hallmark of EBMUD drinking water. It comes from snowmelt that flows from Alpine County high in the Sierra Nevada. Carried by the Mokelumne River, EBMUD water is collected in Pardee and Camanche Reservoirs for use at our Mokelumne Area water systems.



Water Supply

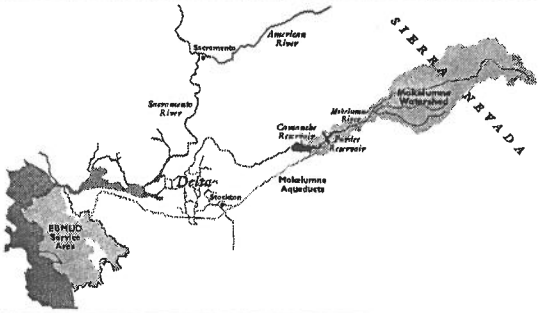
Water conservation continues to be an integral part of water supply at Camanche North Shore. Well #3 was the only source of water in 1997. However, a new well (Well #4) was constructed in 1997. The new well has a design flow of 100 gallons per minute. Well #4 is in the permit process with the State of California Department of Health Services and should be placed in service in the spring of 1998. Well #1 is a non potable source that is used for landscape irrigation for the lawn area near the main office. Well #2 remains an emergency backup supply due to a coliform problem in the well. Treatment and rehabilitation of the well by a contractor was unsuccessful this past year.

Water Quality

EBMUD Water Treatment Specialists operate the water system on a daily basis. The attached water quality report lists parameters that were monitored in 1997. Water quality standards continue to be met with the exception of odor. Water from Well #3 has hydrogen sulfide which is typical of groundwater in the Camanche area. Hydrogen sulfide is oxidized by potassium permanganate and chlorine at the water treatment plant, however a detectable odor remains in the treated water. Treatment optimization studies at the water treatment plant began in 1997. Filter media replacement and changes in water treatment chemical injection points should be completed by the spring of 1998. Please call the Pardee Water Quality Unit (209) 772-8266 with questions or comments about this water quality report.

Water System Improvements

In addition to the new well and treatment optimization studies, a new disinfection system was installed at the water treatment plant. The chlorine gas disinfection system was replaced with a new state-of-the-art calcium hypochlorite disinfection system. The new backwash ponds at the water treatment plant are planned to go into service in 1998 and provide a non potable water source for irrigation in the campground areas.



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CAMANCHE NORTH SHORE
1997 ANNUAL WATER QUALITY REPORT

EBMUD

WATER QUALITY CONSTITUENT	UNITS	STATE MCLs	RAW WATER MIN	RAW WATER MAX	TREATED WATER AVE	TREATED WATER MIN	TREATED WATER MAX
PRIMARY PARAMETERS Health-related Standards							
BACTERIOLOGICAL							
• Coliforms are harmless bacteria common in the environment used as an indicator of possible contamination from human or animal wastes.							
• Turbidity is considered a concern for bacteriological quality since particles in the water may hinder disinfection of organisms.							
• Total coliforms were not detected in the water system in 1997.							
Turbidity	NTU	NS	0.05	4.3	0.04	0.04	0.04
• "Average" for turbidity uses the highest 5% of the month. NTU = Nephelometric Turbidity Units, a measure of clarity.							
INORGANIC CHEMICALS[a]							
• The following Inorganic chemicals were monitored in 1997 and were not detected in any of the water sources. Aluminum, Antimony, Beryllium, Cadmium, Chromium, Nickel, Nitrate, Nitrite and Thallium. Cyanide, Lead, Mercury and Selenium were last monitored in 1996. Sampling for all Inorganic Chemicals is required every three years except nitrate (annually), asbestos (every 9 years) and cyanide (waived until further notice by DOHS). See "Waivers granted by Dept. of Health Services" below.							
Barium (Ba)	mg/L	1	ND	0.238	0.108	ND	0.126
Fluoride (Fl)	mg/L	1.4	0.1	0.01	NR	NR	NR
RADIOLOGICAL PARAMETERS							
• Radiological parameters were monitored in 1997 and the following were not detected: Alpha activity and Uranium.							
VOLATILE ORGANIC CHEMICALS							
• Volatile organic chemicals (from gasoline, diesel fuel, cleaning solvents, etc.) are monitored to determine sources of industrial, commercial and residential contamination. Their presence can pose a health threat since some are known or probable carcinogens. No detectable levels of VOCs were found in 1997, including methyl-tert-butyl-ether (MTBE). See "MTBE" below.							
SYNTHETIC ORGANIC CHEMICALS							
• Synthetic organic chemicals (pesticide, herbicides, etc.) are monitored to determine sources of industrial and agricultural contamination and none were detected in our waters. The following synthetic organic chemicals were monitored in 1997 and were not detected in any of the water sources: Alachlor, Atrazine, Bentazon, 2,4-D, Dalapon, Dinoseb, Molinate, Pentachlorophenol, Picloram, Simazine, Thiobencarb, and 2,4,5-TP (Silvex). Except Atrazine and Simazine, DOHS waived monitoring for all above and the following SOCs, which were last monitored in 1995: Benzo(a)pyrene, Carbofuran, Chlordane, Dibromochloropropane, Di(2-ethylhexyl)adipate, Di(2-ethylhexyl)phthalate, Diquat, Endothall, Endrin, Ethylene dibromide, Glyphosate, Heptachlor, Heptachlor epoxide, Hexachlorobenzene, Hexachlorocyclopentadiene, Lindane, Methoxychlor, Oxamyl, Polychlorinated biphenyls (PCBs), 2,3,7,8-TCDD (Dioxin) and Toxaphene. See "Waivers granted by Dept. of Health Services" below.							
SECONDARY PARAMETERS Aesthetic Standards							
• Secondary parameters include aesthetic qualities such as tastes and odors. The clarity of the water can be measured by color, turbidity and aluminum content. Copper, iron, manganese and zinc levels can affect the color of the water. High odor levels were attributed to high sulfur odors. Treatment for removal of hydrogen sulfide has been improved in 1998. Hydroxide alkalinity, foaming agents (detergents) and silver were not detected in 1997.							
Alkalinity, bicarbonate (as $CaCO_3$)	mg/L	NS	83	83	169	169	169
Alkalinity, carbonate (as $CaCO_3$)	mg/L	NS	ND	ND	1	1	1
Calcium (Ca)	mg/L	NS	27.1	50.2	39.4	28.1	45.4
Chloride (Cl)	mg/L	250	13	13	9.5	5.9	13
Color	units	15	4	4	4	4	4
Copper (Cu)[a]	mg/L	1	ND	124	ND	ND	ND
Hardness	mg/L	NS	76	76	150	150	150
Iron (Fe)	mg/L	0.3	ND	0.043	ND	ND	ND
Magnesium (Mg)	mg/L	NS	2.5	11.7	8.6	3.1	10.9
Manganese (Mn)	mg/L	0.05	0.089	1.04	ND	ND	ND
Odor – Threshold	TON	3	1	1	106	12	200
Potassium (K)	mg/L	NS	ND	12.8	ND	7.8	11.6
pH	pH units	NS	7.7	7.7	7.9	7.9	7.9
Silica	mg/L	NS	NR	NR	70.9	58.2	76.4
Sodium (Na)	mg/L	NS	24.6	35.5	29.4	28.5	31.2
Specific Conductance	µmho/cm	1600	310	310	444	444	444
Sulfate	mg/L	500	47	47	46	46	46
Total Dissolved Solids (TDS)	mg/L	1000	240	240	340	340	340
Turbidity[b]	NTU	5	4.3	4.3	0.04	0.04	0.04
Zinc (Zn)	mg/L	5	0.009	0.682	0.02	0.01	0.038

FOOTNOTES AND ABBREVIATIONS

- Waivers granted by Dept. of Health Services (DOHS): DOHS' waiver process recognizes that water supply sources vary in sanitary conditions and vulnerability to contaminants. DOHS may grant waivers for water supply sources based on: past analytical results, usage of particular contaminants in the aquifer and vulnerability for contamination in the aquifer.

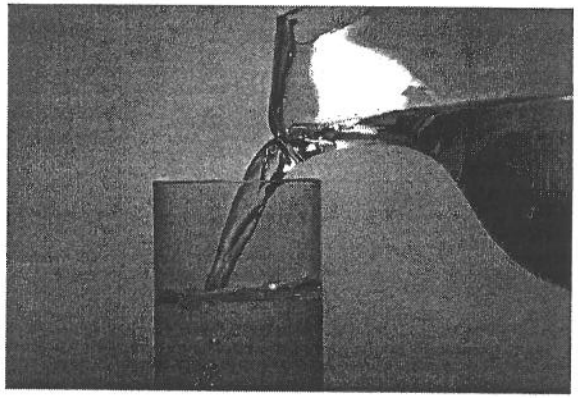
[a] Lead and Copper results shown in the table are from treated water samples. State MCL for Copper is based on Secondary Standards. Samples taken at customer taps as required by the Lead and Copper Rule had no MCLs but "Action Levels" applied to the highest ten percent of the Lead and Copper results. Results completed in 1994 and 1995 complied with the Action Levels.

[b] Turbidity for Secondary Standards use all results, not only the highest 5 percent levels used for the Primary Standards.

MCL = Maximum Contaminant Level
mg/L = milligrams per liter
ND = Not Detected by laboratory
NR = Not Required
NS = No Standard
NTU = Nephelometric Turbidity Unit(s)
TON = Threshold Odor Number
µg/L = micrograms per liter
µmhos/cm = micro mhos per centimeter

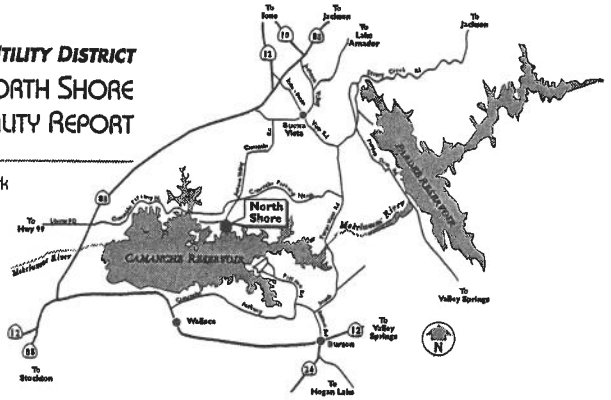
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CAMANCHE NORTH SHORE
1996 ANNUAL WATER QUALITY REPORT



EAST BAY MUNICIPAL UTILITY DISTRICT
CAMANCHE NORTH SHORE
1996 ANNUAL WATER QUALITY REPORT

High quality has always been the hallmark of EBMUD drinking water. It comes from snowmelt that flows from Alpine County high in the Sierra Nevada. Carried by the Mokelumne River, EBMUD water is collected in Pardee and Camanche Reservoirs for use at our Mokelumne Area water systems.



Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) was created to authorize Federal oversight of public water supply safety in the United States. It gives the U.S. Environmental Protection Agency the authority to establish regulations to ensure safe drinking water. The number of constituents in the water regulated by the SDWA has increased from 18 in 1975 to 84 in 1996. The California Department of Health Services is responsible for implementing the SDWA in California. There are two types of drinking water standards.

Primary Standards are related to the protection of public health against substances in water that may be harmful to humans if consumed for long periods of time.

Secondary Standards are based on aesthetic qualities of water such as taste and odor. These standards specify limits for substances that may influence consumer acceptance of the water.

1996 SDWA Amendments

The SDWA was amended in August, 1996. The regulatory process has been revised to include sound science, costs, benefits, and competing risks. Current regulations for fluoride, volatile organic chemicals, total coliforms, surface water treatment, phase II and phase V synthetic organic and inorganic constituents, and lead and copper remain basically unchanged. New deadlines have been established for the regulation of arsenic, sulfate, radon, disinfectants, and disinfection by products, enhanced surface water treatment, and groundwater disinfection.

Camanche North Shore Recreation Area

Water supply and water conservation have been two important issues at Camanche North Shore Recreation Area during the past several years. The park is served by groundwater. Well #3 is currently the only drinking water source at North Shore. Well #2 is undergoing treatment and rehabilitation by a contractor to solve a coliform problem in the well. Well #1 was put back into service in 1996 as a non potable source. It is used for landscape irrigation for the lawn area near the main office.

A new potable groundwater source, well #4, is in the planning stage. Construction bids should be ready by the summer of 1997.

Water Conservation

Water conservation continues to be an integral part of water supply at Camanche North Shore. Voluntary water conservation measures will be implemented in the spring of 1997. Water conservation literature and advice is available from the EBMUD water conservation office at (510) 287-0590.

Water Quality

Water quality is monitored by EBMUD's highly skilled, state certified water treatment operators. Water quality standards continue to be met for all primary and secondary standards with the exception of odor. Water from well #3 has hydrogen sulfide which is typical of groundwater in the Camanche area. Hydrogen sulfide is oxidized by potassium permanganate and chlorine at the water treatment plant, however a detectable odor remains in the treated water. EBMUD is looking at treatment optimization and processes to improve the taste and odor in the water at Camanche North Shore Recreation Area.

Please call the Pardee Water Quality Unit (209) 772-8266 with questions or comments about this water quality report.

CAMANCHE NORTH SHORE
1996 ANNUAL WATER QUALITY REPORT

WATER QUALITY CONSTITUENT	UNITS	STATE MCLs	RAW WATER MIN	RAW WATER MAX	TREATED WATER AVE[a]	TREATED WATER MIN	TREATED WATER MAX
PRIMARY PARAMETERS Health-related Standards							
BACTERIOLOGICAL[c,d]							
Total Coliforms	%presence	1samp/mo[b]	NR	NR	ND	ND	ND
Turbidity	NTU	NS	NR	NR	NR	NR	NR
INORGANIC CHEMICALS[d]							
Aluminum (Al)[e]	µg/L	1,000	NR	NR	<62	<60	<66
Antimony (Sb)	µg/L	6	NR	NR	ND	ND	ND
Arsenic (As)	µg/L	50	NR	NR	ND	ND	ND
Asbestos (fibers > 10 microns)[c]	mf/L	7	NR	NR	ND	ND	ND
Barium (Ba)	µg/L	1,000	NR	NR	ND	ND	106
Beryllium (Be)	µg/L	4	NR	NR	ND	ND	ND
Cadmium (Cd)	µg/L	5	NR	NR	ND	ND	ND
Chromium (Cr)	µg/L	50	NR	NR	ND	ND	ND
Cyanide (CN)	µg/L	200	NR	NR	ND	ND	ND
Lead (Pb)[f]	µg/L	NS	NR	NR	ND	ND	ND
Mercury (Hg)	µg/L	2	NR	NR	ND	ND	ND
Nickel (Ni)	µg/L	100	NR	NR	ND	ND	ND
Nitrate (as NO_3)	mg/L	45	ND	ND	ND	ND	ND
Nitrate+Nitrite as N	mg/L	10	ND	ND	ND	ND	ND
Nitrite (as N)	mg/L	1	ND	ND	ND	ND	ND
Selenium (Se)	µg/L	50	NR	NR	ND	ND	ND
Thallium (Tl)	µg/L	2	NR	NR	ND	ND	ND
Fluoride (F^-)	mg/L	1.4	NR	NR	NR	NR	NR
RADIOLOGICAL PARAMETERS[g]							
Radium 226 & 228	pCi/L	5	NR	NR	NR	NR	NR
Gross Alpha	pCi/L	15	NR	NR	NR	NR	NR
Tritium	pCi/L	20,000	NR	NR	NR	NR	NR
Strontium	pCi/L	8	NR	NR	NR	NR	NR
Gross Beta	pCi/L	50	NR	NR	NR	NR	NR
Uranium	pCi/L	20	NR	NR	NR	NR	NR
VOLATILE ORGANIC CHEMICALS							
Benzene	µg/L	1	ND	ND	ND	ND	ND
Carbon Tetrachloride	µg/L	0.5	ND	ND	ND	ND	ND
1,2-Dichlorobenzene (o-DCB)	µg/L	600	ND	ND	ND	ND	ND
1,4-Dichlorobenzene (p-DCB)	µg/L	5	ND	ND	ND	ND	ND
1,1-Dichloroethane (1,1-DCA)	µg/L	5	ND	ND	ND	ND	ND
1,2-Dichloroethane (1,2-DCA)	µg/L	0.5	ND	ND	ND	ND	ND
1,1-Dichloroethylene (1,1-DCE)	µg/L	6	ND	ND	ND	ND	ND
cis-1,2-Dichloroethylene (c-1,2-DCE)	µg/L	6	ND	ND	ND	ND	ND
trans-1,2-Dichloroethylene (t-1,2-DCE)	µg/L	10	ND	ND	ND	ND	ND
Dichloromethane (Methylene Chloride)	µg/L	5	ND	ND	ND	ND	ND
1,2-Dichloropropane	µg/L	5	ND	ND	ND	ND	ND
cis-1,3-Dichloropropene	µg/L	0.5	ND	ND	ND	ND	ND
trans-1,3-Dichloropropene	µg/L	0.5	ND	ND	ND	ND	ND
Ethylbenzene	µg/L	700	ND	ND	ND	ND	ND
Monochlorobenzene (Chlorobenzene)	µg/L	70	ND	ND	ND	ND	ND
Styrene	µg/L	100	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	µg/L	1	ND	ND	ND	ND	ND
Tetrachloroethylene (PCE)	µg/L	5	ND	ND	ND	ND	ND
Toluene	µg/L	150	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	µg/L	70	ND	ND	ND	ND	ND
1,1,1-Trichloroethane (1,1,1-TCA)	µg/L	200	ND	ND	ND	ND	ND
1,1,2-Trichloroethane (1,1,2-TCA)	µg/L	5	ND	ND	ND	ND	ND
Trichloroethylene (TCE)	µg/L	5	ND	ND	ND	ND	ND
Trichlorofluoromethane (Freon 11)	µg/L	150	ND	ND	ND	ND	ND
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	µg/L	1,200	ND	ND	ND	ND	ND
Vinyl Chloride (VC)	µg/L	0.5	ND	ND	ND	ND	ND
Xylenes (total)	µg/L	1,750	ND	ND	ND	ND	ND

WATER QUALITY CONSTITUENT	UNITS	STATE MCLs	RAW WATER MIN	RAW WATER MAX	TREATED WATER AVE[a]	TREATED WATER MIN	TREATED WATER MAX
SYNTHETIC ORGANIC CHEMICALS[h]							
Alachlor (Alanex)	µg/L	2	ND	ND	ND	ND	ND
Atrazine (Aatrex)	µg/L	3	ND	ND	ND	ND	ND
Bentazon (Basagran)	µg/L	18	NR	NR	ND	ND	ND
Benzo(a)pyrene	µg/L	0.2	NR	NR	ND	ND	ND
Carbofuran	µg/L	18	NR	NR	ND	ND	ND
Chlordane	µg/L	0.1	NR	NR	ND	ND	ND
2,4-D	µg/L	70	NR	NR	ND	ND	ND
Dalapon	µg/L	200	NR	NR	ND	ND	ND
1,2-Dibromo-3-chloropropane (DBCP)	µg/L	0.2	NR	NR	ND	ND	ND
Di(2-ethylhexyl)adipate	µg/L	400	NR	NR	ND	ND	ND
Di(2-ethylhexyl)phthalate	µg/L	4	NR	NR	ND	ND	ND
Dinoseb (DNBP)	µg/L	7	NR	NR	ND	ND	ND
Diquat	µg/L	20	NR	NR	ND	ND	ND
Endothall	µg/L	100	NR	NR	ND	ND	ND
Endrin	µg/L	0.2	NR	NR	ND	ND	ND
Ethylene Dibromide (EDB)	µg/L	0.05	NR	NR	ND	ND	ND
Glyphosate	µg/L	700	NR	NR	ND	ND	ND
Heptachlor	µg/L	0.01	NR	NR	ND	ND	ND
Heptachlor Epoxide	µg/L	0.01	NR	NR	ND	ND	ND
Hexachlorobenzene	µg/L	1	NR	NR	ND	ND	ND
Hexachlorocyclopentadiene	µg/L	50	NR	NR	ND	ND	ND
Lindane	µg/L	0.2	NR	NR	ND	ND	ND
Methoxychlor	µg/L	40	NR	NR	ND	ND	ND
Molinate	µg/L	20	ND	ND	ND	ND	ND
Oxamyl (Vydate)	µg/L	200	NR	NR	ND	ND	ND
Pentachlorophenol (PCP)	µg/L	1	NR	NR	ND	ND	ND
Picloram	µg/L	500	NR	NR	ND	ND	ND
Polychlorinated Biphenyls (PCB's)	µg/L	0.5	NR	NR	ND	ND	ND
Simazine	µg/L	4	ND	ND	ND	ND	ND
Thiobencarb	µg/L	70	ND	ND	ND	ND	ND
Toxaphene	µg/L	5	NR	NR	ND	ND	ND
2,3,7,8-TCDD (Dioxin)	pg/l	30	NR	NR	NR	NR	NR
2,4,5-TP (Silvex)	µg/L	50	NR	NR	ND	ND	ND
SECONDARY PARAMETERS Aesthetic Standards							
Alkalinity, bicarbonate (HCO_3^- as $CaCO_3$)	mg/L	NS	NR	NR	199	199	199
Alkalinity, carbonate ($CO_3^=$ as $CaCO_3$)	mg/L	NS	NR	NR	1	1	1
Alkalinity, hydroxide (OH^- as $CaCO_3$)	mg/L	NS	NR	NR	ND	ND	ND
Boron	mg/L	NS	0.08	0.15	0.14	0.13	0.15
Calcium (Ca)	mg/L	NS	47.8	60.2	54.5	54.5	54.5
Chloride (Cl)	mg/L	250	NR	NR	13	13	13
Color	units	15	NR	NR	ND	ND	ND
Copper (Cu)[f]	µg/L	1,000	ND	ND	ND	ND	ND
Foaming Agents (MBAs)	mg/L	0.5	NR	NR	ND	ND	ND
Hardness	mg/L	NS	NR	NR	200	200	200
Iron (Fe)	µg/L	300	ND	ND	ND	ND	ND
Magnesium (Mg)	mg/L	NS	11.5	14.3	12.7	12.7	12.7
Manganese (Mn)	µg/L	50	434	519	ND	ND	ND
Odor—Threshold	TON	3	NR	NR	4	4	4
pH	pH units	NS	7.3	7.8	7.5	7.3	7.6
Silica	mg/L	NS	71.4	81.3	75.1	72.6	77.4
Silver (Ag)	µg/L	100	ND	ND	ND	ND	ND
Sodium (Na)	mg/L	NS	26.5	34.9	32.8	32.8	32.8
Specific Conductance	µmho/cm	1,600	NR	NR	510	510	510
Sulfate	mg/L	500	45	56	59	59	59
Total Dissolved Solids (TDS)	mg/L	1,000	NR	NR	380	380	380
Turbidity[k]	NTU	5	NR	NR	0.11	ND	0.11
Zinc (Zn)	µg/L	5,000	NR	NR	ND	ND	ND

NOTES AND ABBREVIATIONS

[a] Arithmetic average if sampled more than once annually.

[b] Greater than one positive sample per month for Total Coliforms would exceed MCLs on monthly reporting basis.

[c] Total Coliforms reported from monthly averages of weekly monitoring results. Primary Standard for Turbidity does not apply to water systems with groundwater supplies.

[d] Aluminum and Turbidity are regulated both with Primary and Secondary Standards.

[e] Asbestos sampled in 1995. Monitoring required once every nine years.

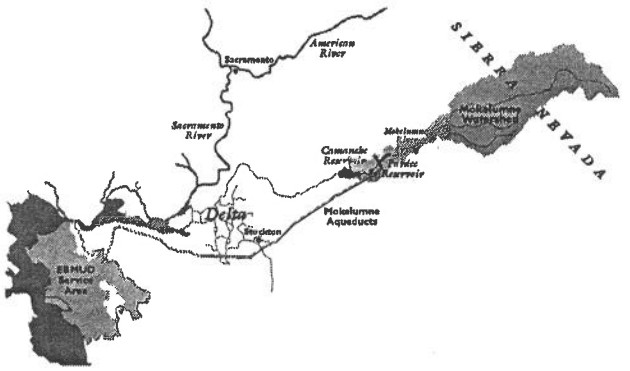
[f] Lead and Copper results shown on table from treated water samples. State MCL for Copper is based on Secondary Standards. Samples taken at customer taps as required by the Lead and Copper Rule had no MCLs but "Action Levels" applied to the highest ten percent of the Lead and Copper results. Results completed in 1994 complied with the Action Levels.

[g] Radiological results from sampling completed in 1994. Monitoring required every four years. Radium 226 & 228 not required if Gross Alpha is less than 5 pCi/L.

[h] Synthetic Organic Chemical results sampled in 1995, except for Alachlor, Atrazine, Molinate, Simazine and Thiobencarb.

[k] Secondary Standard for Turbidity based on maximum levels for treated water only, so Raw Water, Average or Minimum are given for information only.

1samp/mo = one sample per month that coliform organisms are detected.
MCL = Maximum Contaminent Level
NA = Not Analyzed by laboratory
ND = Not Detected by laboratory
NR = Not Required
NS = No Standard
NTU = Nephelometric Turbidity Unit(s)
mf/L = million fibers per liter
mg/L = milligrams per liter
pCi/L = picoCuries per liter
pg/L = picograms per liter
µg/L = micrograms per liter
µmho/cm = micro mhos per centimeter



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CAMANCHE NORTH SHORE
1995 WATER QUALITY REPORT

WATER QUALITY CONSTITUENT	UNITS	FEDERAL MCLs	STATE MCLs	AVE[a]	MIN	MAX
PRIMARY PARAMETERS Health-related Standards						
BACTERIOLOGICAL[c]						
Total Coliforms	%presence	1samp/mo[b]	1samp/mo[b]	ND	ND	1
Turbidity	NTU	1	0.5	0.04	ND	0.15
INORGANIC CHEMICALS[d]						
Aluminum (Al)	µg/L	NS	1,000	ND	ND	ND
Antimony (Sb)	µg/L	6	6	ND	ND	ND
Arsenic (As)	µg/L	NS	50	ND	ND	ND
Asbestos (fibers > 10 microns)	mf/L	7	7	ND	ND	ND
Barium (Ba)	µg/L	2,000	1,000	ND	ND	ND
Beryllium (Be)	µg/L	4	4	ND	ND	ND
Cadmium (Cd)	µg/L	5	5	ND	ND	ND
Chromium (Cr)	µg/L	100	50	ND	ND	ND
Cyanide (CN)	µg/L	200	200	ND	ND	ND
Lead (Pb)[g]	µg/L	15	NS	ND	ND	ND
Mercury (Hg)	µg/L	2	2	ND	ND	ND
Nickel (Ni)	µg/L	NS	100	ND	ND	ND
Nitrate (as N)	mg/L	10	10	ND	ND	ND
Nitrate+Nitrite as N	mg/L	10	10	ND	ND	ND
Nitrite (as N)	mg/L	1	1	ND	ND	ND
Selenium (Se)	µg/L	50	50	ND	ND	ND
Thallium (Tl)	µg/L	2	2	ND	ND	ND
Fluoride (F^-)	mg/L	4	1.4	0.08	0.08	0.08
RADIOLOGICAL PARAMETERS[f]						
Radium 226 & 228	pCi/L	5	5	NR	NR	NR
Gross Alpha	pCi/L	15	15	NR	NR	NR
Tritium	pCi/L	20,000	20,000	NR	NR	NR
Strontium	pCi/L	8	8	NR	NR	NR
Gross Beta	pCi/L	50	50	NR	NR	NR
Uranium	pCi/L	30	20	NR	NR	NR
VOLATILE ORGANIC CHEMICALS[e]						
Benzene	µg/L	5	1	ND	ND	ND
Carbon Tetrachloride	µg/L	5	0.5	ND	ND	ND
1,2-Dichlorobenzene (o-DCB)	µg/L	600	600	ND	ND	ND
1,4-Dichlorobenzene (p-DCB)	µg/L	75	5	ND	ND	ND
1,1-Dichloroethane (1,1-DCA)	µg/L	NS	5	ND	ND	ND
1,2-Dichloroethane (1,2-DCA)	µg/L	5	0.5	ND	ND	ND
1,1-Dichloroethylene (1,1-DCE)	µg/L	7	6	ND	ND	ND
cis-1,2-Dichlorethylene (c-1,2-DCE)	µg/L	7	6	ND	ND	ND
trans-1,2-Dichloroethylene (t-1,2-DCE)	µg/L	10	10	ND	ND	ND
Dichloromethane (Methylene Chloride)	µg/L	5	5	ND	ND	ND
1,2-Dichloropropane	µg/L	5	5	ND	ND	ND
cis-1,3-Dichloropropene	µg/L	NS	0.5	ND	ND	ND
trans-1,3-Dichloropropene	µg/L	700	0.5	ND	ND	ND
Ethylbenzene	µg/L	100	700	ND	ND	ND
Monochlorobenzene (Chlorobenzene)	µg/L	70	70	ND	ND	ND
Styrene	µg/L	100	100	ND	ND	ND
1,1,2,2-Tetrachloroethane	µg/L	1	1	ND	ND	ND
Tetrachloroethylene (PCE)	µg/L	100	5	ND	ND	ND
Toluene	µg/L	150	150	ND	ND	ND
1,2,4-Trichlorobenzene	µg/L	70	70	ND	ND	ND
1,1,1-Trichloroethane (1,1,1-TCA)	µg/L	5	200	ND	ND	ND
1,1,2-Trichloroethane (1,1,2-TCA)	µg/L	5	5	ND	ND	ND
Trichloroethylene (TCE)	µg/L	5	5	ND	ND	ND
Trichlorofluoromethane (Freon 11)	µg/L	150	150	ND	ND	ND
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	µg/L	100	1,200	0.23	0.23	0.23
Vinyl Chloride (VC)	µg/L	2	0.5	ND	ND	ND
Xylenes (total)	µg/L	10,000	1,750	0.1	0.1	0.1
SYNTHETIC ORGANIC CHEMICALS[e]						
Alachlor (Alanex)	µg/L	2	2	NA	NA	NA
Atrazine (Aatrex)	µg/L	3	3	ND	ND	ND
Bentazon (Basagran)	µg/L	NS	18	ND	ND	ND
Benzo(a)pyrene	µg/L	0.2	0.2	ND	ND	ND
Carbofuran	µg/L	40	18	ND	ND	ND
Chlordane	µg/L	2	0.1	ND	ND	ND
2,4-D	µg/L	70	70	ND	ND	ND
Dalapon	µg/L	200	200	ND	ND	ND
1,2-Dibromo-3-chloropropane (DBCP)	µg/L	0.2	0.2	ND	ND	ND
Di(2-ethylhexyl)adipate	µg/L	400	400	ND	ND	ND
Di(2-ethylhexyl)phthalate	µg/L	6	4	ND	ND	ND
Dinoseb (DNBP)	µg/L	7	7	ND	ND	ND
Diquat	µg/L	20	20	ND	ND	ND
Endothall	µg/L	100	100	ND	ND	ND
Endrin	µg/L	2	0.2	ND	ND	ND
Ethylene Dibromide (EDB)	µg/L	0.05	0.05	ND	ND	ND
Glyphosate	µg/L	700	700	ND	ND	ND

Water Quality Constituent	Units	Federal MCLs	State MCLs	Ave[a]	Min	Max
Synthetic Organic Chemicals[e] Continued						
Heptachlor	µg/L	0.4	0.01	ND	ND	ND
Heptachlor Epoxide	µg/L	0.2	0.01	ND	ND	ND
Hexachlorobenzene	µg/L	1	1	ND	ND	ND
Hexachlorocyclopentadiene	µg/L	50	50	ND	ND	ND
Lindane	µg/L	0.2	0.2	ND	ND	ND
Methoxychlor	µg/L	40	40	ND	ND	ND
Molinate	µg/L	20	20	ND	ND	ND
Oxamyl (Vydate)	µg/L	200	200	ND	ND	ND
Pentachlorophenol (PCP)	µg/L	1	1	ND	ND	ND
Picloram	µg/L	500	500	ND	ND	ND
Polychlorinated Biphenyls (PCB's)	µg/L	0.5	0.5	ND	ND	ND
Simazine	µg/L	4	4	ND	ND	ND
Thiobencarb	µg/L	NS	70	ND	ND	ND
Toxaphene	µg/L	3	5	ND	ND	ND
2,3,7,8-TCDD (Dioxin)	µg/L	0.00003	0.00003	NA	NA	NA
2,4,5-TP (Silvex)	µg/L	50	50	ND	ND	ND
Secondary Parameters[d] Aesthetic Standards						
Color	Color units	15	15	ND	ND	ND
Alkalinity (Bicarbonate)	mg/L	NS	NS	227	227	227
Alkalinity (Carbonate)	mg/L	NS	NS	3	3	3
Copper (Cu)	µg/L	1,300	1,000	ND	ND	ND
Foaming Agents (MBAs)	mg/L	0.5	0.5	ND	ND	ND
Iron (Fe)	µg/L	300	300	ND	ND	ND
Manganese (Mn)	µg/L	50	50	ND	ND	ND
Odor—Threshold	TON	3	3	2	2	2
Silver (Ag)	µg/L	100	100	ND	ND	ND
Turbidity	NTU	1	0.5	0.04	ND	0.15
Zinc (Zn)	µg/L	5,000	5,000	ND	ND	ND
Total Dissolved Solids (TDS)	mg/L	500	1,000	440	440	440
Specific Conductance	µmho/cm	NS	1,600	613	613	613
Chloride (Cl)	mg/L	NS	250	17	17	17
Sulfate	mg/L	250	500	77	77	77
Hydroxide Alkalinity	mg/L	NS	NS	ND	ND	ND
Calcium (Ca)	mg/L	NS	NS	62.9	62.9	62.9
Magnesium (Mg)	mg/L	NS	NS	14.6	14.6	14.6
Sodium (Na)	mg/L	NS	NS	38.1	38.1	38.1
Hardness	mg/L	NS	NS	230	230	230
Boron	mg/L	NS	NS	0.16	0.16	0.16
Silica	mg/L	NS	NS	74	74	74
pH	units	NS	NS	8.2	8.2	8.2

Camanche North Shore
1995 Water Quality Report Continued

Footnotes and Abbreviations

[a] Arithmetic average if sampled more than once annually.

[b] Greater than one positive sample per month for Total Coliforms would exceed MCLs on monthly reporting basis.

[c] Total Coliforms and Turbidity reported from monthly averages of weekly and bi-hourly monitoring results, respectively.

[d] Inorganics sampled at treated water in the plant.

[e] Radionuclides, Volatile Organics and Synthetic Organic Chemicals sampled at sources.

[f] Radiological results from sampling completed in 1993. Monitoring required every four years. Radium 226 & 228 not required if Gross Alpha is less than 5 pCi/L.

[g] Lead and Copper samples taken at customer taps on September 19, 1995 as required by Federal Lead and Copper Rule. State MCL for Copper based only on Secondary Standards (Aesthetics) in 1995.

MCL = Maximum Contaminant Level
NA = Not Analyzed by laboratory
ND = Not Detected by laboratory
NR = Not Required
NS = No Standard
NTU = Nephelometric Turbidity Unit(s)
mg/L = milligrams per liter
mf/L = million fibers per liter
pCi/L = picoCuries per liter
µg/L = micrograms per liter
µmho/cm = micro mhos per centimeter

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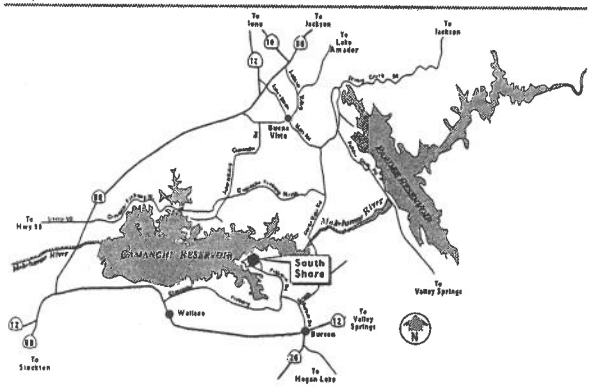
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EAST BAY MUNICIPAL UTILITY DISTRICT

CAMANCHE SOUTH SHORE 1999 WATER QUALITY ANNUAL REPORT



Water System Information

This report includes information such as the source of water, its water quality and comparisons to State and Federal drinking water standards. This information is provided to you because informed customers are our best allies. For more information please call Harold Roberson, Water Treatment/Distribution System Supervisor at (209) 772-8368.

Source of Water

Camanche Reservoir is the water source for Camanche South Shore Recreation Area. Water is treated at the Camanche South Shore Water Treatment Facility. Treatment includes: pre-chlorination, coagulation and filtration. Complying with regulations requires an extensive monitoring program in both the source and treated waters. Water quality regulations were met in 1999, with the exception of one sample for odor.

This report describes the results from sampling water for potential contaminants and gives you information on water related activities. In order to ensure that the water is safe to drink, the California Department of Health Services (Department) prescribes regulations which limit the amount of certain contaminants in water provided by public water systems. We treat the water according to the Department's regulations. The Department's regulations also establish limits for contaminants in bottled water that provide the same protection for public health.

Definitions

Maximum Contaminant Level (MCL): The highest level of a contaminant that is allowed in drinking water. Primary MCLs are set as close to the Public Health Goals (PHGs) or Maximum Contaminant Level Goals (MCLGs) as is economically and technologically feasible. Secondary MCLs are set to protect the odor, taste, and appearance of drinking water.

Maximum Contaminant Level Goal (MCLG): The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs are set by the U.S. Environmental Protection Agency (USEPA).

Public Health Goal (PHG): The level of a contaminant in drinking water below which there is no known or expected risk to health. PHGs are set by the California Environmental Protection Agency.

Primary Drinking Water Standard (PDWS): MCLs for contaminants that affect health along with their monitoring and reporting requirements, and water treatment requirements.

Regulatory Action Level (AL): The concentration of a contaminant which, if exceeded, triggers treatment or other requirements which a water system must follow.

Treatment Technique (TT): A required process intended to reduce the level of a contaminant in drinking water.

Educational Information

Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the EPA's Safe Drinking Water Hotline (1-800-426-4791).

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers.

The sources of drinking water (both tap water and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs, and wells. As water travels over the surface of the land or through the ground, it dissolves naturally-occurring minerals and, in some cases, radioactive material, and can pick up substances resulting from the presence of animals or from human activity.

Cryptosporidium is a microbial pathogen found in surface water throughout the U.S. Although filtration removes cryptosporidium, the most commonly used filtration methods cannot guarantee 100 percent removal. Current test methods do not allow us to determine if the organisms are dead or if they are capable of causing disease. Ingestion of cryptosporidium may cause cryptosporidiosis, an abdominal infection. Symptoms of infection include nausea, diarrhea, and abdominal cramps. Most healthy individuals can overcome the disease within a few weeks. However, immuno-compromised people are at greater risk of developing life threatening illness. We encourage immuno-compromised individuals to consult their doctor regarding appropriate precautions to take to avoid infection. Cryptosporidium must be ingested to cause disease, and it may be spread through means other than drinking water.

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USEPA/Centers for Disease Control (CDC) guidelines on appropriate means to lessen the risk of infection by cryptosporidium and other microbial contaminants are available from the Safe Drinking Water Hotline (1-800-426-4791).

Primary Drinking Water Standards

Contaminants that may be present in the source water include:

Microbiological Contaminants, such as viruses and bacteria, which may come from sewage treatment plants, septic systems, agricultural livestock operations and wildlife. Treatment Techniques (TT) are used to ensure disinfection and inactivation of coliforms and waterborne pathogens. These include: turbidity removal and sufficient disinfectant residual concentrations and time of contact. We found no coliforms in our system in 1999.

Inorganic Contaminants, such as salts and metals, which can be naturally-occurring or result from urban stormwater runoff, industrial or domestic wastewater discharges, oil and gas production, mining or farming.

Sampling for all inorganic chemicals is required once every 12 months, except asbestos (required once every 9 years) and cyanide (requirement waived by the Department). An aluminum sample was taken from treated water.

Lead and copper were last monitored in 1998 at consumer taps, as required by the Lead & Copper Rule. Private plumbing and fixtures may add lead or copper levels above the level delivered by the District. Hot water systems can contain elevated levels of lead and copper so it is not advisable to drink from hot water faucets. Selection of faucets and plumbing materials should be based on the use of approved materials for potable consumption and installed according to local building codes.

Radiological Contaminants, which are naturally occurring. The most recent radiological sampling of source water was performed in 1997.

Synthetic Organic Contaminants or Synthetic Organic Chemicals (SOCs) including pesticides and herbicides which may come from a variety of sources such as agricultural and residential uses. SOCs are monitored to determine sources of industrial and agricultural contamination. The Department waived monitoring requirements for SOCs.

Volatile Organic Contaminants or Volatile Organic Chemicals (VOCs) are by-products of industrial processes and petroleum production, and can also come from gas stations, urban stormwater runoff and septic systems. The latest monitoring occurred in 1998 and no detectable levels of VOCs (including MTBE) were found. The Department requires monitoring of VOCs once every 72 months.

Secondary Parameters include aesthetic qualities such as taste and odor and appearance. The clarity of the water can be measured by color, turbidity and aluminum content. Monitoring of secondary standards is required once every 12 months except Thiobencarb which is waived by the Department. Samples were taken from treated water.

Other Parameters include unregulated contaminants and general minerals and chemicals. Unregulated contaminant monitoring helps the EPA and the Department to determine where certain contaminants occur and whether the contaminants need to be regulated. General minerals and chemicals are monitored once a year as required by the Department.

Camanche South Shore 1999 Water Quality Data

The table below lists all the drinking water contaminants that we detected during the 1999 calendar year. The presence of these contaminants in the water does not necessarily indicate that the water poses a health risk. Unless otherwise noted, the data presented in this table is from testing done January 1, through December 31, 1999. The Department requires us to monitor certain contaminants less than once per year because the concentratio n of these contaminants are not expected to vary significantly from year to year. Some of the data, though representative of the water quality, is more than one year o ld.

PRIMARY CONTAMINANTS	MCL	PHG (MCLG)	LEVEL FOUND	RANGE	SAMPLE DATE	TYPICAL SOURCES
Turbidity (NTU)	TT = 5 NTU	NS	0.15	N/A		Soil erosion
	TT=percentage of samples <0.5 NTU	NS	100%	N/A		

*Turbidity is a measure of the cloudiness of water. We monitor it because it is a good indicator of water quality. High turbidity can hinder the effectiveness of disinfectants.

INORGANIC CONTAMINANTS						
Aluminum (µg/L)	1	1	0.097	N/A		Erosion of natural deposits
RADIOLOGICAL CONTAMINANTS						
Alpha activity (pCi/L)	15	(0)	1	ND – 3	1997	Erosion of natural deposits
COPPER AND LEAD						
Copper (mg/L)	AL = 1.3	0.17	90th percentile = 0.23	No sites above the AL out of 5 sites sampled	1998	Corrosion of household plumbing
Lead (µg/L)	AL = 15	2	90th percentile = 4	No sites above the AL out of 5 sites sampled	1998	Corrosion of household plumbing

SECONDARY PARAMETERS	MCL	AVERAGE	RANGE	SAMPLE DATE	VIOLATION	TYPICAL SOURCES
Color (units)	15	3				Naturally-occurring organic chemicals
Corrosivity	Non-corrosive	Non-corrosive				Natural or industrially-influenced balance of hydrogen, carbon and oxygen in the water; affected by temperature and other factors
Foaming Agents (MBAS) (ug/L)	500	26				Municipal and industrial waste discharges
Odor—Threshold (TON)	3	2.5	1.6 – 3.5	March 23, 1999	YES*	Naturally-occurring organic materials
Total Dissolved Solids (mg/L)	1000	52				Runoff/leaching from natural deposits
Specific Conductance (µmho/cm)	1600	59				Substances that form ions when in water; seawater influence
Chloride (mg/L)	250	4				Runoff/leaching from natural deposits; seawater influence
Sulfate (mg/L)	500	2.1				Runoff/leaching from natural deposits; industrial wastes

*Odor was found at levels that exceeded the secondary MCL of 3 Threshold Number (TON); the Odor MCL was set to protect you against unpleasant aesthetic odor and violating this MCL does not pose a risk to public health.

UNREGULATED CONTAMINANTS	MCLG	AVERAGE	RANGE	TYPICAL SOURCES
Bromodichloromethane (µg/L)	0	1.7	ND – 2.5	By-product of drinking water chlorination
Chloroform (µg/L)	0	31	ND – 48	By-product of drinking water chlorination

OTHER PARAMETERS*	LEVEL FOUND	OTHER PARAMETERS*	LEVEL FOUND
Alkalinity, bicarbonate (mg/L)	18	Magnesium (mg/L)	1.3
Calcium (mg/L)	5.3	Potassium (mg/L)	0.8
Hardness (mg/L)	16	Sodium (mg/L)	2.5

*One sample collected during 1999 from treated water.

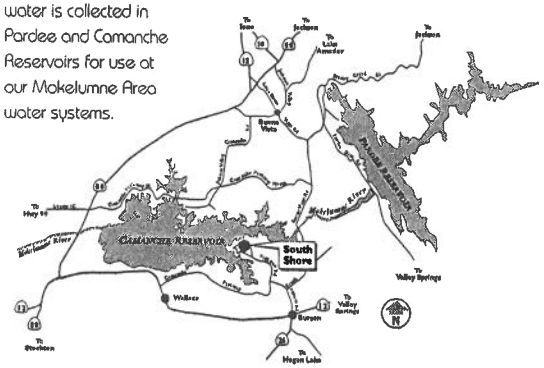
KEY

AL = Regulatory Action Level	**ND** = Not Detected.	**TON** = Threshold Odor Number
MCL = Maximum Contaminant Level	**NS** = No Standards	**TT** = Treatment Technique
MCLG = Maximum Contaminant Level Goal	**NTU** = Nephelometric Turbidity Units	**µmhos/cm** = micro mhos per centimeter, measure of conductivity
mg/L = milligrams per liter, or parts per million (ppm)	**pCi/L** = picoCuries per liter (a measure of radioactivity)	**µg/L** = micrograms per liter, or parts per billion (ppb)
N/A = Not Applicable	**PHG** = Public Health Goal	**90th Percentile** = 90% of samples had lower values than indicated

EAST BAY MUNICIPAL UTILITY DISTRICT

CAMANCHE SOUTH SHORE 1998 WATER QUALITY ANNUAL REPORT

High quality has always been the hallmark of EBMUD drinking water. It comes from snowmelt that flows from Alpine County high in the Sierra Nevada. Carried by the Mokelumne River, EBMUD water is collected in Pardee and Camanche Reservoirs for use at our Mokelumne Area water systems.



Water Supply

Camanche Reservoir is the water source for Camanche South Shore Recreation Area. Water is treated at the Camanche South Shore Water Treatment Facility. Treatment processes include: pre-chlorination, coagulation, filtration, and post-chlorination.

Water Quality

Compliance with state and federal regulations is determined through an extensive monitoring program in both the untreated water sources and in the treated water delivered to consumers. This ensures that EBMUD is consistently providing safe, high-quality drinking water. Water quality standards continue to be met with the exception of odor. Terms for understanding the tables include:

Primary Standards - These are the chemicals or characteristics of concern by state and federal regulations based on public health protection.

Secondary Standards - These are the chemicals or characteristics of concern by state and federal regulations based on aesthetics such as taste, odor, and color.

MTBE

Methl tertiary butyl ether (MTBE) is one of a group of chemicals known as fuel oxygenates required in gasoline by federal and state regulations. Drinking-water reservoirs can be contaminated by MTBE from leaking gas storage tanks and pipes, street runoff and motorboat outboard engines.

In 1998, the District initiated a program that replaced the high emission outboard engines used on its operational and rental boats, expanded its water quality monitoring for MTBE, participated in national and state efforts to control MTBE and other components in its drinking water and kept the public informed of these efforts through its outreach program. The program will be continued in 1999.

The expanded monitoring program detected MTBE in San Pablo, Pardee and Camanche Reservoirs. Average MTBE levels in San Pablo Reservoir were usually below 0.002 parts per million (ppm), and were about half the levels measured in 1997. Average levels in Pardee Reservoir were always under 0.0015 ppm, while average levels at Camanche Reservoir were all below 0.0035 ppm. When MTBE was detected in the treated drinking water delivered to customers from the San Pablo, Pardee and Camanche Reservoirs it was at levels almost 10 times lower than the 0.005 ppm secondary drinking water standard adopted by California's Department of Health Services(DOHS) in January 1999 to avoid sensitive individuals from experiencing objectionable taste and odor. The MTBE levels in the treated drinking water were over 30 times lower than the primary drinking water standard DOHS is expected to adopt in 1999 to protect the health of drinking water consumers.

Water System Improvements

Water system improvements include a new water main and drinking water fountains near the trout pond. Two jumper fire hydrants were installed near the water treatment facility. These hydrants can be used by the fire department for additional water flow if necessary. A permanent generator was installed at the water treatment plant to supply power to this facility during a power outage. Please call Harold Roberson, Water Treatment/Distribution System Supervisor (209) 772-8368 for questions or comments about this water quality report.

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CAMANCHE SOUTH SHORE
1998 ANNUAL WATER QUALITY REPORT

WATER QUALITY CONSTITUENT	UNITS	STATE MCLS	STATE PHGS	RAW WATER MIN	RAW WATER MAX	TREATED WATER AVE	TREATED WATER MIN	TREATED WATER MAX
PRIMARY PARAMETERS								
Health-related Standards								
● Include primary MCLs, specific treatment techniques adopted in lieu of primary MCLs, and monitoring and reporting requirements for MCLs that are specified in regulation.								
● Coliforms are harmless bacteria common in the environment. Turbidity is considered a concern for bacteriological quality since particles in the water may hinder disinfection of organisms.								
BACTERIOLOGICAL								
Total Coliforms	% Presence	1samp/mo	NS	NR	NR	ND	ND	1
Turbidity	NTU	NS	NS	0.3	7	0.06	0.03	0.09
● Greater than one positive sample per month for total coliforms would exceed allowable limits (MCL).								
●"Average" for turbidity uses the highest 5% of the month.								
INORGANIC CHEMICALS								
● The following Inorganic Chemicals were monitored in 1998 and were not detected in any of the water sources: Aluminum, Antimony, Arsenic, Beryllium, Barium, Cadmium, Chromium, Lead, Mercury, Nickel, Nitrate, Selenium and Thallium. Asbestos and Nitrite were last monitored in 1995 and 1997, respectively. Sampling for all Inorganic Chemicals are required annually except asbestos (every 9 years), nitrite (every 3 years) and cyanide (waived until further notice by DOHS). See "Waivers granted by Dept. of Health Services" below.[1]								
RADIOLOGICAL PARAMETERS								
● Radiological parameters were monitored in 1997 and Uranium was not detected. Sampling for Radiological parameters was waived. See ""Waivers granted by Dept. of Health Services" below.[1]								
Alpha activity	pCi/L	15	NS	ND	3	NR	NR	NR
VOLATILE ORGANIC CHEMICALS								
● Volatile Organic Chemicals (from gasoline, diesel, cleaning solvents, etc.) are monitored to determine sources of industrial, commercial, recreational and residential contamination. Their presence can pose a health threat since some are known carcinogens (cancer-causing agents). One of 39 samples was found to have detectable amounts of toluene in 1998. One of 37 samples was found to have detectable amounts of MTBE, an unregulated chemical in 1998. No VOCs were detected in treated water samples. A Secondary Standard for MTBE was established in January 1999 with the MCL at 0.005 mg/L.								
Toluene	mg/L	0.150	NS	ND	0.005	ND	ND	ND
SYNTHETIC ORGANIC CHEMICALS								
● Synthetic Organic Chemicals (pesticides, herbicides, etc.) are monitored to determine sources of industrial and agricultural contamination and none were detected in our waters. The following Synthetic Organic Chemicals were monitored in 1997 and were not detected in any of the water sources: Alachlor, Atrazine, Bentazon, Benzo(a)pyrene, 2,4-D, Carbofuran, Chlordane, Dalapon, Dibromochloropropane, Di(2-ethylhexyl)adipate, Di(2-ethylhexyl)phthalate, Dinoseb, Diquat, Endothall, Endrin, Ethylene dibromide, Glyphosate, Heptachlor, Heptachlor epoxide, Hexachlorobenzene, Hexachlorocyclopentadiene, Lindane, Molinate, Methoxychlor, Oxamyl, Pentachlorophenol, Picloram, Polychlorinated biphenyls (PCBs), Simazine, Thiobencarb, Toxaphene and 2,4,5-TP (Silvex). DOHS waived monitoring for all above and Dioxin in 1997. See "Waivers granted by Dept. of Health Services" below.[1]								
SECONDARY PARAMETERS								
Aesthetics Standards								
● Secondary parameters include aesthetic qualities such as tastes and odors. The clarity of the water can be measured by color, turbidity and aluminum content. Copper[2], iron, manganese and zinc levels can affect the color of the water. High odor levels were attributed to high chlorine residuals. Without chlorine odors, they were well within the allowable level. Carbonate, hydroxide alkalinity, copper[2] and silver were not detected in 1998. See "Volatile Organic Chemicals" above for MTBE.								
Alkalinity, bicarbonate (HCO_3^- as $CaCO_3$)	mg/L	NS	NS	17	17	14	14	14
Boron	mg/L	NS	NS	0.01	0.01	0.01	0.01	0.01
Calcium (Ca)	mg/L	NS	NS	4.1	4.1	4.2	4.2	4.2
Chloride (Cl)	mg/L	250	NS	1.3	1.3	NR	NR	NR
Color	units	15	NS	NR	NR	2	2	2
Foaming Agents (MBAs)	mg/L	0.5	NS	ND	ND	NR	NR	NR
Hardness	mg/L	NS	NS	NR	NR	15	15	15
Iron (Fe)	mg/L	0.3	NS	0.05	0.05	0.02	0.02	0.02
Magnesium (Mg)	mg/L	NS	NS	1.4	1.4	1.4	1.4	1.4
Manganese (Mn)	mg/L	0.05	NS	0.005	0.005	ND	ND	ND
Odor—Threshold	TON	3	NS	NR	NR	50	1	100
Potassium	mg/L	NS	NS	1.3	1.3	2.4	2.4	2.4
pH	pH units	NS	NS	7.4	7.4	6.9	6.9	6.9
Silica	mg/L	NS	NS	7.9	7.9	8.1	8.1	8.1
Sodium (Na)	mg/L	NS	NS	2.1	2.1	2.3	2.3	2.3
Specific Conductance	µmho/cm	1600	NS	35	35	46	46	46
Sulfate	mg/L	500	NS	2.2	2.2	1.9	1.9	1.9
Total Dissolved Solids (TDS)	mg/L	1000	NS	30	30	37	37	37
Turbidity[3]	NTU	5	NS	0.3	7	0.02	0.02	0.02
Zinc (Zn)	mg/L	5	NS	0.01	0.01	0.02	0.02	0.02

FOOTNOTES AND ABBREVIATIONS

[1] The California Department of Health Services (DOHS) waived sampling requirements for all Synthetic Organic Chemicals (SOCs). DOHS' waiver process recognizes that water supply sources vary in sanitary conditions and vulnerability to contaminants. DOHS may grant waivers for water supply sources based on past analytical results, usage of particular contaminants on the watershed and vulnerability to contaminants on the watershed.

[2] The Lead and Copper Rule requires samples taken at customer taps and has no MCLs but "Action Levels" applied to the highest ten percent of the Lead and Copper results. Results completed in 1998 complied with the Lead and Copper Action Levels of 0.015 and 1.30 mg/L, respectively. State MCL for Copper is based on Secondary Standards.

Private plumbing and fixtures may add lead or copper levels above the level delivered by the District. Hot water systems can contain elevated levels of lead and copper so consuming from hot water faucets is not advisable. Selection of faucets and plumbing materials should be based on the use of approved materials for potable consumption and installed according to local building codes.

[3] Turbidity for Secondary Standards use all sample results, not only the highest 5 percent levels that are used for the Primary Standards.

DLR = Detection Levels for the purpose of Reporting. The minimum concentration at which a constituent in water can be found to be present as determined by the State Department of Health Services.

MCL = Maximum Contaminant Level is the highest level of a contaminant allowable for drinking water. MCLs are set as close to the PHGs and MCLGs as is economically and technologically feasible.

MCLG = Maximum Contaminant Level Goal is the level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs are set by the U.S. Environmental Protection Agency (USEPA).

mg/L = milligrams per liter or parts per million (to convert to parts per billion or micrograms per liter, multiply the value in milligrams per liter by 1,000).

ND = This means not detected.

NR = Not required for monitoring. See "DOHS' Waiver Process" above.

NS = No detection limit for reporting (DLR) or established state or federal standard (MCL).

NTU = Nepholometric Turbidity Unit, a measure of water clarity.

pCi/L = picoCuries per liter

PHG = Public Health Goal, which the State has determined as levels of contaminants in drinking water, based on human health risk assessments, that are protective of public health. PHGs may be determined without consideration of feasibility and detection limit. In those cases where the PHGs are less than the DLR, this report will give results in relation to the DLR, since the DLR is the feasible limit of measuring the contaminant.

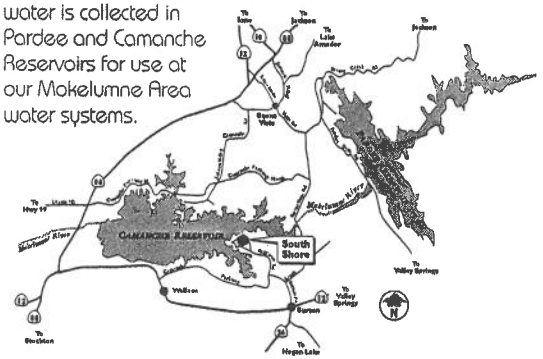
TON = Threshold Odor Number

µmho/cm = micro mhos per centimeter

EAST BAY MUNICIPAL UTILITY DISTRICT

CAMANCHE SOUTH SHORE 1997 WATER QUALITY ANNUAL REPORT

High quality has always been the hallmark of EBMUD drinking water. It comes from snowmelt that flows from Alpine County high in the Sierra Nevada. Carried by the Mokelumne River, EBMUD water is collected in Pardee and Camanche Reservoirs for use at our Mokelumne Area water systems.



Water Supply

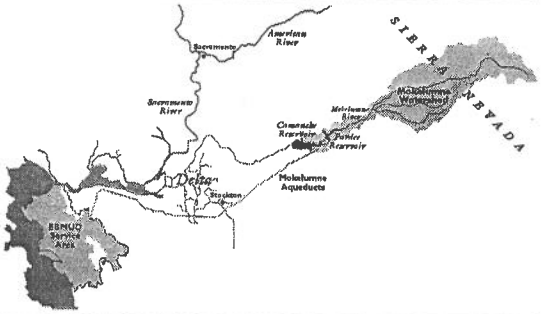
Camanche Reservoir is the water source for Camanche South Shore Recreation Area. Water is treated at the Camanche South Shore Water Treatment Plant. Treatment processes include: pre-chlorination, coagulation, filtration, and post-chlorination.

Water Quality

EBMUD Water Treatment Specialists operate the water system on a daily basis. The attached water quality report lists parameters that were monitored in 1997. Water quality standards continue to be met with the exception of odor due to chlorine in the water. Chlorine is used for disinfection. Chlorine residual in the water ranges from 0.5 mg/L to 1.0 mg/L. Please call the Pardee Water Quality Unit (209) 772-8266 with questions or comments about this water quality report.

Water System Improvements

A new state-of-the-art calcium hypochlorite disinfection system was tested in 1997. The new system will be permanently installed in 1998.



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CAMANCHE SOUTH SHORE
1997 ANNUAL WATER QUALITY REPORT

EBMUD

WATER QUALITY CONSTITUENT	UNITS	STATE MCLs	RAW WATER MIN	RAW WATER MAX	TREATED WATER AVE	TREATED WATER MIN	TREATED WATER MAX
PRIMARY PARAMETERS							
Health-related Standards							
BACTERIOLOGICAL							
• Coliforms are harmless bacteria common in the environment used as an indicator of possible contamination from human or animal wastes.							
• Turbidity is considered a concern for bacteriological quality since particles in the water may hinder disinfection of organisms.							
• Total coliforms were not detected in the water system in 1997.							
Turbidity	NTU	NS	0.4	30	0.05	0.05	0.10
• "Average" for turbidity uses the highest 5% of the month. NTU = Nephelometric Turbidity Units, a measure of clarity.							
INORGANIC CHEMICALS							
• The following Inorganic chemicals were monitored in 1997 and were not detected in any of the water sources: Aluminum, Antimony, Barium, Cadmium, Chromium, Nickel, Nitrate, Nitrite and Thallium. Cyanide, Mercury and Selenium were last monitored in 1996. Sampling for all Inorganic Chemicals is required annually except nitrate (quarterly), asbestos (every 9 years) and cyanide (waived until further notice by DOHS).							
Beryllium (Be)	mg/L	0.004	NR	NR	ND	ND	0.003
Lead (Pb)[a]	mg/L	0.015	NR	NR	ND	ND	0.006
RADIOLOGICAL PARAMETERS							
• Radiological parameters were monitored in 1997 and the following was not detected: Uranium.							
Alpha activity	pico Curies per liter	15	ND	3	NR	NR	NR
VOLATILE ORGANIC CHEMICALS							
• Volatile organic chemicals (from gasoline, diesel fuel, cleaning solvents, etc.) are monitored to determine sources of industrial, commercial and residential contamination. Their presence can pose a health threat since some are known or probable carcinogens. No detectable levels of VOCs were found in 1997, including methyl-tert-butyl-ether (MTBE). See "MTBE" below.							
SYNTHETIC ORGANIC CHEMICALS							
• Synthetic organic chemicals (pesticide, herbicides, etc.) are monitored to determine sources of industrial and agricultural contamination and none were detected in our waters. The following synthetic organic chemicals were monitored in 1997 and were not detected in any of the water sources: Alachlor, Atrazine, Bentazon, Benzo(a)pyrene, 2,4-D, Carbofuran, Chlordane, Dalapon, Dibromochloropropane, Di(2-ethylhexyl)adipate, Di(2-ethylhexyl)phthalate, Dinoseb, Diquat, Endothall, Endrin, Ethylene dibromide, Glyphosate, Heptachlor, Heptachlor epoxide, Hexachlorobenzene, Hexachlorocyclopentadiene, Lindane, Molinate, Methoxychlor, Oxamyl, Pentachlorophenol, Picloram, Polychlorinated biphenyls (PCBs), Simazine, Thiobencarb, Toxaphene and 2,4,5-TP (Silvex). DOHS waived monitoring for all above and Dioxin in 1997. See "Waivers granted by Dept. of Health Services" below.							
SECONDARY PARAMETERS							
Aesthetic Standards							
• Secondary parameters include aesthetic qualities such as tastes and odors. The clarity of the water can be measured by color, turbidity and aluminum content. Copper, iron, manganese and zinc levels can affect the color of the water. High odor levels were attributed to high chlorine residuals. Without chlorine odors, they were well within the allowable level. Carbonate, hydroxide alkalinity, copper and silver were not detected in 1997.							
Alkalinity, bicarbonate (as $CaCO_3$)	mg/L	NS	NR	NR	12	12	12
Boron (B)	mg/L	NS	NR	NR	10	ND	21
Calcium (Ca)	mg/L	NS	NR	NR	3.9	3.6	4.1
Chloride (Cl)	mg/L	250	NR	NR	4.7	2.3	7.0
Color	units	15	NR	NR	3	3	3
Foaming Agents (MBAs)	mg/L	0.5	NR	NR	0.02	0.02	0.02
Hardness	mg/L	NS	NR	NR	13.8	12	25
Iron (Fe)	mg/L	0.3	NR	NR	0.016	0.006	0.080
Magnesium (Mg)	mg/L	NS	NR	NR	1.2	1.1	1.3
Manganese (Mn)	mg/L	0.05	NR	NR	ND	ND	0.006
Odor – Threshold	TON	3	NR	NR	4	4	4
Potassium (K)	mg/L	NS	NR	NR	ND	7.8	11.6
pH	pH units	NS	NR	NR	7	7	7
Silica	mg/L	NS	NR	NR	9.4	8.3	10.3
Sodium (Na)	mg/L	NS	NR	NR	2	1.9	2.2
Specific Conductance	µmho/cm	1600	NR	NR	46	46	46
Sulfate	mg/L	500	NR	NR	1.9	1.9	1.9
Total Dissolved Solids (TDS)	mg/L	1000	NR	NR	37	37	37
Turbidity[b]	NTU	5	0.36	30	0.07	ND	0.30
Zinc (Zn)	mg/L	5	NR	NR	ND	ND	0.06

FOOTNOTES AND ABBREVIATIONS

- Waivers granted by Dept. of Health Services (DOHS): DOHS' waiver process recognizes that water supply sources vary in sanitary conditions and vulnerability to contaminants. DOHS may grant waivers for water supply sources based on: past analytical results, usage of particular contaminants on the watershed and vulnerability for contamination on the watershed.

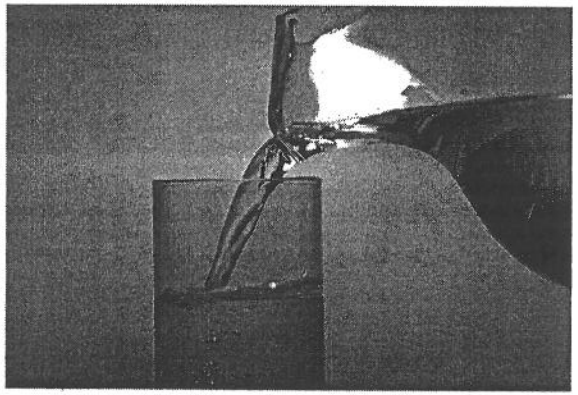
[a] Lead and Copper results shown in the table are from treated water samples. State MCL for Copper is based on Secondary Standards. Samples taken at customer taps as required by the Lead and Copper Rule had no MCLs but "Action Levels" applied to the highest ten percent of the Lead and Copper results. Results completed in 1994 and 1995 complied with the Action Levels.

[b] Turbidity for Secondary Standards use all results, not only the highest 5 percent levels used for the Primary Standards.

MCL = Maximum Contaminant Level
mg/L = milligrams per liter
ND = Not Detected by laboratory
NR = Not Required
NS = No Standard
NTU = Nephelometric Turbidity Unit(s)
TON = Threshold Odor Number
µg/L = micrograms per liter
µmhos/cm = micro mhos per centimeter

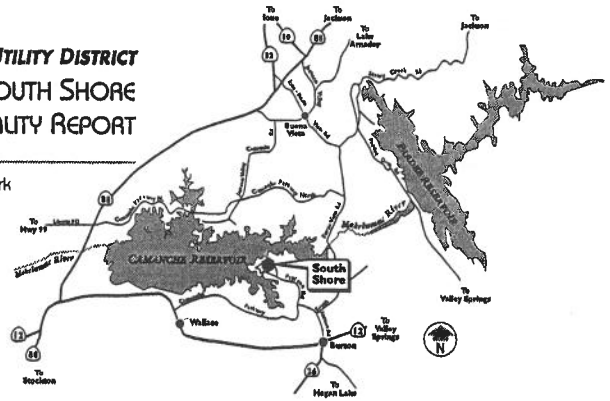
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CAMANCHE SOUTH SHORE
1996 ANNUAL WATER QUALITY REPORT



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Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) was created to authorize Federal oversight of public water supply safety in the United States. It gives the U.S. Environmental Protection Agency the authority to establish regulations to ensure safe drinking water. The number of constituents in the water regulated by the SDWA has increased from 18 in 1975 to 84 in 1996. The California Department of Health Services is responsible for implementing the SDWA in California. There are two types of drinking water standards.

Primary Standards are related to the protection of public health against substances in water that may be harmful to humans if consumed for long periods of time.

Secondary Standards are based on aesthetic qualities of water such as taste and odor. These standards specify limits for substances that may influence consumer acceptance of the water.

1996 SDWA Amendments

The SDWA was amended in August, 1996. The regulatory process has been revised to include sound science, costs, benefits and competing risks. Current regulations for fluoride, volatile organic chemicals, total coliforms, surface water treatment, phase II and phase V synthetic organic and inorganic constituents, and lead and copper remain basically unchanged. New deadlines have been established for the regulation of arsenic, sulfate, radon, disinfectants, and disinfection by-products, enhanced surface water treatment and groundwater disinfection.

Water Quality

The water source for Camanche South Shore Recreation Area is Camanche Reservoir. Water is treated at the Camanche South Shore Water Treatment Plant. Treatment processes include: pre-chlorination, coagulation, filtration, and post-chlorination. Water quality is monitored by EBMUD's highly skilled, state certified water treatment operators. Water quality standards continue to be met at Camanche South Shore Recreation Area for all primary and secondary standards.

Water Conservation

Water conservation is extremely important at Camanche South Shore Recreation Area especially during the Spring and Summer months. EBMUD works closely with the Concessionaire for the most efficient landscape irrigation schedule for the common areas in the park. Homeowners can do their part by irrigating in the morning or in the evening when the air is still and evaporation is minimal. Water conservation literature and advice is available from the EBMUD water conservation office at (510) 287-0590.

Please call the Pardee Water Quality Unit (209) 772-8266 with questions or comments about this report.

CAMANCHE SOUTH SHORE
1996 ANNUAL WATER QUALITY REPORT

WATER QUALITY CONSTITUENT	UNITS	STATE MCLs	RAW WATER MIN	RAW WATER MAX	TREATED WATER AVE[a]	TREATED WATER MIN	TREATED WATER MAX
PRIMARY PARAMETERS Health-related Standards							
BACTERIALOGICAL[c,d]							
Total Coliforms	presence	1samp/mo[b]	NR	NR	ND	ND	ND
Turbidity	NTU	0.5	0.37	1.9	0.06	ND	0.12
INORGANIC CHEMICALS							
Aluminum (Al)[d]	µg/L	1,000	NR	NR	<66	<66	<66
Antimony (Sb)	µg/L	6	NR	NR	ND	ND	ND
Arsenic (As)	µg/L	50	NR	NR	ND	ND	ND
Asbestos (fibers > 10 microns)[e]	mf/L	7	NR	NR	ND	ND	ND
Barium (Ba)	µg/L	1,000	NR	NR	ND	ND	ND
Beryllium (Be)	µg/L	4	NR	NR	ND	ND	ND
Cadmium (Cd)	µg/L	5	NR	NR	ND	ND	ND
Chromium (Cr)	µg/L	50	NR	NR	ND	ND	ND
Cyanide (CN)	µg/L	200	NR	NR	ND	ND	ND
Lead (Pb)[f]	µg/L	NS	NR	NR	ND	ND	ND
Mercury (Hg)	µg/L	2	NR	NR	ND	ND	ND
Nickel (Ni)	µg/L	100	NR	NR	ND	ND	ND
Nitrate (as NO_3)	mg/L	45	ND	ND	ND	ND	ND
Nitrate+Nitrite as N	mg/L	10	NR	NR	ND	ND	ND
Nitrite (as N)	mg/L	1	NR	NR	ND	ND	ND
Selenium (Se)	µg/L	50	NR	NR	ND	ND	ND
Thallium (Tl)	µg/L	2	NR	NR	ND	ND	ND
Fluoride (F)[g]	mg/L	1.4	NR	NR	ND	ND	ND
RADIOLOGICAL PARAMETERS[g]							
Radium 226 & 228	pCi/L	5	NR	NR	NR	NR	NR
Gross Alpha	pCi/L	15	NR	NR	NR	NR	NR
Tritium	pCi/L	20,000	NR	NR	NR	NR	NR
Strontium	pCi/L	8	NR	NR	NR	NR	NR
Gross Beta	pCi/L	50	NR	NR	NR	NR	NR
Uranium	pCi/L	20	NR	NR	NR	NR	NR
VOLATILE ORGANIC CHEMICALS							
Benzene	µg/L	1	ND	ND	ND	ND	ND
Carbon Tetrachloride	µg/L	0.5	ND	ND	ND	ND	ND
1,2-Dichlorobenzene (o-DCB)	µg/L	600	ND	ND	ND	ND	ND
1,4-Dichlorobenzene (p-DCB)	µg/L	5	ND	ND	ND	ND	ND
1,1-Dichloroethane (1,1-DCA)	µg/L	5	ND	ND	ND	ND	ND
1,2-Dichloroethane (1,2-DCA)	µg/L	0.5	ND	ND	ND	ND	ND
1,1-Dichloroethylene (1,1-DCE)	µg/L	6	ND	ND	ND	ND	ND
cis-1,2-Dichlorethylene (c-1,2-DCE)	µg/L	6	ND	ND	ND	ND	ND
trans-1,2-Dichloroethylene (c-1,2-DCE)	µg/L	10	ND	ND	ND	ND	ND
Dichloromethane (Methylene Chloride)	µg/L	5	ND	ND	ND	ND	ND
1,2-Dichloropropane	µg/L	5	ND	ND	ND	ND	ND
cis-1,3-Dichloropropene	µg/L	0.5	ND	ND	ND	ND	ND
trans-1,3-Dichloropropene	µg/L	0.5	ND	ND	ND	ND	ND
Ethylbenzene	µg/L	700	ND	ND	ND	ND	ND
Monochlorobenzene (Chlorobenzene)	µg/L	70	ND	ND	ND	ND	ND
Styrene	µg/L	100	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	µg/L	1	ND	ND	ND	ND	ND
Tetrachloroethylene (PCE)	µg/L	5	ND	ND	ND	ND	ND
Toluene	µg/L	150	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	µg/L	70	ND	ND	ND	ND	ND
1,1,1-Trichloroethane (1,1,1-TCA)	µg/L	200	ND	ND	ND	ND	ND
1,1,2-Trichloroethane (1,1,2-TCA)	µg/L	5	ND	ND	ND	ND	ND
Trichloroethylene (TCE)	µg/L	5	ND	ND	ND	ND	ND
Trichlorofluoromethane (Freon 11)	µg/L	150	ND	ND	ND	ND	ND
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	µg/L	1,200	ND	ND	ND	ND	ND
Vinyl Chloride (VC)	µg/L	0.5	ND	ND	ND	ND	ND
Xylenes (total)	µg/L	1,750	ND	ND	ND	ND	ND

WATER QUALITY CONSTITUENT	UNITS	STATE MCLs	RAW WATER MIN	RAW WATER MAX	TREATED WATER AVE[a]	TREATED WATER MIN	TREATED WATER MAX
SYNTHETIC ORGANIC CHEMICALS[h]							
Alachlor (Alanex)	µg/L	2	NR	NR	NR	NR	NR
Atrazine (Aatrex)	µg/L	3	NR	NR	ND	ND	ND
Bentazon (Basagran)	µg/L	18	NR	NR	ND	ND	ND
Benzo(a)pyrene	µg/L	0.2	NR	NR	ND	ND	ND
Carbofuran	µg/L	18	NR	NR	ND	ND	ND
Chlordane	µg/L	0.1	NR	NR	ND	ND	ND
2,4-D	µg/L	70	NR	NR	ND	ND	ND
Dalapon	µg/L	200	NR	NR	ND	ND	ND
1,2-Dibromo-3-chloropropane (DBCP)	µg/L	0.2	NR	NR	ND	ND	ND
Di(2-ethylhexyl)adipate	µg/L	400	NR	NR	ND	ND	ND
Di(2-ethylhexyl)phthalate	µg/L	4	NR	NR	ND	ND	ND
Dinoseb (DNBP)	µg/L	7	NR	NR	ND	ND	ND
Diquat	µg/L	20	NR	NR	ND	ND	ND
Endothall	µg/L	100	NR	NR	ND	ND	ND
Endrin	µg/L	0.2	NR	NR	ND	ND	ND
Ethylene Dibromide (EDB)	µg/L	0.05	NR	NR	ND	ND	ND
Glyphosate	µg/L	700	NR	NR	ND	ND	ND
Heptachlor	µg/L	0.01	NR	NR	ND	ND	ND
Heptachlor Epoxide	µg/L	0.01	NR	NR	ND	ND	ND
Hexachlorobenzene	µg/L	1	NR	NR	ND	ND	ND
Hexachlorocyclopentadiene	µg/L	50	NR	NR	ND	ND	ND
Lindane	µg/L	0.2	NR	NR	ND	ND	ND
Methoxychlor	µg/L	40	NR	NR	ND	ND	ND
Molinate	µg/L	20	NR	NR	ND	ND	ND
Oxamyl (Vydate)	µg/L	200	NR	NR	ND	ND	ND
Pentachlorophenol (PCP)	µg/L	1	NR	NR	ND	ND	ND
Picloram	µg/L	500	NR	NR	ND	ND	ND
Polychlorinated Biphenyls (PCB's)	µg/L	0.5	NR	NR	ND	ND	ND
Simazine	µg/L	4	NR	NR	ND	ND	ND
Thiobencarb	µg/L	70	NR	NR	ND	ND	ND
Toxaphene	µg/L	5	NR	NR	ND	ND	ND
2,3,7,8-TCDD (Dioxin)	pg/L	30	NR	NR	NR	NR	NR
2,4,5-TP (Silvex)	µg/L	50	NR	NR	ND	ND	ND
SECONDARY PARAMETERS Aesthetic Standards							
Alkalinity, bicarbonate (HCO_3^- as $CaCO_3$)	mg/L	NS	NR	NR	12	12	12
Alkalinity, carbonate ($CO_3^=$ as $CaCO_3$)	mg/L	NS	NR	NR	ND	ND	ND
Alkalinity, hydroxide (OH^- as $CaCO_3$)	mg/L	NS	NR	NR	ND	ND	ND
Boron	units	NS	NR	NR	11	11	11
Calcium (Ca)	mg/L	NS	NR	NR	3.5	3.5	3.5
Chloride (Cl)	mg/L	250	NR	NR	5.8	5.8	5.8
Color	mg/L	15	NR	NR	1	1	1
Copper (Cu)[f]	µg/L	1,000	NR	NR	5.5	3.3	7.8
Foaming Agents (MBAs)	mg/L	0.5	NR	NR	ND	ND	ND
Hardness	mg/L	NS	NR	NR	14	14	14
Iron (Fe)	µg/L	300	NR	NR	11	11	11
Magnesium (Mg)	mg/L	NS	NR	NR	1.1	1.1	1.1
Manganese (Mn)	µg/L	50	NR	NR	1	1	1
Odor—Threshold	TON	3	NR	NR	1.4	1.4	1.4
pH	pH units	NS	7.0	7.4	6.9	6.7	7.0
Silica	mg/L	NS	NR	NR	6.6	6.6	6.6
Silver (Ag)	µg/L	100	NR	NR	ND	ND	ND
Sodium (Na)	mg/L	NS	NR	NR	1.9	1.9	1.9
Specific Conductance	µmho/cm	1600	NR	NR	47	47	47
Sulfate	mg/L	500	NR	NR	1.8	1.8	1.8
Total Dissolved Solids (TDS)	mg/L	1,000	NR	NR	35	35	35
Turbidity[k]	NTU	5	0.37	3.3	0.03	ND	0.43
Zinc (Zn)	µg/L	5,000	NR	NR	ND	ND	ND

NOTES AND ABBREVIATIONS

[a] Arithmetic average if sampled more than once annually.

[b] Greater than one positive sample per month for Total Coliforms would exceed MCLs on monthly reporting basis.

[c] Total Coliforms reported from monthly averages of weekly monitoring results. Primary Standard for Turbidity does not apply to water systems with groundwater supplies.

[d] Aluminum and Turbidity are regulated both with Primary and Secondary Standards.

[e] Asbestos sampled in 1995. Monitoring required once every nine years.

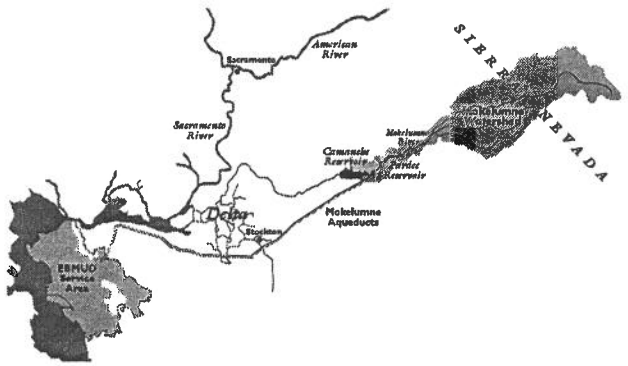
[f] Lead and Copper results shown on table from treated water samples. State MCL for Copper is based on Secondary Standards. Samples taken at customer taps as required by the Lead and Copper Rule had no MCLs but "Action Levels" applied to the highest ten percent of the Lead and Copper results. Results completed in 1994 complied with the Action Levels.

[g] Radiological results from sampling completed in 1994. Monitoring required every four years. Radium 226 & 228 not required if Gross Alpha is less than 5 pCi/L.

[h] Synthetic Organic Chemical results sampled in 1995, except for Alachlor, Atrazine, Molinate, Simazine and Thiobencarb.

[k] Secondary Standard for Turbidity based on maximum levels for treated water only, so Raw Water, Average or Minimum are given for information only.

1samp/mo = one sample per month that coliform organisms are detected.
MCL = Maximum Contaminent Level
NA = Not Analyzed by laboratory
ND = Not Detected by laboratory
NR = Not Required
NS = No Standard
NTU = Nephelometric Turbidity Unit(s)
mf/L = million fibers per liter
mg/L = milligrams per liter
pCi/L = picoCuries per liter
pg/L = picograms per liter
µg/L = micrograms per liter
µmho/cm = micro mhos per centimeter



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CAMANCHE SOUTH SHORE
1995 ANNUAL WATER QUALITY REPORT

WATER QUALITY CONSTITUENT	UNITS	FEDERAL MCLs	STATE MCLs	AVE[a]	MIN	MAX
PRIMARY PARAMETERS Health-related Standards						
BACTERIOLOGICAL[c]						
Total Coliforms	%presence	1samp/mo[b]	1samp/mo[b]	ND	ND	2
Turbidity	NTU	1	0.5	0.05	ND	0.4
INORGANIC CHEMICALS[d]						
Aluminum (Al)	µg/L	NS	1000	ND	ND	ND
Antimony (Sb)	µg/L	6	6	ND	ND	ND
Arsenic (As)	µg/L	NS	50	ND	ND	ND
Asbestos (fibers > 10 microns)	mf/L	7	7	ND	ND	ND
Barium (Ba)	µg/L	2,000	1,000	ND	ND	ND
Beryllium (Be)	µg/L	4	4	ND	ND	ND
Cadmium (Cd)	µg/L	5	5	ND	ND	ND
Chromium (Cr)	µg/L	100	50	ND	ND	ND
Cyanide (CN)	µg/L	200	200	ND	ND	ND
Lead (Pb)[a]	µg/L	15	NS	ND	ND	ND
Mercury (Hg)	µg/L	2	2	ND	ND	ND
Nickel (Ni)	µg/L	NS	100	ND	ND	ND
Nitrate (as N)	mg/L	10	10	ND	ND	ND
Nitrate+Nitrite as N	mg/L	10	10	ND	ND	ND
Nitrite (as N)	mg/L	1	1	ND	ND	ND
Selenium (Se)	µg/L	50	50	ND	ND	ND
Thallium (Tl)	µg/L	2	2	ND	ND	ND
Fluoride (F^-)	mg/L	4	1.4	0.03	0.03	0.03
RADIOLOGICAL PARAMETERS[f]						
Radium 226 & 228	pCi/L	5	5	NR	NR	NR
Gross Alpha	pCi/L	15	15	NR	NR	NR
Tritium	pCi/L	20,000	20,000	NR	NR	NR
Strontium	pCi/L	8	8	NR	NR	NR
Gross Beta	pCi/L	50	50	NR	NR	NR
Uranium	pCi/L	30	20	NR	NR	NR
VOLATILE ORGANIC CHEMICALS[e]						
Benzene	µg/L	5	1	ND	ND	ND
Carbon Tetrachloride	µg/L	5	0.5	ND	ND	ND
1,2-Dichlorobenzene (o-DCB)	µg/L	600	600	ND	ND	ND
1,4-Dichlorobenzene (p-DCB)	µg/L	75	5	ND	ND	ND
1,1-Dichloroethane (1,1-DCA)	µg/L	NS	5	ND	ND	ND
1,2-Dichloroethane (1,2-DCA)	µg/L	5	0.5	ND	ND	ND
1,1-Dichloroethylene (1,1-DCE)	µg/L	7	6	ND	ND	ND
cis-1,2-Dichlorethylene (c-1,2-DCE)	µg/L	7	6	ND	ND	ND
trans-1,2-Dichloroethylene (t-1,2-DCE)"	µg/L	10	10	ND	ND	ND
Dichloromethane (Methylene Chloride)	µg/L	5	5	ND	ND	ND
1,2-Dichloropropane	µg/L	5	5	ND	ND	ND
cis-1,3-Dichloropropene	µg/L	NS	0.5	ND	ND	ND
trans-1,3-Dichloropropene	µg/L	700	0.5	ND	ND	ND
Ethylbenzene	µg/L	100	700	ND	ND	ND
Monochlorobenzene (Chlorobenzene)	µg/L	70	70	ND	ND	ND
Styrene	µg/L	100	100	ND	ND	ND
1,1,2,2-Tetrachloroethane	µg/L	1	1	ND	ND	ND
Tetrachloroethylene (PCE)	µg/L	100	5	ND	ND	ND
Toluene	µg/L	150	150	ND	ND	ND
1,2,4-Trichlorobenzene	µg/L	70	70	ND	ND	ND
1,1,1-Trichloroethane (1,1,1-TCA)	µg/L	5	200	ND	ND	ND
1,1,2-Trichloroethane (1,1,2-TCA)	µg/L	5	5	ND	ND	ND
Trichloroethylene (TCE)	µg/L	5	5	ND	ND	ND
Trichlorofluoromethane (Freon 11)	µg/L	150	150	ND	ND	ND
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	µg/L	100	1,200	ND	ND	ND
Vinyl Chloride (VC)	µg/L	2	0.5	ND	ND	ND
Xylenes (total)	µg/L	10,000	1,750	ND	ND	ND
SYNTHETIC ORGANIC CHEMICALS[e]						
Alachlor (Alanex)	µg/L	2	2	ND	ND	ND
Atrazine (Aatrex)	µg/L	3	3	ND	ND	ND
Bentazon (Basagran)	µg/L	NS	18	ND	ND	ND
Benzo(a)pyrene	µg/L	0.2	0.2	ND	ND	ND
Carbofuran	µg/L	40	18	ND	ND	ND
Chlordane	µg/L	2	0.1	ND	ND	ND
2,4-D	µg/L	70	70	ND	ND	ND
Dalapon	µg/L	200	200	ND	ND	ND
1,2-Dibromo-3-chloropropane (DBCP)	µg/L	0.2	0.2	ND	ND	ND
Di(2-ethylhexyl)adipate	µg/L	400	400	ND	ND	ND
Di(2-ethylhexyl)phthalate	µg/L	6	4	ND	ND	ND
Dinoseb (DNBP)	µg/L	7	7	ND	ND	ND
Diquat	µg/L	20	20	ND	ND	ND
Endothall	µg/L	100	100	ND	ND	ND
Endrin	µg/L	2	0.2	ND	ND	ND
Ethylene Dibromide (EDB)	µg/L	0.05	0.05	ND	ND	ND
Glyphosate	µg/L	700	700	ND	ND	ND

Water Quality Constituent	Units	Federal MCLs	State MCLs	Ave[a]	Min	Max
Synthetic Organic Chemicals[e] Continued						
Heptachlor	µg/L	0.4	0.01	ND	ND	ND
Heptachlor Epoxide	µg/L	0.2	0.01	ND	ND	ND
Hexachlorobenzene	µg/L	1	1	ND	ND	ND
Hexachlorocyclopentadiene	µg/L	50	50	ND	ND	ND
Lindane	µg/L	0.2	0.2	ND	ND	ND
Methoxychlor	µg/L	40	40	ND	ND	ND
Molinate	µg/L	20	20	ND	ND	ND
Oxamyl (Vydate)	µg/L	200	200	ND	ND	ND
Pentachlorophenol (PCP)	µg/L	1	1	ND	ND	ND
Picloram	µg/L	500	500	ND	ND	ND
Polychlorinated Biphenyls (PCB's)	µg/L	0.5	0.5	ND	ND	ND
Simazine	µg/L	4	4	ND	ND	ND
Thiobencarb	µg/L	NS	70	ND	ND	ND
Toxaphene	µg/L	3	5	ND	ND	ND
2,3,7,8-TCDD (Dioxin)	µg/L	0.00003	0.00003	NA	NA	NA
2,4,5-TP (Silvex)	µg/L	50	50	ND	ND	ND
Secondary Parameters[d] Aesthetic standards						
Color	Color units	15	15	ND	ND	ND
Alkalinity (Bicarbonate)	mg/L	NS	NS	18	18	18
Alkalinity (Carbonate)	mg/L	NS	NS	ND	ND	ND
Copper (Cu)	µg/L	1300	1000	ND	ND	ND
Foaming Agents (MBAs)	mg/L	0.5	0.5	ND	ND	ND
Iron (Fe)	µg/L	300	300	ND	ND	ND
Manganese (Mn)	µg/L	50	50	ND	ND	ND
Odor—Threshold	TON	3	3	3	3	3
Silver (Ag)	µg/L	100	100	ND	ND	ND
Turbidity	NTU	1	0.5	0.05	ND	0.40
Zinc (Zn)	µg/L	5000	5000	ND	ND	ND
Total Dissolved Solids (TDS)	mg/L	500	1000	36	36	36
Specific Conductance	µmho/cm	NS	1600	52	52	52
Chloride (Cl)	mg/L	NS	250	4.9	4.9	4.9
Sulfate	mg/L	250	500	2.6	2.6	2.6
Hydroxide Alkalinity	mg/L	NS	NS	ND	ND	ND
Calcium (Ca)	mg/L	NS	NS	4.38	4.38	4.38
Magnesium (Mg)	mg/L	NS	NS	1.4	1.4	1.4
Sodium (Na)	mg/L	NS	NS	2.51	2.51	2.51
Hardness	mg/L	NS	NS	17	17	17
Boron	mg/L	NS	NS	0.02	0.02	0.02
Silica	mg/L	NS	NS	7.3	7.3	7.3
pH	units	NS	NS	7.3	7.3	7.3

Camanche South Shore
1995 Annual Water Quality Report Continued

Footnotes and Abbreviations

[a] Arithmetic average if sampled more than once annually.

[b] Greater than one positive sample per month for Total Coliforms would exceed MCLs on monthly reporting basis.

[c] Total Coliforms and Turbidity reported from monthly averages of weekly and bi-hourly monitoring results, respectively.

[d] Inorganics sampled at treated water in the plant.

[e] Radionuclides, Volatile Organics and Synthetic Organic Chemicals sampled at sources.

[f] Radiological results from sampling completed in 1993. Monitoring required every four years. Radium 226 & 228 not required if Gross Alpha is less than 5 pCi/L.

[g] Lead and Copper samples taken at customer taps on September 19, 1995 as required by Federal Lead and Copper Rule. State MCL for Copper based only on Secondary Standards (Aesthetics) in 1995.

MCL = Maximum Contaminant Level
NA = Not Analyzed by laboratory
ND = Not Detected by laboratory
NR = Not Required
NS = No Standard
NTU = Nephelometric Turbidity Unit(s)
mg/L = milligrams per liter
mf/L = million fibers per liter
pCi/L = picoCuries per liter
µg/L = micrograms per liter
µmho/cm = micro mhos per centimeter

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