A MASS LOADING ASSESSMENT OF MAJOR POINT AND NON-POINT SOURCES DISCHARGING TO SURFACE WATERS IN THE CENTRAL VALLEY, CALIFORNIA, 1985

DRAFT STAFF REPORT

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CENTRAL VALLEY REGION
STANDARDS, POLICIES, AND SPECIAL STUDIES SECTION
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A MASS LOADING ASSESSMENT OF MAJOR POINT AND NON-POINT SOURCES DISCHARGING TO SURFACE WATERS IN THE CENTRAL VALLEY, CALIFORNIA, 1985

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SUMMARY

As part of the Regional Board's continuous planning process, a study was initiated to assess the relative trace metal and oil and grease loads from major point/nonpoint sources discharging in the Central Valley using mostly existing information. Gathering this information was viewed as the essential first step to 1) identifying the major sources of trace metals and oil and grease, 2) providing for rough load estimates, 3) better defining the seasonality of discharges, and 4) identifying additional information needs. Major discharges in the Central Valley include agricultural drainage, urban runoff, acid mine drainage, and National Pollutant Discharge Elimination System (NPDES) dischargers. However, since key studies on agricultural drainage from the San Joaquin Valley and Central Delta are presently underway, loads were not calculated from this major source. Therefore, loading comparisons were made only between dischargers from the Sacramento Valley. The loads remain significant since the Sacramento River Basin supplies greater than 80% of the freshwater inflows to the Sacramento-San Joaquin Delta. The load percentages discussed below represent the percent of the total loads from the sources included.

Agricultural Drainage

1985 flow-volumes from Dept. of Water Resources and Reclamation District gaging stations were combined with averaged historical concentration data for the loads. Most of the concentration data available on Sacramento Valley agricultural drainage was collected for this study in a synoptic survey conducted between January-July, 1987. The study was performed to improve the load estimates by filling known data gaps as well as to determine the potential for seasonal loading surges. Loads were calculated separately for the rice season (May-June) and the rest of the year to reflect the concentration differential that exists from seasonal growing practices. Background loads, i.e., metals coming into the agricultural drainage system from source streams, were not subtracted out.

Sacramento Valley agricultural drainage is primarily associated with rice growing practices. Although there are approximately 17 major discharge locations in the Valley, the bulk of the volume output (around 80% of the annual drainage volume) is contributed by five drains - Colusa Basin Drain, Sacramento Slough, Reclamation District (RD) 1000, RD108, and Toe Drain. These five drains together constituted the highest volume wastewater discharge to the Sacramento River. Agricultural drainage/Sacramento River flow-volume percentages at Freeport ranged from 4 to 28 percent. Drainage/Sacramento River percentages at Freeport were lowest from January to April and thereafter continued to increase to a peak in September when rice fields are typically dewatered in preparation for harvest. Fall and winter outflows reflect both upstream watershed inputs (non-agricultural) and rainfall runoff from fallow fields. Further up the Sacramento River, below Sacramento Slough, around 20% of the River was composed of agricultural drainage during the rice growing period (May-June).

Trace metals (most notably copper, zinc, chromium, and nickel) were consistently present in agricultural drainage at levels generally lower than similar metallic concentrations present in urban runoff and acid mine drainage. Results of a 1987 monitoring survey conducted for this report revealed a high degree of variability in the drainage concentrations. Since concentration variations can affect the accuracy of loads - profoundly for high volume discharges - it is important to understand concentration variations and account for them in the loading estimates.

Water concentrations of copper, chromium, nickel, and zinc varied statistically between the five major drains ($p<0.01$) but the differences were not large enough to incorporate into the loading estimates. Concentration fluctuations were also documented in a major agricultural drain during a single rainstorm event. The concentration of copper, chromium, and zinc fluctuated an order of magnitude in response to a 0.75 inch rainfall event but the variations were not correlated with any measured parameters (drain flow, EC, pH). Rainstorm induced concentration fluctuations were not incorporated into the loads due to the limited nature of the

results. The most important finding from the survey revealed that copper levels were significantly higher ($p<0.05$) during the rice growing season (May-June) compared to January-April levels. Similar variations for the other metals were also statistically significant but the differences were not as substantial as the copper levels (6 ppb compared to 10 ppb during May-June) which may reflect the use (and subsequent release) of copper containing algicides during May-June. Although the concentration database is somewhat limited, the results suggest that notable concentration surges from agricultural drainage can occur during the rice growing season (May-June) and during rainstorm events.

Agricultural drainage discharged 50% of the total chromium loads and 60% of the total nickel loads to the Sacramento Valley. Zinc, cadmium, and copper load contributions were relatively low to moderate (5%, 8%, and 13%, respectively), although, preliminary data indicates that agricultural drainage is a major source of arsenic. Lead and oil and grease are rarely detected in agricultural drainage water. Sacramento Slough and Colusa Basin Drain (the two largest agricultural drains in the Sacramento Valley) were the source of almost all of the trace metal loads (greater than 94%) from the drains included here.

National Pollutant Discharge Elimination System (NPDES) Dischargers

Self-monitoring data from Sacramento Valley NPDES dischargers was compiled to calculate loads for 1985. Furthermore, NPDES permit conditions from Central Valley dischargers were reviewed during the first quarter of 1987 to assess flow-volume relationships and monitoring requirements. This assessment was necessary to determine the scope of coverage from the included sources and allow a basis for recommendations on how load estimates could be improved.

There were three predominant NPDES effluent types discharging to Central Valley surface waters. Plant cooling wastewater (PCW) comprised over half (51%) of the total NPDES baseline flow (from continuous dischargers only) followed by fish hatchery wastewater (23%) and domestic/industrial sewage (STP/WTP) (20%). Treated lagoon and pulp processing wastewater percentages were much lower at 3% and 2%, respectively. All other discharge types combined, comprised less than 1% of the total NPDES outflow. Flow data were not available for permittees with rainfall induced (non-continuous) discharges; their relative contribution is unknown. Only a portion of all continuous outflow from NPDES discharges was monitored for metals or oil and grease (respectively, 15% and 22% of the Central Valley NPDES outflow), although, many of the sources are not expected to contain significant levels of these compounds (e.g., fish hatchery return water). Conversely, almost all of the Central Valley dischargers monitored their effluent for conventional parameters (e.g., pH, DO, Cl, EC, temperature, etc.).

Monthly NPDES discharge/Sacramento River flow-volume percentages were much less than those calculated for agriculture ranging from 3-5% at Freeport.

The relative Sacramento Valley load contributions from NPDES dischargers were fairly diminutive for trace metals ranging from 2% for zinc, copper, and lead to 6-7% for chromium and nickel, although, approximately one-fourth of the total oil and grease loads came from the sum of the included point sources. The bulk of the loads were contributed by a few domestic/industrial sewage treatment plants. Loading estimates for the Sacramento Valley encompassed most of the major NPDES dischargers, however, the estimates were affected by detection limits that were inordinately high in some cases and were highly variable between dischargers. For instance, detection limits for copper and oil and grease between dischargers ranged two orders of magnitude, respectively, from <1 to <100 ppb and from <26 to <5,000 ppb. As a result, inequalities in loading estimates occur - considerably at higher volume facilities - when reported detection limits are replaced with a usable value for the calculations.

Urban Runoff

Urban runoff loads were estimated from 6 major cities in the Sacramento Valley. Acreage estimates, a runoff coefficient of 0.3, city-specific rainfall, representative concentration data, and averaged summer flows were combined for a conservative estimate of loads. The accuracy of the method itself was good to an order of magnitude when checked with measured loads from a Sacramento watershed using actual flow and concentration data.

Runoff from urbanized watersheds was a major wastewater discharge in the Sacramento Valley during 1985. Monthly urban runoff/Sacramento River flow-volume percentages (at Freeport) were estimated to be slightly higher than similar NPDES values except during November when high rainfall and corresponding low River flows increased the monthly value to ten percent. Further, local trace metal monitoring indicates that runoff from Sacramento exhibits a "first flush" of pollutants from the first few storms of the season that occur during the fall (October through December). Therefore, due to both the potential for high runoff/river ratios and pollutant concentrations in the fall, the greatest loads (and thus, the greatest water quality impacts) would be expected to occur during this period.

Urban runoff was the major contributor of lead (80%) and oil and grease (77%) to the Sacramento Valley. Other metallic compounds were discharged at relatively moderate loads; from 7-8% for copper, cadmium, and zinc and 11% for nickel and chromium. The loads calculated are very conservative since total loads from all urbanized areas using this method would, at the very least, be difficult considering the proliferation of towns and the extent of paved street surfaces.

Acid Mine Drainage

Loads were estimated from two inactive mines discharging below major dam structures (Iron Mountain and Afterthought Mines). Iron Mountain Mine (IMM) loads were calculated using 1985-specific flow and concentration data from Spring Creek Diversion Dam. Loads from Afterthought Mine were calculated using averaged historical data.

Mines once active in the extraction of heavy metals have the potential to spontaneously generate acid mine drainage containing toxic levels of copper, cadmium, zinc, and less commonly, other metals (e.g., nickel, lead, chromium). Acid mine drainage from the selected inactive mines consistently made up less than one percent of the Sacramento Valley outflow during 1985. However, acid mine drainage contributed the majority of the cadmium, copper, and zinc loads to the Valley (79%, 56%, and 72%, respectively). Load percentages for chromium, lead, and nickel were much lower ranging from 1-3%. Oil and grease is not expected from the majority of inactive mine sites. The Iron Mountain Mine complex contributed greater than 95% of the loads estimated from the two mine sites. The Iron Mountain Mine Complex is presently undergoing cleanup and abatement proceedings under the U.S.EPA hazardous waste program. Other mine types such as inactive mercury and gold mining prospects may not produce typical acid mine drainage but are known sources of mercury and arsenic from tailing/waste rock piles and past gold amalgamation practices (not included here). A large number of documented and undocumented mines exist below dams that were not included here, and therefore, the loads are very conservative. Many inactive mine sites have not been characterized with respect to their loads or potential for loading; information regarding loads from waste rock and tailings piles is especially lacking.

A large number of inactive mines also reside above major reservoirs. Their contribution to Valley loads is relatively unknown since a certain percentage of the metals discharged become entrained within the reservoir, never fully making it to the Delta. Furthermore, NPDES and urban runoff discharges also enter reservoir watersheds (not included here). Therefore, complete load estimates to the Sacramento River Basin are presently inadequate due to incomplete information on the input-output loading dynamics of major reservoirs.

Dam Releases

Although dams release units are not considered within the same scope as the other discharge types, the loads from three major dams were included to represent the sum of all discharge types upstream of the dams. Shasta, Nimbus, and Oroville Dams contributed low to moderate loads of chromium (32%), copper (22%), nickel (2%), lead (14%), cadmium (3%) and zinc (15%); the highest loads came from Shasta Dam due to high outflows and a few positive detections. Dam loads were based on a dearth of data and, therefore, are believed to be th least accurate of the Valley's load estimates.

Adjusted loads

Loads were recalculated to adjust for the portion of each discharge type not included. Regardless of the adjustments, mines remained the major sources of cadmium, copper, and zinc; urban runoff remained the major source of lead and oil and grease; and agricultural drainage remained the major source of nickel and chromium. The adjustments did not substantially affect the relative contributions from NPDES dischargers; they were not a major contributor of any one compound. Therefore, although actual Sacramento Valley loads may not be fully represented, the association of a pollutant compound with it's major source was very strong.

II. INTRODUCTION

A mass loading study was conducted in the Central Valley to assess the relative contribution of pollutants from several point and non-point discharges. The study was initiated as part of our Unit's continuing planning process to evaluate pollutant sources in our region. Estimating mass loads provides a means of comparison between sources contributing similar pollutants to Valley surface waters. Mass load estimating incorporates both outflows and concentrations in a mass per time statistic that is irrespective of dilution in the receiving waters. Although receiving water dilution is an important consideration when evaluating the potential for water quality degradation, receiving water dilution does not account for the cumulative effects that several dischargers can have on a watershed as well as the potential for pollutants to build up in sediment.

Mass loading estimates are discussed in 40 CFR Ch. 1 Part 130 (7-1-85 Edition) as part of maintaining the state's continuous planning process for developing total maximum daily loads (TMDL). Total maximum daily loads are the sum of load allocation (natural or background and non-point sources) and waste load allocation (point sources) inputs. The intent of a TMDL program is to reduce loads where water quality objectives are not being met (called water quality limited segments). Water quality limited segments typically occur in stretches of river where multiple discharges upstream, while only contributing minor amounts of pollutants individually, cumulatively increase the receiving water pollutant levels beyond the capacity of the feeder streams to adequately dilute them.

Mass loading restrictions are well justified especially for persistent or non-degradative compounds which may effect their toxicity after deposition to the sediment. Contaminants that have settled out can bioaccumulate in benthic organisms and fish in direct contact or close proximity to the sediment (Spies et al., 1987; Neff, 1984; Varnassi et al., 1985). Pollutants can also be released back into the dissolved phase of the overlying water through desorption and dredging practices (Larssen, 1985). The constant release of anthropogenic compounds from particulate matter has been related to the reduction in both the diversity and density of stream dwelling benthic communities (Garie and McIntosh, 1986; Medeiros, et al., 1983; Pratt et al., 1983). Downstream sediment burdens are a result of upstream loading that exceeds the capacity of the system to assimilate or purge the input. The first step in implementing TMDLs is to define and prioritize the major sources contributing pollutants to the Central Valley using sound loading estimation techniques.

The purpose of this report was to quantify the major surface water discharges in the Central Valley and estimate their relative pollutant contributions. Annual loads from agricultural drainage, acid mine drainage, urban runoff, and National Pollutant Discharge Elimination System (NPDES) dischargers were calculated using 1985 flow-volumes and concentration data where possible and averaged historical data when 1985-specific data was not available. Loads of trace metals and oil and grease were calculated due to the relative abundance of concentration data; synthetic organic chemical data was too limited for loading estimations (with the exception of rice herbicides) and were excluded here.

Three of the four major sources (agriculture, urban runoff, and acid mine drainage) contributed 50-77% of the trace metals and oil and grease to the Sacramento Valley. Loads from NPDES dischargers contributed 23% of the oil and grease loads and from two to seven percent of the metals loads, representing a small portion of the total Sacramento Valley trace metal loads. Intercomparisons between Central Valley dischargers were not made since Delta and San Joaquin Valley agriculture was excluded from the estimates. Conversely, loads calculated for the Sacramento Valley included a majority of the discharges within it's scope, although, the estimates are largely conservative.

III. NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM DISCHARGERS

A. INTRODUCTION

The National Pollutant Discharge Elimination System (NPDES) was initiated in 1974 to prohibit the excessive discharge of contaminants that could be detrimental to the quality of downstream surface waters. The NPDES permit process is authorized by Section 402 (a) (1) of the Clean Water Act and is set up so that the owner of a point source effluent must be permitted by the Regional Board to discharge wastewater.

The NPDES permitting process is initiated-when a discharger submits a completed permit application containing a facility description and a thorough accounting of the wastewater's chemical composition. A substantial amount of water quality information is required to disclose the full range of pollutants present in the effluent. From this, the Regional Board develops a permit which specifies conditions under which the discharge will be allowed and a self-monitoring program based on an evaluation of the submitted data. Self-monitoring sample collection and analysis is the responsibility of the discharger and the results are sent to the Regional Board as scheduled. Discharger permits, correspondance, and self-monitoring reports are on file with the Regional Board's three offices.

Jurisdiction for the Central Valley (Region 5) is separated into 3 sub-regions: Redding, Sacramento, and Fresno. Subregions are divided by counties in the upper Sacramento River system (Redding Office), the southern San Joaquin Valley (Fresno Office), and the counties in between (Sacramento Office). The Sacramento Office is the largest with 134 NPDES permits, then the Fresno Office with 57 permits, and Redding monitors 52 dischargers.

B. METHODS

Case files of NPDES permittees were reviewed to assess the relative pollutants contribution from this point source. Furthermore, monitoring requirements were appraised for recommendations on how the accuracy of mass loading estimates could be improved. Information was garnered from permit files during the first quarter of 1987; the latest permits available at the time were examined. Self-monitoring report data was collected for 1985. Dischargers were categorized into 15 waste effluent types. Permittees that never discharged, or were not currently discharging to surface waters at that time, were excluded.

Flow-volume relationships were made with stated baseline flows where available. Average or design flows were used if baseline flows were not specifically stated. Dischargers permitted for seasonal rainfall runoff from the facility grounds (i.e., non-continuous flow) and those discharging to Tulare Basin were excluded from the flow-volume manipulations; it is unknown what the significance of non-continuous flow contributions are.

Mass loading estimates were calculated for trace metals and oil and grease from NPDES dischargers using 1985 self-monitoring data. Dischargers above major dam structures (e.g., Shasta, Oroville, Nimbus) and those not monitoring for either oil and grease or trace metals were excluded from the estimates. The metallic compounds used for the estimates were specific for each discharger based on the availability of data in the submitted self-monitoring reports.

Loading estimates were calculated as the product of concentration, flow-volume, and the proper conversion factors. Flow and concentration data was averaged monthly. If actual data was missing for a month, the geometric mean of the surrounding months was assigned. When only a few samples existed for the year, they were combined for a single concentration value. Monthly values were averaged to calculate the annual loads (months in which values were generated were excluded). Concentrations reported below detection were assigned a value of zero for a conservative estimate. Synthetic organic chemical loads were not calculated due to the paucity of data and the total absence of quality control information.

C. RESULTS AND DISCUSSION

1. Central Valley NPDES Discharge Characteristics

The characteristics of Central Valley NPDES dischargers are compiled by sub-region from north to south in Table A-1 corresponding to Figures A-la-d. County codes and abbreviation definitions are presented in Tables A-2 and A-3. The frequency of toxics monitoring performed by NPDES dischargers is presented in Table A-4. Concentration data for both metals and organic chemicals (where available) as well as flows and load calculations are tabulated in Appendix B.

Almost all NPDES dischargers were required to monitor their effluent for water matrix parameters or constituents (most commonly pH, EC, DO, Cl, and temperature), although, toxics monitoring was much less prevalent (Table III-l). Only 15% of the total NPDES outflow was monitored for metals and organic chemicals and 22% was monitored for oil and grease. Monitoring for organic chemicals was largely limited to phenols, PCBs, PCP, hydrazine, and EPA methods 601-2 and 624-5. Receiving water monitoring for oil and grease and metals was highly infrequent, although, most NPDES dischargers monitored for conventional constituents in the receiving water (Table III-l).

Figure III-l and Table III-2 show that there are three predominant NPDES effluent types discharging in the Central Valley. Plant cooling water (PCW) comprised over half the total volume (51%) followed by fish hatchery waste (FHW; 23%) and domestic/industrial sewage (WTP/STP; 20%). Treated lagoon water (TLW) and pulp process waste (PPW) percentages were much lower at approximately three and two percent, respectively. All other discharges combined, comprised less than one percent of the total NPDES outflow. Although high volume output does not necessarily imply greater water quality degradation, it does indicate a greater loading potential. The three largest NPDES discharge types (PCW, WTP/STP, FHW) and OPW are further discussed with respect to metals and oil and grease.

a. Plant Cooling Wastewater

Plant cooling water made up more than half the total volume of wastewater discharged under the NPDES program. Plant cooling water is primarily made up of "non-contact", "once through", water used to cool industrial machinery, although, PCW use varies with the facility (Table III-3). Most Central Valley PCW was discharged from the PG & E Contra Costa power plant which averaged over 500 million gallons per day (MGD), accounting for 87% of all PCW flows or 44% of all NPDES discharges (Figure III-l). The plant is located at Antioch near the confluence of the Sacramento and San Joaquin Rivers.

Around one percent of the total Central Valley PCW outflow was monitored for metals and oil and grease (Table III-4); the low percentage is due to the lack of required monitoring for a major portion of the PG & E Contra Costa power plant effluent.

Oil and grease concentrations in Central Valley PCW discharges during 1985 averaged around 2,000 ug/l which was slightly lower than the WTP/STP averages similarly calculated (Table III-5). Assuming this average for all PCW dischargers, the loading of oil and grease from all PCW sources would be high due to the large volumes discharged. The variability in the oil and grease levels is inherent in Central Valley PCW due, in part, to the different characteristics of each PCW. Table III-3 shows that, although most of the PCWs employ non-contact cooling processes, the industry uses, unique to each, undoubtedly affect the effluent quality.

Trace metal data for Central Valley PCW effluent was sparse, however, from the data collected, it appears that several compounds were present in PCW effluent (Table III-5). It should be noted that the levels may not necessarily reflect metals contributed strictly by the industry since several PCW dischargers use upstream water sources already containing

Table III-1. PERCENT (%) OF TOTAL NPDES OUTFLOW THAT IS MONITORED.

	MONITORING PERCENTAGE BY VOLUME (%)	
PARAMETER	DISCHARGE	RECEIVING WATERS
Conventional Parameters 1/	100	92
Organic Chemicals	15	11
Metals	15	0.13
Oil and Grease	22	0.06

1/ Temp., pH, DO, TDS, TSS, BOD, COD, coliform, Cl, TOC, MBAS, nitrogen products, etc.

Table III-2. PERCENTAGES OF CENTRAL VALLEY NPDES OUTFLOW TYPES TO THE SACRAMENTO-SAN JOAQUIN DELTA/ESTUARY. 1/

PERCENTAGE	TYPE	EFFLUENT DESCRIPTION
51.17	PCW	Plant Cooling Water
23.41	FHW	Fish Hatchery Waste
18.95	WTP	Wastewater Treatment Plant
3.13	TLW	Treated Lagoon Water
2.22	PPW	Pulp Paper Process Waste
0.74	STP	Sewage Treatment Plant
0.15	AMD	Acid Mine Drainage
0.08	TGW	Treated Ground Water
0.07	FPW	Food Processing Waste
0.04	OPW	Oil Production Waste

1/ Non-continuous dischargers and Tulare Basin dischargers were excluded.

Figure III-1. MAJOR CENTRAL VALLEY NPDES EFFLUENT VOLUME PERCENTAGES.

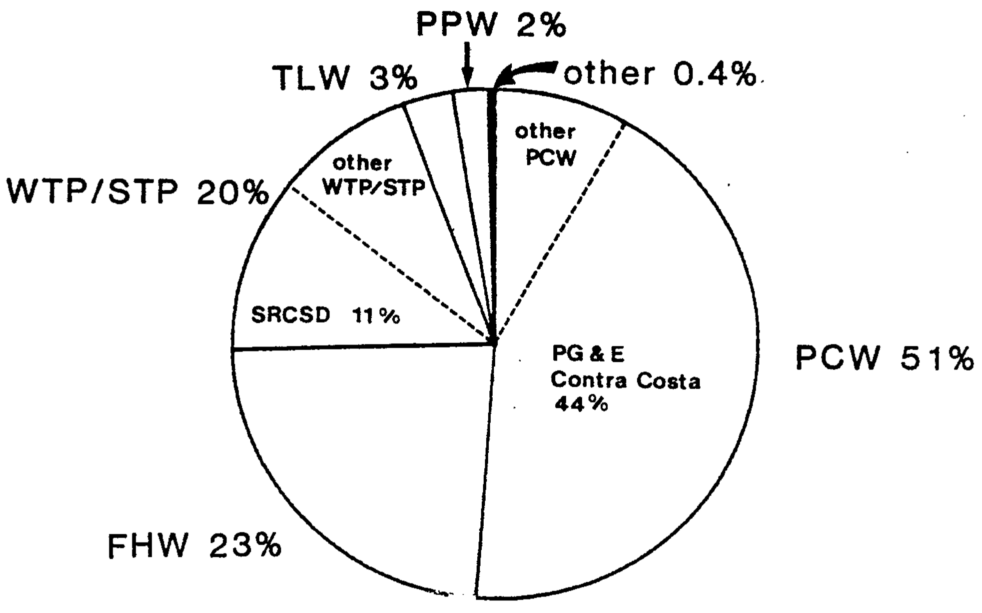


Table III-3. CHARACTERISTICS OF PLANT COOLING WATER (PCW) USES.

FACILITY NAME	INDUSTRY DESCRIPTION	PLANT COOLING WATER USE
-McClellan Air Force Base	Aircraft testing and maintainance	Non-contact building coolers
-McCormic and Baxter	Wood treatment plant	Non-contact equipment cooling used in creosote wood treatment
-Mohawk Rubber Co.	Rubber manufacturing	Non-contact equipment cooling; contact cooling sprayed over freshly manufactured rubber products
-Gold Bond Building Products	Manufacturer of paper boxes	Non-contact power plant equipment cooling
-Gladding and McBean Co.	Clay product manufacturing	Non-contact factory press cooling

		CODE	FLOW (MGD)	USE
-Pacific Gas and Electric Co., Contra Costa Power Plant	Fossil fuel power plant	001	200.430	Reverse osmosis blowdown, filtered boiler blowdown, floor drains, storm runoff, cooling water.
		002	390.485	Boiler blowdown, intake screen wash, cooling water, wash water from chemical cleaning operations, and air preheater and fireside washes.
		003-005	4.092	Fish pumps, storm drainage, intake screen, and fireside washes.

Table III-4. NPDES PCW BASELINE FLOWS AND METALS AND OIL & GREASE MONITORING.

EFFLUENT TYPE 1/	AGENCY NAME	FACILITY NAME	BASELINE FLOW (mgd)	MONITORING: OIL & GREASE	MONITORING: METALS 2/
PCW/PWW	PACIFIC GAS AND ELECTRIC CO.	CONTRA COSTA POWER PLT (ANTIOCH)	594.5100		
PCW/WTP	SACRAMENTO M.U.D.	RANCHO SECO	4.7170	X	X (2)
PCW/SWD	PROCTER AND GAMBLE COMPANY	WASTE TREATMENT PLANT	4.5000		
PCW	DAVIS CANNING COMPANY	ATWATER CANNERY	2.1810		X (1)
PCW	GOLD BOND BUILDING PRODUCTS	STOCKTON FACILITY	1.8000	X	
PCW	FORMICA CORP.	SIERRA PLANT	1.0000		
PCW	LIBBEY OWENS FORD COMPANY	LATHROP PLANT 10,WTP	0.6400	X	X (4)
PCW	MOHAWK RUBBER COMPANY	STOCKTON PLANT	0.5600	X	
PCW	SHELL DEVELOPMENT COMPANY	AGRICULTUAL RESEARCH DIVISION	0.4528		
PCW	MCCORMICK & BAXTER CREOSOTING	STOCKTON WASTE TRT PLANT	0.4100	X	X (2)
PCW	ISC WINES OF CALIFORNIA	COOLING & PROCESS WASTES	0.4000		
PCW	GOODYEAR TIRE AND RUBBER CO.	VITAFILM PLANT	0.3100		
PCW	ISC WINES	ITALIAN SWISS COLONY WINERY	0.3000		
PCW	TURNER WINERY	WASTE TREATMENT FACILITY	0.3000		
PCW/IYS	PACIFIC GAS AND ELECTRIC CO.	CONTRA COSTA POWER PLT (ANTIOCH)	0.2010	X	
PCW	VICTOR BALATA BELTING CO.	VICTOR BALATA BELTING COMPANY	0.0600		
PCW	GLADDING, MCBEAN AND CO.	LINCOLN PLANT	0.0400	X	
PCW	E&J GALLO WINERY	MODESTO FACILITY	0.0350		
PCW	MATER MISERICORDIAE HOSPITAL	MERCY HOSPITAL	0.0180		
PCW	STILLWATER ORCHARDS COMPANY	HOOD COLD STORAGE TERMINAL	0.0050		
PCW	IMPERIAL WEST CHEMICAL	WASTE TRT FACILITY	0.0009		
PCW	UC LAWRENCE LIVERMORE LAB	SITE 300 COOLING WTR DISCHARGE	0.0000		
PCW	TRI VALLEY GROWERS	TOM SPUR PLANT #4	0.0000		
			percent of total outflow monitored =	1%	1%

1/ See Table A-3 for definitions.

2/ Number of metals required to be monitored.

Table III-5. AVERAGE METALS AND OIL AND GREASE CONCENTRATIONS IN CENTRAL VALLEY PCW, WTP, AND OPW WASTEWATER, 1985 (BLANK SPACES INDICATE NO AVAILABLE DATA).

Plant Cooling Wastewater (PCW)

FACILITY	AVERAGE CONCENTRATION (ug/l)										
	As	Cd	Cr	Cu	Pb	Hg	Ni	Ag	Zn	CN	OIL AND GREASE
McCormic and Baxter (001)											957
McCormic and Baxter (002)	<4			7							1,400
Davis Canning Co.			0.9								
Libby Owens Ford			5								2,300
McClellan Air Force Base		5	18	36	16		9	4	123		
Gladding McBean											2,800
Mohawk Rubber Co.											1,900
Gold Bond Building Products											74
Pacific Gas and Electric Co.											4,333
AVERAGE	0	5	8	26.5	16	-	9	4	123		1,966
Harrison et al., 1979 2/				0.8-3.3							

Domestic and Industrial Sewage Wastewater (WTP/STP)

FACILITY	As	Cd	Cr	Cu	Pb	Hg	Ni	Ag	Zn	CN	OIL AND GREASE
Beale Air Force Base		<10	<50 1/	28	<20	1.45				<0.1	2,400
E.I. DuPont			104		38						1,800
Sharpe Army Depot		<10	<50		<100				10		1,500
SRCSD	<5	0.33	10	17	2	0.02	9	<5	91	2.4	1,700
Stockton, City of	0.2	0.8	11	20	12	1.04	38	<5	22	<2	58
Merced, City of	4.3	6			10		2.7				13,100
SMUD											2,800
Crown Zellerbach Corp.											1,700
Lodi, City of											800
Tracy, City of	<10	1	8	<100	<10	<1	700	<5	<100	<100	600
Roseville, City of											300
AVERAGE	2.3	2	33	22	16	0.84	187	0	41	0.8	2,433
Chang and Page, 1977 3/	<5	<5		18	8	0.2	4		40	1	
Laxen and Harrison, 1981 4/		139		36	12						

Oil Production Wastewater (OPW)

FACILITY	As	Cd	Cr	Cu	Pb	Hg	Ni	Ag	Zn	CN	OIL AND GREASE
Termo Co.											2,800
Shell CA Production											3,000
International Oil and Gas Co.											7,300
Pestana, John, Family Trust											5,200
Allied Energy Corp.											2,900
AVERAGE	-	-	-	-	-	-	-	-	-	-	4,240

1/ Same for Cr(6+).
2/ Effluent concentration range from a California power station.
3/ Median concentration from several southern California WTPs.
4/ Grab sample from a WTP with upstream plating works.

pollutants. It is apparent that there is presently not enough information on Central Valley PCW water quality. More monitoring for trace metals and oil and grease is needed to better determine PCW discharge contributions to Valley loads.

b. Fish Hatchery Wastewater

Fish hatchery wastewater accounted for 23% of the total Central Valley NPDES effluent volume. The major hatcheries included the USFWS Coleman Hatchery (located on Battle Creek, Shasta County), the CDFG Mokelumne River Fish Installation, and the CDFG American River Trout Hatchery. Fish hatchery wastewater from flow-through rearing ponds and spawning channels is generally "clean", with pollutant concerns focusing on suspended solids, settleable matter, and the occasional presence of algicides. Conventional constituents and, occasionally, biocides (e.g., Acrolein) are monitored in the effluent; metals and oil and grease monitoring was not required. While the volume is large, pollutant loading impacts from FHW are believed to be minimal.

c. Domestic/Industrial Sewage Wastewater

Domestic/industrial sewage treatment plant effluent (WTP/STP) comprised approximately 20% of the total Central Valley NPDES outflows. Over half the total WTP/STP outflow was from a single discharger, the Sacramento Regional County Sanitation District (SRCSD), located on the Sacramento River at Freeport. Most Central Valley WTP/STP wastewater was monitored for both oil and grease (76%) and metals (75%)(Table III-6). This was primarily due to the extensive monitoring conducted at the two largest WTP facilities, SRCSD and Stockton, which together, accounted for 66% of total WTP/STP outflows. Monitoring for all priority pollutants is required at all WTP/STP plants with flows over 5 MGD (Standard Provisions Requirements), and are also required where the Regional Board believes there may be a problem with these compounds.

Oil and grease levels in Central Valley WTP/STP effluent averaged around 2,500 ug/l and varied considerably, ranging from 58 ug/l to as high as 13,100 ug/l. The wide concentration range was most probably due to the type of system dischargers, analytical methodology, treatment operation, and storm drain input. It should be noted that the high oil and grease concentration for Merced POTW (13,100 ug/l) was the result of a single grab sample and may not be fully representative of the discharge.

Several trace metals were commonly found in WTP/STP effluent (Table III-5). Mercury, copper, lead, cyanide, and zinc were prevalent in Central Valley WTP/STP wastewater at levels similar to those measured at other California POTWs. Data was most abundant for the two largest WTPs (SRCSD [150 MGD] and Stockton [29 MGD]) which monitored priority pollutant metals on a weekly and quarterly basis, respectively. Concentration values for arsenic, chromium, cadmium, and nickel were quite dissimilar between the major WTPs. For instance, Tracy detected 700 ug/l of nickel in a single grab sample, whereas, nickel in Merced's effluent only averaged around 2.7 ug/l. As discussed below, this difference resulted in extremely high nickel loads for Tracy. Concentration inequities between WTPs are due to the type and number of industrial operators discharging to the system, the degree and type of treatment process, analytical laboratory discrepancies, and combined storm drain input (U.S.EPA, 1982). Since most WTP/STPs detected metals averaging in the low- to mid-ppb concentration range, high analytical detection limits reported by several facilities precluded their potential presence at common levels (e.g., copper: <100 ppb; chromium: <50 ppb; cadmium: <10 ppb). The inequities in WTP/STP metals concentrations demonstrates the need for facility-specific data as well as consistent, reasonable, detection limits if the data is to be usable for loading estimates.

d. Oil Production Wastewater

All OPW dischargers were required to monitor for oil and grease but not metals (Table III-6). The average oil and grease concentration from Central Valley OPWs (4,200 ug/l) was higher than either the PCW or WTP discharge averages (as expected)(Table III-5), although, the baseline flows were relatively diminutive. Oil production wastewater is defined here as groundwater that has come in contact with crude oil during the process of extraction.

Table III-6. NPDES WTP/STP WASTWATER BASELINE FLOWS AND METALS AND OIL & GREASE EFFLUENT MONITORING.

EFFLUENT TYPE	AGENCY NAME	FACILITY NAME	BASELINE FLOW (mgd)	MONITORING OIL & GREASE	MONITORING METALS 1/
WTP	SACRAMENTO REGIONAL CO SD	SACRAMENTO REGIONAL WWTP	150.0000	X	X (14)
WTP	STOCKTON-MAIN STP	STOCKTON STP-MAIN PLANT	29.0000	X	X (14)
WTP	ROSEVILLE, CITY OF	ROSEVILLE STP	11.7500	X	X
WTP	TURLOCK, CITY OF	TURLOCK WWTP	8.0000		X
WTP	VACAVILLE, CITY OF	EASTERLY SEWAGE TRT PLANT	6.0000		
WTP	MERCED, CITY OF	WASTE TREATMENT PLANT	5.5000	X	X (14)
WTP/PCW	SACRAMENTO M.U.D.	RANCHO SECO	4.7170	X	X (2)
WTP	LODI, CITY OF	WHITE SLOUGH WATER POLL CON PU	4.7000	X	
WTP	TRACY,CITY OF	TRACY SEWAGE TRT. PLANT	4.0000	X	X (14)
WTP	DAVIS, CITY OF	CITY OF DAVIS STP	3.5800		
WTP	REDDING, CITY OF	REDDING STP-CLEAR CREEK PLANT	3.5000		
WTP	SEWAGE COMM-OROVILLE REGION	WWTP	3.5000		
WTP	YUBA CITY	WASTE WATER RECLAMATION PLANT	3.5000		
WTP	CHICO, CITY OF	MAIN TREATMENT PLANT	3.0000		
WTP	ATWATER, CITY OF	SEWAGE TREATMENT PLANT	2.8600		
WTP	UNIVERSITY OF CALIFORNIA	MAIN STP	1.8000		
WTP	RED BLUFF, CITY OF	RED BLUFF STP	1.2200		
WTP	ANDERSON, CITY OF	ANDERSON STP	1.2000		
WTP	PLACERVILLE, CITY OF	HANGTOWN CREEK WTP	1.2000		
WTP	BEALE AIR FORCE BASE	WWTP	1.1000	X	X (6)
WTP	OLIVEHURST P.U.D.	WWTP	1.0000		
WTP	PLACER CO SEWER MAINT DIST 1	WWTP	0.9500		
WTP	QUINCY SANITARY DISTRICT	QUINCY STP	0.9100		
WTP	E.I. DU PONT DE NEMOURS & CO.	ANTIOCH FACILITY	0.9000	X	X (2)
WTP	GUSTINE, CITY OF	GUSTINE STP	0.9000		
WTP	GALT, CITY OF	GALT SD	0.8750		
WTP	LINDA COUNTY WATER DISTRICT	WPCP	0.8360		
WTP	CORNING, CITY OF	CORNING STP	0.8300		
WTP	AUBURN, CITY OF	WWTP	0.8200		
WTP	WILLOWS, CITY OF	WWTP	0.7500		
WTP	U.S. DEPARTMENT OF INTERIOR	YOSEMITE NATIONAL PARK, EL PORTAL	0.7200		
WTP	JACKSON, CITY OF	JACKSON S.T.P.	0.7100		
WTP	NEVADA CITY, CITY OF	WWTP	0.6900		
WTP	EL DORADO IRRIGATION DISTRICT	EL DORADO HILLS WW TRT PLANT	0.6500		
WTP	RIO ALTO WATER DISTRICT	LAKE CALIFORNIA STP	0.6400		
WTP	SHASTA DAM AREA PUB UTIL DIST	SEWAGE TREATMENT PLANT	0.6000		
WTP	VACAVILLE, CITY OF	INDUSTRIAL WASTE TREAT. FAC.	0.6000		
WTP	NEVADA COUNTY SAN. DIST. NO.1	LAKE OF THE PINES	0.5780		
WTP	NEWMAN, CITY OF	NEWMAN WWTF	0.5750		
WTP	MT SHASTA, CITY OF	MT SHASTA STP	0.5200		
WTP	CHESTER PUBLIC UTILITY DISTRIC	CHESTER SANITARY DISTRICT WWTP	0.5000		
WTP	COLUSA, CITY OF	WWTP	0.5000		

(table continued on next page)

Table III-6. (continued)

EFFLUENT TYPE	AGENCY NAME	FACILITY NAME	BASELINE FLOW (mgd)	MONITORING OIL & GREASE	MONITORING METALS
WTP	SACRAMENTO REGIONAL COUNTY SD	COMBINED WASTEWATER CONTROL SY	0.5000		
WTP	WALNUT GROVE SMD	WALNUT GROVE WWTP	0.5000		
WTP	DUNSMUIR, CITY OF	DUNSMUIR STP	0.4100		
WTP	SHASTA CO. SERVICES AREA NO.17	COTTONWOOD WWTP	0.4000		
WTP	PLANADA COMMUNTIY SERV. DIST.	WASTE TREATMENT FACILITY	0.3770		
STP	BIGGS, CITY OF	BIGGS STP	0.3500		
STP	DOS PALOS, CITY OF	WASTE TREATMENT FACILITY	0.3500		
WTP	PORTOLA, CITY OF	PORTOLA STP	0.3500		
WTP	RIO VISTA, CITY OF	WASTE TRT. FACILITY	0.3500		
STP	ALTURAS CITY OF	ALTURAS MUNICIPAL WWTP	0.3400		
WTP	LIVE OAK, CITY OF	WWTP	0.3000		
WTP	PATTERSON, CITY OF	PATTERSON WASTE TRT PLANT	0.3000		
WTP	PLACER CO SEWER MAINT DIST 3	WASTE TRT FACILITY	0.3000		
WTP	SAN ANDREAS SANITARY DIST.	SAN ANDREAS WWTF	0.3000		
WTP	DONNER SUMMIT PUBLIC UTILITY	WWTP	0.2800		
STP	DEUEL VOC. INSTITUTE	DEUEL VOCATNL INST. STP	0.2500		
STP	NEVADA COUNTY SD NO. 1	LAKE WILDWOOD SP IMPR ZONE 1	0.2500		
STP	PLACER CO SEWER MAINT DIST 2	WWTP	0.2500		
WTP	US ARMY-SHARPE ARMY DEPOT	DOM. AND IND. WASTE TRT. PLANT	0.2200	X	X (4)
WTP	MARIPOSA PUD	WASTE TREATMENT FACILITY	0.2000		
STP	SOUTHERN CALIF EDISON CO.	BIG CREEK POWERHOUSE NO.1	0.0210		
STP	SOUTHERN CALIF EDISON CO.	BIG CREEK POWERHOUSE NO.3	0.0100		
WTP	SIMPSON PAPER COMPANY	RIPON FACILITY	0.0000		
		total =	272.789		
		percent of flow monitored =		77%	75%
OPW	TERMO COMPANY	BRENTWOOD OIL AND GAS FIELDS	0.3360	X	
OPW	SHELL CALIFORNIA PRODUCTION	BRENTWOOD OIL AND GAS FIELDS	0.1890	X	
OPW	INTERNATIONAL OIL & GAS CO.	BRENTWOOD OIL AND GAS FIELDS	0.0280	X	
OPW	PESTANA, JOHN, FAMILY TRUST	BRENTWOOD OIL AND GAS FIELDS	0.0240	X	
OPW	ALLIED ENERGY CORP.	BRENTWOOD OIL AND GAS FIELDS	0.0029	X	
		total =	0.5799		
		percent of flow monitored =		100 %	0 %

1/ Number of metals required to be monitored in parentheses.

Concentrations varied between 2,800 and 7,300 ug/l. The major impact from these sources would be to immediate receiving waters with low flows. Past inspections of streams receiving OPW show traces of oil but no in-depth studies have been completed to date on the effects to resident aquatic biota.

2. Annual Loads
   a. Trace Metals

The 1985 annual loads of 11 trace metals from select NPDES dischargers are presented in Table III-7. With the exception of chromium 6+, four POTW WTPs (SRCSD, Stockton, Tracy, and Merced) together accounted for greater than 90% of the total measured metals loads. In some cases, high POTW loads were due to large outflows, and in other cases, to high concentrations. For instance, although SRCSD had, by far, the largest outflows, loads of arsenic and nickel were primarily contributed by Merced and Tracy, respectively, due to their high effluent concentrations. High metals concentrations, frequently exceeding U.S.EPA water quality criteria, were common in Central Valley POTW effluent. These loading estimates exclude the contribution from a major portion of the PG & E Contra Costa power plant which, because it's high outflows (over 500 MGD), would discharge very large loads regardless of the effluent concentrations.

Trace metal detection limits were highly varied. For instance, copper and cyanide detection limits between dischargers ranged two orders of magnitude from <1 to <100 ppb and <0.1 to <10 ppb, respectively. Because elevated detection limits can conceal the presence of low to moderate levels of metals, mass loading estimates are affected - profoundly at the higher volume facilities. The accuracy of NPDES metals loading estimates would be greatly improved by analyzing with standard limits attainable using graphite furnace detection. Furthermore, trace metal monitoring at larger volume dischargers would also improve loading estimates.

b. Oil and Grease

Annual oil and grease loads for individual NPDES dischargers ranged from 20 to 665,000 pounds (Table III-8). Ninety-five percent of the measured loads were discharged by three WTP/STPs: SRCSD, Merced, and SMUD. The SRCSD was, by far, the single highest loader primarily because of it's high outflow; the diminutive average concentration is an underestimate due to high reported detection limits (<5,000 ug/l). Although Stockton WTP had a relatively high volume output, the low average concentration kept their loading low. Conversely, Merced had the second largest loading value primarily due to an extremely high average concentration, reported from a single grab sample collected during 1985. Both Merced and SMUD oil and grease levels were higher than levels detected at most OPW facilities.

Although OPW oil and grease concentration averages were high (ranging from 2,800 to 7,300 ug/l), their poundage output was relatively low due to their small discharge volumes. Loads from all OPW dischargers combined contributed less than one percent of the Central Valley's total oil and grease loads. Furthermore, OPW dischargers may have lower levels of the toxic component of oil and grease - the polycyclic aromatic hydrocarbons (PAHs) - because PAHs increase sharply in concentration as oil is heated in use (SWRCB Bay-Delta Hearings Testimony, 1987).

Similar to the trace metals analyses, oil and grease detection limits varied substantially between individual dischargers, ranging from <26 to as high as <5,000 ug/l. As a result, inequalities in loading estimates occur because the detection limit values must be replaced with a value at the limit for a worst case estimate or replaced with zero (as was done here). A detection limit of <1,000 ug/l is attainable using a simple gravimetric measurement (EPA method 9070). Detecting oil and grease at the lowest possible limit would greatly increase the accuracy of loading estimates as well as standardize the procedure results between dischargers.

3. Monthly Loads
   a. Trace Metals

Monthly trace metal loads were highly variable during 1985 (Figures III-2A-C) primarily as a result of concentration fluctuations (i.e., monthly flows were fairly constant for each of the

Table III-7. NPDES FACILITY ANNUAL TRACE METALS LOADS, 1985.

TRACE METAL	FACILITY NAME	FACILITY TYPE 1/	LOWEST DETECTION LIMIT (ug/l)	AVERAGE CONCENTRATION (ug/l)	LOADS (lbs.) FACILITY (%)	LOADS (lbs.) TOTAL
ARSENIC	Merced, City of	WTP	4	4.3	72 (86)	
	Stockton, City of	WTP	<1 4/	0.2	12 (14)	
	McCormick & Baxter	PCW 3/	<4	0	0	
	SRCSD	WTP	<5	0 2/	0	
	Tracy, City of	WTP	<10	0	0	
	Wickes Forest Products	TGW	<5	9	0	
						84
CADMIUM	SRCSD	WTP	<1	0.33	132 (42)	
	Merced, City of	WTP	6	6	101 (32)	
	Stockton, City of	WTP	<2	0.8	60 (19)	
	Tracy, City of	WTP	<5	1.4	17 (5)	
	McClellan AFB	PCW	<4 4/	5	3	
	Beale AFB	WTP	<10	0	0	
	Sharpe Army Depot	WTP	<10	0	0	
						313
CHROMIUM	SRCSD	WTP	<5	10	3696 (75)	
	Stockton, City of	WTP	<5	10.6	828 (17)	
	E.I. DuPont De Nemours & Co.	WTP	<20	104	204 (4)	
	Tracy, City of	WTP	<10	11	134 (3)	
	Wickes Forest Products	TGW	NA	489	24	
	Libby Owens-Ford Co.	PCW	<40	5	12	
	McClellan AFB	PCW	6 4/	18	11	
	Davis Canning Co.	PCW	<10	11	0.55	
	Beale AFB	WTP	<50	0	0	
	Merced, City of	WTP	<6	0	0	
	Sharpe Army Depot	WTP	<50	0	0	
						4910
CHROMIUM(6+)	Wickes Forest Products	TGW	NA	248	12 (100)	
	Beale AFB	WTP	<50	0	0	
	Merced, City of	WTP	NA	0	0	
	SRCSD	WTP	<5	0	0	
	Tracy, City of	WTP	NA	0	0	
						12
COPPER	SRCSD	WTP	<5	17	6312 (79)	
	Stockton, City of	WTP	<20	20	1572 (20)	
	Beale AFB	WTP	NA	28	84 (1)	
	McClellan AFB	PCW	12 4/	36	21	
	McCormick & Baxter	PCW 3/	<20	7	0	
	Merced, City of	WTP	<1	0	0	
	Tracy, City of	WTP	<100	0	0	
	Wickes Forest Products	TGW	<10	10	0	
						7989

(continued on next page)

Table III-7. NPDES FACILITY ANNUAL TRACE METALS LOADS, 1985.

TRACE METAL	FACILITY NAME	TYPE 1/	LOWEST DETECTION LIMIT (ug/l)	AVERAGE CONCENTRATION (ug/l)	LOADS (lbs.) FACILITY (%)	LOADS (lbs.) TOTAL
ARSENIC	Merced, City of	WTP	4	4.3	72 (86)	
	Stockton, City of	WTP	<1 4/	0.2	12 (14)	
	McCormick & Baxter	PCW 3/	<4	0	0	
	SRCSD	WTP	<5	0 2/	0	
	Tracy, City of	WTP	<10	0	0	
	Wickes Forest Products	TGW	<5	9	0	
						84
CADMIUM	SRCSD	WTP	<1	0.33	132 (42)	
	Merced, City of	WTP	6	6	101 (32)	
	Stockton, City of	WTP	<2	0.8	60 (19)	
	Tracy, City of	WTP	<5	1.4	17 (5)	
	McClellan AFB	PCW	<4 4/	5	3	
	Beale AFB	WTP	<10	0	0	
	Sharpe Army Depot	WTP	<10	0	0	
						313
CHROMIUM	SRCSD	WTP	<5	10	3,696 (75)	
	Stockton, City of	WTP	<5	10.6	828 (17)	
	E.I. DuPont De Nemours & Co.	WTP	<20	104	204 (4)	
	Tracy, City of	WTP	<10	11	134 (3)	
	Wickes Forest Products	TGW	NA	489	24	
	Libby Owens-Ford Co.	PCW	<40	5	12	
	McClellan AFB	PCW	6 4/	18	11	
	Davis Canning Co.	PCW	<10	11	1	
	Beale AFB	WTP	<50	0	0	
	Merced, City of	WTP	<6	0	0	
	Sharpe Army Depot	WTP	<50	0	0	
						4,910
CHROMIUM(6+)	Wickes Forest Products	TGW	NA	248	12 (100)	
	Beale AFB	WTP	<50	0	0	
	Merced, City of	WTP	NA	0	0	
	SRCSD	WTP	<5	0	0	
	Tracy, City of	WTP	NA	0	0	
						12
COPPER	SRCSD	WTP	<5	17	6,312 (79)	
	Stockton, City of	WTP	<20	20	1,572 (20)	
	Beale AFB	WTP	NA	28	84 (1)	
	McClellan AFB	PCW	12 4/	36	21	
	McCormick & Baxter	PCW 3/	<20	7	0	
	Merced, City of	WTP	<1	0	0	
	Tracy, City of	WTP	<100	0	0	
	Wickes Forest Products	TGW	<10	10	0	
						7,989

(continued on next page)

Table III-7. (continued)

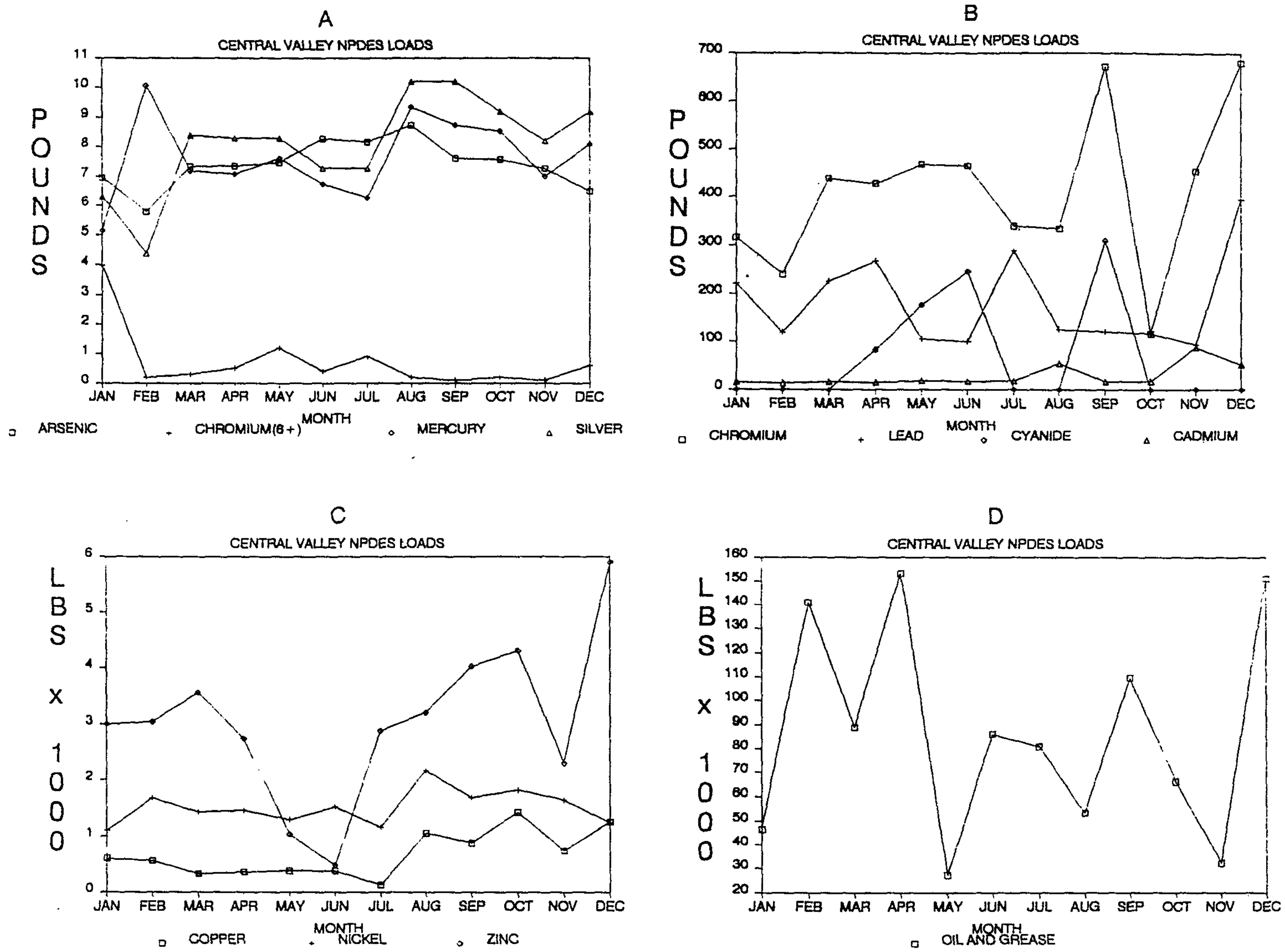
TRACE METAL	FACILITY NAME	TYPE 1/	LOWEST DETECTION LIMIT (ug/l)	AVERAGE CONCENTRATION (ug/l)	LOADS (lbs.) FACILITY	TOTAL
LEAD	Stockton, City of	WTP	<5	12.2	960 (48)	
	SRCSD	WTP	<5	2	792 (40)	
	Merced, City of	WTP	15	10	168 (8)	
	E.I. DuPont DeNemours & Co.	WTP	<6 4/	38	72 (4)	
	McClellan AFB	PCW	41 4/	16	9	
	Beale AFB	WTP	<20	0	0	
	Sharpe Army Depot	WTP	<100	0	0	
	Tracy, City of	WTP	<5	0	0	
						2,001
MERCURY	Stockton, City of	WTP	<0.2	1.04	84 (83)	
	SRCSD	WTP	<0.2	0.02	13 (13)	
	Beale AFB	WTP	<1	1.45	4 (4)	
	Merced, City of	WTP	<1	0	0	
	Tracy, City of	WTP	<1	0	0	
						101
NICKEL	Tracy, City of	WTP	700 4/	700	11,742 (64)	
	SRCSD	WTP	<5	9	3,468 (19)	
	Stockton, City of	WTP	<15 4/	38	2,976 (16)	
	Merced, City of	WTP	27	2.7	45	
	McClellan AFB	PCW	13 4/	9	5	
	Libby Owens-Ford Co.	PCW	<50	0	0	
						18,236
SILVER	Stockton, City of	WTP	1 4/	2.2	96 (98)	
	McClellan AFB	WTP	<3 4/	4	2 (2)	
	Merced, City of	WTP	<8	0	0	
	SRCSD	WTP	<5	0	0	
	Tracy, City of	WTP	<1	0	0	
						98
ZINC	SRCSD	WTP	<11 4/	91	34,260 (95)	
	Stockton, City of	WTP	<11 4/	22	1,728 (5)	
	McClellan AFB	WTP	<22 4/	123	73	
	Merced, City of	WTP	<100	0	0	
	Sharpe Army Depot	WTP	<10 4/	10	0	
	Tracy, City of	WTP	<100	0	0	
						36,061
CYANIDE	SRCSD	WTP	<5	2.4	1,008 (100)	
	Beale AFB	WTP	<0.1	0 2/	0	
	Merced, City of	WTP	<10	0	0	
	Stockton, City of	WTP	<2	0	0	
	Tracy, City of	WTP	<10	0	0	
						1,008

1/ See Table A-3 for definitions.
2/ Single grab sample.
3/ Discharge 001 and 002 combined.
4/ Lowest concentration detected.

Table III-8. NPDES FACILITY ANNUAL OIL AND GREASE LOADS, 1985.

FACILITY NAME	TYPE 1/	LOWEST DETECTION LIMIT (ug/l)	AVERAGE CONCENTRATION (ug/l)	OIL & GREASE (LBS.)	PERCENT OF TOTAL
SRCSD	WTP	<5000	1741	665121	64
Merced, City of	WTP			219447	21
Sacramento Municipal Utility District	PCW/STP	<90 2/	3771	84836	8
Crown Zellerbach	WTP	<1000 2/	1683	17700	2
Lodi, City of	WTP	<100	790	9494	1
Gladding Mc Bean & Co.	PCW	<5000 2/	2833	8508	1
Beale AFB	WTP	<500 2/	2400	7056	1
Tracy, City of	WTP	<100 2/	572	5310	1
Roseville, City of	WTP	<100 2/	298	5023	0.5
Stockton, City of	WTP	<1000	58	4560	0.4
Pacific Gas & Electric	PCW/IYS	<2000 2/	2617	4333	0.4
Libby Owens-Ford Co.	PCW	<100	2329	4032	0.4
E.I. DuPont Denemours & Co.	WTP	<300 2/	1842	3625	0.3
Termo Co.	OPW	<2000	2783	1764	0.2
Shell California Production	OPW	<1100 2/	3020	1392	0.1
Mohawk Rubber Co.	PCW	<2000	1918	1152	0.1
International Oil & Gas Co.	OPW	<3000 2/	7250	612	0.1
McCormick & Baxter	PCW(002)	<1000	1426	540	0.1
Pestana, John (Brentwood Oil & Gas Fields)	OPW	<720 2/	5191	348	0.0
Gold Bond Building Products	PCW	<26 2/	74	343	0.0
McCormick & Baxter	PCW(001)	<1000	957	336	0.0
Sharpe Army Depot	WTP	<300 2/	1500	324	0.0
Allied Energy Corp.	OPW	<2000	2896	20	0.0
	TOTAL			1045876	

1/ See Table A-3 for definitions.
2/ Lowest concentration detected.



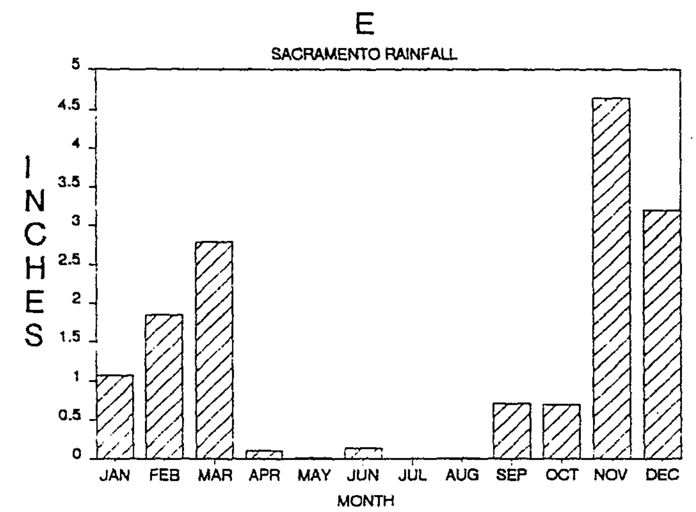


Figure III-2A-E. MONTHLY TRACE METAL AND OIL AND GREASE LOADS FROM NPDES DISCHARGERS IN THE CENTRAL VALLEY, 1985.

major dischargers). Central Valley monthly loading variability (except Cr 6+) was influenced primarily by four POTW WTPs (SRCSD, Stockton, Tracy, and Merced) and is probably reflective of fluctuations in influent concentrations (U.S.EPA, 1982). Loads for several metals common at high levels in urban runoff (lead, copper, zinc) peaked during the rainy season (October-March), suggesting a potential influence from combined urban runoff/sewage inflows. The U.S.EPA (1982) has documented increased pollutant concentrations in the effluent of POTWs accepting combined urban runoff/sewage inputs. Furthermore, other discharge types may be contributing to seasonal load differences since many facilities direct their yard runoff into the system (e.g., PCW). However, the loads did not correlate well with Sacramento rainfall (Figure III-2E), used as an indicator of general Central Valley rainfall trends. Whatever the cause, monthly loads from NPDES dischargers varied dramatically from month to month during 1985, exhibiting the need for several months' data for representative load estimations.

b. Oil and Grease

Monthly oil and grease load fluctuations observed in 1985 NPDES discharges (Figure III-2D) were primarily the result of a few POTWs. Trends in seasonal load increases were not apparent due to the "less than detection" values reported during a few months at the largest POTW (SRCSD), causing the loads to dip dramatically. In-depth trend analysis was restricted due to the limits of the data (e.g., high detection limits) and the methods used.

4. Reliability of Self-Monitoring Data

The accuracy of NPDES self-monitoring data for metals and oil and grease may be questionable. It is well known that most chemical analyses are erroneous when stringent quality control procedures are not followed. More credence could be lent to toxics data from NPDES self-monitoring submissions by including a requirement for choosing an approved analytical laboratory within the permit (presently this requirement is stipulated in the Standard Provisions Requirements, May 1986). The CDHS already has a laboratory approval program for hazardous waste analysis which can be integrated in the NPDES permit conditions as a requirement. Data quality could further be improved by also stipulating the limits of detection as a requirement for important toxic compounds such as trace metals.

IV. ACID MINE DRAINAGE

A. INTRODUCTION

The Central Valley Regional Water Quality Control Board presently manages 81 mines under the Waste Discharge Requirement (WDR) and NPDES permitting programs. The Sacramento office oversees 55 active metal mines permitted under the WDR system, the Redding office has 13, and the Fresno office manages eight (Table IV-1). Those mines with NPDES permits are listed in Table IV-2. Since most inactive mines are classified as non-point sources, the Regional Board manages them on a case to case basis, although in some instances, formal permits have been issued as a basis for further enforcement action.

Mines, once active in the extraction of heavy metals, have the potential to spontaneously generate acid mine drainage (AMD) containing toxic levels of copper, cadmium, zinc, and lesser levels of other toxic metals (e.g., nickel, lead, chromium). Acid mine drainage is produced in abandoned tunnel complexes or at the surface of used waste rock piles. Because mining operations have ceased altogether, the present land/mine owner may be unwilling or economically unable to abate the discharge. Further complications occur when the mine site has been sold by the original mining company. Conversely, active mines must comply with WDR conditions as a requisite for continued operations. Although, active mine waste may pose a water quality threat, the permit conditions usually allow for only inert or non-hazardous waste releases. Substantial progress has been made by the Regional Board in curtailing AMD discharges but forcing or incorporating abatement measures remains very time consuming.

Inactive mining prospects are numerous throughout the Central Valley. For instance, at least 160 mine prospects have been documented in Sierra County alone based on California Dept. of Mines and Geology (CDMG) reports and U.S. Geological Survey (USGS) 7 minute quad maps (Matteoli, pers. comm.). Although, smaller mining prospects are investigated by the Regional Board on a compliant basis, most of the larger mines have already been studied. In Buer et al. (1979), 41 of the largest inactive mines known at the time had been characterized and ranked according to their threat to downstream water quality.

Acid mine drainage (AMD) is formed primarily from the oxidation of pyrite sulfide ores (FeS2)(U.S.EPA, 1973 and 1985; Scott and Hayes, 1975; Shumate et al., 1971; and Shumate and Brant, 1971). The oxidation of pyrite is a chemical reaction that occurs within mine tunnel complexes and at the surface of refuse piles (tailings and waste rock dumps) and usually produces sulfuric acid with a pH of around three. The low pH dissolves metals in the surrounding rock generating a discharge containing high dissolved concentrations of copper, zinc (ppm x 100-1,000), cadmium (ppm x 0.1-10), and sometimes other metals. Tunnel complexes act as accelerators of AMD formation due to the increased area of exposed pyrite (e.g., walls, ceiling) and the wet and humid conditions of the mine's interior. For pyrite oxidation to proceed at a significant rate, oxygen must be supplied in the gaseous phase. For instance, only pyritic material that is situated above the groundwater table and is exposed to an oxygen containing atmosphere can be oxidized at significant rates. The products of AMD, formed in the mine, are carried out of the mine when infiltrating water floods the interior to the level of the lowermost adit. Acid mine drainage is also discharged from refuse piles when rainfall or stream flow contacts the pile, transporting the products to downstream receiving waters. As AMD mixes with normal creek water (e.g., pH 7-8), ferric hydroxide precipitates out (along with other metals) producing the typical orange gelatinous floc seen at inactive mine sites. Acid mine drainage from both refuse piles and tunnels cause the same water quality problems: copper and zinc levels that are toxic to receiving water biota.

The exception to typical Central Valley AMD producing sites are inactive mercury mines. Although some sites release pyrite oxidation products, the primary water quality threat from mercury mines exists as rainfall and surface water runoff from mercury burdened waste piles.

Table IV-1. METAL MINING RELATED FACILITIES MANAGED UNDER THE WASTE DISCHARGE SYSTEM (WDS) IN THE CENTRAL VALLEY.

Sacramento Office

AGENCY NAME	FACILITY NAME	WDS # 1/	COUNTY	WASTE TYPE DESCRIPTION 2/
ALHAMBRA MINES, INC	RUBY MINE	5A462022002	Sierra	Product washwater (I)
ALHAMBRA - ATLANTA GOLD MINE	WILBER E. TIMM AND M.A. TIMM	5A091092001	El Dorado	Product washwater wastes (D)
BAYES MINE	WW POND	5A292018001	Nevada	Waste produced from industrial process (D)
BIG DIPPER MINE	TOM C.DYKE DRILLING & BLASTING	5A312030001	Placer	Waste produced from industrial process (D)
BRUSH CREEK MINING CO. INC	GARDNER'S PT MINE/WHITE MTN CO	5A462017001	Sierra	Waste produced from industrial process (D)
BRUSH CREEK MINING & DEV. INC.	BRUSH CREEK LODE MINE	5A462003001	Sierra	Waste produced from industrial process (D)
CALIF. DEPT. OF PARKS AND REC	MALAKOFF DIGGINS HISTORIC PARK	5A290802001	Nevada	Stormwater runoff (D)
CARSON HILL GOLD MINING CORP.	CARSON HILL MINE	5B052011001	Calaveras	Industrial process waste(D), erosion waste(I)
CHANNEL GROUP,THE	PLACER MINE	5A092016001	El Dorado	Dredging spoils (I)
CORONA MINE	MINING WASTE DISCHARGE	5A282002001	Napa	Product washwater wastes (D)
DEEP MOON I	MINE WW	5A462012001	Sierra	Miscellaneous (I)
DEWEY F. PETTIGREW	WINKEYE MINE	5A462010001	Sierra	Waste produced from industrial process (I)
DICKEY EXPLORATION CO.	ORIENTAL MINE	5A462006001	Sierra	Waste produced from industrial process (D)
EAST BRANCH GRAVEL MINE	GOLD MINE	5A312039001	Placer	Erosion waste (D)
EL DORADO MINE	MINING OPERATIONS	5A312027001	Placer	Dredging spoils (D)
GEOPLACERS INC	JOUBERT DIGGINS	5A462020001	Sierra	Product washwater (I)
GEXA MINES CALIF.	CARR MINE	5A042025001	Butte	Product washwater wastes (D)
GOLD RESERVE MINING INC.	FRENCH CORRAL HYDRAULIC MINE	5A292016001	Nevada	Erosion Waste (I)
GOLD ROCK INDUSTRIES	BLAZING STAR MILL/MINE	5B052013001	Calaveras	Industrial process waste, stormwater runoff(D
GORGE QUEEN MINING COMPANY	MINING OPERATIONS	5A312028001	Placer	Dredging spoils (D)
GREENHORN MINING AND AGGR.INC.	PLACER MINING OPERATION	5A582021001	Yuba	Dredging spoils (I)
HANNIX MINES COMPANY	WASTE WATER PONDS	5A462005001	Sierra	Product washwater (I)
HERMISTON, DAVID	NEWTON MINE	5B032003001	Amador	Waste produced from industrial process (I)
HOMESTAKE MINING COMPANY	McLAUGHLIN MINE	5A172013001	Lake	Erosion waste (D)
INDEPENDENT MINE OPERATORS	MINING OPERATIONS	5A312026001	Placer	Dredging spoils (D)
INT,L RESOURCES AND MINERALS	BIRCHVILLE HYDRAULIC PIT	5A292025001	Nevada	Product washwater wastes (D)
INTERNATIONAL RESOURCES INC.	ABBOTT MINE	5A172005001	Lake	Waste produced from industrial process (D)
JACK WESSMAN, OWNER	MT. DIABLO MERCURY MINE	5B072043001	Contra Cos	Stormwater runoff (H)
JAMES CREEK PLACER MINE	MINING WASTE DISCHARGE	5A282003001	Napa	Contaminated Ground Water(D), erosion waste(I
JASPER PLACER MINE	WW POND	5A292019001	Nevada	Product washwater wastes (D)
LANDERS BAR AND STEAMBOAT BAR	PLACER MINES	5A582017001	Yuba	Dredging spoils (I)
M AND H MINING CO	M & H PLACER MINING CLAIM	5A460103001	Sierra	Product washwater (I)
MARCYES PLACER MINE	MINING OPERATIONS	5A312022001	Placer	Dredging spoils (D)
MICHAEL MEISTER MILLER	OSCEOLA/MORNING GLORY MINES	5A462021001	Sierra	Waste produced from industrial process (I)
MINERAL STRATEGIES	HAZEL CREEK MINE, GOLD MINE	5A092007001	El Dorado	Dredging spoils (I)
MINNIE-HA-HA PLACER MINE	POISON OAK FLAT MILL SITE	5A042029001	Butte	Erosion Waste (I)
MRS T. W. PEARSON, ET AL	CALIFORNIA PLACERS INC.	5A311046001	Placer	Product washwater wastes (D)
NEOCENE EXPLORATIONS	PLACER MINE	5A462014001	Sierra	Waste produced from industrial process (I)
NEW PENN MINES, INC.	PENN MINE	5B052004001	Calaveras	Waste produced from industrial process (I)
NORTH COLUMBIA AGGREGATES	TROOD PLACER MINE	5A292029001	Nevada	Erosion Waste (I)
OAT HILL EXTENSION MINE	WASTE DISCHARGE	5A282005001	Napa	Contaminated Ground Water (D)
OAT HILL MINE	WASTE DISPOSAL FACILITY	5A282006001	Napa	Waste produced from industrial process (D)
OMNI ENTERPRISES,INC.	BLUE GOUGE MINE	5A092014001	El Dorado	Waste produced from industrial process (D)
PLUMBAGO MINES, INC	PLUMBAGO LODE MINE	5A461002001	Sierra	Waste produced from industrial process (I)
RICHTER, B. C.	GOLD MINE	5A042030001	Butte	Product washwater (I)
ROBERT W. PERKIN, JOSEPH S. FO	EL DORADO MILL SITE	5B052010001	Calaveras	Waste produced from industrial process (I)
S R MINERALS CORP	BLUE LEAD MINE	5A042027001	Butte	Erosion waste (D)
SIERRA NEVADA MINE & EXPLOR.	PLACER MINE WASTE TRT. FACILIT	5A582011001	Yuba	Dredging spoils (I)
SOLWOOD MINING CO-ARVO JOKI	SOL WOOD MINE	5A462018001	Sierra	Waste produced from industrial process (I)
SPRING CREEK MINE	WW POND	5A292007001	Nevada	Product washwater wastes (D)
SPRING VALLEY MINERALS, INC.	CHEROKEE MINE	5A041036001	Butte	Contaminated Ground Water (D)
SUMMERS, DEL	TUNGO MINE	5A092005001	El Dorado	Waste produced from industrial process (I)
TERTIARY, INC./E.A. HATHAWAY	HATH-REICH PLACER MINE	5A462009001	Sierra	Product washwater wastes (D)
U.S. GEO. RESOURCES, INC.	SORE FINGER POINT-PLACER CLAIM	5A312032001	Placer	Dredging spoils (D)
U.S.FOREST SERVICE	WALKER MINE TAILINGS	5A320704003	Plumas	Erosion waste (D)

continued on next page

Table IV-1. (continued)

AGENCY NAME	FACILITY NAME	WDS # 1/	COUNTY	WASTE TYPE DESCRIPTION 2/
Redding Office				
CONE ENTERPRISE, KROOM USBLM	CONE ENTERPRISE PLACER MINE	5A459007001	Shasta	Industrial process waste(H),storm runoff(
CONSOLIDATED PLACER DRDG,USBLM	IGO GOLD PLACER COMPANY	5A459009001	Shasta	Waste produced from industrial process (N
FISHER-WATT MINING COMPANY	HAYDEN HILL MINE	5A183001001	Lassen	Waste produced from industrial process (H
IRON MOUNTAIN MINES, INC	IMM PILOT PLANT	5A459001002	Shasta	Waste produced from industrial process (H
JOE MUNKOFF & USBLM	HAYDEN HILL MINE	5A183002001	Lassen	Waste produced from industrial process (H
LUCKY CHANCE MINING COMPANY	SUNNYSIDE MINE	5A322013001	Plumas	Dredging spoils (D)
NICHOLLS PLACER MINING COMPANY	MARY CAMERON MINE WTP	5A322009001	Plumas	Dredging spoils (D)
NORTHAIR MINES LTD	BULLY HILL & RISING STAR MINES	5A459002001	Shasta	Stormwater runoff from contaminated soil(H
RUBY J. MINING CO	PLACER MINE	5A322007001	Plumas	Product washwater wastes (D)
SENECA MINING & DEVELOPMENT CO	SENECA MINE	5A322070001	Plumas	Product washwater wastes (D)
USBLM-MULETOWN MINING COMPANY	MULECO MINE	5A459004001	Shasta	Washwater wastes (D), stormwater runoff (N
USDA FS PLUMAS	WALKER MINE TAILINGS	5A320704003	Plumas	Erosion wastes (H)
WASHINGTON NIAGARA MINING LTD	WASHINGTON MINE	5A459005001	Shasta	Industrial process waste(H),storm runoff(N
Fresno Office				
ARCHER MINING CO.	ARCHER MINE	5D102013001	FRESNO	Miscellaneous wastewater (D)
BROWN, JOEL	RUTH PIERCE MILL	5C221014001	MARIPOSA	Industrial process waste (D)
CAL-MERC MINING CO.	JUNIPER MINES	5C352000001	SAN BENITO	Miscellaneous wastewater (I)
IDRIA LAND & DEVELOPMENT CO.	NEW IDRIA MINE	5C352001001	SAN BENITO	Industrial process waste(D),miscellaneous(D
JORDAN, FRED AND WALKER, DOCK	JORDAN-WALKER TUNGSTEN MILL	5D542039001	TULARE	Washwater wastes (D)
MT. GAINES MINE	MT. GAINES MINE	5C221013001	MARIPOSA	Industrial process waste (D)
SIERRA GOLD PLACERS	McCABE FLAT MINING	5C222000001	MARIPOSA	Washwater wastes (D)
TELEDYNE TUNGSTEN CORP	STRAWBERRY MINE	5C202014001	MADERA	Industrial process waste (I)

1/ Waste Discharge System number. The unique number assigned to each Waste Discharge Requirements recipient.
2/ Description given to agency's activity. D=designated (non-hadardous but may pose water quality threat), N=non-hazardous solid wastes, H=hazardous, and I=inert.

Table IV-2. ACTIVE AND INACTIVE MINING FACILITIES IN THE CENTRAL VALLEY MANAGED UNDER THE NPDES PROGRAM

AGENCY NAME	FACILITY NAME	NPDES #	COUNTY	WASTE TYPE
ALHAMBRA MINES, INC.	MAPLE GROVE MINE	CA0081591	Sierra	process waste
CALCOM MINING, INC.		CA0081906		process waste
D.E.W. CORP.-CANDOR EXP.	SUNNYSIDE MINE	CA0079766	Sierra	process waste
FEATHER FORK MINES	MINE WASTEWATER PONDS	CA0080969	Plumas	process waste
HOMESTAKE MINING CO.	McLAUGHLIN MINE	CA0081477	Lake	process waste
IRON MOUNTAIN MINES, INC.	ACID MINE DRAINAGE	CA0081108	Shasta	acid mine drainage
JAMESTOWN MINE/SMC	SONORA MINING CO.	CA0081698	Tuolumne	process waste
KANAKA CREEK JOINT VENTURE	TH 16 TO 1 MINE	CA0081809	Sierra	process waste
PORTLAND GENERAL ELECTRIC CO.	MIRACLE HOT SPRINGS MINE	CA0081116	Kern	washwater
ROBERT L. BARRY, ET AL.	WALKER MINE	CA0080110	Plumas	acid mine drainage
SHARON STEEL CORP.	MAMMOTH MINE	CA0081876	Shasta	acid mine drainage
SILVER KING MINES INC.	BALAKLALA/KEYSTONE MINES	CA0081868	Shasta	acid mine drainage

Information and histories of fifteen major inactive mines in the Central Valley (as concluded in Buer et al., 1979) were reviewed to determine the extent of their pollutant contribution to the Central Valley. Information was garnered from Regional Board case history files and pertinent reports. A review of the major characteristics of each mine is followed by mass loading estimates from mines situated below major reservoirs.

B. METHODS

Trace metal loads were estimated from inactive mines discharging below major dam structures (Iron Mountain, Newton, New Idria, and Afterthought Mines). Loads were calculated as the product of average water concentrations (total), flow-volumes, and the proper conversion factors. Concentrations reported as "less than detection" were assigned a value of zero for the calculations. Copper and zinc loads from Iron Mt. Mine (IMM) were estimated using monthly Spring Creek Diversion Dam (SCDD) release data and weekly concentration measurements as reported in 1985 U.S. Bureau of Reclamation (USBR) "Daily Operation Sheets"; the concentration data has been confirmed to be relatively accurate (Heiman pers. comm.). Afterthought Mine loads were estimated by separating the data into wet and dry periods corresponding to seasonal sampling information. Loads from Newton and New Idria Mines were calculated with averaged historic values. Although, Cherokee and Manzanita Mines are situated below most major dams, data was too limited for calculating loads.

C. RESULTS AND DISCUSSION

1. Characteristics of Major Central Valley Inactive Mines

Table IV-3 and Figures IV-1 and IV-2 show the characteristics of several major mines and their location in the Central Valley. A majority of the mines are clustered around Redding in the northern Sacramento Valley - the most notable is IMM. The IMM complex is considered the largest AMD pollutant source in the Central Valley. Other major mines around the Valley producing AMD include the Penn, Walker, Cherokee, and Newton Mines. Mercury extraction mines are primarily located in the western foothills of the Central Valley. Although some mercury mines discharge products of pyrite oxidation (e.g., Corona, New Idria, and Mt. Diablo Mines), the mercury content of surrounding refuse piles is considered the major pollutant threatening water quality from these mines. Most of the mines in Table IV-3 possess at least one adit and several adits within a mine complex is more common. The exceptions are Manzanita and Sulfur Bank Mines which are open pit mines. Refuse piles (waste rock and tailings) are present at every mine site.

Inactive mines have degraded water quality from both tunnel releases and runoff from surrounding refuse piles. At almost all the sites, year-round tunnel releases has completely eliminated stream life in the immediate receiving streams (Table IV-3). Further downstream, periodic impairment incidences can occur because of varying discharge volumes and receiving water conditions. For instance, impacts such as fish kills have been chronicled in the upper Sacramento River for over 40 years (Nordstrom et al., 1977). Furthermore, fish kills in localized arms of Shasta Lake occur almost annually where streams, receiving summer AMD from tunnel releases, initially empty into the lake. As with tunnel discharges, rainfall runoff from mine sites can also impact water quality.

The limited number of studies that have been performed on runoff from refuse piles show that the water quality impairment and loading potential from this component of inactive mines can be substantial. For instance, prior to abatement controls, runoff from Penn Mine refuse piles was causing periodic salmonid die-offs at the Mokelumne River fish installation (Rectenwald, 1978). Copper and zinc contaminated runoff travelled the distance of Camanche Reservoir (approximately 10 miles) along the submerged Mokelumne Riverbed to the base of the dam, subsequently causing fish kills several days after a storm event. Other incidences of polluted runoff have been related to mercury extraction mines. Runoff from Mt. Diablo Mine was believed to have contaminated Marsh Creek Reservoir (downstream

Table IV-3. SUMMARY OF 15 MAJOR INACTIVE MINES LOCATED IN THE CENTRAL VALLEY.

MAP I.D.	NAME COUNTY	MAJOR POLLUTANT(S)	MAJOR SOURCE(S) 1/	RANK & RATING 2/	RECEIVING WATERS 3/	CVRWQCB PERMIT(S) ISSUED 4/ OR REQUIRED	ABATEMENT MEASURES COMPLETED 5/ FS	P	RD	SR	AS	HS	CP	SR
AM	-Afterthought (Shasta)	Cu,Zn,Cd	Adit/Refuse	6 H	Norton Gulch*-Little Cow Creek-Cow Creek-Sacramento River	WDR	X							
BM,KM	-Balaklala, Keystone, Shasta King (Shasta)	Cu, Zn, Cd	Adits/Refuse	4,5 H	West Squaw Creek*-Shasta Lake**	NPDES (storm runoff from contaminated soil)	X		X		X	X		
BHM	-Bully Hill and Rising Star (Shasta)	Cu, Zn, Cd, Pb	Refuse/Adits	8 H	Town Creek(?)-Shasta Lake	WDR (storm runoff from contaminated soil)	X							
CKM	-Cherokee (Butte)	Hg	Refuse	17 M	Sawmill Ravine(?)-Dry Creek-Butte Creek	WDR (contaminated runoff)								
CM	-Corona (Napa)	Cu, Hg	2 Adits/Refuse	14 M	James Creek*-Pope Creek**-Lake Berryessa	WDR (wastewater)								
GM	-Greenhorn (Shasta)	Cu, Zn, Cd	Refuse/Adit	12 M	Willow Creek*-Crystal Creek-Clear Creek-Whiskeytown Lake	None	X							
IMM	-Iron Mountain Mine (Shasta)	Cu, Zn, Cd	Adits/Refuse	1 H	Boulder, Slickrock Creeks*-Spring Creek*-Sacramento River**	NPDES (precipitation plants), WDR (pilot plant), TPCA	X (2)		X				X	X
MM	-Mammoth (Shasta)	Cu, Zn, Cd	Adits/Refuse	2 H	Shoemaker Gulch, Little Backbone Creek*-Shasta Lake**	NPDES (storm runoff from contaminated soil)	X (2)		X			X		
MZM	-Manzanita (Colusa)	Hg	Refuse	16 M	Sulfer Creek-Bear Creek-Cache Creek-Toe Drain-Cache Slough-Sacramento River	None								
MDM	-Mt Diablo (Contra Costa)	Hg,As,Zn,Pb,Cd	Refuse/Adit	7 H	Dunn Creek*-Marsh Creek**-Marsh Creek Reservoir**-Marsh Creek-San Joaquin River (near Oakley)	TPCA, WDR (stormwater runoff)	X	X	X					

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Table IV-3 (continued).

MAP I.D.	NAME COUNTY	MAJOR POLLUTANT(S)	MAJOR SOURCE(S) 1/	RANK & RATING 2/	RECEIVING WATERS 3/	CVRWQCB PERMIT(S) ISSUED 4/ OR REQUIRED	ABATEMENT MEASURES COMPLETED 5/ FS	P	RD	SR	AS	HS	CP	SR
NIM	-New Idria (San Benito)													
		As, Cu, Hg	Adit/Refuse	13 M	San Carlos Creek*-Silver Creek-Panoche Creek-Fresno Slough-San Joaquin River (near Mendota)	WDR	X	X						
NM	-Newton (Amador)													
		Cu	Refuse/Adit	11 M	Copper Creek*-Sutter Creek-Dry Creek-Mokelumne River	WDR (process waste)								
PM	-Penn (Calaveras)													
		Cu, Zn, As, Pb	Refuse/Adit	3 H	Hickley Creek, Mine Run Creek, Oregon Creek*-Comanche Lake-Mokelumne River**	TPCA, WDR (process waste)	X (3)	X	X	X				
SBM	-Sulfer Bank Mine (Lake)													
		Hg, As	Refuse	10 H	Clear Lake**	TPCA	X	X	X					
WM	-Walker Mine (Plumas)													
		Cu, Zn	Adits/refuse	9 H	Dollie Creek*-Little Grizzly Creek*-Indian Creek**-East Branch North Fork Feather River-North Fork Feather River-Feather River-Oroville Reservoir	WDR (tailings), WDR (adit), TPCA	X (6)	X	X				X	X

1/ Refuse includes mining produced tailings and/or waste rock.
2/ Rank and rating reported from Buer et al. (1978) (H=high or M=medium threat to water quality).
3/ * indicates complete elimination of aquatic biota in receiving waters downstream of the mine.
** indicates periodic problems (e.g. fish kills, water discoloration, loss of benefical uses) due to the upstream mine.
4/ NPDES=National Pollution Discharge Elimination System
WDR=Waste Discharge Requirements
TPCA=Toxic Pit Control Act
5/ FS=Feasability Study P=Ponding RD=Runoff Diversion SR=Sediment Removal AR=Air Seal HS=Hydrolic Seal
CP=Copper Precipitation Plant SR=Successful Reimbursement (partial or full)

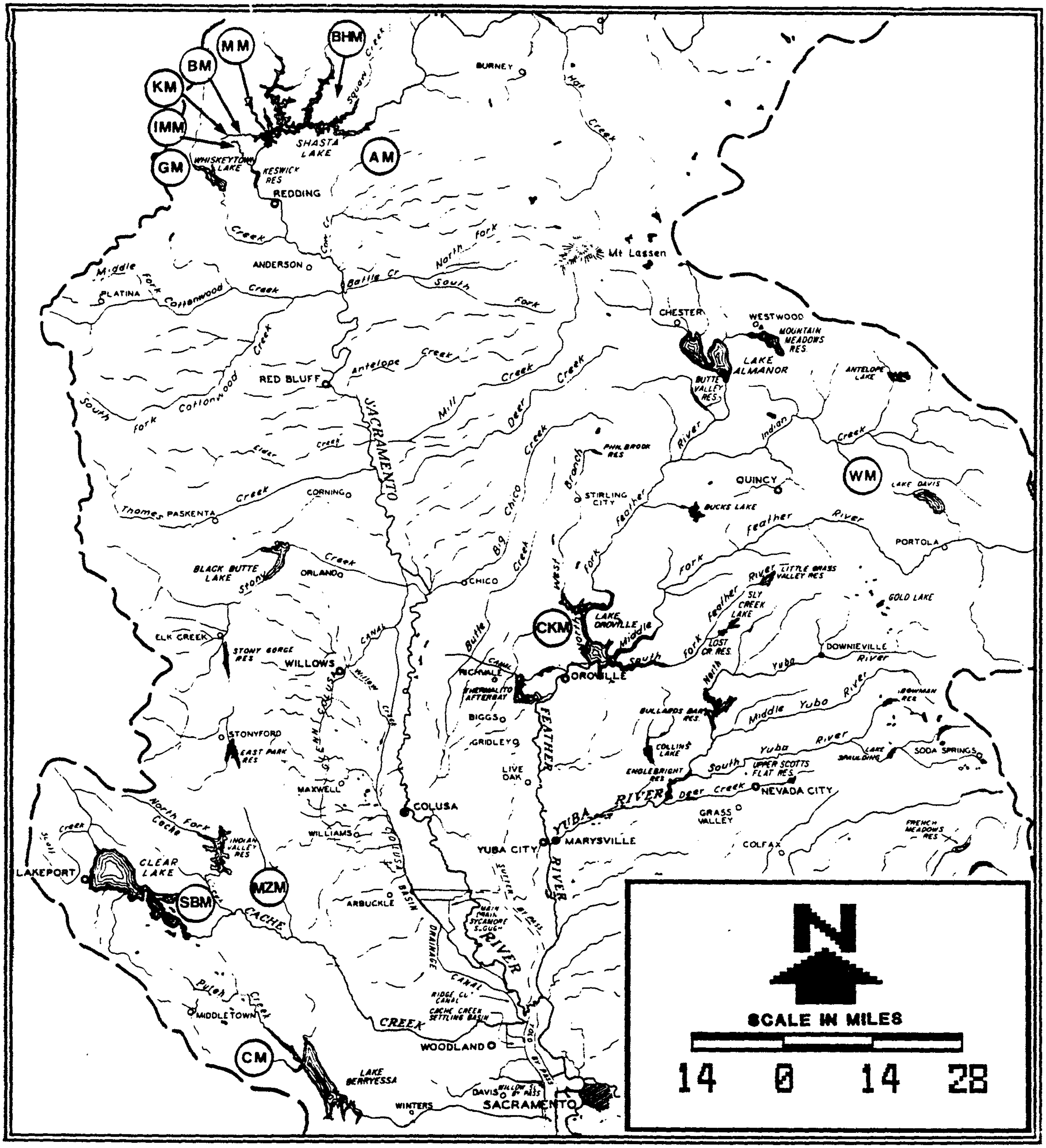

Figure IV-1. MAJOR INACTIVE MINE SITES IN THE NORTHERN CENTRAL VALLEY. SEE TABLE IV-3 FOR MINE DESCRIPTIONS.

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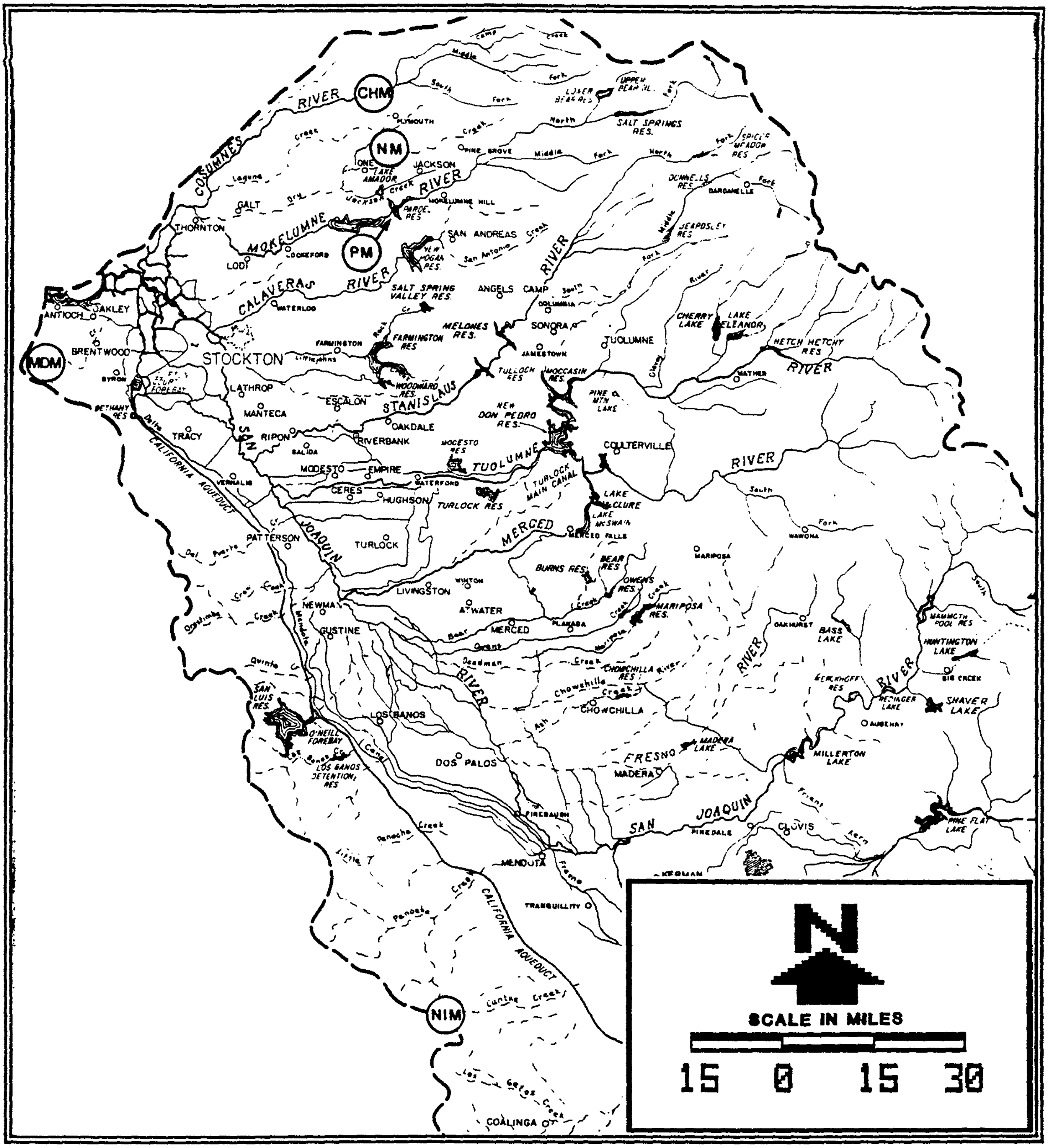


Figure IV-2. MAJOR INACTIVE MINE SITES IN THE SOUTHERN CENTRAL VALLEY. SEE TABLE IV-3 FOR MINE DESCRIPTIONS.

from the mine) to the extent that CDHS was forced to restrict public access due to high levels of mercury in fish. Rainfall runoff from both Mt. Diablo and New Idria Mercury Mines have in the past forced downstream ranchers to find other sources of water for their cattle and farmland when the streams were periodically impacted. Possibly the most extensive mercury pollution problem in the Valley has been the result of overland runoff from a single open pit mine located on the shoreline of Clear Lake (Sulfur Bank Mine). Sulfur Bank Mine has been shown to be a major contributor of mercury laden sediment to the Oaks Arm of Clear Lake (Walker pers. comm.). The California Dept. of Health Services has subsequently posted public warnings against eating the mercury tainted fish there.

Controlling AMD is, and has been, a continuing effort by the Regional Board. Regional Board involvement in pursuing site cleanup in some cases, has exceeded 28 years (e.g., Corona, Mt. Diablo, New Idria, Penn, Sulfur Bank, and Walker Mines). Documented chronologies of Regional Board involvement in inactive mine regulation show that, in the past, the initiation of enforcement action usually leads to litigation proceedings in the California Court system (see chronologies in Appendix B). However, several mine owners have responded well to standard Board efforts to implement mitigative measures (NPDES and WDR permits, Cease and Desist orders, and Cleanup and Abatement orders). Mitigative measures have also been implemented using state Cleanup and Abatement or federal Superfund monies. Point source permits (NPDES) have been issued in the past to mines discharging from copper precipitation plants (e.g., IMM). Waste Discharge requirements have also been issued to several mines as a precursor to further formal enforcement action.

Two general types of control structures have been incorporated at Central Valley mines; at-source controls (e.g., portal seals, diversion works) and treatment (e.g., copper precipitation plants). The most common control measure has been diversion of runoff around refuse piles and, to a lesser extent, around subsidence areas above the mine (Table IV-3). Although a total of four hydraulic plugs have been installed at three mine complexes (Balaklala, Walker, and Mammoth Mines), their effectiveness can vary depending on the characteristics of the mine (e.g., plug integrity, fissures and cracks, and other mine openings). The ponding of tailings runoff has been performed at several sites: the resultant buildup of metals to hazardous levels has subjected these sites to Toxic Pit Control Act (TPCA) regulations.

2. Mass Loads

The concentration and flow data for the four mines are presented in Tables IV-4-8. Several distinctions are apparent from the data. First, data from IMM was most complete since flows and concentration measurements were, respectively, recorded daily and weekly by the USBR. Conversely, a dearth of information existed for New Idria and Newton Mines. For instance, the nature of the Newton Mine suggests that zinc and cadmium may be present at high levels, however, only copper and mercury data was available. Moreover, analysis of the samples occurred during 1965-79, making most of the available results questionable. The lack of data may be inconsequential since outflows from Afterthought, Newton, and New Idria Mines combined, made up only a small fraction of the total outflows compared to IMM. It should be noted that other major AMD discharge sites exist in the Valley but were not included in the loading estimates because of the potential for the pollutants to become entrained within downstream reservoirs.

Iron Mountain Mine discharged the greatest trace metal loads during 1985 (Table IV-9). Loads for copper and zinc were most notable ranging from 3,000 to 35,000 pounds per month for copper and from 18,000 to 370,000 pounds per month for zinc (Figure IV-3). Ninety six percent of the total AMD copper loads and 99% of the zinc loads came from IMM. The lack of concentration data and diminutive flows from the other sites included here may unfavorably distort IMM's relative input, however, high loads from IMM have been confirmed elsewhere. In 1977, IMM was estimated to contribute over 50% of the total metals input to the upper Sacramento River Valley (Nordstrom et al., 1977). This is significant since Nordstrom et al. included mines and stream tributaries above Shasta Dam which were not included here. Therefore, although the loading from IMM is substantial,

Table IV-4. IRON MOUNTAIN MINE COPPER AND ZINC CONCENTRATIONS FROM SPRING CREEK DIVERSION DAM, 1985. DATA OBTAINED FROM USBR DAILY OPERATION SHEETS.

MONTH (1985)	SPRING CREEK DIVERSION DAM RELEASES: RANGE (DAILY CFS)	SPRING CREEK DIVERSION DAM RELEASES: MONTHLY (TOTAL ACRE-FEET)	MEAN WATER CONCENTRATION (MG/L) 1/: COPPER	N	ZINC	N
JANUARY	11-24	702	1.72	4	12.44	4
FEBRUARY	11-40	1246	1.50	4	11.31	4
MARCH	11-24	1420	1.54	3	17.42	2
APRIL	0-24	637	1.58	2	10.60	3
MAY	0-52	926	1.80	1	7.00	1
JUNE	36-43	2902	2.81	3	19.49	3
JULY	2/	2613	4.15	5	29.42	5
AUGUST	31-38	2323	5.62	2	58.40	2
SEPTEMBER	0-38	841	3.69	3	43.41	3
OCTOBER	6-11	667	3.01	3	49.00	3
NOVEMBER	0-12	266	3.15	2	33.16	2
DECEMBER	6-36	1454	1.73	4	10.45	4

1/ N=number of grab samples taken during the month.

2/ Flow values not available for July. Total acre-feet calculated as mean of June and August

Table IV-5. METALS LEVELS IN SPRING CREEK DIVERSION DAM RELEASES (CH2M Hill, 1985).

YEAR	PERIOD	MONTH	DAY	METAL (UG/L) 1/: CADMIUM	CHROMIUM	LEAD	NICKEL 2/
1984	WET	January	4	45	N.A.	N.A.	N.A.
			17	88	N.A.	N.A.	N.A.
		February	1	120	N.A.	N.A.	N.A.
			15	64	N.A.	N.A.	N.A.
			29	71	N.A.	N.A.	N.A.
		March	14	74	N.A.	N.A.	N.A.
			27	33	N.A.	N.A.	N.A.
		April	10	69	N.A.	N.A.	N.A.
			25	91	N.A.	N.A.	N.A.
	AVERAGE			73			
	DRY	May	8	120	N.A.	N.A.	N.A.
			22	90	10	14	<15
		June 3/	5	120	N.A.	11	23
			28	161	N.A.	N.A.	N.A.
	AVERAGE			123	10	13	12

1/ N.A.=not analyzed.

2/ Less than detected (<15) was assigned a value of 0.

3/ Priority pollutant metals not detected on May 22 and June 5, 1984: antimony (<20 ug/l); arsenic (<10 ug/l);beryllium (<1 ug/l); mercury (<0.1 ug/l); selenium (<2 ug/l); silver (<1 ug/l); thalliu (<10 ug/l).

Table IV-6. NEWTON MINE HISTORICAL METALS LEVELS AND FLOW.

YEAR	DATE	DISCHARGE SAMPLED 1/	FLOW (CFS)	CONC. (UG/L) 2/ COPPER	MERCURY	MONITORING AGENCY
1965	April 12	mine area watercourses	0.5	N.A.	N.A.	CVRWQCB
1970	October 9	seepage from stream bank	0.002	N.A.	N.A.	CVRWQCB
1971	April 9	mine area	0.25	12,000	0.2	CVRWQCB
1979	March 12	stream downstream mine	0.32	11,400	N.A.	CVRWQCB
		AVERAGE	0.18	11700	0.2	
	LOADS (POUNDS PER DAY)			11.36	0.00019	

1/ As reported in the file memos.
2/ N.A.= not analyzed.

Table IV-7. NEW IDRIA MINE HISTORICAL METALS LEVELS AND FLOW.

YEAR	DATE	DISCHARGE SAMPLED 1/	FLOW (CFS)	CONCENTRATION (UG/L) 2/ ARSENIC	CADMIUM	COPPER	CHROMIUM	LEAD	MERCURY	MONITORING AGENCY
1971	June 28	waste and creek junction	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	11	CVRWQCB
1975	April 1	main portal	N.A.	50	0	580	0	10	2.3	CVRWQCB
1975	April 8	mine runoff	0.5-6	20	0	450	N.A.	10	4	CVRWQCB
1976	October 29	mine discharge	0.045	N.A.	N.A.	N.A.	N.A.	N.A.	1.4	U.S.EPA
1977	February 4	mine tunnel	N.A.	5	52	80	250	150	0.3	OWNER
		AVERAGE	0.3	25	17.3	370	125	56.7	3.8	
		LOADS (POUNDS PER DAY)		0.040	0.028	0.599	0.202	0.092	0.006	

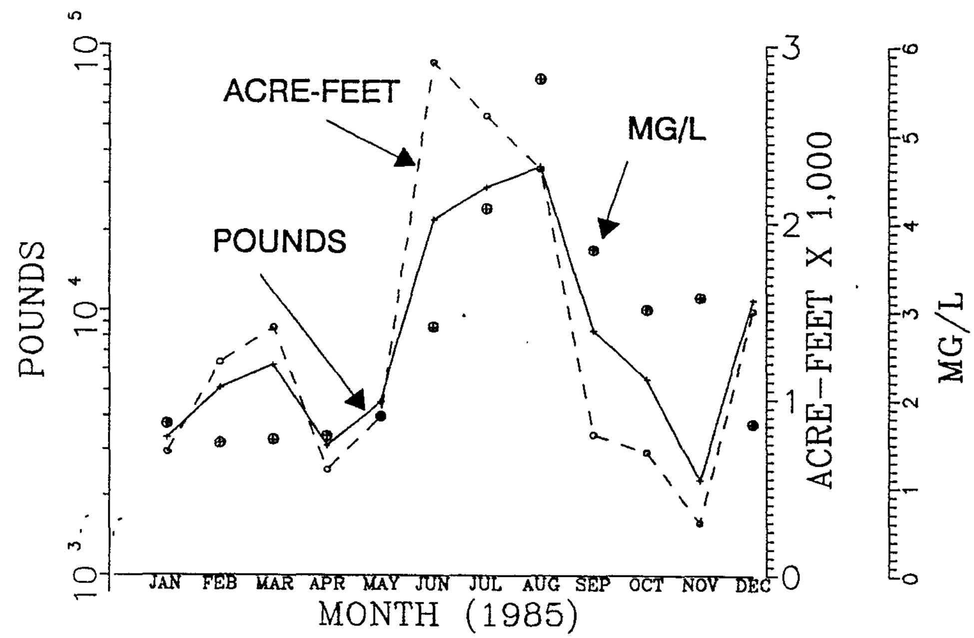
1/ As reported in the file memos.
2/ N.A.= not analyzed.

Table IV-8. AFTERTHOUGHT MINE METALS CONCENTRATIONS AND FLOW RATES.

AMD SOURCE	WEATHER PERIOD	MONTH (YEAR)	FLOW (GPM)	CONCENTRATION (UG/L) CADMIUM	COPPER	ZINC
Seep	Wet	March (1978)	NA	10	10	580
		April (1984)	0.25	0.3	3	220
		December (1984)	0.7	1	5	190
		AVERAGE	0.5	4	6	330
	Dry	June (1984)	Dry	---	---	---
		August (1984)	Dry	---	---	---
		AVERAGE	0.0	0	0	0
Portal (4)	Wet	April (1984)	3.2	60	910	13000
		December (1984)	7.2	120	2820	25400
		AVERAGE	5.2	90	1865	19200
	Dry	June (1984)	0.2	40	950	1300
		August (1984)	Dry	---	---	---
		AVERAGE	0.1	40	950	1300

AMD SOURCE	WEATHER PERIOD	MONTH (YEAR)	FLOW (GPM)	CONCENTRATION (UG/L) CADMIUM	COPPER	ZINC
Portal (6)	Wet	March (1978)	NA	10	2250	2380
		April (1984)	1	10	650	1240
		December (1984)	1	20	750	1460
		AVERAGE	1.0	13	1217	1693
	Dry	June (1984)	0.2	5	450	1020
		August (1984)	Dry	---	---	---
		AVERAGE	0.1	5	450	1020
Portal (8)	Wet	May (1975)	NA	580	19400	127000
		March (1978)	NA	1230	48900	313000
		March (1978)	NA	440	16500	96500
		April (1984)	18.4	410	17600	100000
		December (1984)	28.3	740	34100	177000
		AVERAGE	23.4	680	27300	162700
	Dry	June (1978)	NA	730	26000	149000
		June (1984)	5.4	320	12100	91400
		August (1984)	3.5	740	34100	177000
		AVERAGE	4.5	597	24067	139133

COPPER



ZINC

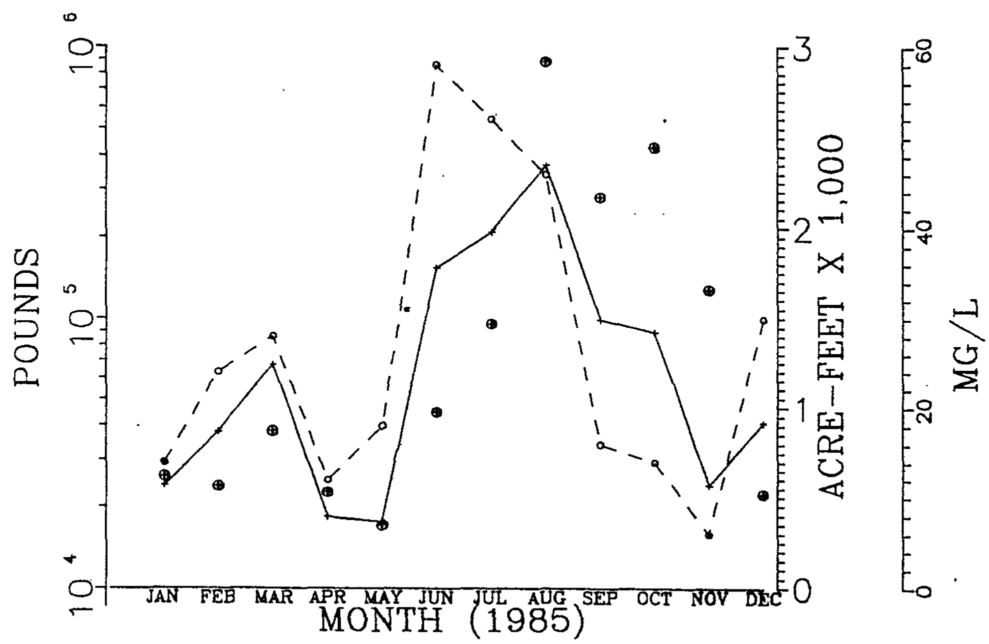


Figure IV-3. SPRING CREEK DIVERSION DAM DISCHARGES OF COPPER, ZINC, AND CADMIUM FROM IRON MOUNTAIN MINE, 1985.

information on the other mines is not complete enough to determine, with certainty, their relative contribution.

Monthly copper and zinc loads from IMM were highest during the summer of 1985 (Figure IV-3). The trend towards summer increases reflects a higher rate of discharge from SCDD in accordance with a release schedule stipulated in a 1980 Memorandum of Understanding with the Regional Board and several other agencies. In short, when Sacramento River flows increase SCDD is allowed to release more (the assumption is higher dilution will occur). During the summer months Shasta Dam releases typically increase by several times over the wet period releases. When coordinated properly, copper and zinc levels in the River downstream SCDD remain below stated criteria (copper: 0.01 mg/l, zinc: 0.072 mg/l), however, in an "emergency", the allowable criteria levels are increased to 0.015 and 0.108 mg/l, respectively. An "emergency" situation exists when SCDD storage exceeds 5,000 acre-feet. During periods of heavy rainfall SCDD may increase releases to lower the reservoir level in an attempt to prevent an uncontrolled spill. Therefore, total monthly loads are expected to increase during both the summer months and during periods of heavy rainfall. Figure IV-2 shows IMM loads did increase during the summer (1985) as expected but did not notably increase during the rainy season. This was possibly due to less than average rainfall received in 1985 that resulted in no uncontrolled releases.

Table IV-9. ANNUAL MASS LOADS OF METALS FROM FOUR MAJOR ABANDONED MINES IN THE CENTRAL VALLEY, 1985 (MINES LOCATED BELOW DAM STRUCTURES).

	POUNDS (PERCENT OF TOTAL IN PARENTHESES)							
MINE NAME	ARSENIC	CADMIUM	CHROMIUM	COPPER	LEAD	MERCURY	NICKEL	ZINC
Iron Mt. Mine	0 (0)	4,800 (99)	500 (87)	137,000 (96)	600 (94)	0 (0)	500 (100)	1,151,000 (99)
Others 1/	12	64	72	6,300	36	2	0	11,000
GRAND TOTAL	12	4,800	500	143,000	600	2	500	1,162,000

1/ Newton, New Idria, and Afterthought Mines.

V. SACRAMENTO VALLEY AGRICULTURAL DRAINAGE

A. INTRODUCTION

Agriculture is pervasive throughout the Sacramento Valley. Much of the Valley's 26,500 square miles (California basin) is devoted to agricultural practices associated with growing rice. Approximately three percent of the total basin or about 36% of the major agricultural watershed acreage is dedicated to rice cultivation (Table V-l)(CDFA, 1979). The bulk of the tail-water from Sacramento Valley agricultural drains originates from rice growing practices (Tanji et al., 1978). Major agricultural watersheds in the Sacramento Valley extend from below Chico, south, to the city of Sacramento (Figures V-1 and V-2).

Only drainage from the Sacramento Valley was reviewed here, although, agriculturally related wastewater also originates from the Central Delta and San Joaquin Valley. San Joaquin drainage was excluded because it is presently being investigated by several state and federal agencies making up the Technical Committee. The number of agricultural discharges from Delta island pumps is extensive and beyond the scope of this report, however, a California Dept. of Water Resources (CDWR) program is apparently underway to locate and characterize these discharges (Proctor, pers. comm.).

Unlike organic chemicals, trace metals (most notably copper, zinc, cadmium, chromium, and nickel) are consistently found in agricultural drainage. Metal concentration trends are discussed next followed by an estimate of metallic mass loads from Sacramento Valley agriculture. Organic chemical loads were not included due to the lack of adequate concentration data - molinate and thiobencarb loads have been performed annually in other reports (Cornacchia et al., 1984-85; CDFA, 1986).

B. METHODS

Much of the trace metal data from Sacramento Valley agriculture has been collected by the Regional Board and the SWRCB over the past three years. Sampling was conducted during the first half of 1987 to fill the existing data gaps from an earlier 1985 monitoring program (Cornacchia, et al., 1986). Samples were collected from Colusa Basin Drain (CBD), Sacramento Slough (SS), RD1OOO, RD108, Toe Drain, and Natomas East Main Drain (NEMD) on a monthly basis from January to April and weekly thereafter to July, 1987. In addition, a metals scan of agricultural drainage during and after a rainstorm event (31 December 1986 to 7 January 1987) was conducted to evaluate the potential for loading surges during the rainy season. Sampling and quality assurance procedures are presented in Appendix F for the 1987 data and in Cornacchia et al. (1986) for the 1985 sampling results.

Mass loads for several trace metals were calculated from five major Sacramento Valley agricultural drains as the product of flow-volumes, total metal concentrations, and the proper conversion factors. Flow-volumes (for 1985) from RD108, CBD, SS, Toe Drain, and RD1OOO were obtained from USGS and CDWR data banks, reclamation districts' records, and CDWR Dayflow Reports (Table V-3). Concentration data for arsenic, cadmium, chromium, copper, nickel, and zinc were averaged for the loading estimates; May-June concentrations were averaged separately corresponding to the pesticide application period. Concentrations reported as "less than detectable" were assigned a value of zero for the averaging.

C. RESULTS AND DISCUSSION

Trace metal concentration data is tabulated in Appendix D. Discussion of the quality control results for the 1987 sample data is presented in Appendix F.

Table V-1. ACREAGE ESTIMATES FOR SEVEN MAJOR SACRAMENTO VALLEY AGRICULTURAL WATERSHEDS, 1982. 1/

COMBINED OUTLET I.D. WATERSHEDS 2/	TOTAL IRRIGATED ACRES	RICE GROWING ACRES	PERCENT OF TOTAL (%)
CBD, RD108, RD787, RCWD	450,000	196,000	44
RD70, BSO, CS, SS	485,000	185,000	38
H	11,500	3,700	32
JS	43,000	21,000	49
BS	51,000	11,000	22
NCC, RD1000, NEMD	147,000	61,000	41
SID, HF	180,000	18,000	10
TOTAL	1,367,500	495,700	36

1/ Adapted from CDWR, 1984 (DRAFT).

2/ See Figures V-1 and V-2 and Table V-2.

Table V-2. AGRICULTURAL DRAINS IN THE SACRAMENTO VALLEY.

MAP I.D. 1/	DRAIN NAME	EFFLUENT STRUCTURE	RECEIVING WATER ROUTE TO THE SACRAMENTO RIVER (SR)
1	Cox Spill	?	Feather R.->SR
2	Honcut Creek	gravity	Feather R.->SR
3	Butte Slough Outfall	gate	SR
4	Jack Slough	?	Feather R.->SR
5	RD 70	pump	SR
6	Best Slough	?	Bear R.->Feather R.->SR
7	RD 108	pump	SR
8	Sacramento Slough	gravity	SR
9	RD 787	pump	SR
10	Colusa Basin Drain	gate	SR
11	Ridge Cut W.D.	gate	Toe Drain->Cache Sl.->SR
12	Natomas Cross Canal	gravity	SR
13	Natomas W. Drain Pump	Pump	SR
14	RD 1000	gate/pump	SR
15	Natomas E. Main Drain	gravity	SR
16	Heidrick Farms	gate	Toe Drain->Cache Sl.->SR
17	Untitled 1	pump	SR
18	Solano I.D.	?	Putah Cr.->Toe Drain->Cache Sl.-SR
19	Sump 90 (Sac. City)	Pump	SR

1/ Refer to Figures V-1 and V-2 for map I.D. location.

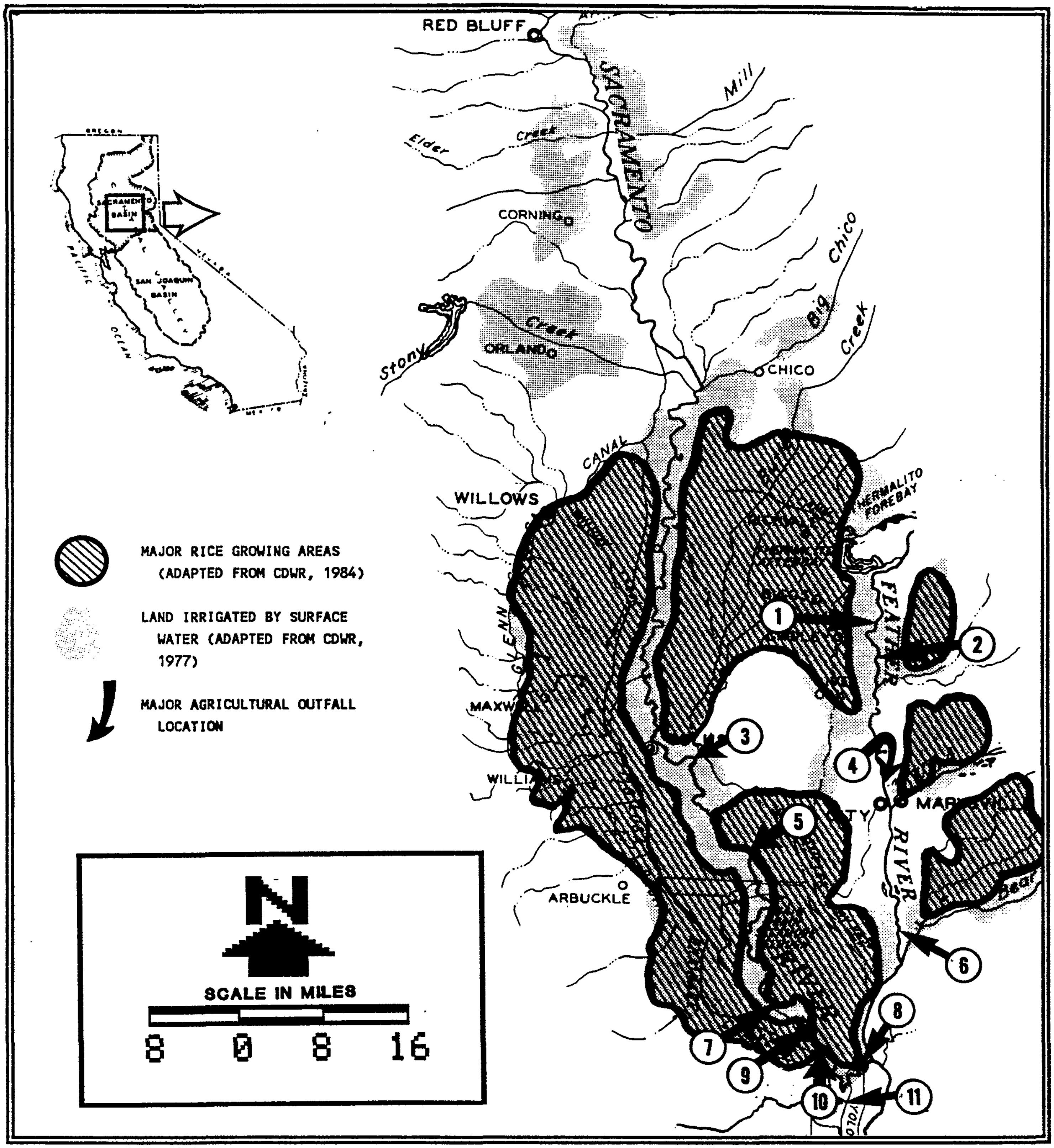


Figure V-1. MAJOR NORTHERN SACRAMENTO VALLEY AGRICULTURAL WATERSHEDS AND THEIR DISCHARGE LOCATIONS. SEE TABLE V-2 FOR LOCATION DESCRIPTIONS.

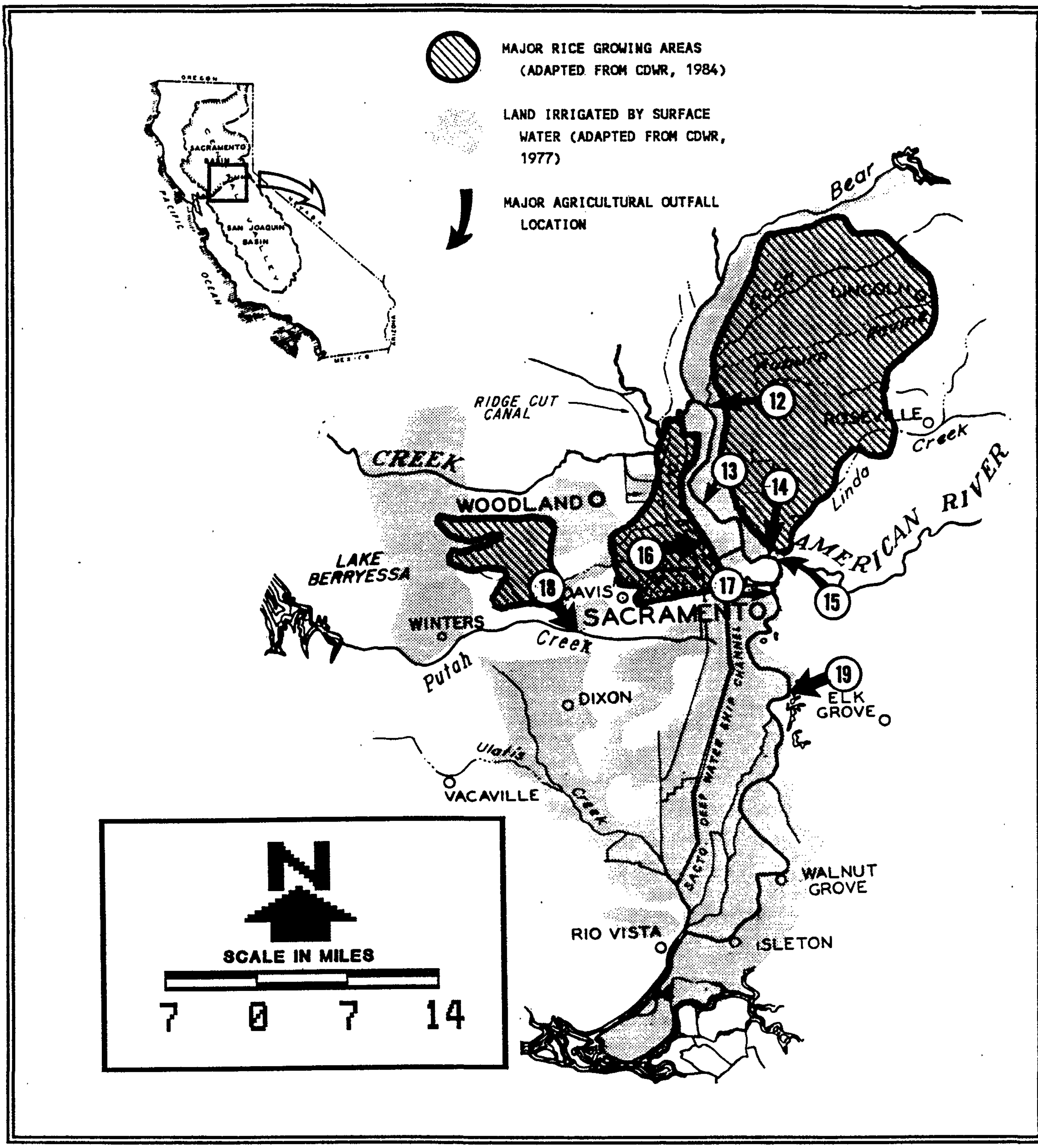


Figure V-2. MAJOR SOUTHERN SACRAMENTO VALLEY AGRICULTURAL WATERSHEDS AND THEIR DISCHARGE LOCATIONS. SEE TABLE V-2 FOR LOCATION DESCRIPTIONS.

Table V-3. MONTHLY FLOW-VOLUMES FROM FIVE MAJOR SACRAMENTO VALLEY AGRICULTURAL DRAINAGES (SOURCES: USGS, CDWR, AND RD1000 DATA BANKS; CDWR DAYFLOW REPORTS).

	AGRICULTURAL DRAIN FLOW VOLUMES (AC-FT)					
MONTH (1985)	RD108	COLUSA BASIN DRAIN	SACRAMENTO SLOUGH	RD1000	TOE DRAIN	TOTAL OUTFLOW
January	2,834	19,210	36,080	1,370	2,981	62,475
February	2,204	10,180	31,640	0	8,707	52,731
March	3,208	12,500	29,720	580	284	46,292
April	2,055	24,470	37,530	500	0	64,555
May	7,932	56,840	51,020	180	0	115,972
June	7,137	39,920	45,860	0	0	92,917
July	7,369	68,840	52,050	157	0	128,416
August	9,363	87,870	89,610	1,339	0	188,182
September	6,369	97,870	97,580	3,506	0	205,325
October	1,295	25,740	95,740	375	1,184	124,334
November	967	45,800	105,100	760	1,431	154,058
December	1,843	44,670	210,200	2,165	10,763	269,641

Table V-4. AVERAGE METALS CONCENTRATION RANGES IN SIX SACRAMENTO AGRICULTURAL DRAINS, 1985-87.

	AVERAGE CONCENTRATION IN UG/L [AVERAGE(LOW-HIGH : NUMBER OF SAMPLES) COV IN PERCENT 2/					
DRAIN 1/	ARSENIC	CADMIUM	CHROMIUM	COPPER	NICKEL	ZINC
RD108	NA	0.2 (0.0-1.5:13)200	4.7 (1.5-9.0:9) 51	7.6 (4.5-14:13)32	8.7 (0.0-16:13) 47	14 (4.0-30:13) 48
CBD	<5-2.3	0.1 (0.0-1.3:31)300	12 (4.5-37:17) 64	9.6 (4.5-21:38)36	8.6 (0.0-26:29) 62	25 (3.0-155:27)112
SS	<5-3.4	0.1 (0.0-0.6:18)100	8.6 (5.0-16:15) 45	8.6 (2.5-29:23)59	7.9 (0.0-22:19) 72	21 (1.0-70:18) 86
RD1000	NA	0.1 (0.0-0.3:10)100	3.1 (0.5-5.5:10)58	8.7 (3.0-43:10)126	3.1 (0.0-7.5:10)100	26 (4.5-144:10)158
NEMD	NA	0.2 (0.0-0.6:14)100	6.5 (2.5-11:10) 37	7.6 (2.0-12:14)33	4.5 (0.0-17:14) 100	34 (9.0-96:14) 76
TD	NA	0.1 (0.0-0.4:9) 100	12 (5.5-21:9) 34	11 (8.0-14:9) 20	22 (12-33:9) 30	21 (14-27:9) 19

1/ See Table V-2 for drain definition.

2/ COV = coefficient of variation in percent (%).

1. Sacramento Valley Agricultural Drain Characteristics

Drainage water from major agricultural watersheds is discharged at approximately 17 locations around the Valley (Table V-2). The Sacramento River is the eventual receiving water for this runoff, however, not all drainages discharge directly to the River. The Feather River and Cache Slough (North Delta) systems both convey drain water to the Sacramento River from relatively large tracts of land (Table V-2; Figures V-1 and V-2). Conversely, Sacramento Slough (SS) and Colusa Basin Drain (CBD) discharge directly to the River. Sacramento Slough and CBD are the two largest drains in the Valley, usually contributing around 70% of all measured irrigation outflow during the May-June rice growing season. Outflow from Natomas East Main Drain (NEMD), RDIOOO, and Sump 90 (S90) is comprised of a combination of wastewater types including agricultural drainage, urban runoff, and NPDES wastewater.

Three major agricultural discharge periods exist within the Sacramento Valley: the rice growing season (May-June), rice field de-watering (August-September), and the wet season. During May-June rice cultivation is initiated with the corresponding use, and subsequent discharge, of a variety of pesticides. Agricultural drainage during this general time has been shown to be acutely toxic to aquatic organisms; the observed toxicity is most likely due to the off-site movement of rice pesticides (Foe, 1987a-b). During July-September Sacramento Valley discharges increase and consist primarily of water purged from rice fields in preparation for harvest (Table V-3). Rainy season outflows typically increase over other months' and have, during periods of extremely high rainfall, overtopped the drain levees (Tanji et al., 1978). However, many of the Valley's agricultural drains are artificially controlled and may not always reflect such trends. Although agriculture outflows increased from July-December, 1985, water tested during this general time period has been shown to be relatively non-toxic (Foe, 1987b).

2. Trace Metal Trends

Trace metals (most notably copper, zinc, chromium, and nickel) were common constituents of Sacramento agricultural drainage at low to moderate levels (Table V-4). Both arsenic and cadmium were found in agricultural drain water, however, their detection frequency was low and limited to levels at just above the analytical limits. Concentration averages were generally lower than similar metallic averages from urban runoff and acid mine drainage. Multiple samples collected on 30 June 1987 show that there was significant variability in metals concentration between the drains ($p < 0.01$)(Table V-5). However, the averaged replicates differed only by two to six ppb - very slight compared to the variability observed from other discharge types (urban runoff, acid mine drainage, and regulated point sources [i.e., NPDES dischargers]). The two largest drains, CBD and SS, differed with respect to chromium and nickel only. Based on this data alone, the loads calculated for this period may not require drain specific data, although, variability between the drains during other seasons is unknown.

Concentration data averaged separately for the rice and non-rice season was significantly different. Copper and nickel concentrations were higher during the rice season (May-June) and chromium was higher during the non-rice season (Table V-6). The copper difference was most notable and may be related to applications of copper sulfate. Copper sulfate is typically applied to standing rice field water during May-June to control blue green algae (Cornacchia et al., 1984). Copper concentrations also fluctuated greater during the rice season (COV = 54% compared to 35%), possibly reflecting pulses of treated and untreated water; higher concentration variability was usually recorded during the non-rice season for the other compounds. Zinc was highly variable, however, a majority of the variation was related to the analytical process (see Appendix F). Although, these results are preliminary in nature, only copper showed any noteworthy difference between seasons, increasing during the rice season possibly as a result of pesticide applications. The difference is large enough (6.4 ppb versus 10.4 ppb) to be considered in future loading estimates.

Trace metals in CBD were scanned during and after a rainstorm event to evaluate the potential for loading surges during the rainy season. Although the results did not indicate

Table V-5. MEAN METALS CONCENTRATIONS FROM FIVE SACRAMENTO AGRICULTURAL DRAINS SAMPLED ON 30 JUNE 1987.

DRAIN 1/	REPLICATE MEAN CONCENTRATION IN UG/L (COV[%]) 2/ CHROMIUM	COPPER	NICKEL	ZINC
RD108	8.8 (5) cd	10 (6) d	13 (8) e	14 (11) abcd
CBD	8.2 (5) c	8.8 (20) bc	9.6 (5) d	13 (13) a
SS	6.4 (8) b	7.9 (5) bc	7.4 (7) c	14 (28) abc
RD1000	2.8 (27) a	6.0 (11) a	5.2 (8) a	12 (29) ab
NEMD	8.8 (9) cd	7.6 (16) b	6.4 (8) b	17 (4) cd

1/ See Table V-2 for abreviation definitions.
2/ COV = coefficient of variation in percent (%). Means with no common letter within a column were significantly different ($p<0.01$; N=5)(1-way ANOVA with Duncan's multiple comparison).

Table V-6. STATISTICAL COMPARISON OF RICE AND NON-RICE SEASON AGRICULTURAL DRAIN METALS CONCENTRATIONS, 1987. 1/

SEASON	AVERAGE CONCENTRATION [(RANGE:N) COV(%)] 1/ CHROMIUM *	COPPER *	NICKEL *	ZINC
RICE	6.3 (4.5-9.0:14) 23	10.4 (6.0-28.5:14) 54	8.5 (3.0-12.0:14) 26	16 (3.0-41.0:14) 64
NON-RICE	8.2 (5.5-12.5:8) 31	6.4 (2.5-11.0:21) 35	6.3 (0.0-16.0:19) 67	27.9 (1.0-155:19) 116

1/ Sacramento Slough and Colusa Basin Drain data only.
2/ Average (range:number of samples) coefficient of variation. Metals with * beside them are statistically different ($p<0.05$; Mann-Whitney U-Test).

any definitive correlations, cadmium, copper, and zinc did fluctuate an order of magnitude during the sampling period and nickel levels stayed essentially consistent throughout (Table V-7). Copper, cadmium, and zinc levels fluctuated within their ranges and somewhat simultaneously indicating some kind of trend. Levels were lowest on 5 January (0920 MST) and notably higher 6 hours later the same day. The concentration fluctuations did not correlate well with concurrently measured drain flows. There was also no strong correlation between any of the metals and EC measurements (R-squared <0.3). Although pesticide concentrations increase in agricultural runoff from rainfall events (Nicholaichuk and Grover, 1983; Mayeux et al., 1984; Wu et al., 1983; Rhode et al., 1980), similar relationships with metals could not be distinguished here. Rainfall and drain flow measurements did, however, corroborate with Cornacchia et al. (1986) showing that CBD outflow increased substantially 2-4 days after incipient rainfall. Metal concentrations in agricultural runoff appear to be more complex in scope than merely related to outflow.

3. Mass Loads

Annual metal loads from the major Sacramento Valley agricultural drains are presented in Table V-8. As expected, SS and CBD had the highest estimated 1985 output primarily due to their large outflows. Sacramento Slough and CBD, combined, contributed over 95% of the total annual arsenic, cadmium, chromium, copper, nickel, and zinc loads from the included agricultural drains. Arsenic loads were based on three samples analyzed at UCD and, although the concentrations are probably reliable, the limited data base makes the load estimates very preliminary. Table V-9 shows the drains included in the loading estimates contributed approximately 83% of the total estimated agricultural outflow in the Valley during 1982. Therefore, the loads probably reflect a good estimate (albeit conservative) since the flow values reflected a majority of the total Sacramento Valley agricultural outflow.

Table V-7. COLUSA BASIN DRAIN METALS CONCENTRATIONS DURING AND AND AFTER A STORM EVENT, 1986-87.

DATE MONTH/DAY	TIME (MST)	REPLICATE CONCENTRATION (UG/L) 1/ COPPER	CADMIUM	NICKEL	ZINC	EC (dS/m)	CUMULATIVE RAINFALL (INCHES) 2/	FLOW (CFS) 3/
12/31	0830						0.12	
1/1	0830		NO SAMPLES TAKEN				0.17	
1/2	0830						0.23	
1/3	1330	6	0.4	6	16	0.870	0.46	247
1/4	1340	7	0.3	6	13	0.900	0.73	262
1/5	0920	5	<0.1	5	9	0.900	0.73	281
1/5	1540	11	0.7	6	24	0.935	0.73	243
1/6	0900	9	0.2	5	23	0.940	0.73	214
1/6	1445	7	0.3	5	35	0.925	0.73	215
1/7	0530	6	1.3	5	20	0.940	0.9	203

1/ Average of two replicates.

2/ Cumulative incipiant rainfall since December 31 (Woodland Cooperative Extention).

3/ Instantaneous flow in cubic feet per second at Highway 20.

Table V-8. ANNUAL MASS LOADS OF TRACE METALS FROM SACRAMENTO VALLEY AGRICULTURAL DRAINS, 1985.

DRAIN	ARSENIC 1/	%	CADMIUM	%	CHROMIUM	%	COPPER	%	NICKEL	%	ZINC	%
	ANNUAL LOADS (LBS) AND PERCENT OF TOTAL											
RD108	372	4	18	3	858	2	1,100	3	1,100	3	1,800	2
Colusa Basin Drain	3,300	32	436	80	2,000	54	14,000	40	12,000	35	36,000	41
Sacramento Slough	6,400	62	79	14	15,000	41	19,000	54	20,000	59	48,000	54
RD1000	77	1	6	1	31	0	126	0	1	0	940	1
Toe Drain	179	2	7	1	827	2	690	2	1,000	3	1,800	2
TOTALS	10,000		546		38,000		35,000		34,000		89,000	

1/ Based on the average of 3 samples (2.3, 2.2, 3.4 ug/l).

Table V-9. AGRICULTURAL DRAINAGE TO THE SACRAMENTO RIVER, 1982. (ADAPTED FROM CDWR, 1984).

DRAIN 1/	MEASURED OUTFLOW (AC-FT)	TOTAL PERCENT (%)
RD 108 *	98,200	9
RD 787	6,800	0.6
Colusa Basin Drain *	293,500	26
Knights Landing Ridge Cut to Toe Drain *	12,400	1
TOTAL	410,900	37
Butte Slough Outfall	109,500	10
RD 107	11,300	1
Sacramento Slough *	473,200	42
Cox Spill	8,000	0.7
TOTAL	602,000	54
Honcut	0 2/	0
Jack Slough	41,000 2/	4
Best Slough	0 2/	0
RD 1000 *	36,600	3
Toe Drain *	23,800 2/	2
TOTAL	101,400	9

1/ * = Drains included in mass loading estimates (83% of total).
2/ Outflow calculated from input less evapotranspiration and deep percolation.

VI. URBAN RUNOFF

A. INTRODUCTION

Runoff from urbanized watersheds is a major point source in the Central Valley (CVRWQCB, 1987). Urban runoff (UR) discharges are a direct result of rainfall inputs to developed watersheds but also continue throughout summer dry periods from domestic/commercial irrigation, groundwater infiltration, and washoff practices. Monthly UR outflows from Sacramento City alone have been estimated to comprise over one percent of the Sacramento River year-round and can exceed as much as six percent of the River during major rainstorm events. A variety of inorganic and organic pollutants are present in UR and are usually found at their highest levels during the early stages of each rainfall event (CVRWQCB, in prep.).

Copper, lead, and zinc are the most prevalent priority pollutants discharged in urban runoff nationwide, although, arsenic, cadmium, chromium, and nickel are also common constituents of the UR matrix (U.S.EPA, 1983). Local studies have documented the common presence of nine trace metals in Sacramento UR (Table VI-1) showing the wide concentration fluctuations (up to two orders of magnitude) that are typically observed in UR during storm events. Water quality criteria exceedances are also common. The corresponding annual loads of copper, lead, and zinc from Sacramento UR was estimated to be greater than similar loads coming from a wastewater/sewage treatment plant servicing roughly the same area (CVRWQCB, 1987). This is significant since the treatment plant (SRCSD) is the second largest NPDES discharge (in volume) in the Central Valley.

Synthetic organic chemicals are less commonly detected in UR water. However, chemicals such as polycyclic aromatic hydrocarbons (PAHs), industrial chemicals (most notably phenols, methylene chloride, phthalates) and a few select few pesticides (e.g., endosulfan, lindane, chlordane) are periodically detected (U.S.EPA, 1983). One class of synthetic organic chemical that is ubiquitous in UR are the PAHs. Polycyclic aromatic hydrocarbons originate from petroleum based products such as fossil fuel combustion, crankcase oil, and road tar, and are commonly detected in storm drain sediment at elevated levels (Table VI-2). Analysis of sediment for these compounds is necessary due to their high affinity for particulate matter sorption. Urban runoff is believed to be contributing substantially to downstream PAH sediment burdens (CVRWQCB, 1987).

Water and sediment from UR discharges are both toxic to aquatic biota. Urban runoff from several Sacramento watersheds has repeatedly caused acute water column toxicity to fish and invertebrates (Foe, 1986, 1987c). Furthermore, reduced survival and growth of indicator fish was observed in the lower American River as a result of upstream urban runoff freshets. Solids deposited from UR loading are associated with compounds that can exert their toxicity on bottom dwelling organisms year-round (Malens, 1984; Pratt et al., 1981; Medeiros et al., 1983). The individual constituent(s) in UR primarily effecting water column toxicity have not yet been completely isolated.

Prior to 1984, UR was managed as a non-point source discharge under the provisions of Section 208 of PL 92-500 (the Pollution Control Amendments of 1972). In 1984, the U.S.EPA ruled that UR was to be covered within the scope of the NPDES permit program as a point source (49FR 37998). As a point source, permit applications will be required by 1990-2 from large cities (over population 100,000) and industrial facilities. Regulations regarding specific permit application conditions are expected from U.S.EPA in autumn 1988.

B. METHODS

Mass loads of several metals and oil and grease were calculated for urban runoff discharges to the Delta during 1985. Loads were estimated as the sum of dry and wet period inputs from the urbanized watersheds of 19 cities in the Central Valley. Cities were included if they were within

Table VI-1. TRACE METALS IN WATER (UG/L) FROM THREE SACRAMENTO CITY STORM DRAINS, 1972-5 (ADAPTED FROM SRCSD AND SAC, 1975).

TRACE ELEMENT	RECOMMENDED CRITERIA 1/	SUMP 104 Mean (range, n)	SUMP 111 Mean (range, n)	ARCADE CREEK AT BRIDGE ROAD Mean (range, n)
Arsenic	190	2.5 (<1-3.6; 28)	2.6 (1-8.2; 26)	1.6 (.4-4.2; 19)
Cadmium	1.1	6.5 (<1-90; 28)	5.6 (0-13; 26)	5.7 (2-11; 19)
Chromium (total)	210	25.9 (10-68; 28)	46.0 (9-103; 27)	34.0 (9-60; 19)
Copper	12	41.8 (2-100; 28)	63.0 (7-170; 27)	30.0 (10-60; 19)
Lead	3.2	395.0 (50-1040; 28)	272.0 (50-580; 27)	73.0 (10-242; 19)
Mercury	0.012	1.2 (<.1-4.6; 28)	1.2 (<.1-3.2; 27)	1.3 (.3-3.6; 19)
Nickel	160	27.0 (<10-48; 28)	48.0 (20-170; 27)	23.0 (6-46; 19)
Silver	0.12	3.0 (0-9; 28)	3.0 (0-10; 27)	4.0 (1-11; 19)
Zinc	110	258.0 (100-490; 28)	397.0 (120-1090; 27)	120.0 (32-210; 19)

1/ Ambient water quality criteria (U.S.EPA) to protect freshwater aquatic life; 4 day average.

Table VI-2. POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG, WET WEIGHT) IN SEDIMENT FROM SACRAMENTO STORM DRAINS AND THE SACRAMENTO RIVER. 1/

SEDIMENT ORIGIN	SACRAMENTO STORM DRAIN						SACRAMENTO RIVER		FISH TISSUE 2/
SAMPLE LOCATION	MORRISON CREEK	ARCADE CREEK	SUMP-111	SUMP-111	SUMP-104	MANLOVE	SACRAMENTO RIVER AT COLUSA	SACRAMENTO RIVER AT COLLINS-VILLE	STRIPED BASS (SACRAMENTO RIVER AT COLLINSVILLE)
% MOISTURE	58	29	46	58	54	36			
% ORGANIC CARBON	2.8	0.58	5.7	1.8	1.7	9			
naphthalene	<100	<100	760	110	<10000	<1000	<100	<100	4
acenaphthylene	<100	<100	<2000	<100	<10000	<1000	<100	<100	ND
acenaphthene	<200	<200	NA	<200	<20000	<2000	<200	<200	3
fluorene	<20	<20	<2000	220	<2000	<200	<20	<20	NA
phenanthrene	22	15	1300	2000	1400	280	<4	12.0	2173
anthracene	3	<2	<2000	470	260	24	<2	2.5	NA
fluoranthene	68	44	1500	3200	2400	720	<10	26.0	348
pyrene	47	43	1500	2400	2600	580	<20	36.0	1256
benzo(a)anthra-cene	25	21	980	1300	1200	380	<10	<10	26
chrysene	<100	28	1300	1000	1200	<1000	<10	19.0	128
benzo(b)fluoran-thene	28	25	900	970	750	270	<5	14.0	35(b +
benzo(k)fluoran-thene	15	14	900	530	<500	170	<5	5.4	35(b +
benzo(a)pyrene	26	28	820	1400	<1000	330	<10	12.0	ND
dibenzo(a,h)an-thracene	<400	<40	<4000	<4000	<4000	<400	<40	<40	NA
benzo(g,h,i)pery-lene	44	<20	<4000	<2000	<2000	<200	<20	<20	NA
I-(1,2,3-cd)pyrene	40	40	<4000	1300	<1000	420	<10	13.0	NA

1/ Detectable values are underlined; < = less than analytical detection; ND = not detected; and NA = not analyzed
2/ U.S.FWS, 1983 (unpublished). Personal files of Marvin Jung, California Dept. of Water Resources. DWR, Sacramento, CA

the top 80th percentile of incorporated populations of all Central Valley cities hydrologically linked with the Sacramento-San Joaquin Delta/Estuary. Wet period volumes were calculated as the product of city-specific rainfall and acreage, a runoff coefficient (0.3), and the appropriate conversion factors. A runoff coefficient of 0.3 was chosen to provide a conservative estimate. Dry period volumes were estimated using a general value of 0.118 acre-feet/acre/month as discussed in CVRWQCB, 1987.

Wet and dry weather concentrations used in the loads are shown in Table VI-3. The lowest value of each compound was used when several median flow-weighted concentrations were available to provide a conservative estimate (values with asterisks). With the possible exception of the U.S.EPA values, all wet weather event mean concentrations (EMCs) were calculated using zero in place of values reported below detection. Rainfall data was obtained from National Weather Service gauge information collected in, or near, the individual cities.

C. RESULTS AND DISCUSSION

Annual mass loads from Central Valley UR are presented in Table VI-4. Copper, zinc, lead, and oil and grease loads were most notable and are compared with other Valley loads and flow-volumes in Chapter VIII. Monthly loads can be expected to increase during the rainy season (October-March) due to the higher concentrations and volumes discharged during that period. It is important to note that the UR loading estimates were highly conservative due to 1) the replacement of "less than detection" values with zeros for the averaging of concentrations, 2) estimating loads from only a portion of the Valley's cities, and 3) using conservative parameters (i.e., runoff coefficient, concentrations) when several were available.

A majority of the UR loads were estimated to originate from the Sacramento Valley due to the higher acreage and rainfall statistics measured there (the pollutant concentrations used were common to all cities and would not have affected spacial loads). Acreage estimates segregated into three general basins - Sacramento River, Central Delta, and the San Joaquin River Basins - revealed that a majority of the urbanized acreage (64%) was situated within the Sacramento River Valley and was largely due to the City of Sacramento (Table VI-5). Rainfall in the Sacramento Valley was also greater than annual rainfall measured in Central Delta or San Joaquin Valley cities. Greater average rainfall combined with apparent high acreage probably indicate a higher actual UR loading potential from the Sacramento Valley.

It should be noted that acreage estimates for the Central Valley were provided by city public works departments and, in most cases, did not account for areas outside city limits. These deficiencies were corrected where possible, however, the acreage estimates may not be fully reflective of the actual acreage. For instance, Stockton's area did not represent it's high population (Table VI-5).

A comparison of actual and estimated UR loads indicates that the methodology used here was accurate to at least an order of magnitude for most pollutants. Estimated loads were compared to actual loads measured from a Sacramento storm drain (Sacramento City sump no. 104) during the 1986-87 rainy season (CVRWQCB, in prep.). Chromium and zinc loading estimates were exceptionally close in magnitude to the corresponding loads measured during the same time period (Table VI-6). The logical explanation for the load similarities extends from the relatedness of the concentration data (i.e., the loads were expected to be close), however, the U.S.EPA flow weighted concentration of 160 ug/l produced a very close estimate for the Sacramento watershed. The actual loads measured were estimated from several multiple, discrete, water samples and concurrently measured flow and are considered to be relatively accurate. Therefore, estimating UR loads from rainfall, acreage statistics, and representative concentrations appears to be an adequate method for roughly estimating mass loads of trace metals.

Table VI-3. AVERAGE DRY AND WET SEASON EVENT FLOW WEIGHTED METALS AND OIL AND GREASE CONCENTRATIONS (ASTERISKED VALUES WERE USED FOR THE LOADING ESTIMATES).

	EVENT MEAN CONCENTRATION (EMC) (UG/L)				DRY WEATHER (UG/L)	
COMPOUND	SACRAMENTO SUMP # 104 SEASONAL MEDIAN 1/	SACRAMENTO SUMP #111 2/	NATIONWIDE MEDIAN 3/	STENSTROM ET AL., 1985	MEDIAN SACRAMENTO 4/	SILVERMAN & STENSTROM, 1984
Arsenic	5 *				4 *	
Cadmium	1 *				0.2 *	
Chromium	17 *				3 *	
Copper	29 *	34	34		10 *	
Lead	84 *	123	144		3 *	
Nickel	18 *				1 *	
Zinc	247	480	160 *		89 *	
Oil and Grease	3500 * 6/			3890 5/	1250 *	1300

1/ CVRWQCB, in prep. (median EMC from Sacramento City storm drain sump number 104 during the 1986-7 rainy season).
2/ CVRWQCB, 1987 (single storm event EMC).
3/ U.S.EPA, 1983.
4/ This study, Appendix E.
5/ Flow weighted average for a residential area. Other averages include 13,130 (commercial watershed) and 7,100 ug/l (industrial watershed).
6/ Estimated from the later portion of the rainy season (i.e., a very conservative estimate since the first storm events of the year were not monitored).

Table VI-4. ANNUAL URBAN RUNOFF LOADS OF METALS AND OIL AND GREASE FROM 19 MAJOR CITIES IN THE CENTRAL VALLEY, 1985.

ANNUAL LOADS (LBS)							
ARSENIC	CADMIUM	CHROMIUM	COPPER	LEAD	NICKEL	ZINC	OIL & GREASE
8,000	700	11,000	26,000	38,000	9,000	194,000	3,200,000

Table VI-5. CHARACTERISTICS OF CENTRAL VALLEY CITIES USED IN THE URBAN RUNOFF LOADING ESTIMATES.

FINAL RECEIVING WATERS	CITY	ANNUAL RAINFALL 1985 (inches)	URBANIZED ACERAGE 1/	POPULATION 2/
Sacramento River	Sacramento	15.22	151,000	322,500
	Redding	25.95	32,000	51,000
	Chico	16.29	27,740	32,750
	Roseville	15.22	18,336	29,900
	Paradise	31.77	12,000	24,850
	Yuba City	13.09	4,535	21,600
	total	118	245,611 (64%)	
Central Delta	Stockton	9.67	18,368	181,600
	Vacaville	17.79	13,280	53,100
	Lodi	14.5	5,983	43,300
	Woodland	13.85	5,900	34,100
	Manteca	10.59	5,422	35,450
	Tracy	10.59	5,400	25,450
	Davis	14.89	3,422	40,550
	total	92	57,775 (15%)	
San Joaquin River	Madera	8.37	38,115	36,550
	Modesto	9.82	19,213	131,400
	Merced	8.89	10,112	46,400
	Turlock	7.92	5,095	33,550
	Ceres	9.82	3,520	17,300
	Atwater	8.89	3,200	20,550
	total	54	79,255 (21%)	
	grand total		382641	

1/ Percent of total in parentheses.

2/ Projected incorporated city populations for 1985 (Dept. of Finance records).

Table VI-6. COMPARISON OF ESTIMATED AND ACTUAL OF METALS AND OIL AND GREASE (O & G) LOADS FROM A SINGLE SACRAMENTO URBAN STORM DRAIN (SUMP # 104), 1986-7.

STORM EVENT DATE (MONTH-DAY)	RAIN (INCHES)	RUNOFF LOADING (LBS/EVENT) 1/ ARSENIC	CADMIUM	CHROMIUM	COPPER	LEAD	NICKEL	ZINC	O & G
9-16	0.13	0.145	0.005	0.251	0.321	0.525	0.196	2.62	
9-24	0.54	0.379	0.076	8.04	5.3	9.19	1.62	20.6	
10-16	0.13	0.095	0	0.367	0.477	2.2	0.443	4.02	
11-28	0.15	0.159	0.015	0.379	0.832	1.21	0.414	5.46	138
12-19	0.44	0.109	0.012	0.345	0.731	2.93	0.478	5.38	112
12-22	0.29	0.046	0.051	0.342	0.627	2.34	0.326	5.6	142
1-3	0.76	0.083	0.066	2.25	2.32	7.43	0.987	18.8	378
2-2	0.34	0.142	0	1.33	1.42	5.17	1	16.82	
2-12	2.42	2.17	0.064	8.02	7.86	28.36	5.05	71.55	396
3-5	1.83	0.4	0	1.23	2.82	9.79	2.2	34.3	
3-12	0.84	0	0	0.866	1.51	3.53	1.59	15.6	
TOTALS	7.87	3.7	0.3	23	24	73	14	201	1166
ESTIMATED 2/		5.9	1.2	20	34	100	21	190	1991

1/ Based on multiple samples and discharge measurements per storm event (CVRWQCB, in prep.).

2/ Estimate calculations are described in the Methods section. See CVRWQCB, 1987 for a description of the watershed drained by Sump 104.

VII. DAM RELEASES

A. INTRODUCTION

Trace metal inputs from dam releases were included from the three largest volume Central Valley dams (Shasta, Oroville, and Nimbus) which together contributed approximately 76% of Sacramento River outflows during 1985. Dam unit releases were included to quantify load allocations, or "background" (natural) inputs, although, dam releases do not necessarily reflect natural loads since several point and non-point sources exist upstream. Several anthropogenic pollutant sources contribute trace metals to the three reservoir watersheds: abandoned mines, NPDES dischargers, urban runoff, and input from recreation boats. It was assumed that the individual sources would be consolidated and accounted for in dam release loads and, therefore, were not duplicated elsewhere, although, the lakes' beds are probably the endpoint for most insoluble pollutants from settling out phenomena. Considering the high potential for loading in reservoirs, the buildup of toxics in sediment occurs and is believed to be substantial in some cases.

B. METHODS

Mass loads of several trace metals were calculated from Shasta, Oroville, and Nimbus Dam releases during 1985. Loads were calculated as the product of Dam releases, average metal concentrations, and the proper conversion factors. Monthly controlled outflows were obtained from USBR and CDWR data sheets (Tables VII-1 and VII-2). Trace metal data from Shasta Dam was obtained from three studies performed during the last four years (1984-7) and averaged for single concentration values. Several samples were collected at the base of Oroville and Nimbus Dams during the spring and summer (1987) and were averaged for the loads estimates. Concentrations reported below the lowest detection limit were assigned a value of zero and included in the averages except when reported detection limits were extremely high, in which case they were excluded from the averages altogether.

C. RESULTS AND DISCUSSION

As expected, the total loads from Shasta, Oroville, and Nimbus Dams were relatively high primarily due to the high outflows from each (Tables VII-1 and VII-2). Copper and zinc were the only loading parameters that could be quantified for Oroville and Nimbus Dams because other metals were not detected. Although loads increased during the summer months from increased outflows, accurate monthly trends were precluded due to the nature of the calculations (i.e., month specific concentration data was not available).

Loading estimates from Nimbus and Oroville Dams were based on one or two replicate samples collected during the summer and spring months (1987) and are, therefore, very rough. Furthermore, the more extensive database for Shasta Dam metals (1984-7) was devalued, to a large extent, by high detection limits (e.g., 10 ppb for arsenic; 40 ppb for nickel). The result of the limited database is an underestimate of loads because "less than detection" values were replaced with zeros for the averaging. Slight concentration increases or just positive detections would substantially affect dam loads due to their high outflows. Clearly, reservoir releases need further study (especially during storm events) if reasonable load allocations are to be estimated. Regardless of the high dam loads, the releases would have a diluting effect on Sacramento River metal concentrations due to the comparatively low levels detected.

Table VII-1. SHASTA DAM TRACE METAL LOADS, 1985.

MONTH	VOLUME (ACRE-FEET)	ARSENIC 1.4	BARIUM 12.00	CADMIUM 0.02	CHROMIUM 2.00	COPPER 3.82	LEAD 0.40	MERCURY 0.22	NICKEL 1.00	VANADIUM 4.00	ZINC 7.64
		LOADS (LBS) 1/									
January	301,094	1,146	9,826	16	1,638	3,128	328	180	819	3,275	6,256
February	223,952	853	7,308	12	1,218	2,326	244	134	609	2,436	4,653
March	207,951	792	6,786	11	1,131	2,160	226	124	566	2,262	4,320
April	323,604	1,232	10,560	18	1,760	3,362	352	194	880	3,520	6,723
May	547,964	2,086	17,882	30	2,980	5,692	596	328	1,490	5,961	11,385
June	616,020	2,345	20,103	34	3,350	6,399	670	369	1,675	6,701	12,799
July	770,442	2,933	25,142	42	4,190	8,003	838	461	2,095	8,381	16,007
August	561,739	2,139	18,331	31	3,055	5,835	611	336	1,528	6,110	11,671
September	173,799	662	5,672	9	945	1,805	189	104	473	1,891	3,611
October	140,032	533	4,570	8	762	1,455	152	84	381	1,523	2,909
November	156,679	597	5,113	9	852	1,628	170	94	426	1,704	3,255
December	125,071	476	4,081	7	680	1,299	136	75	340	1,360	2,599
TOTAL	4,100,000	16,000	135,000	200	23,000	43,000	4,500	2,500	1,000	45,000	86,000

1/ Values below metal = averaged concentrations (ug/l) used to calculate loads. Most concentration used was from (CH2M Hill, 1985).

Table VII-1. NIMBUS AND OROVILLE DAM TRACE METAL MASS LOADS, 1985.

MONTH	VOLUME (ACRE-FEET) OROVILLE	VOLUME (ACRE-FEET) NIMBUS	LOADS (LBS) 1/ COPPER 2/ OROVILLE (2)	COPPER 2/ NIMBUS (0.5)	ZINC 2/ OROVILLE (23)	ZINC 2/ NIMBUS (18)
January	143,360	104,740	780	142	5,127	8,967
February	165,634	121,770	901	166	5,961	10,360
March	122,890	88,430	668	120	4,329	7,686
April	147,511	105,650	802	144	5,172	9,226
May	273,983	158,080	1,490	215	7,738	17,137
June	286,840	168,800	1,560	230	8,263	17,941
July	239,697	180,670	1,304	246	8,844	14,992
August	183,890	142,830	1,000	194	6,991	11,502
September	111,360	117,950	606	160	5,774	6,965
October	133,097	102,200	724	139	5,003	8,325
November	118,480	84,970	644	116	4,159	7,411
December	105,517	88,250	574	120	4,320	6,600
TOTAL	2,000,000	1,500,000	11,000	2,000	72,000	127,000

1/ Arsenic (<4 ug/l), cadmium (<1 ug/l), chromium (<1 ug/l), nickel (<5 ug/l), and lead (<5 ug/l) not detected.

2/ Average concentration from several (2-8) samples in parentheses.

VIII. CENTRAL VALLEY POINT/NON-POINT SOURCE DISCHARGE AND MASS LOAD COMPARISONS

A. INTRODUCTION

Mass loads of trace metals and oil and grease to surface waters were calculated from five major point and non-point sources in the Central Valley. In all cases, the loading estimates were conservative due to the lack of information for some sources and the methods of calculation. Calculated Central Valley loads do not include estimates from San Joaquin Valley and Central Delta agricultural drainage as well as load estimates from approximately 1/2 the total NPDES outflow. Agricultural discharges from the Central Delta and the San Joaquin Valley are presently being studied by the CDWR (Proctor, pers. comm.) and the Technical Committee, respectively. However, the loads calculated for the Sacramento Valley are regarded to be more fully representative of actual loads because a majority of the major dischargers were included within the Valley's scope. Therefore, Central Valley discharges are lightly discussed with references made to their inadequacies but full intercomparisons between the sources are made for loads from the Sacramento Valley. Acid mine drainage was excluded from the discussion of discharge/river percentages (DRPs) because the outflows (primarily from SCDD) consistently made up less than one percent of Sacramento River outflow.

B. DISCHARGE/RIVER FLOW-VOLUME PERCENTAGES

Agricultural drainage to the Sacramento Valley in 1985 constituted the highest volume wastewater discharge to the Sacramento River. Below Sacramento (at Freeport) the monthly agricultural drainage/Sacramento River percentages ranged from four (February) to 28 (September) percent (Table VIII-1). The monthly DRPs at Chipps Island (confluence of the Sacramento and San Joaquin Rivers) were slightly lower than at Freeport (a decrease in the DRP from zero to four percent) indicating that, during 1985, other inputs to the Delta were not substantial. Since San Joaquin Valley and Central Delta agricultural return water was not included, the Chipps Island percentages are an underestimate.

Agricultural drain DRPs were relatively high for the extent of the Sacramento River upstream of Freeport to Colusa Basin Drain. For example, almost two-fifths of the River was composed of agricultural drainage just below Sacramento Slough (Table VIII-2). The River assimilated the largest volumes during the fall months (September-December, 1985) due to high outflows and corresponding low River flows. Although agricultural drainage during the fall does not appear to effect downstream toxicity (Foe, 1987a-b), loads would generally increase due to higher outflows.

Monthly DRPs calculated for NPDES discharges to the Sacramento River were much less than agricultural drainage DRPs ranging from three to five percent at Freeport and increasing substantially at Chipps Island to 9-17% (Table VIII-1). The increase in NPDES wastewater at Chipps Island is primarily due to the large volumes discharged from the PG & E Contra Costa power plant. Similar to agricultural drainage, NPDES outflow made up a larger portion of the Sacramento River during September-December primarily due to reduced River flows (i.e., monthly NPDES outflows did not radically vary). Percentages calculated for the Sacramento River upstream of Freeport were roughly similar to the Freeport DRPs (Table VIII-2). All NPDES discharges above and below dams (except non-continuous) were included and, therefore, the values are just slightly conservative.

Monthly urban runoff (UR) DRPs on the Sacramento River were slightly higher than the NPDES values except during November when high rainfall and corresponding low River flows increased the DRP to 10% (Table VIII-1). Central Valley UR percentages were only slightly higher at Chipps Island, and fluctuated similarly to Sacramento River values. Preliminary toxicity studies show UR to be highly toxic during storm events (Foe, 1986, 1987c). Further, local trace metal monitoring indicates that runoff from Sacramento exhibits a "first flush" of pollutants from the

Table VIII-1. WASTEWATER/RIVERINE DILUTION RATIOS FROM NPDES DISCHARGES, URBAN RUNOFF, AND SACRAMENTO VALLEY AGRICULTURAL DRAINAGE AT FREEPORT (SACRAMENTO RIVER) AND CHIPPS ISLAND (DELTA OUTFLOW), 1985.

MONTH (1985)	WASTEWATER/RIVER DILUTION RATIO (%) SACRAMENTO RIVER (FREEPORT) AGRICULTURE 1/	NPDES 2/	UR 3/	(TOTAL)	DELTA (CHIPPS ISLAND) AGRICULTURE 1/	NPDES 2/	UR 3/	(TOTAL)
January	6	3	4	13	5	10	4	19
February	4	3	4	11	4	9	5	18
March	5	3	6	14	4	12	7	23
April	9	3	4	16	7	13	5	25
May	14	3	4	21	12	13	5	30
June	12	3	4	19	10	14	5	29
July	13	3	3	19	11	11	4	26
August	23	3	4	30	19	13	5	37
September	28	4	5	37	24	14	7	46
October	21	5	6	31	17	17	7	41
November	25	4	10	39	20	17	11	48
December	26	3	5	34	23	11	6	40

1/ Sacramento Valley agricultural drains.

2/ National Pollutant Discharge Elimination System dischargers.

3/ Urban Runoff.

Table VIII-2. WASTEWATER/SACRAMENTO RIVER DILUTION RATIOS FROM AGRICULTURAL DRAINAGE, AND NPDES DISCHARGES, 1985.

MONTH (1985)	WASTEWATER/SACRAMENTO RIVER DILUTION RATIO (%) NPDES SHASTA DAM	BEND BRIDGE	COLUSA	VERONA	AGRICULTURAL DRAIN BELOW RD108	BELOW SS	VERONA
January	2	4	3	3	0.47	9	7
February	2	4	3	3	0.41	8	5
March	2	4	3	4	0.63	8	6
April	1	3	3	4	0.46	13	10
May	1	3	4	4	1.81	21	17
June	1	2	4	4	1.78	19	14
July	1	2	3	3	1.29	19	15
August	1	2	4	4	2.10	30	26
September	3	4	5	4	1.99	39	32
October	4	5	6	6	0.45	30	25
November	3	5	5	5	0.30	32	28
December	4	4	3	3	0.36	34	30

first few storms of the season that occur during the fall (October through December)(CVRWQCB, in prep.). Therefore, due to both the potential for high runoff/river ratios and pollutant concentrations in the fall, the greatest loads (and thus, the greatest water quality impacts) would be expected to occur during this period.

In conclusion, a major portion of all Sacramento River outflow is made up of wastewater - more than 40% during the fall months. Total monthly outflow from the Central Valley was estimated to be composed of from 18 to almost 50% wastewater and would, undoubtedly, be greater if San Joaquin Valley and Central Delta agricultural discharges had been included. Although agricultural drainage and possibly NPDES discharges are not expected to increase substantially in the near future, disproportionately higher UR discharges are predicted from rapid development around the Valley.

C. MASS LOADS BY SOURCE

Table VIII-3 shows the total annual loads from Central Valley point and non-point source discharges. These values are largely conservative due to the exclusion of agricultural drainage from the Central Delta and San Joaquin Valley and approximately 1/2 of the total NPDES outflow. However, the loading scope for the Sacramento Valley encompassed a majority of the largest and most intensively studied surface discharges, and therefore, the following discussion refers to poundage estimates and corresponding percentages from Sacramento Valley discharges (Table VIII-4). It should be noted that the loads were intentionally conservative by substituting zeros for "less than detection" values when averaging. Other factors further enhanced the conservativeness of the estimates and are discussed below for each source. Although loads for other trace metals (e.g., mercury, chromium 6+) were calculated if data was available (as presented in the individual sections), an inter-comparison would be inappropriate due to a paucity of data. Furthermore, several other pollutant sources exist around the Valley but were not included here. Other sources include illegal dumping, atmospheric fallout, general watershed contributions, power boats, surface transport spills, etc.

Sixty percent of Sacramento Valley's total nickel loads and 50% of the chromium loads were estimated to originate from agricultural discharges. Other relative metal load contributions were non-existent (0%) to moderate (13%), although, agricultural drainage is probably a major contributor of arsenic. The loading relationships indicate that a major portion of the total nickel and chromium inputs to the Sacramento River originate from Sacramento Valley agriculture. Although rice pesticides are suspected to cause off-site toxicity primarily during May and June, they either have been discussed elsewhere or are too infrequently detected for loading estimates.

The relative load contributions from Sacramento Valley NPDES dischargers were fairly diminutive for trace metals, ranging from 2% (zinc, lead) to 7% (nickel), although, approximately, one-fourth of the total oil and grease loads came from this point source. The loads are moderately conservative due to the high detection limits commonly reported. Synthetic organic chemical loads were not calculated here, albeit, NPDES dischargers are, no doubt, sources of low level discharges of several chemicals. Regardless, stringent, controlled regulation has been successful in keeping the discharge of trace metal toxicants to comparatively low levels.

Acid mine drainage contributed the majority of Sacramento Valley's cadmium, copper, and zinc loads; 77%, 56%, and 72%, respectively. Greater than 95% of the acid mine drainage loads (calculated from mines below major dam structures) originated from a single mine in the upper Sacramento River system (Iron Mountain Mine complex) and released via Spring Creek Diversion Dam (SCDD). The high SCDD loading values were primarily due to extremely high effluent concentrations; monthly flows were consistently below one percent of total Sacramento River outflows. Acid mine drainage loads are conservative since a large number of documented and undocumented mines exist both above and below dams and were not included in the estimates. Loads above major reservoirs were expected to be accounted for in the dam loads. Acid mine drainage contributed minor amounts of other metallic compounds (e.g., chromium, lead, and nickel)(Table VII-4), although, inactive mercury and gold mining prospects are undoubtedly a

Table VIII-3. ANNUAL MASS LOADS OF TRACE METALS AND OIL AND GREASE FROM SEVEN MAJOR CENTRAL VALLEY POINT AND NON-POINT SOURCE DISCHARGERS, 1985. 1/

ANNUAL LOADS IN THOUSANDS OF POUNDS								
ARSENIC	CADMIUM	CHROMIUM	COPPER	LEAD	NICKEL	ZINC	TOTAL METALS	OIL AND GREASE
34.1	6.6	77.0	257.0	43.9	58.5	1,994.0	2,537.0	4,452.0

1/ Only Sacramento Valley agricultural drainage is represented.

Table VIII-4 . ANNUAL MASS LOADS OF TRACE METALS AND OIL AND GREASE SEVERAL MAJOR SACRAMENTO VALLEY POINT AND NON-POINT SOURCE DISCHARGERS, 1985.

	ANNUAL LOADS IN THOUSANDS OF POUNDS (PERCENT OF TOTAL NEXT TO POUNDS)															
DISCHARGER	CADMIUM		CHROMIUM		COPPER		LEAD		NICKEL		ZINC		TOTAL METALS		OIL AND GREASE	
NPDES	0.1	2	4	6	6	2	1	2	4	7	34	2	56	2	670	23
Mines	4.8	79	1	1	143	56	1	3	1	2	1,376	72	1,528	63	1/	
Urban runoff	0.5	8	8	11	18	7	28	80	6	11	131	7	202	8	2,206	77
Agriculture	0.5	8	36	50	33	13	1/	0	33	60	88	5	251	10	1/	
Dams (Shasta, Nimbus, and Oroville)	0.2	3	23	32	56	22	5	14	11	20	285	15	400	16	1/	
TOTALS	6		72		256		35		55		1,914		2,437		2,876	

1/ Not typically found at present analytical detection limits.

major source of mercury and arsenic from tailings/waste rock piles and past amalgamation practices. It must be stressed that SCDD was estimated to be the single largest discharger of cadmium, copper, and zinc to the Sacramento Valley in 1985.

Urban runoff was the principal source of total lead (80%) and oil and grease (77%) loads to the Sacramento Valley; other compounds were discharged at relatively moderate levels (from 7% to 11%). Although a majority of the largest urban areas were accounted for in the estimates, the loads were largely conservative due to the omnipresence of developed lands (e.g., roadway acreage, rural towns) and the conservative parameters used in the calculations (e.g., runoff coefficient, concentrations). Loads for synthetic organic chemicals most notable in urban runoff (e.g., PAHs, a few select pesticides, and industrial solvents) were not estimated here due to the lack of adequate water quality data for loading purposes.

Dam loads were based on a minimum of data and, therefore, are believed to be the least accurate of the Valley's load estimates. Shasta, Nimbus, and Oroville Dams contributed low to moderate loads of chromium (32%), copper (22%), nickel (20%), and zinc (15%); the highest loads came from Shasta Dam due to high outflows and a few positive detections. Both Nimbus and Oroville Dam loads were based on one or two sampling runs and contributed slight amounts of zinc and copper only. Although outflow measurements were accurate, the frequent "below detection" concentrations precluded any loading estimate at all in most cases. Regardless, input from the dams would have a diluting effect on downstream pollutant concentrations. It is safe to assume that very few synthetic organic chemicals are discharged from these units.

It should be noted that dam loads do not necessarily reflect background (natural) loads since several point and non-point sources exist above the dams. Acid mine drainage from abandoned mines, NPDES effluent, and, to some extent, urban runoff is discharged within each of the reservoirs' watersheds. For instance, loads of cadmium, copper, and zinc would be expected to be relatively high from Shasta releases due to the existence of several major abandoned mines within the watershed. Metal inputs to reservoirs probably settle out, never fully making it into the Delta except during rainy periods when higher concentrations are expected from the base of the structures due to upstream metal laden runoff.

D. MASS LOADS BY METAL

To compare the relative accuracy of the trace metal load estimates, water concentrations in the lower Sacramento River were calculated using loading values and compared to historical concentration data. Table VIII-5 shows the calculated values aside monitoring data believed to be reliable. It should be noted that the 1986 values (Stuka, 1986) are reported to be extremely accurate due to methodology used to reduce the detection limits into the part per trillion range (Gunther et al., 1987).

Calculated values for copper, cadmium, and zinc were very similar to actual levels with the exception of values calculated for the summer months. During June-August, the calculated concentrations were elevated due to the estimated increase in AMD loading from SCDD. Actual monitoring data did not show a similar increase. Several reasons may explain the calculated-observed concentration discrepancies and include the movement of the metals with bedload, settling and entrapment in slow moving portions of the River (e.g., Keswick Dam), or the sampling simply did not coincide with SCDD discharge increases. The zinc inequalities can be further explained by interference problems commonly plaguing zinc analyses (as documented in this study [Appendix F]) that reduces both the accuracy and precision of the results.

Calculated nickel and chromium concentrations were relatively close to observed levels with the exception of a few extremely high samples. A single positive detection for lead in the Sacramento River (0.5 ppb) was below the level of 1.3 ppb calculated for September. Lead concentration was predicted to increase during the rainy season (November-March) as a result of higher urban runoff inputs during those months. Nickel and chromium concentrations were predicted to be the greatest during August-December due to the high agricultural drainage output and

Table VIII-5. COMPARISON OF CALCULATED AND OBSERVED MONTHLY METAL CONCENTRATION IN THE LOWER SACRAMENTO RIVER.

MONTH	CONCENTRATION IN UG/L								
	CALCULATED	OBSERVED	SAMPLE DATE (DAY/YEAR) 1/	CALCULATED	OBSERVED	SAMPLE DATE (DAY/YEAR) 1/	CALCULATED	OBSERVED	SAMPLE DATE (DAY/YEAR) 1/
	CADMIUM			CHROMIUM			COPPER		
January	0.1			1			4		
February	0.1	<1	(21/84)	1	<5	(21/84)	4	<5	(21/84)
March	0.2	<1	(18/85a)	2	<5	(18/85a)	5	6	(18/85a)
April	0.1			2			5		
May	0.2	<1, <50	(31/83,10/85b)	3	12,<10	(31/83,10/85b)	7	18, 8	(31/83,10/85b)
June	0.5	<1, <1, <5	(3/85a,3/85b,19/85b)	3	<5, 12, 15	(3/85a,3/85b,19/85b)	16	<5, 7, 4	(3/85a,3/85b,19/85b)
July	0.4	<1	(13/85b)	3	11	(13/85b)	16	7	(13/85b)
August	0.4	13	(24/83)	4	9	(24/83)	21	5	(24/83)
September	0.2	1, 0.2	(17/85,86)	4	<5, 1.7	(17/85a,86)	9	<5, 2.8	(17/85a,86)
October	0.2			2			8	5	(2/85b)
November	0.2	<1, <1	(22/83,8/85b)	4	<5, 6, 7	(22/83,8/85b,20/85b)	7	<10, 16, 6	(22/83,8/85b,20/85b)
December	0.2	1	(18/85a)	3	<5, 60	(18/85a,12/85b)	8	<5, 13	(18/85a,5/85b)
	LEAD			NICKEL			ZINC		
January	0.8			1			98		
February	1.3	<5	(21/84)	1	<5	(21/84)	29	30	(21/84)
March	2.1	<5	(18/85a)	1	<5	(18/85a)	45	37	(18/85a)
April	0.5			1			27		
May	0.5		(31/83)	2	25, <50	(31/83,10/85b)	31	31	(31/83)
June	0.7	<5	(3/85a)	2	<5, <5, <40	(3/85a,3/85b,19/85b)	95	16	(3/85a)
July	0.5			2	<5	(13/85b)	100		
August	0.5	<5	(24/83)	3	5	(24/83)	187	7, 2	(24/83,13/85b)
September	1.3	<5, 0.5	(17/85a,86)	3	5, 2	(17/85a,86)	73	28, 2.6	(17/85a,86)
October	1.1			2	7	(2/85b)	78		
November	4.3	<5	(22/83)	3	<5, 9, <5	(22/83,8/85b,20/85b)	42	48, 30, 10	(22/83,8/85b,11/85b)
December	1.9	<5	(18/85a)	3	<5, 32	(18/85a,5/85b)	35	<5, 5	(18/85a,5/85b)

1/ Sources of data: 1983-85a: SRCSD data sheets of samples taken at Freeport bridge.
1985b: Exhibit #10 from CVRWQCB submission to the pollutant phase of the 1987 Bay-Delta Hearings.
1986: Stukas, 1986 samples taken in the Sacramento River at Rio Vista.

correspondingly low River flows. In all cases, nickel, chromium, cadmium, and lead were calculated below the reported detection limits of most of the historical samples. Trace metal concentrations below standard detection limits were confirmed with a single sample (1986 values) reported to be highly reliable (Gunther et al., 1987). It is suggested for purposes of both practicality and reliability that Delta water samples for arsenic, cadmium, chromium, nickel, and lead be analyzed with methods capable of lower detection than is presently commercially available.

A similar loading study in 1977 calculated a surprisingly close estimate of Sacramento Valley copper loads. Table VIII-6 shows the breakdown of individual loaders were somewhat dissimilar, but a range of 271,000-384,000 pounds was very close to the 257,000 estimate calculated here considering the multitude of sources. The extremely high loading from mines was confirmed by both studies. Although 257,000 pounds is largely conservative, the methods used for their estimates were very "rough" and included AMD from mines above Shasta Dam. Regardless, the comparison indicates that loading estimates can be closely duplicated with the methods used here.

One trend not apparent from the monthly calculated concentrations are fluctuations that may occur from storm events. Trace metals in the Sacramento River are known to increase by several times during and immediately after major rainstorm events. The attenuating affects of averaging monthly loads during the rainy season are partially responsible for masking short duration (days-week) surges in metals, and therefore, are inadequate to predict daily downstream concentration trends. However, the methodology used here was successful in it's intent to provide relatively good loading estimations.

Table VIII-6. COMPARISON OF ANNUAL COPPER LOADS IN THE CENTRAL VALLEY.

	LOADS (THOUSANDS OF POUNDS)	
DISCHARGE	THIS STUDY	SAC, 1977
NPDES	8	11-22
Mines	143	250-350
Urban runoff	26	6-8 1/
Agriculture	34	no estimate
Dams	46	no estimate
Algicides	no estimate	4
TOTALS 2/	257	271-384

1/ Sacramento County only.
2/ Both totals stated to be conservative.

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APPENDIX A

LISTING OF CENTRAL VALLEY NPDES DISCHARGER CHARACTERISTICS, LOCATIONS, AND MONITORING FREQUENCY

Table A-1. CHARACTERISTICS OF NPDES DISCHARGERS IN THE CENTRAL VALLEY FROM NORTH TO SOUTH BY MAP I.D. NUMBER.

MAP 1/ I.D. #	PERMIT NUMBER	AGENCY NAME	FACILITY NAME	COUNTY 2/	EFFLUENT TYPE 3/	EVENTUAL RECEIVING WATERS	BASELINE FLOW (MGD) 4/	CONTINUOUS FLOW 5/
REDDING OFFICE								
1	CA0078921	ALTURAS CITY OF	ALTURAS MUNICIPAL WWTP	25	STP	Shasta Lake	0.3400	Y
2	CA0080713	CALANDOR PINE CORPORATION	SAWMILL	25	LDR	Shasta Lake	0.0000	N
3	CA0079791	ADIN LUMBER AND MILLWORK INC.	ADIN SAWMILL	25	LDR	Shasta Lake	0.1300	N
4	CA0081451	BIG VALLEY LUMBER COMPANY	SAWMILL AND COGENERATION	18	LDR	Shasta Lake	0.0480	N
5	CA0004553	CALIF DEPT OF FISH & GAME	PIT RIVER FISH HATCHERY	45	FHW	Shasta Lake	25.4000	Y
6	CA0004588	CALIF DEPT OF FISH & GAME	CRYSTAL LAKE FISH HATCHERY	45	FHW	Shasta Lake	16.5000	Y
7	CA0003981	SIERRA PACIFIC INDUSTRY	BURNEY LUMBER MILL	45	LDR	Shasta Lake	0.0000	N
8	CA0081655	INDIAN SPRINGS SCHOOL DISTRICT	INDIAN SPRINGS SCHOOL	45	GHW	Sacramento River	0.0870	Y
9	CA0004596	CALIF DEPT OF FISH & GAME	MT SHASTA FISH HATCHERY	47	FHW	Sacramento River	10.1000	Y
10	CA0078051	MT SHASTA, CITY OF	MT SHASTA STP	47	WTP	Sacramento River	0.5200	N
11	CA0078441	DUNSMUIR, CITY OF	DUNSMUIR STP	47	WTP	Sacramento River	0.4100	N
12	CA0081876	SHANON STEEL CORP.	MAMMOTH MINE	45	AMD	Shasta Lake	0.8669	Y
13	CA0081868	SILVER KING MINES INC.	BALAKLALA, KEYSTONE MINES	45	AMD	Shasta Lake	0.3096	Y
26	CA0081191	CALAVERAS CEMENT, INC.	CEMENT MANUFACTURE & QUARRY	45	GCR	Sacramento River	0.0000	N
27	CA0004693	SHASTA DAM AREA PUB UTIL DIST	SUMMIT CITY WATER PLANT	45	WTW	Sacramento River	0.0250	N
28	CA0081345	SHASTA DAM AREA PUB UTIL DIST	WATER TREATMENT PLANT	45	WTW	Sacramento River	0.0500	Y
29	CA0081400	SIERRA PACIFIC INDUSTRY	CENTRAL VALLEY LUMBER MILL	45	LDR	Sacramento River	0.0000	N
30	CA0079511	SHASTA DAM AREA PUB UTIL DIST	SEWAGE TREATMENT PLANT	45	WTP	Sacramento River	0.6000	N
31	CA0081108	IRON MOUNTAIN MINES, INC	ACID MINE DRAINAGE	45	AMD	Sacramento River	0.6500	Y
32	CA0080799	BELLA VISTA WATER DISTRICT	BELLA VISTA WATER FILT PLANT	45	WTW	Sacramento River	0.7500	N
33	CA0079731	REDDING, CITY OF	REDDING STP-CLEAR CREEK PLANT	45	WTP	Sacramento River	3.5000	Y
34	CA0077704	ANDERSON, CITY OF	ANDERSON STP	45	WTP	Sacramento River	1.2000	Y
35	CA0004065	SIMPSON PAPER COMPANY	SHASTA MILL WWTP	45	PPW	Sacramento River	12.7500	Y
36	CA0004031	ROSEBURG LUMBER CO.	ANDERSON SAWMILL	45	LDR	Sacramento River	0.0000	N
37	CA0079936	PAUL BUNYAN LUMBER COMPANY	ANDERSON SAWMILL	45	LDR	Sacramento River	0.0000	N
38	CA0081205	SILLER BROTHERS INC.	SAWMILL	45	LDR	Sacramento River	0.0000	N
39	CA0081329	SHASTA LIVESTOCK AUCTION INC.	SHASTA LIVESTOCK AUCTION YARDS	45	LSR	Sacramento River	0.0000	N
40	CA0081507	SHASTA CO. SERVICES AREA NO.17	COTTONWOOD WWTP	45	WTP	Sacramento River	0.4000	Y
41	CA0081167	BATTLE CREEK TROUT FARM	MANTON FISH HATCHERY	52	FHW	Sacramento River	0.3500	Y
42	CA0004561	CALIF DEPT OF FISH & GAME	DARRAH SPRINGS FISH HATCHERY	45	FHW	Sacramento River	26.7000	Y
43	CA0004201	US FISH AND WILDLIFE SERVICE	COLEMAN FISH HATCHERY	45	FHW	Sacramento River	67.0000	Y
44	CA0077852	RIO ALTO WATER DISTRICT	LAKE CALIFORNIA STP	52	WTP	Sacramento River	0.6400	Y
45	CA0080381	MT LASSEN TROUT FARMS	DALES FACILITY	52	FHW	Sacramento River	3.6000	Y
46	CA0080373	MT LASSEN TROUT FARMS	MEADOWBROOK FACILITY	52	FHW	Sacramento River	2.1600	Y
61	CA0004821	PACKAGING CO. OF CALIFORNIA	RED BLUFF FIBER PLANT	52	PPW	Sacramento River	2.0000	Y
62	CA0078891	RED BLUFF, CITY OF	RED BLUFF STP	52	WTP	Sacramento River	1.2200	Y
63	CA0010671	US FISH AND WILDLIFE SERVICE	TEHAMA COLUSA FISH FACILITY	52	FHW	Sacramento River	0.0000	N
64	CA0004073	CRANE MILLS	SAWMILL AND SWDS	52	LDR	Sacramento River	0.0000	N
65	CA0081469	OLIVES, INCORPORATED	OLIVE PRODUCTION PLANT	52	CSW	Sacramento River	0.0450	Y
66	CA0081639	BELL-CARTER FOODS, INC.	OLIVE PLANT	52	CSW	Sacramento River	0.1250	Y
67	CA0004995	CORNING, CITY OF	CORNING STP	52	WTP	Sacramento River	0.8300	Y

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Table A-1 (Continued).

MAP 1/ I.D. #	PERMIT NUMBER	AGENCY NAME	FACILITY NAME	COUNTY 2/	EFFLUENT TYPE 3/	EVENTUAL RECEIVING WATERS	BASELINE FLOW (MGD) 4/	CONTINUOUS FLOW 5/
81	CA0077747	CHESTER PUBLIC UTILITY DISTRIC	CHESTER SANITARY DISTRICT WWTP	32	WTP	Lake Oroville	0.5000	N
82	CA0004391	COLLINS PINE COMPANY	CHESTER SAWMILL	32	PCW	Lake Oroville	71.0050	Y
83	CA0081906	CALGOM MINING, INC.			MPW	Lake Oroville	0.0000	N
84	CA0081493	INDIAN VALLEY HOSPITAL DIST.	COOLING WATER	32	GHW	Lake Oroville	0.0700	Y
85	CA0078981	QUINCY SANITARY DISTRICT	QUINCY STP	32	WTP	Lake Oroville	0.9100	N
86	CA0080357	SIERRA PACIFIC INDUSTRY	QUINCY SAWMILL	32	LDR	Lake Oroville	0.0000	N
87	CA0080110	ROBERT L. BARRY, ET AL.	WALKER MINE	32	AMD	Lake Oroville	0.1293	Y
88	CA0077984	PLUMAS COUNTY FC & WC DIST.	LAKE DAVIS WATER TRT PLT	32	WTW	Lake Oroville	0.0500	N
89	CA0077844	PORTOLA, CITY OF	PORTOLA STP	32	WTP	Lake Oroville	0.3500	N
90	CA0081744	GRIZZLY LAKE RESORT IMP DIST.	DELLECKER WASTE WATER PONDS	32	WTP	Lake Oroville	0.1000	N
91	CA0080969	FEATHER FORK MINES	MINE WASTE WATER PONDS	32	MPW	Lake Oroville	0.6000	N
SACRAMENTO OFFICE								
68	CA0077861	SPRINGS OF LIVING WATER	WASTE DISPOSAL	04	STP	Sacramento River	0.0150	N
69	CA0079081	CHICO, CITY OF	MAIN TREATMENT PLANT	04	WTP	Sacramento River	3.0000	Y
87	CA0080110	ROBERT L. BARRY, ET AL	WALKER MINE	32	AMD	Lake Oroville	0.1293	Y
92	CA0079766	D.E.W. CORPORATION-CONDOR EXP.	SUNNYSIDE MINE	46	MPW	Feather River	0.0050	N
93	CA0081621	DONNER SUMMIT PUBLIC UTILITY	WWTP	29	WTP	Feather River	0.2800	N
94	CA0081591	ALHAMBRA MINES, INC.	MAPLE GROVE MINE	46	MPW	Feather River	0.0360	Y
95	CA0081809	KANAKA CREEK JOINT VENTURE	THE 16 TO 1 MINE	46	MPW	Feather River	0.1440	Y
96	CA0081060	YUBA CO WATER DIST-BUTTE CO	WATER TREAT PLANT-FORBESTOWN	04	WTW	Feather River	0.0150	Y
97	CA0078000	SIERRA MOUNTAIN MILLS	WW DISP FAC	58	LDR/PCW	Feather River	0.0050	N
98	CA0004570	CALIF DEPT OF FISH & GAME	FEATHER RIVER HATCHERY	04	FHW	Feather River	29.0000	Y
99	CA0079235	SEWAGE COMM-OROVILLE REGION	WWTP	04	WTP	Feather River	3.5000	Y
100	CA0079634	RICHVALE SD	WWTP	04	WTP	Sacramento River	0.0300	Y
101	CA0077763	GLENN MILK PRODUCERS ASSOC.	MILK PROCESSING	11	FPW/PCW	Sacramento River	0.9500	Y
102	CA0078034	WILLOWS, CITY OF	WWTP	11	WTP	Sacramento River	0.7500	Y
103	CA0079987	MAXWELL P.U.D.	WASTE TREATMENT FACILITY	06	WTP	Sacramento River	0.1200	Y
104	CA0077933	WILLIAMS, CITY OF	WILLIAMS STP	06	STP	Sacramento River	0.3800	Y
105	CA0078999	COLUSA, CITY OF	WWTP	06	WTP	Sacramento River	0.5000	Y
106	CA0078930	BIGGS, CITY OF	BIGGS STP	04	STP	Sacramento River	0.3500	Y
107	CA0003921	TRI VALLEY GROWERS	GRIDLEY PLANT-WTP	04	PCW	Sacramento River	3.0000	N
108	CA0079022	LIVE OAK, CITY OF	WWTP	51	WTP	Sacramento River	0.3000	Y
109	CA0080403	JOSEPH A. MOREHEAD	BUTTE ROCK AND GRAVEL	51	GCR	Feather River	0.0300	N
110	CA0079260	YUBA CITY	WASTE WATER RECLAMATION PLANT	51	WTP	Feather River	3.5000	N
111	CA0079651	LINDA COUNTY WATER DISTRICT	WPCP	58	WTP	Feather River	0.8360	N
112	CA0077836	OLIVEHURST P.U.D.	WWTP	58	WTP	Feather River	1.0000	Y
113	CA0004642	ERICKSON LUMBER COMPANY	WW DISP FAC	58	LDR/PCW	Feather River	0.0100	N
114	CA0110299	BEALE AIR FORCE BASE	WWTP	58	WTP	Feather River	1.1000	Y
115	CA0081574	HAMMONTON GOLDEN VILLAGE	SEWAGE TREATMENT PLANT	58	STP	Feather River	0.0500	N

Table A-1 (Continued).

MAP 1/ I.D. #	PERMIT NUMBER	AGENCY NAME	FACILITY NAME	COUNTY 2/	EFFLUENT TYPE 3/	EVENTUAL RECEIVING WATERS	BASELINE FLOW (MGD) 4/	CONTINUOUS FLOW 5/
116	CA0077828	NEVADA COUNTY SD NO. 1	LAKE WILDWOOD SP IMPR ZONE 1	29	STP	Feather River	0.2500	Y
117	CA0079421	NEVADA UNION HIGH SCHOOL	WWTP	29	STP	Feather River	0.0450	Y
118	CA0079901	NEVADA CITY, CITY OF	WWTP	29	WTP	Feather River	0.6900	Y
119	CA0077771	GRASS VALLEY READY MIX	READYMIX CONCRETE	29	GCR	Feather River	0.0050	N
120	CA0079898	GRASS VALLEY, CITY OF	STP	29	STP	Feather River	1.5500	Y
121	CA0081612	NEVADA COUNTY SAN. DIST. NO.1	LAKE OF THE PINES	29	WTP	Feather River	0.5780	N
131	CA0079529	COLFAX, CITY OF	COLFAX STP	31	WTP	Folsom Lake	0.1300	Y
132	CA0079316	PLACER CO SEWER MAINT DIST 1	WWTP	31	WTP	Sacramento River	0.9500	Y
133	CA0081701	VICTOR BALATA BELTING CO.	VICTOR BALATA BELTING COMPANY	31	PCW	Sacramento River	0.0600	Y
134	CA0077712	AUBURN, CITY OF	WWTP	31	WTP	Sacramento River	0.8200	Y
135	CA0077801	LINCOLN CLAY PRODUCTS CO.	WW DISP FAC	31	GCR	Sacramento River	0.5000	N
136	CA0004332	GLADDING, MCBEAN AND CO.	LINCOLN PLANT	31	PCW	Sacramento River	0.0400	Y
137	CA0004057	FORMICA CORP.	SIERRA PLANT	31	PCW	Sacramento River	1.0000	Y
139	CA0077879	TENCO TRACTOR INC.	WW DISP PONDS	51	TIS	Sacramento River	0.0020	Y
140	CA0078875	CAL OFFICE OF STATE PRINTING	STATE PRINTING & WAREHOUSES	34	PCW	American River	1.0200	Y
141	CA0079111	SACRAMENTO REGIONAL COUNTY SD	COMBINED WASTEWATER CONTROL SY	34	WTP	Sacramento River	0.0000	N
142	CA0005037	SACRAMENTO, CITY OF	SACRAMENTO RIVER WTP	34	WTW	Sacramento River	0.4200	N
143	CA0078522	TOSCO CORPORATION	SACRAMENTO TERMINAL	34	IYS	Sacramento River	0.0010	N
144	CA0078581	CA. STATE, CENTRAL PLANT OPER.	CENTRAL HEATING & COOLING PLAN	34	PCW	Sacramento River	5.0000	Y
145	CA0080781	SHELL OIL COMPANY	WEST SACRAMENTO PLANT	57	IYS/PSW	Sacramento River	0.0000	N
146	CA0004359	MCCLELLAN AIR FORCE BASE	MCCLELLAN AFB	34	PCW/IYS	Sacramento River	0.2330	Y
147	CA0078786	PLACER CO. SERVICE AREA NO. 11	SABRE CITY WW TREATMENT PLNT	31	WTP	Sacramento River	0.0450	Y
148	CA0079502	ROSEVILLE, CITY OF	ROSEVILLE STP	31	WTP	Sacramento River	11.7500	Y
149	CA0079359	PLACER CO SEWER MAINT DIST 2	WWTP	31	STP	Sacramento River	0.2500	Y
150	CA0079804	ROCKLIN LOOMIS MUD	ROGERSDALE STP	31	STP	Sacramento River	0.0400	N
151	CA0079642	PLACER CO DEPT OF PUBLIC WORKS	MINERS RAVINE WWTP	31	WTP	Sacramento River	0.1090	Y
152	CA0079367	PLACER CO SEWER MAINT DIST 3	WASTE TRT FACILITY	31	WTP	Sacramento River	0.3000	Y
153	CA0081710	EL DORADO IRRIGATION DISTRICT	SOUTH FORK AMERICAN RIVER DEV.	09	CWW	Folsom Lake	0.2900	N
154	CA0078841	MICHIGAN-CAL LUMBER	MICHIGAN-CAL LUMBER WTP	09	LDR	Folsom Lake	0.3500	N
155	CA0004774	CALIF DEPT OF FISH & GAME	AMERICAN RIVER TROUT HATCHERY	34	FHW	Lower American River	41.0187	Y
156	CA0004111	AEROJET GENERAL CORPORATION	SACRAMENTO FACILITY	34	IYS/PWW	Lower American River	0.1500	N
157	CA0078956	PLACERVILLE, CITY OF	HANGTOWN CREEK WTP	09	WTP	Folsom Lake	1.2000	Y
200	CA0081477	HOMESTAKE MINING COMPANY	McLAUGHLIN MINE	17	MPW	Lake Berryessa	0.0000	N
201	CA0080659	STONEHOUSE MUTUAL WATER CO.	WATER TREATMENT PLANT	17	WTW	Lake Berryessa	0.0030	Y
202	CA0077950	WOODLAND, CITY OF - DOMESTIC	SEWAGE TRT FACILITY	57	STP	Sacramento River	3.0400	N
203	CA0079049	DAVIS, CITY OF	CITY OF DAVIS STP	57	WTP	Sacramento River	3.5800	Y
204	CA0079227	HUNT WESSON FOODS, INC.	WASTE TRT FACILITY	57	FPW	Sacramento River	1.0000	N
205	CA0077895	UNIVERSITY OF CALIFORNIA	MAIN STP	57	WTP	Sacramento River	1.8000	Y
206	CA0004316	PROCTER AND GAMBLE COMPANY	WASTE TRT PLANT	34	PCW/SWD	Sacramento River	4.5000	Y
207	CA0078564	EL DORADO IRRIGATION DISTRICT	EL DORADO COUNTY SD #2	09	STP	Folsom Lake	0.7500	N
208	CA0078662	EL DORADO IRRIGATION DISTRICT	DEER CREEK WASTEWATER RECL	09	STP	San Joaquin River	1.5000	Y
209	CA0078671	EL DORADO IRRIGATION DISTRICT	EL DORADO HILLS WW TRT PLANT	09	WTP	San Joaquin River	0.6500	N
210	CA0079979	WETSEL OVIATT LUMBER COMPANY	WETSEL OVIATT LUMBER COMPANY	09	LDR	San Joaquin River	0.0000	N

Table A-1 (Continued).

MAP 1/ I.D. #	PERMIT NUMBER	AGENCY NAME	FACILITY NAME	COUNTY 2/	EFFLUENT TYPE 3/	EVENTUAL RECEIVING WATERS	BASELINE FLOW (MGD) 4/	CONTINUOUS FLOW 5/
211	CA0077682	SACRAMENTO REGIONAL COUNTY SD	SACRAMENTO REGIONAL WWTP	34	WTP	Sacramento River	150.0000	Y
212	CA0079171	EAST YOLO COMM. SERVICES DIST	WEST SACRAMENTO STP	57	STP	Sacramento River	4.5000	Y
213	CA0004901	DELTA SUGAR CORPORATION	WASTE TRT FACILITY, CLARKSBURG	57	PCW	Sacramento River	4.3700	N
214	CA0004855	NEWHALL LAND AND FARMING CO.	NEWHALL LAND & FARM-CLARKSBURG	57	FPW	Sacramento River	0.0125	N
215	CA0004928	STILLWATER ORCHARDS COMPANY	HOOD COLD STORAGE TERMINAL	34	PCW	Sacramento River	0.0050	Y
216	CA0078018	VACAVILLE, CITY OF	INDUSTRIAL WASTE TREAT. FAC.	48	WTP	Sacramento River	0.6000	Y
217	CA0081531	WICKES FOREST IND.	WICKS WOOD PRESERVING	48	TGW	Sacramento River	0.0110	Y
218	CA0077691	VACAVILLE, CITY OF	EASTERLY SEWAGE TRT PLANT	48	WTP	Sacramento River	6.0000	Y
219	CA0078697	GALT, CITY OF	GALT SD	34	WTP	San Joaquin River	0.8750	N
220	CA0079961	SACRAMENTO COUNTY DPW	RIO CONSUMNES CORRECTIONAL CTR	34	WTP	San Joaquin River	0.2500	N
221	CA0078794	WALNUT GROVE SMD	WALNUT GROVE WWTP	34	WTP	San Joaquin River	0.5000	N
222	CA0004758	SACRAMENTO M.U.D.	RANCHO SECO	34	WTP/PCW	San Joaquin River	4.7170	Y
223	CA0004229	NORTH AMERICAN REFRACTORIES	CLAY MINING AND PROCESSING	03	GCR	San Joaquin River	0.0000	N
224	CA0079391	JACKSON, CITY OF	JACKSON S.T.P.	03	WTP	San Joaquin River	0.7100	Y
225	CA0079464	SAN ANDREAS SANITARY DIST.	SAN ANDREAS WWTF	05	WTP	San Joaquin River	0.3000	N
228	CA0004791	CALIF DEPT FISH & GAME,REG.2	MOKELUMNE RIVER FISH INSTALL	39	FHW	San Joaquin River	42.8200	Y
229	CA0078069	TURNER WINERY	WASTE TREATMENT FACILITY	39	PCW	San Joaquin River	0.3000	N
230	CA0079588	RIO VISTA, CITY OF	WASTE TRT. FACILITY	48	WTP	Sacramento River	0.3500	Y
231	CA0081370	FILIPE JOHANSSON PROJECT	BETHEL ISLAND PROJECT	07	TLW	San Joaquin River	0.0000	N
233	CA0078531	CROWN ZELLERBACH CORP	ANTIOCH FACILITY	07	PPW	San Joaquin River	15.0000	Y
234	CA0004936	E.I. DU PONT DE NEMOURS & CO.	ANTIOCH FACILITY	07	WTP	San Joaquin River	0.9000	Y
235	CA0004863	PACIFIC GAS AND ELECTRIC CO.	CONTRA COSTA POWER PLT ANTIOCH	07	PCW/PWW	San Joaquin River	594.5100	Y
235	CA0004863	PACIFIC GAS AND ELECTRIC CO.	CONTRA COSTA POWER PLT ANTIOCH	07	PCW/IYS	San Joaquin River	0.2010	Y
236	CA0081248	IMPERIAL WEST CHEMICAL	WASTE TRT FACILITY	07	PCW	San Joaquin River	0.0009	Y
237	CA0080683	INTERNATIONAL OIL & GAS CO.	BRENTWOOD OIL AND GAS FIELD	07	OPW	San Joaquin River	0.0280	Y
238	CA0080845	TERMO COMPANY	BRENTWOOD OIL AND GAS FIELDS	07	OPW	San Joaquin River	0.3360	Y
239	CA0080675	ALLIED ENERGY CORP.	BRENTWOOD OIL AND GAS FIELD	07	OPW	San Joaquin River	0.0029	Y
240	CA0081647	PESTANA, JOHN, FAMILY TRUST	BRENTWOOD OIL & GAS FIELDS	07	OPW	San Joaquin River	0.0240	Y
241	CA0004014	SHELL CALIFORNIA PRODUCTION	BRENTWOOD OIL & GAS FIELDS	07	OPW	San Joaquin River	0.1890	Y
242	CA0079910	RECLAMATION DISTRICT NO. 800	DISCOV.BAY DEVEL.-BYRON TRACT	07	TLW	San Joaquin River	42.0000	Y
243	CA0078590	CONTRA COSTA CO.SAN.DIST.NO.19	DISCOVERY BAY TRMT PLANT	07	STP	San Joaquin River	0.1220	Y
244	CA0081396	UC LAWRENCE LIVERMORE LAB	SITE 300 COOLING WTR DISCHARGE	39	PCW	San Joaquin River	0.0000	Y
245	CA0079243	LODI, CITY OF	WHITE SLOUGH WATER POLL CON PU	39	WTP	San Joaquin River	4.7000	N
246	CA0003913	TRI VALLEY GROWERS	TOM SPUR PLANT #4	39	PCW	San Joaquin River	1.2000	N
248	CA0003883	GOLD BOND BUILDING PRODUCTS	STOCKTON FACILITY	39	PCW	San Joaquin River	1.8000	Y
249	CA0004472	MCCORMICK & BAXTER CREOSOTING	STOCKTON WASTE TRT PLANT	39	PCW	San Joaquin River	0.4100	Y
250	CA0079138	STOCKTON-MAIN STP	STOCKTON STP-MAIN PLANT	39	WTP	San Joaquin River	29.0000	Y
251	CA0004456	MOHAWK RUBBER COMPANY	STOCKTON PLANT	39	PCW	San Joaquin River	0.5600	Y
253	CA0003905	US ARMY-SHARPE DEPOT	DOM. & IND. WASTE TRT PLANT	39	WTP	San Joaquin River	0.1120	Y
255	CA0004839	LIBBEY OWENS FORD COMPANY	LATHROP PLANT 10,WTP	39	PCW	San Joaquin River	0.6400	N
257	CA0079154	TRACY,CITY OF	TRACY SEWAGE TRT. PLANT	39	WTP	San Joaquin River	4.0000	Y
258	CA0078093	DEUEL VOC. INSTITUTE	DEUEL VOCATNL INST. STP	39	STP	San Joaquin River	0.2500	Y
259	CA0080021	ISC WINES OF CALIFORNIA	COOLING & PROCESS WASTES	39	PCW	San Joaquin River	0.4000	Y

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Table A-1 (Continued).

MAP 1/ I.D. #	PERMIT NUMBER	AGENCY NAME	FACILITY NAME	COUNTY 2/	EFFLUENT TYPE 3/	EVENTUAL RECEIVING WATERS	BASELINE FLOW (MGD) 4/	CONTINUOUS FLOW 5/
260	CA0081426	ESCALON PACKERS, INC.	ESCALON PACKERS, INC.	39	PCW	San Joaquin River	1.6200	Y
261	CA0004146	HERSHEY FOODS CORP	HERSHEY CHOCOLATE CO, OAKDALE	50	PCW	San Joaquin River	2.0000	Y
262	CA0080837	SHELL DEVELOPMENT COMPANY	AGRICULTUAL RESEARCH DIVISION	50	PCW	San Joaquin River	0.4528	N
263	CA0004006	SIMPSON PAPER COMPANY	RIPON FACILITY	39	WTP	San Joaquin River	0.5000	N
300	CA0081698	JAMESTOWN MINE / SMC	SONORA MINING CO.	55	MPW	San Joaquin River	0.0000	N
301	CA0004804	CALIF DEPT OF FISH & GAME	MOCCASIN CREEK FISH HATCHERY	55	FHW	San Joaquin River	19.3000	Y
302	CA0003999	E&J GALLO WINERY	MODESTO FACILITY	50	PCW	San Joaquin River	0.0350	Y
303	CA0079103	MODESTO, CITY OF	SEWAGE TRT FACILITY	50	WTP	San Joaquin River	22.4000	N
304	CA0078735	PATTERSON, CITY OF	PATTERSON WASTE TRT PLANT	50	WTP	San Joaquin River	0.3000	N
305	CA0078948	TURLOCK, CITY OF	TURLOCK WWTP	50	WTP	San Joaquin River	8.0000	Y
306	CA0079472	NEWMAN, CITY OF	NEWMAN WWTF	50	WTP	San Joaquin River	0.5750	N
FRESNO OFFICE								
307	CA0110957	U S DEPT INTERIOR	YOSEMITE NAT PRK, EL PORTAL	22	WTP	San Joaquin River	0.7200	Y
308	CA0080055	CALIF DEPT OF FISH & GAME	MERCED RIVER REARING FACILITY	24	FHW	San Joaquin River	7.7000	Y
310	CA0081272	GUSTINE CITY OF	GUSTINE STP	24	WTP	San Joaquin River	0.9000	Y
311	CA0080616	DAVIS CANNING COMPANY	ATWATER CANNERY	24	PCW	San Joaquin River	2.1810	Y
312	CA0079197	ATWATER, CITY OF	STP	24	WTP	San Joaquin River	2.8600	Y
313	CA0004260	MATER MISERICORDIAE HOSPITAL	MERCY HOSPITAL	24	PCW	San Joaquin River	0.0180	Y
314	CA0080071	GOODYEAR TIRE AND RUBBER CO.	VITAFILM PLANT	24	PCW	San Joaquin River	0.3100	Y
315	CA0081833	GENERAL ELECTRIC COMPANY	GEN. ELEC. - THE KENDALL CO.	24	TGW	San Joaquin River	1.0000	Y
316	CA0079219	MERCED, CITY OF	WASTE TREATMENT PLANT	24	WTP	San Joaquin River	5.5000	Y
317	CA0078950	PLANADA COMMUNITY SERV. DIST	WTF	24	WTP	San Joaquin River	0.3770	Y
318	CA0079286	DOS PALOS, CITY OF	WASTE TRT FACILITY	24	STP	San Joaquin River	0.3500	Y
319	CA0079430	MARIPOSA PUD	WASTE TREATMENT PLANT	22	WTP	San Joaquin River	0.2000	Y
320	CA0081761	BAUSCH, JOHN H.	COARSEGOLD SELF SERVICE, INC.	20	TGW	San Joaquin River	0.0001	N
321	CA0078221	SEQUOIA FOREST INDUSTRIES	NORTH FORK MILL	20	LDR	San Joaquin River	0.0001	N
322	CA0079545	SOUTHERN CALIF EDISON CO	BIG CREEK POWERHOUSE NO 1	10	STP	San Joaquin River	0.0210	Y
323	CA0078468	SOUTHERN CALIF EDISON CO	BIG CREEK POWERHOUSE NO 3	10	STP	San Joaquin River	0.0100	Y
324	CA0081337	SOUTHERN CALIF EDISON CO	BALSAM MEADOWS HYDRO. PROJ.	10	CWW	San Joaquin River	0.1900	Y
326	CA0004812	CALIF DEPT OF FISH & GAME	SAN JOAQUIN FISH HATCHERY	10	FHW	San Joaquin River	22.6000	Y
328	CA0081086	ISC WINES	ITALIAN SWISS COLONY WINERY		PCW	San Joaquin River	0.3000	N
400	CA0080109	ISC WINES	CELLA WINERIES	10	PCW	Kings River	0.1040	Y
401	CA0081230	REEDLEY, CITY OF	STP	10	WTP	Kings River	1.5300	N
402	CA0004090	DEL MONTE CORPORATION	CALIF. DIV. PLANT NO. 25	10	PCW	Kings River	0.6000	N
403	CA0081485	CUTLER-OROSI JT POWERS WW AUTH	WWTF	54	WTP	Tulare Lake	1.0000	N
404	CA0081779	SOUTHERN CALIF EDISON CO	VISALIA POLE YARD	54	TGW	Tulare Lake	0.4000	Y
405	CA0081728	PACIFIC WESTERN EXTRUD. PL. CO	PACIFIC WESTERN EXTRUD. PL. CO	54	PCW	Tulare Lake	0.0310	Y
406	CA0079189	VISALIA,CITY OF	STP	54	WTP	Tulare Lake	8.6000	Y
407	CA0081256	KRAFT, INC. DAIRY DIVISION	VISALIA PLANT	54	PCW	Tulare Lake	0.0300	Y

C—108759

Table A-1 (Continued).

MAP 1/ I.D. #	PERMIT NUMBER	AGENCY NAME	FACILITY NAME	COUNTY 2/	EFFLUENT TYPE 3/	EVENTUAL RECEIVING WATERS	BASELINE FLOW (MGD) 4/	CONTINUOUS FLOW 5/
408	CA0081671	EARLY CALIF. FOODS	OLIVE CANNING FACILITY	54	CSW	Tulare Lake	0.0210	Y
409	CA0080900	AKERS WEST PARTNERSHIP	VISALIA MEDICAL CLINIC	54	PCW	Tulare Lake	0.2000	N
410	CA0080233	EXETER, CITY OF	EXETER STP	54	STP	Tulare Lake	0.7000	N
411	CA0081353	SPRINGVILLE PUBLIC UTILITIES D	WATER TREATMENT PLANT	54	WTW	Tulare Lake	0.1800	N
412	CA0081663	BECKMAN INSTRUMENTS, INC.	BECKMAN INST., PORTERVILLE	54	TGW	Tulare Lake	2.8000	Y
413	CA0078131	CALIF DEPT OF FISH & GAME	KERN RIVER HATCHERY	15	FHW	Kern River	25.0000	Y
414	CA0081116	PORTLAND GENERAL ELECTRIC CO	MIRACLE HOT SPRINGS MINE	15	MPW	Kern River	0.5000	Y
415	CA0079537	EMJAYCO	MOUNT POSO	15	OPW	Poso Creek	0.0500	Y
416	CA0081094	STEELE PETROLEUM CO.	MOUNT POSO	15	OPW	Poso Creek	0.0500	Y
417	CA0078859	SCHAEFER OIL CO., INC.	MOUNT POSO	15	OPW	Poso Creek	0.3500	Y
418	CA0078255	R & D OIL CO.	MOUNT POSO	15	OPW	Little Dry Creek	0.0001	N
419	CA0078867	ANGUS PETROLEUM CORP.	POSO CREEK	15	OPW	Poso Creek	0.0500	Y
420	CA0081124	ANCORA-VERDE CORPORATION	POSO CREEK	15	OPW	Poso Creek	0.0300	Y
421	CA0081604	ANDERSON, BRUCE	POSO CREEK	15	OPW	Poso Creek	0.0400	Y
422	CA0081132	PETRO RESOURCES, INC.	MOUNT POSO	15	OPW	Poso Creek	0.0450	Y
423	CA0078336	ELF AQUITAINE OIL & GAS, INC.	POSO CREEK	15	OPW	Poso Creek	0.3500	Y
424	CA0080209	THOMAS OIL CO.	ROUND MOUNTAIN	15	OPW	Poso Creek	0.0130	Y
425	CA0080128	THOMAS OIL CO.	MT. POSO	15	OPW	Poso Creek	0.3400	Y
426	CA0079928	SOUTHERN CALIF EDISON CO	KERN R. POWERHOUSE NO. 1	15	STP	Kern River	0.0030	Y
427	CA0081311	VALLEY WASTE DISPOSAL CO.	KERN FRONT NO. 2	15	OPW	Irrigation canals	1.2600	Y
428	CA0080853	CHEVRON USA, INC.	KERN RIVER	15	OPW	Kern River	6.3000	Y
429	CA0078352	TEXACO, INC.	KERN RIVER	15	OPW	Kern River	7.4000	Y
430	CA0078280	TENNECO OIL CO.	KERN RIVER	15	OPW	Kern River	0.0001	Y
431	CA0079839	KERN COUNTY PUBLIC WORKS DEPT	KERN RIVER PARK AND CAMPGROUND		WTW	Kern River	0.0011	Y
432	CA0079758	OLCESE WATER DIST.	WATER TREATMENT PLANT	15	WTW	Kern River	0.0300	N
433	CA0079821	KERN COUNTY PUBLIC WORKS DEPT	HART MEMORIAL PARK		WTW	Kern River	0.0011	Y
434	CA0081213	BEAR VALLEY SPRINGS COM. SERV	STP	15	WTP	Irrigation canals	0.0600	N
435	CA0080161	TAFT, CITY OF	STP	15	WTP	Agricultural lands	1.0000	N
436	CA0081221	KINGS RIVER CONSERVATION DISTR	DINKEY CREEK HYDROELECTRIC PRO	10	CWW	Kings River	0.0001	Y

1/ See Figures A-1a-k for map I.D. location.
2/ See table A-3 for county code definitions.
3/ See table A-4 for definitions and descriptions.
4/ Million Gallons per Day.
5/ Yes or No.

C-108760

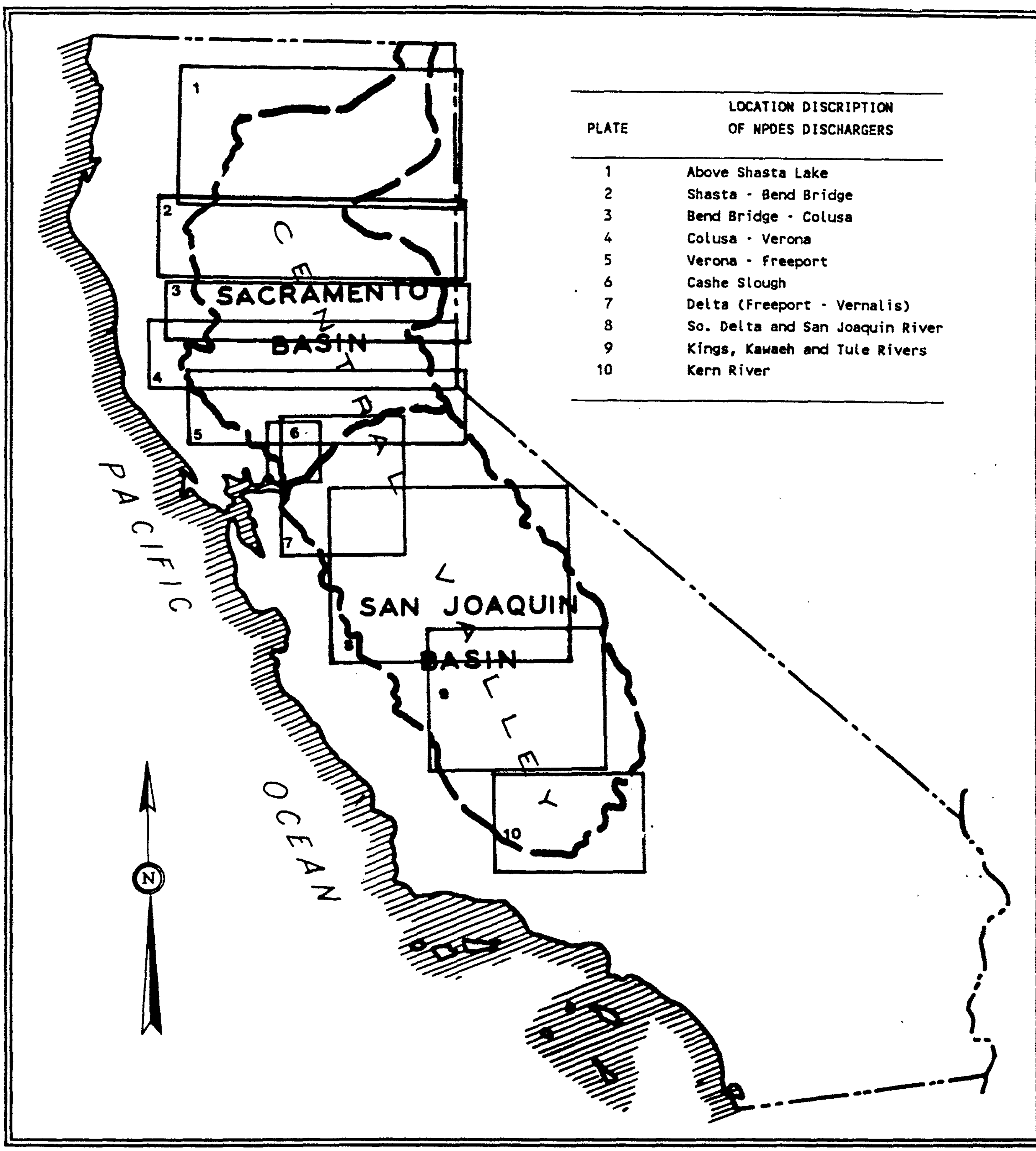


Figure A-1 [PLATES 1-10]. AREAL LOCATIONS OF NPDES DISCHARGERS IN THE CENTRAL VALLEY. SEE TABLE A-1 FOR DESCRIPTIONS CORRESPONDING TO MAP I.D. NUMBERS.

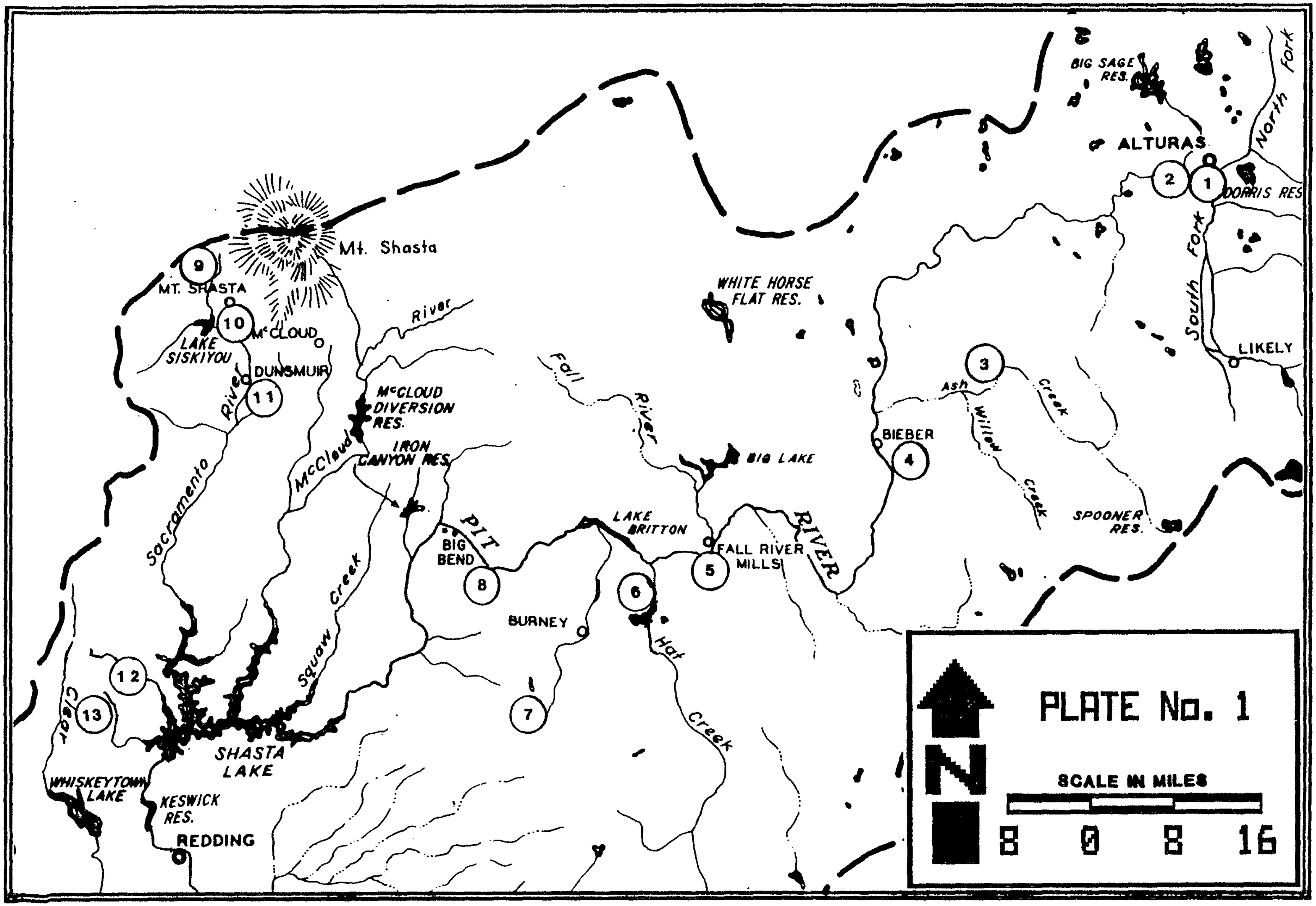
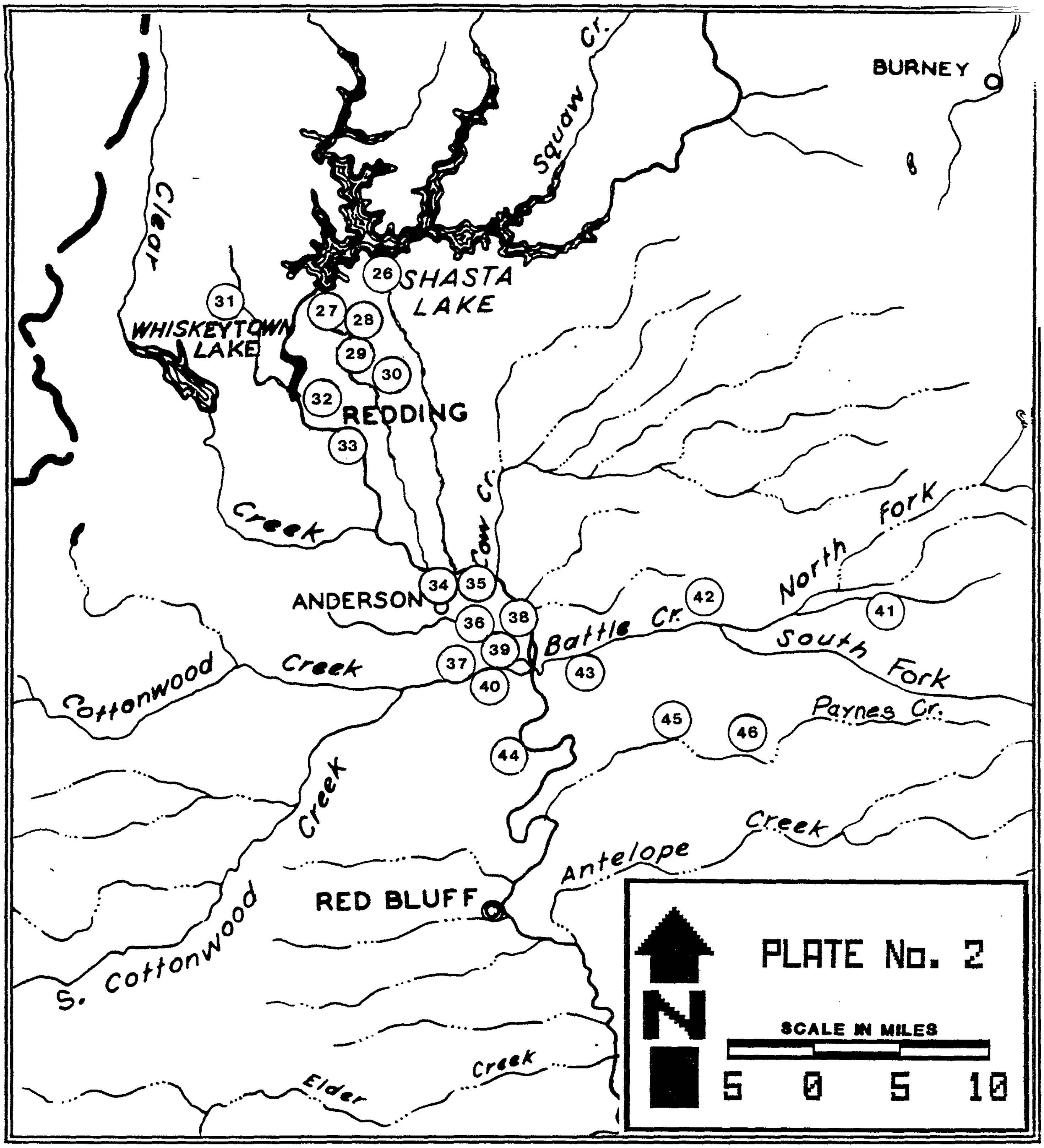
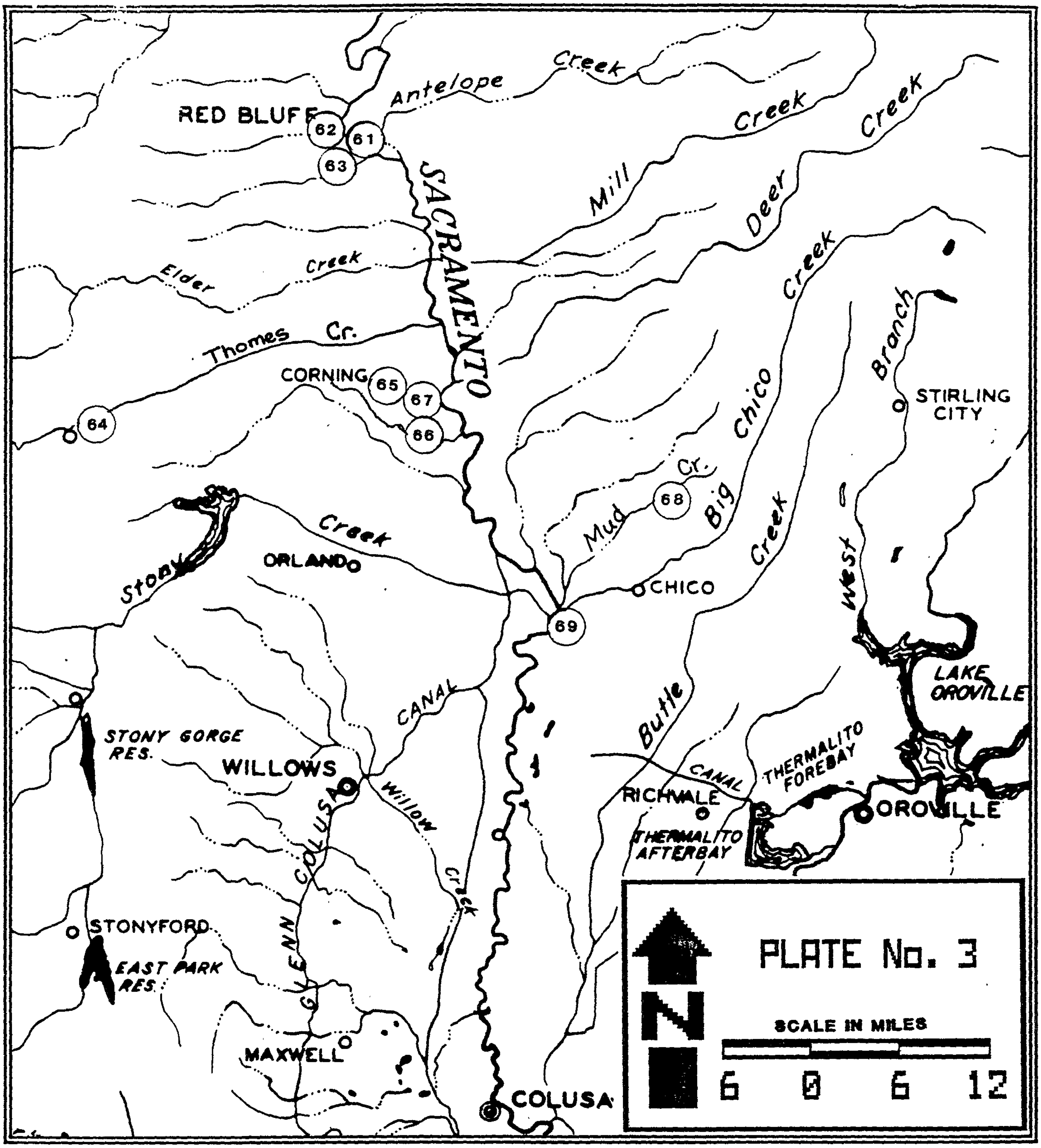


PLATE No. 1
SCALE IN MILES
8 0 8 16
N
Mt. Shasta
MT. SHASTA
McCLOUD
LAKE SISKIYOU
DUNSMUIR
McCLOUD DIVERSION RES.
IRON CANYON RES.
BIG BEND
PIT
RIVER
BURNEY
LAKE BRITTON
FALL RIVER MILLS
BIG LAKE
WHITE HORSE FLAT RES.
BIEBER
ALTURAS
BIG SAGE RES.
DORRIS RES
LIKELY
SPOONER RES.
North Fork
South Fork
Ash Creek
Willow Creek
Fall River
Hat Creek
Squaw Creek
McCloud River
Sacramento River
Clear Creek
SHASTA LAKE
WHISKEYTOWN LAKE
KESWICK RES.
REDDING
1
2
3
4
5
6
7
8
9
10
11
12
13

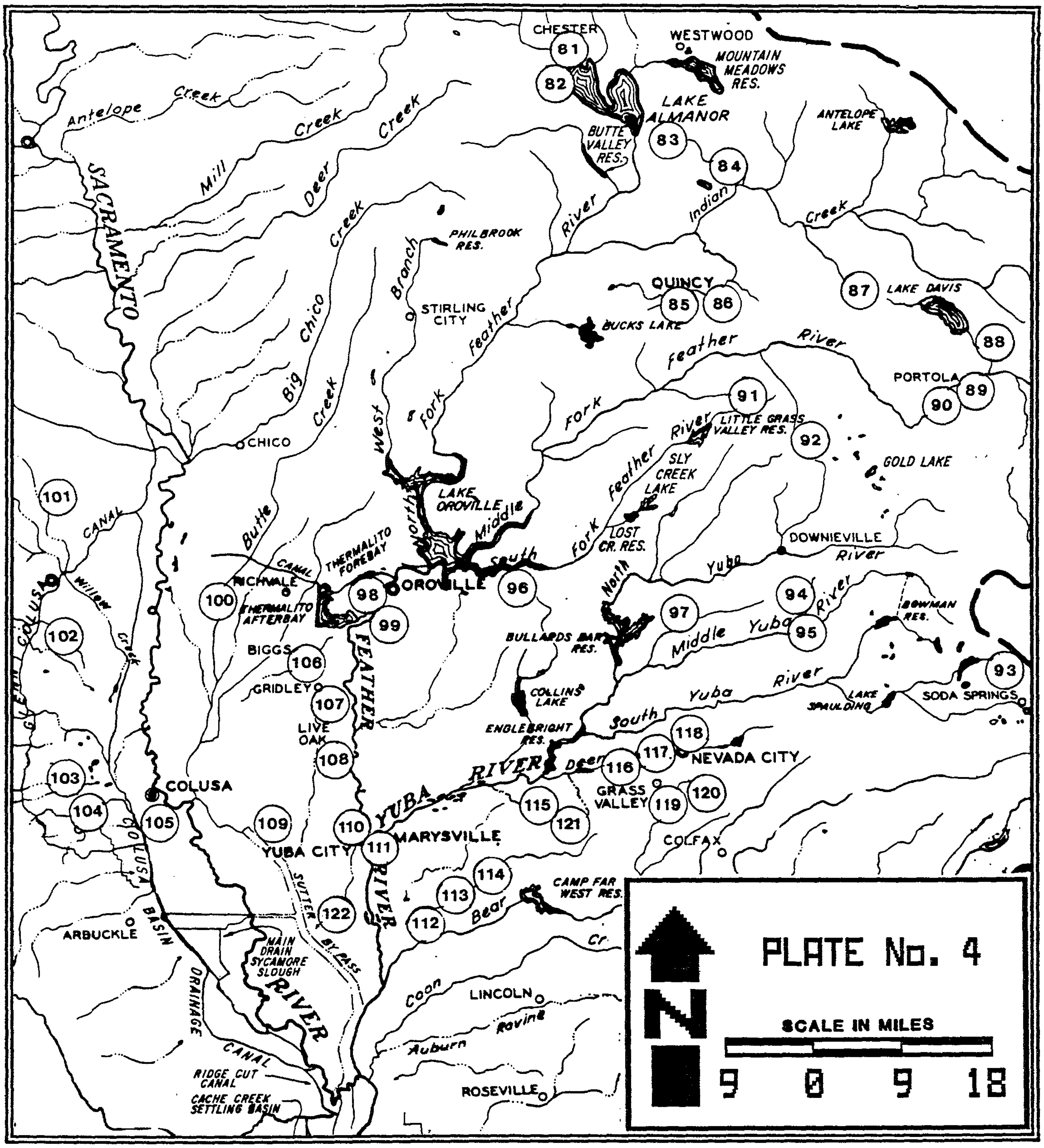
C—108762


BURNEY
Squaw Cr.
Clear
SHASTA
LAKE
WHISKEYTOWN
LAKE
REDDING
Creek
Cow Cr.
ANDERSON
North Fork
Battle Cr.
South Fork
Paynes Cr.
Cottonwood
Creek
Creek
Antelope
Creek
RED BLUFF
S. Cottonwood
Creek
Elder
Creek
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
PLATE No. 2
N
SCALE IN MILES
5 0 5 10

C-108763

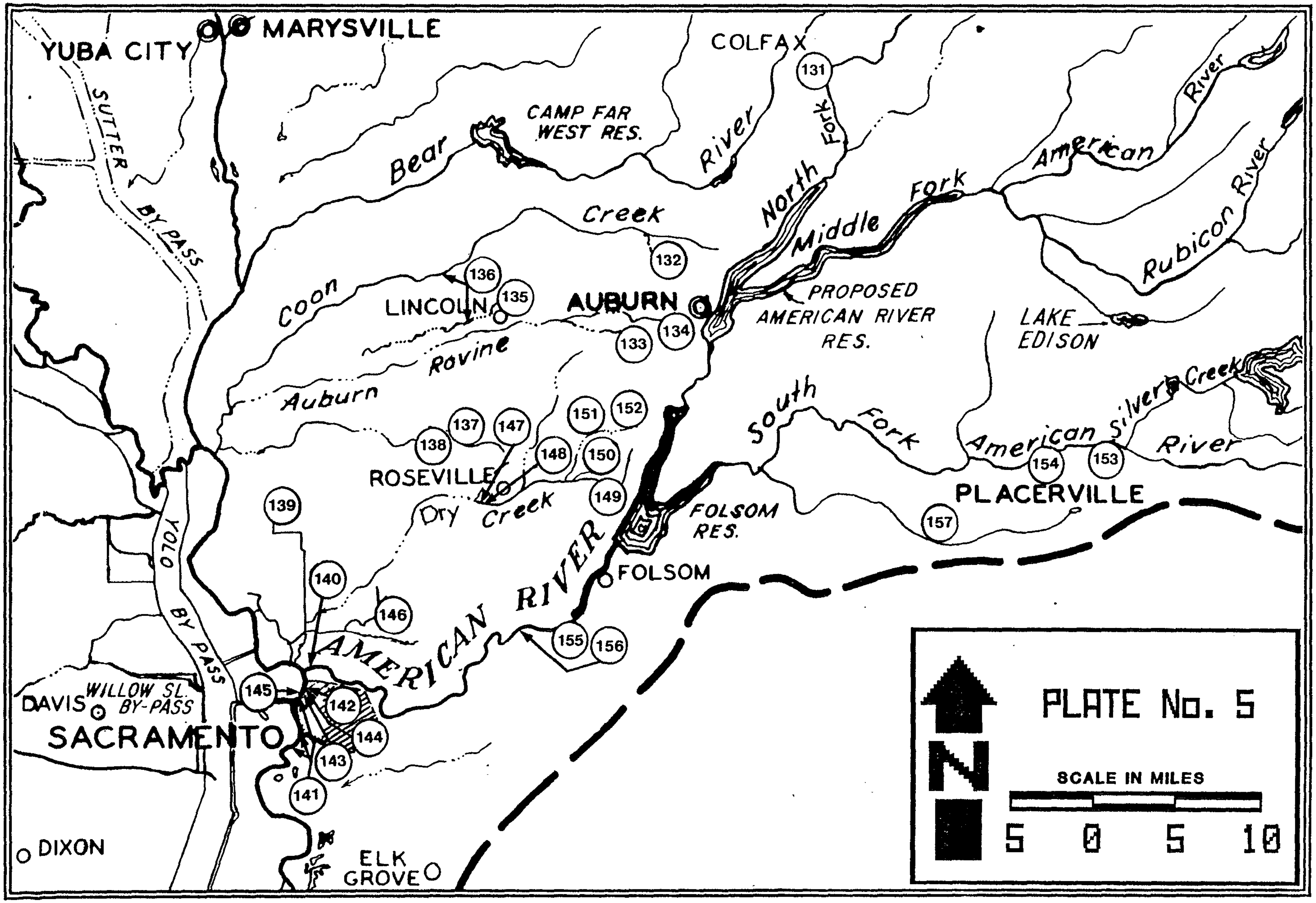

RED BLUFF
Antelope Creek
Mill Creek
Deer Creek
SACRAMENTO
Elder Creek
Thomes Cr.
CORNING
Chico Creek
Branch
STIRLING CITY
Mud Cr.
Big Chico Creek
Stony Creek
ORLANDO
CHICO
West
LAKE OROVILLE
Butte
CANAL
STONY GORGE RES.
WILLOWS
COLUSA
Willow Creek
THERMALITO FOREBAY
CANAL
RICHVALE
OROVILLE
THERMALITO AFTERBAY
GLENN
STONYFORD
EAST PARK RES.
MAXWELL
COLUSA
61
62
63
64
65
66
67
68
69
N
PLATE No. 3
SCALE IN MILES
6 0 6 12

C-108764



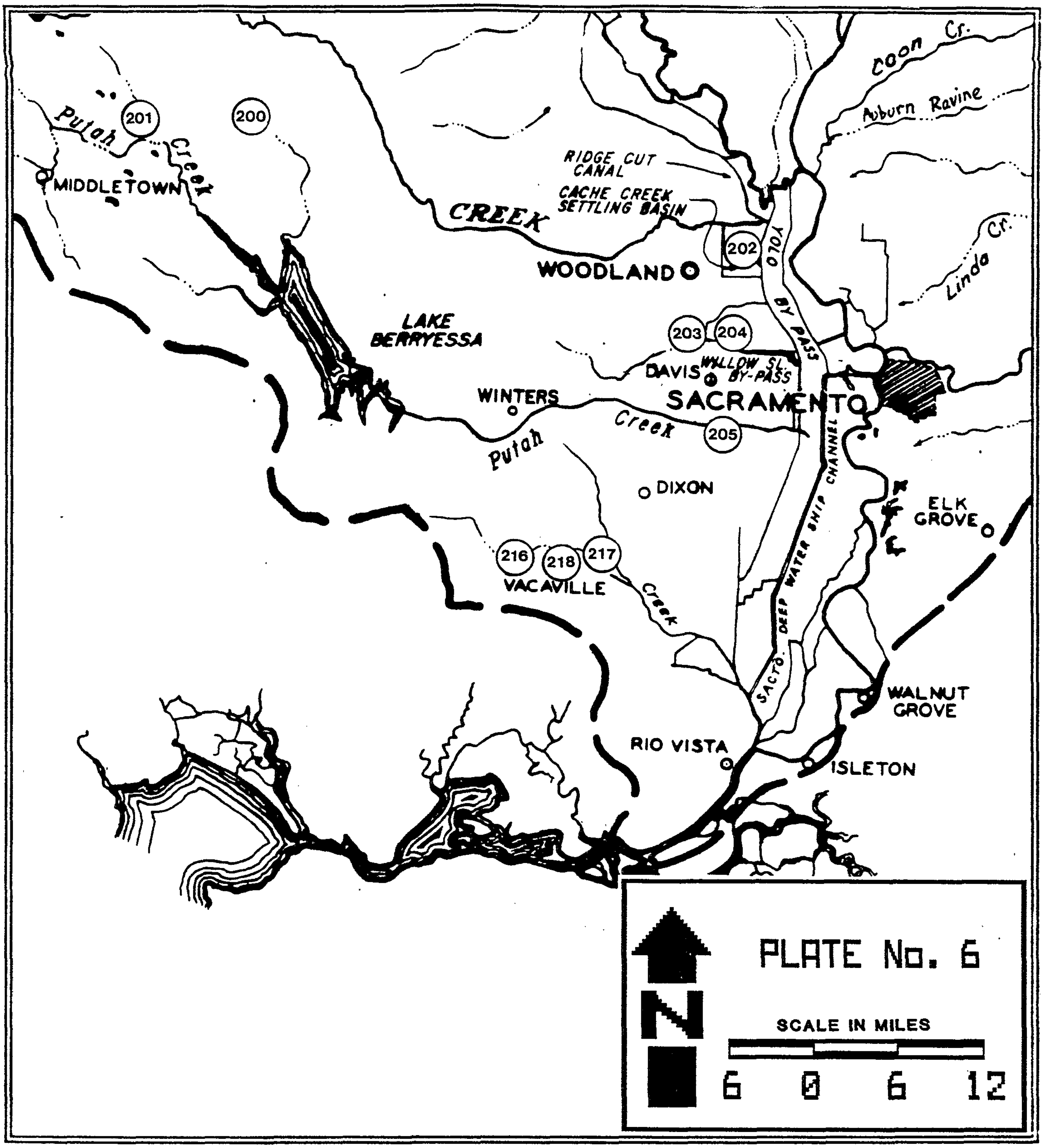
C-108765

C-108765

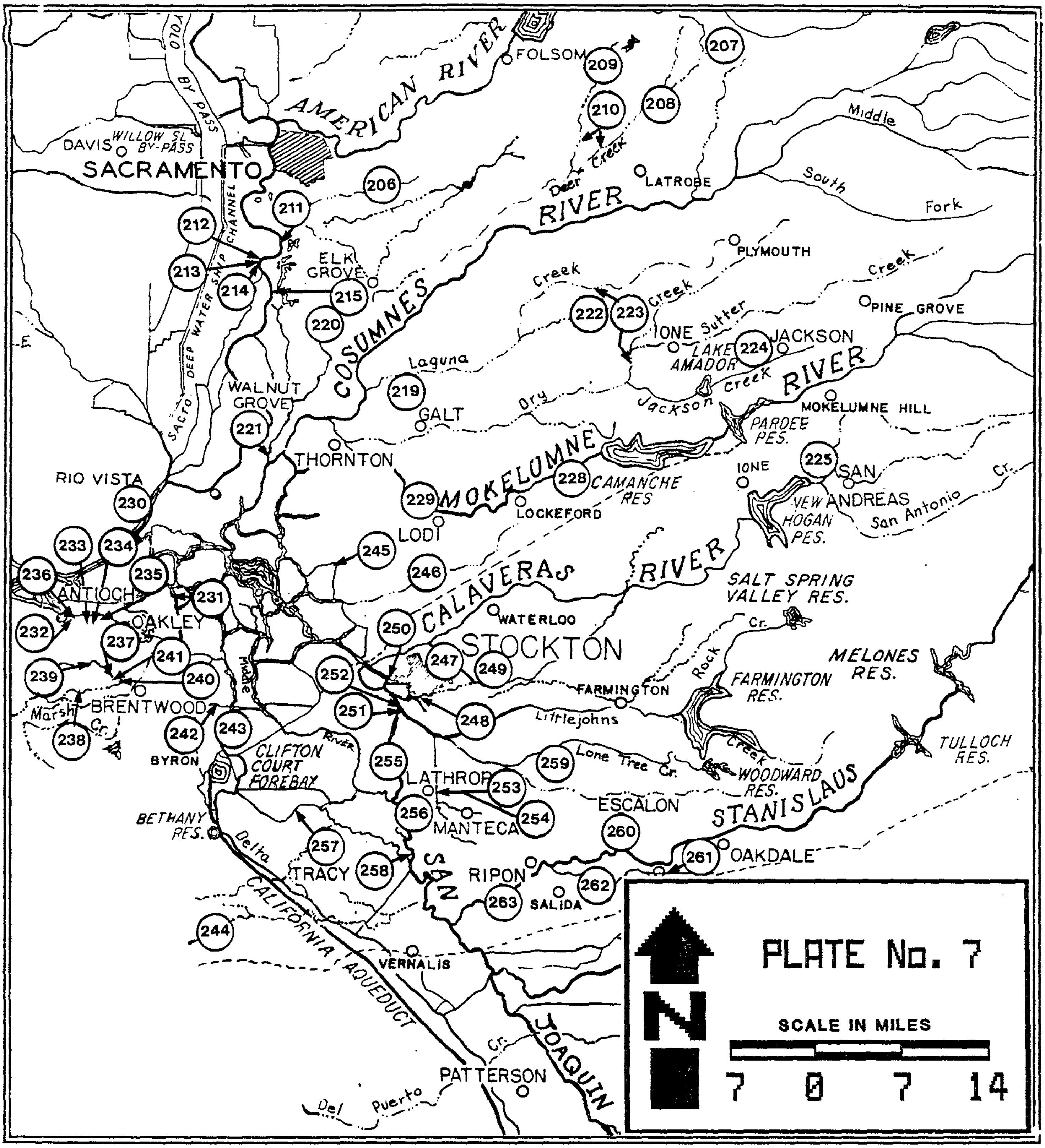


MARYSVILLE
YUBA CITY
COLFAX
SUTTER BY PASS
CAMP FAR WEST RES.
Bear River
North Fork
American River
Middle Fork
Rubicon River
Creek
Coon Creek
LINCOLN
AUBURN
PROPOSED AMERICAN RIVER RES.
LAKE EDISON
Auburn Ravine
South Fork American River
Silver Creek
ROSEVILLE
Dry Creek
FOLSOM RES.
PLACERVILLE
FOLSOM
AMERICAN RIVER
YOLO BY PASS
WILLOW SL. BY-PASS
DAVIS
SACRAMENTO
DIXON
ELK GROVE
131
132
133
134
135
136
137
138
139
140
141
142
143
144
145
146
147
148
149
150
151
152
153
154
155
156
157
PLATE No. 5
N
SCALE IN MILES
5 0 5 10

C-108766

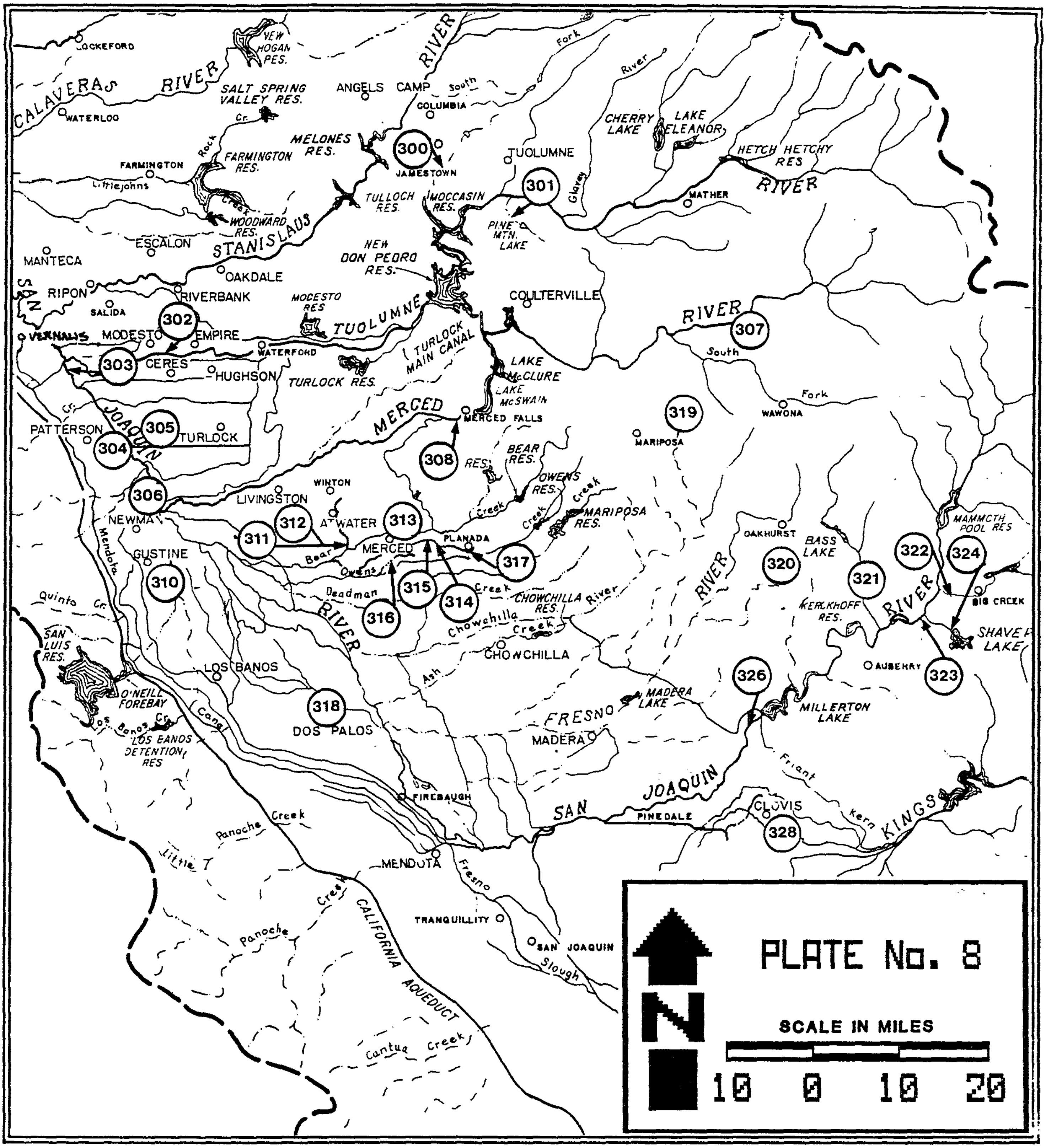


Coon Cr.
Auburn Ravine
RIDGE CUT CANAL
CACHE CREEK SETTLING BASIN
CREEK
Putah Creek
MIDDLETOWN
201
200
202
YOLO BY PASS
Linda Cr.
WOODLAND
LAKE BERRYESSA
203
204
WILLOW SL. BY-PASS
DAVIS
SACRAMENTO
WINTERS
Putah Creek
205
DIXON
SACTO. DEEP WATER SHIP CHANNEL
ELK GROVE
216
218
217
VACAVILLE
Creek
WALNUT GROVE
RIO VISTA
ISLETON
N
PLATE No. 6
SCALE IN MILES
6 0 6 12



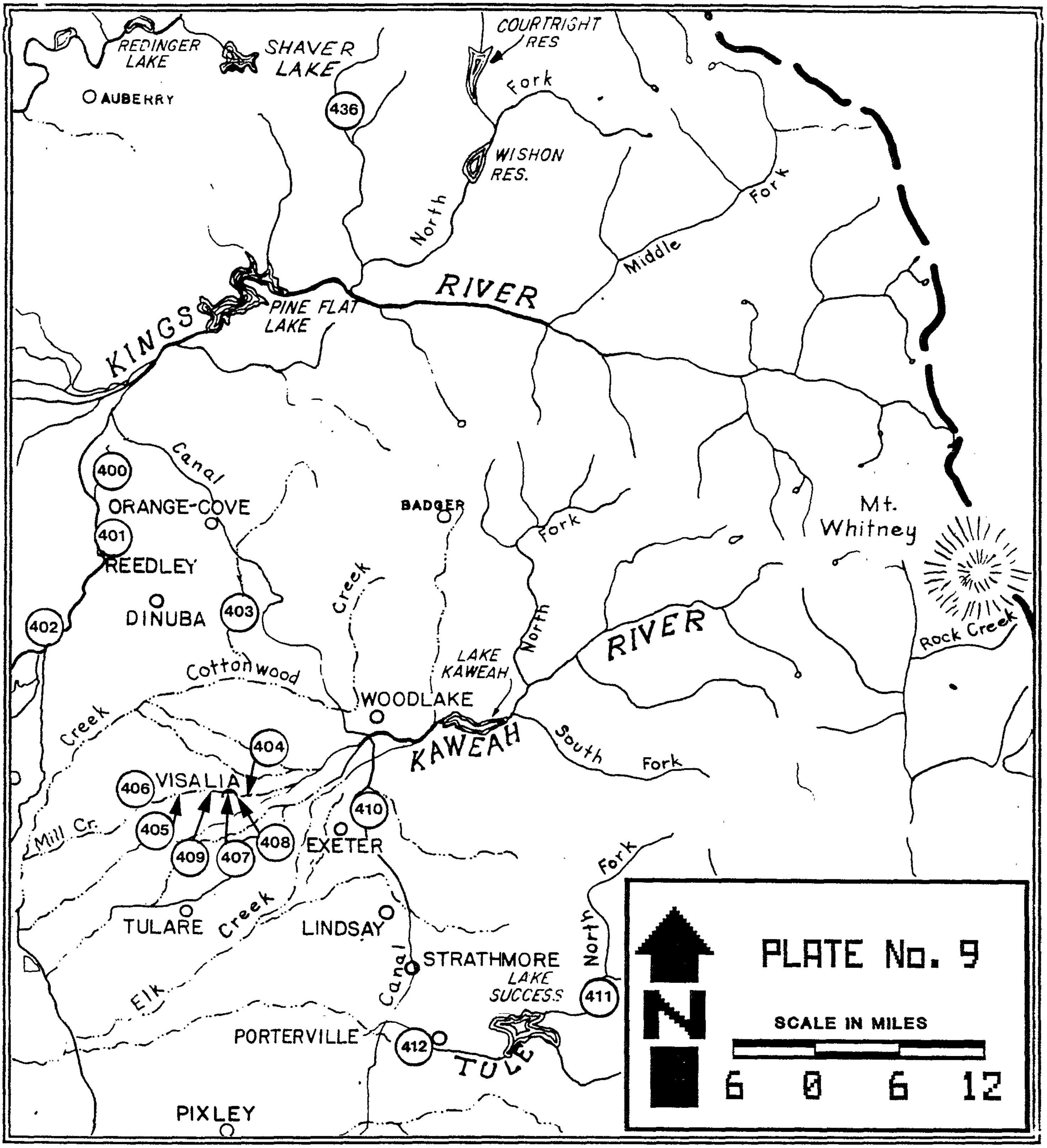
C —1 0 8 7 6 8

C-108768



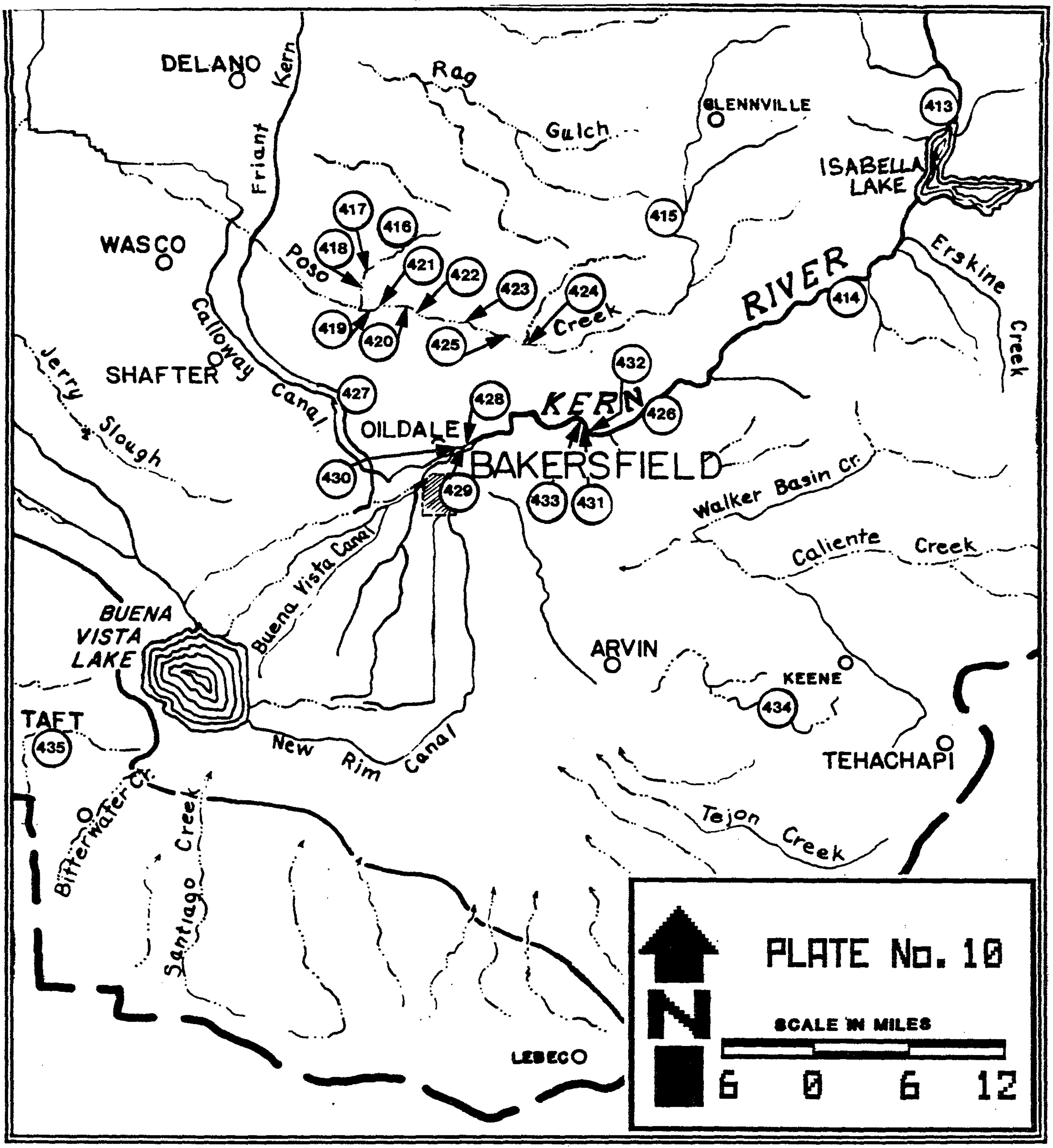
C—108769

C-108769



C—108770

C-108770



C-108771

C-108771

Table A-2. COUNTY CODE DEFINITIONS FOR CENTRAL VALLEY REGIONAL WATER QUALITY CONTROL BOARD NPDES DISCHARGERS.

SACRAMENTO OFFICE		Yolo	57
Alameda	1	Yuba	58
Alpine	2		
Amador	3	FRESNO OFFICE	
Butte	4		
Calaveras	5	Fresno	10
Colusa	6	Kern	15
Contra Costa	7	Kings	16
El Dorado	9	Madera	20
Glenn	11	Mariposa	22
Lake	17	Merced	24
Bapa	28	San Benito	35
Nevada	29	Tulare	54
Placer	31		
Plumas	32	REDDING OFFICE	
Sacramento	34		
San Joaquin	39	Lassen	18
Sierra	46	Modoc	25
Solano	48	Shasta	45
Stanislaus	50	Siskiyou	47
Sutter	51	Tehama	52
Tuolumne	55		

Table A-3. NPDES EFFLUENT TYPE CODE DESCRIPTIONS.

CODE	EFFLUENT TYPE	EFFLUENT DESCRIPTION
AMD	Acid Mine Drainage	Pyrite oxidation products.
CSW	Container Sterilizing Water	Once used rinse water for cleaning containers for food packaging.
CWW	Construction Waste Water	Dewatering, washwater, etc.
FHW	Fish Hatchery Waste	Flow through rearing ponds and hatchery raceways water.
FPW	Food Processing Waste	Waste water from food processing plants.
GCR	Gravel & Clay Mining, and Cement Plant Runoff	Runoff from gravel and clay mining, and cement plant operations.
GHW	Geothermal Heating Water	Once through geothermal water for interior space heating.
IYS	Industrial Yard Storm runoff	Rainfall and other facility yard runoff.
LDR	Logdeck Runoff	Log irrigation water runoff.
LSR	Livestock runoff	Rainfall and other runoff from livestock farms.
MPW	Mine Processing Waste (no acid mine drainage)	Waste water from mining operations other than acid mine waste.
OPW	Oil Production Waste	Waste water or runoff from oil production facilities.
PCW	Plant Cooling Water	Once through non-contact cooling water.
PPW	Pulp Paper process Waste	Waste water from facilities processing pulp for paper.
STP	Sewage Treatment Plant	Treated (mostly) and untreated domestic sewage.
TGW	Treated Ground Water	Groundwater treated to remove contaminants.
TIS	Treated Industrial Steam cleaning waste	Waste water from steam cleaning.
TLW	Treated Lake Water	Lagoon or lake water, occassionally treated with an algicide.
WTP	Wastewater Treatment Plant	Treated domestic and industrial sewage.
WTW	Water Treatment Waste	Filter backwash.

Table A-4. CHRONOLOGY OF NPDES DISCHARGER MONITORING
FOR PRIORITY POLLUTANTS AND OIL AND GREASE
(SEE TABLE A-6 FOR ABREVIATION DEFINITIONS).

YEAR	MONTH	CVRWQCB ACTION	ORDER NUMBER	TYPE	FLOW	REQUIRED METALS	ORGANICS	OIL & GREASE	BIO-ASSAY
** FACILITY NAME = AEROJET									
1985	April	WDR, MRP, SPRR	85-242	IYS/PCW	W		Hydrazine,Phenol(W)		
** FACILITY NAME = ALLIED ENERGY CORP.									
1978	September	WDR,MRP,SPRR	ON 78-128	OPW	Q			Q	
** FACILITY NAME = BEALE AFB									
1986	March	WDR, MRP	ON 86-080	WTP	C	Cu, Ba, Cr(6+), Pb,Cd, Hg, Ag, CN (Q)	PCP (M)	M	Q
** FACILITY NAME = CALIFORNIA OFFICE OF STATE PRINTING									
1987	February	WDR,MRP	ON 87-041	RW	D		EPA 601-2 (seasonal)		
1987	February	WDR,MRP	ON 87-041	PCW/IYS	D		EPA 601-2 (seasonal)		
** FACILITY NAME = CHAMPION INTERNATIONAL CORPORATION									
1982	May	NPDES permit(renewal of ON 76-44)	ON 82-107	LDR/PCW				M	M
** FACILITY NAME = CROWN ZELLARBACH									
1984	October	WDR, MRP	ON 84-120	WTP	D			M	
** FACILITY NAME = DAVIS CANNING COMPANY									
1982	June	WDR, MRP, SPRR	82-080	D		Cr (W)			
** FACILITY NAME = DEUEL VOCATIONAL CENTER									
1986	December	MRP	ON 74-272	SWD		ICPES (M)	EPA 624 (M)		
1986	December	MRP	ON 74-272	WTP	C	ICPES (SA)	EPA 624 (SA)		W
** FACILITY NAME = E.I. DUPONT DE NEMOURS AND CO.									
1984	August	WDR, MRP	On 84-084	WTP	D	Cr(Y),Pb(M)		W	M
** FACILITY NAME = EL DORADO IRRIGATION DISTRICT									
1986	December	WDR,MRP,NPDES permit,SPRR	ON 86-223		D				
** FACILITY NAME = FORMICA CORP. (SIERRA PLANT)									
1982	May	WDR,MRP,SPRR	ON 84-084	RW			Phenols (M)		
1982	July	WDR,MRP,SPRR	ON 84-084	PCW	D		Phenols (BM)		
** FACILITY NAME = GENERAL ELECTRIC COMPANY									
1986	August	WDR, MRP, SPRR	86-146	TGW	D		PurgeableHaloCs(W-M)		
** FACILITY NAME = GLADDEN MCBEAN AND CO.									
1984	January	WDR,MRP,SPRR	ON 84-013	ACW/IYS				M	
** FACILITY NAME = GOLD BOND BUILDING PRODUCTS									
1979	August	WDR,NPDES permit, MRP, SPRR	ON 79-186	PCW	W			M	

Table A-4 (continued).

YEAR	MONTH	CVRWQCB ACTION	ORDER NUMBER	TYPE	FLOW	REQUIRED METALS	ORGANICS	OIL & GREASE	BIO-ASSAY
** FACILITY NAME = GREENLEAF POWER CORP.									
1985	January	WDR,MRP,SPRR	ON 85-002	PCW	D			M	
** FACILITY NAME = HOMESTAKE MINING CO.									
1985	January	WDR,MRP,SPRR	ON 85-031	MPW	D	As,Ba,Be,Cd,Cr,Cu,Pb ,Hg,Ni,Se,Vd,Zn (D)			
1985	January	WDR, MRP, SPRR	ON 85-031	RW	D	As,Be,Ba,Cd,Cr,Cu,Pb ,Hg,Ni,Se,Vd,Zn (D)			
** FACILITY NAME = INTERNATIONAL OIL AND GAS CO.									
1984	September	WDR,MRP,SPRR	ON 84-104	RW				Q	
1984	September	WDR,MRP,SPRR	ON 84-104	OPW	M			M	
** FACILITY NAME = J-M MANUFACTURING CO, INC.									
1985	January	WDR, MRP, SPRR	85-005	RW		METALS (Q)			
1985	January	WDR, MRP, SPRR	85-005	PCW/GPW	C	METALS (Q), ASBESTOS (M)			
** FACILITY NAME = LIBBY OWENS FORD CO.									
1985	Arpil	WDR,MRP,SPRR	ON 85-069	WTP/PCW	D	Se,Cr,Ni,Co (M)		W	M
** FACILITY NAME = LODI, CITY OF									
1986	November	WDR, MRP, SPRR	86-041	WTP	D			W	W
** FACILITY NAME = MANTECA, CITY OF									
1985	July	WDR, MRP, SPRR	85-068	WTP	C			W	BM
** FACILITY NAME = MCCLELLAN AIR FORCE BASE									
1986	August	MRP revised monitoring requirements for ON 82-125	NA	PCW/WTP		SEE TABLE A-5 FOR MONITORING REQUIREMENT			
** FACILITY NAME = MCCORMICK AND BAXTER CREOSOTING									
1980	April	WDR, MRP, SPRR	80-056	PCW	D	Copper (w)	PCP (W), Phenols(w)	W	
** FACILITY NAME = MOHAWK RUBBER CO.									
1980	January	WDR,MRP,SPRR (partial)	ON 80-009	PCW	W			W	
** FACILITY NAME = P.G.&E. CONTRA COSTA POWER PLANT									
1986	June	Amended WDR,MRP,SPRR	ON 83-066	PCW/IYS	D		PCB(SA)	M	
1986	June	Amended WDR,MRP,SPRR	ON 83-066	IYS	D	Cr,Pb,Ni,Cu,Va,Zn (AA)			
** FACILITY NAME = PESTANA, JOHN (OIL AND GAS FIELDS)									
1984	September	WDR,MRP,SPRR	84-105	OPW	M			M	
1984	September	WDR,MRP,SPRR	ON 84-105	RW				Q	
** FACILITY NAME = PLACER COUNTY SERVICE AREA #2 (SUNSET)									
1984	January	WDR,MRP,SPRR	ON 84-014	WTP	D		Phenols (BM)		
** FACILITY NAME = ROSEVILLE, CITY OF (WTP)									
1982	December	WDR,MRP,SPRR	ON 82-138	WTP	D			W	BM

Table A-4 (continued).

YEAR	MONTH	CVRWQCB ACTION	ORDER NUMBER	TYPE	FLOW	REQUIRED METALS	ORGANICS	OIL & GREASE	BIO-ASSAY
** FACILITY NAME = SACRAMENTO CITY (WATER TREATMENT PLT)									
1985	June	WDR,MRP,SPRR	ON 85-151	WTW	C	Cr(W)			
** FACILITY NAME = SACRAMENTO MUNICIPAL UTILITY DISTRICT									
1985	August	WDR,MRP,SPRR	ON 85-210	STP	C				
1985	August	WDR,MRP,SPRR	ON 85-210	PCW	C	Cr,Zn (M)		W	
** FACILITY NAME = SACRAMENTO REGIONAL CO. SANITATION DIST.									
1985	September	WDR,MRP,SPRR	ON 85-245	WTP	D	At,As,Be,Cd,Cr,Cr(6+),Cu,Pb,Hg,Ni,Se,Ag	Zn,CN(M) EPA624-5(Q)	M	W
** FACILITY NAME = SHELL CALIFORNIA PRODUCTION									
1985	August	WDR,MRP,SPRR,NPDES permit	ON 85-206	OPW	M			M	
** FACILITY NAME = SHELL OIL CO. (WEST SACRAMENTO PLANT)									
1987	January	WDR,MRP,SPRR	ON 87-022	IYS	W			W	
** FACILITY NAME = SIERRA PACIFIC INDUSTRIES									
1982	September	WDR	ON 82-108	LDR				M	AA
** FACILITY NAME = SIMPSON PAPER COMPANY									
1983	June	WDR,MRP,ON 79-185 recinded	ON 83-067	PPW			MERCAPTANS(M)		W
** FACILITY NAME = STOCKTON, CITY OF (MAIN STP)									
1986	April	WDR,MRP,SPRR	86-088	WTP	D		CHLORINATED PHENOL-W	W	W
** FACILITY NAME = TEHAMA-COLUSA FISH FACILITIES									
1984	November	WDR,MRP	ON 84-131	FHW	D		HERBICIDES(AA)		
** FACILITY NAME = TERMO CO.									
1984	August	WDR,MRP,SPRR,NPDES permit	ON 84-081	OPW	Q			M	
1984	August	WDR,MRP,SPRR,NPDES permit	ON 84-081	RW				Q	
** FACILITY NAME = TOSCO CO. (SACRAMENTO TERMINAL)									
1984	March	WDR,MRP,SPRR,NPDES permit	ON 84-039	IYS	W			W	
** FACILITY NAME = TRACY, CITY OF (WTP)									
1985	August	WDR,MRP,SPRR	ON 85-214	WTP	D			W	W
** FACILITY NAME = WETSEL QUIATT LUMBER CO.									
1985	October	WDR,SPRR,MRP,NPDES permit	ON 85-277	LDR				M	
** FACILITY NAME = WICKES WOOD PRESERVING									
1984	March	WDR,MRP,SPRR, NPDES permit	ON 84-038	TGW	C	Cr(6+),Cu(W),Cr,As(B W)			
1984	March	WDR,MRP,SPRR,NPDES permit	ON 84-038	RW		Cr,Cr(6+),As,Cu(M)			

Table A-5. MCCLELLAN AIR FORCE BASE (MCAFB) TOXICS MONITORING SCHEDULE (Order Number 82-125 [1985, 1986]). 1/

REQUIRED PARAMETER	MCAFB DISCHARGES 2/ 001	005	CW	DOWNSTREAM RECEIVING WATERS 3/ R1	R2	R6
flow	C	C	M			
cadmium		2xW	Q	2xW	2xW	2xW
chromium(T)		2xW	Q	2xW	2xW	2xW
chromium(6+)		2xW		2xW	2xW	2xW
copper		2xW	Q	2xW	2xW	2xW
cyanide		2xW		2xW	2xW	2xW
lead		2xW	Q	2xW	2xW	2xW
nickel		2xW	Q	2xW	2xW	2xW
silver		2xW	Q	2xW	2xW	2xW
zinc		2xW	Q	2xW	2xW	2xW
phenol		2xW		2xW	2xW	2xW
oil&grease		2xW		2xW	2xW	2xW
volatiles				2xW	2xW	2xW
bioassay	W 4/	W 5/				

1/ C = continuous, M = monthly, Q = quarterly, W = weekly.

2/ Discharges: 001 tertiary treated domestic sewage to cooling water inlet to Magpie Creek.
005 storm drain runoff to Arcade Creek.

3/ Downstream Rec water: R1 Second Creek at west exit to base property.
R2 Magpie Creek at west exit of base property.
R6 Arcade Creek.

4/ 96-hour flow-through.
5/ 96-hour static.

Table A-6. ABREVIATION DEFINITIONS FOR TABLES A-4 AND A-5.

ABREVIATION	
AA	As applicable - whenever the discharge occurs.
ACLC	Administrative cival liabilities compliant - issued in cases where the discharger negligently violates a Cease and Desist order.
BM	Bi monthly.
BW	Bi weekly.
C	Continuous.
D	Daily.
ICPES	Inductively coupled plasma emission spectrometry.
M	Monthly.
MRP	Monitoring and Reporting Program.
NPDES	National Pollution Discharge Elimination System.
N/A	Not available.
ON	Order number.
Q	Quarterly.
SA	Semi annual.
SO	Special Order - used when discharger requests and obtains a modification (usually for a relaxation in requirements).
SPRR	Standard Provisions and Reporting Requirements.
W	Weekly.
WDR	Waste Discharge Requirements.

APPENDIX B

NPDES DISCHARGER CONCENTRATION, FLOW, AND LOAD DATA

C-108777

Table B-1. ALLIED ENERGY CORP. OPW MONTHLY OIL AND GREASE CONCENTRATIONS AND LOADS, 1985.

MONTH	DAY	OIL AND GREASE (UG/L)	LOADS(LBS) 1/
January	30	1000	1
February 2/		1250	1
March	1	1500	1
April	30	3000	2
May	31	11000	8
June	27	4000	3
July	30	3000	2
August	28	<2000	0
September	30	4000	3
October 3/			0
November 3/			0
December	13	6000	4
AVERAGE		2896	2
ANNUAL TOTAL			20

1/ Actual flows were not available (a baseline flow of 0.0029 MGD was used).
2/ Data not available (surrounding values were averaged).
3/ No discharge.

Table B-2. BEALE AFB WTP METALS AND OIL AND GREASE CONCENTRATIONS, 1985.

DATE (MONTH-DAY)	CONCENTRATION (UG/L) CADMIUM	CHROMIUM	CHROMIUM (6+)	COPPER	LEAD	MERCURY	CYANIDE	OIL AND GREASE
4-29	<10	<50	<50	43	<20	<1	NA	500 1/
7-12	<10	<50	<50	21	<20	1.2	NA	NA
5-13	NA	NA	NA	NA	NA	NA	<0.01	NA
10-11	<10	NA	<50	23	<20	2.3	NA	NA
11-9	<10	NA	<50	23	<20	2.3	NA	4300
AVERAGE	0	0	0	27.5	0	1.45	0	2400

1/ Sampled on May 9 1985.

Table B-3. BEALE AFB MONTHLY WTP MASS LOADS OF METALS AND OIL AND GREASE, 1985.

MONTH	AVERAGE DAILY FLOW (MGD)	LOADS (LBS) CADMIUM	CHROMIUM	CHROMIUM (6+)	COPPER	LEAD	MERCURY	CYANIDE	OIL AND GREASE
January	0.925	0	0	0	6	0	0.34	0	556
February	1.129	0	0	0	8	0	0.41	0	678
March	1.100	0	0	0	8	0	0.40	0	661
April	0.773	0	0	0	5	0	0.28	0	464
May	0.872	0	0	0	6	0	0.32	0	524
June	0.964	0	0	0	7	0	0.35	0	579
July	0.981	0	0	0	7	0	0.36	0	589
August	0.970	0	0	0	7	0	0.35	0	583
September	0.942	0	0	0	6	0	0.34	0	566
October	0.897	0	0	0	6	0	0.33	0	539
November	1.099	0	0	0	8	0	0.40	0	660
December 1/	1.099	0	0	0	8	0	0.40	0	660
AVERAGE	0.979				7		0.36		588
ANNUAL TOTAL					84		4.32		7056

1/ Flows not available for December (November flow used).

Table B-4. CHAMPION INTERNATIONAL CORP. LDR/PCW OIL AND GREASE CONCENTRATIONS, 1985.

MONTH	DAY	OIL AND GREASE (UG/L)
January	29	<5000
February	7	<5000
March	8	<5000
April	8	<5000
May	2	<5000
June	4	<5000
July	3	<5000
August	7	<5000
September	4	<5000
October	7	<5000
November	4	<5000
December	NA	

Table B-5. CROWN ZELLARBACH WTP MONTHLY OIL AND GREASE CONCENTRATIONS AND LOADS, 1985.

DATE (MONTH-DAY)	OIL AND GREASE (UG/L)	AVERAGE FLOW (MGD)	LOADS (LBS)
1-1	3200	4.1	3285
2-11	1000	3.4	851
3-26	2300	4.0	2303
4-24	1400	3.8	1332
5-30	1400	4.1	1437
6-25	1700	3.6	1532
7-10	1000	3.4	851
8-28	2000	3.2	1602
9-24	1900	3.3	1570
10-29	1200	3.1	931
11-26	1300	3.3	1074
12-31	1800	3.2	1442
AVERAGE	1683	3.5	1475
ANNUAL TOTAL			17700

TABLE B-6. DAVIS CANNING COMPANY PCW MONTHLY CHROMIUM CONCENTRATIONS AND LOADS, 1985.

MONTH	DAY	CHROMIUM (UG/L)	CHROMIUM AVERAGE	FLOWS (MGD) 1/ MINUMUM	FLOWS (MGD) 1/ MAXIMUM	FLOWS (MGD) 1/ AVERAGE	LOADS (LBS)
January	18	<10	0	0	0.037	0.007	0
	23	<10					
Feburary	22	<10	0	0	0.037	0.007	0
	28	<10					
March 2/	*	*	*	*	*	*	*
April	18	<10	0	0	0.024	0.007	0
	25	<10					
May	3	<10	0	0	0.024	0.003	0
	31	<10					
June	7	<10	0	0	0.024	0.016	0
	14	<10					
	21	<10					
	27	<10					
July	2	<10	6.7	0	1.3	0.56	0.93
	19	10					
	26	10					0
August	2	10	3.3	0	1.3	0.89	0.73
	9	<10					
	16	<10					
	31	<10					
September	6	<10	0	0	1.3	0.86	0
	12	<10					
	20	<10					
	27	<10					
October	10	<10	0	0	0.024	0.003	0
November	1	<10	0	0	0.024	0.009	0
	8	<10					
	15	<10					
	21	<10					
	27	<10					
December	12	<10	0	0	0.024	0.009	0
	17	<10					
	24	<10					
MONTHLY AVERAGE			0.91			0.197	0.05
ANNUAL TOTAL							0.55

1/ Minimum flows equal to 0 define days of no production.

2/ No flow values or metal testing took place in March because of no production by Davis Canning Company.

Table B-7. E. I. DUPONT DEMOURS AND CO. WTP WEEKLY OIL AND GREASE CONCENTRATIONS AND MONTHLY LOADS, 1985.

MONTH	DAY	OIL AND GREASE (UG/L)	OIL AND GREASE AVERAGE	AVERAGE FLOW (MGD)	LOADS (LBS)
January	7	7200	3625	0.689	625.31
	14	1600			
	21	2700			
	28	3000			
February	4	1300	1550	0.724	280.96
	11	300			
	18	3100			
	25	1500			
March	6	900	2950	0.624	460.87
	11	8000			
	18	2500			
	25	400			
April	1	2200	1660	0.837	347.86
	8	2900			
	15	2300			
	22	300			
	29	600			
May	6	500	3400	0.712	606.08
	13	2400			
	20	5100			
	27	5600			
June	3	800	1275	0.68	217.06
	10	1900			
	17	1900			
	24	500			
July	1	800	920	0.678	156
	8	1000			
	15	1400			
	22	300			
	29	1100			
August	5	1600	1100	0.578	159
	12	1300			
	19	600			
	26	900			
September	4	2100	1220	0.509	155
	10	600			
	17	400			
	23	1400			
	30	1600			
October	7	400	1350	0.62	210
	14	400			
	21	2200			
	28	2400			
November	4	1500	1625	0.607	247
	11	2000			
	18	1900			
	25	1100			
December	2	1700	1860	0.602	280
	9	1600			
	16	4600			
	23	400			
	30	1000			
AVERAGE		1842		0.655	302
ANNUAL TOTAL					3625

Table B-8. E. I. DUPONT DENEMOURS AND CO. WTP MONTHLY LEAD AND CHROMIUM CONCENTRATIONS AND LOADS, 1985.

MONTH	DAY	AVERAGE FLOW (MGD)	LEAD (UG/L)	LEAD LOADS (LBS)	CHROMIUM (UG/L)	CHROMIUM LOADS (LBS)
January	7	0.689	6	1	200	34
February	4	0.724	36	7	<20	0
March 1/ 2/		0.624	84	13	50	8
April 2/	1	0.837	50	10	50	10
May	6	0.712	20	4	100	18
June	3	0.680	40	7	100	17
July	1	0.678	50	8	200	34
August 2/		0.578	50	7	150	22
September	4	0.509	50	6	100	13
October	7	0.620	30	5	100	16
November	4	0.607	10	2	100	15
December	2	0.602	30	5	100	15
AVERAGE		0.655	38	6	104	17
ANNUAL TOTAL				75		204

1/ Lead value average of 31 grab samples.

2/ Concentration data not available (surrounding values were averaged).

Table B-9. FORMICA CO. (SIERRA PLANT) MONTHLY PCW PHENOL CONCENTRATIONS AND MASS LOADS, 1985.

MONTH	DAY	PHENOL (UG/L) 24HR COMP. 1/	AVERAGE	AVERAGE DAILY FLOW (MGD)	LOADS (LBS)
January 2/	NA	NA	11.5	0.83	2.40
February	6	16	11.5	0.83	2.40
	11	7			
March	5	12	12	0.78	2.34
	11	12			
April	4	28	22.5	0.81	4.56
	8	17			
May	6	32	25.5	0.87	5.54
	14	19			
June	5	108	100	1.13	28.33
	11	92			
July	3	18	21.5	0.76	4.10
	24	25			
August	5	35	34.5	0.93	8.03
	14	34			
September	3	36	33	0.94	7.76
	13	30			
October	3	13	30.5	0.88	6.69
	14	48			
November	6	13	12	0.74	2.22
	14	11			
December	9	8	12	0.73	2.19
	17	16			
AVERAGE		26		0.85	5.60
ANNUAL TOTAL					67.20

1/ 24-hour composite sample.
2/ January values not available (February values were used).

Table B-10. GENERAL ELECTRIC COMPANY TGW HALOGENATED HYDROCARBON CONCENTRATIONS SUMMARIZED BY WELL LOCATION, 1985.

COMPOUND (MONTH-DAY) / SAMPLE DATE	7-17	8-9	8-9	8-21	8-22	8-23	8-26	8-27	8-28	8-29	8-30	9-3	9-24	10-31	12-11
	CONCENTRATION (UG/L) 1/														
SAMPLE LOCATION: MERCED CITY WELL NO. 10															
tetrachloroethene		1.1			0.2	0.1	0.1			0.2	0.1				
1,2-dichloroethane	5.1														
1,1,1-trichloroethane			0.5												
SAMPLE LOCATION: TRI-VALLEY GROWERS WELL NO. 1															
trichloroethene	3.5	1.6	1.0	1.3	1.4	1.4	1.1	2.8	0.2	1.1	1.3	0.7	0.1	31	0.5
		1.6													
		2.1	1.1												
SAMPLE LOCATION: TRI-VALLEY GROWERS WELL NO. 3															
trichloroethene			0.6												
1,1,1-trichloroethane			0.6												
SAMPLE LOCATION: 3457 EAST BAKER															
trichloroethene	4.2												4.1	9.1	5.0
															3.4
SAMPLE LOCATION: 3397 EAST BAKER															
trichloroethene	2.4														
SAMPLE LOCATION: MIXTURE OF ALL WATER SAMPLES															
trichloroethene										0.2		0.7			

1/ All concentration values for these compounds that do not appear in this table under the listed sample dates were reported as less than detectable. U.S.EPA method 601 analysis was performed at each well site, all other compounds not reported in this table were not detected at a detection limit range 0.1 to 2.0 ug/l.

Table B-11. GLADDING MCBEAN AND CO. PCW MONTHLY OIL AND GREASE MONTHLY CONCENTRATIONS AND MONTHLY LOADS, 1985.

DATE (MONTH-DAY)	OIL AND GREASE CONC. (UG/L)	LOADS (LBS) 1/
1-9	ND	0
2-13	5000	1252
3-13	ND	0
4-10	ND	0
5-8	ND	0
6-12	17000	4256
7-10	ND	0
8-14	7000	1753
9-11	ND	0
10-9	ND	0
11-13	5000	1252
12-11	ND	0
AVERAGE	2833	709
ANNUAL TOTAL		8508

1/ Baseline flow of 1.0 MGD was used (flows not required).

Table B-14. LIBBY OWENS-FORD CO. PCW MONTHLY CHROMIUM, COBALT, NICKEL, AND SELENIUM CONCENTRATIONS AND LOADS, 1985.

	CHROMIUM		COBALT		NICKEL		SELENIUM	
MONTH	(UG/L)	LOADS (LBS)	(UG/L)	LOADS (LBS)	(UG/L)	LOADS (LBS)	(UG/L)	LOADS (LBS)
January 1/	40	5	50	7	<50	0	<10	0
February 1/	40	5	50	6	<50	0	<10	0
March 1/	40	5	50	6	<50	0	<10	0
April 1/	40	4	50	5	<50	0	<10	0
May	40	6	50	8	<50	0	<10	0
June	<40	0	<50	0	NA	0	NA	0
July	<40	0	80	10	NA	0	NA	0
August	<50	0	<50	0	NA	0	NA	0
September	<50	0	<50	0	NA	0	NA	0
October	<50	0	<50	0	NA	0	NA	0
November	<50	0	<40	0	NA	0	NA	0
December	<20	0	<50	0	<50	0	<50	0
AVERAGE 2/	5	1	16	6	0	0	0	0
ANNUAL TOTAL		12		72		0		0

1/ NA=not analyzed (values for May were used).
2/ Average annual flow = 0.577 MGD.

Table B-12. GOLD BOND BUILDING PRODUCTS PCW WEEKLY OIL AND GREASE CONCENTRATIONS AND LOADS, 1985

MONTH	DAY	OIL AND GREASE (UG/L)	MONTHLY AVERAGE (UG/L)	FLOW (MGD) MIN	MAX	AVERAGE	LOADS (LBS)
January	1/		52			1.559	20
February	1/		52			1.559	20
March	1/		52			1.559	20
April	1/		52			1.559	20
May	1/		52			1.559	20
June	1/		52			1.559	20
July	10	30	52	0.950	2.333	1.559	20
	17	26					
	31	100					
August	7	60	85	1.180	2.275	1.910	33
	14	150					
	22	60					
	28	70					
September	4	70	61			1.549	24
	12	56					
	18	38					
	25	80					
October	2	84	87.2	0.567	1.417	1.188	26
	9	50					
	15	38					
	23	130					
	30	134					
November	1/		87.2			1.188	26
December	1/		87.2			1.188	26
AVERAGE		74				1.552	29
ANNUAL TOTAL							345

1/ Values not available (surrounding values were averaged).

Table B-13. INTERNATIONAL OIL AND GAS CO. OPW MONTHLY OIL AND GREASE CONCENTRATIONS AND LOADS, 1985.

MONTH	OIL AND GREASE (UG/L) EFFLUENT	RECEIVING WATER 1/ UPSTREAM	DOWNSTREAM	LOADS (LBS) 2/
January 3/	11000	NA	NA	77
February 3/	11000	NA	NA	77
March 3/	11000	NA	NA	77
April 3/	11000	NA	NA	77
May	11000	<2000	6000	77
June	4000	<2000	<2000	28
July	3000	3000	<2000	21
August	6000	2000	3000	42
September	3000	2000	2000	21
October	9000	5000	7000	63
November	10000	6000	8000	70
December	12000	NA	NA	84
AVERAGE	7250			51
ANNUAL TOTAL				612

1/ Receiving water monitoring upstream and downstream of effluent discharge.
2/ Flows were not available; a baseline flow of 0.028 MGD was used to calculate loads.
3/ Values not available (surrounding levels were used).

Table B-15. LIBBY OWENS-FORD CO. PCW WEEKLY OIL AND GREASE CONCENTRATIONS AND MONTHLY LOADS, 1985.

MONTH	DAY	OIL AND GREASE (UG/L) GRAB	MONTHLY AVERAGE	AVERAGE FLOW (MGD)	LOADS (LBS)
January	8	1500	2250	0.522	294
	22	3000			
February	NA	2300	2300	0.516	297
March	5	1600	1800	0.510	230
	19	2000			
April	2	2000	1000	0.400	100
	16	<100			
May	7	730	3033	0.643	488
	14	2600			
	21	2500			
	31	6300			
June	4	12000	4150	0.615	639
	11	3100			
	19	900			
	25	600			
July	2	1900	1500	1.065	400
	9	1700			
	16	1100			
	23	500			
	30	2300			
August	1	1100	2080	0.711	370
	8	2300			
	18	<2000			
	22	3500			
	29	3500			
September	13	760	380	0.386	37
	20	<50			
October	4	1400	2175	0.789	430
	10	3500			
	17	2800			
	24	1000			
November	6	3700	2800	0.446	313
	12	2900			
	19	4600			
	27	<50			
December	3	4400	2933	0.315	231
	10	2200			
	17	2200			
AVERAGE		2329		0.577	336
ANNUAL TOTAL					4032

Table B-16. LODI WTP WEEKLY OIL AND GREASE CONCENTRATIONS AND MONTHLY LOADS, 1985.

MONTH	DAY	OIL AND GREASE (UG/L)	OIL AND GREASE AVERAGE	FLOWS (MGD) MINIMUM	FLOWS (MGD) MAXIMUM	FLOWS (MGD) AVERAGE	LOADS (LBS)
January	2	1100	1900	4.508	5.765	4.968	2363
	9	1600					
	17	2000					
	23	1600					
	30	3200					
February	6	400	900	4.428	5.39	4.86	1095
	14	1300					
	27	1000					
March	5	1600	850	4.5	5.383	4.774	1016
	13	700					
	20	700					
	27	400					
April	3	400	500	4.333	5.31	4.778	598
	11	800					
	17	500					
	24	300					
May	7	500	550	4.435	5.307	4.95	682
	22	600					
June	5	300	300	4.652	5.386	5.084	382
July	23	1200	1200	4.998	5.642	5.348	1607
August	7	1000	875	4.522	5.362	4.949	1084
	14	600					
	21	1600					
	27	300					
September	3	400	300	4.201	4.867	4.651	349
	11	200					
	18	200					
	24	400					
October	2	100	660	4.334	5.17	4.628	765
	9	<100					
	15	<100					
	23	3000					
	30	200					
November	5	500	475	4.249	5.562	4.473	532
	12	700					
	20	200					
	26	500					
December	3	200	575	4.958	4.736	4.388	632
	10	500					
	17	800					
	25	800					
AVERAGE		790				4.450	791
ANNUAL TOTAL							9494

Table B-17. MCCLELLAN AFB PCW MONTHLY TRACE METAL LOADS, 1985.

MONTH	FLOW VOLUME 1/	LOADS (LBS) 2/ COPPER	CADMIUM	CHROMIUM	LEAD	NICKEL	SILVER	ZINC
January	7	2.1	0.3	1.1	0.9	0.5	0.5	7
February	8	2.4	0.3	1.2	1.1	0.6	0.6	8
March	8	2.4	0.3	1.2	1.1	0.6	0.6	8
April	7	2.1	0.3	1.1	0.9	0.5	0.5	7
May	7	2.1	0.3	1.1	0.9	0.5	0.5	7
June	7	2.1	0.3	1.1	0.9	0.5	0.5	7
July	7	2.1	0.3	1.1	0.9	0.5	0.5	7
August	4	1.2	0.2	0.6	0.5	0.3	0.3	4
September	4	1.2	0.2	0.6	0.5	0.3	0.3	4
October	4	1.2	0.2	0.6	0.5	0.3	0.3	4
November	4	1.2	0.2	0.6	0.5	0.3	0.3	4
December	4	1.2	0.2	0.6	0.5	0.3	0.3	4
AVERAGE	5.9	1.8	0.2	0.9	0.8	0.4	0.4	6.1
TOTAL		21	3	11	9	5	2	73

1/ Million gallons per month for all seven discharges.
2/ Loads calculated using yearly averages from Table B-19.

Table B-18. MCCLELLAN AFB PCW OUTFLOW, 1985.

MONTH	COOLING WATER FLOWS (MGD) 1/ CW1	CW2	CW3	CW4	CW5	CW6	CW7	TOTAL MONTHLY FLOW (MG)
January		0.10	0.01	0.02	0.10	0.00	0.00	7
February		0.10	0.01	0.02	0.10	0.02	0.03	8
March		0.10	0.01	0.02	0.10	0.02	0.03	8
April		0.10	0.01	0.02	0.10			7
May		0.10	0.01	0.02	0.10			7
June		0.10	0.01	0.02	0.10			7
July		0.10	0.01	0.02	0.10			7
August		0.10	0.01	0.02				4
September		0.10	0.01	0.02				4
October		0.10	0.01	0.02				4
November		0.10	0.01	0.02				4
December		0.10	0.01	0.02				4
	AVERAGE							6

1/ Blank spaces indicate either no data available or no flows;
[illegible]

Table B-19. MCCLELLAN AFB PCW QUARTERLY TRACE METAL CONCENTRATIONS, 1985

EFFLUENT I.D.	CONCENTRATION (MG/L) (DETECTION LIMITS IN PARENTHESES) CADMIUM (<0.010)	CHROMIUM(T) (<0.050)	COPPER (<0.020)	LEAD (<0.020)	NICKEL (<0.050)	SILVER (<0.010)	ZINC (<0.050)
APRIL							
CW1	0.01	0	0	0	0	0	0.022
CW2	0	0	0	0	0.07	0	0.041
CW3	0	0	0	0	0	0	0.413
CW4	0.013	0	0	0	0	0	0.023
CW5	0	0	0	0	0	0	0.118
CW6	0.02	0.159	0.597	0.063	0	0.013	0.119
CW7	0.017	0	0.025	0.054	0	0.012	0.76
MAY							
CW1	0	0	0	0	0	0.011	0.06
CW2	0	0.074	0	0	0	0.01	0.055
CW3	0	0.055	0	0	0	0.012	0.178
CW4	0	0	0	0	0	0.017	0.071
CW5	0	0	0	0	0	0	0.069
CW6 1/							
CW7 1/							
AUGUST							
CW1	0	0	0	0	0	0	0.022
CW2	0.014	0	0.02	0	0	0	0.05
CW3	0.01	0	0	0	0	0	0.113
CW4	0	0	0	0	0	0	0.03
CW5	0	0	0	0	0	0	0
CW6 1/							
CW7 1/							
DECEMBER							
CW1	0.005	0.019	0.032	0.061	0.027	0.003	0.124
CW2	0.004	0.006	0.012	0.041	0.013	0.003	0.037
CW3	0.013	0.01	0.048	0.057	0.019	0.004	0.226
CW4	0.006	0.077	0.066	0.096	0.082	0.008	0.144
CW5	0.019	0	0	0	0	0	0.051
CW6 1/							
CW7 1/							
AVERAGE	0.005	0.018	0.036	0.016	0.009	0.004	0.123

1/ Dat [illegible] available.

C-108784

Table B-20. MCCORMICK AND BAXTER PCW(001) COPPER, ARSENIC, PHENOLS, AND OIL AND GREASE CONCENTRATIONS AND LOADS, 1985.

		OIL AND GREASE			PHENOLS			COPPER		ARSENIC	
MONTH	DAY	(UG/L)	AVERAGE	LOADS (LBS)	(UG/L)	AVERAGE	LOADS (LBS)	(UG/L)	LOADS (LBS)	(UG/L)	LOADS (LBS)
January	8	<1000	0	0	<10	0	0	<20	0	NA	
	15	<1000			<10			<20		NA	
	29	<1000			<10			<20		NA	
February 2/		NA		0	NA		0	NA	0	NA	
March	5	<1000	0	0	<10	0	0	<20	0	NA	0
	12	<1000			<10			<20		NA	
	19	<1000			<10			<20		<4	
	26	<1000			<10			<20		NA	
April	2	1000	1400	40	<10	0	0	<20	2	NA	0
	9	1000			<10			<20		NA	
	16	1000			<10			<20		NA	
	23	2000			<10			320		<4	
	30	2000			<10			<20		NA	
May	7	1000	500	14	<10	0	0	<20	0	NA	0
	14	1000			<10			<20		NA	
	21	NA			<10			<20		<4	
	28	<1000			<10			<20		NA	
June	4	3000	2000	58	<10	0	0	<20	0	NA	0
	11	2000			<10			<20		NA	
	18	<1000			<10			<20		<4	
	25	3000			<10			<20		NA	
July	2	<1000	2200	63	<10	0	0	<20	0	NA	0
	9	3000			<10			<20		NA	
	16	2000			<10			<20		NA	
	23	4000			<10			<20		<4	
	30	2000			<10			<20		NA	
August	6	3000	2250	65	30	7.5	0.22	<20	0	NA	0
	13	<2000			<10			<20		NA	
	20	3000			<10			<20		<4	
	27	3000			<10			<20		NA	
September	3	<2000	500	14	<10	20	0.58	<20	0	NA	0
	10	<2000			<10			<20		NA	
	17	<2000			<10			<20		<4	
	24	2000			80			<20		NA	
October	1	2000	800	23	50	30	0.86	<20	0	NA	0
	8	<2000			100			<20		NA	
	15	<2000			<10			<20		<4	
	22	<2000			<10			<20		NA	
	29	2000			<10			<20		NA	
November	5	<2000	0	0	<10	0	0.00	<20	0	NA	0
	12	<2000			<10			<20		NA	
	19	<2000			<10			<20		<4	
	26	<2000			<10			<20		NA	
December	3	<2000	500	14	<10	0	0.00	<20	0	NA	
	10	<2000			<10			<20		NA	
	17	<2000			<10			<20		NA	
	31	2000			<10			<20		NA	
AVERAGE		957		28	6		0.17	7	0	0	0
ANNUAL TOTAL				336			2		0		0

1/ Flows consistently measured at 0.115 MGD were used.2/ February values not available (surrounding values were averaged).

Table B-21. MCCORMICK AND BAXTER PCW(002) COPPER, ARSENIC, PENTACHLOROPHENOL (PCP), AND OIL AND GREASE LEVELS & LOADS, 1985.

		OIL AND GREASE			PCP			COPPER		ARSENIC	
MONTH	DAY	(UG/L)	AVERAGE	LOADS (LBS)	(UG/L)	AVERAGE	LOADS (LBS)	(UG/L)	LOADS (LBS)	(UG/L)	LOADS (LBS)
January	8	<1000	667	19	<2	0	0.00	<20	0	NA	
	15	1000			<2			<20		NA	
	29	1000			<2			<20		NA	
February 2/		NA		0	NA		0.00	NA	0	NA	
March	5	<1000	0	0	<2	0	0.00	<20	0	NA	0
	12	<1000			<2			<20		NA	
	19	<1000			<2			<20		<4	
	26	<1000			<2			<20		NA	
April	2	<1000	2000	58	16	3.2	0.10	<20	0	NA	0
	9	2000			<2			<20		NA	
	16	2000			<2			<20		NA	
	23	3000			<2			<20		<4	
	30	3000			<2			<20		NA	
May	7	3000	1250	36	<2	0	0.00	<20	0	NA	0
	14	2000			<2			<20		NA	
	21	<1000			<2			<20		<4	
	28	<1000			<2			<20		NA	
June	4	4000	2750	79	<2	0	0.00	<20	0	NA	0
	11	<1000			<2			<20		NA	
	18	<1000			<2			<20		<4	
	25	7000			<2			<20		NA	
July	2	2000	2600	75	<2	0	0.00	<20	0	NA	0
	9	3000			<2			<20		NA	0
	16	2000			<2			<20		NA	
	23	4000			<2			<20		<4	
	30	2000			<2			<20		NA	
August	6	<2000	3500	101	<2	0	0.00	<20	0	NA	0
	13	6000			<2			<20		NA	
	20	4000			<2			<20		<4	
	27	4000			<2			<20		NA	
September	3	<2000	1250	36	<2	0	0.00	<20	0	NA	0
	10	5000			<2			<20		NA	
	17	<2000			<2			<20		<4	
	24	<2000			<2			<20		NA	
October	1	<2000	600	17	<2	0	0.00	<20	0	NA	0
	8	<2000			<2			<20		NA	
	15	<2000			<2			<20		NA	
	22	<2000			<2			<20		<4	
	29	3000			<2			<20		NA	
November	5	4000	1000	29	<2	0	0.00	<20	0	NA	0
	12	<2000			<2			<20		NA	
	19	<2000			<2			<20		<4	
	26	<2000			<2			<20		NA	
December	3	<2000	0	0	<2	0	0.00	<20	0	NA	0
	10	<2000			<2			<20		NA	
	17	<2000			<2			<20		NA	
	31	<2000			<2			<20		NA	
AVERAGE		1426		45	0.34		0.01	0	0	0	0
ANNUAL TOTAL				540			0.12		0		0

1/ Daily average flows of 0.126 MGD were used. 2/ February values were not available (surrounding values were averaged).

Table B-22. MERCED, CITY OF, WTP MONTHLY METALS AND OIL AND GREASE LOADS, 1985. 1/

MONTH	TOTAL OUTFLOW (MG/MONTH)	ARSENIC (4.3)	CADMIUM (6)	LEAD (10)	NICKEL (2.7)	OIL AND GREASE (13100)
		LOADS (LBS/MONTH) 2/				
January	153.632	6	8	13	3	16796
February	136.505	5	7	11	3	14923
March	154.735	6	8	13	3	16916
April	154.627	6	8	13	3	16905
May	170.723	6	9	14	4	18664
June	190.705	7	10	16	4	20849
July	198.589	7	10	17	4	21711
August	192.617	7	10	16	4	21058
September	176.964	6	9	15	4	19347
October	171.525	6	9	14	4	18752
November	157.846	6	8	13	4	17256
December	148.828	5	7	12	3	16271
TOTAL ANNUAL		72	101	168	45	219447

1/ U.S.EPA scans 624/625 and 608 were reported to be below detection.

2/ Average concentration used in the estimates are in parentheses(ug/l)(metals: N=3; oil and grease: N=1). All other priority pollutants metals were not detected below typical FAA detection limits.

Table B-25. PACIFIC GAS AND ELECTRIC CONTRA COSTA POWER PLANT PCW/IYS MONTHLY OIL AND GREASE CONENTRATIONS AND LOADS, 1985.

MONTH	DAY	OIL AND GREASE (UG/L)	AVERAGE FLOWS (MGD)	LOADS (LBS)
January	21	7000	0.291	510
February	25	5000	0.255	319
March	25	3000	0.190	143
April	29	6000	0.204	306
May	20	7000	0.114	200
June	17	6000	0.208	312
July	22	5000	0.126	158
August	26	2000	0.158	79
September	30	2000	0.107	54
October	21	3000	0.173	130
November	18	3000	0.237	178
December	16	3000	0.351	264
AVERAGE		4333	0.201	218

Table B-23. MOHAWK RUBBER CO. PCW WEEKLY OIL AND GREASE CONCENTRATIONS AND MONTHLY LOADS, 1985.

MONTH	DAY	OIL AND GREASE (UG/L)	OIL AND GREASE AVERAGE	LOADS (LBS) 1/
January	3	4000	5600	280
	10	5000		
	17	10000		
	24	4000		
	31	5000		
February	7	4000	2750	138
	14	<2000		
	21	3000		
	28	4000		
March	7	4000	1750	88
	14	<2000		
	21	3000		
	28	<2000		
April	4	<2000	4750	238
	11	10000		
	18	6000		
	25	3000		
May	2	<2000	400	20
	10	2000		
	16	<2000		
	23	<2000		
	30	<2000		
June 2/		<2000	200	10
July	3	<2000	0	0
	11	<2000		
	19	<2000		
	25	<2000		
August	1	3000	1200	60
	8	<2000		
	16	<2000		
	23	<2000		
	29	3000		
September	5	3000	2000	100
	12	<2000		
	19	5000		
	26	<2000		
October	3	<2000	0	0
	10	<2000		
	18	<2000		
	24	<2000		
	31	<2000		
November	7	<2000	750	38
	14	<2000		
	21	<2000		
	27	3000		
December	5	2000	2500	125
	12	2000		
	19	2000		
	26	4000		
AVERAGE			1918	96
ANNUAL TOTAL				1152

1/ Flows were not available; a baseline flow of 0.2 MGD was used.

2/ Data not available (surrounding values were averaged).

Table B-24. MOHAWK RUBBER CO. PCW POSITIVE U.S.EPA 624/625 ANALYSIS RESULTS GRAB SAMPLED ON 26 JUNE 1985. 1/

CHEMICAL	CONCENTRATION (UG/L)
Phenol	1
Tetrachloroethene	7
Toluene	4

1/ Standard detection limits.

Table B-26. PESTANA, JOHN (BRENTWOOD OIL AND GAS FIELDS) OPW MONTHLY OIL AND GREASE CONCENTRATIONS AND LOADS, 1985.

MONTH	OIL AND GREASE (UG/L)	TOTAL MONTHLY FLOW (MG)	LOADS (LBS)
January	1950	0.742	12
February	3320	0.670	19
March	2560	0.703	15
April	5340	0.689	31
May	1600	0.539	7
June	1150	0.647	6
July	720	0.719	4
August	37400	0.742	232
September	1870	0.706	11
October	1450	0.641	8
November	1500	0.648	8
December	3430	0.669	19
AVERAGE	5191	0.676	29
ANNUAL TOTAL			348

Table B-27. ROSEVILLE WTP WEEKLY OIL AND GREASE CONCENTRATIONS AND MONTHLY LOADS, 1985

MONTH	DAY	OIL AND GREASE (UG/L)	OIL AND GREASE AVERAGE	FLOWS (MGD) MINIMUM	FLOWS (MGD) MAXIMUM	FLOWS (MGD) AVERAGE	LOADS (LBS)
January	2	200	275	4.58	7.58	6.21	311
	10	300					
	18	100					
	29	500					
February	7	300	275	4.1	9.25	6.24	469
	14	500					
	22	200					
	27	100					
March	8	200	325	5.15	7.77	6.45	323
	11	600					
	20	200					
	27	300					
April	5	300	325	4.09	7.16	6.17	463
	10	100					
	19	200					
	25	700					
May	3	400	250	4.39	6.2	5.87	588
	8	400					
	17	100					
	22	100					
	29	300					
June	7	200	200	4.48	5.68	4.89	245
	12	200					
	21	300					
	26	100					
July	5	100	375	4.24	7.32	4.96	124
	10	500					
	19	500					
	25	400					
August	2	200	350	0.3	5.64	4.36	218
	9	600					
	15	500					
	22	100					
September	13	500	500	3.27	5.71	5.08	636
	19	600					
	27	400					
October	2	200	200	4.32	5.79	5.06	253
	9	100					
	18	100					
	24	300					
	31	300					
November	7	300	220	4.21	13.29	5.91	444
	14	0					
	20	300					
	27	200					
December	4	300	375	4.54	8.72	6.11	459
	10	100					
	20	500					
	26	600					
AVERAGE		298				5.61	418
ANNUAL TOTAL							5023

Table B-28. SACRAMENTO MUNICIPAL UTILITY DISTRICT PCW/STP WEEKLY OIL AND GREASE CONCENTRATIONS AND LOADS, 1985.

MONTH	DAY	OIL AND GREASE (UG/L)	OIL AND GREASE AVG	FLOWS (MGD) MIN	FLOWS (MGD) MAX	FLOWS (MGD) AVG	LOADS (LBS)
January	1	600	940	8.7	11.5	10.9	2565
	9	800					
	17	500					
	24	1700					
	31	1100					
February	7	<1000	4075	6.3	11.5	10.0	10202
	14	2400					
	21	4400					
	28	9500					
March	6	3400	7900	8.9	13.5	11.5	22745
	14	7500					
	22	15200					
	28	5500					
April	1	6100	6600	2.7	11.1	5.5	9088
	11	18500					
	17	1200					
	26	600					
May	2	1400	1375	3.1	7.5	4.3	1480
	16	3700					
	22	100					
	29	300					
June	5	700	6750	4	13.6	6.0	10140
	14	19900					
	18	1200					
	27	5200					
July	1	340	2015	3.6	9.8	5.1	2573
	11	90					
	16	6300					
	25	1330					
August	1	5000	1960	3.8	8.9	7.2	3533
	8	2000					
	15	500					
	22	1000					
	29	1300					
September	5	2000	6780	2.4	8.6	5.0	8487
	12	1200					
	19	19800					
	20	2100					
	25	8800					
October	3	3100	2233	4.9	14.1	7.6	4249
	9	1500					
	17	200					
	24	3900					
	30	100					
	31	4600					
November	7	2000	4025	5	10.5	8.9	8969
	13	2700					
	21	11300					
	28	100					
December	5	3000	1775	3.3	11.6	6.4	2844
	12	300					
	19	3400					
	26	400					
AVERAGE		2398				7.4	7077
ANNUAL TOTAL							84928

Table B-29. SACRAMENTO REGIONAL COUNTY SANITATION DISTRICT (SRCSD) WTP MONTHLY METALS CONCENTRATIONS AND LOADS, 1985.

MONTH	DAY	FLOW (MGD)	CADMIUM (UG/L)	CADMIUM LOAD (LBS)	CHROMIUM (UG/L)	CHROMIUM LOAD (LBS)	COPPER (UG/L)	COPPER LOAD (LBS)	LEAD (UG/L)	LEAD LOAD (LBS)	MERCURY (UG/L)	MERCURY LOAD (LBS)	NICKEL (UG/L)	NICKEL LOAD (LBS)	ZINC (UG/L)	ZINC LOAD (LBS)	CYANIDE (UG/L)	CYANIDE LOAD (LBS)
January	21	120	<1	0	7	210	17	511	5	150	<0.2	0	<5	0	96	2884	<5	0
February	18	123	<1	0	6	185	16	493	<5	0	0.2	6	19	585	96	2956	NA	0
March	18	124	<1	0	11	341	6	186	<5	0	<0.2	0	6	186	110	3415	<5	0
April	16	109	<1	0	12	327	8	218	6	164	<0.2	0	6	164	95	2592	3	82
May	20	117	<1	0	12	352	8	234	<5	0	<0.2	0	<5	0	30	879	6	176
June	3	123	<1	0	12	370	8	246	<5	0	<0.2	0	17	524	11	339	8	246
July	15	129	<1	0	7	226	<5	0	6	194	<0.2	0	7	226	85	2745	<10	0
August	19	135	1	34	6	203	26	879	<5	0	<0.2	0	20	676	89	3008	<10	0
September	17	124	<1	0	18	559	23	714	<5	0	<0.2	0	11	341	124	3850	10	310
October	21	127	<1	0	<5	0	40	1272	<5	0	<0.2	0	13	413	130	4133	<10	0
November	26	143	2	72	10	358	17	609	<5	0	<0.2	0	11	394	60	2148	<10	0
December	18	143	1	36	16	573	31	1110	8	286	<0.2	0	<5	0	160	5728	<10	0
AVERAGE		126	0.33	11	10	308	17	526	2	66	0.02	0.53	9	289	91	2855	2	71
ANNUAL TOTAL				132		3696		6312		792		6.36		3468		34260		852

Table B-30. SACRAMENTO REGIONAL COUNTY SANITATION DISTRICT WTP UNDETECTED METALS, 1985.

		METALS NOT DETECTED (UG/L) 1/					
MONTH	DAY	ANTIMONY	ARSENIC	BERYLLIUM	SELENIUM	SILVER	THALLIUM
January	21	NA	NA	NA	NA	<5	NA
February	18	<5	<5	<3	<5	<5	<5
March	18	NA	NA	NA	NA	<5	NA
April	16	NA	NA	NA	NA	<5	NA
May	20	NA	NA	NA	NA	<5	NA
June	3	NA	NA	NA	NA	<5	NA
July	15	NA	NA	NA	NA	<5	NA
August	19	NA	NA	NA	NA	<5	NA
September	17	NA	NA	NA	NA	<5	NA
October	21	NA	NA	NA	NA	<5	NA
November	26	NA	NA	NA	NA	<5	NA
December	18	NA	NA	NA	NA	<5	NA

1/ NA=not analyzed

Table B-32. SACRAMENTO REGIONAL COUNTY SANITATION DISTRICT WTP QUARTERLY ORGANIC PRIORITY POLLUTANT CONCENTRATIONS, 1985. 1/

	CONCENTRATION (UG/L)			
COMPOUND / MONTH-DAY	2-19	5-20	8-19	11-25
1,1,1-trichloroethane	<0.2	1	<0.2	<1
chloroform	13	11	10	11
methlylene chloride	7	8.9	0.6	39
tetrachloroethylene	6.6	1.7	0.7	7.4

1/ Other EPA 624/625 priority pollutants were not detected at standard analysis quantitation limits.

Table B-34. SHELL CALIFORNIA PRODUCTION OPW MONTHLY OIL AND GREASE CONCENTRATIONS AND LOADS, 1985

MONTH	OIL AND GREASE (UG/L)	FLOW (MGD)	LOADS (LBS)
January	1100	0.155	43
February 1/	4050	0.155	157
March 1/	4050	0.155	157
April 1/	4050	0.155	157
May 1/	4050	0.155	157
June 1/	4050	0.155	157
July 1/	4050	0.155	157
August	7000	0.155	272
September 1/	4500	0.155	175
October	2000	0.155	78
November	2000	0.152	76
December	3000	0.147	110
AVERAGE	3020	0.153	116
ANNUAL TOTAL			1392

1/ Data not available (surrounding values were averaged).

Table B-31. SACRAMENTO REGIONAL COUNTY SANITATION DISTRICT WTP MONTHLY OIL AND GREASE CONCENTRATIONS AND LOADS, 1985.

MONTH	AVERAGE OIL AND GREASE CONC. (UG/L) 1/	N 2/	AVERAGE FLOW (MGD)	LOADS (LBS)
January	618	(17)	120	18567
February	3556	(9)	123	109505
March	1400	(10)	124	43463
April	4417	(12)	109	120538
May	0	(6)	117	0
June	1500	(8)	123	46192
July	1600	(10)	129	51675
August	600	(10)	144	21631
September	2500	(8)	124	77612
October	1200	(10)	127	38155
November	0	(1)	143	0
December	3500	(2)	143	125306
AVERAGE	1741		127	55427
ANNUAL TOTAL				665121

1/ Detection limit (<5000 ug/l) was replaced with zero for the averages.

2/ N=number of samples per month.

Table B-33. SHARPE ARMY DEPOT WTP MONTHLY OIL AND GREASE CONCENTRATIONS AND LOADS, 1985.

MONTH	OIL AND GREASE (UG/L)	AVERAGE FLOW (MGD)	LOADS (LBS)
January	1800	0.114	51
February 1/	2450	0.093	57
March	3100	0.107	83
April	1800	0.092	41
May 1/	1150	0.072	21
June 1/	1150	0.072	21
July 1/	1150	0.072	21
August	500	0.052	7
September	300	0.048	4
October 1/	300	0.048	4
November 1/	300	0.048	4
December 1/	300	0.048	4
AVERAGE	1500	0.072	27
ANNUAL TOTAL			324

1/ Data not available (surrounding values were averaged).

Table B-35. SHELL OIL CO. (YOLO COUNTY) OIL AND GREASE CONCENTRATIONS FROM YARD RUNOFF, 1985.

DATE (MONTH-DAY)	OIL AND GREASE (UG/L)
1-8	1900
1-29	7100
2-07	700
3-6	1400
3-27	700
10-23	800
11-11	600

Table B-37. STOCKTON WTP MONTHLY TRACE METAL LOADS, 1985.

MONTH	AVERAGE FLOW(MGD)	LOADS (LBS) ANTIMONY	ARSENIC	BERYLLIUM	CADMIUM	CHROMIUM	COPPER	CYANIDE	MERCURY	NICKEL	LEAD	SELENIUM	THALLIUM	ZINC
January	18.42	0.00	1	0.00	4	49	92	0.00	5	175	56	0.00	0.00	101
February	13.33	0.00	1	0.00	3	35	67	0.00	3	127	41	0.00	0.00	73
March	26.14	0.00	1	0.00	5	69	131	0.00	7	249	80	0.00	0.00	144
April	26.19	0.00	1	0.00	5	70	131	0.00	7	249	80	0.00	0.00	144
May	28.19	0.00	1	0.00	6	75	141	0.00	7	268	86	0.00	0.00	155
June	24.72	0.00	1	0.00	5	66	124	0.00	6	235	76	0.00	0.00	136
July	22.76	0.00	1	0.00	5	60	114	0.00	6	217	70	0.00	0.00	125
August	34.47	0.00	2	0.00	7	91	173	0.00	9	328	105	0.00	0.00	190
September	32.37	0.00	2	0.00	6	86	162	0.00	8	308	99	0.00	0.00	178
October	31.55	0.00	2	0.00	6	84	158	0.00	8	300	96	0.00	0.00	174
November	25.14	0.00	1	0.00	5	67	126	0.00	7	239	77	0.00	0.00	138
December	29.63	0.00	1	0.00	6	79	148	0.00	8	282	91	0.00	0.00	163
AVERAGE	26.08	0	1	0	5	69	131	0	7	248	80	0	0	144
TOTAL ANNUAL		0	12	0	60	828	1572	0	84	2976	960	0	0	1728

Table B-36. SIMPSON PAPER COMPANY PPW MONTHLY MERCAPTAN CONCENTRATIONS AND AVERAGE FLOWS, 1985.

MONTH	MERCAPTANS (UG/L)	AVERAGE MONTHLY FLOW (MGD)
January	<0.2	10.53
February	<0.2	12.90
March	<0.2	11.83
April	<0.2	12.31
May	<0.2	12.15
June	<0.2	11.44
July	<0.2	10.57
August	<0.2	11.74
September	<0.2	12.87
October	<0.2	13.36
November	<0.2	13.35
December	<0.2	13.35

Table B-38. STOCKTON WTP TRACE METAL CONCENTRATIONS, 1985.

TRACE METAL	CONCENTRATION (UG/L) DATE (MONTH-DAY) 1-24	4-24	7-25	8-31	10-24	AVERAGE CONC. (UG/L)
Antimony	NA	NA	NA	<500	NA	0
Arsenic	<5	<5	<5	<40	1	0.2
Beryllium	<1	<1	<1	<10	<1	0
Cadmium	<2	<2	<2	<2	4	0.8
Chromium	9	9	5	30	<5	10.6
Copper	47	30	13	<20	10	20
Cyanide	<20	<20	<20	<2	<20	0
Mercury	<.2	<.2	<.2	5	0.2	1.04
Nickel	34	35	36	70	15	38
Lead	35	<5	23	<50	3	12.2
Selenium	<5	<5	<5	<50	<5	0
Thallium	<1	<1	<1	<100	<1	0
Zinc	25	30	14	30	11	22

Table B-37. STOCKTON WTP MONTHLY TRACE METAL LOADS, 1985.

Table B-39. STOCKTON WTP WEEKLY OIL AND GREASE CONCENTRATIONS AND MONTHLY LOADS, 1985.

MONTH	DAY	OIL AND GREASE (UG/L)	FLOWS (MGD) MINIMUM	MAXIMUM	AVERAGE	LOADS (LBS)
January	7	<1000	3.39	26.35	18.42	0
	14	<1000				
	23	<1000				
	28	<1000				
February	4	<1000	0.12	21.47	13.33	0
	11	<1000				
March	6	<1000	4.69	20.55	26.14	0
	11	<1000				
	18	<1000				
	25	<1000				
April	1	<1000	12.38	41.69	26.19	2295
	8	1400				
	17	<1000				
	22	<1000				
	29	<1000				
May	6	<1000	11.79	41.72	28.64	1972
	28	1100				
June	3	<1000	2.07	38.87	24.72	0
	17	<1000				
	25	<1000				
July	1	<1000	0.24	22.76	22.76	0
	8	<1000				
	15	<1000				
	22	<1000				
August	9	<1000	7.98	52.88	34.47	0
	15	<1000				
	19	<1000				
September	3	<1000	21.78	39.92	32.37	0
	9	<1000				
	16	<1000				
	23	<1000				
October	4	<1000	8.44	38.66	31.55	0
	10	<1000				
	15	<1000				
	21	<1000				
November	4	<1000	5.26	44.17	25.14	0
	12	<1000				
	19	<1000				
	25	<1000				
December	2	<1000	16.47	50.26	29.63	0
	9	<1000				
	20	<1000				
	23	<1000				
AVERAGE		58			26.11	384
ANNUAL TOTAL						4609

Table B-40. STOCKTON WTP U.S.EPA METHODS 624/625 POSITIVE DETECTIONS (COMPOUNDS NOT REPORTED WERE NOT DETECTED AT 2 UG/L). 1/

CHEMICAL	CONCENTRATION (UG/L)
chloroform	28
ethylbenzene	27
bromoform	2.6
dichlorobromomethane	20
chlorodibromomethane	9.3
toluene	12
pentachlorophenol	2.4

1/ Sampled on 10-17-1985.

Table B-41. TERMO CO. OPW MONTHLY OIL AND GREASE CONCENTRATIONS AND LOADS, 1985.

DATE (MONTH-DAY)	OIL & GREASE (UG/L) GRAB	OIL & GREASE (UG/L) AVERAGE	AVERAGE FLOW (MGD)	LOADS (LBS)
1-29	400	3133	0.190	19
3-16	6000			285
3-25	3000			143
4-28	<2000	1000	0.202	0
5-28	3000			152
6-25	<2000			0
7-31	<2000	1333	0.226	0
8-28	4000			226
9-26	<2000			0
10-29	3000	5667	0.227	170
11-27	7000			398
12-30	7000			398
AVERAGE	2783		0.211	147
ANNUAL TOTAL				1764

TABLE B-42. TRACY (CITY OF) WTP METAL CONCENTRATIONS, 1985.

COMPOUND	CONCENTRATION (ug/l) APRIL 18 1/	SEPTEMBER 3 2/	AVERAGE
Arsenic	<10	<10	0
Cadmium	2	<5	1
Chromium	16	<10	8
Copper	<100	<100	0
Cyanide	<100	<10	0
Lead	<5	<10	0
Mercury	<1	<1	0
Silver	<1	<5	0
Zinc	<100	<100	0
Nickel	700	na	700

1/ Phenolic concentration = 5 ug/l.
2/ Phenolic concentration = 9 ug/l.

TABLE B-44. TRACY (CITY OF) WTP TRACE METAL LOADS, 1985. 1/

MONTH	FLOWS (MGD) MINIMUM	MAXIMUM	AVERAGE	LOADS (LBS) 2/ CADMIUM	CHROMIUM	NICKEL
January	3.1	6.5	5.3	1.3	11	929
February	3.4	7.4	5.5	1.4	11	964
March	3.2	7.1	5.7	1.4	11	999
April	3.5	7.6	6.0	1.5	12	1052
May	4.4	7.4	5.9	1.5	12	1034
June	4.2	5.2	4.4	1.1	9	771
July	2.1	4.5	4.1	1.0	8	719
August	4.4	7.8	6.6	1.7	13	1157
September	3.0	8.8	5.9	1.5	12	1034
October	3.1	8.3	6.3	1.6	13	1104
November	3.2	8.7	5.8	1.5	12	1016
December	2.3	2.1	5.5	1.4	11	964
MONTHLY AVERAGE			5.6	1.4	11	978
ANNUAL TOTAL				17	134	11742

1/ Using metal averages from Table B-42.
2/ Loads for As, Cu, Cn, Pb, Hg, Ag, and Zn were all zero.

Table B-43. TRACY WTP WEEKLY OIL AND GREASE CONCENTRATIONS AND MONTHLY LOADS, 1985.

		OIL AND GREASE		FLOWS (MGD)			
MONTH	DAY	(UG/L)	AVERAGE	MINIMUM	MAXIMUM	AVERAGE	LOADS (LBS)
January	10	200	100	2.92	3.88	3.51	88
	18	100					
	25	0					
February	1	100	260	2.98	3.94	3.44	224
	8	400					
	15	300					
	22	400					
	28	100					
March	5	100	125	1.70	4.90	4.02	126
	15	100					
	21	200					
	27	100					
April	5	200	225	2.87	3.67	3.36	189
	9	100					
	18	200					
	25	400					
May	2	0	180	2.71	3.62	3.23	145
	9	300					
	16	0					
	23	600					
	29	0					
June	6	800	400	2.50	5.80	4.05	406
	13	100					
	20	700					
	26	0					
July	4	200	533	2.82	5.10	4.17	556
	16	200					
	23	1200					
August	8	100	275	3.50	4.98	4.29	296
	15	200					
	22	800					
	28	0					
September	8	200	250	2.67	4.62	3.94	247
	11	400					
	19	300					
	26	100					
October	2	6100	1825	2.09	4.33	3.35	1530
	9	100					
	17	100					
	24	1000					
November	7	400	975	2.00	3.56	2.75	670
	12	2000					
	17	400					
	25	1100					
December	5	1500	2167	2.10	3.78	3.19	1731
	12	4000					
	19	1000					
AVERAGE		572				3.09	443
ANNUAL TOTAL							5310

Table B-44. WICKES FOREST PRODUCTS TGW WEEKLY CHROMIUM (6+ AND TOTAL), ARSENIC, AND COPPER CONCENTRATIONS AND MONTHLY LOADS, 1985. 1/

		ARSENIC			CHROMIUM			CHROMIUM (6+)			COPPER		
MONTH	DAY	(UG/L)	MONTHLY AVERAGE	LOADS (LBS)	(UG/L)	MONTHLY AVERAGE	LOADS (LBS)	(UG/L)	MONTHLY AVERAGE	LOADS (LBS)	(UG/L)	MONTHLY AVERAGE	LOADS (LBS)
January	1	<5	11	0.04	420	1248	4	180	1110	4.00	<10	14	0.05
	1	11			5100			5100			23		
	11	11			290			190			<10		
	26	21			230			50			31		
	31	12			200			30			14		
February	2	72	32	0.12	270	380	1	40	57	0.20	<10	11	0.04
	15	11			370			50			32		
	22	13			500			80			<10		
March	1	7	9	0.03	310	412	1	100	90	0.32	19	18	0.06
	8	13			360			60			14		
	15	9			450			80			25		
	22	9			480			100			12		
	29	9			460			110			20		
April	5	9	15	0.05	550	638	2	130	128	0.46	17	27	0.10
	12	11			690			110			12		
	19	22			680			120			92		
	20	20			660			140			<10		
	29	12			610			140			15		
May	20	<5	20	0.07	830	725	3	280	335	1.21	12	6	0.02
	28	39			620			390			<10		
June 2/		NA	15	0.05	NA	665	1	NA	290	0.42	NA	8	0.01
July	12	5	8	0.03	450	580	2	210	245	0.88	14	10	0.03
	15	11			790			260			12		
	22	9			490			280			12		
	29	7			590			230			<10		
August	5	5	1	0.00	450	465	1	190	153	0.22	14	6	0.01
	12	<10			370			21			10		
	20	<10			550			200			<10		
	27	<5			490			200			<10		
September	4	<10	0	0.00	210	200	1	200	65	0.23	<10	0	0.00
	10	<10			190			10			<20		
	16	<10			180			10			<10		
	30	<10			220			40			<10		
October	7	<10	0	0.00	180	160	1	60	67	0.24	<10	0	0.00
	14	<10			140			60			<10		
	23	<10			160			80			<10		
November 2/		NA	2	0.01	NA	179	0	NA	124	0.13	NA	0	0.00
December	2	20	4	0.01	170	198	1	100	180	0.65	<10	0	0.00
	9	<30			190			220			<10		
	13	<10			190			190			<20		
	16	<30			210			210			<20		
	23	<20			230			180			<10		
AVERAGE		9		0.03	489		2	248		1	10		0
ANNUAL TOTAL				0.36			24			12			0

1/ Flows consistently measured at 0.0144 MGD were used
2/ Concentrations not available (surrounding values were averaged).

APPENDIX C

ABANDONED MINE COMPLEX DESCRIPTIONS AND CHRONOLOGIES OF SIGNIFICANT EVENTS

Table C-1. CHRONOLOGY OF SIGNIFICANT EVENTS IN THE MANAGEMENT OF ABANDONED MINES IN THE CENTRAL VALLEY BY THE REGIONAL BOARD.

YEAR MONTH	SIGNIFICANT EVENT	MINES INCLUDED	CONCLUSIONS OR CONDITIONS
1939 August	CDFG conducts survey of streams draining to Shasta Lake and their relative contribution of mine runoff.	All mines in the Shasta Lake watershed.	Five creeks in the Shasta Lake watershed were found to be contaminated by mine tunnel drainage.
1953 February	CDFG completes study titled "A preliminary report on the upper Sacramento River copper pollution investigation".	All upper Sacramento River mines.	
1974	CVRWQCB contracted with USGS to perform studies on the upper Sacramento River watershed.	All mines in the Shasta County region.	Study to provide description of problems and recommend methods to reduce metal discharges.
1974 July	CVRWQCB adopts Proposed Demonstration of the Correction of Mine Pollution from Abandoned Copper Mines Adjacent to the Sacramento River. Resolution No. 74-432.	All mines in thé upper Sacramento River watershed.	CVRWQCB requests SWRCB to contract with USGS for $43,000 to perform study.
1975 August	SWRCB adopted Resolution No. 75-80 calling for action by the CVRWQCB Executive Officer tó protect water quality.	All mines in the Tulare Basin.	Surface waters to be protected and pollutants discharges to be managed by CVRWQCB.
1976	Study completed titled "The weathering of sulfide ores in Shasta County, CA and its relationship to pollution associated with acid mine drainage" (Potter, 1976).	All mines within Shasta County.	Conclusions: 1.) buffering AMD and portal sealing may compound the problem, 2.) Several factors contribute to AMD formation, and 3.) an understanding of the hydrologic environment is necessary.
1977 March	USGS study completed titled "Heavy metal discharges into Shasta Lake and Keswick Reservoirs on the upper Sacramento River, California" (Nordstrom et al., 1977).	All mines in the upper Sacramento River watershed.	Four of 17 streams contribute up to 94% of heavy metal loads to upper Sacramento River under low flow conditions. Fifty percent of total was contributed by Spring Creek (Iron Mountain Mine).
1978 May	USGS study completed titled "An evaluation of problems arising from AMD in the vicinity of Shasta Lake, Shasta County, California" (Fuller et al., 1978).	All mines in the upper Sacramento River watershed.	Suggested methods of treatment: 1.) air and hydraulic sealing, 2.) lime neutralization, 3.) channeling of runoff away from mine and tailings area, and 4.) the grading/sealing of tailings dumps.
1978 September	CVRWQCB funded CDFG to perform bioassay studies.	AMD in general.	CDFG to determine the levels of copper, zinc, and cadmium that are toxic to steelhead and salmon.
1979 December	Study completed titled "Abatement of water pollution from inactive mines in California: A legal institutional study" (Miller et al., 1979).	All California abandoned mines.	Study evaluated regulatory and funding options for AMD.
1979 December	CVRWQCB completes study of abandoned mines ranking their potential to aquatic biota in receiving waters (Buer et al., 1979).	41 major abandoned mines in the Central Valley.	Ten mines listed as a high hazard, 7 as medium, 20 as low, 2 as unknown, and 2 as special based primarily on CVRWQCB monitoring and contracted studies.
1981 March	CVRWQCB adopts Resolution No. 81-22	All abandoned mines.	Requires CVRWQCB to use U.S.EPA funds to implement measures to abate pollution from abandoned mines.

AFTERTHOUGHT MINE

Afterthought Mine had been worked, at one time or another, for copper, silver, zinc, lead, gold, and barite during 1862-1952. The underground tunnels have filled with water and frequently discharge AMD from several mine portals. The main portal of the mine is the primary source of metals loading from the complex. The remaining portals and tailings contribute comparatively minor amounts. Copper, zinc, and cadmium are the major metallic constituents in the effluent. Afterthought mine drains to Norton Gulch to Little Cow Creek to Cow Creek and then to the Sacramento River. The mine's discharges have eliminated aquatic life in Norton Gulch and has affected the biota in Little Cow Creek. Afterthought Mine has been ranked 6 as a high threat to Central Valley water quality.

Table C-2. CHRONOLOGY OF SIGNIFICANT EVENTS FOR AFTERTHOUGHT MINE.

YEAR MONTH	SIGNIFICANT EVENT	CONDITION OR RESULT
1978 February	Owners propose to restart mining activity on the existing slag deposits.	Contractor developed CEQA required document for the proposed construction of necessary operations, open pit mining, and construction of conveyer belt system from the open pit mine to the mill site.
1978 June	CVRWQCB makes comments on draft EIR for the startup of Afterthought Mine.	Conclusions: 1.) inadequate in it's discussion of water quality impacts, and 2.) no information on how stated potential water quality impacts will be specifically mitigated.
1978 July	CDFG submits study of AMD from Afterthought Mine.	Conclusions: 1.) main portal is the primary source of AMD, and 2.) proposed injection into main portal will increase discharges.
1978 October	CVRWQCB requires owner to file a report of waste discharge.	
1982 April	CVRWQCB contracts with Advanced Environmental Consultants to study Afterthought Mine pollution.	Purpose: 1.) develop and evaluate feasible solutions to AMD, 2.) solutions to require little or no power or maintenance, and 3.) restore receiving waters to a condition which is capable of supporting aquatic life. Contract cancelled from CA funds freeze
1984	CVRWQCB contracts with CDWR to perform study of Afterthought and Greenhorn Mines.	Evaluate and identify methods to control AMD and recommend the best feasible approach.
1984 July	CDWR completes AMD control and abatement report (Buer, 1985).	Recommendations: 1) bulkhead sealing of 3 portals, 2) surface drainage controls at Greenhorn Mine, and 3) revegitation, landscaping, sloping, and/or removing mine dumps.

BULLY HILL AND RISING STAR MINES

The Bully Hill and Rising Star mines were operated to recover gold, silver, copper, and zinc from ore bodies from around 1860 to 1956 (USGS, 1974). The tunnel complexes have been flooded since 1950 and the AMD escapes through the caved debris at the main adit of each mine. The Bully Hill main adit discharges have been measured at 4 to 12 GPM and vary seasonally. Seepage from a waste pile below the mine also discharges to Town Creek, the receiving water of both AMD and seepage. Town Creek drains to Shasta Lake. The Rising Star discharges have been measured at 7-40 GPM varying seasonaly and contain higher metal content than Bully Hill AMD. Rising Star drainage discharges to Horse Creek which also drains to Shasta Lake. Both mines discharge high concentrations of copper, zinc, cadmium, and a small amount of lead. Seventy to 90 % of the pollution from both mine complexes is caused by surface water percolating through waste piles, exposed ore dumps, and slag bodies.

Table C-3. CHRONOLOGY OF SIGNIFICANT EVENTS FOR BULLY HILL AND RISING STAR MINES.

YEAR	MONTH	SIGNIFICANT EVENT	CONDITION OR RESULT
1978	January	CVRWQCB correspondence to Glidden Co. and SCM Corp. (owners) requesting report of Waste Discharge.	Report of discharge to cover all mine holdings on the Horse and Town Creek watersheds. A second letter was sent in March because no response was received from the two responsible parties.
1978	September	CVRWQCB adopted Waste Discharge Requirements (Order No. 78-155).	SCM Co. and M&B Mining Services LTD. were required: 1.) minimize inflow to mine adits and shafts, 2.) reduce metals runoff from waste tailings, ore dumps, and exposed ore bodies to surface waters.
1978	October	SCM Corp. and M&B Mining Services Ltd. received an official copy of Order No 78-155.	
1978	November	CVRWQCB inspection.	Bully Hill flow measured 5 GPM, Rising Star mine flow measured at 100 GPM to Horse Creek. Both mines show massive erosion.
1978	December	CVRWQCB requests monitoring results of mine discharges from Northair Mines Ltd. (current Leasee).	Northair Mines Ltd. sent results of samples taken in November 1978.
1979	January	Northair Mines Ltd. completes report on Bully Hill and Rising Star mines pollution control.	1.) summarized test results on mine effluents, 2.) recommended abatement measures to be followed during different stages of development of the mines, 3.) discussed lime neutralization, and 4.) the potential costs to be incurred.
1979	March	Northair Mines Ltd. reported monthly monitoring results.	Results of monitoring were sent for March and May.
1979	March	CVRWQCB inspected and advised monitoring program.	CVRWQCB also provided sampling and advice on weir placement in May.
1979	August	Northair Mines Ltd. reports on their progress.	Described placement of wiers at the portals and below the dump.
1980	September	BEAK Consultants, Inc., proposed future exploration and mining in the Bully Hill area.	Proposed drilling activities would be conducted to reduce impacts on Town Creek to an extent that was practical. Water quality and flow data to be submitted throughout the drilling operation.
1981	January	Cooksley Geophysics, Inc., proposes opening Bully Hill adit.	Agreed to install berm at outer edge of spoils pile. Monitoring proposed.
1981	March	CVRWQCB requested Northair Mines, Inc., to continue correspondance.	Requested: 1.) continued monitoring, 2.) copies of any pertinant reports, and 3.) communication on the status of exploration and pollution abatement work at the mines.
1987	June	Northair Mines Ltd. found to be in violation of Order No. 78-155.	No attempt had been made to comply since completion of exploratory drilling in 1982. Abatement measures requested by CVRWQCB.

CHEROKEE MINE

Cherokee Mine was issued Waste Discharge Requirements and has rarely discharged mining pollutants to surface waters. No file of past inspections has been found although the mine has been ranked as a medium threat to Central Valley water quality.

CORONA MINE

Corona Mine began production of mercury during 1895 and operated on and off until the 1970s. The underground mine is one of several that operated or are still operating within the same watershed. The major outflows have been observed to be from 2 adits which discharge primarily during the wet season. The AMD contains high levels of mercury and copper. Tailing piles on the Corona Mine property are also a source of metals and silt to James Creek which flows directly adjacent the mine. James Creek is a tributary to Pope Creek which drains to Lake Berryessa. No aquatic life exists in James Creek downstream of the mine and Pope Creek has been periodically affected by Corona Mine drainage. Pope Creek water quality is further degraded by runoff from the other abandoned and operational mines within the Creek's watershed. Numerous complaints have been received from downstream landowners adjacent to Pope Creek. Corona Mine has been ranked 14 as a medium water quality threat from abandoned mines in the Central Valley (Buer, et al., 1978).

Table C-4. CHRONOLOGY OF SIGNIFICANT EVENTS FOR CORONA MINE.

YEAR MONTH	SIGNIFICANT EVENT	CONDITION OR RESULT
1941	CDFG pronounced Corona Mine harmless to aquatic life on James Creek.	
1949	Development work at mine suspected of causing discharge from mine.	Increase in mineral content of James Creek.
1958 October	CVRWQCB inspection with CDFG as a result of several landowners' compliants.	Operations to recover mercury from tailings occurred periodically. Corona tunnel discharging 3 GPM causing iron precipitation in James Creek.
1965 March	CVRWQCB inspection.	Pope Creek found to be heavily silted from Corona Mine tailings.
1965 May	CVRWQCB inspection.	Several mining operations active in Pope Creek watershed.
1966 March	CVRWQCB and CDFG inspection of James and Pope Creek.	No aquatic insects or fish found in James Creek below mines. CDFG requests action by CVRWQCB.
1966 March	CVRWQCB declined to take action.	Mineral values of mining operation stated to exceed the fishery value of James Creek.
1966 April	CDFG requests CVRWQCB to write Waste Discharge requirements for operating mines on Pope Creek drainage.	CVRWQCB requests more information of condition and usage of the waters.
1966 June	CDFG conducted stream survey.	Presented survey to CVRWQCB as evidence.
1966 July	CVRWQCB adopts Waste Discharge Requirements for two major mines in the Pope Creek drainage (Corona mine included).	Stated the owner abate discharge from main tunnel of Corona Mine.
1966 July	CVRWQCB inspection.	
1966 August	Napa County requests CVRWQCB to set water quality standards for Pope Creek.	
1968 September	CVRWQCB requests CDFG to submit fishery data.	Waste Discharge Requirements to be set would be based on information sent.
1969 July	CVRWQCB inspection.	Corona Mine in operation, no discharges from tunnels observed.
1969 August	CVRWQCB Board meeting.	Extensive testimony given by mine owners.
1969 August	CVRWQCB adopts Waste Discharge Requirements Resolution No. 70-5 for Corona Mine.	Discharge should not pollute James Creek.
1970 May	CVRWQCB inspections in May and July.	Discharger found in violation of Resolution No. 70-5. Flows from adits totaled 25-200 GPM.
1970 July	CVRWQCB inspection.	Two tunnels at Corona Mine discharging a total of 55 to 110 GPM.
1971 July	CVRWQCB adopted Waste Discharge Requirements Order No. 72-110.	Conditions: Corona Mine shall not discharge pollutants to James Creek.
1971 November	CVRWQCB completed pre-feasibility study.	Proposal to study methods of abatement of Corona Mine discharges over a 4 year period.
1972 July	CVRWQCB requests funds from U.S.EPA to study Corona Mine.	Study to include ways to abate mine pollution. Cost was determined to be too prohibitive with respect to the value of the mine.
1979 March	CVRWQCB inspection.	Adit discharge flow measured at 0.1-0.8 CFS. Owner found in violation of Order NO. 72-110 for causing creek discoloration and flow off of tailings.
1981 May	CVRWQCB inspection.	Adit discharge measured at 5 GPM, erosion of tailings evident.

GREENHORN MINE

The Greenhorn Mine complex has been mined at one time or another for copper, gold, and silver between 1900 and 1957 (CDMG, 1974). Most of the AMD comes the main portal and from several springs located at the base of the tailings pile. Several hundred acres of unvegitated tailings are situated directly adjacent Willow Creek. The mine covers approximately 33 acres and annual precipitation is about 65 inches (Buer, 1985). Acid mine drainage from the main portal has been estimated from 8 to 20 GPM. The flow from a major spring located at the base of the waste pile has been estimated at 7 GPM (Buer, 1985). The seepage flows to Willow Creek, then to Crystal Creek a tributary to Clear Creek which courses about 1 mile before reaching Whiskeytown Lake. High levels of copper, zinc, and cadmium have been detected in the runoff. A severe reduction in the number of invertebrates and fish in Willow Creek has been measured for a stretch of 4 miles.

Table C-5. CHRONOLOGY OF SIGNIFICANT EVENTS FOR GREENHORN MINE.

YEAR	MONTH	SIGNIFICANT EVENT	CONDITION OR RESULT
1976	August	CVRWQCB inspection.	
1978	July	CDFG requested CVRWQCB to include Greenhorn Mine to be included in inventory report.	
1979	February	CVRWQCB inspection.	Site surveyed with owner to discuss ways to reduce erosion and AMD.
1981	January	CVRWQCB inspection with CDF.	Investigated possibility of obtaining funding through the California Forest Improvement Program (CDF) for erosion control on private lands.
1981	April	CVRWQCB and CDFG inspection and benthological survey of Greenhorn Mine and Willow Creek.	Results: 1.) invertebrates almost totally eliminated in Willow Creek from the mine downstream to Crystal Creek. Diverse insect populations were found in Willow Creek above the mine.
1982	February	CVRWQCB announcement of request for proposals for mining studies.	Study to evaluate and recommend solutions to AMD from portals, seeps, and tailings piles. Other mines were included in the RFP.
1982	April	CVRWQCB contracted with Avanced Environmental Engineers.	Study to control AMD from Greenhorn Mine.
1982	May	CVRWQCB inspection.	Flow from main portal (15-20 GPM) had not substantially increased from summertime flows. Flow from seeps were similar to summer time seepage rate. Portal flow and seepage at the toe of overburden material were relatively equal in their metals discharge
1984	January	CVRWQCB proposes to study Greenhorn and Afterthought mines with Section 205(j) funds.	Purpose: 1.) identify and prioritize all pollution sources, 2.) identify and evaluate methods of controlling AMD, and 3.) identify the best control strategy for each mine including estimated costs and implementation strategy.
1984	March	CVRWQCB memorandum summarizing Greenhorn mine monitoring results, 1976 to 1984.	
1984	December	Greenhorn mine was recommended for inclusion in cleanup list using CDHS bond funds.	
1986	January	CVRWQCB adopted Resolution No. 86-039.	Report on the Greenhorn and Afterthought mines was approved.
1986	March	Resolution No. 86-25 adopted by SWRCB.	Phase 1 final report (205(j) funded) accepted. Report addressed a plan for the control and abatement of AMD from several Shasta County mines.

IRON MOUNTAIN MINE

Within the Iron Mountain Mine (IMM) complex, ore bodies have been mined at one time or another for copper, zinc, gold, silver, pyrite (for sulfuric acid) and iron oxide between 1879-1963 (CDMG, 1974). Groundwater exposed to underground mineral deposits contained on Iron Mountain is the major source of acid mine drainage. High levels of copper, zinc, and cadmium have been detected in adit seepage as well as in rainfall and spring runoff from tailing piles. Rainfall in the area averages around 63 inches annually. Iron Mountain mine was ranked first above all other Central Valley abandoned mines for causing water quality problems (Buer et al., 1978). Acid mine drainage enters Boulder Creek from the Richmond and Hornet mines as well as from surface runoff from exposed pyrite tailing deposits surrounding the mines. In 1964, a copper precipitation plant was upgraded on Boulder Creek to treat the 50-250 GPM of AMD generated (Prokopovich, 1965). The plants efficiency was estimated at around 95-99% in removing copper from the inffluent during the first year of operation. Both surface runoff and AMD from Old Mine and No. 8 Mine discharge to Slickrock Creek. Approximately 25-200 GPM of AMD seeps into the creek. A copper cementation plant was built in 1977 to treat Slickrock Creek discharges. Both Slickrock and Boulder creeks drain to Spring Creek which eventually reaches the Sacramento River at Keswick Lake. Boulder, Slickrock, Flat, and Spring Creek are essentially devoid of aquatic life downstream of the mines. Fish kills in the Redding area due to Spring Creek discharges have been documented since 1940 (Fuller et al., 1978), however, their frequency increased following the completion of Shasta Dam in 1944 (USGS, 1973). Spring Creek Dam was built in 1963 by USBR to regulate flows from Spring Creek corresponding to Shasta releases in an effort to maintain a specified safe level of dilution (Prokopovich, 1963). Present Status.

Table C-6. CHRONOLOGY OF SIGNIFICANT EVENTS FOR IRON MOUNTAIN MINE.

YEAR MONTH	SIGNIFICANT EVENT	CONDITION OR RESULT
1976 November	Cleanup and Abatement Order issued to Stauffer Chemical Company.	
1976 December	Iron Mountain Mine area sold to Iron Mountain Mines Inc. (IMMI) by Stauffer Chemical Company.	
1977 July	Waste Discharge Requirements issued to Iron Mountain Mine Inc. (Order Number 77-225).	WDR conditions: 1.) 1 year monitoring program, 2.) Feasibility report for copper removal on Slickrock Creek, and 3.) Reduce discharges from adits and tailings runoff.
1977 August	Cleanup and abatement order adopted.	Required compliance with Order No. 77-225.
1978 September	NPDES permit adopted (Order No. 78-152).	Conditions: 1.) AMD collection systems be maintained with no bypasses, 2.) Copper cementation plants must be operated above 95 % efficiency, and 3.) Weekly monitoring.
1978 December	CVRWQCB inspection found discharger not in compliance with Order No. 78-152.	Findings: 1.) Cementation plants not operating properly, 2.) Bypasses were occuring, 3.) Difficulty in gaining property access, and 4.) no self monitoring report data was submitted.
1979 January	Cease and Desist Order No. 79-31 adopted.	Required IMMI to operate the existing copper precipitation plant.
1979 January	CVRWQCB performed 6 inspections between February 1979 and February 1980.	1.) IMMI found in violation of Cease and Desist Order, 2.) self monitoring reports were not submitted as scheduled, and 3.) difficulties in IMMI cooperation in gaining access to property for inspections.
1979 July	Order was adopted for referral to the Attorney General's Office.	Request for injunctive relief and cival monitary remidies.
1980	CVRWQCB contracted with D'Appolonia Consulting Engineers.	Proposed to develop and demonstrate cost-effective process for removal of zinc, cadmium, and other persistent metals from AMD.
1980 January	Memorandum of Understanding was signed by SWRCB, DFG, and U.S. Water and Power Resources.	Specifies agency roles for Spring Creek dam releases in conjunction with Sacramento River Flows at Keswick dam.
1980 July	CVRWQCB prepared RFP to contract study.	Contractor to study various methods of treating, minimizing, and eliminating discharges of AMD.
1980 July	Stipulated preliminary injunction was issued by Shasta County Superior Court.	
1980 August	CVRWQCB inspected IMM more than 11 times between August 1980 and June 1981.	Discharger was found to be in violation of the conditions of operation and maintenance of the copper cementation plants as stated in the Stipulated Injunction (July 1980)(Provisions 1(a,b) and 2(a,b).
1981 March	Discharger was found in contempt of court.	IMMI failed to comply with conditions stated in the injunction issued by Shasta County Superior Court.
1981 June	CVRWQCB inspection.	Boulder Creek plant copper removal efficiency averaged 85 %. Slickrock Creek plant operating at an unsatisfactory efficiency of 40 %.

Table C-6. CHRONOLOGY OF SIGNIFICANT EVENTS FOR IRON MOUNTAIN MINE.

YEAR MONTH	SIGNIFICANT EVENT	CONDITION OR RESULT
1981 July	CVRWQCB adopted Section 13305 abatement order under the provisions of Porter-Cologne.	Provided access for CVRWQCB personnel and required operation of copper removal plant at 95 % efficiency.
1981 November	Shasta County Superior Court adopted Section 13305 abatement order in favor of the CVRWQCB.	Allow access to CVRWQCB and required the operation of copper cementation plant at 95 % efficiency.
1981 December	CVRWQCB contracts with 2 consulting firms for further study of IMM.	Cooksley Geophysics Inc. was to evaluate Brick Flat Pit and install a flow device on Slickrock Creek. B. C. Research was contracted to assist in optimizing copper removal.
1981 December	CVRWQCB inspected IMM several times between November and December 1981.	Boulder and Slickrock creek copper removal plants operated at 99 and 65 % efficiency. Access to property was facilitated by obtaining a key and IMMI was more cooperative in maintenance and operation of plants.
1982	CVRWQCB contracted with Ott Water Engineers for special study.	Proposed to evaluate methods of controlling acid and heavy metals runoff from waste rock and tailing piles at the mine site--Recommendations were for a combination of surface diversions and impervious coverage to cap piles.
1982	Iron Mountain Mine added to hazardous waste site list scheduled for cleanup.	Controlled under the State and Federal Superfund program.
1982 February	CVRWQCB brought cival action against IMMI for past NPDES permit and Order No. 13305 violations.	Shasta Superior Court issued perminant injunction requiring IMMI to: 1.) comply with NPDES conditions, 2.) allow CVRWQCB to continue feasibility studies, and 3.) pay $16.8 million in violation penalties.
1982 February	IMMI requested the SWRCB to review the CVRWQCB's actions.	
1982 May	IMMI filed action in Superior Court to set aside default judgement.	
1982 May	SWRCB adopted an order upholding the CVRWQCB's 13305 order.	
1982 June	Motion to set aside default judgement denied.	
1982 December	Court Order against IMMI requiring reimbursement to State, $90,000.	Reimbursement for expenditures for operation of copper cementation plants during winter 1982.
1983	CVRWQCB contracted with CH2M Hill to evaluate feasibility of treating AMD.	
1983 April	IMMI reimburses State $90,000.	
1983 May	IMMI files apeal of default judgement with 3rd District Court of Appeals.	
1983 July	Agreement reached for stipulated settlement filed with the Court of Appeals.	Required IMMI to pay State $400,000 over a four year period.
1984 June	IMMI defaults on payment schedule stipulated in appeals Court Agreement.	U.S.EPA issues inforcement order against IMMI for violation of NPDES permit conditions.
1984 July	CVRWQCB votes to proceed against lein on IMMI property in the form of an execution sale.	
1984 August	Stipulated judgement amount paid by attorneys defending suit brought by IMMI.	Forced sale of property cancelled.
1985 August	Study by CH2M Hill completed (CH2M Hill, 1985).	Conculsions: 1.) lime neutralization was preferred method but cost-prohibitive, 2.) groundwater flow characterized, 3.) Sources of groundwater infiltration quantitated, and 4.) portals were ranked in order of relative contribution.
1985 December	CVRWQCB conducted study between December 1985 and April 1986 to evaluate wet period discharges.	Conclusions: 1.) relative contribution between portals was similar to 1984 study (CH2M Hill, 1985), 2.) total discharges during the wet season were much higher during 1985-86 (wet year) than during 1984-85 (dry year).
1986 May	Interim NPDES application for cementation plant operations.	
1986 December	CVRWQCB reported the results of an in-depth monitoring study on cementation plant efficiency.	Copper removal efficiency on Boulder and Slickrock creek cementation plants averaged 99 and 54 %, respectively. Retention times were 2 and 1-1 1/2 hours, respectively, for Boulder and Slickrock creek plants.

MAMMOTH MINE

Within the Mammoth mine complex, ore bodies have been mined, at one time or another, for zinc, gold, silver, lead, and mercury between 1900 and 1958 (USMG, 1975). Groundwater exposed to underground mineral deposits are the main source of acid mine drainage (96-99% of the copper and zinc discharges). High levels of copper, zinc, and cadmium have been detected in adit outflow from the underground mines as well as in rainfall runoff from unprocessed ore containing waste rock piles. Rainfall in the area averages around 50-80 inches annually. Mammoth mine complex was estimated to contribute 13 % of the total copper and 18 % of the total zinc discharged to the upper Sacramento River system (USGS, 1973). The mammoth mine was ranked third behind Iron Mountain and Balaklala mines for causing water quality problems in the Central Valley (Buer et al., 1978). The largest of the mine's discharges was the Mammoth main portal and at one time contributed 90 % of the metals discharged (at 80-250 GPM) to Little Backbone Creek (includes surrounding Golinsky and Sutro mine complexes). Another AMD source, the Friday Louden adit, discharged 60-200 GPM to Shoemaker gulch. Both Shoemaker gulch and Little Backbone Creek drain to Shasta Lake. Several other smaller mine adits, such as Sutro and Golinsky, exist in the same two watersheds but had not contributed as much AMD (CH2M Hill, 1985). Little Backbone Creek has been found to be devoid of aquatic life downstream of the mine (Fuller et al., 1978). Fish kills have been documented at the confluence of Little Backbone Creek and Shasta Lake. Presently, Mammoth and Friday Louden portals have been plugged, significantly reducing AMD to Little Backbone Creek and Shoemaker Gulch. However, an apparent hydraulic connection between the surrounding mines increased the flows out of the Gossen mine No. 2 portal. To reduce fish kills in Little Backbone Creek arm of Shasta Lake, the valve on the Friday Louden was opened in 1984 to allow outflow to Shoemaker Gulch.

Table C-7. CHRONOLOGY OF SIGNIFICANT EVENTS FOR MAMMOTH MINE.

YEAR	MONTH	SIGNIFICANT EVENT	CONDITION OR RESULT
1978	September	Waste Discharge Requirements issued to U. V. Industries (owner) for Mammoth Mine (Order No. 78-154).	Requirements: 1.) Eliminate or reduce AMD from adit and waste rock piles 2.) Submit progress report by June 1979 and feasibility study for copper removal, and 3.) Monthly monitoring.
1979	May	U. V. Industries requested extention of Order No. 78-154 requirements.	Additional time to prepare the feasibility study was the stated reason.
1979	September	CVRWQCB inspection for compliance.	1) Proposed flow measurement weirs in place and operating properly, 2.) Diversion ditch around waste rock pile in place to divert AMD, 3.) Gossen portal still discharging over waste rock pile.
1980	May	CVRWQCB aerial and ground surveillance of Mine downstream waters.	Fish kill (primarily rainbow trout) reported to DFG at the confluence of Little Backbone Creek and Shasta Lake.
1980	June	CVRWQCB observed fish kill at Little Backbone Creek arm of Shasta Lake.	Dead rainbow trout were observed.
1980	August	Transfer of ownership from U. V. Industries to Sharon Sharon Steel Corporation (SSC).	Transaction speculated to be an exercise as both companies have same address.
1980	November	CVRWQCB requested submission of feasibility study.	No effort had been made over the 2 years to reduce as per the Order. SSC had complied with the stipulated monitoring program.
1981	March	Revised Waste Discharge Requirements issued to Sharon Steel Corporation (Order No. 81-047): Order No. 78-154 rescinded.	Order No. 81-047 required short and long-term feasibility studies and a time schedule for AMD elimination or reduction.
1981	July	Sharon Steel Corp. submitted required feasibility report to comply with Order No. 81-047.	Proposed: 1.) Installation of concrete plugs in Mammoth and Friday Louden adits, 2.) Control runoff from waste rock piles. Propositions based on evaluation of hydrology/geology of the underground workings.
1981	August	CVRWQCB approved proposal to install cement plugs in mine adits.	CVRWQCB requested the gossen mine to be included. Work to be completed by end of 1981.
1981	October	CVRWQCB inspection of adit plug installation activity.	
1982	May	CVRWQCB conducted 4 inspections during May and June.	Fish kills of rainbow and brown trout were observed at Little Backbone Creek arm of Shasta Lake.
1983	August	Request For Proposal by CVRWQCB to conduct study under Section 205(j) CWA.	Study objective: develop feasible solutions to reduce AMD to restore Little Backbone Creek and a portion of Shasta Lake to a condition capable of supporting aquatic life.
1985	February	CDHS requires SSC to post warning signs at Mammoth Mine site.	
1985	August	Report funded by EPA 205(j) grant money completed (CH2M Hill, 1985).	Conclusions: 1.) plugging of Mammoth main and Friday Louden portals ineffective, 2.) plugging of other surrounding portals was recommended, 3.) owners have responsibility for implementing control program.

Table C-7. CHRONOLOGY OF SIGNIFICANT EVENTS FOR MAMMOTH MINE.

YEAR	MONTH	SIGNIFICANT EVENT	CONDITION OR RESULT
1986	May	Sharon Steel Corp. submits NPDES application.	
1986	May	CDFG reported fish kills in Little Backbone Creek arm of Shasta Lake several times in March, April, May, and June.	5-100 dead mature trout and sometimes trash fish were observed.
1986	May	CDFG repored fish kills in Shoemaker Gulch arm of Shasta Lake im March, April, and May.	2-10 dead trout and some bass typically observed.
1986	June	CVRWQCB adopted Cease and Desist Order No. 86-145 to Sharon Steel Corporation	Requirements: 1.) Discharger (SSC) must submit a feasibility report on possible pollution control strategies at Mammoth, Keystone, and Stowell mines by September 1986.
1986	June	CVRWQCB adopted Waste Discharge Requirements Order No. 86-144 to Sharon Steel Corp.	Order No. 81-047 recinded.

MANZANITA MINE

Within the Manzanita underground mine complex, ore bodies were initially worked for their gold content starting in 1863. After increasing amounts of cinnabar were discovered, mercury was the main commodity mined until 1943 when the mine was abandoned. Central, Wideawake, and Empire mines are also within the same area. Past inspections have documented no AMD from the main portal. The potential for downstream contamination exists as runoff from open cuts, shallow adits, and drifts. A secondary source of contamination exists from the leaching of ore bodies. Sulfer creek (ephemeral) flows next to the mine and combines with Bear Creek which discharges to Cache Creek, Cache Creek drains to the Yolo Causeway via the Toe Drain then to the North Delta at Cache Slough. Aquatic life in Sulfer Creek has been found to be abundant. Manzanita Mine was ranked 15 as a medium threat to water quality for the potential to discharge mercury laden sediment during storm events (Buer et al, 1978).

Table C-8. CHRONOLOGY OF SIGNIFICANT EVENTS FOR MANZANITA MINE.

YEAR	MONTH	SIGNIFICANT EVENT	CONDITION OR RESULT
1972		California Department of Mines and Geology referred to Manzanita Mine as a "potential mercury contamination problem".	
1978	May	CVRWQCB inspection.	Mercury was detected in tailings runoff. There was no outflow from adits at the site.
1980	August	CVRWQCB inspection.	Potential mercury contribution from rainfall runoff over tailings existed. Drainage was dry at time of inspection.

MT DIABLO MINE

Mt Diablo Mine began production of mercury in 1875 and the underground operation continued on and off until the last exploratory activity ceased in 1971. Discharges of AMD from the main mine shaft date back to 1938 when the tunnel was dewatered into the adjacent creekbed. Dunn Creek drains the mine complex as well as several acres of mountainous land west of the mine. Dunn Creek drains to Marsh Creek which empties into Marsh Creek Reservior. Marsh Creek continues from the dam where it drains to the San Joaquin River at Oakley. A sludge pond had been constructed during the period of mining activity to trap runoff from the mine during periods of rain and AMD from the main adit. The major source of pollution had been the periodic overflows of this pond due to siltation and structural failure of the containment pond. Furthermore, when Dunn Creek is flowing (Dunn Creek is an ephemeral creek that is fed, in part, by natural springs), it contacts exposed waste tailings. A small amount of AMD comes from the tunnel. High levels of mercury, arsenic, zinc, lead, and cadmium have been detected in runoff and sludge on Mt Diablo mine property. Complaints from downstream land owners have been frequent occurances. Pond overflow and rainfall runoff from the property have caused discoloration of the Marsh Creekbed and have at times rendered the creek unsuitable for agricultural or livestock use. Marsh Creek Reservoir has been closed to the public because of the high levels of mercury in fish. Mt Diablo Mine was ranked 9th as a high threat to water quality from abandoned mines in the Central Valley.

Table C-9. CHRONOLOGY OF SIGNIFICANT EVENTS FOR MT. DIABLO MINE.

YEAR MONTH	SIGNIFICANT EVENT	CONDITION OR RESULT
1950 March	CVRWQCB recieves complaint from landowner downstream of Mt Diablo Mine.	Pollutants had been allowed to flow down Marsh Creek from Mt. Diablo Mine. Landowner stated no fish exist in the creek.
1950 August	CDHS determined site is not "contaminated".	Based on periodic sampling form 1939-50. CVRWQCB refers problem to CDWR.
1951 December	CDWR submits report on Mt Diablo Mine.	Groundwater contamination partly due to mine wastes. No other definitive conclusions made.
1952 May	CVRWQCB adopts Resolution 135 for Mt Diablo Mine.	Water quality standards set for effluent and downstream water quality shall not be impacted by discharge.
1954 April	Mt Diablo Mine becomes active.	Owner expressed interest in cooperation with CVRWQCB when mining for merury.
1957 January	CVRWQCB inspection due to complaint.	Pond sludge/water had been released in the past due to failure of control structure that had corroded. No violation of Resolution Order at the time of inspection.
1957 February	Mt Diablo Quicksilver Company, LTD. (MDQC, owners) drained pond.	Pollution of downstream receiving waters reported by several landowners and sheriff.
1958	CVRWQCB inspections.	MDQC found to be in compliance at times of inspections.
1959	CVRWQCB inspections.	MDQC allowed to drain pond during high flows.
1961	Property ownership transferred from MDQC to Victoria Resources Company.	
1961	CVRWQCB inspections.	Discharges periodically occurred in the past.
1963	CVRWQCB inspections.	Mine drainage control structures damaged by heavy rainfalls discharges of pond water occurred.
1965 November	CVRWQCB inspection with owner.	The startup of mining operations were discussed.
1969 February	CVRWQCB inspection	Mine in compliance. Pond full of silt.
1970 September	CVRWQCB inspection.	Mercury mine was in operation. Iron precipitates present in Dunn Creek. Report of wastes anticipated to be discharged were recommend.
1970 October	Guadalupe Mining Company submits Waste Discharge Requirements application.	
1975 January	CVRWQCB inspection.	Mine activity and pond discharges decreased water quality of Dunn Creek. Dunn Creek was observed to be devoid of aquatic and vegitative life below mine.
1975 October	CVRWQCB requests time schedule for waste containment from new owners (Wessman).	
1976	Sale of parcel of land from Wessman to Meyer.	Containment pond lies on parcel of land sold to Meyer but was operated by Wessman.

Table C-9. CHRONOLOGY OF SIGNIFICANT EVENTS FOR MT. DIABLO MINE.

YEAR MONTH	SIGNIFICANT EVENT	CONDITION OR RESULT
1978 September	Wessman (owner) submits objections to Order No. 78-114 requirements.	Discharger contended natural springs contribute to pollution of Dunn Creek and he is not responsible for these.
1978 March	CVRWQCB adopted Waste Discharge Requirements Order No. 78-114 for Mt Diablo Mine to Wessman.	Conditions: 1.) Discharger shall not cause degradation of downstream waters, and 2.) time schedule to be submitted for construction of containment pond for onsite seepage, AMD, and tailings runoff.
1978 October	Wessman submits containment construction proposal.	
1978 November	CVRWQCB adopts Cleanup and Abatement Order.	Discharger required to perform ditching and complete containment work to prevent downstream releases of mine pollutants.
1978 December	CVRWQCB inspection.	Most construction work completed but did not completely satisfy Order No. 78-114 requirements.
1979 March	CVRWQCB conducts meeting with owner and other interested agencies.	Compromises were made with respect to Order No. 78-114. Wessman submitted proposal for work the same month.
1979 April	CVRWQCB requests Department of Parks and Recreation to cleanup tailings.	Mt Diablo mine tailings within park property were to be contained and prevented from contacting surface water.
1979 August	CVRWQCB inspection.	Work on containment construction by Wessman had stopped. Engineering plans had not been submitted as requested.
1979 October	CVRWQCB inspections in October, November, and December.	Discharger found in violation of Order No. 78-114 during all inspections.
1980 January	CVRWQCB requests work to be completed by owner.	
1980 September	CDFG reports fish in Marsh Creek Reservoir contaminated with mercury.	Monitoring conducted under TSMP supervision found 5 of 7 fish analyzed contained mercury levels in flesh above FDA recommended guidelines. Reservoir was closed to the public as a result of the contamination.
1981 June	CVRWQCB requests monitoring data from owner as required in Order No. 78-114.	
1982	CVRWQCB inspection.	Construction and maintenance of containment pond found to be in compliance of Order No. 78-114. No monitoring reports had been submitted.
1984 January	CVRWQCB inspection with CDFG, Parks personnel (partial owner), and Wessman (partial owner).	Wessman had not submitted monitoring results as required. Mercury, lead, zinc levels high in water and sediment sampled. Discharges causing discoloration of downstream waters. Possible coordination between Parks and Wessman to build second pond.
1984 December	CVRWQCB inspection.	Sludge samples collected from the pond contained hazardous levels of mercury, nickel, and cadmium.
1985 January	CVRWQCB requested State Department of Parks and Recreation to construct retention pond under Subchapter 15 requirements.	Clay liner required in pond to be constructed by registered engineers to specifications stated in Subchapter 15 of the California Administrative Code.
1985 March	CVRWQCB requests Wessman to submit techincal report for monitoring requirements as per Subchapter 15.	
1986 February	CVRWQCB informs Wessman he may be subject to TPCA requirements.	Wessman was requested to submit application.
1987 January	CVRWQCB notifies Wessman is required to pay fees and penalties under TPCA program.	Wessman did not comply with submission deadlines.
1987 February	CVRWQCB requests TPCA application from Meyer (present owner).	

NEW IDRIA MINE

The New Indria Mine was mined for gold beginning in 1853 and soon after cinnabar was discovered, mercury was the major commodity mined up to 1971. The mine was the largest single producer of mercury in the U.S. after 1941. The main portal is the primary source of AMD which flows through 2 holding ponds and a ditch before reaching San Carlos Creek which has a summer flow measured at ca. 2 CFS. San Carlos Creek flows to Silver Creek then to Panoche Creek to Fresno Slough which drains to the San Joaquin River west of Mendota. Portal drainage has been found to contain high levels of arsenic, copper, and mercury. Pollutants are also contributed from rainfall runoff and natural drainage over tailings piles surrounding the mine. The annual precipitation for the area averages around 15 inches. The mine has been ranked 13 as a medium water threat to Central Valley water quality (Buer et al., 1979). The quality of water in San Carlos Creek which passes through a private ranch downstream was determined to be unsatisfactory for domestic animal use and marginal for irrigation. Aquatic fauna in San Carlos and Sulfer Creeks below the mine was found to be non-existant. A downstream rancher has been activily involved in writing letters to both U.S.EPA and the CVRWQCB in an attempt to aleviate a problem that has been detrimental to his ranching operation for over 20 years.

Table C-10. CHRONOLOGY OF SIGNIFICANT EVENTS FOR NEW IDRIA MINE.

YEAR	MONTH	SIGNIFICANT EVENT	CONDITION OR RESULT
1959	April	CVRWQCB inspection.	Aquatic fauna non-existant in San Carlos Creek below mine, high levels of chromium found in the water.
1969	December	CVRWQCB requests New Idria Mining and Chemical Co.(NIMCC, owner) to submit a Report of Waste Discharge.	
1970	June	CVRWQCB adopts Waste Discharge Requirements for New Idria Mining and Chemical Company (Resolution No. 70-205).	Conditions: 1.) discharge shall not cause a nuisance, 2.) monitoring reports to be submitted on schedule.
1975	August	NIMCC constructed earthen dam to control mine releases.	Dam immediately filled and began releasing over the top.
1975	April	CVRWQCB investigation of a complaint from the rancher 1 1/2 miles downstream from New Idria Mine.	1.) NIMCC found to be in violation of Resolution No. 70-205, 2.) runoff from mine discoloring San Carlos Creek, and 3.) water concentrations of several metals were above recommended levels for livestock use as reported by U.S.EPA.
1976	May	New Idria Mine sold by NIMCC to Energies Corporation (EC).	
1976	October	CVRWQCB inspection with U.S.EPA.	1.) earthen dam discharging AMD through pipe, 2.) mine discharges found to be in violation of Resolution No. 70-205.
1976	November	U.S.EPA submits report of inspection to EC.	Documents detrimental effect of NIM on San Carlos Creek.
1976	December	U.S.EPA finds EC in violation of the Federal Water Pollution Control Act (1972 Amendment) at the New Idria Mine site.	Order requires EC to either terminate all discharges of pollutants to San Carlos Creek or apply for an NPDES permit for such discharges pursuant to Section 402 of the Act.
1977	January	EC submitted NPDES permit application for New Idria Mine discharges.	
1977	January	CVRWQCB inspection with mine operators and downstream land owner.	Discussed increasing the dam capacity and periodically releasing the polluted water.
1977	March	CVRWQCB transmits water quality effluent limitations based on the application of best practicable control technology currently available.	Mercury and nickel included.
1977	June	EC submits consultant report on ways to reduce discharges.	Proposed enlarging dam capacity and releasing water to balance inflow and evaporation.
1980	August	CVRWQCB requests NPDES application from EMC Energies, Inc. for proposed discharge of wastewater from mine tailings processing.	EMC Energies, Inc., submitted proposed restart of mining operations at New Idria Mine which includes extraction of gold and silver from tailings.
1980	December	NIM reported to be pumping and treating water from shaft to surface water.	Sheriff was told the mine had proper permits.
1982	September	Owner filed application for WDR permit	
1983	March	San Benito County Planning Commission issues EIR and Natural Resourses studies to New Idria Land and Development Co.	Permit to operate temporarily for 90 days.
1985	January	Fresno Bee article titled "Defunct New Idria mercury mine makes Nader hazardous list".	

NEWTON MINE

Newton Mine was worked underground for it's copper containing ore from 1863 to 1901 and then again during 1943-1947 and 1965-67. The primary source of pollution is copper which mostly originates from stream flow and surface runoff through portions of waste rock and tailings at the mine. A secondary source of pollution is ground water seepage and adit discharges. Total flows offsite have been estimated at 1/4 to over 2 GPM. Copper Creek flows through the area to Sutter Creek which goes for 2 miles to Dry Creek and then to the Mokelumne River. Copper is high in the discharges although arsenic and mercury were the only other pollutants analyzed. Aquatic life in Copper Creek is not present from below the mine to it's confluence with Sutter Creek. Newton Mine was ranked 11 as a medium threat to water quality in the Central Valley.

Table C-11. CHRONOLOGY OF SIGNIFICANT EVENTS FOR NEWTON MINE.

YEAR	MONTH	SIGNIFICANT EVENT	CONDITION OR RESULT
1965	March	Correspondence from Utah Construction and Mining Co. (UCMC) to CVRWQCB stating their intended mining operations.	UCMC intended to leach copper from existing underground workings with dilute sulfuric acid. Stated no discharges should take place.
1965	April	CVRWQCB inspection.	Flow noted at 0.5 CFS draining from mine area to natural water courses. Mine was not operating.
1965	June	CVRWQCB adopted tentative Waste Discharge Requirements Resolution No. 65-63.	Governed the nature of the intended waste disposal from Newton Mine.
1966	March	CVRWQCB inspection.	Evidence of AMD discharges to Mountain Springs Creek. Discolored seepage discharging to Mountain Springs Creek.
1967	March	CVRWQCB inspection.	Discharge was found to meet the Board's requirements.
1967	May	UCMC sold Newton Mine to Mr. David L. Hermiston.	
1967	June	CVRWQCB adopts tentative Waste Discharge Requirements Resolution No 67-167.	Requires UCMC to limit discharges so that downstream receiving waters and groundwater are not endangered.
1967	June	CVRWQCB adopts Waste Discharge Requirements Resolution No. 67-167 to Newton Mine owner, Hermiston.	Similar to Resolution 65-63.
1967	October	Hermiston found to be in violation of Order No. 67-167.	
1968	May	CVRWQCB inspection.	Mine drainage continued to add yellow iron sediment to Mountain Springs streambed. No mining activity. Discharge met Board's requirements.
1970	October	CVRWQCB inspection.	Flow from mine estimated at 1 GPM, seepage estimated at 1 GPM. Discharge violated Board's requirements for pH exceedance and unsightliness. Hermiston (owner) was informed.
1971	April	CVRWQCB inspection.	Flow from the mine estimated at 0.25 GPM. Discharger found to be in violation of Board's order. Actual ownership of parcel was discovered and new discharge requirements were sent to Nellie Mondani (owner).
1979	March	CVRWQCB inspection during March and April.	Copper found in high concentrations in water downstream mine.
1980	February	CVRWQCB inspection.	Flow from mine estimated at 0.75 CFS, copper concentration high.

PENN MINE

Penn Mine began underground operations during 1861 and had been extensively mined for it's copper and zinc containing ores until 1958. Several recovery operations were attempted in the 1960s and 1970s to extract copper from mine site waters. During the years of active extraction operations, mine wastes were accumulated in settling ponds and waste solids were stacked at numerous locations on the mine property. The primary source of pollution from Penn Mine came from rainfall runoff and direct contact with creek waters that flowed across the mining wastes to the Mokelumne River below Pardee dam. The influx of zinc and copper contaminated runoff and sediment from Penn Mine waste piles, have been responsible for toxic conditions in the downstream receiving waters. Two portals discharged some AMD on a seasonal basis, however, the inflow was determined insignificant in comparison to the indirect discharges. Hickley, Mine Run, and Oregon creeks all pass through the mine's property over tailings. Mine Run Creek is very short, forming on the mine property and coursing through 2 large tailings ponds before draining to the Comanche Lake. Hinkley Creek drains to Mine Run Creek before entering the Comanche Lake. Oregon Creek also drains to the Lake. Penn Mine runoff waters have been found to contain high levels of copper, zinc, arsenic, and lead and was, in part, responsible for the decline of a historically strong salmon run on the Mokelumne River. Fish kills in the Mokelumne River have been observed as far back as the 1930s. After the completion of Comanche Reservoir Dam, fish kills at the Mokelumne River Fish Installation, below the dam, continued. Contaminated sediment discharged from the mine property during the rainy seasons, moved through the reservior and were released from the dam. Penn Mine is located in the upper arm of Lake Comanche, approximately 10 miles from the dam structure. Penn Mine was ranked 3 (behind Iron Mountain and Mammoth mines) as a high threat to water quality from abandoned mines in the Central Valley.

Table C-12. CHRONOLOGY OF SIGNIFICANT EVENTS FOR PENN MINE.

YEAR MONTH	SIGNIFICANT EVENT	CONDITION OR RESULT
1952 December	CDFG correspondance to CVRWQCB.	Levels of copper and lead in fish tissue collected from Mokelumne River downstream from Penn Mine were at or near toxic levels.
1955	CVRWQCB inspection in 1955, 1956, and 1957.	Samples showed high metal levels at mine.
1955 March	CDFG states Penn Mine responsible for decline of salmon run on Mokelumne River.	Numbers had declined from 40,000 to a few hundred.
1957 April	CVRWQCB requests Water Pollution Control form from Penn Mine owner.	Owner proposed to dewater mine adits over copper cementation ponds. Owner submitted Discharge Requirements application May 1957.
1958 January	CVRWQCB adopts Waste Discharge Requirements Resolution NO. 58-2.	1.) water quality limits set, 2.) discharge shall not affect aquatic biota, and 3.) submit periodic monitoring data.
1958 January	CDFG reports fish kill at Mokelumne River Fish Installation (downstream Penn Mine).	
1958 August	CVRWQCB inspections in August and December.	The holding and cementation ponds were observed to be a potential hazard to overflow during rains.
1959 January	Inspection by Calaveras County, CDFG, CDWR, and owner.	Primary source of contamination observed to be from 2 mill tailings ponds which contained waste from copper and zinc ore milling and were an acre in size.
1959 April	CRWQCB inspections in April, July, and October.	New copper extraction plant in operation but ponds still posed a potential hazard of overflowing. Operations suspended in July 1959.
1959 October	Transfer of ownership.	New Penn Mine, Inc. (NPMI) purchased the mine.
1959 December	CVRWQCB inspection.	Inspections occurred in December 1959 through March 1960 to document and sample pollution source.
1960 July	CVRWQCB filed complaint with Superior Court of Calaveras County.	Requested order to restrain owner from discharging. Order request denied because no violation was apparent and it was stated that action was the responsibility of the State Board.
1961 June	CDFG submits report to CVRWQCB on Penn Mine discharge toxicity.	Penn Mine had damaged Mokelumne River fishery (salmon and steelhead). Recommended CVRWQCB take action.
1961 July	CVRWQCB directs problem to District Attorney for action under Section 13380, Water Code.	
1961 November	District Attorney filed action against NPMI.	Suit was dorment due to Attorney's work load or priorities.
1963 July	District Attorney judged in favor of NPMI.	
1963 October	CVRWQB adopts Waste Discharge Requirements Resolution No 63-218 to NPMI.	Water quality limits set for the surrounding creeks.
1963 November	CVRWQCB inspections in November 1963, and in January and March 1964.	Discharger found in violation of Resolution 63-218. NPMI replied it had no intention complying with Resolution.

Table C-12. CHRONOLOGY OF SIGNIFICANT EVENTS FOR PENN MINE.

YEAR	MONTH	SIGNIFICANT EVENT	CONDITION OR RESULT
1964		Comanche Reservior dam completed.	
1964	April	CVRWQCB adopts Cease and Desist Resolution No. 63-31.	Required NPMI to comply with Resolution No. 63-218.
1964	November	East Bay Municipal Utilities District (EBMUD) aquires certain portions of Penn Mines' land.	
1965	January	CVRWQCB refers case to Attorney General.	Attorney General files action under Section 13063, Water Code, in March 1965. Case dismissed in 1971 as 5 year statue of no action ran out.
1967		CDFG documents fish kill at Mokelumne River Fish Installation.	High copper levels were determined to be the cause.
1969	November	CVRWQCB inspections.	In-situ bioassays performed with trout were acutely toxic in the Mokelumne River downstream of Penn Mine.
1971	September	CVRWQCB adopts Waste Discharge Requirements Order No. 72-57 and Monitoring and Reporting Program Order No. 72-90.	1.) water quality limits set for Hinkley and Mine Run creeks, 2.) discharge shall not be detrimental to fisheries in these creeks, and 3.) monitoring reports to be submitted.
1972	July	CVRWQCB revised Order No. 72-57 as instructed by SWRCB.	NPMI petitioned SWRCB for more time to submit reports and comply with order. SWRCB adopts Order No. 72-15 to change Order No. 72-57.
1972	November	CVRWQCB inspection with CDFG.	Discharge in violation of Order No. 72-57.
1972	December	CVRWQCB adopts Cease and Desist Order No. 73-128.	Owner required to submit proposal for abating pollution. Time schedule for implementation required as well as periodic monitoring reports. Owner appeals order to SWRCB.
1973		CDFG documents fish kill at Mokelumne River Fish Installation.	High levels of zinc was the cause.
1973	January	Lower dam on Hinkley Creek washed out releasing AMD contents.	Two tailings ponds in Mine Creek watershed also overflowed.
1973	January	CDFG documents fish kill at Comanche Dam Fish Hatchery in January and February.	
1973	March	SWRCB upholds CVRWQCB Order No. 72-57.	SWRCB rejects owners petition based upon past documented information.
1973	November	CVRWQCB inspections in November 1973 and in January and March 1974.	Discharger in violation of Order No. 72-57.
1976	March	CVRWQCB contracts with CDFG to conducts bioassays.	
1976	July	CVRWQCB requests assistance from Attorney General to prosecute under Section 13304, Water Code.	
1976	July	CDFG submits bioassay results to CVRWQCB of Penn Mine Pollution.	Water from Penn Mine acutely toxic to fish.
1977	August	CDFG completes study of Penn Mine discharge toxicity (Rectonwald, et al., 1977).	Source of pollution and metals transported from Penn Mine move through Comanche Lake in the sediment.
1977	September	EBMUD released water from Pardee Reservior which allegedly caused fish kill downstream.	Fish kill occurred at Mokelumne River Fish Installation: 22,000 king salmon killed due to metals.
1977	October	CVRWQCB adopts Cleanup and Abatement Order to NPMI.	Requested technical report from owner to complete abatement work promptly or State will perform work and recover costs at expense of owner.
1977	November	CDFG, CCC, and Caltrans crews begin ditching and dam construction.	Money from CVRWQCB, EBMUD, EPA, and Cleanup and Abatement funds were used to fund proposed abatement actions at Penn Mine site.
1977	November	Plans formulated to remove top 1 foot of sediment from Oregon Bar.	Emergency action as required to comply with Cease and Desist order.
1977	December	CVRWQCB adopts Cease and Desist Order to EBMUD.	Required EBMUD to prevent toxic sediments on Oregon Bar (EBMUD propery) from pollution downstream waters.
1978		Abatement work at Penn Mine completed.	1.) diversion of creeks around tailings, 2.) contaminated sediment removed from Oregon Bar, and 3.) several evaporation ponds constructed.
1978	January	CDFG documents fish kill at Fish Installation.	100,000 fry killed by high copper and zinc levels.
1978	April	CVRWQCB inspection	Large diversion channel on Hinckley Creek completed as are several lesser diversions and detention ponds.
1978	April	CVRWQCB adopts Resolution No. 78-55.	Requests EBMUD to abate condition of pollution from Penn Mine.
1978	December	USDA submits report on possible revegitation of mine tailings.	Tegmar, berber orchardgrass, 'zorro', nitgrass, and rattlesnake/quaking grass seeds were ordered and planted on the mines tailings.
1979	March	CVRWQCB, CDFG, and EBMUD enter into agreement of cleanup.	Abatement measures taken to date were temporary and further work was necessary to fully terminate the pollution problem.
1979	November	EBMUD completed much of the mine abatement measures.	Accumulated toxic mud from Oregon Bar had been removed. Mine Run dam completed. CVRWQCB Cease and Desist Order recinded.
1980	May	CVRWQCB requests Attorney General to assist in recovering costs incurred by placing lien on Penn Mine property ownership.	Costs incurred included cival and contractural expenditures accrued from cleanup and abatement measures. Total costs came to about $500,000.
1980	June	CVRWQCB serves lien against NPMI for recovery of costs for mine tailings abatement actions.	Lien to pay cival costs and EBMUD expenditures for removal of silt from Oregon Bar and contruction of impoundment structures to control runoff.
1980	June	Notice of lein submitted to owners (NPMI and Fleming).	
1981	September	CVRWQCB contracts to pipe clean water around holding ponds.	Cement pipes required to prevent evaporation ponds from overflowing from rainwater flows from watershed above ponds. Work completed in March 1982.
1984	April	CVRWQCB inspection.	Pond sludge and water leaving pond contained high levels of lead.
1985	December	CVRWQCB requested TPCA application exemption for EBMUD.	
1986	January	CVRWQCB requests Cleanup and Abatement funds for operational costs incurred through December 1986.	Maintenance costs include operation of pumps to transfer mine runoff water back into evaporation ponds.
1986	January	Controlled release of water from detention ponds occurred.	Discharge in violation of Order No. 72-58.
1986	February	CVRWQCB requests EBMUD to file TPCA application for Mine Creek Dam.	The pond met the conditions of an impoundment containing hazardous materials.
1986	October	Attorney General filed complaint against suspected owners (Fleming, NPMI, and Curtis).	Prior requests for a voluntary submittal of their assets were unsuccessful.
1986	November	Owners countersue CVRWQCB for $100 million.	Claims: 1.) taking of 1953 riparian rights, 2.) ex post facto application of law, and 3.) destruction of property during abatement contsruction. Suit dismissed December, 1986.

SILVER KING MINES INC. (BALAKLALA, KEYSTONE, AND SHASTA KING MINES)

Within the Silver King Mine, Inc., complex (which includes the Balaklala, Keystone and Shasta King Mines), ore bodies have been mined at one time or another for copper, zinc, gold, and silver from before 1890 to 1928 (CDMG, 1974). Groundwater exposed to underground mineral deposits which drain primarily from the Balaklala and Keystone mines was determined to be the main source of AMD. High levels of copper, zinc, and cadmium were detected in adit seepage as well as in surface runoff flowing across tailings. Rainfall in the area averages around 80 inches annually. All three mines together were estimated to contribute 22-23% of the total copper and zinc loads to the Sacramento River system from active and inactive mines in the Redding-Shasta area (Fuller, 1977). Prior to the installation of control structures, the Balaklala mine was the major discharger of all mines in the watershed. Background flows of 144 GPM had been measured and most of that was discharged from the Weil portal (2 other portals exist, Kinkel et al., 1956). The Weil portal also had the highest metal levels and was implicated as contributing 50-70 % of the copper and zinc from the area's mines (CDWR, 1969). Balaklala AMD flowed over waste rock dumps and eventually to West Squaw Creek. West Squaw Creek drains to Shasta Lake. An hydraulic seal has been installed in the Weil Portal of Balaklala Mine. Keystone mine is made up of 3 tunnels (Kinkel et al., 1956), although a single main portal contributed to most of the AMD (ca 36 GPM). The Shasta King Mine discharged AMD (ca 0.1 CFS) over and through waste rock dumps which extend into West Squaw Creek. Tailings from 8 other tunnels extend from their portals to the creek bottom where water flowed through the pyritic debris (Fuller et al., 1978). Total elimination of aquatic life downstream of the mines has been observed in West Squaw Creek (Nordstrom, et al., 1978). Frequent fish kills in the West Squaw Creek arm of Shasta Lake have been documented (CDWR, 1969; Fuller et al., 1978). The Balaklala and Keystone mines, combined, were ranked second to Iron Mountain Mine for mines causing the most severe water quality problems in the Central Valley (Buer et al., 1978).

Table C-13. CHRONOLOGY OF SIGNIFICANT EVENTS FOR SQUAW CREEK MINES (BALAKLALA, KEYSTONE, SHASTA KING).

YEAR	MONTH	SIGNIFICANT EVENT	CONDITION OR RESULT
1969	November	CDWR completed study on Squaw Creek water quality and biology (CDWR, 1969)	Investigated problems and ways to ameliorate AMD on Squaw Creek. Recommended the CVRWQCB work with the present mine owners to control AMD.
1974	July	CDFG reports major fish kill.	More than 4000 trout were observed dead in the Squaw Creek arm of Shasta Lake. Water Quality Samples were taken.
1975	August	CDFG reports fish kill.	Fish kill noted and water quality samples were taken at Little Squaw Creek bridge crossing.
1978	January	CVRWQCB requested SKMI (Shasta King Mine, Inc.[owner]) to submit a report of waste discharge.	SKMI did not respond at first, however, after further correspondence stated that the requested information was being collected.
1978	September	Waste Discharge Requirement Order No. 78-153 adopted.	Conditions: 1.) reduce or eliminate AMD from adits and surface runoff, 2.) prepare feasibility report to reduce copper discharged by the main portal by 95 %, and 3.) submit monitoring results.
1978	December	CVRWQCB inspection.	The Weil portal was estimated to contribute 70 % of the metals discharged to Squaw Creek from all portals.
1979	July	CVRWQCB inspection.	SKMI was found to be in violation of Order No. 78-153.
1979	August	SKMI completed diversion ditch around Keystone Mine dumps.	Ditch had been previously constructed but was in need of repair. Ditch was lined with bentonite in an attemp to reduce flows from the Weil portal.
1980	May	CVRWQCB inspection and report of fish kill.	Two fish kills in May were observed in the Squaw Creek arm of Shasta Lake. Most of the dead and dying fish were mature rainbow trout.
1980	June	SKMI completed diversion of water around Glory Hole at Balaklala Mine.	Water was diverted away from Balaklala workings and dumps and returned to the drainage below the dumps.
1980	August	Report from SKMI was submitted to the CVRWQCB.	Report detailed progress on their water pollution control project. Another report was sent to the CVRWQCB in November, 1980.
1980	November	Air seal installed in the Weil portal.	Installed to comply with Order No. 78-153 which requires a 95 % reduction in the copper concentration of AMD from the Weil portal.
1981	May	CVRWQCB inspection.	The air seal constructed on the Weil portal was found to be ineffectve in reducing metal concentrations.

Table C-13. CHRONOLOGY OF SIGNIFICANT EVENTS FOR
SQUAW CREEK MINES (BALAKLALA, KEYSTONE, SHASTA KING).

YEAR MONTH	SIGNIFICANT EVENT	CONDITION OR RESULT
1981 July	CVRWQCB compliance inspection.	All diversion works repaired and working.
1981 September	CVRWQCB inspection finds SKMI in violation of Order NO. 78-153.	The air seal installed on Weil portal ineffective in causing a 95 % reduction in the concentration of copper in the effluent. CVRWQCB requested the air seal be converted to a complete seal in an attempt to completely eliminate discharges.
1982 March	CVRWQCB attempted to contract with Advanced Environmental Consultants Inc.	Evaluate and develop solutions to AMD from Balaklala, Keystone, and Shasta King Mines complex.
1982 February	CVRWQCB inspection of Keystone and Balaklala mines.	1.) diversions at Balaklala in place, 2.) Weil portal modifications in place (plug thickness increased from 18" to 36").
1982 March	CVRWQCB inspection.	Flow out of Weil portal terminated with a substantial reduction in Squaw Creek metals levels.
1982 September	CVRWQCB inspection of portal plug effectiveness.	Concentration of metals below levels of past years at Balaklala portals. Dead trout observed at confluence of West Squaw Creek and Lake Shasta.
1983 May	CVRWQCB inspected West Squaw Creek several times in May and June.	Dead fish observed at the confluence of West Squaw Creek and Shasta Lake, the number of dead declining towards the end of June.
1983 October	CVRWQCB approved Resolution No. 83-136.	Approved 208 funded reports on sources and control of AMD from Shasta County mines discharging to West Squaw Creek.
1984 January	CVRWQCB inspection.	Balaklala and Keystone mines contribute 77 % of total metals loading to West Squaw Creek while Shasta King portals contribute 9%.
1984 April	CVRWQCB inspection.	Balaklala portal flow estimated 200 GPM, Keystone flow estimated 30 GPM.
1985 January	CDHS issues order to SKMI to post hazardous warning sign at Balaklala mine.	
1985 April	CVRWQCB inspections in April and August.	
1985 May	CVRWQCB reissued Waste Discharge Requirements Order No. 85-136 (Order No. 78-153 recinded).	Conditions: 1.) maintain and improve Wiel portal seals as well as install seals in remaining portals or treat effluent to reduce metals, 2.) submit schedule of action, and 3.) submit scheduled monitoring results.
1986 January	CVRWQCB inspection.	Balaklala seal ineffective. SKMI is not in compliance with NPDES Order No. 86-144.
1986 March	CVRWQCB inspection.	Balaklala seal is in place but flow continues (400 GPM), AMD was overflowing from pond just below Keystone mine portal (200 GPM).
1986 June	CVRWQCB inspection.	Balaklala mine seal continues to leak (50GPM), repairs in progress.
1986 June	CVRWQCB issues notice of public hearing to consider issuance of Ceas and Desist Order to SKMI.	
1986 June	CVRWQCB adopted NPDES Waste Discharge Requirements to Sharon Steel Corporation (SSC).	SSC (owner of Keystone mine) was issued NPDES No. CA0081876 (Order No. 86-144, previously governed by Order No. 81-047. 1.) restricted discharge of metals, 2.) recinded Order No. 81-047, 3.) develop and implement program for furthur loading reductions.
1986 June	CVRWQCB adopts WDR Order No.86-144 for Keystone Mine(also Mammoth /Stovell Mines)to Sharon Steel Co.	Conditions: 1)water quality limits set, 2)develop and implement pollutant mitigation measures, 3)required to submit monitoring results from standard provisions (NPDES).

SULFER BANK MINE

Sulfer Bank Mine (SBM) is an open pit excavation covering approximately 2 acres directly adjacent to Clear Lake that was active during 1865-1947 and 1955-57. Borax crystals and sulfer were the principal compounds mined during the early years until cinnabar was uncovered and was mined for it's mercury until 1947. Underground seepage and surface runoff filled the 100-200 foot deep Herman pit soon after and had to be dewatered prior to the activation of the mine during the mid-fifties. The pit water was apparently drained directly to the Oaks Arm of Clear Lake; Clear Lake drains via Cache Creek to the Toe Drain which enters Cache Slough in the North Delta. The mine is believed to have contributed substantial loads of mercury and possibly arsenic to Clear Lake from pit dewatering and runoff leaching of tailings and exposed mine waste gravel. The mine was ranked 10 as a water quality threat compared to other mines in the Central Valley. Herman pit is situated approximately 100 feet from the Lake and is also adjacent to the Elam Indian Colony. The pH of the water in the pit was measured at <3.0. Mercury and arsenic have been measured in high concentrations in the water, surrounding mine tailings, and in Clear Lake sediment and fish. Waste gravel and dirt excavated from Herman pit surrounds the mine and constitutes part of the Eastern shoreline at the lower southeast end of Clear Lake around Oaks Arm. The California Department of Health Services (CDHS) issued an Health Advisory for Clear Lake warning people not to eat the fish because of mercury contamination.

Table C-14. CHRONOLOGY OF SIGNIFICANT EVENTS FOR SULFER BANK MINE.

YEAR	MONTH	SIGNIFICANT EVENT	CONDITION OR RESULT
1952	July	CVRWQCB adopted Resolution 153 with CDWR, CDPH and CDFG.	Outlined permissible limits of various substances discharged to Clear Lake.
1966	March	CDWR completed Clear Lake water Quality investigation (CDWR, 1966)	
1970		Interagency Committee on the Environment reported finding mercury in fish from Clear Lake.	Mercury was found in flesh tissue excised from largemouth bass and white catfish.
1973		USGS reported mercury in core samples from Clear Lake.	Mercury was found in sediment from before 1800's and highest levels found in Oaks Arm of Clear Lake only in the past century.
1976		CDFG analyzed Clear Lake fish for pollutants.	Fish (n=62) from Oaks Arm had highest levels mercury compared to other arms sampled. Highest levels were found in preditor fish (largemouth bass).
1976		Mature largemouth bass sampled from bass derby.	From 25 mature (>13 inches) fish, 20 % exceeded the FDA maximum level in fish for safe consumption. No correlation in size and residue levels.
1976		Food and Drug Administration analyzed fish from Clear Lake for pollutants.	High levels of mercury and low levels of chlorinated hydrocarbons were found in 12 commercial species.
1977	March	CDFG memo.	Reported levels of mercury in 25 largemouth bass collected from several Clear Lake locations.
1978		USGS completed study of mercury in Clear Lake bottom sediment (USGS, 1978).	Attempted to determine the time of emplacement of the mercury ore body from sediment samples.
1979		CVRWQCB requested SBMC to build pit release control dam.	Dam would reduce mine drainage to Clear Lake.
1979	November		
1979	November	CVRWQCB inspection.	Earthen and rock dam completed by owners on west end of Herman pit as requested.
1980	March	CVRWQCB inspection during rainstorm.	Dam at west end of pit had effectively impeded surface flow to Clear Lake. Precipitation was observed to wash waste tailings to lake.
1980	June	CVRWQCB inspection.	Dam to prevent spillage to Clear Lake was structurally intact.
1980	June	SBMC reports construction finished on second clay lined dam.	Dam constructed between old dam and Clear Lake. Ditches south of pit have been repaired so surface runoff from hills and ravines will be diverted around the pit to Clear Lake.
1981		CDFG analyzed fish from Clear Lake during TSMP special study.	Notablyu higher levels of mercury were found in fish collected around Rattlesnake Island (upper arm) then from fish from Garner Island (lower arm) and Rodman Slough arm (west).
1982		CDFG again collected fish from Clear Lake for special TSMP study.	
1982		CDHS studied mercury in drinking water data.	Stated no cause for concern of public drinking water.
1982	October	CVRWQCB inspection.	Dam on west end of Herman pit was intact and no surface discharge to Clear Lake was observed.

Table C-14. CHRONOLOGY OF SIGNIFICANT EVENTS FOR SULFER BANK MINE.

YEAR MONTH	SIGNIFICANT EVENT	CONDITION OR RESULT
1982 December	CVRWQCB proposed to study mercury contamination in Clear Lake.	Proposed: 1.) further define mercury sources, 2.) evaluate impacts and distribution of mercury in Clear Lake, and 3.) develop and implement corrective action for reducing impacts.
1983 February	Elem Tribal Colony requested EPA to investigate SBM as a health threat exposure and fish consumption	U.S.EPA recommended CVRWQCB/DHS apply Hazard Ranking System to score site for inclusion on the National Priorities List.
1983 February	CVRWQCB inspection in response to public complaints.	Indian colony next to SBM claim that their health is threatened from mercury in mine tailings. Drainage with high mercury and arsenic entering the lake was observed.
1983 April	CVRWQCB Board meeting in Lakeport, CA.	Residents of Elem Indian Colony expressed the potential health threat of mercury in Clear Lake and adjacent SBM. CVRWQCB agreed to prepare requested staff report.
1983 May	CVRWQCB staff report completed.	Conclusions: 1.) mercury entering via SBM, 2.) fish in Clear Lake in immediate vicinity of SBM contain high levels of mercury, and 3.) Proposed the need for further study.
1983 June	Correspondence from SBMC to CVRWQCB.	Explained past mining practices as they pertained to the alleged releases of mercury form their site. States mercury comes from natural springs. Asked CVRWQCB for guidence on possible dam construction.
1983 June	County of Lake Task Force meeting (first).	Various studies and reports over last 15 years were compiled and discussed.
1983 July	County of Lake Task Force Meeting (second).	Presented summary of fish tissue levels of mercury from Clear Lake. Five of 115 fish collected since 1970 had exceeded the Food and Drug Administration guidelines for maximum allowable levels in edible fish tissue.
1983 August	County of Lake Task Force meeting (third).	
1983 August	Correspondence from SBMC to CVRWQCB.	Reviewed history of the mine and the geology surrounding the mine. Stated they may not be the cause of high lake sediment of fish levels.
1983 December	CDFG collected fish form upper and lower Oak arms of Clear Lake.	Analysis for mercury under special TSMP study.
1984	SBM listed on state and federal Hazardous Waste Site list.	
1984 February	CVRWQCB requests report from SBMC.	Study to include: 1.) definition of problem, 2.) develop solutions to eliminate discharges of toxic compounds, and 3.) present time table for above tasks.
1985 April	CVRWQCB meets with Columbia Geoscience.	Discussed work to be performed on SBM to satisfy CVRWQCB requirements.
1985 September	CVRWQCB requests plan of action from Columbia Science.	Requirements include plan of action and time schedule to implement program of corrective action.
1985 September	Columbia Geoscience submits literature review to CVRWQCB.	
1985 November	CVRWQCB meets with Columbia Geoscience.	Consultants recommend: 1.) planting vegitation on tailings for stability, 2.) route surface runoff to Herman pit, and 3.) construct dam to impound seasonal overflow to allow evaporation to dispose of water.
1985 December	CVRWQCB requests BMC to submit Columbia Geoscience report by February 1986.	
1986 May	CDHS issues advisory for Clear Lake.	Advises against consumption of fish caught in Clear Lake.
1986 May	CVRWQCB requests from SWRCB funds to perform futher mercury studies focusing on the SBM problem.	Proposal for FY 1987-88 was not approved by SWRCB Budget Review Committee. Stated the SBM problem should be studied using Cleanup and Abatement funds.
1986 May	CVRWQCB requests Cleanup and Abatement funds from SWRCB for SBM.	Request appoved by SWRCB in May. Proposal: 1.) Further define the source of mercury in Clear Lake, 2.) determine beneficial use impairments, 3.) discuss and develop potential solutions to stop toxics discharges to Clear Lake, and 4.) implement # 3.
1986 May	SBMC provides CVRWQCB with copy of Columbia Geoscience report.	Discussed the geological aspects of arsenic and mercury along the estern edge of Clear Lake.
1987 February	CVRWQCB review of Columbia Geoscience document.	CVRWQCB disagreed with their conclusions that the metals in Clear Lake 1.) were occurred naturally, 2.) were not contributed by mining activities, and 3.) could not be defined as to their source from the sediment samples taken.
1987 February	CVRWQCB solicits for consultant to further study mercury in Clear LAke.	

WALKER MINE

Walker Mine was operated during 1915 to 1941 and was one of the largest copper producers in the U.S. during the late 1930's. The major source of discharge had been documented as coming from one of the main adits constructed specifically to drain the mine. A secondary source of pollution was from the flow of Dollie Creek and surface runoff in contact with an extensive waste rock pile. Major contaminants include copper and zinc. Dollie Creek, which is the immediate receiving waters for the mine, has been impacted since the mine closed; no fish or aquatic organisms were observed below the mine. Dollie Creek drains to Little Grizzly Creek to Indian Creek which drains to the Feather River via the East Branch of the North Fork of the Feather River. No fishery exists in Little Grizzly Creek and periodic fish kills have been observed and documented in Indian Creek and apparently cannot support carp and sucker populations. Oroville Reservoir is the receiving waters for the Feather River. Walker Mine had been ranked 9 as a medium threat to Central Valley water quality.

Table C-15. CHRONOLOGY OF SIGNIFICANT EVENTS FOR WALKER MINE.

YEAR	MONTH	SIGNIFICANT EVENT	CONDITION OR RESULT
1953	June	CDFG documents fish kills on Indian, Grizzly, and Dollie creeks.	Suggested that the cause is runoff from abandoned Walker Mine.
1955	July	Plumas County requests an investigation by the CVRWQCB.	The CVRWQCB began investigation after August 1955.
1958	April	CVRWQCB adopts Waste Discharge Requirements (Resolution No. 58-180) for Walker Mine to Barry (owner).	Drainage should not cause detrimental effects on downstream receiving waters.
1958	June	CVRWQCB adopts Waste Discharge Requirements Resolution No. 58-311 issued to Barry (owner).	Requirements established for a milling operation to be located at the mine site. Conditions required turbidity limits in downstream waters.
1958	October	CVRWQCB has Public Hearing Conference on Walker Mine the the Attorney Generals office.	The CVRWQCB requested the services of the Attorney Generals Office to initiate corrective action under provisions of Section 13060 to 13063 of the Water Code.
1960	June	CVRWQCB adopts Summary Abatement Resolution No. 60-106 for Walker Mine and requests prosecution from District Attorney's office.	Resolution and past data and information sent to Plumas County District Attorney as evidence and technical advice as required in the prosecution of this action. District Attorney states his office is too busy to handle the case.
1960	August	Contractor performed some ditch bypassing to divert flows into settling ponds.	
1961	April	CVRWQCB forwards request for an investigation under provisions of paragraph 13063, Water Code to Attorney General.	District Attorney's office did not proceed with the mine pollution problem. Attorney General begins investigation November 1967, and in March 1968 suggests using Government Code bylaws enforce cleanup of nuisances using money collected from the owner.
1963	July	CVRWQCB adopts Order to Cease and Desist Resolution No 63-147 for Walker Mine.	Discharger required to comply with Resolution No 58-180.
1970	October	Hearing held on condition of pollution and nuisance of Walker Mine represented by Calicopia Corp. (CC) the property owner.	
1970	October	CVRWQCB adopts Order No. 71-93 for the discharge from Walker Mine to CC.	CC required to cease discharges and submit time schedule for abatement of pollution. Time schedule submitted after the required date and was incomplete and not the responsibility of the company under option agreement with the owner.
1971	September	CVRWQCB requested Division of Mines and Geology to study abatement measures required at Walker Mine.	Injunctive relief as well as a lien was the means of funding such a study.
1973	July	CVRWQCB adopts Resolution No. 73-1 to CC and Barry (president of CC).	Requests the assistance of the Attorney General to take appropriate action under Section 13304 of the California Water Code.
1974	July	CC mining consultant submits a proposal for abatement of pollution from Walker Mine.	Methods included copper precipitation, reverse osmosis, neutralization of mine water, dilution, and liquid ion exchange as well as futher ditch work to divert water around mine.

Table C-15. CHRONOLOGY OF SIGNIFICANT EVENTS FOR WALKER MINE.

YEAR MONTH	SIGNIFICANT EVENT	CONDITION OR RESULT
1974 August	CVRWQCB contracts with UCD professor to review abatement proposal and provide further suggestions using Cleanup and Abatement funds.	Suggested the mine be plugged to terminally eliminate discharges to creek.
1975 May	CVRWQCB adopts Waste Discharge Requirements Order No. 75-119 for Walker Mine under the NPDES program (NPDES No. CA0080110).	Conditions: 1.) effluent and receiving water limitations set, 2.) discharges shall not be detrimental to receiving waters, 3.) monitoring of discharge and receiving waters to be submitted.
1975 July	CVRWQCB inspection were made in July and October.	Extensive work had been performed to abate pollution from the mine. Copper precipitation plant in operation, ditching work completed, and monitoring ongoing. Discharger in Violation of order requirements.
1976 May	CVRWQVB inspections in May, July, and November.	Discharger found in violation of Order No. 75-119.
1977 May	CVRWQCB inspections in May and November.	Discharger found in violation of Order No. 75-119.
1977 July	CC upgraded copper precipitation plant.	Repairs and revisions were made to increase efficiency of cementation plant.
1978 January	Conoco (mining interest) submitted monitoring data collected 1976-77.	CVRWQCB requested Conoco to submit technical proposal of their exploration activities.
1978 June	CVRWQCB inspections in June, October, and December.	Discharger found in violation of Order No. 75-119.
1978 November	CVRWQCB contracts with D'Appalonia to study Walker Mine pollution problem using 208 funds from U.S.EPA.	
1979 December	D'Appolonia submits final report on the evaluation of Walker Mine discharges and conceptual abatement plans.	Two-phased abatement approach recommended: 1.) reduction of inflow to the mine by diversion of runoff, and 2.) treatment of remaining outflow from mine adit. CC was requested to submit plan to implement the abatement plans.
1980 May	CVRWQCB adopts Cleanup and Abatement Order No. 80-070 and Waste Discharge Requirements Order No. 80-058 and Order No. 80-071 for referal.	Directs CC to cleanup and abate pollution from the mine on a specified time schedule. Order No 80-071 refers the matter to the Attorney General for recovery of cival monitary remidies.
1981 May	CVRWQCB contracts with Geo-Technical Services Inc. to design and construct pollution abatement measures at Walker Mine	
1983		
1983 December	CVRWQCB adopts Request to Abate Pollution Order No. 83-148 for Walker Mine to CC.	Requests all parties involved to abate discharges from Walker Mine and requested abatement plan from CC.
1984	CVRWQCB contracted with consultant SRK to study sealing the mine portal and then perform the work.	
1984 January	Pollution abatement proposal submitted by consultants hired by CC to the CVRWQCB.	Proposed: 1.) clean and stabilize main adit level, 2.) identify areas of contamination, 3.) construct flume and launder system, 4.) monitor, 5.) design and construct best available technology economically acheivable system, and 6.) monitor.
1984 April	CVRWQCB terminates contract with Pearson and Potter consultants.	The recommended abatement facility would have been too prohibitive in cost.
1985 January	CVRWQCB adopts NPDES Waste Discharge Requirements Order No. 85-033.	A new order was adopted adding Standard Bullion (mining interes) as a discharger. The existing receiving water limitations were affirmed.
1985 June	CVRWQCB inspection with consultants to determine mine seal feasibility.	Access was granted by Court Order (June 1985). Mine access was not allowed during the inspection which was a violation of the June 1985 Plumas County Superior Court Order.
1985 November	SRK submits final feasibility and design report.	Report Schedule of events: 1.) background monitoring, 2.) seal main adit, 3.) seal second, smaller adit, and 4.) monitor to check for improvement.
1986 February	CVRWQCB adopts Resolution No. 86-056 approving proposed Negative Declaration for compliance with CEQA.	The construction of the mine seal would comply with CEQA requirements.
1986 February	CVRWQCB adopts Resolution No. 86-057 directing Executive Officer to take steps to seal Walker Mine.	Mine seal to be in accordance with SRK recommended specifications.
1986 February	Consultant hired by CC submits abatement proposal for Walker Mine.	
1986 July	CVRWQCB contracts with EBY Mine Service, Inc. for the construction of one concrete mine seal.	Seal to plug main adit of Walker Mine.

APPENDIX D

AGRICULTURAL DRAIN CONCENTRATION DATA

C-108817

Table D-1. METALS CONCENTRATIONS IN SACRAMENTO VALLEY AGRICULTURAL DRAINS, 1987.

DRAIN	DATE SAMPLED MONTH	YEAR	DAY	pH	EC(dS/m)	T 4/	REPLICATE CONCENTRATION (TOTAL UG/L) ARSENIC	CADMIUM		CHROMIUM		COPPER		NICKEL		ZINC	
RD 108	1	1987	5					0.5				8		16		30	
	2	1987	15					<0.1	<0.1			8	7	10	10	14	15
	3	1987	9					<0.1				5		8		6	
		1987	24					<0.1	0.2	6	5	5	9	8	10	15	20
	4	1987	7	7.8	1.2			<0.1	<0.1	7	5	5	4	<5	<5	<1	20
		1987	22					0.1				10		10		10	
	5	1987	8	7	0.5			0.4	0.4	7	7	13	15	10	13	16	19
		1987	15	7.4	0.6	29		0.3	0.3	9	9	9	10	11	14	7	7
		1987	26	8	0.6	22		<0.1	<0.1	3	3	5	5	3	4	5	3
	6	1987	4					<1	<1	2	1	8	9	6	6	16	16
		1987	12	7.8	0.6	28		<1	3	2	2	5	5	6	6	11	23
		1987	18	7.6	0.4			<1	<1	3	2	7	6	7	7	11	7
		1987	26	7.4	0.6	27		<1	<1	5	6	8	8	12	14	18	19
COLUSA BASIN	1	1987	3					0.5	0.4			6	6	6	6	17	15
DRAIN		1987	4					0.3	0.3			7	6	6	6	13	13
		1987	5					<0.1	<0.1			5	5	5	5	9	8
		1987						0.7	0.7			11	11	6	6	23	25
		1987						<0.1				7		26		10	
		1987	6					0.2	0.2			8	9	5	5	25	21
		1987						0.2	0.4			7	7	5	5	35	36
		1987	7					1.3	1.2			6	6	5	5	22	18
		1987	29									9	9				
		1987	30									7					
		1987	31									9	9				
		1987										10	9				
	2	1987	1									9	11				
		1987										11	10				
		1987	2					0.1	<0.1	15	10	10	11	10	8	200	110
		1987										8	8				
		1987	15					<0.1	<0.1			6	6	10	10	11	12

C-108818

C-108819

Table D-1. (continued).

DRAIN	MONTH	YEAR	DAY	pH	EC(dS/m)	T 4/	ARSENIC		CADMIUM		CHROMIUM		COPPER		NICKEL		ZINC	
							REPLICATE CONCENTRATION (TOTAL UG/L)											
	3	1987	9						<0.1	<0.1			7	7	14	14	15	17
		1987	24						<0.1	<0.1	10	10	12	10	18	14	23	15
	4	1987	7	6.8	0.6				<0.1	<0.1	11	11	8	8	8	11	37	22
		1987	22	7.2	0.4				0.2	0.1	7	7	8	8	6	5	80	6
		1987	22						0.1				9		9		6	
	5	1985	10				<10		<50		<10		12		<50		51 1/	
		1987	8	7	0.5				0.1	0.1	5	4	8	8	6	<5	3	3
		1987	15	7.3	0.5	26			0.3	0.4	9	8	14	19	12	12	7	7
		1987	26	7.2	0.5	20			0.3	0.3	9	9	10	11	9	8	12	10
	6	1985	3				2.3 2/	2.2	<1	<1	17	17	17	18	11	12	<10 1/	45 1/
		1985	19				<100		<5		17		16		<40		12 1/	
		1987	4						<1	<1	6	6	10	10	8	9	17	12
		1987	12	8.1	0.6	29			<1	<1	8	8	10	10	10	10	13	11
		1987	18	7.3	0.5	23			<1	<1	6	5	8	8	11	10	17	10
		1987	26	7.6	0.5	26			<1	<1	6	6	8	10	12	10	45	37
	8	1985	13				<5	<5	<1	<5 1/	<10 1/	22	13	<50 1/	11	<50 1/	50 1/	
	9	1985	3				<10		<1		37		13 3/		<5		18 3/	57 1/
	10	1985	2				<5		<1		14		21		<5		22	46 1/
	11	1985	8				<200		<5		<10		<25		<40		<20 1/	
		1985	20						<1		10		7		5		20	
	12	1985	5								21		14		18		50	<50 1/
		1986	15						<1	<1			5	4	<5	5	5	2
SACRAMENTO	1	1987	5						<0.1				5		8		3	
SLOUGH	2	1987	15						<0.1	<0.1			1	4	<5	<5	8	10
	3	1987	9						<0.1				4		<5		10	
		1987	24						<0.1	<0.1	8	8	10	10	10	10	45	39
	4	1987	7	7.1	0.5				<0.1	<0.1	5	6	6	6	<5	<5	15	23
		1987	22	7.2	0.4				<0.1				8		7		7	
		1987	22						<0.1	<0.1	6	6	6	6	6	6	47	38
	5	1985	10				<10		<50		<10		12		<50		41 1/	38

Table D-1. (continued).

DRAIN	MONTH	YEAR	DAY	pH	EC(dS/m)	T 4/	ARSENIC	CADMIUM		CHROMIUM		COPPER		NICKEL		ZINC	
		1987	8	7.4	0.5			0.6	0.6	6	5	29	28	7	8	34	31
		1987	15	7.3	0.5	26		0.2	0.1	5	5	8	6	6	6	8	6
		1987	26	7.1	0.5	20		0.2	0.1	8	8	8	8	7	8	10	10
	6	1985	3				3.4 2/	<1		13		11		8		41 1/	
		1985	19				<100	<5		14		11		<40		58 1/	
		1987	4					<1	<1	5	5	7	7	8	8	14	11
		1987	12	7.8	0.5	27		<1	<1	7	7	8	8	9	8	17	15
		1987	18	7.1	0.5	23		<1	<1	5	5	6	6	7	8	12	18
		1987	26	7.6	0.5	26		<1	<1	6	5	9	8	11	10	37	20
	8	1985	13				<5	<5		16		12		15		56 1/	
	9	1985	3									8 3/					
	10	1985	2									9				10	
	11	1985	20							10		8		22		70	
	12	1985	5							15		8		18		40	
		1986	15					<1	<1			2	3	<5	<5	1	1
	3	1987	24					<0.1	<0.1	5	5	6	6	6	6	8	280
NATOMAS MAIN	4	1987	7	7.4	0.9			<0.1	0.6	<1	2	3	3	<5	<5	20	80
DRAIN		1987	22	7.2	0.5			<0.1	0.2	<1	1	3	4	<5	<5	22	5
	5	1987	8	7.2	0.3			<0.1	<0.1	2	2	42	43	<5	<5	16	<1
		1987	15	7	0.4	24		0.2	0.2	3	1	5	6	<5	<5	21	1
		1987	26	6.8	0.4	20		<0.1	<0.1	5	6	6	6	5	6	4	5
	6	1987	4					<1	<1	5	4	6	5	7	6	12	7
		1987	12	7.2	0.4	26		<1	<1	4	4	4	5	5	5	2	7
		1987	18	7	0.4	19		<1	<1	4	6	5	6	8	7	6	10
		1987	26	7.4	0.4	23		<1	<1	1	1	5	5	<5	<5	11	5
NATOMAS EAST	1	1987	5					0.2				8		17		16	
MAIN DRAIN	2	1987	15					0.1	0.1			6	6	<5	5	31	160
		1987															
	3	1987	9					<0.1				8		7		21	
		1987	24					<0.1	<0.1	5	4	10	14	5	10	32	33

Columns ARSENIC through ZINC are headed: REPLICATE CONCENTRATION (TOTAL UG/L); DATE SAMPLED spans MONTH, YEAR, DAY.

Table D-1. (continued).

DRAIN	DATE SAMPLED			pH	EC(dS/m)	T 4/	REPLICATE CONCENTRATION (TOTAL UG/L)											
	MONTH	YEAR	DAY				ARSENIC		CADMIUM		CHROMIUM		COPPER		NICKEL		ZINC	
	4	1987	7	6.2	0.3				0.1	0.2	2	3	4	6	<5	<5	19	19
		1987	22	6.6	0.3				0.4	0.4	8	6	6	8	<5	<5	44	120
	5	1987	8	6.7	0.2				0.4	0.5	8	9	9	11	<5	5	16	22
		1987	15	6.8	0.3				0.7	0.5	4	3	9	7	6	<5	80	38
		1987	26	6.6	0.2	20			0.3	0.2	7	6	6	5	<5	<5	10	10
	6	1987	4						<1	<1	10	11	7	9	7	7	33	27
		1987	12	7.2	0.3	26			<1	<1	8	8	9	12	6	6	30	28
		1987	18	6.6	0.3	22			<1	<1	6	5	7	6	6	<5	16	18
		1987	26	7.2	0.3	26			<1	<1	9	8	9	12	8	6	25	35
	12	1986	15						<1				2		<5		9	
TOE DRAIN	4	1987	7	7.4	0.9				0.1	<0.1	14	12	9	8	12	12	26	28
		1987	22	7.6	1.1				0.2	<0.1	10	9	10	9	19	14	20	29
	5	1987	8	8.2	1				0.4	0.4	9	8	13	13	21	22	23	15
		1987	15	8	1	26			0.2	0.2	15	16	13	13	26	29	14	13
		1987	26	8	1	20			<0.1	0.2	14	14	13	14	21	21	18	18
	6	1987	4						<1	<1	13	14	11	12	27	27	20	20
		1987	12	8	1	29			<1	<1	21	20	14	13	30	35	25	20
		1987	18	7.8	0.9	24			<1	<1	9	10	8	9	23	24	22	26
		1987	26	7.6	0.8	27			<1	<1	5	6	8	8	12	14	18	19
BUTTE SLOUGH	1	1987	5						0.1				9		29		25	
	2	1987	15						<0.1	<0.1			6	6	7	7	13	13
	3	1987	9						<0.1				8		20		10	

1/ ICPES analysis.
2/ Analyzed at U.C., Davis.
3/ Mean of replicates.
4/ Temperature.

C-108821

APPENDIX E

URBAN RUNOFF DRY PERIOD METALS AND OIL AND GREASE CONCENTRATIONS IN FIVE SACRAMENTO CITY AND COUNTY STORM DRAINS

Table E-1. URBAN RUNOFF DRY PERIOD METALS AND OIL AND GREASE CONCENTRATIONS IN FIVE SACRAMENTO STORM DRAINS, 1987. 1/

Drainage 2/	Date 3/	REPLICATE CONCENTRATION (ug/l)							Oil & Grease (mg/l)	
		As	Cd	Cr	Cu	Pb	Ni	Zn	replicates	average
Sump 99	4-23		<0.1	1	5		<5	140	<2, <2	0
	5-20		0.3, 0.3	3, 2	7, 7		<5, <5	56, 55		
	6-5	<4, <4	<1, <1	<1, 1	3, 3	<5, <5	<5, <5	50, 60	<2, 2	1
	6-24	<4, <4	<1, <1	1, 2	6, 8	<5, <5	<5, <5	16, 45		
Sump 104	4-23		<0.1, <0.1	1, 3	5, 12		<5, <5	140, 20		
	5-20		0.1	4	8		<5	18		
	6-5	4, 4	<1, <1	2, 2	9, 8	<5, <5	<5, <5	18, 19	2, 2	2
	6-24	<4, <4	<1, <1	13, 13	24, 24	9, <5	15, 14	60, 80		
Chicken/Strong Ranch Slough	4-23		0.1, 0.2	2, 2	10, 11		<5, <5	180, 200	<2, <2	0
	5-20		0.4, 0.4	2, 2	7, 7		<5, <5	38, 37	<2, <2	0
	6-5	14, 13	1, 1	3, 4	20, 20	9, <5	<5, <5	70, 60	<2, <2	0
	6-24	6, 7	<1, <1	2, 2	22, 22	<5, <5	<5, <5	27, 70		
Arcade Creek	4-23		<0.1	4	4		<5	550	<2, <2	0
	5-20		<0.1, <0.1	2, 2	4, 3		<5, <5	4, 4	<2, 6	3
	6-5	4, 4	<1, <1	1, 2	7, 8	8, 9	6, <5	20, 18	<2, 3	1.5
	6-24	5, 5	<1, 2	3, 2	7, 9	8, 9	<5, <5	19, 44		
Sump 111	4-23		0.2	2	10		<5	100	18, 16	17
	5-20								310, 680	445
	6-24	<4, <4	<1, <1	1, 1	43, 43	9, 10	<5, <5	150, 160	8400, 8100	8250

1/ See Appendix F for methods and quality control results.
2/ For locations see CVRWQCB, 1987.
3/ Month-Day.