CALFED

TECHNICAL REPORT
AFFECTED ENVIRONMENT

SUPPLEMENT TO WATER QUALITY

DRAFT

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CALFED
BAY-DELTA
PROGRAM

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LIST OF ACRONYMS

AF/yr	acre-feet per year
ALs	action levels
BATs	Best Available Technologies
C-FOG	California-Federal Operations Group
CMP	Sacramento River Coordinated Monitoring Program
Corps	U.S. Army Corps of Engineers
D-1485	Decision 1485
DFG	California Department of Fish and Game
DWR	California Department of Water Resources
DHS	California Department of Health Services
EPA	U.S. Environmental Protection Agency
CUWA	California Urban Water Agencies
CVP	Central Valley Project
CVRQCB	Central Valley Regional Water Quality Control Board
CVPIA	Central Valley Project Improvement Act
CWA	Clean Water Act
CCWD	Contra Costa Water District
DCC	Delta Cross Channel
DIDI	Delta Island Drainage Investigations
D/DBPR	Disinfectant/Disinfection Byproducts Rule
EBEP	Enclosed Bays and Estuaries Plan
EC	electrical conductivity
ESA	Endangered Species Act
ESWTR	Enhanced Surface Water Treatment Rule
IDHAMP	Interagency Delta Health Aspects Monitoring Program
IOC	inorganic chemical
ISWP	Inland Surface Water Plan
IEP	Interagency Ecological Program
ISDP	Interim South Delta Water Management Program
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
MWQI	Municipal Water Quality Investigation
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NSDWR	national secondary drinking water regulations
WQN	National Water Quality Monitoring Network
NAWQA	National Water Quality Assessment
Reclamation	U.S. Bureau of Reclamation
RMP	Regional Monitoring Program
SDWA	Safe Drinking Water Act
SFEI	San Francisco Estuary Institute
SJRMP	San Joaquin River Monitoring Program
SMWP	State Mussel Watch Program
SWP	State Water Project
SWRCB	State Water Resources Control Board
SWTR	Surface Water Treatment Rule

LIST OF ACRONYMS (Continued)

SOC	synthetic organic chemical
TMDL	total maximum daily load
TTHM	total trihalomethane
TSMP	Toxic Substances Monitoring Program
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VOC	volatile organic chemical
WDR	waste discharge requirement
WQCP	water quality control plan

SUPPLEMENT TO WATER QUALITY

This information supplements the Water Quality Draft Affected Environment Technical Report.

SOURCES OF INFORMATION

Water Quality Monitoring Programs

Many federal, state, and local agencies conduct ongoing water quality monitoring programs in the Delta. The following section reviews previous and ongoing studies that provide primary data on key water quality parameters for CALFED.

REGIONAL PROGRAMS

INTERAGENCY ECOLOGICAL PROGRAM OF THE SACRAMENTO-SAN JOAQUIN ESTUARY

The Interagency Ecological Program (IEP) was initiated by the California Department of Water Resources (DWR), the California Department of Fish and Game (DFG), the U.S. Bureau of Reclamation (Reclamation), and the U.S. Fish and Wildlife Service (USFWS) to provide information about the effects of Central Valley Project (CVP) and State Water Project (SWP) exports on fish and wildlife in the Bay-Delta estuary. Analysis of water quality components has focused on salinity and algal productivity (nutrient) effects. The State Water Resources Control Board (SWRCB), the U.S. Environmental Protection Agency (EPA), the U.S. Army Corps of Engineers (Corps), and the U.S. Geological Survey (USGS) currently provide additional program assistance. IEP investigations have changed periodically as new information is gathered and resource topics decrease or increase in importance. Program data are available to the public, annual IEP reports are issued, and newsletters and annual meetings provide information about study results.

SAN FRANCISCO ESTUARY INSTITUTE REGIONAL MONITORING PROGRAM

The 1993, 1994, and 1995 Annual Reports for Trace Substances provide water quality monitoring data. Ambient concentration data are available throughout the Delta and Bay regions for toxic and potentially toxic trace elements and organic contaminants.

Sacramento River Coordinated Water Quality Monitoring Program

The Sacramento River Coordinated Monitoring Program (CMP) was initiated in 1991 by the City and County of Sacramento. The program is now a component of the larger Sacramento River Watershed Program. Sampling under the program began in December 1992. Ambient water quality monitoring is conducted at five locations on the lower Sacramento River (Red Bluff to the Delta) in the vicinity of Sacramento. Water quality data are reported in annual reports for 1992 to 1995.

San Joaquin River Monitoring Program

San Joaquin River Monitoring Program (SJRMP) is a real-time water quality management program with ongoing monitoring of flow and electrical conductivity (EC) in the main stem of the San Joaquin River and major tributaries to monitor compliance with Vernalis EC objectives.

Federal Programs

U.S. Environmental Protection Agency

Clean Water Act Section 305(b)

SWRCB is required to report (biennially) on water quality conditions in California streams, lakes, and groundwater basins. The SWRCB submits its report to EPA. Individual Delta channels are not classified in the Section 305(b) reports.

Clean Water Act Section 303(d)

Clean Water Act (CWA) Section 303(d) requires states to identify waterbodies within their boundaries that exceed water quality standards based on water quality conditions as reported under CWA Section 305(b). As a result, the SWRCB identifies and maintains a list of the state's impaired waterbodies. For each waterbody, the SWRCB identifies the water quality problem, its source(s), and areal extent. In addition to identifying impaired waterbodies, states are required to prioritize the impaired waterbodies based on the severity of the water quality problem and their beneficial uses, and to estimate the maximum parameter load allowable, known as the total maximum daily load (TMDL). In 1996, the SWRCB identified approximately 355 impaired waterbodies in California. Approximately 26 impaired waterbodies are in the Sacramento River Region, 14 in the San Joaquin River Region, four in the Delta Region, 10 in the Bay Region, and 100 in the SWP and CVP Service Areas Outside the Central Valley Region. The CWA Section 303(d) list of impaired waterbodies is reviewed and updated biennially to coincide with the CWA Section 305(b) reporting schedule.

United States Geological Survey

Much of the available water temperature information is based on USGS records, which were obtained from the compact-disk version of USGS WATSTORE database. Additional USGS data on water quality and streamflow was found using the National Water Quality Monitoring Networks (WQN) HomePage.

National Water Quality Assessment Program

The National Water Quality Assessment (NAWQA) Program of USGS is designed to describe the status and trends in the quality of the nation's groundwater and surface water resources, and to provide a sound understanding of the natural and human factors that affect the quality of these resources. As part of the program, investigations will be conducted in 59 areas or "study units" throughout the nation to provide a framework for national and regional water quality assessment. Regional and national synthesis of information from study units will consist of comparative studies of specific water quality issues using nationally consistent information. The San Joaquin and Sacramento River basins are two such NAWQA study units, begun in 1991 and 1994, respectively.

Although both local study units began their initial surveys with an emphasis on routine water quality, nutrients, and pesticides, the two units have a somewhat different emphasis in routine data collection and special studies. The Sacramento unit, with 11 stations throughout the Sacramento River watershed for routine collections, has emphasized the detailed study of metals speciation and transport, including mercury, methyl mercury, copper, and zinc. Part of this study is cooperative work with the Sacramento County Sanitation District. The San Joaquin River basin NAWQA study has emphasized the characterization of pesticides and nutrients as chemicals of most concern.

STATE PROGRAMS

CALIFORNIA DEPARTMENT OF WATER RESOURCES

Municipal Water Quality Investigations Program

DWR's Municipal Water Quality Investigations (MWQI) Program encompasses the previous Interagency Delta Health Aspects Monitoring Program (IDHAMP) and Delta Island Drainage Investigations (DIDI) Program. IDHAMP was initiated to provide water quality information for judging the suitability of the Delta as a source of drinking water (DWR 1989). Issues of concern included sodium, asbestos, and the potential formation of DBPs. More water quality constituents have been added, including the characterization of Delta inflows and exports, to provide a means of chemically tracking the movement of water through the Delta. The DIDI program staff started collecting agricultural drainage samples and testing for pesticide residues, organic materials, and THM precursors in 1985 to evaluate drainage quality among islands with different soil and farming practices (DWR 1990).

DAYFLOW Records

Daily Delta hydrology is specified in the DAYFLOW database maintained by the DWR Central District. The DAYFLOW records include daily CVP Delta operations for 1967 to 1991. Simulation results from the monthly Delta operations planning models are provided by DWRSIM.

STATE WATER RESOURCES CONTROL BOARD

Delta Flow and Salinity Measurements

As conditions of their water rights permits, SWRCB requires DWR and Reclamation to conduct comprehensive water quality monitoring of the Delta and adjust SWP and CVP operations to satisfy the applicable objectives. Salinity (EC) monitoring stations at Jersey Point and Emmaton are especially important for managing releases at upstream reservoirs and export pumping to satisfy water quality objectives. DWR's Delta Operations Water Quality Section prepares and distributes a daily report of data on flows and EC to help in making operational decisions. Reclamation also maintains continuous EC recorders at approximately 20 Delta locations.

The Central Valley Regional Water Quality Control Board (CVRQCB) has conducted Delta monitoring of selenium, pesticides, metals, and toxicity since 1984.

Sediment Monitoring Programs

STATE PROGRAMS

DEPARTMENT OF WATER RESOURCES

Interim North Delta Water Management Program

In an effort to define the potential environmental impact that would result from proposed dredging that could occur in the north Delta area, a field investigation was conducted in fall and winter 1992 to collect and analyze sediment samples for chemicals of environmental concern.

Interim South Delta Water Management Program

An environmental study was conducted to help determine the impact that could result from proposed dredging activities associated with the Interim South Delta Water Management Program (ISDP), including the effects of the physical and chemical components of dredged material on the environment. The ISDP area generally comprises lands and channels southwest of Stockton and north of Tracy.

Dredging Projects

From 1990 to 1994, sediment samples were collected during actual dredging operations at Staten Island, South Fork Mokelumne River, and the North Delta.

San Francisco Estuary Institute Regional Monitoring Program

The Regional Monitoring Program (RMP) of the San Francisco Estuary Institute (SFEI) is responsible for routinely collecting and analyzing sediments from the Bay-Delta system. The program's sediment quality objectives are to obtain baseline data describing the concentration of toxic and potentially toxic trace elements and organic contaminants in the sediment of the estuary, to determine compliance with objectives established by the Regional Board's Basin Plan, and to provide a database on sediment quality that is compatible with data being developed in other ongoing studies in the region.

FEDERAL PROGRAMS

UNITED STATES GEOLOGICAL SURVEY

National Water Quality Assessment Program

The USGS NAWQA program has analyzed sediment chemistry from a variety of stations in the San Joaquin and Sacramento basins in support of their long-term characterizations of contamination in those watersheds. Sacramento Basin studies have emphasized metals chemistry while the San Joaquin system samples were primarily analyzed for pesticides and trace elements.

Biological Tissue Monitoring Programs

STATE AND FEDERAL PROGRAMS

STATE WATER RESOURCES CONTROL BOARD

Mussel Watch Program

Initiated in 1977, the California State Mussel Watch Program (SMWP) was organized to provide a uniform statewide approach to the detection and evaluation of the occurrence of toxic substances in the waters of California's bays, harbors, and estuaries. This is accomplished through the analysis of transplanted and resident mussels and clams. The SMWP primarily targets areas with known or suspected impaired water quality and is not intended to give an overall water quality assessment. The DFG carries out the statewide SMWP for the SWRCB by collecting and analyzing samples.

Information collected in the SMWP is used by the SWRCB, RWQCB, and other agencies to identify waters affected by toxic pollutants. Through the SWRCB's statewide Water Quality Assessment, SMWP results are used to help classify waterbodies from good to impaired water quality relative to each other. SMWP results also are used in the SWRCB's Bay Protection Program in helping to identify "Toxic Hot Spots." SMWP results are used in the normal regulatory activities of the RWQCBs and other state agencies such as the Department of Pesticide Regulation (SWRCB 1996).

Toxic Substances Monitoring Program

Initiated in 1976, the Toxic Substances Monitoring Program (TSMP) sampled aquatic organisms, such as freshwater clams, carp, bass, and trout, in major California waterbodies; and tested for synthetic organic chemicals and heavy metals in tissues of aquatic organisms throughout the state to determine the extent of bioaccumulation. (SWRCB 1985). Funding for the TSMP was discontinued in 1996.

The SFEI analyzes transplanted bivalves for tissue chemistry of trace elements and organic compounds as well as survival and condition as a means of assessing background conditions in the estuary.

UNITED STATES GEOLOGICAL SURVEY

National Water Quality Assessment Program

As part of the NAWQA programs for the San Joaquin and Sacramento basins, the USGS has collected bivalve mollusks and various bottom-feeding fish species for contaminants analysis; samples have been analyzed for tissue chemistry of metals and organochlorines.

Additional Sources of Information

Ongoing studies and analyses of the Delta Region serve as important sources of information for this report. Recent studies and reports include the DWR Bulletin 160-93, California Water Plan Update (DWR 1994); documentation for Reclamation's CVP operations (Reclamation 1992); an environmental report prepared by the SWRCB in support of the 1995 Delta water quality control plan (WQCP) (SWRCB 1995); estuarine standards proposed in December 1993 by the EPA; draft environmental documents for major water resource projects in or adjacent to the Delta, including the Contra Costa Water District's (CCWD's) Los Vaqueros Project (CCWD and Reclamation 1993); DWR's North Delta Program (DWR 1990a), South Delta Program (DWR 1990b), Interim South Delta Program (DWR 1996a), and Los Banos Grandes (DWR 1990c); and the draft EIR/EIS for the Delta Wetlands Project (Jones & Stokes Associates 1995).

ENVIRONMENTAL SETTING

Regulatory Context

WATER RIGHTS

Water use in California is characterized by two basic types of water rights: riparian water rights and appropriative water rights. Riparian water rights are based on ownership of land adjacent to a waterbody, while appropriative water rights are unrelated to riparian land ownership and are based on the principle of "first in line, first in right."

Riparian water rights are not lost if unused and are not quantified. Landowners with these rights can divert portions of a waterbody's natural waterflow for reasonable and beneficial use on their land, provided the land is located in the same watershed as the waterbody. During times of water shortage, all riparian water rights holders must share the available supply according to each landowner's reasonable requirements and uses (SWRCB 1989). Appropriative water rights account for the vast majority of water rights in California. These rights are based on the concept that the first to claim and beneficially use a specific amount of water has a superior claim to later appropriators.

Appropriative rights are quantified and may be lost if unused. Appropriative water rights issued after 1914 are under the jurisdiction of the SWRCB. All water users existing in 1914 were assigned the same seniority. The SWRCB issues appropriative rights with conditions to protect other water rights holders, including Delta and upstream riparian water users, and to protect the public interest, including fish and wildlife resources. The quantity and quality of water used by existing riparian and senior appropriative users must not be impaired by subsequent appropriative water rights. (See the Surface Water and Groundwater Resources Technical Reports.)

SOURCE WATER QUALITY RULES, REGULATIONS, & REQUIREMENTS

The following rules and regulations relate to *source* water quality requirements for environmental, agricultural, M&I, and recreational uses of water. For environmental and recreational beneficial uses, the requirements generally are based on existing federal or state regulations translated into criteria, objectives, or standards. For agricultural and M&I beneficial uses, source water quality requirements are relevant because the quality of source water can strongly influence the ability to meet treated drinking water standards, can affect cropping pattern selection and operations, and can affect the operations of industrial facilities. Source water quality has significant economic effects on all these beneficial uses. Following are the major federal and state regulations associated with water quality.

THE DELTA PROTECTION ACT OF 1959

The Delta Protection Act of 1959 requires adequate water supplies for multiple uses, such as agriculture, industry, urban, and recreation, within the Delta and for export. Since the law was passed, various water quality and flow objectives have been established by the SWRCB and the CVRWQCB. These objectives are designed to ensure that the amount and quality of water in the Delta is sufficient to satisfy multiple uses. For example, water quality objectives require limiting Delta water supply operations, particularly the SWP and CVP, that affect the freshwater-saltwater balance in the Delta.

PORTER-COLOGNE ACT

In 1967, the Porter-Cologne Act established the SWRCB and nine Regional Boards as the state agencies with primary authority over the regulation of water quality and allocation of appropriative surface water rights in California. The Porter-Cologne Act is the primary state water quality legislation administered by SWRCB and provides the authority to establish WQCPs that are reviewed and revised every 3 years. The nine RWQCBs implement SWRCB policies and procedures throughout the state. WQCPs, also known as Basin Plans, designate beneficial uses for specific surface water and groundwater resources, and establish water quality objectives to protect those uses. To ensure that water quality objectives are met, SWRCB issues water right permits and RWQCBs issue waste discharge requirements (WDRs) for the major point-source waste dischargers, such as municipal wastewater treatment plants and industrial facilities.

SWRCB recently enacted the Enclosed Bays and Estuary Plan and the Inland Surface Waters Plan that set numeric and narrative criteria for toxic metals and organic compounds. Litigation brought against the plans in 1994 resulted in their revocation, and they currently are under review for readoption in 1997. Criteria promulgated in the plans would apply to all permitted and nonpermitted point-source discharges. SWRCB and the RWQCBs also implement sections of the federal CWA administered by EPA, including the National Pollutant Discharge Elimination System (NPDES) permitting process for point sources and certain nonpoint sources of waste discharges.

Both numerical and narrative water quality objectives are established to protect beneficial uses. Water quality objectives generally are established to protect human health or aquatic life. Once approved by EPA, the objectives become water quality standards that must be implemented under the CWA, the primary federal legislation administered in California by SWRCB.

The Delta is under the jurisdiction of the Central Valley (Region 5) and the San Francisco Bay (Region 2) RWQCBs, which implement policies and procedures adopted under several WQCPs. Each region issues a basin plan that identifies numeric and narrative water quality criteria for that region. The most recent Basin Plan for Regions 2 and 5 were adopted in 1995 (RWQCB 1995). Amendments to the Basin Plan for the control of agricultural subsurface drainage and lower San Joaquin River water quality objectives currently are being considered for adoption (RWQCB 1996a).

D-1485 AND THE 1978 WATER QUALITY CONTROL PLAN

In 1978, SWRCB adopted the WQCP for the Sacramento-San Joaquin Delta and Suisun Marsh (1978 Delta Plan). At the same time, SWRCB adopted water-rights Decision 1485 (D-1485), replacing the previous Water Control Plan D-1379, which replaced D-1275. D-1485 required compliance with water quality objectives in the 1978 Delta Plan that were designed to protect natural resources by maintaining Delta conditions as they occurred before operation of the CVP and SWP. D-1485 also required monitoring and study of Delta aquatic resources. The effect of D-1485 was the amendment of Reclamation and DWR permits for operating the CVP and SWP. In the 1980s, legal challenges were brought against D-1485 and the 1978 Delta Plan. In 1986, the State was required to revise its water quality standards based on the "Racanelli Decision" (*United States v. State Water Resources Control Board* 182 Cal. App. 3d 82 [1986]). Pursuant to that decision, SWRCB implemented a hearing process, known as the Bay-Delta hearings, to review and amend the 1978 Delta Plan. Following this hearing process, SWRCB issued revised water quality objectives in the 1991 Delta Water Quality Control Plan for Salinity, Temperature, and Dissolved Oxygen (1991 Delta Plan). Subsequently, EPA objected to the level of fish and wildlife protection afforded in the 1991 Delta Plan, and Governor Pete Wilson's 1992 water policy called for SWRCB to develop interim measures to protect fish and wildlife. SWRCB then prepared interim water-right terms and conditions for the 1991 Delta Plan in the draft D-1630. Actions taken by the National Marine Fisheries Service (NMFS) and USFWS to protect winter-run chinook salmon and Delta smelt, respectively, resulted in the withdrawal of D-1630 during the hearing process. However, several new Delta water management concepts presented in D-1630 have been partially adopted in other actions taken by SWRCB, DWR, Reclamation, fishery protection agencies, and other regulatory agencies.

CLEAN WATER ACT SECTION 303(D)

Section 303(d) of the CWA requires that each state develop a list, known as a 303(d) list, of waterbodies that are impaired with respect to water quality. The 303(d) list for each state identifies impaired waterbodies and sources of impairment such as mine drainage, agricultural drainage, urban and industrial runoff, and M&I wastewater discharges. The list is prepared biennially. In 1996, the State of California identified approximately 355 impaired waterbodies in its 303(d) list. CALFED is using this list to make a preliminary assessment of existing environmental water quality problems in California's Central Valley and Bay-Delta.

Federal Guidance on Water Quality Criteria for Toxic Pollutants

The EPA has developed National Guidance on Water Quality Criteria (Clean Water Act Section 304[a]) for pollutants toxic to human health and aquatic life protection. Relevant pollutants are identified under Section 307 of the CWA. These criteria were used by the State in development of the now defunct 1991 Inland Surface Water Plan (ISWP) and Enclosed Bays and Estuaries Plan (EBEP). Based on the National Guidance, the National Toxics Rule was promulgated in 1992. California was included in the rule for parameters that were not addressed in the Inland Surface Water Rule. Currently, a California Toxics Rule is being developed by EPA that will address parameters previously covered by the defunct ISWP and EBEP and not included in the original National Toxics Rule. The California Toxics Rule will be an update of the National Rule based on best currently available scientific data. Decisions regarding site-specific conditions will be deferred to the RWQCBs.

Endangered Species Act

The federal Endangered Species Act (ESA) requires assessment of effects on species listed under the ESA as threatened or endangered. In February 1993, NMFS issued its biological opinion on the effects of SWP and CVP operations on winter-run chinook salmon. In March 1995, USFWS issued a biological opinion on the effects of SWP and CVP operations on Delta smelt. The biological opinions establish requirements for SWP and CVP operations that impose important constraints on Delta water supply management to protect these listed species. These include requirements for Delta inflow, Delta outflow, Delta Cross Channel (DCC) gate closure, QWEST flows (net Delta outflows), and reduced export pumping because of specified incidental "take" limits. ("Take," as defined in the ESA, includes harassment of or harm to a species, entrainment, directly and indirectly caused mortality, and actions that adversely modify habitat.)

Central Valley Project Improvement Act of 1992

The Central Valley Project Improvement Act (CVPIA) dedicates 800,000 acre-feet per year (AF/yr) of water for fish and wildlife recovery, and mandates the acquisition of additional water for fish and wildlife purposes. Reclamation implemented interim changes in its Delta operations during 1993 and 1994, as recommended by USFWS, to dedicate the 800,000 AF/yr. Long-term changes in CVP operations that may be required to satisfy CVPIA are being evaluated by Reclamation and USFWS, and a programmatic EIS for this activity is expected to be published in early 1998.

Suisun Marsh Preservation Agreement

The Suisun Marsh Preservation and Restoration Act of 1979, and an associated agreement between federal and state agencies signed in 1987, were designed to mitigate the effects of CVP and SWP operations and other upstream diversions on water quality in the marsh. The agreement includes specific water quality objectives for salinity in Suisun Marsh channels; however, SWRCB has not yet approved this agreement. A salinity control structure (tidal gate) was completed on Montezuma Slough in 1988. D-1485 also directed Reclamation and DWR to develop a plan to protect Suisun Marsh resources. D-1485 set water salinity standards for Suisun Marsh from October through May to preserve the area as a brackish water tidal marsh and to provide optimum conditions for plant production as food for waterfowl.

Bay-Delta Framework Agreement and Bay-Delta Accord

In June 1994, a Bay-Delta Framework Agreement was signed by the Federal Ecosystem Directorate and the Governor's Water Policy Council of the State of California. The framework established a comprehensive program in the Bay-Delta Estuary for coordination and cooperation of environmental protection and water supply activities. The Principles for Agreement, or Bay-Delta Accord, was signed on December 15, 1994. It contains three major categories of protection measures: (1) Control of freshwater outflow to improve estuarine conditions in the Suisun Bay area; (2) Regulation of water project operations and flows to minimize harmful environmental impacts of water export activities; and (3) Projects to address non-flow related factors affecting the ecosystem (including unscreened diversions, habitat degradation, and pollution). The agreement also commits to the development of a long-term comprehensive solution for maintaining both environmental protection and economic uses of the Bay-Delta.

1995 Water Quality Control Plan

In March 1994, SWRCB initiated development of new water quality standards and released a draft version on December 15, 1994, with the Bay-Delta Accord. SWRCB subsequently released an environmental report that documented the effects of implementing the plan. The WQCP was adopted in May 1995 (1995 WQCP) and incorporated several elements of EPA, NMFS, and USFWS regulatory objectives for salinity and endangered species protection. The 1995 WQCP objectives are expected to be fully implemented with a new water-rights decision (to replace D-1485) within the next 3 years. The major changes associated with the 1995 WQCP in relation to the 1978 and 1991 WQCPs and associated D-1485 requirements are as follows.

- Water-year classifications are based on the 40-30-30 Sacramento Valley Four-River Index and the 60-20-20 San Joaquin Valley Four-River Index. The outflow requirements from February through June depend on the previous month's Eight-River Index runoff volume.

- Delta outflow requirements are the combination of fixed monthly requirements and estuarine habitat requirements (expressed in terms of "X2," the position of the 2-parts-per-thousand [2-ppt] salinity gradient). Because the X2 requirements in the 1995 WQCP depend on the previous month's Eight-River index runoff, the required outflow must be calculated for each month. The position of X2 in the Delta is regulated by Delta outflows but generally is described in relation to Chipps Island.

- New EC and pulse-flow objectives were established for the San Joaquin River at Vernalis.

- Combined SWP and CVP Delta exports are limited to a percentage of the Delta river inflow that does not include rainfall. These percentages are 35% from February through June and 65% for the remainder of the year. Export pumping during the pulse-flow period was limited to an amount equivalent to the pulse flow during half of April and half of May.

CALIFORNIA-FEDERAL OPERATIONS GROUP

The 1994 Bay-Delta Framework Agreement established the California-Federal Operations Group (C-FOG) to coordinate SWP and CVP operations, and to recommend changes in combined Delta operations that might provide additional fish protection and allow Delta exports with reduced negative fishery impacts. C-FOG specifically was charged with recommending operational changes based on real-time fish-monitoring results to minimize incidental take and satisfy other requirements of ESA biological opinions. C-FOG also was charged with the exchange of information and the discussion of strategies to implement fish protection measures, to satisfy 1995 WQCP water quality objectives, to cooperate with IEP to determine factors affecting Delta habitat and the health of fisheries, and to identify appropriate corrective measures for CVP and SWP.

CALIFORNIA URBAN WATER AGENCIES

In December 1996, the California Urban Water Agencies (CUWA) issued a report on Bay Delta Drinking Water Quality Criteria. The report detailed the anticipated future regulatory scenario, listed treatment criteria for coagulation and ozonation processes that potentially could be implemented by users of Delta water, and provided an estimate of source water that would allow users implementing the defined treatment technologies to comply with the regulatory scenario. The source water quality characteristics were framed in the context of total organic carbon and bromide concentrations, two important contributions to the formation of carcinogenic DBPs.

For some parameters, particularly those affecting environmental beneficial uses, source water quality regulatory standards, objectives or criteria have been developed. In other cases, particularly at municipal and agricultural water intakes, source water standards have not been developed. However, stakeholders that represent these beneficial uses have recommended ranges or levels considered adequate for source water quality. Table S-1 summarizes the source water quality targets for the CALFED water quality parameters of concern.

C-009361

Parameter	Sacramento River	San Joaquin River	Delta
Boron		Water: Mouth of Merced to Vernalis: **2.0 mg/l** (15 March - 15 September)[d] **0.8 mg/l** (monthly mean, 15 March - 15 September)[d] **1.0 mg/l** (monthly mean, 16 September - 14 March)[d] **1.3 mg/l** (monthly mean, critical year)[d]	Water: Agricultural Intakes: **< 0.7 mg/l**
Cadmium	Water: River and Tributaries from above State Hwy 32 bridge at Hamilton City: **0.22 µg/l** [a,c,d] Below Hamilton City: **2.2 µg/l** (4 day average) [a,e] **4.3 µg/l** (1 hour average) [a,e] Sediment: [z] **5.0 ppm** (dry weight)	Water: **2.2 µg/l** (4 day average) [a,e] **4.3 µg/l** (1 hour average) [a,e] Sediment: [z] **5.0 ppm** (dry weight)	Water: East of Antioch Bridge: **2.2 µg/l** (4 day average) [a,e] **4.3 mg/l** (1 hour average) [a,e] West of Antioch Bridge: **1.1 µg/l** (4 day average) [x] **3.9 µg/l** (1 hour average) [x] Sediment: [z] **1.2 ppm** (dry weight)
Copper	Water: River and Tributaries from above State Hwy 32 bridge at Hamilton City: **5.6 µg/l** [a,c,d] Below Hamilton City: **10 µg/l** (no hardness connection) [a,d,f] Sediment: [z] **70.0 ppm** (dry weight)	Water: **9.0 µg/l** (4 day average) [a,e] **13 µg/l** (1 hour average) [a,e] Sediment: [z] **70.0 ppm** (dry weight)	Water: East of Antioch Bridge: **10 µg/l** (no hardness connection) [a,d,f] West of Antioch Bridge: **6.5 µg/l** (4 day average) [x] **9.2 µg/l** (1 hour average) [x] Sediment: [z] **34.0 ppm** (dry weight)
Mercury (inorganic)	Water: **0.012 µg/l** (4 day average) [b,e] **2.1 µg/l** (1 hour maximum) [a,e] Sediment: [z] **0.15 ppm** (dry weight) Tissue: [i,y] **0.5 µg/gm** (whole fish, wet weight)	Water: **0.012 µg/l** (4 day average) [b,e] **2.1 µg/l** (1 hour maximum) [a,e] Sediment: [z] **0.15 ppm** (dry weight) Tissue: [i,y] **0.5 µg/gm** (whole fish, wet weight)	Water: East of Antioch Bridge: **0.012 µg/l** (4 day average) [b,e] **2.1 µg/l** (1 hour maximum) [a,e] West of Antioch Bridge: **0.025 µg/l** (4 day average) [x] **2.4 µg/l** (1 hour average) [x] Sediment: [z] **0.15 ppm** (dry weight) Tissue: [i,y] **0.5 µg/gm** (whole fish, wet weight)
Selenium	Water: **20 µg/l** (1 hour maximum) [b,e] **5.0 µg/l** (4 day average) [b,e]	Water: [j] South of Merced River: **20 µg/l** (1 hour maximum) [b,e] **5.0 µg/l** (4 day average) [b,e]	Water: East of Antioch Bridge: **20 µg/l** (1 hour maximum) [b,e] **5.0 µg/l** (4 day average) [b,e]

Table S-1. CALFED Water Quality Targets for Parameters of Concern

Parameter	Sacramento River	San Joaquin River	Delta
Selenium (Continued)	Tissue: [aa] **4-12 ppm** (fish, whole body, dry weight) **3-7 ppm** (fish food items, food chain, dry weight)	North of Merced River: **12µg/l** (maximum)[b,e] **5.0 µg/l** (4 day average)[b,e] Tissue: [aa] **4-12 ppm** (fish, whole body, dry weight) **3-7 ppm** (fish food items, food chain, dry weight)	West of Antioch Bridge: **20 µg/l** (1 hour average) [b,e] **5.0 µg/l** (4 day average) [b,e] Tissue: [aa] **4-12 ppm** (fish, whole body, dry weight) **3-7 ppm** (fish food items, food chain, dry weight)
Zinc	Water: River and Tributaries from above State Hwy 32 bridge at Hamilton City: **16 µg/l** [a,c,d] Below Hamilton City: **100 µg/l** (no hardness connection) [a,d,e] Sediment: [z] **120.0 ppm** (dry weight)	Water: **120 µg/l** (4 day average) [a,e] **120 µg/l** (1 hour average) [a,e] Sediment: [z] **120.0 ppm** (dry weight)	Water: East of Antioch Bridge: **100 µg/l** (no hardness connection) [a,d] West of Antioch Bridge: **106µg/l** (4 day average) [x] **117 µg/l** (1 hour average) [x] Sediment: [z] **150.0 ppm** (dry weight)
Carbofuran	Water:[k] **0.4 µg/l** (daily max. and total pesticide) [h]	Water: **0.4 µg/l** (daily max. and total pesticide) [h]	Water: **0.4 µg/l** (daily max. and total pesticide) [h]
Chlordane	Water: **2.4 µg/l** (instantaneous max.) [e] **0.0043 µg/l** (4 day average, total pesticide) [e] Sediment: [z] **7.1 ppm** (dry weight)	Water: **2.4 µg/l** (instantaneous max.) [e] **0.0043 µg/l** (4 day average, total pesticide) [e] Sediment: [z] **7.1 ppm** (dry weight)	Water: **2.4 µg/l** (instantaneous max.) [e] **0.0043 µg/l** (4 day average, total pesticide) [e] Sediment: [z] **7.1 ppm** (dry weight)
Chlorpyrifos	Water:[m] **0.02 µg/l** (4 day average, total pesticide) [l,g]	Water:[m] **0.02 µg/l** (4 day average,total pesticide) [l,g]	Water:[m] **0.02 µg/l** (4 day average,total pesticide) [l,g]
Diazinon	Water:[n] **0.08 µg/l** (1 hour average,total pesticide)[l] **0.04 µg/l** (4 day average, total pesticide)[l]	Water:[n] **0.08 µg/l** (1 hour average,total pesticide)[l] **0.04 µg/l** (4 day average, total pesticide)[l]	Water:[n] **0.08 µg/l** (1 hour average,total pesticide)[l] **0.04 µg/l** (4 day average, total pesticide)[l]
DDT	Water: **1.1 µg/l** (instantaneous max., total pesticide) [e] **0.001 µg/l** (4 day average, ,total pesticide) [e] Tissue: [y] **1 µg/l** (whole fish, wet weight)	Water: **1.1 µg/l** (instantaneous max., total pesticide) [e] **0.001 µg/l** (4 day average, ,total pesticide) [e] Tissue: [o,y] **1 µg/l** (whole fish, wet weight)	Water: East of Antioch Bridge: **1.1 µg/l** (instantaneous max., total pesticide) [e] **0.001 µg/l** (4 day average, ,total pesticide) [e] West of Antioch Bridge: **1.1 µg/l** (instantaneous maximum) **0.001 µg/l** (24 hour average) Tissue: [y] **1 µg/l** (whole fish, wet weight)

Table S-1. CALFED Water Quality Targets for Parameters of Concern (Continued)

Parameter	Sacramento River	San Joaquin River	Delta
PCBs	<u>Water:</u> **0.014 µg/l** (4 day average) [a] (each of 7 congeners) <u>Sediment:</u> [z] **50 ppm** (dry weight, total) <u>Tissue:</u> [y] **0.5 µg/l** (whole fish, wet weight, total)	<u>Water:</u> **0.014 µg/l** (4 day average) [a] (each of 7 congeners) <u>Sediment:</u> [z] **50 ppm** (dry weight, total) <u>Tissue:</u> [y] **0.5 µg/l** (whole fish, wet weight, total)	<u>Water:</u> East of Antioch Bridge: **0.014 µg/l** (4 day average) [a] (each of 7 congeners) West of Antioch Bridge: **0.014 µg/l** (24 hour average) <u>Sediment:</u> [z] **50 ppm** (dry weight, total) <u>Tissue:</u> [y] **0.5 µg/l** (whole fish, wet weight, total)
Toxaphene	<u>Water:</u> **0.73 µg/l** (1 hour average) [a] **0.0002 µg/l** (4 day average) [a] <u>Tissue:</u> [y] **0.1 µg/l** (whole fish, wet weight) (sum of 9 organochlorine insecticides)	<u>Water:</u> **0.73 µg/l** (1 hour average) [a] **0.0002 µg/l** (4 day average) [a] <u>Tissue:</u> [y] **0.1 µg/l** (whole fish, wet weight) (sum of 9 organochlorine insecticides)	<u>Water:</u> East of Antioch Bridge: **0.73 µg/l** (1 hour average) [a] **0.0002 µg/l** (4 day average) [a] West of Antioch Bridge: **0.0002 µg/l** (4 day average) [a] <u>Tissue:</u> [y] **0.1 µg/l** (whole fish, wet weight) (sum of 9 organochlorine insecticides)
pH (Alkalinity as $CaCO_3$)			<u>Water:</u> Agricultural Intakes: **< 1.5 me/l**
Ammonia	<u>Water:</u> **0.08 - 2.5 µg/l** (4 day average) [a,p] **0.58 - 35 µg/l** (1 hour average) [a,p]	<u>Water:</u> **0.08 - 2.5 µg/l** (4 day average) [a,p] **0.58 - 35 µg/l** (1 hour average) [a,p]	<u>Water:</u> East of Antioch Bridge: **0.08 - 2.5 µg/l** (4 day average) [a,p] **0.58 - 35 µg/l** (1 hour average) [a,p] West of Antioch Bridge: **0.025 µg/l** (annual median) **0.16 µg/l** (maximum)
Bromide			<u>Water:</u> Drinking Water Intakes: **<50 µg/l** [ee, hh,ll] **; 50 - 150 µg/l** [uu]
TOC			<u>Water:</u> Drinking Water Intakes: **<3 mg/l** [ee,pp]**; 2 - 4 mg/l** [tt]

Table S-1. CALFED Water Quality Targets for Parameters of Concern (Continued)

Parameter	Sacramento River	San Joaquin River	Delta
Chloride			Water: Agricultural Intakes: For surface irrigation:[bb] **SAR: < 3**[cc] For sprinkle irrigation:[dd] **< 3 me/l** Drinking Water Intakes: **250 mg/l**[jj, kk]**; 150 mg/l**[ll]
Nutrients (Nitrate)			Water: Agricultural Intakes: **< 5.0 mg/l** Drinking Water Intakes: **10 mg/l**[jj]; no increase in nitrate levels[mm]
Salinity (EC_w)			Water: East of Antioch Bridge: West of Antioch Bridge: Agricultural Intakes: **< 0.7 dS/m or mmho/cm**[ee]
SAR:EC_w[ff] relationship			Water: Agricultural Intakes: SAR EC_w: **0 - 3 > 0.7** **3 - 6 > 1.2** **6 - 12 > 1.9** **12 - 20 > 2.9** **20 - 40 > 5.0**
Salinity (TDS)	Water:	Water:	Water: East of Antioch Bridge: West of Antioch Bridge: Agricultural Intakes: **< 450 mg/l** Drinking Water Intakes: <220mg/L (10-yr avg); <440mg/L (monthly avg)[oo]

Table S-1. CALFED Water Quality Targets for Parameters of Concern (Continued)

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Parameter	Sacramento River	San Joaquin River	Delta
Dissolved Oxygen	Water: Keswick Dam to Hamilton City, June 1 to August 31: **9.0 mg/l**[d,q] Below I Street Bridge: **7.0 mg/l**[d]	Water: Between Turner Cut and Stockton, September 1 through November 30: **6.0 mg/l** [d]	Water: [a] All Delta waters west of Antioch Bridge: **7000 µg/l** (minimum) [d,x] All Delta waters: **5.0 mg/l** [d,r]
Pathogens			Water: Drinking Water Intakes: **no MCL standard** [kk];<1 oocyst/100L for Giardia and Cryptosporidium[mm]
Temperature	Water: Keswick Dam to Hamilton City: **< 56° F** [d,u] Hamilton City to I Street Bridge: **< 68° F** [d,u] I Street Bridge to Freeport: **< 68°F** [d,v] I Street Bridge to Freeport, January 1 through March 31:< **66°F** [d,w]	Water: At Vernalis: **< 68°F** [d,v]	Water: West of Antioch Bridge: < **5°C** increase above for receiving water designated as cold or warm freshwater habitat. [x] Alteration of temperature shall not adversely affect beneficial uses. [x] Agricultural Intakes:
Turbidity			Water: West of Antioch Bridge: **No adverse effect or > 10 % change** Drinking Water Intakes: **0.5 or 1.0 NTU** [ll]; **50 NTU**[nn] Agricultural Intakes:
Unknown Toxicity [t]			Water: West of Antioch Bridge: Acute- A median of not less than **90%** survival and a 90 percentile of not less than **70%** survival Chronic - **no chronic toxicity** in ambient waters

NOTES:

- [a] dissolved form.
- [b] total recoverable form.
- [c] The effects of these concentrations were measured by exposing test organisms to dissolved aqueous solutions of 40 mg/l hardness that had been filtered through a 0.45-micron membrane filter. Where deviations from 40 mg/l of water hardness occur, the objectives (in mg/l) shall be determined using the following formulas:
  $Cu = e^{(0.905)(\ln hardness)} - 1.612 \times 10^3$
  $Zn = e^{(0.830)(\ln hardness)} - 0.289 \times 10^3$
  $Cd = e^{(1.160)(\ln hardness)} - 5.777 \times 10^3$
- [d] Central Valley Regional Water Quality Control Plan.
- [e] General U.S. Environmental Protection Agency (EPA) 304(a) guideline.

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[f] Within the next year, the State Water Resources Control Board (SWRCB) or EPA will promulgate/adopt objectives that are hardness dependent. The adoption language is likely to contain a clause saying that the most stringent objective applies. Sometimes the 10 µg/l objective will be more stringent, and at other times the new rule will be more stringent.

[g] Similar to the objectives for copper, the SWRCB or EPA is expected to promulgate new objectives within the next year that will be more stringent than current objectives.

[h] The Central Valley Regional Water Quality Control Board expects to adopt an objective for carbofuran within the next year. The objective probably will be very similar to the performance goal.

[i] Water quality-limited segments for mercury in fish tissue occur in the Sacramento River and Delta.

[j] Water quality-limited segments for selenium in the water column from Salt Slough to Vernalis on the San Joaquin River.

[k] The lower Sacramento River is a water-quality limited segment for carbofuran.

[l] California Department of Fish and Game acute (1-hour) and chronic (4-day) hazard assessment criteria.

[m] The Sacramento River, San Joaquin River, and Delta are water quality-limited segments for chlorpyrifos.

[n] The Sacramento River, San Joaquin River, and Delta are water quality-limited segments for diazinon.

[o] The San Joaquin River is a water quality-limited segment for DDT in tissue.

[p] Values are a function of pH, temperature, and designation of the waterbody as cold water or warmwater fish beneficial use.

[q] When natural conditions lower dissolved oxygen below this level, the concentrations shall be maintained at or above 95% of saturation.

[r] Except those waterbodies constructed for special purposes and from which fish have been excluded, or where the fishery is not important and a beneficial use.

[s] The southern Delta around Stockton is a water quality-limited segment for dissolved oxygen.

[t] Bioassay results or other special studies demonstrate toxicity. The Sacramento River, San Joaquin River, and Delta are water quality-limited segments for "unknown toxicity."

[u] *The temperature shall not be elevated above 56°F in the reach from Keswick Dam to* Hamilton City nor above 68°F in the reach from Hamilton City to I Street Bridge during periods when temperature increases will be detrimental to the fishery.

[v] The daily average water temperature shall not be elevated by controllable factors above 68°F from the I Street Bridge to Freeport on the Sacramento River, and at Vernalis on the San Joaquin River between April 1 through June 30 and between September 1 through November 30 in all water year types.

[w] The daily average water temperature shall not be elevated by controllable factors above 66°F from the I Street Bridge to Freeport on the Sacramento River between January 1 through March 31.

x San Francisco Regional Water Quality Control Board objectives at 100 mg/l hardness. Formulas for calculating objectives for varying hardness levels are as follows:

$Cd = e^{(0.7852H - 3.490)}$ (4-day average)

$= e^{(1.128H - 3.828)}$ (1-hour average)

$Cu = e^{(0.8545H - 1.465)}$ (4-day average)

$= e^{(0.9422H - 1.464)}$ (1-hour average)

$Zn = e^{(0.8473H + 0.7614)}$ (4-day average)

$= e^{(0.8473H + 0.8604)}$ (1-hour average)

[y] National Academy of Sciences (NAS)-National Academy of Engineering 1973. ***[need this cite]***

[z] Effect range-low (ERL) concentrations.

[aa] San Luis Drain Reuse, Technical Advisory Committee Selenium ecological risk guidelines.

[bb] For surface irrigation, most tree crops and woody plants are sensitive to sodium and chloride—use the values shown. Most annual crops are not sensitive—use the salinity tolerance in Ayers and Westcot ***[year?]*** or equivalent.

[cc] SAR means sodium adsorption ratio. SAR sometimes is reported by the symbol RNa.

[dd] For overhead sprinkle irrigation, and low humidity (< 30%), sodium and chloride greater than 70 or 100 mg/l, respectively, have resulted in excessive leaf adsorption and crop damage to sensitive crops, see Ayers and Westcot ***[year?]***.

[ee] EC_w means electrical conductivity of irrigation water, reported in mmho/cm ***[use µmho?]*** or dS/m.

[ff] At a given SAR, the infiltration rate increases as salinity EC_w increases. To evaluate a potential permeability problem, examine SAR and EC_w together.

[gg] Value arrived at in discussion with California Urban Water Agencies (CUWA).

[hh] Bromide value is predicated on the assumption that the MCL for Bromate will be 5 µg/l.

[ii] EPA secondary MCL. 1995.

[jj] EPA current MCL. 1995.

[kk] EPA requires removal of 99.9 % of *Giardia* and 99.99% of viruses during water treatment.

[ll] Target level based on the CUWA Expert Panel Report recommendations (Bay-Delta Water Quality Criteria, December 1996). Expert panel assumed future drinking water regulatory scenario for disinfection byproduct (DBP) control and inactivation of *Giardia* and *Cryptosporidium* based on the proposed Stage Two D/DBP Rule and Proposed Enhanced Surface Water Treatment Rule (ESWTR). *The bromide target level is constrained by the formation of bromate when using* ozone to inactivate *Cryptosporidium*.

[mm] Nutrients are a critical reservoir management issue. Nutrient levels are a determining factor governing the growth of taste- and odor-producing algae in water storage reservoirs. SWP supplies are nitrogen-limited; however, phosphorous is present in great excess. This is a problem with respect to the growth of blue-green algae, which can fix their own nitrogen. Water quality impacts of nutrients are driven by reservoir management issues as opposed to human health effects; as a result, use of the MCL for nitrate (as N) of 10 mg/L is not appropriate.

[nn] Desirable target levels are based on likely future regulatory scenarios under the ESWTR that will base required levels of pathogen removal/inactivation treatment on pathogen density in source water. Future regulations may require additional log *removal requirements for Cryptosporidium.* Increasing treatment for removal of pathogens makes it more difficult to control the formation of DBPs. To balance disinfection requirements for controlling pathogens with the production of DBPs, selection of a Bay-Delta alternative should not result in degraded water quality necessitating increased removal requirements for pathogens.

[oo] Target levels for TDS would allow compliance with the TDS objectives contained in Article 19 of the SWP Water Service Contract. The average TDS levels in SWP supplies over the last 10 years consistently have exceeded the 220 mg/L (10-year average) SWP objective. The 10-year averaging period for the 220mg/L objective is too long to be sufficiently protective of source water quality. Metropolitan Water District staff currently are exploring the development of appropriate alternative TDS objectives for shorter time frames (1-year and 6-month averages) and will forward that information to CALFED when available. The SWP TDS objective of 440 mg/L (monthly average) is a problem for water resource management programs, especially in April and September, and there is a real need to reduce peaks in TDS in SWP supplies. Consistently low TDS levels are needed to minimize the following salinity-related impacts: increased demand for Delta water supplies when such water is used to blend with other higher salinity water sources; and adverse impacts on water recycling and groundwater replenishment programs, which depend on Delta water supplies to meet local resource program salinity objectives. Failure to develop local resource programs may result in increased demand on Delta exports and economic impacts on industrial, residential, and agricultural water users.

[pp] Target level based on the California Urban Water Agencies Expert Panel report recommendations (Bay-Delta Drinking Water Quality Criteria, December 1996). Expert panel assumed future drinking water regulatory scenario for DBP control and inactivation of *Giardia* and *Cryptosporidium* based on the proposed Stage 2 D/DBP Rule and proposed ESWTR. The proposed D/DBP Rule requires increased levels of total organic carbon (TOC) removal as TOC concentrations in source waters increase. The recommended TOC target level is constrained by the formation of total trihalomethanes when using enhanced coagulation for TOC removal and free chlorine to inactivate *Giardia*.

[qq] Reduced variability in turbidity is needed to improve treatment plant performance. When source water turbidity increases, water is more difficult and costly to treat. Also, increased turbidity reduces protection from pathogens because turbidity

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interferes with disinfection.

[rr] Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary. May 1995. 95-IWR. SWRCB and Cal-EPA. According to the Water Quality Control Plan, this value applies from October to September during all water-year types for Contra Costa Canal at Pumping Plant No. 1, West Canal at Mouth of Clifton Court Forebay, Delta-Mendota Canal at Tracy Pumping Plant, Barker Slough at North Bay Aqueduct Intake, and Cache Slough at City of Vallejo Intake.

[ss] Water Quality Control Plan for the San Francisco Bay/Sacramento - San Joaquin Delta Estuary, May 1995. 95-IWR. According to the Water Quality Control Plan, this value applies to a certain number of days per year, depending on water-year type, to the Contra Costa Canal at Pumping Plant No. 1 and the San Joaquin River at Antioch Water Works Intake.

[tt] EPA recommendation September 30, 1997.

[uu] EPA recommendation July 24, 1997.

Table S-1. CALFED Water Quality Targets for Parameters of Concern (Continued)

DRINKING WATER RULES, REGULATIONS, AND REQUIREMENTS

Drinking water regulations primarily define requirements for "treated" water quality versus the regulations noted above that define requirements for "source" water quality. Following are the regulatory water quality requirements for drinking water.

SAFE DRINKING WATER ACT

The Safe Drinking Water Act (SDWA) (Public Law 99-339) was enacted by the U.S. Congress and signed into law by the President in 1974. Through the SDWA, the federal government gave EPA the authority to set standards for contaminants in drinking water supplies. The SDWA was reauthorized in August 1996. Amendments were developed to provide more flexibility, more state responsibility, and more cooperative approaches. The law changes the standard-setting procedure for drinking water and establishes a State Revolving Loan Fund to help public water systems to improve their facilities and ensure compliance with drinking water regulations. Under the provisions of the SDWA, the California Department of Health Services (DHS) has primary enforcement responsibility. Title 22 of the California Administrative Code establishes DHS authority and stipulates drinking water quality and monitoring standards. To maintain primacy, a state's drinking water regulations can be no less stringent than the federal standards. These amendments also created a source water assessment program that requires states to delineate the boundaries of public water supply areas and to identify potential sources of contaminants and the vulnerability of supplies to these contaminants.

NATIONAL PRIMARY DRINKING WATER STANDARDS

The National Primary Drinking Water Standards or maximum contaminant levels (MCLs) are the maximum permissible levels of contaminants in water that enter the distribution system of a public water system, except in the case of bacteriological quality and trihalomethanes, where the MCLs are measured within the distribution system. The federal and state MCLs are enforceable and must be met by appropriate public drinking water systems. The MCLs generally are derived by balancing the technologic and economic concerns that are directly related to the use of water for domestic supplies. Health effects information is developed in the risk assessment process as part of the derivation of the MCLs.

National maximum contaminant level goals (MCLGs) depict the maximum level of a contaminant in drinking water at which no known or anticipated adverse effect on the health of persons would occur, and which allows an adequate margin of safety. MCLGs are non-enforceable health goals and are strictly health based. The derivation of MCLGs does not include a technological or economic evaluation.

Action levels (ALs) are health-based numbers that take into account analytical detection levels. They are interim guidance levels that may trigger mitigation action on the part of a water purveyor. Public notification is not required when an AL is exceeded; but may be recommended by DHS. When an MCL is promulgated and final, it supercedes an AL.

The Phase I Rule was promulgated in 1987 and established MCLs, MCLGs, and best available technologies [BATs] for eight volatile organic chemicals (VOCs). Phase II and IIB Rules were promulgated in 1991 and regulated an additional 16 synthetic organic chemicals (SOCs), 10 VOCs, and seven inorganic chemicals (IOCs). Phase II and IIB Rules contain MCLs, MCLGs, and treatment techniques for these chemicals. The Phase V Rule was promulgated in 1992 and regulates 13 SOCs, five

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IOCs, and three VOCs. Phase V established MCLGs, MCLs, laboratory criteria, and BATs for these 23 contaminants.

NATIONAL SECONDARY DRINKING WATER REGULATIONS

National secondary drinking water regulations (NSDWR) or secondary MCLs were established by the EPA in 1979 and 1991. The secondary MCLs are maintained to protect public welfare and to assure a supply of pure, wholesome, and potable water. The MCLs are applied at the point of delivery to the consumer and generally involve protection of the taste, odor, or appearance of drinking water. Federal secondary MCLs are nonenforceable; however, state secondary MCLs are enforceable for all new systems and new sources developed by existing systems. In California, DHS regulates and enforces secondary standards. Public notification is required if the 2.0 mg/l secondary standard for fluoride is exceeded.

TRIHALOMETHANE REGULATIONS

These regulations apply to all public water systems serving populations greater than 10,000. Large-sized utilities were required to begin monitoring for total trihalomethanes (TTHMs) in November 1980. The regulation established an MCL of 100 μg/L for TTHMs in the distribution system. TTHMs include the summation of chloroform, bromodichloromethane, dibromochloromethane, and bromoform concentrations. Because THMs form as a result of the application of the disinfectant, compliance with the MCL is based on a running annual average of at least four representative sampling points for each treatment plant, with 25% of the samples taken at locations in the distribution system representing the maximum residence time of water in the system, and with at least 75% of the samples collected from representative sites in the distribution system (considering number of persons served, sources of water, and treatment methods).

FEDERAL LEAD AND COPPER RULE

The final Lead and Copper Rule was promulgated by the EPA in 1991 (56 FR 26460). The first flush water samples from consumers' taps are to be monitored. If more than 10% of these samples contain greater than the AL of 0.015 mg/l for lead or 1.3 mg/l for copper, three required actions initially must be taken: corrosion control treatment, source water treatment, and public education. The Lead and Copper Rule eliminated the lead MCL and the copper secondary MCL.

FEDERAL SURFACE WATER TREATMENT RULE

The Surface Water Treatment Rule (SWTR) was promulgated by the EPA in June 1989 to protect against *Giardia lamblia*, viruses, *Legionella*, and heterotrophic bacteria in U.S. surface drinking water sources and in groundwater sources influenced by surface water. These five contaminants were included on the list of 83 contaminants to be regulated by the EPA according to the 1986 SDWA Amendments. Water systems with clean and protected source waters meeting the source water quality and site-specific criteria may not have to filter if they meet the disinfectant contact time criteria continuously. For those that must filter, June 1993 was the deadline to meet filtration requirements and performance criteria for both turbidity and disinfection.

The SWTR requires all utilities with a surface water supply, or a groundwater supply under the influence of a surface water supply, to provide adequate disinfection and, under most conditions, to provide filtration. Exemptions from filtration of surface water supplies are provided in rare occasions where the source water supply meets extremely rigid requirements for water quality and the utility possesses control of the watershed. Each utility also must perform a watershed sanitary survey at least every 5 years, according to California state law.

EPA proposed an Enhanced Surface Water Treatment Rule (ESWTR) as an amendment to the SWTR in July 1995. The purpose of the amendment is to provide additional protection against disease-causing organisms such as *Giardia lamblia, Cryptosporidium parvum*, and viruses in drinking water. The ESWTR outlines several alternatives for treatment requirements based on source water concentrations for these pathogens.

CALIFORNIA SURFACE WATER TREATMENT REGULATIONS

State surface water treatment regulations are the result of a series of amendments to the National Primary Drinking Water Regulations. The state regulations that are found in Title 22 of the California Code of Regulations became effective in 1991. Like the federal rule, the state required multi-barrier treatment for microbiological contaminants, effective June 1993. Unlike the federal rule, all public water systems in California must filter all surface water and the part of their groundwater that is under the influence of surface water. Due to high implementation costs, this aspect of the regulation may be amended in the future to allow qualifying systems to avoid filtration.

DISINFECTANTS/DISINFECTION BYPRODUCTS RULE

The 1986 amendments to the federal SDWA require that the EPA propose a rule for disinfectants and DBPs. The rule must balance the need for protection from cancer-causing chemicals (the byproducts) with the need for protection from pathogenic microbes (bacteria, viruses, and protozoans) that are killed by disinfection. In 1992, the EPA initiated a rule-making process. The negotiators consisted of state and local health and regulatory agency staff, elected officials, consumer groups, environmental groups, and representatives of public water systems. The "Reg-Neg" process resulted in a two-stage approach for regulation development.

Stage One of regulation is the draft Disinfectant/Disinfection Byproducts Rule (D/DBPR), which was proposed by the EPA in 1994. Stage One regulations are expected to be promulgated in 1998. Compounds affected under the first stage of the D/DBPR are TTHMs, total haloacetic acids, TOC, bromate, chlorine, chloramines, chlorine dioxide, and chlorite.

In Stage Two, EPA will collect data on parameters that influence DBP formation and occurrence of DBPs in drinking water through the Information Collection Rule process. Based on this information and new data collected from research, EPA will re-evaluate the Stage One regulations and make changes as necessary.

FEDERAL TOTAL COLIFORM RULE

The Total Coliform Rule became effective in 1990. The Rule establishes microbiological standards and monitoring requirements that apply to all public water systems. Compliance is based on the presence or absence of total coliforms in a sample, rather than on an estimate of coliform density.

CALIFORNIA TOTAL COLIFORM REGULATIONS

The State of California has analogous total coliform regulations that are found under Title 22, Chapter 15 of the California Code of Regulations. DHS has set an enforceable drinking water standard for total coliforms, identical to that of the federal rule.

A list of contaminants currently regulated for drinking water by both the EPA and DHS is presented in Table S-2. The table identifies the federal regulation and the section of the regulation, as well as the MCL or treatment technology associated with each contaminant. At the state level, the DHS has promulgated regulations for a number of contaminants at levels below the EPA MCLs.

Classification	Contaminant	Regulation	MCL (mg/L)
Inorganics (Section 64432)			
	Aluminum	DHS	1
	Antimony	Phase V	0.006
	Arsenic	NPDWR	0.05
	Barium	Phase II	1[a]
	Beryllium	Phase V	0.004
	Cadmium	Phase II	0.005
	Chromium	Phase II	0.05[a]
	Cyanide	Phase V	0.2
	Fluoride	NPDWR	1.4 to 2.4[a]
	Lead	LCR	0.015[b]
	Mercury	Phase II	0.002
	Nickel	Phase V	0.1[d]
	Selenium	Phase II	0.05
	Thalium	Phase V	0.002
Nitrate, Nitrite (Section 64432.1)			
	Nitrate	Phase II	45 (as N03)
	Nitrite	Phase II	1 (as N)
Asbestos (Section 64432.2)			
	Asbestos	Phase II	7 MFL
Secondary Standards (Section 64449, Table 64449-A)			
	Aluminum	DHS	0.2
	Color	DHS	15 Units
	Copper	LCR	1.0[b]
	Corrosivity	DHS	non-corrosive
	Foaming Agents	DHS	0.5
	Iron	DHS	0.3
	Manganese	DHS	0.05
	Odor-Threshold	DHS	3 Units
	Silver	DHS	0.1
	Thiobencarb	DHS	0.001
	Turbidity	SWTR	0.5/5 NTU
	Zinc	DHS	5
Secondary Standards (Section 64449, Table 64449-B)			
	Total Dissolved Solids	DHS	"500/1,000/1,500[c]"
	Specific Conductance	DHS	"900/1,600/2,200[c]"
	Chloride	DHS	250/500/600[c]
	Sulfate	DHS	250/500/600[c]
General Mineral (Section 64449 (c) (2))			
	Bicarbonate	DHS	MO
	Carbonate	DHS	MO
	Hydroxide	DHS	MO
	Alkalinity	DHS	MO
	pH	DHS	MO
	Calcium	DHS	MO

Table S-2. Summary of Contaminants Currently Regulated by EPA and DHS

Classification	Contaminant	Regulation	MCL (mg/L)
	Magnesium	DHS	MO
	Sodium	DHS	MO
	Hardness	DHS	MO
(Volatile) Organic Chemicals (Section 64444, Table 64444-A (a))			
	Benzene	Phase I	0.001[a]
	Carbon Tetrachloride	Phase I	0.0005[a]
	o-Dichlorobenzene	Phase II	0.6
	p-Dichlorobenzene	Phase I	0.005[a]
	"1,1-Dichloroethane"	DHS	0.005
	"1,2-Dichloroethane"	Phase I	0.0005[a]
	"1,1-Dichloroethylene"	Phase I	0.006[a]
	"cis-1,2-Dichloroethylene"	Phase II	0.006[a]
	"trans-1,2-Dichloroethylene"	Phase II	0.010[a]
	Dichloromethane	Phase V	0.005
	"1,2-Dichloropropane"	Phase II	0.005
	"1,3-Dichloropropene"	DHS	0.0005
	Ethylbenzene	Phase II	0.7
	Monochlorobenzene	Phase II	0.07[a]
	Styrene	Phase II	0.1
	"1,1,2,2-Tetrachloroethane"	DHS	0.001
	Tetrachloroethylene	Phase II	0.005
	Toluene	Phase II	0.15[a]
	"1,2,4-Trichlorobenzene"	Phase V	0.07
	"1,1,1-Trichloroethane"	Phase I	0.2
	"1,1,2-Trichloroethane"	Phase V	0.005
	Trichloroethylene	Phase I	0.005
	Trichlorofluoromethane	DHS	0.15
	1,1,2-Trichloro-1,2,2-Triflouroethane	DHS	1.2
	Vinyl Chloride	Phase I	0.0005[a]
	Xylenes (total)	Phase II	1.75[a]
(Non-Volatile Synthetic) Organic Chemicals (Section 64444, Table 64444-A (b))			
	Acrylamide	Phase II	TT (PAP)
	Alachlor	Phase II	0.002
	Atrazine	Phase II	0.003
	Bentazon	DHS	0.018
	Benzo(a)pyrene	Phase V	0.0002
	Carbofuran	Phase II	0.018[a]
	Chlordane	Phase II	0.0001[a]
	"2,4,-D"	Phase II	0.07
	Dalapon	Phase V	0.2
	Dibromochloropropane	Phase II	0.0002
	Di (2-ethylhexyl) Adipate	Phase V	0.4
	Di (2-ethylhexyl) Phthalate	Phase V	0.004[a]
	Dinoseb	Phase V	0.007
	Diquat	Phase V	0.02
	Endothall	Phase V	0.1
	Endrin	Phase V	0.002
	Epichlorohydrin	Phase II	TT (PAP)
	Ethylene Dibromide	Phase II	0.00005

Table S-2. Summary of Contaminants Currently Regulated by EPA and DHS (Continued)

Classification	Contaminant	Regulation	MCL (mg/L)
	Glyphosate	Phase V	0.7
	Heptachlor	Phase II	0.00001[a]
	Heptachlor Epoxide	Phase II	0.00001[a]
	Hexachlorobenzene	Phase V	0.001
	Hexachlorocyclopentadiene	Phase V	0.05
	Lindane	Phase II	0.0002
	Methoxychlor	Phase II	0.04
	Molinate	DHS	0.02
	Oxamyl (vydate)	Phase V	0.2
	Pentachlorophenol	Phase II	0.001
	Picloram	Phase V	0.5
	PCBs	Phase II	0.0005
	Simazine	Phase V	0.004
	Thiobencarb	DHS	0.07
	Toxaphene	Phase II	0.003
	"2,3,7,8-TCDD (Dioxin)"	Phase V	3.00E-08
	"2,4,5-TP (Silvex)"	Phase II	0.05
Unregulated (Volatile) Organic Chemicals (Section 64450, Table 64450-A)			
	Bromobenzene	Phase I	MO
	Bromodichloromethane	Phase I	MO
	Bromoform	Phase I	MO
	Bromomethane	Phase I	MO
	Chlorodibromomethane	Phase I	MO
	Chloroethane	Phase I	MO
	Chloroform	Phase I	MO
	Chloromethane	Phase I	MO
	o-Chlorotolulene	Phase I	MO
	p-Chlorotoluene	Phase I	MO
	Dibromomethane	Phase I	MO
	m-Dichlorobenzene	Phase I	MO
	Dichlorodifluoromethane	DHS	MO
	1,3-Dichloropropane	Phase I	MO
	2,2-Dichloropropane	Phase I	MO
	1,1-Dichloropropene	Phase I	MO
	1,1,1,2-Tetrachloroethane	Phase I	MO
	1,2,3-Trichloropropane	Phase I	MO
Unregulated Organic Chemicals (Section 64450, Table 64450-B)			
	Bromacil	DHS	MO (if vulnerable)
	Bromochloromethane	DHS	MO (if vulnerable)
	n-Butylbenzene	DHS	MO (if vulnerable)
	sec-Butylbenzene	DHS	MO (if vulnerable)
	tert-Butylbenzene	DHS	MO (if vulnerable)
	Chlorothalonil	DHS	MO (if vulnerable)
	Diazinon	DHS	MO (if vulnerable)
	Dimethoate	DHS	MO (if vulnerable)
	Diuron	DHS	MO (if vulnerable)
	Hexachlorobutadiene	DHS	MO (if vulnerable)
	Isopropylbenzene	DHS	MO (if vulnerable)
	p-Isopropyltoluene	DHS	MO (if vulnerable)

Table S-2. Summary of Contaminants Currently Regulated by EPA and DHS (Continued)

Classification	Contaminant	Regulation	MCL (mg/L)
	Naphthalene	DHS	MO (if vulnerable)
	n-Propylbenzene	DHS	MO (if vulnerable)
	Prometryn	DHS	MO (if vulnerable)
	1,2,3-Trichlorobenzene	DHS	MO (if vulnerable)
	1,2,4-Trimethylbenzene	DHS	MO (if vulnerable)
	1,3,5-Trimethylbenzene	DHS	MO (if vulnerable)
Unregulated Organic Chemicals (Section 64450, Table 64450-C)			
	Aldicarb	Phase II	0.003
	Aldicarb Sulfone	Phase II	0.002
	Aldicarb Sulfoxide	Phase II	0.004
	Aldrin	Phase II	MO
	Butachlor	Phase II	MO
	Carbaryl	Phase II	MO
	Dicamba	Phase II	MO
	Dieldrin	Phase II	MO
	3-Hydroxycarbofuran	Phase II	MO
	Methomyl	Phase II	MO
	Metolachlor	Phase II	MO
	Metribuzin	Phase II	MO
	Propachlor	Phase II	MO
Natural Radioactivity (Section 64441)			
	Gross Alpha Particle Activity	NPDWR	15 pCi/L
	Radium 226 & 228	NPDWR	5 pCi/L
	Uranium	DHS	20 pCi/L
Man-Made Radioactivity (Section 64443)			
	Tritium	DHS	"20,000 pCi/L"
	Strontium-90	DHS	8 pCi/L
	Gross Beta Particle Activity	NPDWR	50 pCi/L
Microbial			
	Giardia Lamblia	SWTR	3-log Reduction
	Heterotrophic Plate Counts	SWTR	<500/mL
	Legionella		SWTR
	Viruses	SWTR	4-Log Reduction
	Disinfectant Residual	SWTR	0.2
	Fecal Coliform		TCR
	E. Coli	TCR	<5% monthly samples pos.
	Total Coliform	TCR	<5% monthly samples pos.

NOTES:

TT = Treatment Technology.
PAP = Polymer Addition Practices.
MO = Monitored Only.
[a] DHS MCL lower than EPA.
[b] Action Level.
[c] Recommended/Upper/Short-Term MCLs.
[d] DHS MCL lower than EPA, EPA remanded in 1995.

Table S-2. Summary of Contaminants Currently Regulated by EPA and DHS (Continued)

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Valence State	Common Forms	Inorganic or Organic	Solubility in Water	Toxicity[a]	Remarks
Se^{+6}	Selentate ion (SeO_4^{-2})	Inorganic	Highly soluble	Moderately toxic	Most common form in San Joaquin Valley waters. Readily taken up by plants.
Se^{+4}	Selenite ion (SeO_3^{-2})	Inorganic	Moderately soluble	Moderately to highly toxic	Common waterborne form. Readily reduced to elemental selenium and precipitates with iron and aluminum.
Se^{0}	Elemental selenium (Se^0)	Inorganic	Insoluble	Nontoxic	Metalloid mineral. Poorly taken up by organisms.
Se^{-2}	Selenomethionine ($C_5H_{11}NO_2Se$)	Organic	Highly soluble	Moderately to highly toxic	Amino acid. May be dominant form in plant tissues.
Se^{-2}	Selencysteine ($C_3H_7NO_2Se$)	Organic	Highly soluble	Unknown	Amino acid. May be dominant form in animal tissues.
Se^{-2}	Selencystine ($C_6H_{12}N_2O_4Se_2$)	Organic	Highly soluble	Slightly toxic	Amino acid.
Se^{-2}	Dimethyl selenide ($(CH_3)_2Se$)	Organic	Relatively insoluble	Nontoxic	Volatile, rapidly changes form. Common form excreted through exhalation.
Se^{-2}	Dimethyl diselenide ($(CH_3)_2Se_2$)	Organic	Relatively insoluble	Unknown	Volatile, rapidly changes form. Common form released by plants.
Se^{-2}	Hydrogen selenide (H_2Se)	Inorganic	Relatively insoluble	Highly toxic	Occurs in industrial settings. Volatile, rapidly decomposes to elemental selenium and water in presence with oxygen.
Se^{-2}	Trimethyl selenonium ion ($(CH_3)_3Se^{+1}$)	Organic	Soluble	Nontoxic	Excreted with urine.
Se^{-2}	Metal selenides	Inorganic	Insoluble	Nontoxic	Excreted with feces.

[a] Relative toxicity of chemical in elevated concentrations (in concentrations greater than would be expected in uncontaminated [background] environments).

Table S-3. Selenium: Chemical Forms and Characteristics

SUPPLEMENTAL INFORMATION PERTAINING TO PARAMETER LOADING TABLES

Bromide Loading Notes

a. Concentration data were received from Ray Tom of the Department of Water Resources. Concentration data were collected at Green's Landing for the Sacramento River and Vernalis for the San Joaquin River. Flow data are from USGS Water Data Reports for the years in which concentration data were available.

   Loads were calculated for each day data were available. For the period of record the average daily load was calculated from all the daily values. The annual load for the period of record is the product of the average daily load multiplied times the number of seconds in a year. The resulting value was converted to an average annual value by dividing the annual load for the period of record by the average daily flow over the period of record and then multiplying the result times the long term daily average flow rate.

   average annual load = ((average daily load * number of seconds in a year) / average daily flow over the period of record)* long term daily average flow rate

b. See note a for explanation.

Cadmium Loading Notes

a. The original data for the load estimate were obtained from "A mass loading assessment of major point and non-point sources discharging to surface waters in the Central Valley, California, 1985" prepared by the RWQCB Central Valley Region in 1988. Flow and load data were compiled for four inactive mines including Iron Mountain, Newton, New Idria and Afterthought Mines. Only mines that drain to the Sacramento River or its tributaries below Shasta, Oroville and Nimbus Dams were considered. Eighty-five percent of the load was from Iron Mountain. A later report by Central Valley RWQCB prepared in 1989 and entitled "A mass loading assessment of major point and non-point sources in the Sacramento Valley, California, 1985" estimated that the earlier mine drainage estimate only represented 25% of the total. A further review of the two RWQCB documents was made by Woodward-Clyde in light of information contained in a 1992 report by the Central Valley Board entitled "Inactive mine drainage in the Sacramento Valley". Data in this report suggests that mine drainage represents about 50% of the total cadmium load from inactive mines. The 50% estimate was used to scale up the loads originally calculated by RWQCB. The loads calculated in the 1988 RWQCB were segregated into the three geographical areas, delta, San Joaquin Basin and Sacramento Basin below dams.

b. The original data for the load estimate were obtained from "A mass loading assessment of major point and non-point sources discharging to surface waters in the Central Valley, California, 1985" prepared by the RWQCB Central Valley Region in 1988. Flow and load data were compiled from several NPDES dischargers who have been monitoring copper. including the largest in the Central Valley the Sacramento Regional County Sewer District. Woodward-Clyde divided the results into two geographical areas, the delta and the Sacramento Basin. A later report by Central Valley RWQCB prepared in 1989 and entitled "A mass loading assessment of major point and non-point sources in the Sacramento Valley, California, 1985" estimated that the earlier M and I estimate only represented 50% of the total. This percentage was used to scale up the loads.

c. The original data for the load estimate were obtained from "A mass loading assessment of major point and non-point sources discharging to surface waters in the Central Valley, California, 1985" prepared by the RWQCB Central Valley Region in 1988. Urban runoff estimates were made for 19 large cities in the Central Valley. Flow data were calculated using rainfall data for cities, urban acreage and a runoff factor of 0.3. Quality data for the city of Sacramento were used for all cities. A later report by Central Valley RWQCB prepared in 1989 and entitled "A mass loading assessment of major point and non-point sources in the Sacramento Valley, California, 1985" estimated that the earlier urban runoff estimate only represented 35% of the total. A further review of the original data by Woodward-Clyde concluded that the original estimate probably captured 70% of the load, because all major urban areas were included in the calculations. The 70% figure was used to scale up the original estimates. The data allowed separation of the loads into three geographical areas, the delta, San Joaquin Basin and the Sacramento Basin.

d. The original data for the load estimate were obtained from "A mass loading assessment of major point and non-point sources discharging to surface waters in the Central Valley, California, 1985" prepared by the RWQCB Central Valley Region in 1988. Flow and concentration information was compiled for the major drains in the Sacramento Basin, including Sacramento Slough, Colusa Basin Drain, RD1000, RD108 and Natomas East Main Drain. A later report by Central Valley RWQCB prepared in 1989 and entitled "A mass loading assessment of major point and non-point sources in the Sacramento Valley, California, 1985" estimated that the earlier agricultural runoff estimate only represented 80% of the total. This percentage was used to scale up the estimates.

e. See note a for explanation.

f. See note b for explanation.

g. See note c for explanation.

h. Concentration data are from EarthInfo USGS Quality of Water databases on CD-ROM (EarthInfo, 1996). Flow data arefrom USGS Water Data Reports for the years in which concentration data were available. For the Sacramento River concentration and flow data used in the load calculation are from Freeport. For the San Joaquin River concentration and flow data used in the load calculation are from Vernalis.

   Loads were calculated for each day data were available. For the period of record the average daily load was calculated from all the daily values. The annual load for the period of record is the product of the average daily load multiplied times the number of seconds in a year. The resulting value was converted to an average annual value by dividing the annual load for the period of record by the average daily flow over the period of record and then multiplying the result times the long term daily average flow rate.

   average annual load = ((average daily load * number of seconds in a year) / average daily flow over the period of record)* long term daily average flow rate.

i. See Note a for explanation.

j. See Note b for explanation.

k. See Note c for explanation.

l See Note h for explanation.

m. Reported in Table 19 of "State of the Estuary: A report on conditions and problems in San Francisco Bay/Sacramento-San Joaquin Delta Estuary' San Francisco Estuary Project, 1992. Middle of range of values used .

n. See Note mc for explanation.

o. Total emission from upper Sacramento Basin was calculated using flow and concentration data for releases from Shasta, Oroville and Nimbus Dams. Reported in "A mass loading assessment of major point and non-point sources discharging to surface waters in the Central Valley, California, 1985" prepared by the RWQCB Central Valley Region in 1988.

Copper Loading Notes

a. The original data for the load estimate were obtained from "A mass loading assessment of major point and non-point sources discharging to surface waters in the Central Valley, California, 1985" prepared by the RWQCB Central Valley Region in 1988. Flow and load data were compiled for four inactive mines including Iron Mountain, Newton, New Idria and Afterthought Mines. Only mines that drain to the Sacramento River or its tributaries below Shasta, Oroville and Nimbus Dams were considered. Ninety-five percent of the load was from Iron Mountain. A later report by Central Valley RWQCB prepared in 1989 and entitled "A mass loading assessment of major point and non-point sources in the Sacramento Valley, California, 1985" estimated that the earlier mine drainage estimate only represented 25% of the total. A further review of the two RWQCB documents was made by Woodward-Clyde in light of information contained in a 1992 report by the Central Valley Board entitled "Inactive mine drainage in the Sacramento Valley". Data in this report suggests that Iron Mountain represents about 50% of the total copper load from inactive mines. The 50% estimate was used to scale up the loads originally calculated by RWQCB. The loads calculated in the 1988 RWQCB were segregated into the three geographical areas, delta, San Joaquin Basin and Sacramento Basin below dams.

b. The original data for the load estimate were obtained from "A mass loading assessment of major point and non-point sources discharging to surface waters in the Central Valley, California, 1985" prepared by the RWQCB Central Valley Region in 1988. Flow and load data were compiled from several NPDES dischargers who have been monitoring copper. including the largest in the Central Valley the Sacramento Regional County Sewer District. Woodward-Clyde divided the results into two geographical areas, the delta and the Sacramento Basin. A later report by Central Valley RWQCB prepared in 1989 and entitled "A mass loading assessment of major point and non-point sources in the Sacramento Valley, California, 1985" estimated that the earlier M and I estimate only represented 50% of the total. This percentage was used to scale up the loads.

c. The original data for the load estimate were obtained from "A mass loading assessment of major point and non-point sources discharging to surface waters in the Central Valley, California, 1985" prepared by the RWQCB Central Valley Region in 1988. Urban runoff estimates were made for 19 large cities in the Central Valley. Flow data were calculated using rainfall data for cities, urban acreage and a runoff factor of 0.3. Quality data for the city of Sacramento were used for all cities. A later report by Central Valley RWQCB prepared in 1989 and entitled "A mass loading assessment of major point and non-point sources in the Sacramento Valley, California, 1985" estimated that the earlier urban runoff estimate only represented 35% of the total. A further review of the original data

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by Woodward-Clyde concluded that the original estimate probably captured 70% of the load, because all major urban areas were included in the calculations. The 70% figure was used to scale up the original estimates. The data allowed separation of the loads into three geographical areas, the delta, San Joaquin Basin and the Sacramento Basin.

d. Copper concentrations are available from various sampling locations within the Delta and at the San Joaquin River inflow to the Delta. Most of this data can be found at the Interagency Ecological Program web site. Work is in progress to acquire matching discharge data and calculate loads.

e. The original data for the load estimate were obtained from "A mass loading assessment of major point and non-point sources discharging to surface waters in the Central Valley, California, 1985" prepared by the RWQCB Central Valley Region in 1988. Flow and concentration information was compiled for the major drains in the Sacramento Basin, including Sacramento Slough, Colusa Basin Drain, RD1000, RD108 and Natomas East Main Drain. A later report by Central Valley RWQCB prepared in 1989 and entitled "A mass loading assessment of major point and non-point sources in the Sacramento Valley, California, 1985" estimated that the earlier agricultural runoff estimate only represented 80% of the total. This percentage was used to scale up the estimates.

f. See Note a for explanation.

g. See Note b for explanation.

h. See Note c for explanation.

i. Concentration data are from EarthInfo USGS Quality of Water databases on CD-ROM (EarthInfo, 1996). Flow data are from USGS Water Data Reports for the years in which concentration data were available. For the Sacramento River concentration and flow data used in the load calculation are from Freeport. For the San Joaquin River cncentration and flow data used in the load calculation are from Vernalis.

   Loads were calculated for each day data were available. For the period of record the average daily load was calculated from all the daily values. The annual load for the period of record is the product of the average daily load multiplied times the number of seconds in a year. The resulting value was converted to an average annual value by dividing the annual load for the period of record by the average daily flow over the period of record and then multiplying the result times the long term daily average flow rate.

   average annual load = ((average daily load * number of seconds in a year) / average daily flow over the period of record)* long term daily average flow rate

j. See Note a for explanation.

k. See Note c for explanation.

l. See Note I for explanation.

m. Reported in Table 19 of "State of the Estuary: A report on conditions and problems in San Francisco Bay/Sacramento-San Joaquin Delta Estuary' San Francisco Estuary Project, 1992. Middle of range of values used .

n. See Note m for explanation.

o. Total emission from upper Sacramento Basin was calculated using flow and concentration data for releases from Shasta, Oroville and Nimbus Dams. Reported in "A mass loading assessment of major point and non-point sources discharging to surface waters in the Central Valley, California, 1985" prepared by the RWQCB Central Valley Region in 1988.

Dissolved Organic Carbon (DOC) Loading Notes

a. Load data were obtained from the "Study of Drinking Water Quality in Delta Tributaries" from the California Urban Water Agencies, April 1995 Report. The data estimated using Figure 4-1 which shows total loads of DOC and TOC and percentages for various contributing sources. The total in pounds per day in the Sacramento River at Greene's Landing is 310,000 lbs/day, 13.75 % of that is from agriculture. The data were evaluated using two techniques. One involves constructing and evaluating time-series plots for rainfall, flow, concentration and load allowing for a directs and detailed examination of seasonal and historical patterns and allow for a direct and detailed examination of periods when concentrations are high. The second technique included combining data from different sets of conditions/types of seasonal periods to average loads.

b. The "Study of Drinking Water Quality in Delta Tributaries", California Urban Water Agencies, April 1995 shows a 1.1 mg/L increase in DOC concentrations from agricultural drainage by comparing Inflow, Observed and Predicted DOC Five Years (1987-91) of Monthly Average DOC data. No flow data were supplied, therefore, no load calculations can be performed until further literature review has been performed.

c. A single sample reported in the Study of Drinking Water Quality in Delta Tributaries. California Urban Water Agencies, April 1995, was collected in 1989 (4.4-500mg/l) for urban runoff in Sacramento. No flow data available for this sample. Further data search must be performed to obtain additional TOC data information for load calculations.

Mercury Loading Notes

a. Concentration data are from EarthInfo USGS Quality of Water databases on CD-ROM (EarthInfo, 1996). Flow data are from USGS Water Data Reports for the years in which concentration data were available. For the Sacramento River concentration and flow data used in the load calculation are from Freeport. For the San Joaquin River concentration and flow data used in the load calculation are from Vernalis.

   Loads were calculated for each day data were available. For the period of record the average daily load was calculated from all the daily values. The annual load for the period of record is the product of the average daily load multiplied times the number of seconds in a year. The resulting value was converted to an average annual value by dividing the annual load for the period of record by the average daily flow over the period of record and then multiplying the result times the long term daily average flow rate.

   average annual load = ((average daily load * number of seconds in a year) / average daily flow over the period of record)* long term daily average flow rate

b. See Note a for explanation.

c. Reported in Table 19 of "State of the Estuary: A report on conditions and problems in San Francisco Bay/Sacramento-San Joaquin Delta Estuary' San Francisco Estuary Project, 1992. Middle of range of values used .

d. See Note c for explanation.

e. Emission was calculated using flow and concentration data for release from Shasta Dam. No similar data were available for Oroville and Nimbus Dams so this is probably an underestimate. Reported in "A mass loading assessment of major point and non-point sources discharging to surface waters in the Central Valley, California, 1985" prepared by the RWQCB Central Valley Region in 1988. The emission is the product of a large flow and a small concentration, probably based on limited data. Consequently, a small error in concentration can greatly effect the emission rate.

Nitrate Loading Notes

a. Nitrate loads were calculated by Woodward-Clyde for the Contra Costa Clean Water Program (Contra Costa Clean Water Program, 1994). The loads assessment model is based upon a relationship between rainfall quantities, runoff pollutant concentrations, and the relationship between pollutant loads and land use. The loads assessment model contains the following assumptions:

- Uniform precipitation between isohyets
- Constant runoff coefficient based upon land use
- Runoff water quality was constant for each land use
- Isohyetals based on average annual precipitation

The reported load in the loading table is from Figure 4-1 of the report (Contra Costa Clean Water Program, 1994).

b. See Note a for explanation.

c. Nitrate loads were calculated for the Sacramento NPDES Stormwater Discharge Characterization Program (Larry Walker & Associates). Loads were initially calculated in 1992 using the following methodology:

- Regression models were developed showing the relationship of urban runoff pollutant discharge factors.
- The regression equations were then used as input to a continuous simulation model for Sacramento urban runoff mass loading over a 58 year period.
- The model was refined in 1996, using the updated database of urban runoff monitoring data available form the Sacramento NPDES Stormwater Monitoring Program. the load reported in the loading table is from Table 15 of the report (Larry Walker & Associates).

Selenium Loading Notes

a. Concentration data are from EarthInfo USGS Quality of Water databases on CD-ROM (EarthInfo, 1996). Flow data are from USGS Water Data Reports for the years in which concentration data were available. For the Sacramento River concentration and flow data used in the load calculation are from Freeport. For the San Joaquin River concentration and flow data used in the load calculation are from Vernalis.

Loads were calculated for each day data were available. For the period of record the average daily load was calculated from all the daily values. The annual load for the period of record is the product of the average daily load multiplied times the number of seconds in a year. The resulting value was converted to an average annual value by dividing the annual load for the period of record by the average daily flow over the period of record and then multiplying the result times the long term daily average flow rate.

average annual load = ((average daily load * number of seconds in a year) / average daily flow over the period of record)* long term daily average flow rate

b. See Note a for explanation.

c. Selenium loads to San Francisco Bay are reported in "Mass Emissions Reduction Strategy for Selenium" prepared by San Francisco Bay RWQCB in 1992. The loads are estimated as 7.1 kg/day from oil refineries, 2.2 kg/day from municipal wastewater treatment plants and 2 kg/day from riverine sources under average flow conditions. No selenium was detected in samples of municipal wastewater. The RWQCB assumed that it was present in municipal wastewater at the detection limit used in the analyses and thus calculated 2.2 kg/day. The RWQCB noted this was a probable overstatement. It is worth noting that the estimated load to the bay from riverine sources (1,600 lbs/yr) is much lower than the sum of the Sacramento and San Joaquin River inputs to the Bay-Delta system (11,000 lbs/yr reported in "State of the Estuary: A report on conditions and problems in San Francisco Bay/Sacramento-San Joaquin Delta Estuary" San Francisco Estuary Project, 1992. Perhaps, this is attributable chemical reactions and biological uptake in the Delta.

Total Dissolved Solids (TDS) Loading Notes

a. One study on drinking water quality in Delta tributaries calculated the relative proportions of TDS loads in the Sacramento River at Greene's Landing (California Urban Water Agencies, 1995). The load was subdivided into the following five categories: other sources, Sacramento Regional Wastewater Treatment Plant, Sacramento Combined Sewer Overflow, urban runoff, and the Sacramento Slough and Colusa Basin Drain. The load from Sacramento Slough and Colusa Basin Drain is assumed to be drainage from rice fields and therefore represents the agricultural load for the Lower Sacramento Basin.. The study calculated loads for both wet and dry years. The table contains an average for both years.

b. The portion of the load attributed to the Sacramento Regional Wastewater Treatment Plant in the drinking water study referenced in note represents a load from the area serviced by the plant. The load in the table does not represent a total load form all POTW's in the Lower Sacramento River Basin. The load value in the table is an average of wet and dry year loads.

c. The TDS concentration was developed from a continuous simulation analysis as a sum of the loads from wet weather, dry season and inter-storm loads (Larry Walker & Associates, 1996).

d. Concentration data were received from Ray Tom of the Department of Water Resources. Concentrations data were collected at Green's Landing for the Sacramento River and Vernalis for the San Joaquin River. Flow data are from USGS Water Data Reports for the years in which concentration data were available.

Loads were calculated for each day data were available. For the period of record the average daily load was calculated from all the daily values. The annual load for the period of record is the product of the average daily load multiplied times the number of seconds in a year. The resulting value was converted to an average annual value by dividing the annual load for the period of record by the average daily flow over the period of record and then multiplying the result times the long term daily average flow rate.

average annual load = ((average daily load * number of seconds in a year) / average daily flow over the period of record)* long term daily average flow rate

e. The study referenced in note a above also calculated loads for the San Joaquin River at Vernalis. The load was subdivided into contributions from Mud and Salt Sloughs and other sources. The load from Mud and Salt Sloughs is assumed to be agricultural drainage. The load value in the table is an average of wet and dry year loads.

f. One study (Fresno Metropolitan Flood Control District, 1995) estimated the annual pollutant loads, summing the loads from the San Joaquin River, Dry Creek and Bidon Canal.

g. See explanation for note d.

Total Organic Carbon (TOC) Loading Notes

a. Load concentrations to the mud and salt sloughs from agriculture in the Sacramento Area were reported in the "Study of Drinking Water Quality in Delta Tributaries". (California Urban Water Agencies, 1995). The value was obtained from Appendix D, Table D-7. The value used here is the highest value from the Table and in Wet year/wet season. The annual load was calculated assuming an average of 30,850 lb/day and 365 days in the wet season as defined in the study.

b. Load data were obtained from the "Study of Drinking Water Quality in Delta Tributaries" from the California Urban Water Agencies, April 1995 Report. The data estimated using Figure 4-1 which shows total loads of DOC and TOC and percentages for various contributing sources. The total in pounds per day in the Sacramento River at Greene's Landing is 310,000 lbs/day, 4.75 % of that is from agriculture. The data were evaluated using two techniques. one involves constructing and evaluating time-series plots for rainfall, flow, concentration and load allowing for a directs and detailed examination of seasonal and historical patterns and allow for a direct and detailed examination of periods when concentrations are high. The second technique included combining data from different sets of conditions/types of seasonal periods to average loads.

c. Concentration data were received from Ray Tom of the Department of Water Resources. Concentrations data were collected at Green's Landing for the Sacramento River and Vernalis for the San Joaquin River. Flow data are from USGS Water Data Reports for the years in which concentration data were available.

Loads were calculated for each day data were available. For the period of record the average daily load was calculated from all the daily values. The annual load for the period of record is the product of the average daily load multiplied times the number of seconds in a year. The resulting value was converted to an average annual value by dividing the annual load for the period of record by the average daily flow over the period of record and then multiplying the result times the long term daily average flow rate.

average annual load = ((average daily load * number of seconds in a year) / average daily flow over the period of record)* long term daily average flow rate

d. Load data were obtained from the "Study of Drinking Water Quality in Delta Tributaries" from the California Urban Water Agencies, April 1995 Report. The data estimated using Figure 4-1 which shows total loads of DOC and TOC and percentages for various contributing sources. The total in pounds per day in the San Joaquin River at Vernalis is 47,950 lbs/day, 61.51 % of that is from agriculture. The data were evaluated using two techniques. One involves constructing and evaluating time-series plots for rainfall, flow, concentration and load allowing for a directs and detailed examination of seasonal and historical patterns and allow for a direct and detailed examination of periods when concentrations are high. The second technique included combining data from different sets of conditions/types of seasonal periods to average loads.

Additional sampling has been conducted by the Department of Pesticide Regulations along the San Joaquin River. Sampling occurred periodically from March of 1991 through February of 1993. It can be assumed that these samples are being collected to estimate contaminants from agriculture. Concentration and flow data are available for values collected in the San Joaquin River. Further Investigation on the locations of these monitoring stations and surrounding land use will be performed prior to load calculations.

e. Concentration data are from EarthInfo USGS Quality of Water databases on CD-ROM (EarthInfo, 1996). Flow data are from USGS Water Data Reports for the years in which concentration data were avarailable. For the Sacramento River concentration and flow data used in the load calculation are from Freeport. For the San Joaquin River concentration and flow data used in the load calculation are from Vernalis.

Loads were calculated for each day data were available. For the period of record the average daily load was calculated from all the daily values. The annual load for the period of record is the product of the average daily load multiplied times the number of seconds in a year. The resulting value was converted to an average annual value by dividing the annual load for the period of record by the average daily flow over the period of record and then multiplying the result times the long term daily average flow rate.

The load was calculated using the equation in note c.

Zinc Loading Notes

a. The original data for the load estimate were obtained from "A mass loading assessment of major point and non-point sources discharging to surface waters in the Central Valley, California, 1985" prepared by the RWQCB Central Valley Region in 1988. Flow and load data were compiled for four inactive mines including Iron Mountain, Newton, New Idria and Afterthought Mines. Only mines that drain to the Sacramento River or its tributaries below Shasta, Oroville and Nimbus Dams were considered. Eighty-five percent of the load was from Iron Mountain. A later report by Central Valley RWQCB prepared in 1989 and entitled "A mass loading assessment of major point and non-point sources in the Sacramento Valley, California, 1985" estimated that the earlier mine drainage estimate only represented 25% of the total. A further review of the two RWQCB documents was made by Woodward-Clyde in light of information contained in a 1992 report by the Central Valley Board entitled "Inactive mine drainage in the Sacramento Valley". Data in this report suggests that mine drainage represents about 50% of the total zinc load from inactive mines. The 50% estimate was used to scale up the loads originally calculated by RWQCB. The loads calculated in the 1988 RWQCB were segregated into the three geographical areas, delta, San Joaquin Basin and Sacramento Basin below dams.

b. The original data for the load estimate were obtained from "A mass loading assessment of major point and non-point sources discharging to surface waters in the Central Valley, California, 1985" prepared by the RWQCB Central Valley Region in 1988. Flow and load data were compiled from several NPDES dischargers who have been monitoring copper. including the largest in the Central Valley the Sacramento Regional County Sewer District. Woodward-Clyde divided the results into two geographical areas, the delta and the Sacramento Basin. A later report by Central Valley RWQCB prepared in 1989 and entitled "A mass loading assessment of major point and non-point sources in the Sacramento Valley, California, 1985" estimated that the earlier M and I estimate only represented 50% of the total. This percentage was used to scale up the loads.

c. Loads were taken from "A mass loading assessment of major point and non-point sources discharging to surface waters in the Central Valley, California, 1985" prepared by the RWQCB Central Valley Region in 1989.

d. See note a for explanation.

e. See note c for explanation.

f. See note c for explanation.

g. Concentration data are from EarthInfo USGS Quality of Water databases on CD-ROM (EarthInfo, 1996). Flow data are from USGS Water Reports for the years in which concentration was available. For the Sacramento River concentration and flow used in the load calculation is from Freeport. For the San Joaquin River concentration and flow used in the load calculation is from Vernalis.

Loads were calculated for each day were available. For the period of record the average daily load was calculated from all the daily values. The annual load for the period of record is the product of the average daily load multiplied times the number of seconds in a year. The resulting value was converted to an average annual value by dividing the annual load for the period of record by the average daily flow over the period of record and then multiplying the result times the long term daily average flow rate.

average annual load = ((average daily load * number of seconds in a year) / average daily flow over the period of record)* long term daily average flow rate.

h. See note a for explanation.

i. See note g for explanation.

j. Estimate of Bay Region loads were made by adding estimated pollutant loads of Contra Costa, Alameda and Santa Clara Counties. This value probably underestimates the total contribution of zinc by the Bay Region.

FURTHER RESEARCH REQUIRED TO ALLOCATE LOADS

Carbofuran Loading Notes

General Notes

- Applied to alfalfa fields in March and to rice fields from April through June.

a. Several studies report carbofuran concentrations detected in the Sacramento River at various locations (USGS, 1995, Open File Report 95-110); (Crepeau et. al.); (Department of Fish and Game, Rice Pesticide Concentrations in the Sacramento River and Associated Agricultural Drains); (Department of Water Resources, August 1989). Discharge is available for many of the locations where carbofuran was sampled. Load calculations are in progress.

b. See Note a for explanation.

Chlorpyrifos Loading Notes

General Notes

- Applied to almond orchards in January and February and again in May through August.
- Applied to alfalfa fields in March.
- Particle bound compound.

a. Concentration is from EarthInfo USGS Quality of Water databases on CD-ROM (EarthInfo, 1996). Flow is from USGS Water Reports for the years in which concentration was available. For the Sacramento River concentration and flow used in the load calculation is from Freeport. For the San Joaquin River concentration and flow used in the load calculation is from Vernalis.

Loads were calculated for each day were available. For the period of record the average daily load was calculated from all the daily values. The annual load for the period of record is the product of the average daily load multiplied times the number of seconds in a year. The resulting value was converted to an average annual value by dividing the annual load for the period of record by the average daily flow over the period of record and then multiplying the result times the long term daily average flow rate.

average annual load = ((average daily load * number of seconds in a year) / average daily flow over the period of record)* long term daily average flow rate.

Diazinon Loading Notes

General Notes

- Applied to almond orchards in January and February and again in May through August.
- Applied to alfalfa fields in March.

a. One study (Conner, 1996) reports diazinon concentrations in urban runoff from the cities of Stockton and Sacramento and the San Francisco Bay Area. The concentration from the City of Stockton could be used to calculate a load for the Delta. However, further investigation is required to determine if discharge can be matched to the sampling events and locations.

b. See Note a for explanation.

c. Loads were estimated based on measured diazinon concentrations and measured streamflows. Diazinon concentrations in the San Joaquin River at Vernalis were obtained from The USGS WATSTOR database and the USGS Open File Report 95-110. Diazinon in the Sacramento River at Sacramento were obtained from the USGS Open File Report 95-110. Flows in the Sacramento River are from the USGS gage at Freeport (#11447650).

d. Flows in the San Joaquin River are from the USGS gage at Vernalis (#11303500). At Vernalis loads were estimated for years 1991, 1993, and 1994. The average is reported in the table. At Sacramento loads were estimated for 1993 and 1994 and the average reported. Note, the estimated diazinon load at Sacramento includes urban runoff from Sacramento and surrounding areas in addition to agricultural runoff. Non-detect was not included in the loads analysis.

Stakeholder Involvement

The CALFED Water Quality Program has accessed and utilized a large group of water quality technical experts to assist in the development of the Water Quality Program. These stakeholders, known as the Water Quality Technical Group, represent federal, state and local agencies, environmental advisory groups, industry (e.g., pesticide, mining, etc.), agriculture, recreation, urban water supply, and watershed interests.

Initially, three technical teams of stakeholders were formed to identify the source water quality requirements of environment, urban, and agriculture water users. The environment team was primarily comprised of federal and state agency representatives (U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, California Departments of Fish and Game and Pesticide Regulation, State Water Resources Control Board, and Region 2 and 5 Water Quality Control Boards). The urban team included both agency staff and urban water agency representatives. The agriculture team was represented by agency staff, farmers, and agricultural water suppliers. Using available data and technical knowledge, the teams identified parameters that were of "concern" to their respective beneficial use of water, and identified actions that might be taken to reduce these parameters. CALFED then invited additional stakeholders to join in the process. The stakeholders included those who might be impacted by implementation of the recommended water quality actions (e.g., parties responsible for mine drainage, agricultural drainage, urban runoff, wastewater, and industrial discharges, etc.) and representatives of environmental and watershed interests.

During the course of its meetings, the CALFED Water Quality Technical Group identified parameters of concern to beneficial uses of water. These parameters of concern are listed in the following table . This list of parameters may change over time in response to additional knowledge.

Environment	Urban	Agriculture	Recreation	Industrial
Metals&Toxic Elements	**Disinfection By-Product Precursors**	**Other**	**Metals**	**Other**
Cadmium	Bromide	Boron	Mercury	Salinity
Copper	TOC	Chloride	**Organics/Pesticides**	pH
Mercury	**Other**	Nutrients (nitrate)	PCBs	Alkalinity
Selenium	Pathogens	pH (alkalinity)	DDT	Phosphates
Zinc	Turbidity	Salinity (TDS, EC)	**Other**	Ammonia
Organics/Pesticides	Salinity (TDS)	SAR	Pathogens	
Carbofuran	Nutrients (nitrate)	Turbidity	Nutrients	
Chlordane	pH	Temperature		
Chlorpyrifos	Chloride			
DDT				
Diazinon				
PCBs				
Toxaphene				
Other				
Ammonia				
Dissolved Oxygen				
Salinity (TDS, EC)				
Temperature				
Turbidity				
Unknown toxicity[a]				

[a] Unknown toxicity refers to observed aquatic toxicity, the source of which is unknown.

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To develop water quality targets for each parameter of concern, the program convened a Parameter Assessment Team (PAT) to evaluate existing water quality standards and criteria. The PAT was composed of 12 technical experts from the CALFED Water Quality Technical Group. The PAT recommended that CALFED use Basin Plan objectives (Region 2 or 5 as appropriate), and USEPA promulgated National Toxics Rule or soon to be promulgated California Toxics Rule standards when developing water quality targets to protect ecosystem health. This approach provides water column reference targets for the Delta, Sacramento, and San Joaquin rivers for cadmium, copper, mercury, selenium, DDT, PCBs, toxaphane, ammonia, dissolved oxygen, and turbidity.

For fish tissue bioaccumulation of contaminants, PAT recommended using National Academy of Sciences (NAS) guidance numbers as tissue concentration targets for mercury, DDT, PCBs, and Toxaphane. No recommendation was made regarding selenium tissue levels due to lack of NAS guidance criteria on selenium. Similarly, the PAT did not make recommendations for target levels of carbofuran, diazinon, and chlorpyrifos. The Regional Board is in the process of developing a water quality objective for carbofuran. The PAT made no recommendation on sediment targets because there are currently no Basin Plan objectives and USEPA standards are limited to 5 organic compounds. The PAT recommended the use of the narrative statements in the Basin Plans for establishing targets for unknown toxicity.

In addition to the technical workgroup meetings CALFED held workshops to inform the general public about the Program's activities. CALFED staff met with a variety of groups including the Clean Water Caucus, California Water Environment Association, and the California Urban Water Agencies. The CALFED Bay Delta Advisory Committee has been kept apprised of the Program's progress through informational segments at their regularly scheduled meetings. Stakeholder involvement in CALFED water quality activities is planned to continue throughout the life of the CALFED effort.

Monitoring and Watershed Coordination

Through its stakeholder involvement efforts, CALFED has identified two major issues: the need for a comprehensive monitoring program and the need for coordination among various watershed groups. CALFED is exploring approaches to addressing these issues through a comprehensive monitoring, assessment and research program (CMARP) and through a watershed coordination effort. While some background information exists on water quality problems in the CALFED solution area, much is yet to be learned. CALFED is developing the CMARP to address the need for adequate scientific support not only for water quality, but also for the system integrity, ecosystem restoration, and water supply reliability resource areas. CMARP is central to the CALFED philosophy of adaptive management.

A primary role of CALFED is to coordinate the solution of Bay-Delta system problems on a large scale. CALFED watershed management will be an outgrowth of this role, emphasizing the efforts of diverse interests—environmental; agricultural; industrial; municipal; and other local, state, and federal agencies— working together to achieve long-term solutions to the problems of the Bay-Delta system.

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WATER QUALITY

LIST OF PREPARERS

John A. Davis
M.S., Sanitary Engineering, University of California, Berkeley
B.S., Civil Engineering, London University
Years experience: 31
Primary author of water quality impacts Technical Appendices

Judith A. Heath
M.S., Human Anatomy, University of California, Davis
B.S., Biology, California State University, Sacramento
Years of Experience: 25
Lead Coordinator and writer for Watershed Management Study
Coordinator/reviewer of Water Quality Appendix and PEIS/EIR

Sarah Holmgren
M.S., Conservation Ecology and Sustainable Development, University of Georgia
B.S., Environmental Health Science, University of Georgia
Years of experience: 3
CALFED Water Quality Affected Environment Report revisions

Carol Howe
B.S., Environmental Studies, Pennsylvania State University
Years of experience: 15
Preparation of Water Quality Affected Environment Report.

Peter M. Standish-Lee
M.S., Water Resources, California State University, Sacramento
B.S., Oceanography, California State University, Humboldt
A.B., Zoology, University of California, Berkeley
Years of experience: 27
Planning of alternatives and Lead Consultant for Water Quality, Geology and Soils, Flood Management, Terrestrial and Aquatic Ecology, Air Quality and Noise, Visual Resources, Transportation Systems Technical Reports

Peter Mangarella
Ph.D., Civil Engineering, Stanford University
M.S., Civil Engineering, Stanford University
B.S., Civil Engineering Carnegie Mellon
Years of experience: 28
Preparation of Water Quality Impacts Technical Report, specifically synthesis of water quality modeling results and Water Quality Affected Environment Technical Report: Source Loading Analysis

Vanessa Nishikawa

M.S., Civil Engineering, University of California, Davis
B.S., Biomedical Engineering, Northwestern University
Years of experience: 4
CALFED Watershed Management Strategy revision

Chris Smith

M.S., Civil Engineering, California State University, Sacramento
B.S., Environmental Resources Engineering, California State University, Humboldt
Years of experience: 6
Compilation of water quality and sediment data for the CALFED Water Quality Affected Environment Report