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Phase I - Consultant  
Reports

**TO:** CALFED Ecosystem Water Quality Committee

**FROM:** Carol Howe, CALFED Consultant Team

**DATE:** August 16, 1996

**SUBJECT:** **Information Packet for Ecosystem Water  
Quality Committee Meeting - Thursday, August 22, 1996**

At the first meeting of the Ecosystem Water Quality Committee held on August 1, it was agreed that the trace elements of concern in the Delta and Suisun Bay were cadmium, copper, mercury, selenium and zinc. The consultant team has summarized the available information on these selected trace elements based on information received from the committee members (both at the meeting and subsequently) and a literature search. The information packet that is attached contains this information. The contents are as follows:

1. Summary Effects of Trace Elements that Occur in the Bay/Delta Estuary
2. Concentrations of Trace Elements in Waters of the Bay/Delta Estuary (ppb)
3. Concentrations of Trace Elements in San Francisco Bay Sediments (ppm)
4. Summary Concentrations of Trace Elements in Bay/Delta Estuary Biota
5. Geographic Hot Spots for Trace Elements Parameters of Concern
6. Water Quality Goals for Trace Elements Established by the State of California, USEPA, and the Regional Water Quality Control Boards
7. Committee Evaluation of Proposed CALFED Water Quality Actions and Affected Parameters that Impact Ecosystem Water Quality
8. Reference List of Bay-Delta Documents

Please review this information before Thursday's meeting. If you have additional information or sources of information, corrections and/or additions to the attached information please bring this information to the next meeting.

At the next meeting we would like to quickly wrap-up the discussion on trace elements and move on to identifying the remaining parameters of concern (including organics, solids and salinity) for the Delta and Suisun Bay and known problem areas.

If you have any questions about the enclosed information or the upcoming meeting you can contact either Ron Ott at CALFED 657-2666 or me at 921-3509.



Carol Howe  
CALFED Consultant Team

**Summary Effects of Trace Elements that Occur  
in the Bay/Delta Estuary**

<b>Trace Element</b>	<b>Effects</b>
<b>Cadmium</b>	Carcinogenic/Mutagenic/Teratogenic. Highly toxic in aquatic environments. Bioaccumulates up to 250,000 times concentration in water. Of exceptional toxicity to mammals, including humans.
<b>Copper</b>	Chronically toxic to marine organisms at concentrations in water of 0.01 - 10 ppm. Acutely toxic at concentrations in water greater than 0.1 ppm. Bioaccumulates in shellfish up to 30,000 times concentration in water. Highly bioavailable in the estuary.
<b>Mercury</b>	Teratogenic. Most toxic of all trace elements. Effects occur at low ppb level. Wide range of acute and chronic toxicities to aquatic biota. Bioaccumulates in some aquatic biota at levels 100,000 times that in water.
<b>Selenium</b>	Teratogenic. Toxicity depends greatly on chemical form. Toxic effects occur at concentrations of 10 ppb in freshwater, 1 ppm dry mass in sediments, and 0.3 ppm wet weight in shellfish.
<b>Zinc</b>	Moderately toxic. Chronic toxicity in marine organisms. Acute toxicity to marine and freshwater animals occurs at concentrations in water above 0.1 ppm. Bioaccumulates in shellfish to levels 100,000 times that of water.

**Source:** Monroe, Michael W., Judy Kelly, and Nina Lisowski. 1992. State of the Estuary. San Francisco Estuary Project. 270 pp.

### Concentrations of Trace Elements in Waters of the Bay/Delta Estuary (ppb)

Trace Element	Range of Total Concentrations	State Water Quality Objective Upstream of San Pablo Bay	Any Samples Exceeding State Water Quality Objectives?
Cadmium	0.005 - 0.159	1.1 (4D); 3.9 (1H)	No
Copper	0.9 - 7.2	6.5 (4D); 9.2 (1H)	Yes
Mercury	0.001 - 0.032	0.025 (4D); 2.4 (1H)	Yes
Selenium	0.013 - 4.700	--	--
Zinc	1.4 - 17.4	38 (1D); 170 (Inst.)	No

Dashes indicate that either reliable data or water quality objectives do not exist.

4D = Four day average

1H = One hour average

Inst. = Instantaneous value

Source: Monroe, Michael W., Judy Kelly, and Nina Lisowski. 1992. State of the Estuary. San Francisco Estuary Project. 270 pp.

### Concentrations of Trace Elements in San Francisco Bay Sediments (ppm)

Trace Element	Mean	Range
Cadmium	1.06	0.02 - 17.3
Copper	51	1 - 1500
Mercury	0.5	<0.01 - 6.80
Selenium	--	0.001 - 0.035
Zinc	~ 100	< 100 - 1255

Dashes indicate that data are not available.

Source: Monroe, Michael W., Judy Kelly, and Nina Lisowski. 1992. State of the Estuary. San Francisco Estuary Project. 270 pp.

Summary Concentrations of Trace Elements in Bay/Delta Estuary Biota

Trace Element	Concentration (ppm wet weight)					Concentrations Exceeding Alert Levels in Delta <sup>a</sup>	Comments
	Mussel	Clam	Fish	Bird	Seal		
Cadmium	0.11 - 4.91	--	0.03 - 0.48	4.17	<0.06 - 0.33	No, but elevated levels in Bay shellfish	Highly persistent in mammals once accumulated; Highly bioavailable
Copper	0.314 - 4.385	10 - 100	1.3 - 3.0	7.14 - 13.86	3.0 - 8.7	Yes. Levels in some Suisun Bay and Delta fish exceed MIS.	Elevated levels acutely toxic to striped bass;
Mercury	0.01 - 0.46	--	0.13 - 0.94	0.16 - 0.6	0.40 - 3.65	Yes. Levels in some Delta fish exceed MIS.	May interact with selenium in biota; Health advisories for consumption of striped bass; Bioaccumulates; Elevated levels in Endangered Clapper Rail may be causing reproductive effects; Reproductive effects in Willets;
Selenium	0.19 - 0.66	0.3 - 1.30	0.28 - 22.0	24 - 58	2.07 - 6.49	No, but elevated levels in Bay shellfish, fish, and ducks	Elevated levels detected in striped bass tissues; Causes bird deformities and reproductive problems; Health advisories for consumption of fish from Kesterson area; Bivalve accumulation in Bay/Delta
Zinc	11.0 - 45.8	--	16.0 - 43.0	21.6	--	No alert levels established for tissue.	Elevated levels detected in striped bass tissues;

<sup>a</sup> Alert Levels refer to maximum tissue residue levels that are protective of human health. They include:

- 1) the median international standard (MIS), which is a general guideline of what other nations consider to be elevated contaminant levels in fish and shellfish tissue;
- 2) the U.S. Food and Drug Administration (FDA) action levels, which represent maximum allowable concentrations for some toxic substances in human foods;
- 3) the State Department of Health Service's maximum allowable residue levels (MARL), established to ensure that a consumer of specified fish or wildlife species does not exceed the permissible intake level for particular contaminants.

Source: Monroe, Michael W., Judy Kelly, and Nina Lisowski. 1992. State of the Estuary. San Francisco Estuary Project. 270 pp.

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### Geographic Hot Spots for Trace Element Parameters of Concern

Trace Element	Known Hot Spots	Potential Hot Spots
<b>Cadmium</b>	<b>Sacramento River-Freeport to Hood (2,400 acres); San Joaquin River-Vernalis to Old River (654 acres)</b>	<b>Carquinez Strait-Mare Island Strait (10-50 acres); Suisun Bay-Concord Naval Weapons Station (50-250 acres) Peyton Slough (&lt;10 acres); Delta Waterways-Entire (48,000 acres)</b>
<b>Copper</b>	<b>Carquinez Strait/Suisun Bay-Multiple stations including Honker Bay, Peyton, Boynton, Peytonia and Chadbourne Sloughs (&gt;250 acres); Sacramento River-Freeport to Hood (2,400 acres); San Joaquin River-Vernalis to Old River (654 acres)</b>	<b>Carquinez Strait-Mare Island Strait (10-50 acres); Suisun Bay-Concord Naval Weapons Station (50-250 acres), Peyton Slough (&lt;10 acres); Delta Waterways-Entire (48,000 acres)</b>
<b>Mercury</b>	<b>SF Bay/Delta (&gt;250 acres); Sacramento River Freeport to Hood (2,400 acres)</b>	<b>Carquinez Strait-Mare Island Strait (10-50 acres); Suisun Bay-Concord Naval Weapons Stations (50-250 acres), Peyton Slough (&lt;10 acres); Sample point off Vallejo (&lt;10 acres)</b>
<b>Selenium</b>	<b>Suisun Bay (&gt;250 acres); San Joaquin River-Vernalis to Old River (654 acres)</b>	<b>Suisun Bay-Concord Naval Weapons Stations (50-250 acres)</b>
<b>Zinc</b>	<b>Sacramento River-Freeport to Hood (2,400 acres)</b>	<b>Suisun Bay-Concord Naval Weapons Station (50-250 acres); Carquinez Strait Peyton Slough (&lt;10 acres)</b>

Source: SWRCB & RWQCBS. 1993. Status of the Bay Protection and Toxic Cleanup Program Staff Report.

**Known toxic hot spot**-exceed water or sediment quality objectives, water or sediment exhibit toxicity associated with toxic pollutants, and tissue toxic pollutant levels of organisms collected from the site exceed levels established by OEHHA, FDA, DHA and NAS.

**Potential toxic hot spot**-sites with existing information indicating possible impairment, but without sufficient information to be classified as "known" toxic hot spot.

# Water Quality Goals Established by the State of California, USEPA, and the Regional Water Quality Control Boards

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Parameter of Concern	California Inland Surface Waters Plan <sup>c</sup> Numerical Water Quality Objectives Freshwater Aquatic Life Protection				USEPA National Ambient Water Quality Criteria <sup>c</sup> Freshwater Aquatic Life Protection Recommended Criteria			Regional Water Quality Control Boards <sup>j</sup> 1995 Water Quality Control Plans						
	4-day average	Daily Average	1-hour Average	Instantaneous Maximum	Continuous Concentration (4 day Average)	24-hour Average	Maximum Concentration (1-hour Average)	Region II			Region V			
								Value	Sacramento River	San Joaquin River	Delta	Value	Bay	
<b>METALS</b>														
Cadmium <sup>d</sup>	0.38 - 3.4 µg/l <sup>b</sup>		0.82 - 19 µg/l <sup>b</sup>		0.37 - 2.9 µg/l <sup>a</sup>		0.82 - 17 µg/l <sup>a</sup>	0.00022 mg/l <sup>f</sup>	River and tributaries from above State Hwy 32 bridge at Hamilton City					
Copper <sup>d</sup>	3.6 - 39 µg/l <sup>b</sup>		4.8 - 65 µg/l <sup>b</sup>		3.5 - 37 µg/l <sup>a</sup>		4.6 - 63 µg/l <sup>a</sup>	0.0056 mg/l <sup>f</sup>	River and tributaries from above State Hwy 32 bridge at Hamilton City					
								0.01 mg/l <sup>e</sup>	Keswick Dam to I Street Bridge			Unspecified		
Mercury <sup>c</sup>			2.4 µg/l		0.012 µg/l <sup>b</sup>		2.1 µg/l <sup>a</sup>							
Selenium	5 µg/l		20 µg/l		5.0 µg/l <sup>b</sup>		20 µg/l <sup>b</sup>	0.012 mg/l; 0.005 mg/l <sup>h</sup>		Mouth of Merced River to Vernalis				
								0.002 mg/l <sup>i</sup>	Water supplies used for waterfowl habitat in specific areas					
Zinc <sup>d</sup>	33 - 340 µg/l <sup>b</sup>		36 - 380 µg/l <sup>b</sup>		32 - 340 µg/l <sup>a</sup>		35 - 370 µg/l <sup>a</sup>	0.1 mg/l <sup>e</sup>	Keswick Dam to I Street Bridge			Unspecified		
								0.016 mg/l <sup>f</sup>	River and tributaries from above State Hwy 32 bridge at Hamilton					

<sup>a</sup> dissolved form  
<sup>b</sup> total recoverable  
<sup>c</sup> includes Methyl Mercury  
<sup>d</sup> varies in relation to water hardness  
<sup>e</sup> data compiled from Jon Marshack. July 1995. A Compilation of Water Quality Goals.  
<sup>f</sup> 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.  
<sup>g</sup> deviations from 40 mg/l of water hardness occur, the objectives, in mg/l shall be determined using the following formulas:  
 $Cu = e^{(0.905)(\ln \text{hardness})} - 1.612 \times 10^3$   
 $Zn = e^{(0.830)(\ln \text{hardness})} - 0.289 \times 10^3$   
 $Cd = e^{(1.160)(\ln \text{hardness})} - 5.777 \times 10^3$   
<sup>h</sup> Does not apply to Sacramento River above State Hwy 32 bridge at Hamilton City.  
<sup>i</sup> 4-day average; The Regional Water Control Board has adopted these selenium concentrations. These selenium concentrations were promulgated by USEPA on 22 December 1992 after USEPA disapproved the Regional Water Board's selenium concentrations. The selenium concentrations promulgated by USEPA are currently in effect, and are provided in this table solely for reference.  
<sup>j</sup> This objective applies to any water supplies used for waterfowl habitat in the Grassland Water District, San Luis National Wildlife Refuge, and Los Banos State Wildlife Area.  
<sup>k</sup> The 1995 State Water Resources Control Board Water Quality Plan did not contain standards for metals.

D-032714

ACTION	BENEFIT	AFFECTED PARAMETERS																												
		TRACE ELEMENTS										ORGANICS			NUTRIENTS			OTHER												
		Metals	Cadmium	Chromium	Copper	Lead	Mercury	Molybdenum	Nickel	Selenium	Silver	Zinc	Arsenic	Pesticides (Insecticides, Herbicides, etc.)	Petroleum Related	Other Organics	Nitrogen (other than Ammonia)	Ammonia	Phosphorous	Dissolved Oxygen (D.O.)	Pathogens	pH	Temperature	Salinity (TDS, EC)	Chloride	Sodium	Suspended Solids (SS)	Settleable Solids	Oil & Grease	
1. Expand and extend existing programs to provide incentives for pollution source control on agricultural lands.	Improved instream and Delta water quality.				2			1		3				3	1	1														
2. Establish incentives for retirement of lands with the most severe drainage problems and where cost effective.	Improved instream and Delta water quality; reduces demand for irrigation water.							1		3				2	1	1								1						
3. Manage drainage timing to reduce instream impacts of water quality.	Reduces the concentration of pollutants entering and its tributaries during low flow periods and allows better coordination of discharges and dilution flows.		1	1	1	1	1	1		3				2	1	1								1						
4. Construct wetlands to treat upstream wastewater effluent and Delta agricultural drainage.	Improves Delta water quality by allowing some filtration and reduction in biological oxygen demand to result from constructed wetland treatment.		1	?	?	?	?	?	?	?	?			3	1								1							
5. Increase enforcement of source control regulations for agricultural drainage to moderately; reduce leachate conc. and vol., restrict spray programs adjacent to waterways, reduce runoff vols., reduce concerns of pollutants in runoff.	Reduces in-Delta and tributary surface water concentrations of pesticides (herbicides, fungicides, fungicides), fertilizers, concentrated mineral salts, and microbial agents from agricultural drainage.							1		2				3	2	1	1	1						1						
6. Coordinate following or retirement of agricultural lands with severe, costly drainage problems with water supply management actions.	Reduces volume of drainage water and constituent pollutant contributions to Delta and tributary surface waters.		1	1	1	1	1	2	1	3	1			2	1	1	1							2	1	1	1			







## BAY-DELTA SOURCES

### Bay-Delta Oversight Council

1. BDOC. August 1993. **Draft Briefing Paper on Delta Water Quality for Drinking Water and Agricultural Uses.** 200 pp.
2. Howard Bailey, Steve Clark, Jay Davis, and Lan Wiborg. date unknown. **Final Report The Effects of Toxic Contaminants in Waters of the San Francisco Bay and Delta.** 136 pp.
3. BDOC. December 1994. **Initial Report of the Water Quality Technical Advisory Committee, Draft.** 100 pp.
4. BDOC. November 1994. **Work Product Summary, Plant and Wildlife Resources Technical Advisory Committee.** 129 pp.

### CALFED Bay-Delta Program

1. CALFED. June 25, 1996. **Workshop 7 Information Packet, Including Preliminary Draft Phase II Alternatives.**
2. CALFED. December 4, 1995. **Public Workshop Information Package.**
3. CALFED. March 1996. **Draft Problem/Objective Definition.** 35 pp.
4. CALFED. January 1996. **Programs and Projects, Study Results and Data Collection for Alternatives Development.** 100 pp.
5. CALFED. April 1996. **Workshop 6 Information Packet, 10 Draft Alternatives.** 300 pp.

### San Francisco Estuary Project

1. SFEP. June 1992. **State of the Estuary: A Report on the Conditions and Problems in the San Francisco Bay/Sacramento-San Joaquin Delta Estuary.** 269 pp.
2. SFEP. June 1993. **Comprehensive Conservation and Management Plan.** 236 pp.
3. SFEP. March 1991. **Status and Trends Report on Pollutants in the San Francisco Estuary.** 239 pp.
4. SFEP. March 1992. **Status and Trends Report on Aquatic Resources in the San Francisco Estuary.** 257 pp.

**San Francisco Bay-Delta Aquatic Habitat Institute/San Francisco Estuary Institute**

1. Aquatic Habitat Institute. March 1992. **Proceedings of a Workshop on Chronic Toxicity Identification Evaluations in the San Francisco Bay Region.** 109 pp.
2. Aquatic Habitat Institute. 1993. **A Workshop on Toxicity Identification Evaluations (TIE's) in the San Francisco Bay Region: Lessons Learned.** 108 pp.
3. Andrew J. Gunther, Jay A. Davis, and David J.H. Phillips. SFEI. August 1987. **An Assessment of the Loading of Toxic Contaminants to the San Francisco -Bay Delta: Executive Summary.** 330 pp.
4. Aquatic Habitat Institute. David Phillips. 1987. **Toxic Contaminants in the San Francisco Bay-Delta and Their Possible Biological Effects.** 413 pp.
5. Aquatic Habitat Institute. April 1991. **Evaluation of Turbidity and Turbidity-Related Effects on the Biota of the San Francisco Bay-Delta Estuary.** 84 pp.
6. Andrew J. Gunther, Jay A. Davis, and David J.H. Phillips. SFEI. August 1987. **An Assessment of the Loading of Toxic Contaminants to the San Francisco-Bay Delta: Executive Summary.** 24 pp.
7. Aquatic Habitat Institute. David J.H. Phillips. August 1987. **Toxic Contaminants in the San Francisco Bay-Delta and Their Possible Biological Effects: Executive Summary.** 15 pp.
8. SFEI. **1993 Annual Report San Francisco Estuary Regional Monitoring Program for Trace Substances.** 214 pp.
9. David J.H. Phillips. August 1987. **Toxic Contaminants in the San Francisco Bay-Delta and Their Possible Biological Effects.** 413 pp.
10. David J.H. Phillips. December 1988. **Monitoring of Toxic Contaminants in the San Francisco Bay-Delta: A Critical Review, Emphasizing Spatial and Temporal Trend Monitoring: Executive Summary.** 14 pp.
11. David J.H. Phillips. December 1988. **Monitoring of Toxic Contaminants in the San Francisco Bay-Delta: A Critical Review, Emphasizing Spatial and Temporal Trend Monitoring.** 200 pp.
12. David J.H. Phillips and Donald J. Baumgartner. November 1987. **Screening Problems Relating to the San Francisco Bay-Delta.** 62 pp.
13. Andrew J. Gunther. ed. October 1988. **The Bioavailability of Toxic Contaminants in the San Francisco Bay-Delta, Proceedings of a Two-Day Seminar Series.** 182 pp.

14. SFEL. date unknown. **Research Recommendations for the San Francisco Estuary, Understanding the Ecosystem.** 45 pp.
15. SFEL. date unknown. **1994 Annual Report, San Francisco Regional Monitoring Program for Trace Substances.** 339 pp.

### **Regional Water Quality Control Board-Central Valley Region (Region 5)**

1. RWQCB. 1994. **Water Quality Control Plan (Basin Plan) for the California Regional Water Quality Control Board Central Valley Region Sacramento River and San Joaquin River Basins.**
2. RWQCB. March 1996. **Amendments to the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins for the Control of Agricultural Subsurface Drainage Discharges: Executive Summary.** Draft Report. 20 pp.
3. Jon B. Marshack. July 1995. **A Compilation of Water Quality Goals.**
4. Barry L. Montoya. December 1991. **An Analysis of the Toxic Water Quality Impairments in the Sacramento-San Joaquin Delta/Estuary.** 54 pp.
5. Christopher Foe. June 1995. **Evaluation of the Potential Impact of Contaminants on Aquatic Resources in the Central Valley and Sacramento-San Joaquin Delta Estuary.** 23 pp.

### **Regional Water Quality Control Board--San Francisco (Region 2)**

1. RWQCB. June 1995. **Contaminant Levels in Fish Tissue from San Francisco Bay, Final Report.** 135 pp.
2. RWQCB. date unknown. **Water Quality Control Plan for the California Regional Water Quality Control Board San Francisco Bay Region.**

### **State Water Resources Control Board**

1. SWRCB. April 1991. **California Inland Surface Waters Plan.** Resolution No. 91-33.
2. SWRCB. May 1991. **Executive Summary: Water Quality Control Plan for Salinity--San Francisco Bay/Sacramento-San Joaquin Delta Estuary.** Report No. 91-15WR.
3. SWRCB. May 1991. **Water Quality Control Plan for Salinity--San Francisco Bay/Sacramento-San Joaquin Delta Estuary.** Report No. 91-15WR.
4. SWRCB. December 1984. **Water Quality and Pesticides. Toxic Substances Control Program.**
  - A. **Malathion**

- B. **Rice Herbicides: Molinate and Thiobencarb**
  - C. **Glyphosphate**
  - D. **Toxaphene**
  - E. **1,2-Dichloropropane (1,2-D); 1,3-Dichloropropane (1,3-D)**
  - F. **Endosulfan**
  - G. **Ethylene Dibromide**
  - H. **2,4-D**
5. SWRCB. May 1992. **Toxic Substances Monitoring Program 1990 Data Report. 92-1WQ.**
  6. SWRCB. December 1984. **Water Quality and Pesticides: A California Risk Assessment Program. Volume 1. 175 pp.**
  7. SWRCB. May 1995. **Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary. 95-1WR.**
  8. SWRCB. June 1993. **The Clean Water Strategy. 27 pp.**
  9. SWRCB. October 1995. **Reports of the Public Advisory Task Forces to the State Water Resources Control Board Regarding Development of the Inland Surface Waters Plan and the Enclosed Bays and Estuaries Plan Final. Multiple Documents.**
  10. Del Rasmussen. October 1995. **Toxic Substances Monitoring Program 1992-93 Data Report. 95-1WQ. 3 pp.**
  11. SWRCB. March 1989. **Selenium and Agricultural Drainage Studies in California, Progress Report. 88-3-WR. 179 pp.**
  12. SWRCB. December 1988. **Tributyltin: A California Water Quality Assessment. 181 pp.**
  13. SWRCB. December 1984. **Ethylene Dibromide (EDB): A Water Quality Assessment. 47 pp.**
  14. SWRCB. October 1995. **Draft Staff Report: Status of the Bay Protection and Toxic Cleanup Program. 50 pp.**
  15. SWRCB. May 1996. **Scientific Planning and Review Committee Briefing Document for Recommendations on the Bay Protection and Toxic Cleanup Program Monitoring Activities. 75 pp.**
  16. SWRCB. June 1990. **Pollutant Policy Document, San Francisco Bay/Sacramento-San Joaquin Delta Estuary.**
  17. SWRCB. July 1994. **Bay Protection and Toxic Cleanup Program, Quality Assurance Project Plan.**

18. SWRCB. November 1993. **Status of the Bay Protection and Toxic Cleanup Program, Staff Report.** 230 pp.
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20. SWRCB. December 1994. **California 305(b) Report on Water Quality.** 67 pp.
21. SWRCB. January 1996. **Porter-Cologne Water Quality Control Act.** 132 pp.
22. SWRCB. February 1994. **Polluted Runoff, Watershed Solutions.** 31 pp.
23. SWRCB. April 1991. **Responses to Comments on the Draft Water Quality Control Plan, San Francisco Bay/Sacramento-San Joaquin Delta Estuary.**
24. SWRCB. September 1995. **Initiatives in Nonpoint Source Management.** 13 pp.
25. SWRCB. December 1994. **Water Quality Assessment.**
26. SWRCB. August 1978. **Water Right Decision 1485, Sacramento-San Joaquin Delta and Suisun Marsh.**
27. SWRCB. June 1991. **Workplan for the Development of Sediment Quality Objectives for Enclosed Bays and Estuaries of California.** 25 pp.
28. SWRCB. August 1990. **Toxic Substances Monitoring Program, Ten Year Summary Report 1978-1987.**
29. SWRCB. August 1987. **Regulation of Agricultural Drainage to the San Joaquin River.**
30. SWRCB. August 1987. **Regulation of Agricultural Drainage to the San Joaquin River, Executive Summary.**
31. SWRCB. May 1993. **California Enclosed Bays and Estuaries Plan.** 93-5WQ.
32. SWRCB. date unknown. **California State Mussel Watch, 1985-1986.**
33. SWRCB. December 1977. **Water Quality Control Policy, Use and Disposal of Inland Waters used for Powerplant Cooling.**
34. SWRCB. June 1991. **Toxic Substances Monitoring Program, 1988-1989.**
35. SWRCB. October 1990. **Sacramento River Toxic Chemical Risk Assessment Project, Final Project Report.** 90-11WQ.

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1. DFG and the Fish and Game Commission. March 1996. **California Sport Fishing Regulations Effective March 1, 1996 thru February 28, 1998.** 52 pp.
2. DFG. April 1989. **Selenium Verification Study, 1987-1988, A Report to the State Water Resources Control Board.** 100 pp.

## **Department of Pesticide Regulation**

1. DPR. **Pesticide Use Report. Annual 1992. Indexed by Chemical.**

## **Department of Water Resources**

1. DWR. 1993. **Delta Atlas.** 121 pp.
2. DWR. 1994. **California Water Plan Update. Volume 1 & 2 and Executive Summary. Bulletin 160-93.** 398 pp.

## **USEPA**

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3. USEPA. April 1996. **Biological Criteria Technical Guidance for Streams and Small Rivers.** 163 pp.
4. USEPA. June 1996. **Environmental Indicators of Water Quality in the United States, Fact Sheets.**

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2. Dorene MacCoy, Kathryn L. Crepeau, and Kathryn M. Kuivila. 1995. **Dissolved Pesticide Data for the San Joaquin River at Vernalis and the Sacramento River at Sacramento, California, 1991-94.** U.S. Geological Survey. Open File Report 95-110.

3. Kathryn L. Crepeau, Joseph L. Domagalski, Kathryn M. Kuivila. 1994. **Methods of Analysis and Quality-Assurance Practices of the U.S. Geological Survey Organic Laboratory, Sacramento, California--Determination of Pesticides in Water by Solid-Phase Extraction and Capillary Column Gas Chromatography/Mass Spectrometry.** U.S. Geological Survey. Open File Report 94-362.
4. Kathryn M. Kuivila and Frederic H. Nichols. date unknown. **Overview of San Francisco Bay Estuary Toxic Contaminants Study.**
5. Kathryn M. Kuivila. 1991. **Distribution of Pesticides in the Sacramento-San Joaquin Delta.** U.S. Geological Survey Yearbook.
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7. Kathryn M. Kuivila and Christopher G. Foe. 1995. **Concentrations, Transport and Biological Effects of Dormant Spray Pesticides in the San Francisco Estuary, California.** Environmental Toxicology and Chemistry, Vol. 14, No. 7. 1141-1150 pp.
8. Kathryn M. Kuivila, Robert C. Shepline, and Christopher G. Foe. In press. **Distribution and Possible Biological Effects of Diazinon in the San Joaquin River and the Sacramento-San Joaquin Delta, California, February 1993.** 15 pp.
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10. Joseph L. Domagalski and Kathryn M. Kuivila. 1993. **Distributions of Pesticides and Organic Contaminants Between Water and Suspended Sediment, San Francisco Bay, California.** Estuaries Vol. 16, No. 3A, 416-426 pp.

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3. Brown and Caldwell. May 1995. **Study of Drinking Water Quality in Delta Tributaries.** 300 pp.
4. J.W. Buell. March 1994. **Relationship Between Average Location of X2 and Annual Abundance Indices of Various Estuarine Organisms.** 18 pp.

5. J. Phyllis Fox and Elain Archibald. July 1996. **Aquatic Toxicity and Pesticides in Surface Waters of the Central Valley: Revised Draft.** 170 pp.

### **Other**

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