SECTIONFIVE

SURFACE WATER RESOURCES

Section 5 describes the affected environment for surface water resources in the project area: San Joaquin River reaches and tributaries, the San Francisco Bay–Sacramento-San Joaquin River Delta (Bay-Delta), Estero Bay, and drinking water resources. It evaluates the environmental effects of No Action and the Disposal Alternatives on these resources. An environmental effects summary is provided in Section 5.2.13.

5.1 AFFECTED ENVIRONMENT

This section describes the physical and regulatory setting of surface waters in the project area that are potentially affected by the San Luis Drainage Feature Re-evaluation. As discussed in Section 1.3, the drainage study area is located in the western San Joaquin Valley and consists of the lands within the boundary of the CVP's San Luis Unit. Potential discharge locations for the Out-of-Valley Disposal Alternatives include the Delta (Chipps Island or Carquinez Straits) and Point Estero, located northwest of the city of San Luis Obispo. The physical environment is discussed for each of these locations, and the regulatory environment is discussed in greater detail than in Section 4 as needed.

Selenium (Se) is a semimetallic trace element that is widely distributed in the earth's crust at levels less than 1 milligram per kilogram (mg/kg) and with chemical properties similar to sulfur. The natural source of Se in the San Joaquin Valley is erosion of marine shales in the mountain soils of the eastern side of the Coast Range, followed by deposition of sediment in the valley, which forms the parent material for valley soils. Accelerated transfer of Se into the valley aquatic ecosystem occurs when Se-bearing materials are subject to floods or disturbed by road building, mining, overgrazing, and agricultural irrigation.

Irrigation water applied to agricultural lands in the western San Joaquin Valley can leach Se from the soil to the shallow groundwater. Tile drains have been installed on some farms to reduce the harmful effects of salts reaching the root zone. However, these drains have unintentionally accelerated the leaching of Se into the valley's surface waters. Consequently, portions of the San Joaquin River contain elevated levels of Se and salts, which have exceeded levels considered safe for fish and wildlife species.

5.1.1 Surface Water Resources

5.1.1.1 San Joaquin Valley

Major surface water resources in the San Joaquin Valley include the San Joaquin River and its tributaries, water supply reservoirs and canals, and wetlands maintained for wildlife habitat. None of the action alternatives would result in direct discharge of drainwater to surface water resources in the San Joaquin Valley. However, portions of the Northerly Area currently discharge to the San Joaquin River through Mud Slough as a part of the Grassland Bypass Project. Under the action alternatives, this discharge would be shifted to one of the disposal alternatives. As a result, water quality and quantity in Mud Slough and the San Joaquin River downstream of Mud Slough could be affected, and are discussed below. The San Joaquin River provides the major drainage outlet from the San Joaquin Valley. The San Joaquin River flows north along the valley trough and converges with the southerly flowing Sacramento River in the Bay-Delta. From there the water flows through Suisun Bay and Carquinez Strait into San Francisco Bay (the Bay) and out to the Pacific Ocean.

In the drainage study area, water supply for purposes other than drinking water is mainly derived from runoff from the mountains and foothills of the Coast Ranges and the Sierra Nevada foothills. The primary use of surface water in the study area is for agriculture. Surface water supplies have been developed by local irrigation districts, county agencies, private companies, and State and Federal agencies. The San Joaquin River is the main natural drainage for surface water, but it has been augmented by various human-made drainage systems.

5.1.1.2 Precipitation

The drainage study area is semiarid, characterized by hot, dry summers and mild winters. Summer temperatures may reach 110°F, while winter temperatures may fall below 25°F. The high summer temperatures and low relative humidity combine for a high rate of surface water evaporation.

Water quality in the San Joaquin River system is influenced by seasonal and annual variations. Mean precipitation increases heading northward. Average annual precipitation at the Los Banos Detention Reservoir Precipitation Gauge is approximately 8.6 inches per year but varies from 2.4 to 20.63 inches. Almost all of the rainfall occurs from November through April. For the purposes of classifying and reporting flows, water year types have been established by DWR. A water year extends from October 1 of one year to September 30 of the next year and is classified according to total annual unimpaired runoff (i.e., runoff uninfluenced by human activities) in the four major rivers in the San Joaquin River Basin, which are the San Joaquin, Merced, Tuolumne, and Stanislaus rivers (Table 5.1-1).

Table 5.1-1
San Joaquin Valley Water Year Hydrologic Classification

Year Type	Unimpaired Runoff (Millions of Acre-Feet)
Wet	> 3.8
Above Normal	> 3.1 to ≤ 3.8
Below Normal	> 2.5 ≤ 3.1
Dry	> 2.1 ≤ 2.5
Critical	≤ 2.1

Source: State Board 1995.

5.1.1.3 San Joaquin River Flow

Flows in and to the San Joaquin River play a major role in dictating its water quality. From a regional perspective, flows in the San Joaquin River are controlled mostly by dams on east-side tributaries and on the main stem upstream from Fresno. Water stored in Millerton Reservoir, located on the San Joaquin River upstream of Fresno, is diverted through the Friant-Kern and Madera canals. Releases from the reservoir infiltrate into the river bottom, and the river is often dry much of the year in a stretch below Gravelly Ford. The channel is usually wet in the area of San Mateo Avenue. Water supply developments on the major east-side tributaries have reduced the flow of the San Joaquin River (SJVDP 1990). Flow contributions to the San Joaquin River upstream of Crows Landing (Station N) are shown on Figure 5.1-1. As illustrated, major contributors of flow to the San Joaquin River in the project area include the upstream flows in the San Joaquin River above the Salt Slough confluence, Salt and Mud sloughs, the major west-side tributaries of the San Joaquin River, and the Merced River. By far the largest of these sources is the Merced River, which accounts for approximately 50 to 75 percent of the flow in the San Joaquin River measured at Crows Landing. Note that releases from Friant Dam located on Millerton Reservoir upstream from the drainage area are not generally a major source of flow at Crows Landing except during flood releases. Releases from Friant Dam are for riparian water users and flood control. In 1999–2000, the Vernalis Adaptive Management Plan (VAMP) (implemented by the San Joaquin River Agreement) on the San Joaquin River has resulted in regulated spring releases (April-May) from the dams and reservoirs located on the east side of the San Joaquin Valley.

The largest flows in the San Joaquin River in the project area occur during the late winter and spring from January through May. The lowest flows occur during the late summer in August and September. Thirty years of flow records are available at Crows Landing. A review of these flow records indicates that during winter months, the high flows at Crows Landing are highly influenced by large storm events. Figure 5.1-2 shows the average and median monthly flow at Crows Landing based on the 30-year record. During the winter to early summer (January-July), the statistics of the flow record are highly skewed. The average is influenced by a few large events and is not representative of the typical flow rate in the river. This is indicated by the large difference between the average and the median flow (the median flow is the flow that is exceeded 50 percent of the time; i.e., half the flows are greater and half the flows are less than the median). In this situation, the median provides a better representation of the typical condition. In fact, for any given month, about 70 percent of the monthly flows are less than the average monthly flows.

5.1.2 Water Quality in San Joaquin River Reaches and Tributaries

Annual average existing water quality in the San Joaquin River Basin is mapped by river segment for Se, salinity, and boron, the principal parameters of concern from the drainage study area, on Figures 5.1-3 to 5.1-5. Water Year 1999 was used as representative of the existing water quality because data were readily available and representative of general conditions in the receiving water. Note: modeling in Appendix D4 used nine years of flow records consistent with the TMDL for Se, salt, and boron proposed by the Sacramento Regional Board. Data were summarized from the Grassland Bypass Monitoring Program.

Selenium

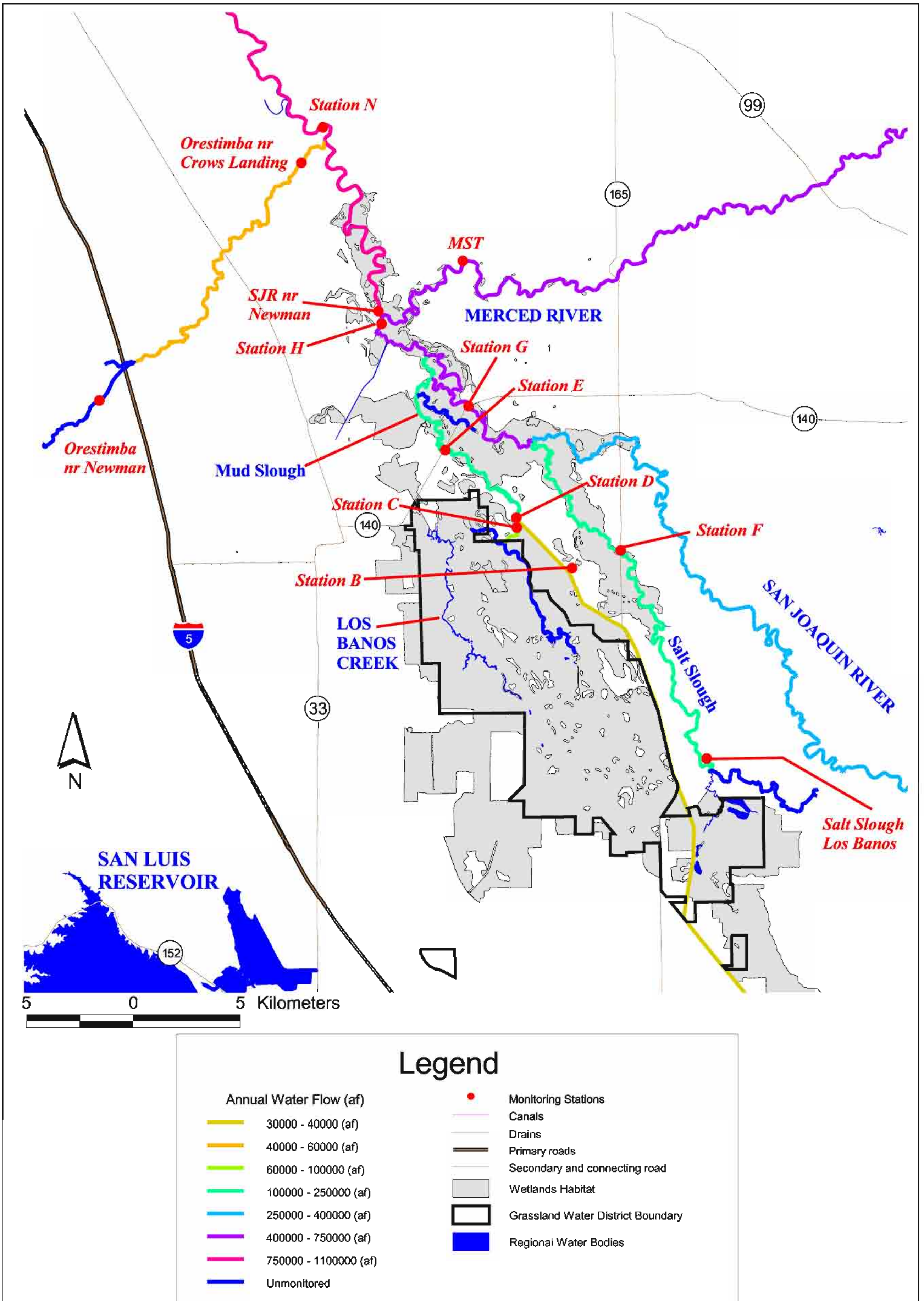
Under certain high-flow conditions, a major source of Se discharge to the Delta is from the San Joaquin River. Median Se values in the river upstream from Vernalis occasionally exceed the EPA's ambient water quality criteria of 5 µg/L for protection of aquatic life (SFEI 2002a).

In Water Year 1999 Se concentrations were highest in the San Luis Drain, Mud Slough, and the segment of the San Joaquin River between the Mud Slough and Merced River confluences as shown on Figure 5.1-3. Annual average Se concentrations exceeded the 5 µg/L water quality criteria in these reaches. Upstream water quality was generally good (usually below 1 µg/L), providing a source of dilution water for discharges from the GDA.

Salinity

The streams within the study area are intermittent and often highly mineralized, and many have been recognized as having impaired water quality under Clean Water Act (CWA) Section 303(d). Over 130 miles of the main stem of the San Joaquin River downstream of Friant Dam are listed as water quality-impaired for salinity. The salt concentrations of water in the lower San Joaquin River and south Delta frequently exceed desirable levels for agricultural and other beneficial uses. The 700 micromhos per centimeter (µmhos/cm) specific conductance (or electrical conductivity [EC]) water quality objective (WQO) for the San Joaquin River near Vernalis for April to August has been exceeded over 50 percent of the time from 1986 through 1997 (Reclamation 2001c).

Salt concentrations are mapped for the different river reaches on Figure 5.1-4. The distribution of salt is more widespread than the distribution of Se. Salt concentrations are highest in the San Luis Drain and in the San Joaquin River upstream of Salt Slough. Significant concentrations of salt are also present in Salt Slough. The major source of less saline dilution water is from the Merced River, with annual average TDS concentrations of approximately 100 mg/L.



San Luis Drainage Feature Re-evaluation	Mean Annual Water Flow in the San Joaquin River	Figure 5.1-1
17324004		

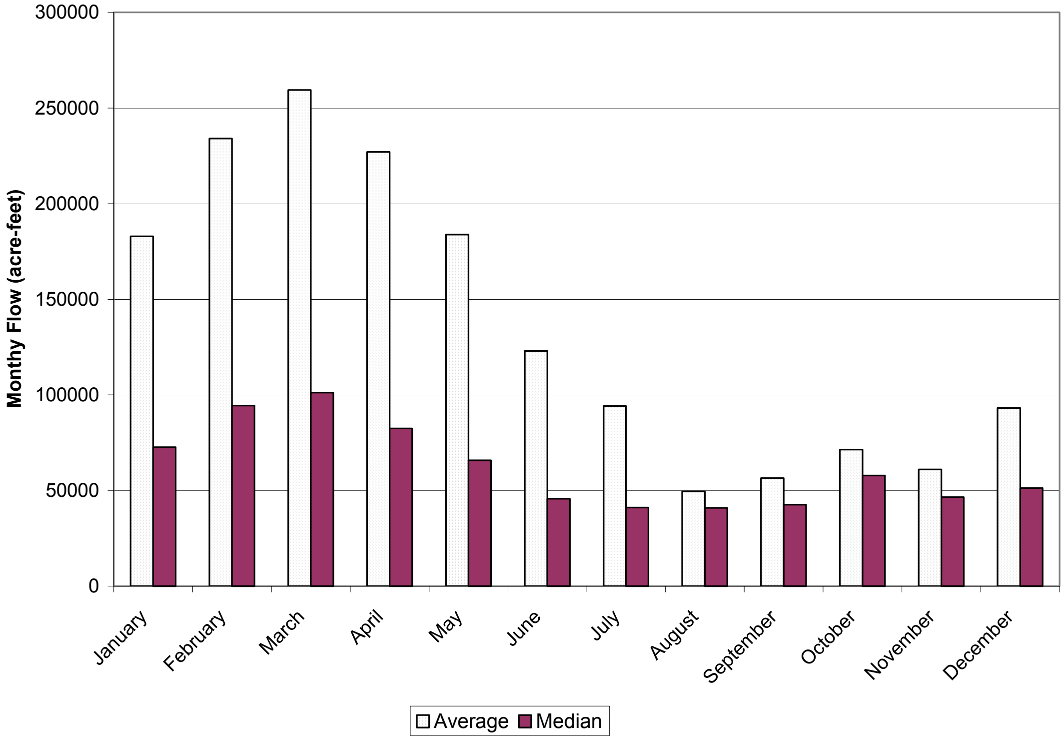


Figure 5.1-2 Average and Median Monthly Flows in the San Joaquin River at Crows Landing (Based on 30 Years of Records)

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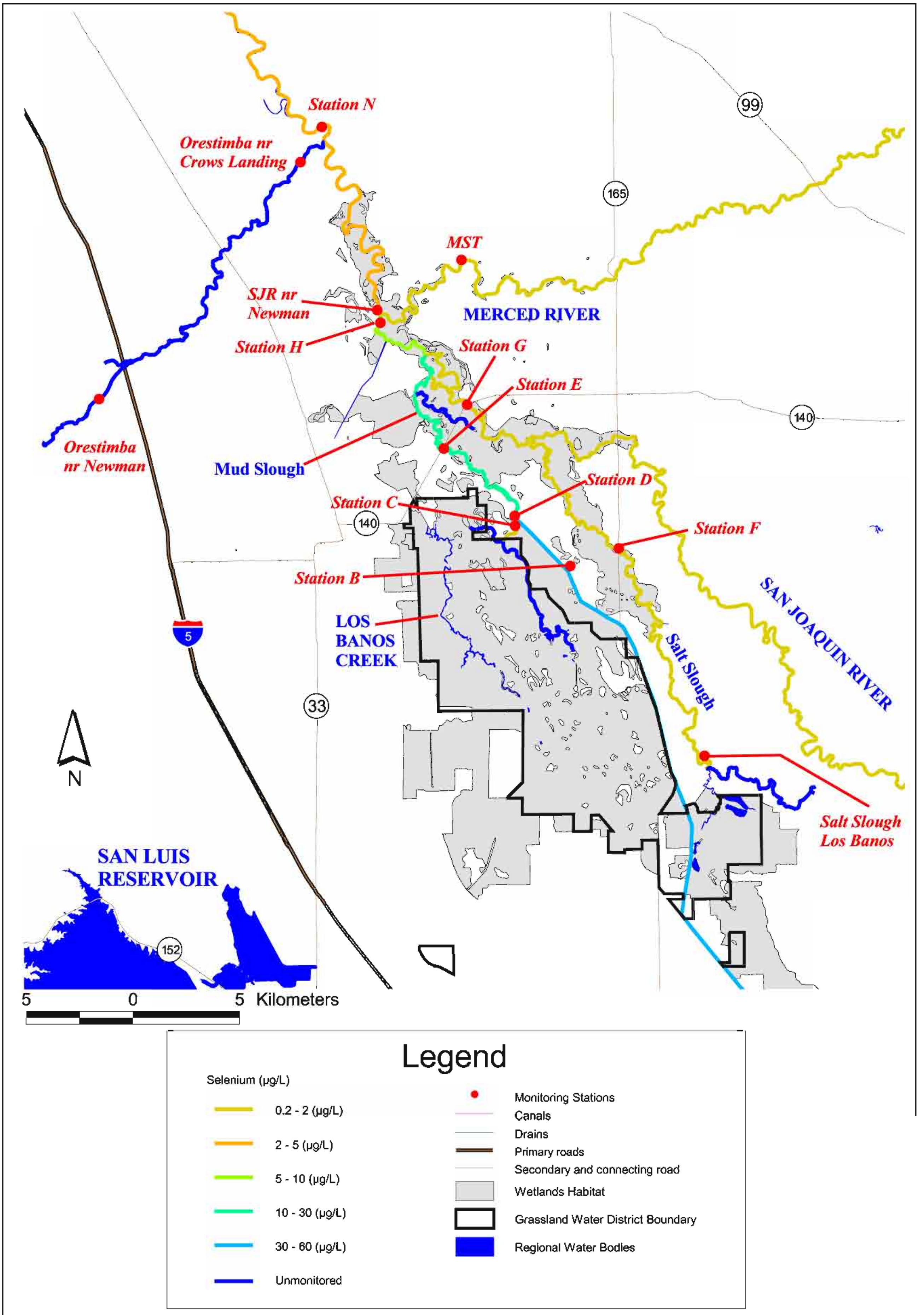
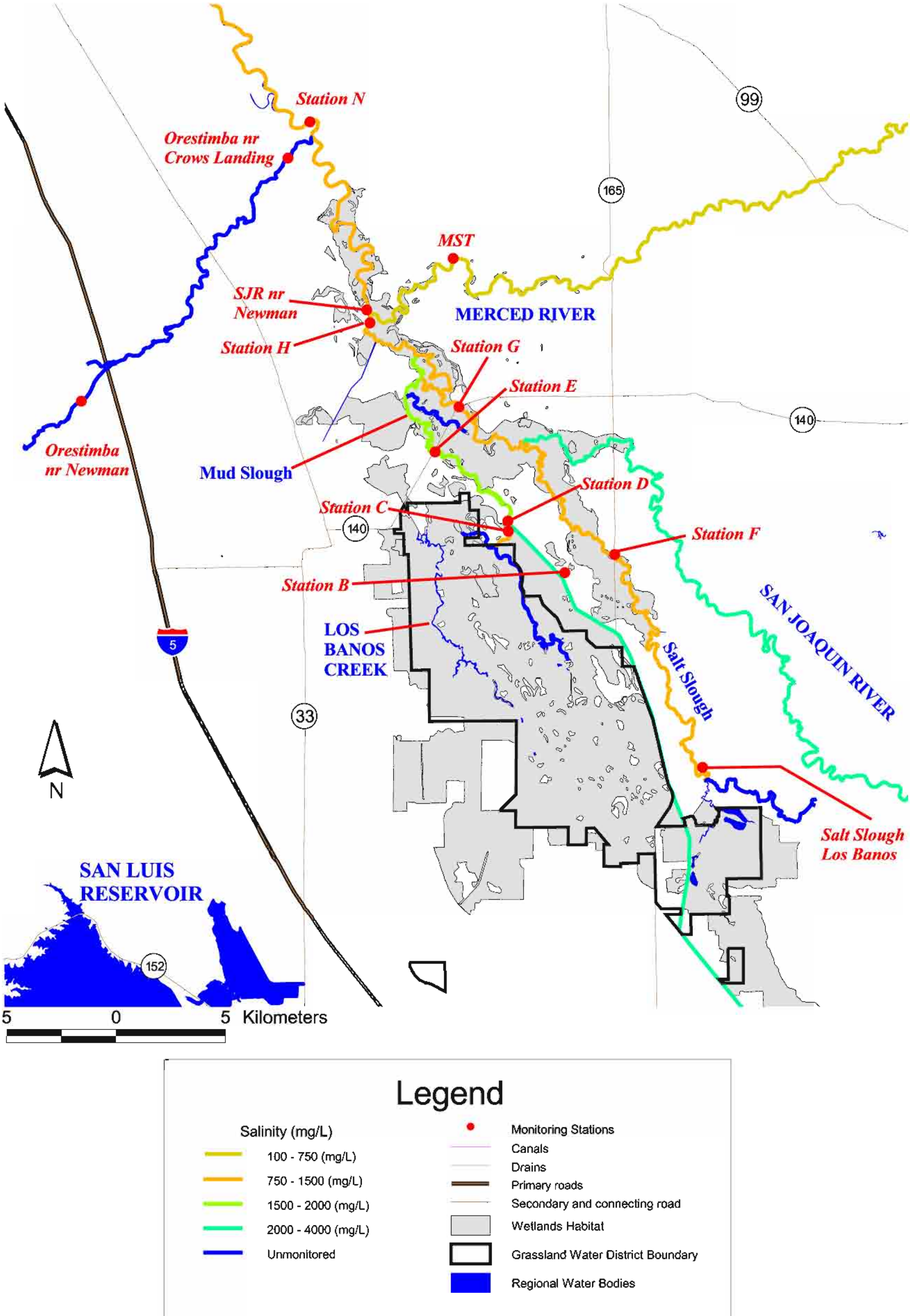
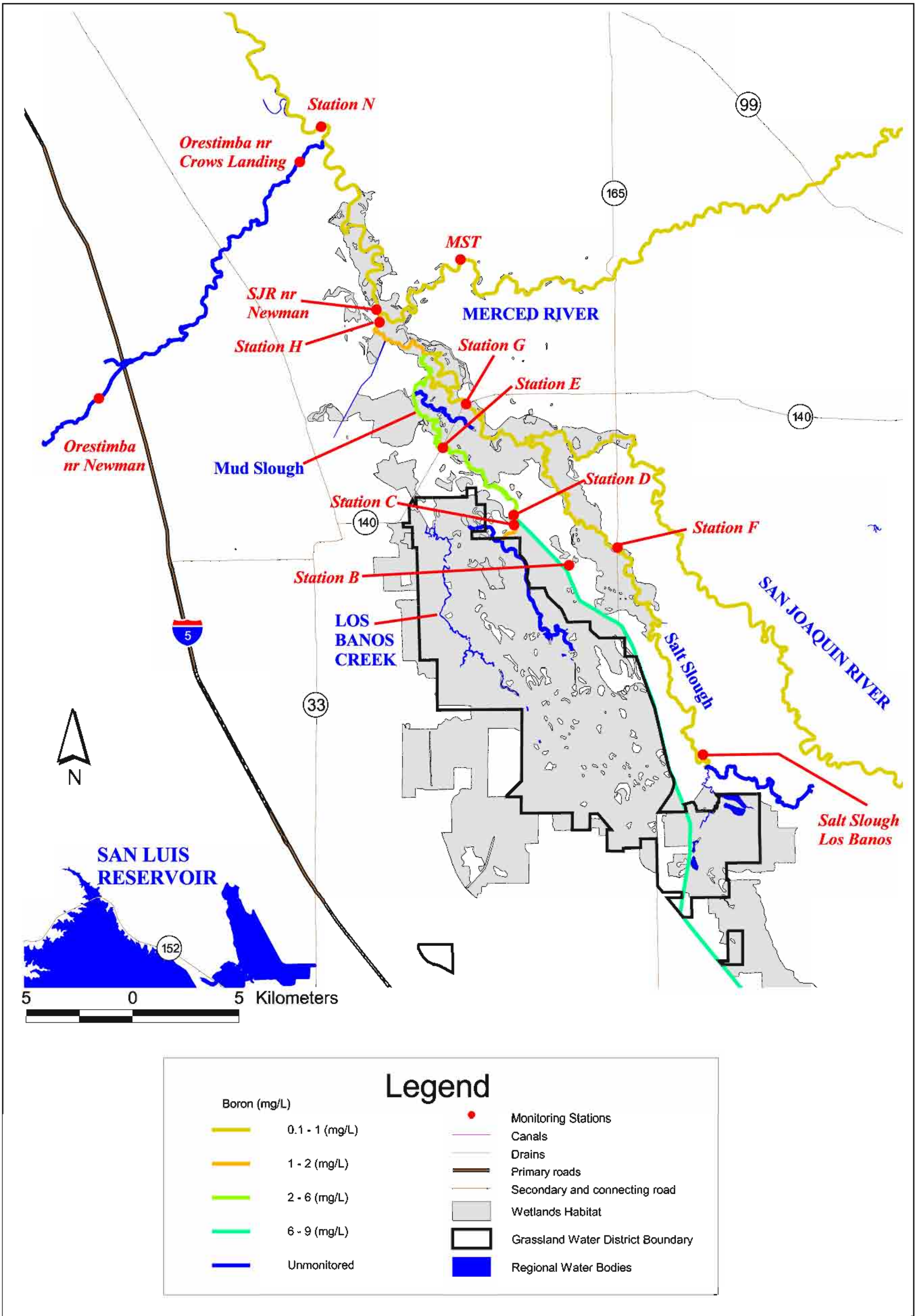


San Luis Drainage Feature Re-evaluation	Existing Conditions for Selenium (WY 1999)	Figure 5.1-3
17324004		



San Luis Drainage Feature Re-evaluation	Existing Conditions for Salinity (WY 1999)	Figure 5.1-4
17324004		



San Luis Drainage Feature Re-evaluation	Existing Conditions for Boron (WY 1999)	Figure 5.1-5
17324004		

Freshwater streamflows are depleted by irrigation diversions and subsequently increased by drainwater high in Se and salts. Surface flows and subsurface agricultural drainwaters are the major source of salt in the lower San Joaquin River Basin.

- Surface agricultural runoff (tailwater discharges and stormwater runoff) contributes a portion of the salt load to the San Joaquin River and the Delta. Discharge of tailwater is prohibited by the Northerly Area water districts. However, salt in water supply and Se in stormwater runoff can represent a large percentage of the salt and Se in surface agricultural runoff. Irrigation water supply quality is, therefore, one key factor in determining surface agricultural runoff quality.
- Subsurface drainage is a more concentrated source of salt than surface runoff. Discharge of subsurface drainage is occurring through the Grassland Bypass Project, which conveys drainage from the Northerly Area to Mud Slough and on to the San Joaquin River.

This salt loading contributes to impairment of water quality in the lower San Joaquin River and Delta region. The San Joaquin River is the most heavily concentrated source of agricultural salt discharge to the Delta. Agricultural drainwater has been estimated to carry as much as 740,000 tons of total annual salt into the Delta. Streamflows into the Delta are also influenced by tidal action, further increasing the salt content. Natural tidal fluctuation and the resulting intrusion of seawater further increase the Delta's salinity.

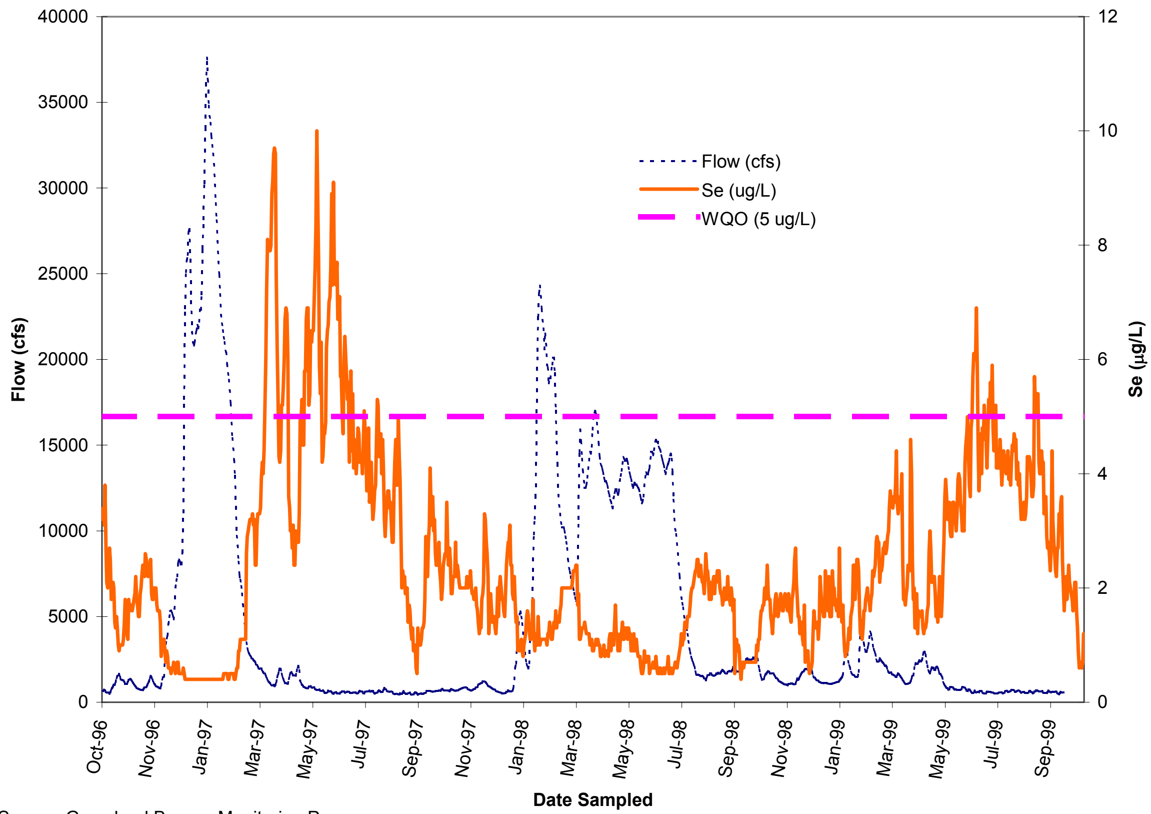
Boron

The distribution of boron in the San Joaquin River Basin is similar to that of Se (Figure 5.1-5). Boron concentrations were highest in the San Luis Drain, Mud Slough, and the segment of the San Joaquin River between the Salt Slough and Mud Slough confluences. Upstream water quality was generally good (usually below 1 µg/L), providing a source of dilution water for discharges from the GDA.

5.1.2.1 San Joaquin River - Merced River to Crows Landing (River Miles ~ 118.5 to 100.0)

Downstream of the Merced River confluence, the San Joaquin River at Crows Landing (site of Station N) is a Regional Board compliance point for Se. Flows at this point in the San Joaquin River are an aggregate of all the flows from Mud Slough, Salt Slough, the San Joaquin River upstream of Salt Slough, and the Merced River. Other water sources contribute to the San Joaquin River in this reach, including Orestimba Creek and various other surface and subsurface flows. Flows in this portion of the San Joaquin River vary seasonally, with high flows in the winter and low flows during the summer. Figure 5.1-6 presents the daily flow and Se concentrations in the San Joaquin River at Crows Landing. The monthly mean Se concentration exceeded 5 µg/L twice in 12 months for Water Years 1996 and 1997, i.e., before and after Grassland Bypass Project implementation. The concentration did not exceed 5 µg/L as a monthly mean in either Water Year 1998 or 1999. As a 4-day running average, however, the concentration exceeded 5 µg/L during 4 months in Water Years 1997 and 1999. Based on the comparison of the mass of Se discharged from the San Luis Interceptor Drain (the Drain) and Se mass monitored at Crows Landing, the bulk of the Se found in the San Joaquin River at Crows Landing originates from the agricultural drainage discharged to Mud Slough (North).

Monthly TDS concentrations at Station N in Water Year 1999 ranged between approximately 260 and 840 mg/L (420 and 1,350 microSiemens per centimeter [µS/cm] EC), with an annual average of 570 mg/L (920 µS/cm EC). The monthly TDS concentrations for Water Years 1997 to 1998 ranged between approximately 100 and 910 mg/L (160 and 1,460 µS/cm EC), with a 2-year daily average of 440 mg/L (710 µS/cm EC) over both years. The TDS/EC ratio of 0.62 was used to convert between TDS and EC at Station N, based on the value given for the closest location (San Joaquin River near Patterson) in *Loads of Salt, Boron, and Se in the Grassland Watershed and Lower San Joaquin River* (Regional Board, Central Valley 1998a).



Source: Grassland Bypass Monitoring Program

Figure 5.1-6 Selenium Concentrations and Daily Flow in the San Joaquin River at Crows Landing (Station N)

5.1.2.2 San Joaquin River at Vernalis (River Mile <77)

Discharges from the GDA, together with all other inputs in the watershed, contribute to water quality at Vernalis. Water quality at Vernalis is of concern because this is the current compliance point for EC objectives. The State Board under CWA Section 303(d) has listed this site as an impaired waterbody for salt and dissolved oxygen. The major tributaries including the Merced, Tuolumne, and Stanislaus rivers as well as west-side inputs contribute to flows in this portion of the San Joaquin River. Flow in the San Joaquin River at Vernalis ranges from 118,243 to 609,622 AF per month (Water Year 1999 data). Peak discharges generally occur in February to May with low flows occurring in the late summer. Constituents of concern in the San Joaquin

River at Vernalis include salt (characterized as EC), boron, dissolved oxygen, and Se. Elevated salinity concentrations have resulted in exceedances of WQOs for the San Joaquin River in previous years. The 700 µmhos/cm 30-day running average specific conductance (or EC) WQO for the San Joaquin River near Vernalis for the April to August period has been exceeded 54 percent of the time from 1986 through 1997. The l,000 µmhos/cm WQO for the September to March period has been exceeded 13 percent of the time (CALFED 2000a). Since Water Year 1995, monthly average Se concentrations have not exceeded the 5 µg/L 4-day average WQO. Water Year 1995 through 1998 Se concentrations have ranged from <0.2 to 2.9 µg/L with a long-term average of 1.1 µg/L. However, samples are collected on a weekly basis, making a direct comparison to the 4-day average difficult. Since Water Year 1995, boron concentrations have been lower than the 0.8 mg/L monthly mean WQO.

Low dissolved oxygen conditions have been measured in the San Joaquin River around the Stockton area. Dissolved oxygen concentrations as low as 0.34 mg/L have been quantified in Smith Canal, Mosher Slough, 5-Mile Slough, and the Calaveras River. They tend to occur during late summer and fall due to a combination of high water temperature, nutrients, algal blooms, and discharge (CALFED 2000a). Low dissolved oxygen concentrations are of concern due to the potential hazard to fisheries.

5.1.3 Water Quality in the Bay-Delta

The Regional Monitoring Program (RMP) for Trace Substances administered by the San Francisco Estuary Institute (SFEI) for the Regional Board, San Francisco, and Bay dischargers conducts monitoring three times a year along the main spine of the Bay, from the Delta to the South Bay (Figure 5.1-7). The RMP measures concentrations of trace constituents in water, sediment, and transplanted bivalves at various locations in the Bay-Delta. The monitoring station nearest the potential Carquinez Strait discharge location is Davis Point. The monitoring station nearest the potential Chipps Island discharge location is Honker Bay. Figure 5.1-7 also shows the San Joaquin and Sacramento River stations and the Golden Gate station, which have been included to estimate ambient concentrations at the potential ocean discharge point at the downstream edge of the Delta. RMP water data from 1993 to 2000 were summarized for pollutants of concern and are shown in Table 5.1-2.

The entire northern Bay-Delta and the Golden Gate consistently exceed water quality criteria for polychlorinated biphenyls (PCBs). While the Sacramento and San Joaquin river stations contained the lowest PCB levels, the Golden Gate station showed the fewest criteria exceedances (Table 5.1-2). Polycyclic aromatic hydrocarbons (PAHs) were problematic in the North Bay as well. While the Golden Gate station and the Sacramento and San Joaquin river stations did not exceed PAH criteria during 1993-2000, all other northern Bay-Delta stations did, although not to the same extent as for PCBs (Table 5.1-2).

No concentrations for pollutants of concern were significantly higher at the Davis Point station than the average for the entire northern Bay-Delta. However, PAHs, PCBs, and total mercury exceeded the water quality criteria for protection of human health through ingestion of fish at least once. Davis Point also contained the highest nickel and total Se concentrations in the North Bay-Delta, but they never exceeded water quality criteria. Davis Point's proximity to multiple industrial dischargers near Carquinez Strait may explain the station's higher concentrations.

Table 5.1-2
Summary of Regional Monitoring Program Data for San Francisco Bay-Delta

	Total PAHS (ng/L)	Total PCBs (pg/L)	Cu Dissolved (µg/L)	Ni Dissolved (µg/L)	Pb Dissolved (µg/L)	Se Dissolved (µg/L)	Se Total (µg/L)	Hg Total (µg/L)	Salinity (by SCT) o/oo
California Toxics Rule Water Quality Criteria (averaging period)			4.8 (1-hour)	74 (1-hour)	210 (1-hour)		20 (1-hour)		
		170 (30-day)	3.1 (4-day)	8.2 (4-day)	8.1 (4-day)		5 (4-day)	0.051 (30-day)	
Basin Plan Water Quality Objective (averaging period)	31 (30-day)							0.025 (4-day)	
Station									
Davis Point									
Mean	33.42	658.95	1.75	1.84	0.04	0.17	0.21	0.020	12.39
Median	25.00	413.50	1.80	1.68	0.01	0.17	0.18	0.013	11.20
Std Dev	23.97	538.64	0.39	0.70	0.10	0.07	0.09	0.020	7.88
# of Samples Exceeding Criteria	6/17	17/20	0/21	0/21	0/21		0/22	1/18	
Golden Gate									
Mean	5.68	311.26	0.47	0.63	0.01	0.18	0.17	0.0012	29.19
Median	5.00	126.00	0.40	0.60	0.01	0.12	0.12	0.0011	30.20
Std Dev	4.61	650.12	0.21	0.23	0.00	0.10	0.11	0.0005	3.79
# of Samples Exceeding Criteria	0/17	8/19	0/20	0/20	0/20		0/16	0/15	
Grizzly Bay									
Mean	29.38	521.95	1.89	1.52	0.08	0.16	0.17	0.023	2.89
Median	24.00	287.00	1.83	1.35	0.02	0.15	0.17	0.015	0.40
Std Dev	22.89	546.23	0.51	0.86	0.12	0.06	0.06	0.018	3.51
# of Samples Exceeding Criteria	6/16	17/19	0/21	0/21	0/21		0/22	1/19	
Honker Bay									
Mean	.	.	1.70	1.31	0.06	0.13	0.16	0.018	1.26
Median	.	.	1.65	1.15	0.05	0.12	0.15	0.014	0.00
Std Dev	.	.	0.41	0.44	0.06	0.05	0.05	0.013	1.95
# of Samples Exceeding Criteria	0/0	0/0	0/18	0/18	0/18		0/19	0/15	
Pacheco Creek									
Mean	.	.	1.84	1.55	0.07	0.18	0.19	0.015	4.03
Median	.	.	1.89	1.38	0.03	0.16	0.18	0.013	0.30
Std Dev	.	.	0.47	0.73	0.11	0.07	0.07	0.008	4.68
# of Samples Exceeding Criteria	0/0	0/0	0/21	0/21	0/21		0/21	0/18	
Point Pinole									
Mean	22.65	622.84	1.57	1.66	0.02	0.16	0.19	0.014	14.56
Median	18.50	323.00	1.50	1.46	0.01	0.15	0.17	0.009	15.85
Std Dev	16.54	792.29	0.27	0.56	0.02	0.07	0.08	0.012	7.31
# of Samples Exceeding Criteria	3/16	18/19	0/21	0/21	0/21		0/21	0/18	

Table 5.1-2 (concluded)
Summary of Regional Monitoring Program Data for San Francisco Bay-Delta

	Total PAHS (ng/L)	Total PCBs (pg/L)	Cu Dissolved (µg/L)	Ni Dissolved (µg/L)	Pb Dissolved (µg/L)	Se Dissolved (µg/L)	Se Total (µg/L)	Hg Total (µg/L)	Salinity (by SCT) o/oo
California Toxics Rule Water Quality Criteria (averaging period)			4.8 (1-hour)	74 (1-hour)	210 (1-hour)		20 (1-hour)		
		170 (30-day)	3.1 (4-day)	8.2 (4-day)	8.1 (4-day)		5 (4-day)	0.051 (30-day)	
Basin Plan Water Quality Objective (averaging period)	31 (30-day)							0.025 (4-day)	
Station									
Red Rock									
Mean	15.00	403.78	1.23	1.32	0.02	0.16	0.17	0.0055	20.45
Median	13.00	262.50	1.22	1.20	0.01	0.13	0.15	0.0047	21.20
Std Dev	10.73	513.11	0.41	0.45	0.02	0.10	0.08	0.0032	8.81
# of Samples Exceeding Criteria	1/17	16/18	0/18	0/18	0/18		0/16	0/16	
Sacramento River									
Mean	8.38	253.75	1.61	1.30	0.09	0.14	0.15	0.0086	0.17
Median	8.00	182.50	1.50	1.00	0.07	0.12	0.15	0.0060	0.00
Std Dev	3.95	201.85	0.42	0.64	0.08	0.07	0.06	0.0081	0.63
# of Samples Exceeding Criteria	0/17	11/20	0/21	0/21	0/21		0/20	0/19	
San Joaquin River									
Mean	7.88	209.56	1.82	1.27	0.10	0.17	0.18	0.0076	0.13
Median	6.10	172.50	1.70	1.10	0.07	0.16	0.18	0.0072	0.00
Std Dev	5.07	157.12	0.41	0.56	0.10	0.07	0.09	0.0037	0.40
# of Samples Exceeding Criteria	0/17	9/18	0/21	0/21	0/21		0/21	0/18	
San Pablo Bay									
Mean	40.79	742.95	1.65	1.73	0.04	0.16	0.19	0.024	13.73
Median	24.50	430.00	1.60	1.60	0.01	0.15	0.17	0.015	13.35
Std Dev	37.21	806.70	0.35	0.60	0.08	0.05	0.07	0.024	7.86
# of Samples Exceeding Criteria	7/16	19/20	0/21	0/21	0/21		0/21	2/18	
Listed Stations									
Average	20	469	1.56	1.42	0.05	0.16	0.18	0.014	9.86
Std Dev	22	592	0.56	0.67	0.08	0.07	0.08	0.015	10.73
Average Ocean Concentration (Bruland 1983)			0.266	0.491	0.00217	0.14		0.00105 (as dissolved)	35

The Honker Bay station is closest to the potential Chipps Island discharge point and did not have available PAH or PCB data. Generally, Honker Bay concentrations for pollutants of concern were average for the North Bay and Delta.

The processing of fossil fuels and irrigation of lands geologically derived from organic marine shales are two principal causes of Se mobilization in the environment. Both have caused significant Se loading to the northern Bay-Delta and the Delta. Fossil fuel processing discharges at and near Carquinez Strait and the discharge of the San Joaquin River from the Central Valley, which contains Se-rich soil, have caused Se to be listed by the State as a key contaminant in the Bay-Delta. Se is known to be an efficient bioaccumulator, most often expressing toxicity in the form of reproductive defects and toxicity in higher fish and bird predators (Luoma and Presser 2000).

While Se levels found in water in the Bay-Delta are not significantly higher than those in other major estuaries (Cutter 1989), Se concentrations in bivalves have previously exceeded thresholds of toxicity for ingestion by predators (Luoma and Presser 2000). Also, concentrations in bivalve tissue and sediments have increased in the last few years (SFEI 2002b), and perhaps the most important biological pathway for Se uptake is through benthic filter feeders (Luoma and Presser 2000).

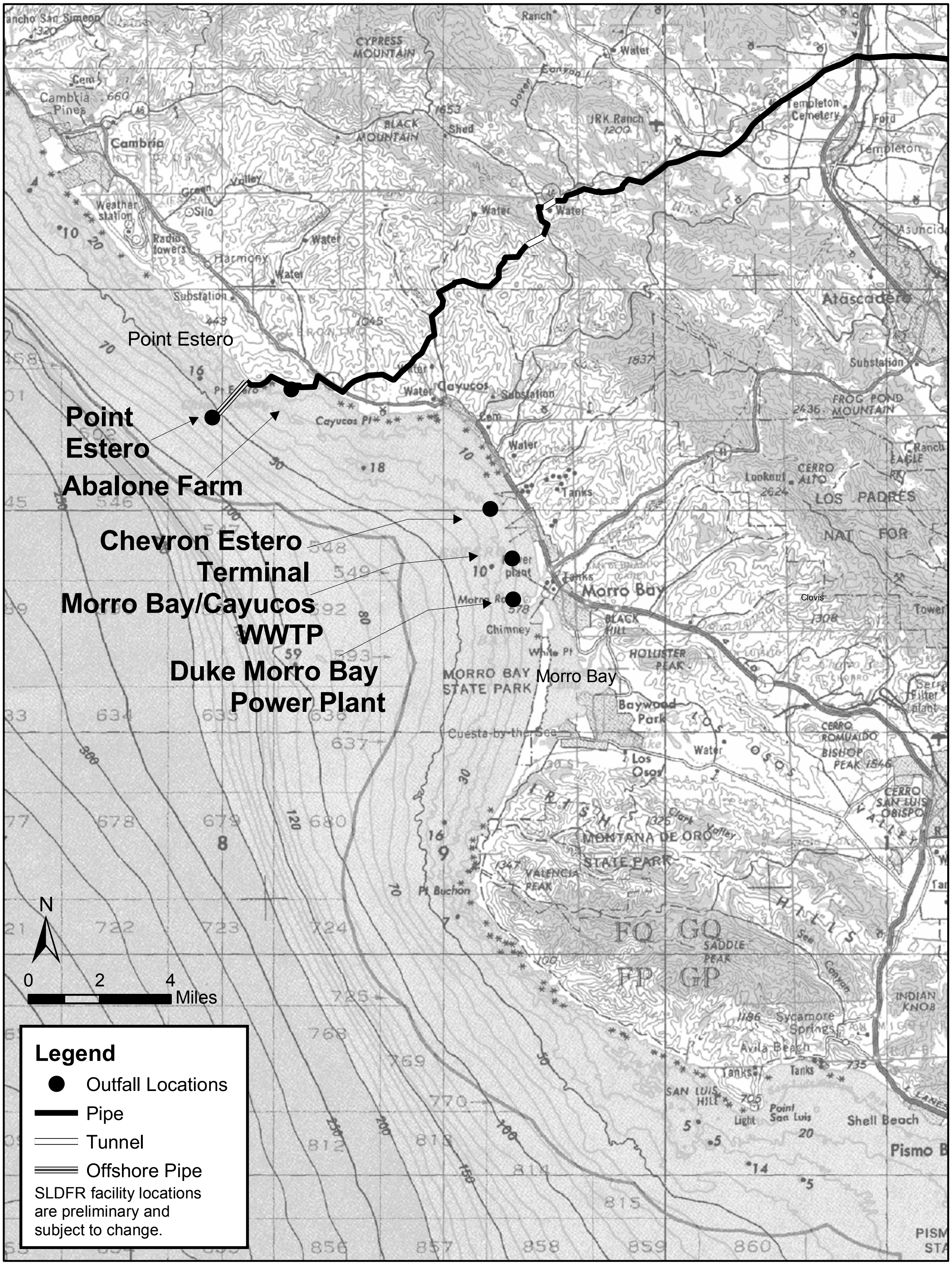
The Delta receives water from the Sacramento and San Joaquin rivers; however, the Sacramento River does not contain appreciable amounts of Se. The San Joaquin River at Vernalis during the period from 1993 to 2000 contained average concentrations of total Se of 1.86 µg/L (Table 5.1-3). A higher percentage of freshwater flow from the Delta originates from the Sacramento River than the San Joaquin River. Average Se concentrations in the San Joaquin River as it exits the Delta (as measured by the RMP) are significantly lower than those measured at upstream locations such as near Vernalis or Crows Landing (Table 5.1-3).

5.1.4 Water Quality in Estero Bay

Estero Bay is located along California's Central Coast in San Luis Obispo County, extending from Point Estero to the north approximately 20 miles southward along the coast to Point Buchon. The Morro Bay estuary is centrally located within the larger embayment known as Estero Bay. The Regional Board defines the Estero Bay hydrologic unit as extending approximately 25 miles farther north than Point Estero, to San Carpofaro Creek near the northern boundary of San Luis Obispo County. This discussion focuses on the actual embayment, which lends its name to the hydrologic unit. The coastline along Estero Bay includes the unincorporated community of Cayucos on the north, the City of Morro Bay near the middle, and the unincorporated communities of Los Osos and Baywood Park to the southeast and south of the Morro Bay estuary. Figure 5.1-8 shows Estero Bay and its vicinity and identifies the major features in the area.

The shoreline along Estero Bay is generally rocky in its northern and southern limits, with outcrops of Franciscan rock dominating. In the central portion of the shoreline, the coast is characterized by sedimentary formations presenting shallow bluffs up to about 20 feet in height. Narrow sandy beaches are also located in this area in Cayucos, and the northerly unit of Morro Strand State Beach (south of Cayucos). Broader sandy beaches dominate the coastline in the south central area of Estero Bay and include Morro Strand State Beach (also shown as Atascadero State Beach on older maps), the city beach north of Morro Bay, and the Morro Bay

San Luis Drainage Feature Re-evaluation	Regional Monitoring Program Sampling Station Locations	Figure 5.1-7
17324004		



San Luis Drainage Feature Re-evaluation	Estero Bay and Ocean Disposal Alternative Outfall Locations	Figure 5.1-8
17324004		

Sandspit. Morro Rock is a prominent feature near the center of Estero Bay, north of the entrance to Morro Bay and its estuary. This large outcrop is an exposed volcanic plug and is one of seven such features extending southeast to the City of San Luis Obispo.

Table 5.1-3
Summary of Regional Monitoring Program Results By Region

Constituent	RMP Stations			San Joaquin River at Vernalis[2]
	Golden Gate[1]	North Bay Avg[1]	San Joaquin (Delta)[1]	
Dissolved Copper (µg/L)[3]	0.47	1.66	1.82	
Dissolved Nickel (µg/L)[3]	0.63	1.56	1.27	
Dissolved Lead (µg/L)	0.01	0.05	0.1	
Dissolved Chromium (µg/L)	0.13	0.53	0.53	
Dissolved Cadmium (µg/L)	0.06	0.04	0.01	
Total Se (µg/L)[3]	0.17	0.18	0.18	1.86
Salinity (ppt)	29.19	9.9	0.01	0.35

Notes:
[1] Data from RMP, averages from 1993-2000 (SFEI 2002b).
[2] Data from California Department of Water Resources, 1993-2000 (http://cdec.water.ca.gov).
[3] High-priority constituents.
ppt parts per thousand

From north to south, the major creeks that drain into Estero Bay are as follows:

- Villa Creek
- Cayucos Creek
- Old Creek (includes Whale Rock Reservoir)
- Willow Creek
- Torro Creek
- Morro Creek
- Little Morro Creek
- Morro Bay, which includes
  - Chorro Creek
  - Los Osos Creek
- Islay Creek
- Coon Creek

These creeks flow only during and shortly after the rainy season. The only significant impoundment is the Whale Rock Dam and Reservoir on Old Creek. This reservoir stores local runoff and water imported from the Santa Margarita Lake (also known as the Salinas Reservoir), which is located about 20 miles to the east.

Grazing dominates the interior land uses in the north, and urban development has occurred to varying degrees along the coastal reaches of most of these creeks. Urbanization is more extensive in the central areas around Morro Bay. The southernmost drainages (Islay and Coon creeks) are located in Montana De Oro State Park and the generally undeveloped lands around the park extending into the Irish Hills. Most of this land is maintained in an undeveloped condition as a buffer around the Diablo Canyon Nuclear Power Plant, which is located on the coast about 4 miles south of Point Buchon.

The southern limits of the Monterey Bay National Marine Sanctuary extend to the community of Cambria, approximately 9 miles north of Point Estero, and north of Estero Bay.

Discharges into Estero Bay from human-made sources currently amount to approximately 530 million gallons per day (mgd) from several sources that are permitted with design flows that total almost 680 mgd. By far, the largest of these sources is the Duke Energy power plant at Morro Bay. The major discharge from this facility is noncontact cooling water that is discharged in shallow water just north of Morro Rock. The daily flow from the power plant discharge averages about 525 mgd. Other minor discharges are associated with the power plant, including intake screen washings (discharged through the thermal outfall) and local stormwater runoff discharged adjacent to the power plant property.

The second largest discharger into Estero Bay is the Abalone Farm, located approximately 2.5 miles southeast of Point Estero. The Abalone Farm is a marine aquaculture facility with a nearshore discharge of approximately 6.8 mgd of ocean water that has been passed through abalone farming tanks.

Discharges into Estero Bay that contain waste material originate from the Morro Bay/Cayucos Waste Water Treatment Plant (WWTP) and the Chevron Estero Marine Terminal. The Morro Bay/Cayucos WWTP, located in Morro Bay, discharges treated sewage effluent with a volume that averages about 2 mgd. The Chevron facility is permitted for the discharge of 210,000 gallons per day and discharged this volume until mid-1999. Most of this volume consisted of tanker ballast water, boiler blow down, and tank wash water. Stormwater and some tank and pipe test water were, and continue to be, discharged to local impoundments and creeks on the property. The facility was decommissioned in 1999, and since then discharges have been reduced. Current discharges consist of treated remediation water, test and wash water, and stormwater. As maintenance, decommissioning, and reuse activities continue, the discharges will vary but will always be within the limits allowed by the facility permit.

Table 5.1-4 summarizes the permitted discharges into Estero Bay, and Figure 5.1-8 shows the outfall locations of these facilities.

Table 5.1-4
Summary of Current Permitted Discharges into Estero Bay

Facility Name	Waste Type	Design Flow (mgd)	Base Flow (mgd)	Notes
The Abalone Farm	Marine aquaculture return flow	8.4	6.8	Discharges approx. 2.5 miles southeast of Estero Point
Chevron Estero Marine Terminal	Tank test water, boiler blowdown, water softener brine. Stormwater	0.21	0.21	Formerly included tanker ballast water. Stormwater discharged to adjacent creeks.
Duke Morro Bay Power Plant	Cooling water, screen washings. Stormwater	668	525	Discharge is to surface, just north of Morro Rock
Morro Bay/Cayucos WWTP	Domestic sewage	2.36	1.7	
Morro Bay Temp Desal Plant	Brine	0.83	0.001	Through Morro Bay/Cayucos WWTP outfall

The ocean water quality along the Estero Bay coastline and in the adjacent waters is good. Heal the Bay Foundation, a nongovernmental agency that compiles and rates beach water quality data for the California Coast, monitors four points in Estero Bay. These include two points in Cayucos just north and south of the Cayucos pier, and two points on the Morro Bay city beach just north of the entrance to Morro Bay. With a few exceptions, the water quality at these locations has consistently rated an A to A+ grade during both dry and wet weather periods over the past several years. The ratings involve a complex assessment of coliform concentrations and other water quality parameters that affect health and enjoyment of beaches. More detailed information is available at the Heal the Bay Foundation web site (www.healthebay.org).

The Central Coast Regional Board's Central Coast Ambient Monitoring Program (www.ccamp.org) assesses water quality data in surface waters. For the creeks draining into Estero Bay, the general assessment provided by the monitoring program identifies siltation originating from agricultural uses and/or storm runoff as an issue in Cayucos Creek and Torro Creek.

5.1.5 Drinking Water Resources

5.1.5.1 San Joaquin Valley

Drinking water sources in the San Joaquin Valley are primarily composed of deep aquifer wells. The cities of Merced, Turlock, Ceres, Mendota and Los Banos receive all of their drinking water from groundwater. The City of Modesto obtains about 155 mgd of water from the ground and 30 mgd from the Modesto Reservoir in San Joaquin County, which is owned and operated by the Modesto Irrigation District (City of Modesto 2002).

5.1.5.2 Bay-Delta

Project effects on drinking water quality derived from surface water sources are an important issue because approximately two-thirds of California's drinking water comes from the Delta region. Se, bromide, total organic carbon (TOC), and salts are constituents of major concern for drinking water, and excessive salts are of importance to agricultural users of Delta water. In addition, high levels of TDS, salinity, and turbidity affect consumer acceptance of drinking water as well as treatment plant operations.

In 1995 the State Board adopted the Water Quality Control Plan for the Bay-Delta. The main objectives of the plan are to adopt WQOs to protect the beneficial uses of water in the Bay-Delta against the adverse effects of water diversions and to implement these WQOs through water right orders. The State Board encouraged interested parties to resolve among themselves the responsibilities for meeting the objective of the plan.

In 2000, as part of the CALFED Program Plan, the CALFED Program concluded the following with regard to Delta drinking water supplies:

> Drinking water supplies from the Delta contain higher bromide concentrations than are found in the drinking water supplies of about 90 percent of the nation. Bromide reacts with disinfection chemicals to form by-products that have increasingly raised health concerns for consumers. Most of this bromide comes from the ocean as a result of its connection with the Bay-Delta estuary. Additional pollutants of concern for drinking water include organic carbon, which also has disinfection by-product ramifications, and pathogens.
>
> The CALFED drinking water quality objective is to continuously improve water quality that allows for municipal water suppliers to deliver safe, reliable, and affordable drinking water that meets, and where feasible, exceeds applicable drinking water standards. The CALFED strategy for improving drinking water quality is to reduce the loads and/or impacts of bromide, total organic carbon, pathogens, nutrients, salinity, and turbidity through a combination of measures including source reduction, alternative sources of water, treatment, and storage and conveyance improvements.
>
> CALFED's specific target for providing safe, reliable, and affordable drinking water in a cost effective way is to achieve either (a) average concentrations at Clifton Court Forebay and other south and central Delta drinking water intakes of 50 µg/L bromide and 3.0 mg/L total organic carbon, or (b) an equivalent level of public health protection using a cost-effective combination of alternative source waters, source control, and treatment technologies. CALFED has not adopted a specific numeric target for salinity (other than meeting existing Delta standards) but does have a preliminary objective of reducing the salinity of Delta supplies.

CVP water is delivered through the Contra Costa Canal to the Contra Costa Water District (CCWD). The CCWD delivers water throughout eastern Contra Costa County providing for the municipal water needs of over 450,000 county residents. CCWD draws Delta water from Rock Slough, Old River (near the Discovery Bay community), and Mallard Slough. The water is transferred through the Contra Costa Canal to CCWD's treatment plants and can also be stored in Los Vaqueros, Contra Loma, Mallard, and Martinez reservoirs. Los Vaqueros Reservoir becomes the major source during periods when Delta water is unavailable or of unacceptable quality. Water taken from the reservoir is replaced at relatively high expense incurred by pumping costs.

Canal water is also delivered to industrial users, public water supply retailers, and to CCWD's treatment facilities (Bollman and Randall-Bold water treatment plants). Treated water is distributed to about 230,000 residents in Clayton, Clyde, Concord, Pacheco, Port Costa, and parts of Pleasant Hill, Martinez, and Walnut Creek. Some treated water is also distributed to Antioch, Bay Point, and Brentwood. CCWD also sells raw water to the cities of Antioch, Martinez, and Pittsburg, California Cities Water Company (Bay Point), and Diablo Water District (Oakley).

At present, the Bay-Delta water quality is not desirable from a raw drinking water standpoint during extended portions of the year. Five contaminants or gross contaminant measures have been identified as contaminants of concern for this EIS: bromide, TOC, TDS, Se and nutrients. Their current status is discussed in detail in the following sections. Summaries shown for the constituents are derived from data obtained from CCWD. The DWR Municipal Water Quality Index also provides vast amounts of data for different, more inland portions of the Bay-Delta region. The index is a good source for data because it keeps records of dozens of samples for each contaminant at each location.

For this EIS, agricultural drains and tracts near the San Joaquin River and the CCWD raw water intakes were analyzed. The analysis of the Municipal Water Quality Index revealed that a handful of Delta locations contained bromide concentration averages greater than the highest detected level in the drainwater. For example, the bromide concentration averaged 2.85 mg/L and 2.92 mg/L, with maximums of 106 mg/L and 5.28 mg/L, at Venice Island and Clifton Court Agricultural Drain, respectively, from a period between 1990 and 1996 (DWR 2003). These Delta locations greatly exceed the target for raw drinking water, which is 0.05 mg/L. Similarly, dissolved organic carbon (DOC) tests show that most Delta locations contain DOC averages much higher than the goal for TOC, meaning that the inland Delta water is high in organic carbon. In fact, the lowest average, 2.92 mg/L at False River at the Southerly Tip of Webb Tract, still approached the TOC target of 3 mg/L, with the maximum DOC reaching 360 mg/L at Old River at Bacon Island (DWR 2003). San Luis Drain water averages 1 mg/L of bromide and 6 mg/L of TOC (Reclamation 2002). When comparing these data to the San Luis Drain data, it is evident that the inland Delta water often contains more bromide and organic carbon than does the San Luis Drain water.

Bromide

Influx of seawater adds chloride and bromide ions to the Delta water, especially in the dry season (when freshwater inflow is low). Seawater has a high concentration of bromide (around 65 mg/L) and, therefore, bromide concentrations in the Delta increase in the vicinity of the ocean. However, bromide levels are unnaturally increasing in upstream freshwater portions as an increasing amount of impaired water is discharged to the Delta. The 2000 Water Quality Plan produced by CALFED states that, exclusive of the bay-ocean, "the San Joaquin River is the most important source of bromide to the Delta system" (CALFED 2000b). Samples taken from 1990 to 1998 reveal an average bromide concentration of 310 µg/L in the San Joaquin River, compared to an 18 µg/L average in the Sacramento River (CALFED 2000b).

CCWD monitoring data shows a slight decrease in bromide concentrations at three Delta drinking water intakes. In general, the concentration decreases moving inland because there is less seawater influence upstream. Seawater tends to have higher concentrations of bromide. All average concentrations are above the goal of 0.05 mg/L, meaning that water from both intakes must be treated for bromide removal at the CCWD water treatment plants. Summary data are shown below in Table 5.1-5 and Figure 5.1-9.

Table 5.1-5
Summary of Regional CCWD Intake Bromide Concentrations

Intake	Sample Dates	Min (mg/L)	Max (mg/L)	Average (mg/L)
Mallard Slough	12/91 - 3/03	0.1	20	5.55
Rock Slough at Plant #1	11/91 - 12/97	0.1	0.81	0.36
Rock Slough at Fish Screen	1/98 - 3/03	0.1	0.68	0.32

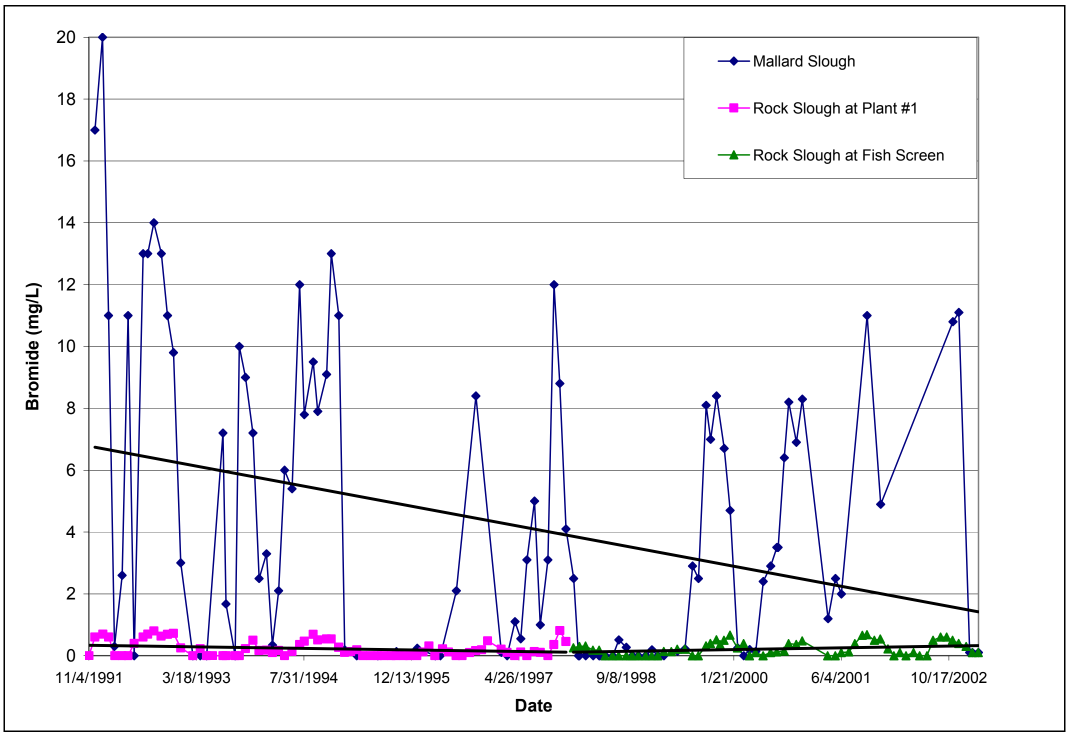


Figure 5.1-9 CCWD Intake Bromide Concentrations

Total Organic Carbon

CCWD TOC monitoring data show a decreasing trend. All average concentrations, except for Rock Slough at Fish Screen are above the raw water target of 3 mg/L, meaning that water from both intakes must be treated for TOC removal at the CCWD water treatment plants. Summary data are shown below in Table 5.1-6 and Figure 5.1-10.

Table 5.1-6
Summary of Regional CCWD Intake TOC Concentrations

Intake	Sample Dates	Min (mg/L)	Max (mg/L)	Average (mg/L)
Mallard Slough	3/98 - 3/03	0.2	10	2.71
Rock Slough at Plant #1	1/91 - 10/97	2	12	5.1
Rock Slough at Fish Screen	1/98 - 3/03	1.65	11	3.68

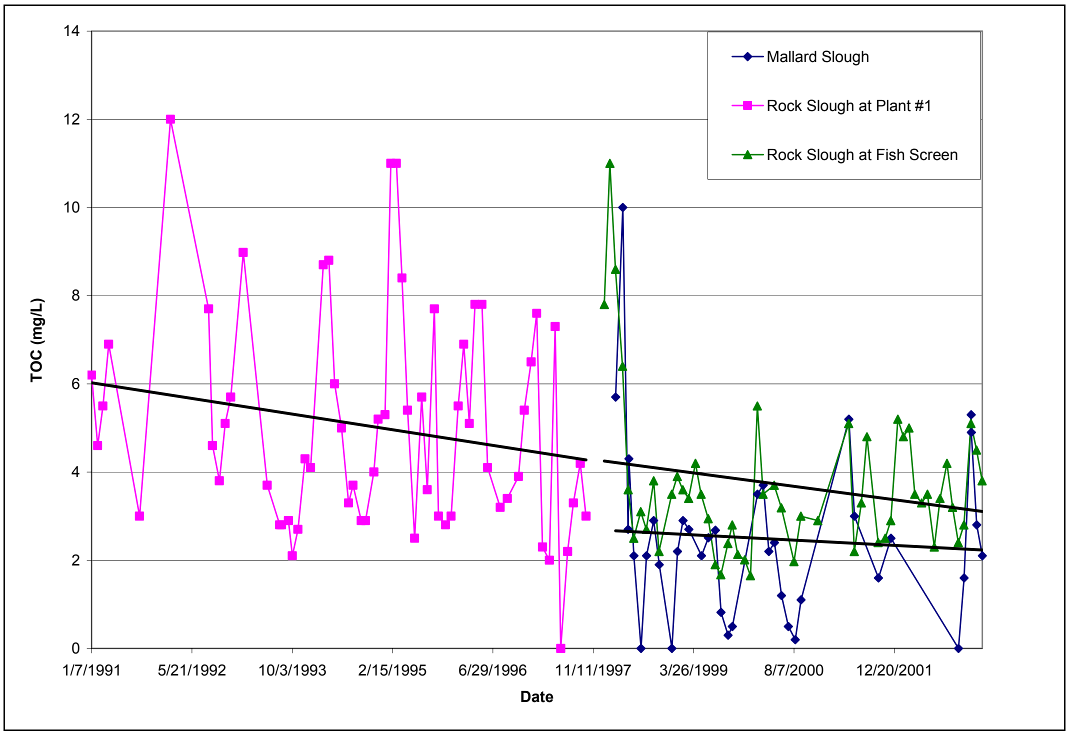


Figure 5.1-10 CCWD Intake TOC Concentrations

Total Dissolved Solids

The Mallard Slough average and median concentrations are well above the treated water secondary maximum concentration limit (MCL) of 500 mg/L. However, the TDS concentrations at Mallard Slough are decreasing. The mean and median TDS concentration at both Rock Slough locations are below the secondary MCL. Summary data are shown below in Table 5.1-7 and Figure 5.1-11.

Table 5.1-7
Summary of Regional CCWD Intake TDS Concentrations

Intake	Sample Dates	Min (mg/L)	Max (mg/L)	Average (mg/L)
Mallard Slough	1/91 - 3/03	80	7,500	2,289.9
Rock Slough at Plant #1	1/91 - 11/97	70	560	268.2
Rock Slough at Fish Screen	1/98 - 3/03	51	622	262.6

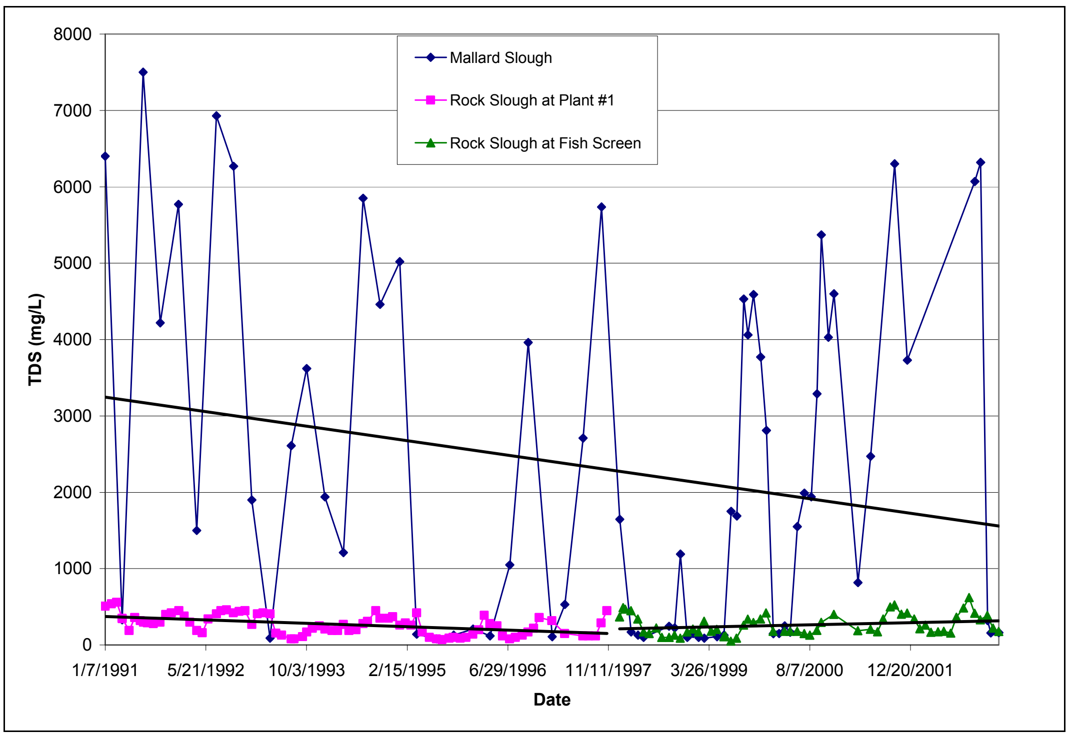


Figure 5.1-11 CCWD Intake TDS Concentrations

Selenium

Se concentrations at all sampled locations are below the State and Federal Se primary MCL of 50 µg/L. Summary data are shown below in Table 5.1-8 and Figure 5.1-12.

Table 5.1-8
Summary of Regional CCWD Intake Selenium Concentrations

Intake	Sample Dates	Min (µg/L)	Max (µg/L)	Average (µg/L)
Mallard Slough	1/91 - 10/01	< 2	17.5	< 5
Rock Slough at Plant #1	1/91 - 10/97	< 2	< 5	< 5
Rock Slough at Fish Screen	1/98 - 7/02	< 1	5	< 5

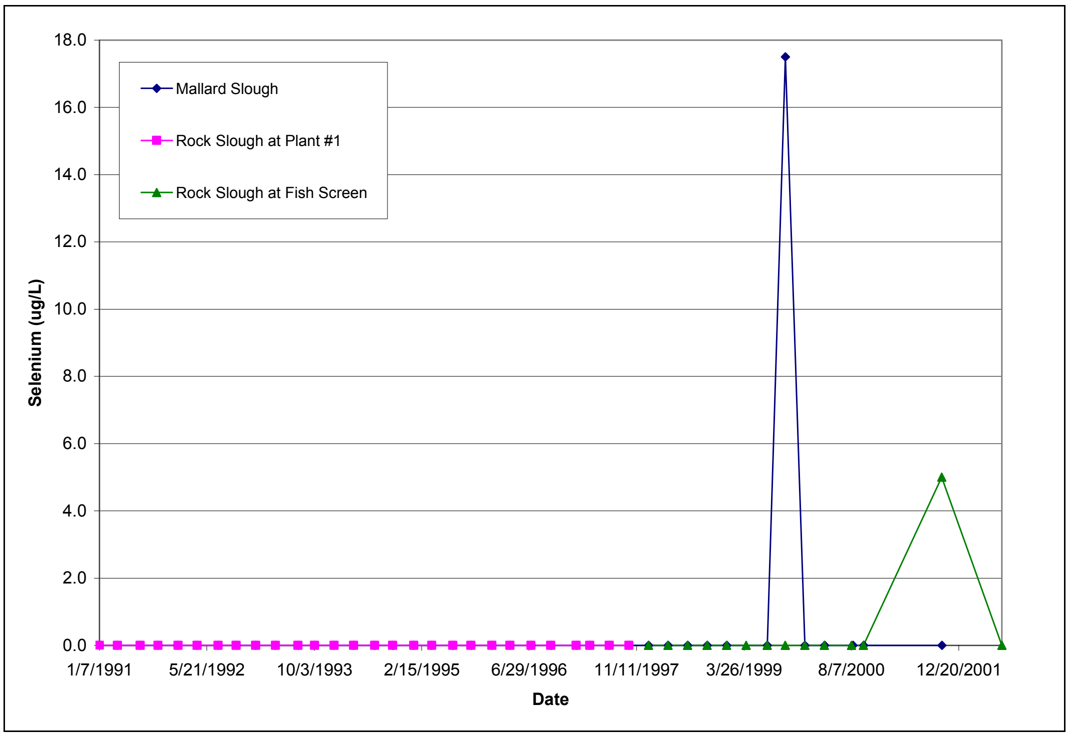


Figure 5.1-12 CCWD Intake Selenium Concentrations

Nutrients

Algae occasionally pose problems at water treatment plants in that their populations vary seasonally in both type and number. A diatom, *Melosira*, has created problems in the past, most often reflected in short filter runs (6 to 8 hours). The Randall-Bold Water Treatment Plant, being a direct filtration plant, is ill equipped by its design to effectively remove algae. Diatoms are particularly troublesome because they produce oils that make them float. In addition, many species resist coagulation and enmeshment in floc particles. As a result, large numbers are often present in filter-applied water. In some instances, diatoms and other small algae have been found in finished water. From 1997 through 1999, the average diatom count in raw water at the Randall-Bold Water Treatment Plant was 669 units/milliliter (mL). The counts were highly variable, however, as reflected by the median (85 units/mL) and standard deviations (2,592 units/mL). The maximum count over the period of record available for this report was 8,925 on February 22, 1999. Flagellated algae, which include many that produce grassy and fishy odors, have been observed in raw water at elevated population levels. In the period from 1997 through 1999, the data indicate an average of 100 units/mL (median 10 units/mL and standard deviation 411 units/mL). The count was 3,180 units/mL on March 1, 1999, the highest count during the period evaluated.

Blue-green algae (cyanobacteria) have appeared in raw water in small numbers but apparently have not caused shortened filter runs. Attached cyanobacterial growths in the canal, however, could result in troublesome earthy and musty odors, especially during the warmer months of the year. Flavor Profile Analysis data available for this report indicated a slight earthy odor only on a few occasions.

CCWD intake monitoring data show a decrease in nitrate concentrations. The concentration increases inland because of greater Delta agricultural drain influence upstream. Agricultural drainwater tends to have high concentrations of nitrate due to the use of nitrate-based fertilizers. All average concentrations are below the treatment regulation requirement of 15 mg/L. Summary data are shown below in Table 5.1-9 and Figure 5.1-13.

Table 5.1-9
Summary of Regional CCWD Intake Nitrate Concentrations

Intake	Sample Dates	Min (mg/L)	Max (mg/L)	Average (mg/L)
Mallard Slough	1/91 - 3/03	0.23	6.7	1.7
Rock Slough at Plant #1	1/91 - 12/97	0.17	11.7	2.45
Rock Slough at Fish Screen	1/98 - 3/03	0.1	12	2.48

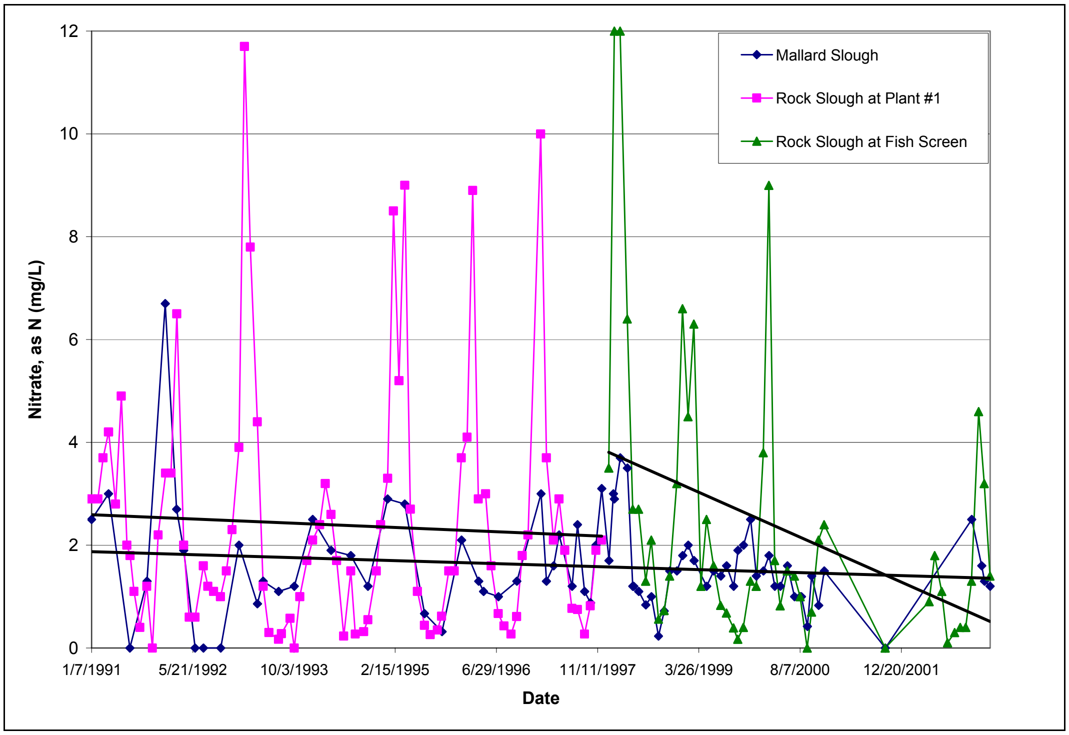


Figure 5.1-13 CCWD Intake Nitrate Concentrations

5.1.5.3 Ocean

No drinking water intakes are located near Point Estero. The closest water treatment facility plants are Lopez Water Treatment Plant in Arroyo Grande (22 miles inland from the ocean) and Lompoc Water Treatment Plant (40 miles inland from the ocean).

5.1.6 Regulatory Environment

Construction and operation of the action alternatives would be subject to a variety of regulatory compliance actions that are in place to safeguard the human environment. Section 4 describes the major regulatory programs that pertain to the alternatives. The following sections describe the regulatory compliance requirements for surface water resources in greater detail.

5.1.6.1 Water Quality Control Plans

Under the provisions of the Porter-Cologne Act and CWA, the Regional Boards implement water quality regulations in their respective watersheds. Each Regional Board adopts a Water Quality Control Plan (Basin Plan) describing the existing environment, WQOs, and implementation policies. The Basin Plan is updated every 5 years. The Basin Plan identifies beneficial uses and WQOs for waters of the State, including surface waters and groundwaters, as well as effluent limitations and discharge prohibitions intended to protect beneficial uses. A summary of regulatory provisions is contained in 23 California Code of Regulations 3912.

The California Water Code (CWC) (Stat. 1969, Chapter 482) also provides for establishment of a plan to protect ocean waters of the State (Ocean Plan) pursuant to the authority contained in

Section 13170 and 13170.2 (Stat. 1971, Chapter 1288). The State Board is the agency responsible for the preparation of the Ocean Plan. The permitting requirements in the Ocean Plan are implemented by the Regional Boards who must evaluate both the Ocean Plan and Basin Plan and choose the most stringent standards necessary to protect beneficial uses.

The Basin Plan identifies surface waters in each region as consisting of inland surface water (freshwater lakes, rivers, and streams), estuaries, enclosed bays, and ocean waters as applicable to the region. Historical and ongoing wasteloads contributed to the surface waterbodies in the region come from upstream discharges carried into the regions, direct input in the forms of point and nonpoint sources, and indirect input via groundwater seepage.

The Basin Plan describes the water quality control measures that contribute to the protection of the beneficial uses. The Basin Plan identifies beneficial uses for each segment of river, bay ocean and its tributaries, WQOs for the reasonable protection of the uses, and an implementation plan for achieving these objectives. Beneficial uses for potentially affected surface waters are shown in Table 5.1-10.

The Westlands portion of the project area falls within the Tulare Lake Basin, and regulations for this study area are described in Tulare Lake Basin Plan (Regional Board, Central Valley 1995). The Northerly Area falls with the San Joaquin River Basin and regulations are described in the *Sacramento River Basin/San Joaquin River Basin Water Quality Control Plan* (Regional Board, Central Valley 1998b). The Out-of-Valley Disposal Alternatives include discharge to the Delta at Chipps Island, which falls within the Bay-Delta Plan and *Sacramento River Basin/San Joaquin River Basin Water Quality Control Plan* (State Board 1995; Regional Board, Central Valley 1998b); discharge to the Bay-Delta at Carquinez Strait, which falls in the San Francisco Bay Regional Board Basin Plan (Regional Board, San Francisco Bay 1995); and discharge to Point Estero, which is within the jurisdiction of the Ocean Plan (State Board 2001).

5.1.6.2 Water Quality Objectives and Criteria

CWA Section 303 requires the EPA to develop and adopt water quality criteria to protect beneficial uses of receiving waters. The Porter-Cologne Water Quality Control Act also contains similar requirements. WQOs are promulgated and included in periodic updates to the Basin Plans. In California, the EPA developed and adopted standards for certain toxic pollutants in the California Toxics Rule (CTR) as required under CWA Section 303c(2)(B) (40 Code of Federal Regulations Part 131). Numeric water quality criteria contained in the CTR have not currently been incorporated into the Basin Plans.

The Central Valley Regional Board has designated municipal and domestic supply beneficial uses for many waterways in the Central Valley. To protect human health, the Water Quality Control Plan for the Sacramento and San Joaquin rivers specifies narrative WQOs. However, numeric WQOs are not in place for a number of pollutants that may adversely affect drinking water supplies such as organic carbon and specific pathogens. The CALFED Drinking Water Quality Program is pursuing an effort to amend the Sacramento-San Joaquin Basin Plan with a Drinking Water Policy to protect drinking water as a municipal beneficial use of Delta water, the technical work for which will be started soon. With this amendment, stricter drinking water standards will mean a greater protection of Delta drinking water sources (CBDA 2003).

Table 5.1-10
Beneficial Uses of Potentially Affected Surface Waters

Basin	AGR	ASBS	COLD	COMM	EST	FRSH	GWR	IND	MAR	MIGR	MUN	NAV	PROC	RARE	REC-1	REC-2	SHELL	SPWN	WARM	WILD
Carquinez Strait and Suisun Bay				E	E			E		E		E		E	E	E		E		E
Bay-Delta	E	E	E	E	E		E	E		E	E	E	E	E	E	E	E	E	E	E
Ocean Waters		E						E	E	E		E		E	E	E		E		E
San Pablo Bay				E	E			E		E		E		E	E	E	E	E		E
South San Francisco Bay				E	E			E		E		E		E	E	E	E	P		E
Lower San Francisco Bay				E	E			E		E		E		E	E	E	E			E
Central San Francisco Bay				E	E			E		E		E	E	E	E	E	E	E		E

AGR – Agricultural supply
ASBS – Areas of special biological significance
COLD – Cold freshwater habitat
COMM – Ocean, commercial, and sport fishing
EST – Estuarine habitat
FRSH – Freshwater replenishment
GWR – Groundwater recharge
IND – Industrial service supply
MAR – Mariculture
MIGR – Fish migration
MUN – Municipal and domestic supply
NAV – Navigation
PROC – Industrial process supply
RARE – Preservation of rare and endangered species
REC1 – Contact water recreation
REC2 – Noncontact water recreation
SHELL – Shellfish harvesting
SPWN – Fish spawning
WARM – Warm freshwater habitat
WILD – Wildlife Habitat
E= Existing Use
P = Potential Use

Tables 5.1-11 and 5.1-12 show the lowest applicable water quality criteria for the Delta disposal locations and ocean disposal locations. Table 5.1-13 shows WQOs and criteria for the San Joaquin River.

The State Board must also comply with the Federal antidegradation policy. The antidegradation policy requires each State to have a policy which, at a minimum, is consistent with the Federal antidegradation policy. The antidegradation policy states that increases in pollutant loadings or changes in surface water quality may be permitted only if (1) existing in-stream water uses and adequate level of water quality are maintained and protected, (2) the State finds that allowing a lower water quality is necessary to accommodate important economic or social development in the area in which the waters are located, and (3) water quality is maintained and protected where high quality waters constitute an outstanding national resource (Attwater 1987).

5.1.6.3 Waste Discharge Permitting Program

Point source discharges to surface waters are generally controlled through Waste Discharge Requirements (WDRs) issued under Federal NPDES permits. Although the NPDES program was established by the Federal CWA, the permits are prepared and enforced by the various Regional Boards, per California's delegated authority for the act.

Issued in 5-year terms, an NPDES permit usually contains components such as discharge prohibitions, effluent limitations, and necessary specifications and provisions to ensure proper treatment, storage, and disposal of the waste. The permit often contains a monitoring program that establishes monitoring stations at effluent outfall and receiving waters. NPDES Permits may, under certain circumstances, contain an allowance for dilution credits that provide for a limited mixing zone where water quality may not meet some water quality objectives. Granting a mixing zone is subject to various site-specific factors and is provided on a case-by-case basis depending on the nature of the discharge and the receiving water conditions.

Under California's Porter-Cologne Water Quality Control Act, any person discharging or proposing to discharge waste within the region (except discharges into a community sewer system) that could affect the quality of the waters of the State is required to file a Report of Waste Discharge. The Regional Board reviews the nature of the proposed discharge and adopts WDRs to protect the beneficial uses of waters of the State. WDRs could be adopted for an individual discharge or for a specific type of discharge in the form of a general permit. The Regional Board may waive the requirements for filing a Report of Waste Discharge or issuing WDRs for a specific discharge where such a waiver is not against the public interest. NPDES requirements may not be waived.

Table 5.1-11
Selected Water Quality Objectives and Criteria for Ocean Waters

Constituent	Units	Limiting Concentrations 6-month Median	Daily Maximum	Inst. Maximum	30-day Average
Ammonia	µg/L as N	600	2400	6000	
Antimony	µg/L				1200
Arsenic	µg/L	8	32	80	
Beryllium	µg/L				0.033
Cadmium	µg/L	1	4	10	
Chlorine, total resid	µg/L	2	8	60	
Chromium (hex. or total)	µg/L	2	8	20	
Chromium III	mg/l				190
Copper	µg/L	3	12	30	
Cyanide	µg/L	1	4	10	
Dissolved oxygen		Not to be depressed by more than 10% from natural levels			
Lead	µg/L	2	8	20	
Mercury	µg/L	0.04	0.16	0.4	
Nickel	µg/L	5	20	50	
pH	--	Less than 0.2-unit variation from natural level			
Selenium	µg/L	15	60	150	
Silver	µg/L	0.7	2.8	7	
Sulfide		In sediments, water near seds, no significant increase			
Thallium	µg/L				2
Tributyltin	µg/L				0.0014
Zinc	µg/L	20	80	200	
Acute toxicity	TUa	N/A	0.3	N/A	
Chronic toxicity	TUc	N/A	1	N/A	
Aldrin	µg/L				0.000022
Chlordane	µg/L				0.000023
DDT	µg/L				0.00017
Dieldrin	µg/L				0.00004
PCBs	µg/L				0.000019
Toxaphene	µg/L				0.00021

Notes:
1. Limits are from California Ocean Plan.
2. Temperature requirements: maximum discharge temperature will not exceed the natural receiving water temperature by more than 20°F; discharge will be far enough from an area of special biological significance (ASBS) to maintain natural temperature in the ASBS; discharge will not result in increases in the natural water temperature exceeding 4°F at the shoreline, at the surface of any ocean substrate, or at the ocean surface >1,000 feet from the discharge. Meeting the 20°F temperature difference between discharge and receiving water is anticipated to be sufficient to meet the other temperature requirements at the Point Estero discharge location; at Needle Point, a variance or exemption will be required for discharge to the ASBS.
3. Water contact standards: total coliform less than 1,000/100 mL, with no more than 20 percent of samples at any station, in any 30-day period, may exceed 1,000/100 mL; no single sample when verified within 48 hours will exceed 10,000/100 mL. Fecal coliform: based on 5 or more samples in any 30-day period, will not exceed geometric mean of 200/100 mL, nor will more than 10 percent of total samples during any 60-day period exceed 400/100 mL. Standards apply to water contact areas, including all kelp beds (outside of zone of initial dilution) and a zone within 1,000 feet of shore or the 30-foot depth contour, whichever is farthest from the shoreline. For shellfish harvesting areas, median coliform density will not exceed 70/100 mL, with no more than 10 percent of samples exceeding 230/100 mL.
4. Narrative Toxicity standard will apply.

Table 5.1-12
Selected Water Quality Objectives and Criteria for Bay-Delta Waters in the Carquinez Strait and Chipps Island Vicinity

Constituent	Units	Likely Receiving Water Objective/Criteria	303d listing? (See Note 3)	Notes on Limits (see Note 4)	Source of Limit
Ammonia	mg/L	0.025		As annual median, with 0.16 maximum limit	Basin Plan limits as un-ionized ammonia
Antimony	µg/L	14		As long-term average concentration	CTR value for protection of human health (water + organisms)
Arsenic	µg/L	36		As 4-day average concentration	Basin Plan saltwater criterion (supersedes CTR value)
Cadmium	µg/L	1.1		As 4-day average concentration	Basin Plan criterion for freshwater, assuming hardness of 100 mg/L (supersedes CTR value), limit is for dissolved cadmium
Chromium 6 or total	µg/L	11		As 4-day average concentration	Basin Plan criterion for freshwater
Copper	µg/L	3.1	yes (2008)	As 1-hour or 1-day average concentration	CTR 4-day average criterion for saltwater, limit is for dissolved copper
Cyanide	µg/L	5		As 1-hour average	Basin Plan criterion for saltwater
Dissolved Oxygen	mg/L	7			Basin Plan criterion for tidal waters upstream of Carquinez Bridge
Lead	µg/L	3.2		As 4-day average concentration	Basin Plan criterion for freshwater, assuming 100 mg/L hardness (supersedes CTR value), limit is for dissolved lead
Mercury	µg/L	0.025	yes (2003)		Basin Plan criterion for freshwater and saltwater
Nickel	µg/L	7.10	yes (2010)	7.1 As 24-hr average; 8.3 As 4-day average	7.1 µg/L is Basin Plan criterion, 8.3 µg/L is EPA criterion (incorporated into Basin Plan)
pH	--	6.5-8.5		No change greater than 0.5 unit from ambient	Basin Plan objective
Selenium	µg/L	5	yes (2010)	As 4-day average concentration	CTR and National Toxics Rule for total recoverable Se, applicable to waters of San Francisco Bay, Suisun Marsh, and Delta
Silver	µg/L	2.30		As instantaneous maximum	Basin Plan objective for dissolved silver in freshwater at hardness of 100 mg/L
Thallium	µg/L	1.7		As long-term average concentration	CTR value for protection of human health (water + organisms)
Zinc	µg/L	58.00		As 1-hour or 1-day average concentration	Basin Plan criterion for freshwater assuming 100 mg/L hardness (supersedes CTR)

Notes:

1. WQO and criteria are based upon the lowest of the CTR values and Basin Plan WQOs, including lowest of freshwater or saltwater limits.
2. For constituents that are currently on the Section 303(d) list (List of Impaired Waters), the TMDL process may determine ultimate mass loadings to the receiving water. The date of scheduled TMDL completion is shown.
3. Carquinez Strait and Suisun Bay are designation REC-1 and REC-2, with the following WQOs: **Fecal Coliform:** log mean <200 MPN/100 ml; 90th percentile <400 MPN/100 ml; **total coliform:** median < 240 MPN/100 ml with no sample > 10,000 MPN/100 ml, all based upon at least 5 consecutive samples equally spaced over 30-day period. EPA criteria also apply by use category, with the following numbers for steady-state and for maxima at designated beach, moderately used area, lightly used area, and infrequently used area: in colonies per 100 ml: **Enterococci** freshwater (33, 61, 89, 108, 151); **E. coli** freshwater (126, 235, 298, 406, 576); **Enterococci** saltwater (35, 104, 124, 276, 500). A dilution credit of 10:1 would likely be allowed for bacterial constituents.
4. Anticipated **temperature requirements:** discharge temperature will not exceed receiving water temperature by more than 20°F; discharge will not create a zone wherein the water temperature exceeds the receiving water temperature by more than 1°F over more than 25 percent of the cross-sectional channel area; discharge will not cause a surface-water temperature increase of more than 4°F above the natural receiving water temperature.
5. Narrative **Toxicity** Standard will apply.

Table 5.1-13
Selected Water Quality Objectives and Criteria for the San Joaquin River

Constituent	Units	Receiving WQO / Criteria	303d Listing	Notes on Limits	Source of Limit
Antimony	µg/L	4300		As total recoverable, 30-day average	CTR value for protection of human health (water + organisms)
Boron (from mouth of Merced River to Vernalis)	mg/L	2.6 1 2 0.8 1.3		maximum, Sept. 16 through Mar. 14 monthly mean, Sept. 16 through Mar. 14 maximum, Mar. 15 through Sept. 15 monthly mean, Mar. 15 through Sept. 15 critical year	Basin Plan criterion for Trace Element WQOs
Chlorpyrifos			yes (2005)		1998 California 303(d) List and TMDL Priority Schedule, Central Valley Regional Water Quality Control Board
Copper	µg/L	3.1 1300 29[1] 50[1]		As 1-hour or 1-day average concentration As total recoverable, 30-day average Continuous Conc (4-day average) maximum (1-hour average)	Basin Plan criterion for Trace Elements CTR, human health (water + organisms) CTR, freshwater aquatic life CTR, freshwater aquatic life
Chromium (III)	µg/L	550[1] 1700[1]		Continuous Conc (4-day average) maximum (1-hour average)	CTR for protection of freshwater aquatic life CTR for protection of freshwater aquatic life
DDT			yes (2011)		1998 California 303(d) List and TMDL Priority Schedule, Central Valley Regional Water Quality Control Board
Diazinon			yes (2005)		1998 California 303(d) List and TMDL Priority Schedule, Central Valley Regional Water Quality Control Board
Electrical Conductivity (at Airport Way Bridge, Vernalis)	mmhos/cm	0.7 1	yes (1999)	April through August, max 30-day running average of mean daily September through March, max 30-day running average of mean daily	Basin Plan criterion for Agricultural Uses in the South Delta
Group A Pesticides			yes (2011)		1998 California 303(d) List and TMDL Priority Schedule, Central Valley Regional Water Quality Control Board

Table 5.1-13 (continued)
Selected Water Quality Objectives and Criteria for the San Joaquin River

Constituent	Units	Receiving WQO / Criteria	303d Listing	Notes on Limits	Source of Limit
Lead	µg/L	11[1] 280[1]		Continuous Conc (4-day average) Maximum (1-hour average)	CTR for protection of freshwater aquatic life CTR for protection of freshwater aquatic life
Molybdenum (Salt Slough and Wetland Water Supply Cannels)	µg/L	50 19		maximum monthly mean	Basin Plan criterion for Trace Element WQOs
Molybdenum (Mud Slough, North, and the San Joaquin River from Sack Dam to the Merced River)	µg/L	50 19		maximum monthly mean	Basin Plan criterion for Trace Element WQOs
Molybdenum (from mouth of Merced River to Vernalis)	µg/L	50 10		maximum monthly mean	Basin Plan criterion for Trace Element WQOs
Nickel	µg/L	170[1] 1500[1]		Continuous Conc (4-day average) maximum, (1 hr avg)	CTR for protection of freshwater aquatic life CTR for protection of freshwater aquatic life
Selenium (Salt Slough and Wetland Water Supply Channels)	µg/L	20 2	yes (2000)	maximum monthly mean	CTR and National Toxics Rule for total recoverable Se, applicable to waters of San Francisco Bay, Suisun Marsh, and Delta
Selenium (Mud Slough, North, and the San Joaquin River from Sack Dam to the Merced River)	µg/L	20 5	yes (2000)	maximum 4-day average	Basin Plan criterion for Trace Element WQOs
Selenium (from mouth of Merced River to Vernalis)	µg/L	12 5	yes (2000)	maximum 4-day average	Basin Plan criterion for Trace Element WQOs
Silver	µg/L	37		instantaneous maximum	CTR for protection of freshwater aquatic life

Table 5.1-13 (concluded)
Selected Water Quality Objectives and Criteria for the San Joaquin River

Constituent	Units	Receiving WQO / Criteria	303d Listing	Notes on Limits	Source of Limit
Thallium	µg/L	6.3		As total recoverable, 30-day average	CTR value for protection of human health (water + organisms), National Toxics Rule
Unknown Toxicity			yes (2011)		1998 California 303(d) List and TMDL Priority Schedule, Central Valley Regional Water Quality Control Board
Zinc	µg/L	380[1] 380[1]		Continuous Conc (4-day average) maximum (1-hour average)	CTR for protection of freshwater aquatic life CTR for protection of freshwater aquatic life

[1] Based on hardness ceiling of 400 mg/L

Acceptable control measures for point source discharges must ensure compliance with NPDES permit conditions, including the discharge prohibitions and the effluent limitations provided by the Basin Plan. In addition, control measures must satisfy WQOs set forth in the Basin Plans, unless the Regional Board judges that related economic, environmental, or social considerations merit a modification after a public hearing process has been conducted. Control measures employed must be sufficiently flexible to accommodate future changes in technology, population growth, land development, and legal requirements. For discharge of agricultural drainage from the San Luis Drain to the Bay-Delta the Regional Board, San Francisco Bay requested in 1981 that the State Board take the lead in developing, revising, renewing, and enforcing water discharge requirements for the Drain.

5.1.6.4 *Section 303(d) Listed Pollutants*

CWA Section 303(d) requires each State to identify waters that will not achieve water quality standards after application of effluent limits. For each water and pollutant, the State is required to propose a priority for development of a load-based (as opposed to concentration-based) limit called the total maximum daily load (TMDL). The TMDL determines how much of a given pollutant can be discharged from a particular source without causing water quality standards to be violated. Priorities for development of TMDLs are set by the State based on the severity of the pollution and uses of the waters. Table 5.1-14 shows a complete listing of the constituents for TMDL implementation and their priority.

Table 5.1-14
TMDL Priority List for Potentially Affected Waters

Receiving Water	Boron	Chlordane	Chlorpyrifos	Copper	DDT	Diazinon	Dieldrin	Dioxin Compounds	Electrical Conductivity	Exotic species	Furan Compounds	Group A Pesticides	Mercury	Nickel	PCBs	PCBs (Dioxin-Like)	Pesticides	Se	Unknown Toxicity
Mud Slough	L	-	-	-	-	-	-	-	L	-	-	-	-	-	-	-	L	H	L
San Joaquin River	H		H	-	L	H	-	-	-	-	-	L	-	-	-	-	-	H	-
Sacramento/San Joaquin Delta	-	L	-	M	L	M	L	H	-	H	H	-	H	L	M	H	-	L	M
Suisun Bay	-	L	-	M	L	M	L	H	-	H	H	-	H	L	M	H	-	L	-
Carquinez Straight	-	L	-	M	L	M	L	-	-	H	H	-	H	L	M	H	-	L	-
San Pablo Bay	-	L	-	M	L	M	L	H	H	H	H	-	H	L	M	H	-	L	-
SF Bay (Central)	-	L	-	M	L	M	L	H	-	H	H	-	H		M	H	-	L	-
SF Bay (Lower)	-	L	-	M	L	M	L	H	-	H	H	-	H	M	M	H	-	-	-
SF Bay (South)	-	L	-	H	L	M	L	H	-	H	H	-	H	H	M	H	-	L	-

H = High-Priority Constituent
M = Medium-Priority Constituent
L = Low-Priority Constituent

San Joaquin River Basin

High-priority constituents for TMDL implementation in the San Joaquin River include boron, chlorpyrifos, diazinon, EC, and Se. EC (salt concentrations) in the San Joaquin River is a concern for many water users. The Central Valley Regional Board has recently proposed salt and boron TMDLs for the Lower San Joaquin River designed to reduce the loading of salt to the river (and subsequently reduce the concentrations in the river). TMDLs for the San Joaquin River are already in place for Se. Dichlorodiphenyltrichloroethane (DDT) and Group A pesticides (aldrin, endrin, heptachlor, heptachlor epoxide, hexachlorocyclohexane, endosulfan, and toxaphene) are low-priority constituents in the San Joaquin River.

Mud Slough

Se is listed as a high-priority constituent for Mud Slough, which receives discharge from the GDA. Boron, EC, pesticides, and unknown toxicity are all listed as low-priority constituents in Mud Slough.

Bay-Delta

High-priority constituents for TMDL implementation in the North and Central bays and the Delta include dioxin compounds, exotic species, furan compounds, dioxin-like PCBs, and mercury. Dioxin-like PCBs have been listed as high-priority constituents by the EPA. Mercury is designated as high priority because consumption of fish and wildlife from San Francisco Bay is affected, and a health advisory is in effect for multiple fish species including striped bass and shark. In the Lower and South bays, high-priority constituents include dioxin compounds, furan compounds, dioxin-like PCBs, and mercury.

In 1990, the EPA listed Carquinez Strait as an impaired waterbody due to elevated Se levels in diving ducks. In 1992, the EPA established aquatic life criteria for Se of 5 µg/L for the entire Bay-Delta (EPA National Toxics Rule, Code of Federal Regulations Part 131).

Se is listed as a low-priority constituent in the Bay because individual control strategies have already been implemented at the refineries that discharge to the North Bay. The listing was developed due to elevated concentrations found in animal tissues in the Bay. Because of its bioaccumulatory character and the fact that it is a major component of Central Valley drainwater, Se is a highly important pollutant for the Bay-Delta in the context of this EIS. The introduction in the mid-1980s of exotic bivalve species may have made the food chain more susceptible to Se accumulation. Moreover, a human health advisory by the Regional Board has been issued for the consumption of scaup and scoter (diving ducks) due to Se levels in these animals.

The potential discharge points for the Delta Disposal Alternatives are Chipps Island and Carquinez Strait. Due to the sites' proximity to local drinking water intakes, salinity is a high-priority constituent for these alternatives.

Constituents of medium-priority in the North Bay, Central Bay, and Delta include copper, diazinon, and nondioxin-like PCBs. Copper is a medium-priority constituent in several waters of the North Bay and Delta. Copper has been prioritized due to exceedances of the EPA's CTR dissolved metals criteria, National Toxics Rule total metals criteria, elevated water and sediment concentrations, and elevated fish tissue levels. Specific waterbodies that have been listed include the Lower Bay, Central Bay, Carquinez Strait, San Pablo Bay, Suisun Bay, and the Delta. However, proposed amendments to the Section 303(d) list in 2001 have removed copper from the priority list due to recent toxicity studies that indicate copper is less toxic in the receiving waters than in the laboratory tests that formed the basis for the WQOs and criteria.

In San Francisco Bay, low-priority constituents on the Section 303(d) list are chlordane, DDT, dieldrin, and Se. Se, as discussed above, is listed as a low-priority constituent in the Bay and Delta; however, because Se is a major constituent of Central Valley drainwater, it is a highly important constituent for the purposes of this EIS.

TMDL Constituents for Coastal Waters

Point Estero, the potential ocean discharge point, is not listed in the 1998 California 303(d) List and TMDL Schedule. Waterbodies in the Point Estero vicinity are shown in Table 5.1-15.

Table 5.1-15
Summary of 303(d)-Listed Waterbodies in the Estero Bay Vicinity

Waterbody or Segment	Pollutants/Stressor	Potential Sources	TMDL Priority
Chorro Creek (drains to Morro Bay Estuary)	Fecal coliform Nutrients Sedimentation/siltation	Source unknown Municipal point sources Agriculture Irrigated crop production Agricultural storm runoff Many natural and human-made sources	Low High High
Chumash Creek (tributary to Chorro Creek)	Fecal coliform	Source unknown	Low
Dairy Creek (tributary to Chorro Creek)	Fecal coliform Low dissolved oxygen	Source unknown Source unknown	Low Low
Los Osos Creek (drains to Morro Bay Estuary)	Fecal coliform Nutrients Pesticides	Source unknown Agriculture Irrigated crop production Agriculture-storm runoff Agricultural return flows Agriculture	Low High Low
Morro Bay	Metals Pathogens	Surface mining Range grazing-upland Urban runoff/storm sewers Septage disposal Natural sources Nonpoint source	Medium High
Walters Creek (tributary to Chorro Creek)	Fecal coliform	Source unknown	Low
Warden Creek (tributary to Los Osos Creek)	Fecal coliform Low dissolved oxygen	Source unknown Source unknown	Low Low

Source: State Board 2003:61-79.

The waterbodies identified above include Morro Bay and creeks that drain into Morro Bay. None of the beaches along Estero Bay or creeks that drain directly to Estero Bay have been identified as impaired waterbodies, and no TMDLs are pending for these areas.

5.1.6.5 Safe Drinking Water Act

The Safe Drinking Water Act (Public Law 99-339) became law in 1974 and was reauthorized in 1986 and again in August 1996. Through this act, the U.S. Congress gave the EPA the authority to set standards for contaminants in drinking water supplies. Amendments to this act provide more flexibility, more State responsibility, and more problem prevention approaches. The law changes the standard-setting procedure for drinking water and establishes a State Revolving Loan Fund to help public water systems improve their facilities, to ensure compliance with drinking water regulations, and to support State drinking water program activities.

Under provisions of this act, the California Department of Health and Safety (DHS) has the primary enforcement responsibility. The California Health and Safety Code establishes this authority and stipulates drinking water quality and monitoring standards. To maintain primacy, a State's drinking water regulations cannot be less stringent than the Federal standards.

The Underground Inspection Control Program, part of this act, provides the Federal authority for regulating deep-well injection. It establishes a scheme for the regulation of public drinking water systems and sets minimum standards for drinking water supplies. This program utilizes the complex operating, tracking, and monitoring requirements set up under the Federal hazardous waste statutes. Disposal of hazardous waste into an injection well generally requires compliance with both the Federal and State regulatory schemes: compliance with this program, including a Federal operating permit, a hazardous waste facilities permit from the DHS, and submission to the DHS and the Regional Board of a hydrological assessment report.

In 1996, amendments made to the Safe Drinking Water Act resulted in the Stage 2 Disinfectants/Disinfection By-Products Rule (Stage 2 DBPR) and the Long-Term Stage 2 Enhanced Surface Water Treatment Rule (LT2ESWTR). These new regulations incorporate the concept of risk balancing in which short-term (acute) microbial risk and potential long-term (chronic) risk from disinfectant by-products (DBPs) are considered. These new rules are more complex than older regulations, and both will require utilities to perform additional monitoring before making a decision about future potential treatment and/or operational changes to comply with the future regulations. Because of the regulation pairing (long and short-term risk addressed in the LT2ESWTR and Stage 2 DBPR, respectively) aspect, systems will not be able to comply with just the DBP regulation by reducing the disinfectant concentration because this will likely increase microbial risk (Roberson 2003).

The EPA's disinfection by-product-related rules are driven by a concern to protect consumers from long-term exposure to by-products of drinking water chlorination that result when natural organic matter in raw drinking water reacts with chlorine. This rule updated or created health goals and legal limits on 38 contaminants including DBPs as well as frequently applied agricultural chemicals like nitrate. One of the most important elements of the Stage 2 rule is a reduction in the MCL of total trihalomethanes (TTHMs) from 100 to 80 μg/L and the establishment of a new MCL for haloacetic acids (HAAs) of 60 μg/L. The HAAs are believed to be a more harmful, major class of halogenated DBPs than TTHMs.

TOC contributes to the formation of DBPs and is therefore a constituent of special concern for facilities that treat their water with chlorine. All of CCWD's drinking water is treated with ozone as the disinfectant. Ozone is effective in destroying potentially harmful bacteria and viruses and at the same time reduces the potential of forming trihalomethanes. Ozone lacks a long-lasting residual to control biological contaminants within the distribution system, so CCWD still adds chloramines as a residual at the end of the treatment process. Because of this, the level of TOC dictates the amount of ozone required before the residual is added. The expense of ozone is one of the reasons that CCWD would like to minimize the level of TOC in its source water.

Furthermore, the high level of bromide in the CCWD raw water is of concern because when water containing bromide is treated with ozone, bromate is formed. Bromate formation is a function of ozone dose, so optimizing the ozone feed system through better controls or refining the ozone disinfection credit calculation can lower the dose and hence the bromate formation. CCWD is involved in a variety of studies for control of bromate formation and other DBPs. Research has linked bromate to kidney cancer in laboratory animals and is therefore not desirable in drinking water. Because of this discovery, in 1999, the EPA included bromate in its list of disinfection byproducts to be regulated (University of Arizona 2002).

Stage 2 Disinfectants/Disinfection By-Products Rule

The Stage 2 DBPR, which will be finalized in late 2004, maintains the levels established under the 1998 Stage 1 Rule, i.e., 0.080 mg/L for TTHMs and 0.060 mg/L for HAAs. However, monitoring procedures and schedules will be modified to ensure that the data obtained more closely represent actual long-term exposure conditions.

Should an MCL be exceeded at one or more system monitoring points (based on annual running average DBP concentrations), the system would be considered to be in violation of the Stage 2 regulation regardless of results for the remaining monitoring sites. This represents a major change from current TTHM and Stage 1 DBP regulations, as the "system averaging" concept would be eliminated under the Stage 2 regulation.

Considerable pressure to reduce the Stage 1 MCL for bromate to 0.005 mg/L or less currently exists, as ongoing research suggests that this contaminant may be more carcinogenic than originally believed. (This change would primarily affect utilities such as CCWD that practice ozonation for primary disinfection.) However, the recently completed Agreement in Principle recommends that the Stage 2 DBPR MCL for bromate remain at the current value of 0.010 mg/L. Under this agreement, EPA would commit to reviewing the bromate MCL as part of the 6-year regulatory review process required under the Safe Drinking Water Act to determine whether the MCL should remain at 0.010 mg/L or be reduced to 0.005 mg/L or lower.

Long-Term 2 Enhanced Surface Water Treatment Rule

The LT2ESWTR is to be finalized in late 2004. This rule will apply to all public water systems that use surface water or groundwater under the direct influence of surface water. Recommendations presented in the recently completed Stage 2 Disinfectants/Disinfection By-Products Agreement in Principle include an initial period of raw water microbial monitoring, with treatment requirements established based on microbial contaminant levels present in the supply. Utilities serving 10,000 or more consumers and practicing "conventional treatment" (coagulation, sedimentation, and filtration) would be required to conduct monthly monitoring of the raw water supply for *Cryptosporidium* (using EPA Method 1622/23 with minimum 10L samples), *E. coli*, and turbidity over a 24-month period.

Systems serving 10,000 or more consumers must complete this monitoring and submit a report summarizing the monitoring results to their State/Primacy Agency within 2½ years of promulgation of this regulation. Additional treatment requirements under the LT2ESWTR, based on average raw water *Cryptosporidium* oocyst concentrations, are summarized in Table 5.1-16.

Table 5.1-16
***Cryptosporidium* Action Bins Requirement Table**

Bin Number	Average *Cryptosporidium* Concentration, Oocysts per Liter[1]	Additional Treatment Requirements for Systems with Conventional Treatment that are in Full Compliance with IESWTR
1	*Cryptosporidium* < 0.075/L	No Action
2	0.075/L ≤ *Cryptosporidium* < 1.0/L	1-log treatment (systems may use any technology or combination of technologies from toolbox as long as total credit is at least 1-log)
3	1.0/L ≤ *Cryptosporidium* < 3.0/L	2.0 log treatment (systems must achieve at least 1-log of the required 2-log treatment using ozone, chlorine dioxide, UV, membranes, bag/cartridge filters, or in-bank filtration)
4	*Cryptosporidium* ≥ 3.0/L	2.5 log treatment (systems must achieve at least 1-log of the required 2.5-log treatment using ozone, chlorine dioxide, UV, membranes, bag/cartridge filters, or in-bank filtration)

[1] Based on maximum value for 12-month running annual average, or 2-year mean if twice-monthly monitoring is conducted.

Water systems will then choose from a microbial toolbox that provides a combination of technologies or approaches to meet the additional removal requirements. Ultimate compliance with toolbox requirements would not be required until 2010. The LT2ESWTR will also exempt plants from all initial monitoring and bin classification requirements that have alternative treatment that achieves 5.5-log or greater removal of *Cryptosporidium* (Pontius 2003).

5.1.6.6 San Francisco Bay Conservation and Development Commission

The San Francisco Bay Conservation and Development Commission regulates all filling and dredging in San Francisco Bay (which includes San Pablo and Suisun bays, sloughs, and certain creeks and tributaries that are part of the Bay system, salt ponds and certain other areas that have been diked off from the Bay). It provides protection to Suisun Marsh, the largest remaining wetland in California, by administering the Suisun Marsh Preservation Act in cooperation with local governments. It regulates new development within the first 100 feet inland from the Bay to ensure that maximum feasible public access to the Bay is provided. It minimizes pressures to fill the Bay by ensuring that the limited amount of shoreline area suitable for high priority water-oriented uses is reserved for ports, water-related industries, water-oriented recreation, airports, and wildlife areas. It pursues an active planning program to study Bay issues so that Commission plans and policies are based upon the best available current information. It administers the Federal Coastal Zone Management Act within the San Francisco Bay segment of the California coastal zone to ensure that Federal activities reflect Commission policies. It participates in the regionwide State and Federal program to prepare a Long-Term Management Strategy for dredging and dredge material disposal in San Francisco Bay. It participates in California's oil spill prevention and response planning program.

5.1.6.7 California Toxic Injection Well Control Act

The State has authority to regulate the deep-well injection of hazardous waste under the Toxic Injection Well Control Act and the Hazardous Waste Management Act. The Toxic Pits Control Act is inapplicable here as it only attempts to regulate surface impoundments. Both the Toxic

Injection Well Control Act and Hazardous Waste Management Act recognize the increased occasion of contaminant migration from land treatment facilities, such as injection wells and, therefore, provide authority for State regulation.

5.2 ENVIRONMENTAL CONSEQUENCES

5.2.1 Evaluation Criteria

A series of modeling exercises were undertaken to determine what effects to surface waters may occur due to implementing each of the Out-of-Valley Disposal Alternatives. The methodologies described in this section were developed to predict changes in salinity (TDS), TOC, bromide, and Se concentrations both in the near-field and far-field settings. Near-field changes were considered significant if they resulted in obstruction of a critical zone of passage for sensitive species. Far-field changes in TDS concentrations were predicted at major CCWD intake locations in the Delta and intakes located near Antioch in the Bay and at Clifton Court Forebay, where Delta water is diverted into State and Federal water projects and compared to existing conditions. Increases over existing conditions were deemed significant if they would result in a 5 percent increase in concentrations of constituents of concern or exceed a primary or secondary MCL. Predicted changes in Se concentrations were compared to Federal and State WQOs and were used to estimate changes in bioaccumulation. Toxic effects levels due to bioaccumulation were derived from a review of the scientific literature and are discussed in Section 8.1 and Appendix G (Section G-3).

5.2.2 Modeling Method and Assumptions

A variety of modeling tools were used to assist in the evaluation of potential effects of disposal to the Bay-Delta and ocean. Near-field changes (adjacent to the discharge) were assessed using EPA’s Visual Plumes modeling software to determine the size of the mixing zone (where discharge water is initially diluted with receiving water). Far-field changes (away from the mixing zone) were assessed using one-dimensional and two-dimensional hydrodynamic water quality models (Fischer Delta and MIKE 21 models). Changes in Se concentrations were predicted using the two-dimensional hydrodynamic and water quality model coupled with a bioaccumulation model. Each of these models is described briefly below. The No Action Alternative was not expressly modeled for the Delta. Instead, No Action was assumed to be similar to the modeled existing condition. Modeling No Action for the 50-year project planning period would require speculation on the quantitative effect of multiple actions by a variety of agencies involved in management of the Bay-Delta. As these programs are focused on improving the quality of the Bay-Delta, assuming No Action is similar to existing conditions is conservative in that if future conditions are better than current, water quality goals and standards would be met more frequently than are predicted using current conditions.

Modeling assumptions developed by the Sacramento Regional Board in the development of the TMDLs for Se in the Lower San Joaquin River (August 2001) and TMDLs for salinity and boron in the San Joaquin River (August 2002) were used to represent the No Action Alternative (Appendix D4). Quantitative comparison of existing conditions with No Action was performed by the Regional Board in setting and determining the TMDLs. The results of the Regional Board comparison showed that water quality in the river would improve. As no direct discharges to the river are proposed as part of the action alternatives, no additional model comparisons were performed for existing conditions.

Existing conditions in the Point Estero vicinity were also assumed to be equivalent to No Action. This assumption is necessary because no reliable mechanism is available to predict changes in local ocean currents over the next 50 years. Appendix D, Water Quality Modeling, provides more detailed information.

5.2.2.1 Near-Field Modeling Method and Assumptions

Concentrations of Se, TDS, TOC, and bromide resulting from the proposed discharges are the key water quality concerns for the potential project. However, for this localized diffuser analysis, Se WQOs were more restrictive than objectives for other constituents, and hence Se objectives governed the analysis. Se concentration was used as the design criterion for the diffusers, and TDS, TOC, and bromide concentrations resulting at the boundary of the zone of initial dilution were calculated. The aquatic life criterion of 5 µg/L of Se reported in the CTR was used as the standard for evaluating the Delta diffuser design and resultant plume. The 6-month median marine aquatic life criterion of 15 µg/L of Se reported in the State Board California Ocean Plan was used as the standard for evaluating the ocean diffuser design and resultant plume. These are the most stringent currently applicable Se criteria. Key design parameters for the diffuser analysis are shown in Table 5.2-1 (see Appendix C, Section C2.6).

Table 5.2-1
San Luis Drain Effluent Data

Effluent Characteristic	Value
Flow Rate	29.1 feet^3/second (cfs)
TDS/Salinity Concentration*	19 ppt
Temperature	50.7 °F = 10.4 °C (Winter) 79.4 °F = 26.3 °C (Summer)
Selenium Concentration, discharge to Delta	10 µg/L
Selenium Concentration, discharge to Ocean	220 µg/L
TOC Concentration, Delta & Ocean	8.5 ppm
Bromide Concentration, Delta & Ocean	5.2 ppm

*For the purposes of this analysis, the design TDS concentration of 19,000 ppm (19 ppt) was assumed to be equivalent to the effluent salinity. Although this correlation is not perfect, the assumption is reasonable given the preliminary nature of this analysis.
ppm parts per million

The diffuser was evaluated for the ocean diffuser at 10-meter and 20-meter depths, which are the minimum depths to achieve the required dilution. Added depth would reduce the concentration of key constituents in the plume by the time the plume reached the water surface.

Delta Discharge Locations: Carquinez Strait and Chipps Island

In combination with the effluent data provided in Table 5.2-1, ambient data for the Carquinez Strait near Martinez, reported by Brown and Caldwell (1987), were used to formulate a preliminary diffuser design for the two Delta disposal sites. Temperature and salinity data for both summer and winter conditions were simulated since seasonal fluctuations can significantly alter the characteristics of the diffuser plume. Worst-case zero velocity scenarios were simulated, along with 0.91 meter per second (3.0 feet per second) current velocity scenarios. Table 5.2-2 summarizes the ambient temperature and salinity data used in this analysis.

Table 5.2-2
Ambient Temperature and Salinity Data, Carquinez Strait, California

Summer Conditions			Winter conditions		
Depth (m)	Salinity (ppt)	Temperature (°C)	Depth (m)	Salinity (ppt)	Temperature (°C)
0.00	19.56	14.78	0.00	17.50	8.00
0.50	19.59	14.79	1.52	17.50	8.00
2.13	20.63	14.82	2.13	17.30	7.67
3.96	20.62	14.88	2.74	17.93	6.67
6.20	20.68	14.82	3.35	17.23	6.21
			3.96	17.26	6.21
			4.57	17.39	6.22
			5.18	17.52	6.26
			5.79	17.34	6.96
			6.10	17.34	6.96

Source: Brown and Caldwell 1987.

Based on these data, the EPA Visual Plumes (VP) program was used to design a diffuser to meet the CTR Se concentration criterion of 5 µg/L within a reasonable zone of initial dilution. The depth of the water column was assumed to be 6.2 meters, although depths at both Carquinez Strait and Chipps Island fluctuate daily due to tidal influence. According to USGS topographic surveys, a 6.2-meter depth represents a very low-tide condition since depths generally exceed 9 meters at mean low tide in both locations. Tideflex® diffuser valves were specified for all diffuser ports to maintain adequate diffuser velocity and minimize debris accumulation within the diffuser.

Three diffuser options were developed for the Delta sites. Option 1 is an approximately 49-meter-long diffuser with 33 ports. Option 2 is an approximately 21-meter-long diffuser with 15 ports. Option 3 is an approximately 200-meter-long diffuser that stretches across two-thirds of the channel width, with 15 ports. Option 3 would achieve complete mixing across the channel width more quickly than the other two options, and for this reason, if it is economically feasible, it should be selected over the other two options. If Option 3 is economically infeasible, the least expensive of Options 1 and 2 should be selected. Table 5.2-3 lists key diffuser design parameters for the three options.

Table 5.2-3
Diffuser Design Parameters, Delta Discharge Locations

Diffuser Design Parameter	Option 1	Option 2	Option 3
Diffuser port valve type	Tideflex	Tideflex	Tideflex
Port diameter	10.2 cm	15.2 cm	15.2 cm
Diffuser depth	6.2 meter	6.2 meter	6.2 meter
Port elevation above channel bottom	0.61 meter	0.61 meter	0.61 meter
Port angle	45° from vertical, alternate ports	45° from vertical, alternate ports	45° from vertical, alternate ports
Number of ports	33	15	15
Port spacing	1.5 meters on center	1.5 meters on center	14.3 meters on center
Diffuser length	49 meters	21 meters	200 meters
Diffuser discharge velocity	3.08 meters/second	3.01 meters/second	3.01 meters/second

Source: Flow Science VP analysis, 2003.

Ocean Discharge Location: Point Estero

In combination with the effluent data listed in Table 5.2-1, ambient ocean data gathered from several sources were used to formulate a preliminary diffuser design for the Point Estero ocean disposal site. Data sources included CalCOFI (the California Cooperative Oceanic Fisheries Investigations program), CDIP (the Coastal Data Information Program of the Scripps Institution of Oceanography at UC San Diego), NDBC (the National Data Buoy Center of the National Oceanic and Atmospheric Administration (NOAA), and the Central California Coastal Circulation Study (CCCCS, sponsored by Interior). Data were gathered from both web sites and published reports. CalCOFI data are from the cruise stations nearest the proposed outfall location, 25.5 miles away on average. CDIP data are for the Diablo Canyon buoy, approximately 19.0 miles from the proposed outfall location. NDBC data are for the buoy at Point San Luis, approximately 24.3 miles from the proposed outfall location. CCCCS data were collected at two stations, 19.3 and 22.3 miles from the proposed outfall location, respectively. Table 5.2-4 provides a description of each ambient ocean data source used in the analysis.

Table 5.2-4
Ambient Ocean Data Sources and Descriptions

Source	# Data Points*	Date Range	Temperature Data	Salinity Data	Current Data
CalCOFI	28	January 1972 – March 1986	•	•	
CDIP	80,165	June 1996 – August 2002	•		
NDBC	82,513	July 1997 – June 2002	•		•
CCCCS	38,448	February 1984 – July 1985	•	•	•

*One data point is defined as a temperature, salinity, or current *profile* taken at a specific location at a specific date. Each profile may consist of several measurements.

Source: Flow Science data collection, 2002.

It should be noted that ocean temperature, salinity, and especially current data can vary significantly due to local ocean floor topography and hydrodynamics. While the oceanographic data collected for this analysis are the most representative data readily available for the site, they may not perfectly represent conditions at the proposed outfall location. However, although neither a detailed long-term site-specific monitoring program nor a hydrodynamic modeling study of the project area have been conducted to date, it is the qualitative assessment of the EIS preparers that current data used for this analysis are reasonably representative of diffuser site conditions. The EIS preparers have no knowledge of the proposed diffuser site being a special null zone that would lead to short-term or long-term constituent accumulation. It should also be noted that the diffuser design-limiting condition is zero current (i.e., stagnant) conditions. Therefore, the design is not immediately dependent on precise current conditions at the site.

Both summer and winter ambient conditions were simulated since seasonal fluctuations can significantly alter the characteristics of the diffuser plume. As mentioned, a worst-case zero current velocity scenario was also simulated. It should be noted that this stagnant condition is unlikely to occur for any substantial time period. Table 5.2-5 summarizes the ambient ocean data used in this analysis.

Table 5.2-5
Ambient Ocean Data, Point Estero, California

Depth (meters)	Salinity, Summer and Winter (ppt)	Temperature (°C)		Ocean Currents					
		Summer	Winter	Worst-Case Velocity (meter/s)	Maximum Speed, Summer (meter/s)	Dominant Direction, Summer (°)	Maximum Speed, Winter (meter/s)	Dominant Direction, Winter (°)
0	33.4	16.8	11.3					
10				0.0			0.447	75
20	33.4	15.0	11.3					
25				0.0	0.470	95	0.678	275
41				0.0	0.506	95	0.683	285
50	33.5	11.8	10.2					
57				0.0	0.576	95	0.629	285
73				0.0	0.485	95	0.588	105
75	33.6	10.3	9.6					
89				0.0	0.514	95	0.545	95
100	33.7	9.5	9.0					
105				0.0	0.440	105	0.486	95

Sources: California Cooperative Oceanic Fisheries Investigations Program, Coastal Data Information Program, National Data Buoy Center, and Central California Coastal Circulation Study data collected by Flow Science, 2002.

Based on these data, the EPA VP program was used to design a diffuser to meet the Se criterion of 15 µg/L within a reasonable zone of initial dilution. Two port sizes were modeled using VP, 10.2 centimeters (cm) and 15.2 cm. Modeling showed that the water quality criterion could reasonably be met using either port size. It is assumed that the 15.2-cm design would be preferable since it results in a shorter diffuser. However, it also requires water that is approximately 10 meters deeper than the 10.2-cm option. The cost trade-off between length of diffuser and water depth should be evaluated before a final diffuser design is selected.

Tideflex® diffuser valves were specified for all diffuser ports to maintain adequate diffuser velocity and minimize debris and sand accumulation within the diffuser. Key diffuser design parameters for both options are listed in Table 5.2-6. These parameters are appropriate for the worst-case zero ocean current scenario.

Table 5.2-6
Diffuser Design Parameters, Point Estero Diffuser

Diffuser Design Parameter	10.2-cm Option	15.2-cm Option
Diffuser port valve type	Tideflex®	Tideflex®
Port diameter	10.2 cm	15.2 cm
Approximate recommended diffuser depth	10 meter	20 meter
Port elevation above ocean floor	0.61 meter	0.61 meter
Port angle	Vertical (0^o)	Vertical (0^o)
Number of ports	33	15
Port spacing	1.5 meters on center	1.5 meters on center
Diffuser length	48.8 meters	21.3 meters
Diffuser discharge velocity	3.08 meters/second (10.1 feet per second)	3.01 meters/second (9.9 feet per second)
Approximate maximum height above diffuser where plume = 15 µg/L Se	6.3 meter	12.5 meter
Maximum Plume Width at 15 µg/L Se	2.1 meter	3.8 meter
Maximum Plume Length at 15 µg/L Se	51 meter	25 meter

Source: Flow Science VP analysis, 2003.

5.2.2.2 Far-Field Modeling Method and Assumptions

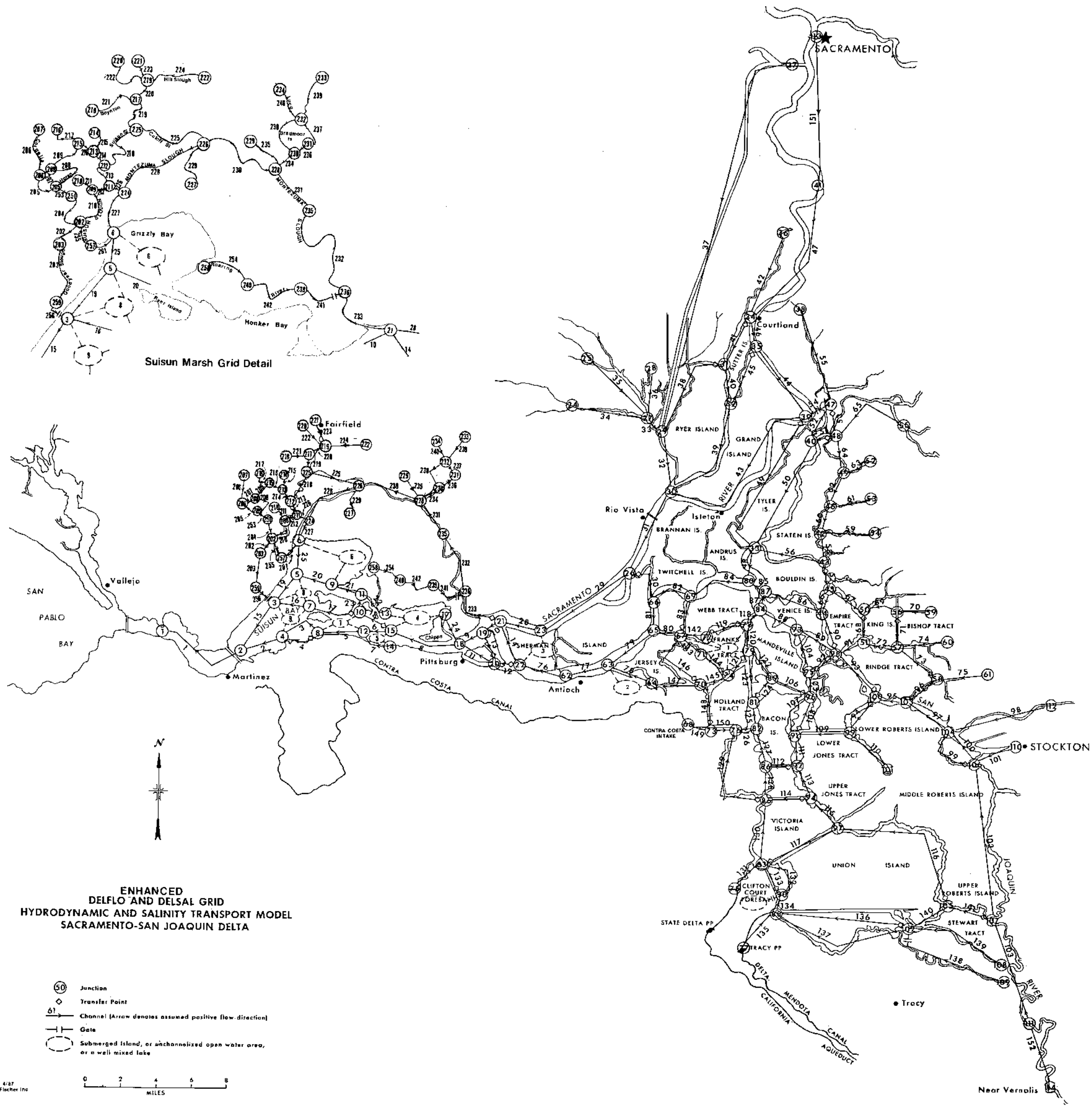
Modeling was the primary tool used to assess far-field changes due to the Chipps Island and Carquinez Strait discharges. The one-dimensional Fischer-Delta Model (FDM) Version 8.2 was used to predict changes in salinity, TOC, and bromide concentrations in the Delta and in the Bay to Carquinez Strait. The two-dimensional MIKE 21 model was used to predict changes in salinity and Se concentrations in the Bay and in the Delta to Jersey Island.

Fischer-Delta Model

The Fischer-Delta Model was used to estimate the distribution of salt, Se, TOC, and bromide concentrations within the Delta that would result from a steady discharge of treated agricultural drainwater at Chipps Island.

To provide a realistic simulation of the likely effect of the potential Chipps Island discharge, a 35-year simulation was prepared using the actual Delta flows, exports, and hydrology for the period 1956–1991. For these simulations, FDM Version 8.2 was used with San Francisco Bay replaced by a downstream boundary condition at Carquinez Strait. This model has been widely used to simulate the operation of the Delta, and the State Board has accepted the model output in several permit hearings. The modeled grid is shown on Figure 5.2-1.

The discharge at Chipps Island is presumed to have a flow rate of 29.1 cfs with a TDS concentration of 19,000 ppm, representing a discharge of 15.7 kilograms of salt per second (kg/s). The 29.1-cfs discharge represents average annual flow conditions. Since the seasonal peak in flow rate will be regulated by the storage capacity of the aquifer beneath the potential SLDFR reuse facilities, a constant flow is expected over the course of the year. Therefore, 29.1 cfs represents a worst-case scenario. The concentrations of Se, TOC, and bromide in the discharge are assumed to be 10 µg/L or (ppb), 8.5 ppm, and 5.2 ppm respectively.



San Luis Drainage Feature Re-evaluation	Fischer-Delta Model Grid	Figure 5.2-1
17324004		

The addition of 29.1 cfs of flow to the Delta at Chipps Island provides a negligible increase in the total estuary flow at that location so that the actual drainage flow rate is insignificant in relation to natural Delta flows. The modeling assumes that the discharge will be uniformly mixed across the river by a multiport diffuser, enabling a far-field analysis to be carried out on the basis that the discharge is completely mixed with the river at the point of discharge.

MIKE 21 Salinity and Selenium Model

The effect of the SLDFR discharge at Chipps Island and Carquinez Strait on TDS and Se concentrations in San Francisco Bay and the Delta was modeled in this study using the MIKE 21 software developed by the Danish Hydraulic Institute (DHI 1998a, b). MIKE 21 is a two-dimensional, finite difference, free surface modeling system that has been used to simulate hydraulics and hydraulics-related phenomena in estuaries, coastal waters, and seas where stratification can be neglected.

MIKE 21 consists of three linked modules. The first is a hydrodynamic module (MIKE 21 HD) that solves the time-dependent, vertically integrated equations of continuity and conservation of momentum in two horizontal directions. The second is an advection-dispersion module (MIKE 21 AD) that calculates the transport of conservative substances such as TDS in the water column. Lastly, the heavy metals module (MIKE 21 ME) uses the computational algorithms from MIKE 21 HD and AD, but additionally calculates nonconservative mass transfer (i.e., sorption) between dissolved Se and suspended or benthic sediment.

The first step in using this MIKE 21 modeling software was to properly define the system to be modeled, identify the important processes to be included, and calibrate the model. In this study, the model domain was the Bay-Delta from Jersey Island in the Delta to the Pacific Ocean, discretized into 200-by-200-meter rectangular grid cells (Figure 5.2-2). The processes included in the model were tides, wind, waves, erosion, deposition, diffusion, adsorption, and desorption. In addition, loading from major watersheds draining to the Bay was important for sediment, salt, and Se. Model set-up and calibration is discussed in Appendix D.3.

5.2.3 No Action Alternative

The No Action Alternative evaluates the effect of not conveying drainwater out of the drainage study area for disposal. This alternative is defined as what could be expected to occur in the 50-year planning period if drainage service is not provided to the Unit and related areas. It represents existing conditions for drainage management plus changes in management reasonably expected to be implemented by individual farmers and districts in the absence of Federal drainage services and not of a magnitude to require CEQA/NEPA documentation (e.g., not major new projects). The No Action Alternative includes only regional conveyance, treatment, or disposal facilities that existed in 2001, or that are authorized, funded projects. No planned use of the San Luis Drain would occur after December 31, 2009, as a new action (e.g., use agreement and CEQA/NEPA documentation) would be required.

5.2.3.1 Construction Effects

No new Federal construction would occur as part of the No Action Alternative. Therefore, no construction effects are predicted.

5.2.3.2 Operational Effects

It is not anticipated that any new water quality effects would occur except for effects on groundwater quality that could result in increased salinity and Se in the San Joaquin River due to unplanned, uncontrollable seepage discharges. Implementation of new and evolving water quality control programs such as TMDLs should result in a gradual improvement in surface-water quality in the San Joaquin River, Delta, and San Francisco Bay. However, increased water demand and competition for scarce water supplies in the absence of new storage may result in unknown and potentially adverse effects.

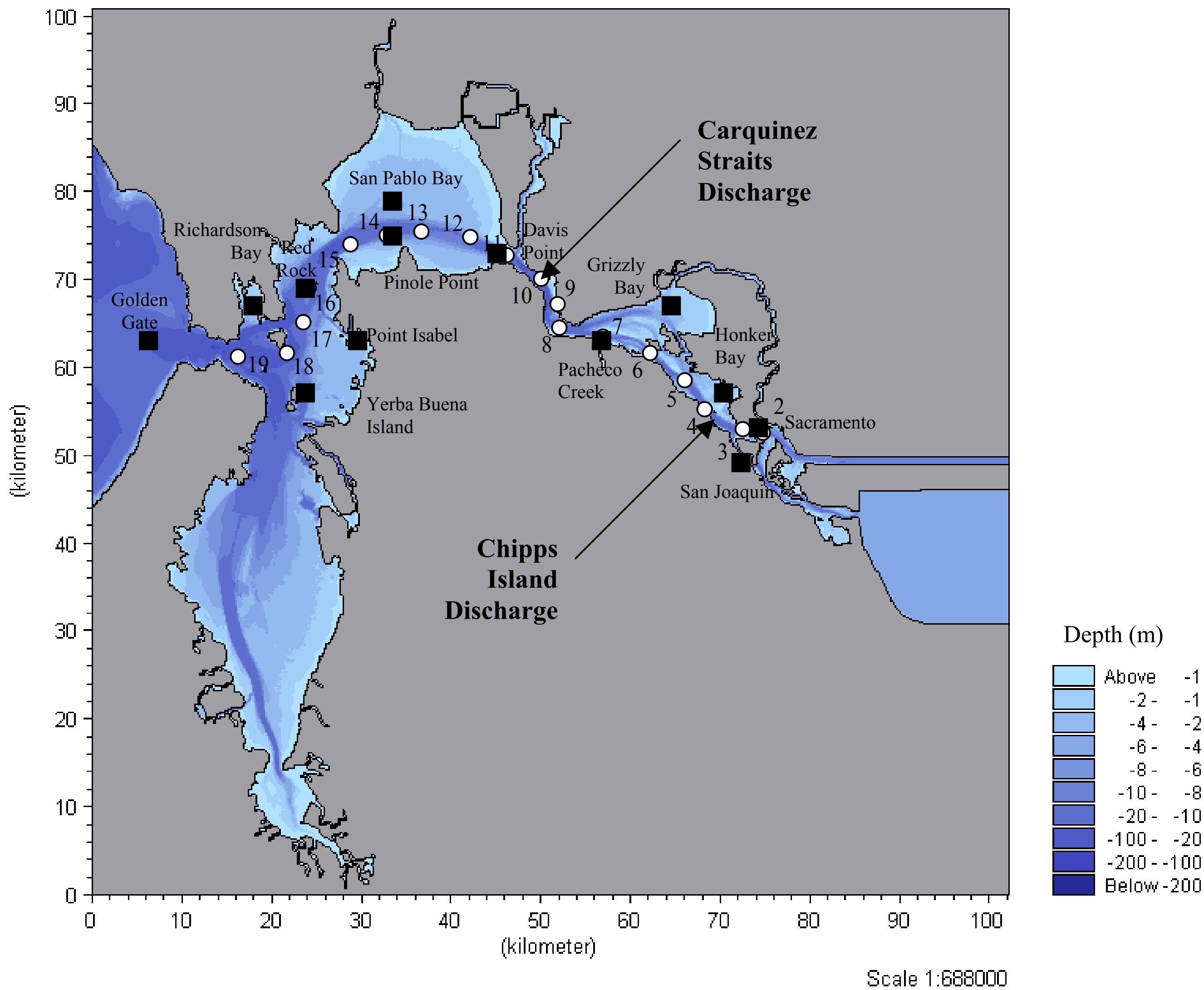
5.2.3.3 Drinking Water Intakes

Under No Action, some drainwater would continue to (1) flow uncontrolled into the San Joaquin River above the Merced River confluence via seepage into wetland channels from the Northerly Area due to rising groundwater levels, as discussed in the *Grassland Bypass Project Final EIS/EIR* (Reclamation 2001c), or (2) flow as managed, individual farm discharges but in compliance with the TMDL requirements. Because the San Joaquin River flows to the Delta, drinking water intakes in the Delta are susceptible to drainwater contamination. This is presently a concern for CCWD and would continue to be a concern if No Action is implemented.

Under No Action, the drainwater would not receive any Se treatment and the amount that would be legally discharged would be very limited to comply with the TMDL requirements. The larger concern is the adverse effect of the unmanaged seepage of subsurface drainage into wetland channels and, consequently, into the San Joaquin River.

5.2.4 In-Valley Disposal Alternative

This alternative would contain the drainage and disposal service within the San Luis Unit. Existing and planned retired lands are 44,106 acres. The components comprising this alternative include the installation of tile drains for drainage-impaired lands and a collection system to convey the drainwater to four agricultural reuse facilities located within the drainage study area. At the reuse facilities drainwater would be used to irrigate salt-tolerant crops. Applying the drainwater at a rate of 4 AF per acre would result in a 27 percent leaching rate. Approximately 73 percent of the original drainwater would be lost to ET. Following reuse application, remaining drainwater would go through treatment prior to entering evaporation basin disposal facilities. The treatment facilities would consist of RO facilities for water reclamation and biological treatment reactors for Se removal from brine. The flow-weighted average Se and TDS concentrations in RO brine after several years of reuse facility operation are estimated to be 480 µg/L and 35,600 mg/L prior to Se treatment. Se biotreatment is estimated to reduce Se concentrations to below 10 µg/L. Following Se biotreatment drainwater would be discharged into evaporation basin disposal facilities to reduce the reused and treated drainwater to a dry salt. The residual dry salt would be permanently disposed of on site.



San Luis Drainage Feature Re-evaluation	Bathymetry for MIKE 21 Model and Location of Modeled Discharges and USGS (Open Circles) and RMP (Closed Squares) Monitoring Stations	Figure 5.2-2
17324004		

5.2.4.1 Construction Effects

Construction effects could include increases in sediment in local creeks and waterways, and soil erosion due to land disturbance. Compliance with the Construction General Permit 99-08-DWQ and Section 404 permitting requirements will require development and implementation of BMPs to minimize erosion and sediment transport to waters of the State. As a result of this required permitting, results from construction on surface water resources are not significant.

5.2.4.2 Operational Effects

Due to the treatment facilities and the potential irrigation application rate, the effects to surface water would be minimal. Under the In-Valley Disposal Alternative permitted discharges from the GDA to the Lower San Joaquin River as a part of the Grassland Bypass Project would be discontinued and placed into evaporation basins. Removal of the water and chemicals from the River is expected to result in a significant beneficial effects to the concentration of Se in the Lower San Joaquin River (see Appendix D4). Improvements in the concentrations of salt and boron would also be significant although not as great as Se, due to existence of other significant sources of these chemicals to the River.

Removal of drainwater associated with the Grassland Bypass Project from the Lower San Joaquin River would reduce the amount of dilution water required to be released from New Melones Reservoir to achieve the EC water quality objective at Vernalis. Modeling results shown in Appendix D4 indicate for the 10-year period from 1985 through 1995 the average reduction in dilution flow would be 21,000 AF/year. This is a significant beneficial effect to New Melones Reservoir Operations.

5.2.4.3 Drinking Water Intakes

Treating and disposing the drainwater in the valley would eliminate the drainwater discharges into the San Joaquin River from the GDA. The In-Valley Disposal Alternative would help to contain and consolidate the drainwater and, therefore, prevent a spread of the drainage contamination. As a result, the San Joaquin River water quality would improve as the existing daily discharge and buildup from drainwater contamination is eliminated.

5.2.5 In-Valley/Groundwater Quality Land Retirement Alternative

This alternative would contain the drainage and disposal service within the San Luis Unit. This alternative consists of retiring all the lands in Westlands with Se concentration greater than 50 ppb in the shallow groundwater, lands acquired by Westlands, and 10,000 acres in Broadview Water District in the Northerly Area. Total land retirement is 92,592 acres. This alternative would also include irrigation system improvements to reduce deep percolation to shallow groundwater. The components comprising this alternative include the installation of tile drains for drainage-impaired lands and a collection system to convey the drainwater to four agricultural reuse facilities located within the drainage study area. At the reuse facilities drainwater would be used to irrigate salt-tolerant crops. Applying the drainwater at a rate of 4 AF/acre would result in a 27 percent leaching rate. Approximately 73 percent of the original drainwater would be lost to ET. Following reuse application, remaining drainwater would go through RO treatment. The flow-weighted average Se and TDS concentrations in RO brine after several years of reuse facility are estimated to be 528 µg/L and 33,000 mg/L prior to Se treatment. Se biotreatment is estimated to reduce Se concentrations to below 10 µg/L. Following Se biotreatment drainwater would be discharged into evaporation basin disposal facilities to reduce the reused and treated drainwater to a dry salt. The residual dry salt would be permanently disposed of on site.

5.2.5.1 Construction Effects

Construction effects could include increases in sediment in local creeks and waterways, and soil erosion due to land disturbance. Compliance with the Construction General Permit 99-08-DWQ and Section 404 permitting requirements will require development and implementation of BMPs to minimize erosion and sediment transport to waters of the State. As a result of this required permitting, results from construction on surface water resources are not significant.

5.2.5.2 Operational Effects

Due to the treatment facilities and the potential irrigation application rate the effects to surface water would be minimal. Under all the In-Valley/Groundwater Quality Land Retirement Alternative permitted discharges from the GDA to the Lower San Joaquin River as a part of the Grassland Bypass Project would be discontinued and placed into evaporation basins. Removal of the water and chemicals from the river is expected to result in a significant beneficial effects to the Se concentration in the Lower San Joaquin River (see Appendix D4). Improvements in the concentrations of salt and boron would also be significant although not as great as Se, due to the existence of other significant sources of these chemicals to the river.

Removal of drainwater associated with the Grassland Bypass Project from the Lower San Joaquin River would reduce the amount of dilution water required to be released from New Melones Reservoir to achieve the EC water quality objective at Vernalis. Modeling results shown in Appendix D4 indicate for the 10-year period from 1985 through 1995 the average reduction in dilution flow would be 21,000 AF/year. This is a significant beneficial effect to New Melones Reservoir Operations.

5.2.5.3 Drinking Water Intakes

Treating and disposing the drainwater in the valley would eliminate the drainwater discharges into the San Joaquin River from the GDA. The In-Valley/Groundwater Quality Land Retirement Alternative would help to contain and consolidate the drainwater and, therefore, prevent a spread of the drainage contamination. As a result, the San Joaquin River water quality would improve as the existing daily discharge and buildup from drainwater contamination is eliminated.

5.2.6 In-Valley/Water Needs Land Retirement Alternative

This alternative would contain the drainage and disposal service within the San Luis Unit. This alternative would retire enough lands to meet the internal water use needs of the San Luis Unit or 193,956 acres. This value would include lands with Se concentrations greater than 20 ppb in Westlands, lands acquired by Westlands, and 10,000 acres in Broadview Water District. The alternative would include irrigation system improvements to reduce deep percolation to shallow groundwater. The components comprising this alternative include the installation of tile drains for drainage-impaired lands and a collection system to convey the drainwater to four agricultural reuse facilities located within the drainage study area. At the reuse facilities drainwater would be used to irrigate salt-tolerant crops. Applying the drainwater at a rate of 4 AF/acre would result in a 27 percent leaching rate. Approximately 73 percent of the original drainwater would be lost to ET. Following reuse application, remaining drainwater would go through RO treatment. The flow-weighted average Se and TDS concentrations in RO brine after several years of reuse facility are estimated to be 534 µg/L and 32,520 mg/L prior to Se treatment. Se biotreatment is estimated to reduce Se concentrations to below 10 µg/L. Following Se biotreatment drainwater would be discharged into evaporation basin disposal facilities to reduce the reused and treated drainwater to a dry salt. The residual dry salt would be permanently disposed of on site.

5.2.6.1 Construction Effects

Construction effects could include increases in sediment in local creeks and waterways, and soil erosion due to land disturbance. Compliance with the Construction General Permit 99-08-DWQ and Section 404 permitting requirements will require development and implementation of BMPs to minimize erosion and sediment transport to waters of the State. As a result of this required permitting, results from construction on surface water resources are not significant.

5.2.6.2 Operational Effects

Due to the treatment facilities and the potential irrigation application rate the effects to surface water would be minimal. Under the In-Valley/Water Needs Land Retirement Alternative permitted discharges from the GDA to the Lower San Joaquin River as a part of the Grassland Bypass Project would be discontinued and placed into evaporation basins. Removal of the water and chemicals from the river is expected to result in a significant beneficial effect to the Se concentration in the Lower San Joaquin River (see Appendix D4). Improvements in the concentrations of salt and boron would also be significant although not as great as Se, due to the existence of other significant sources of these chemicals to the river.

Removal of drainwater associated with the Grassland Bypass Project from the Lower San Joaquin River would reduce the amount of dilution water required to be released from New Melones Reservoir to achieve the EC water quality objective at Vernalis. Modeling results shown in Appendix D4 indicate for the 10-year period from 1985 through 1995 the average reduction in dilution flow would be 21,000 AF/year. This is a significant beneficial effect to New Melones Reservoir Operations.

5.2.6.3 Drinking Water Intakes

Treating and disposing the drainwater in the San Joaquin Valley would eliminate the drainwater discharges into the San Joaquin River from the GDA. The In-Valley/Water Needs Land Retirement Alternative would help to contain and consolidate the drainwater and, therefore, prevent a spread of the drainage contamination. As a result, the San Joaquin River water quality would improve as the existing daily discharge and buildup from drainwater contamination is eliminated.

5.2.7 In-Valley/Drainage-Impaired Area Land Retirement Alternative

This alternative would contain the drainage and disposal service within the San Luis Unit. This alternative would retire 308,000 acres, including all of the drainage-impaired lands in Westlands – approximately 298,000 acres. The Northerly Area (non-Westlands) is excluded from land retirement except for 10,000 acres in Broadview Water District. This alternative would include irrigation system improvements to reduce deep percolation to shallow groundwater. The components comprising this alternative include the installation of tile drains for drainage-impaired lands and a collection system to convey the drainwater to four agricultural reuse facilities located within the drainage study area. At the reuse facilities drainwater would be used to irrigate salt-tolerant crops. Applying the drainwater at a rate of 4 AF/acre would result in a 27 percent leaching rate. Approximately 73 percent of the original drainwater would be lost to ET. Following reuse application, remaining drainwater would go through RO treatment. The flow-weighted average Se and TDS concentrations in RO brine after several years of reuse facility are estimated to be 640 µg/L and 30,000 mg/L prior to Se treatment. Se biotreatment is estimated to reduce Se concentrations to below 10 µg/L. Following Se biotreatment drainwater would be discharged into evaporation basin disposal facilities to reduce the reused and treated drainwater to a dry salt. The residual dry salt would be permanently disposed of on site.

5.2.7.1 Construction Effects

Construction effects could include increases in sediment in local creeks and waterways, and soil erosion due to land disturbance. Compliance with the Construction General Permit 99-08-DWQ and Section 404 permitting requirements will require development and implementation of BMPs to minimize erosion and sediment transport to waters of the State. As a result of this required permitting, results from construction on surface water resources are not significant.

5.2.7.2 Operational Effects

Due to the treatment facilities and the potential irrigation application rate the effects to surface water would be minimal. Under the In-Valley/Drainage-Impaired Area Land Retirement Alternative permitted discharges from the GDA to the Lower San Joaquin River as a part of the Grassland Bypass Project would be discontinued and placed into evaporation basins. Removal of the water and chemicals from the river is expected to result in a significant beneficial effect to the Se concentration in the Lower San Joaquin River (see Appendix D4). Improvements in the concentrations of salt and boron would also be significant although not as great as Se, due to the existence of other significant sources of these chemicals to the River.

Removal of drainwater associated with the Grassland Bypass Project from the Lower San Joaquin River would reduce the amount of dilution water required to be released from New Melones Reservoir to achieve the EC water quality objective at Vernalis. Modeling results shown in Appendix D4 indicate for the 10-year period from 1985 through 1995 the average reduction in dilution flow would be 21,000 AF/year. This is a significant beneficial effect to New Melones Reservoir Operations.

5.2.7.3 Drinking Water Intakes

Treating and disposing the drainwater in the San Joaquin Valley would eliminate the drainwater discharges into the San Joaquin River from the GDA. The In-Valley/Drainage-Impaired Area Land Retirement Alternative would help to contain and consolidate the drainwater and, therefore, prevent a spread of the drainage contamination. As a result, the San Joaquin River water quality would improve as the existing daily discharge and buildup from drainwater contamination is eliminated.

5.2.8 Ocean Disposal Alternative

This alternative collects drainwater for delivery to in-valley reuse facilities through a series of pumping stations, piping, tunneling, and a 1-mile-long siphon and discharges the drainwater about 10 miles north of the city of San Luis Obispo into the ocean near Point Estero. Approximately 209 miles of pipeline would be installed plus 2 miles of tunnel and approximately 1.5 miles of marine pipeline. The outfall location is approximately 10 miles south of Monterey Bay National Marine Sanctuary and 200 feet below sea level 1.4 miles offshore from Point Estero.

5.2.8.1 Construction Effects

Construction effects could include increases in sediment in local creeks and waterways, and soil erosion due to land disturbance. Compliance with the Construction General Permit 99-08-DWQ and Section 404 permitting requirements will require development and implementation of BMPs to minimize erosion and sediment transport to waters of the State. As a result of this required permitting, results from construction on surface water resources are not significant.

5.2.8.2 Operational Effects

Under the Ocean Disposal Alternative permitted discharges from the GDA to the Lower San Joaquin River as a part of the Grassland Bypass Project would be discontinued and placed into the ocean. Removal of the water and chemicals from the River is expected to result in a significant beneficial effect to the concentration of Se in the Lower San Joaquin River. Improvements in the concentrations of salt and boron would also be significant although not as great as Se, due to existence of other significant sources of these chemicals to the River.

Removal of drainwater associated with the Grassland Bypass Project from the Lower San Joaquin River would reduce the amount of dilution water required to be released from New Melones Reservoir to achieve the EC water quality objective at Vernalis. Modeling results shown in Appendix D4 indicate for the 10-year period from 1985 through 1995 the average reduction in dilution flow would be 21,000 AF/year. This is a significant beneficial effect to New Melones Reservoir Operations.

The aqueduct, which is a combination of pipeline, tunnels, and pumping plants, traverses through and over the Coast Ranges and then discharges the drainwater into the ocean. The concentrated drainwater would have increased levels of salt and Se, but because of the closed nature of the aqueduct, little chance exists of spills or seepage of drainwater to the groundwater or surface water along the route.

5.2.8.3 Near-Field Changes in Receiving Waters

Under worst-case ocean current conditions (i.e., zero velocity), the resulting Se plume for the EPA VP modeled diffuser design would reach a concentration of 15 µg/L at 6 to 12 meters above the diffuser, under both summer and winter temperature conditions. At this elevation, the plume would be between 2 and 4 meters wide and 25 to 51 meters long (Table 5.2-6). Under maximum ocean current conditions (both summer and winter), the 15 µg/L criterion would be achieved at a depth of 2 meters above the diffuser ports. The plume would be approximately 2 meters wide and between 23 and 51 meters long. At the 15 µg/L Se contour, concentrations of TOC and bromide will vary based on background ambient concentrations, for which site specific data were unavailable. However, the diffuser concentration *increments* at the 15 µg/L Se contour for TOC and bromide are estimated at 0.58 ppm and 0.35 ppm, respectively, corresponding to a dilution ratio of approximately 14.5:1. TDS concentration would be approximately 33.0 ppt and would be largely governed by the ambient ocean concentration, which tends to be reasonably uniform at 34 ppt (almost double the discharge concentration). As previously stated, the appraisal-level design is for the outfall to be located at a depth of 200 feet (61 meters). However, for the purposes of this analysis, minimum diffuser depths were modeled (10 and 20 meters). This assumption has no effect on the results of the analysis; plume geometry relative to the diffuser would be identical for both the proposed and modeled cases.

Far-Field Changes in Receiving Waters

Far-field changes were not modeled due to the high dilution capacity of the ocean environment and the location of the diffuser relative to the shoreline (1.4 miles offshore). Entrainment of discharged water (which is the cause of most far-field increases in concentration) is not envisioned to occur to a measurable degree outside of the mixing zone. Therefore, far-field effects are not significant for the Ocean Disposal Alternative.

5.2.8.4 Effects on Drinking Water Intakes

The closest water treatment facility plants are Lopez Water Treatment Plant in Arroyo Grande (22 miles inland from the ocean) and Lompoc Water Treatment Plant (40 miles inland from the ocean). Because no drinking water intakes are identified in the Point Estero vicinity, no negative or significant effects would occur.

5.2.9 Delta-Chipps Island Disposal Alternative

Under this alternative the drainwater would come from a treatment facility collector point at South Dos Palos through the existing San Luis Drain. The drainwater would be conveyed northwest through a new pipeline or open canal and two pump stations and be disposed of at a point south of Chipps Island. The outfall would be affected by ocean tides.

5.2.9.1 Construction Effects

Construction effects could include increases in sediment in local creeks and waterways, and soil erosion due to land disturbance. Compliance with the Construction General Permit 99-08-DWQ and Section 404 permitting requirements will require development and implementation of BMPs to minimize erosion and sediment transport to waters of the State. As a result of this required permitting, results from construction on surface water resources are not significant.

5.2.9.2 Operational Effects

Under the Delta-Chipps Island Disposal Alternative permitted discharges from the GDA to the Lower San Joaquin River as a part of the Grassland Bypass Project would be discontinued. Removal of the water and chemicals from the River is expected to result in a significant beneficial effects to the concentration of Se in the Lower San Joaquin River. Improvements in the concentrations of salt and boron would also be significant although not as great as Se, due to existence of other significant sources of these chemicals to the River.

Removal of drainwater associated with the Grassland Bypass Project from the Lower San Joaquin River would reduce the amount of dilution water required to be released from New Melones Reservoir to achieve the EC water quality objective at Vernalis. Modeling results shown in Appendix D4 indicate for the 10-year period from 1985 through 1995 the average reduction in dilution flow would be 21,000 AF/year. This is a significant beneficial effect to New Melones Reservoir Operations.

The conveyance route from the valley to the Delta aligns with the Contra Costa Canal right-of-way in Contra Costa County. The project should be designed such that the conveyance is well away, and hydraulically isolated, from the Contra Costa Canal.

5.2.9.3 Near-Field Changes in Water Quality

Results for all three Delta diffuser options are very similar. Under worst-case zero velocity conditions (both summer and winter), the contribution of the plume to Se concentrations would fall below 5 µg/L (the CTR criterion) at a depth of approximately 5.3 meters, approximately 0.3 meters above the diffuser ports. At this elevation, the plume would have traveled a horizontal distance of approximately 1.1 meters in the direction of the port angle. Under 0.91 meter/s current conditions (both summer and winter), the contribution of the plume to Se concentrations would fall below 5 µg/L at a depth of more than 5.3 meters, less than 0.2 meters above the diffuser ports. Assuming Delta flow in the same direction as the port angle, at this elevation the plume would have traveled a horizontal distance of approximately 0.7 meters in the direction of the port angle. If Delta flow is in the opposite direction to the port angle, the plume would travel a maximum horizontal distance of 0.5 meter before its contribution to Se concentrations would fall below 5 µg/L. Since diffusion occurs rapidly with each option, individual plumes from each port would not merge before the contribution to Se concentrations falls below 5 µg/L. Instead, individual port plumes would have a diameter of approximately 1.2 meters and remain distinct above each port, over the length of the diffuser. At the point at which the contribution of the plume to Se concentrations falls below 5 µg/L, absolute concentrations of TDS, TOC, and bromide would vary widely based on ambient concentrations. However, at that point the contributions of the plume to TOC and bromide concentrations are estimated at 4.25 and 2.6 ppm, respectively. The TDS concentration at the 5 µg/L Se contour of the plume is approximately 19,000 mg/L, which is close to ambient concentration. In summary, water quality objectives would be met outside of the mixing zone, and the effect is not significant.

5.2.9.4 Far-Field Changes in Water Quality

FDM-Predicted Changes in TDS Concentrations

In the 35-year simulations 15.7 kg/s of salt was added at a constant flow rate into the Delta at Chipps Island and the TDS increments at Suisun Bay, Rock Slough, Martinez and Clifton Court Forebay were tracked for the 35-year period. Simulation results are shown on Figure 5.2-3, which presents the temporal distribution of the mean TDS increment that is predicted to occur at Suisun Bay and at the CCWD export point at Rock Slough. The predicted TDS increments at Martinez and Clifton Court Forebay are shown on Figure 5.2-4. As shown in both figures, the maximum effect of the simulated agricultural discharge is predicted to have occurred in the 1977 drought period, the driest period on record.

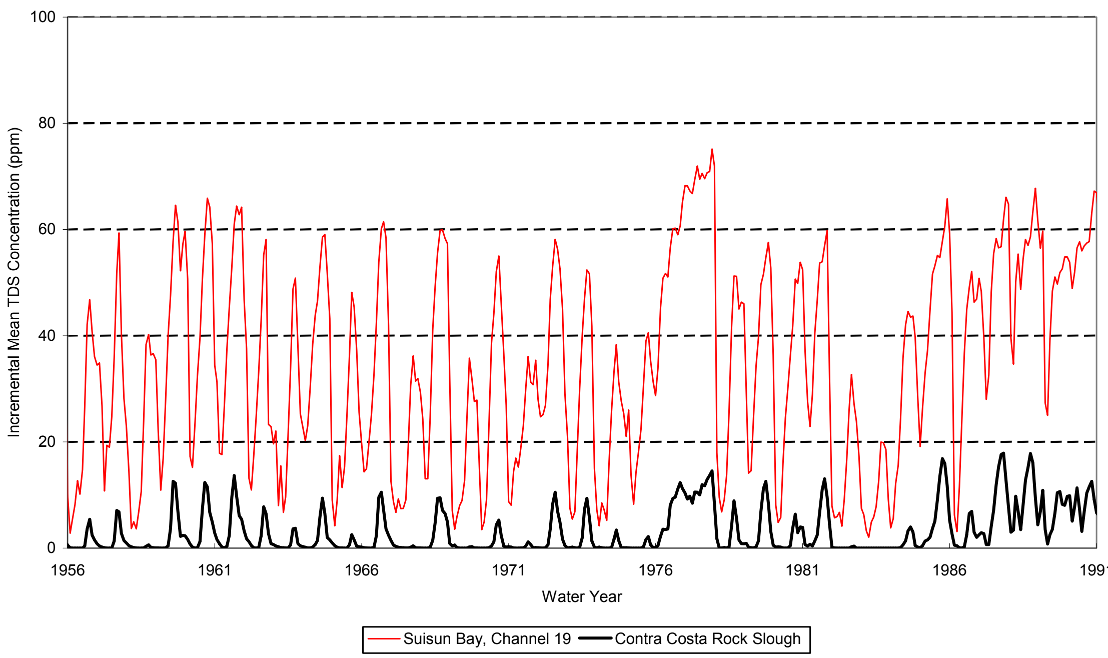


Figure 5.2-3 Chipps Island Discharge (Suisun Bay, Channel 19; Contra Costa Rock Slough), 1956-91 Mean TDS Increment

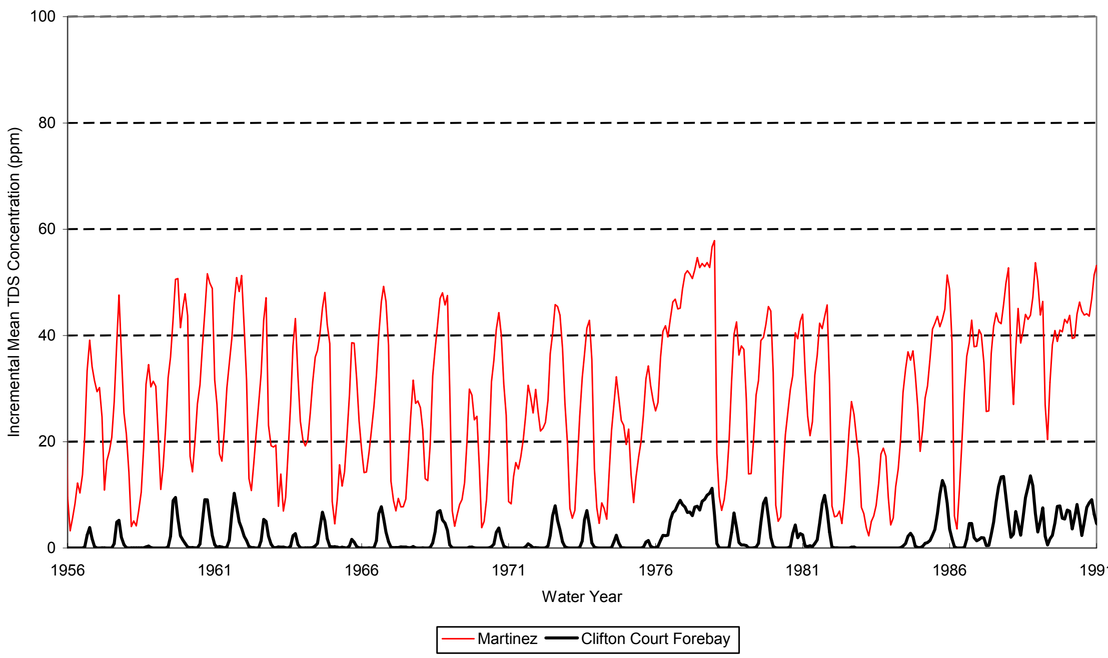


Figure 5.2-4 Chipps Island Discharge (Martinez; Clifton Court Forebay), 1956-91, Mean TDS Increment

In a similar way the predicted concentration increments for Se, TOC, and bromide were computed as time series for the period 1956 through 1991. The results of these computations are shown on Figures 5.2-5 through 5.2-10. Table 5.2-7 summarizes predicted maximum concentration increments at the four Delta locations. Maximum modeled monthly concentration increments occurred during the 1977 drought period. Concentrations would be proportionately reduced (or increased) if the discharge or inflow concentration is reduced (or increased).

Table 5.2-7
Maximum Monthly Concentration Increments

Delta Location	TDS (ppm)	Selenium (µg/L)	TOC (ppm)	Bromide (ppm)
Suisun Bay, Channel 19	75.2	0.04	0.034	0.021
Rock Slough, CC Intake	17.9	0.01	0.008	0.005
Martinez	57.9	0.03	0.026	0.016
Clifton Court Forebay	13.6	0.01	0.006	0.004

Source: Flow Science FDM modeling, 2004.

With the results of the simulations available as a time series, it is possible to determine the frequency with which specified TDS (or other constituent) levels would be attained at each of the sampling locations. These results provide the probability of a given salinity (or other constituent) level being exceeded in any month of the year, or during any randomly selected year.

The TDS exceedance probabilities computed from the analysis are presented on Figures 5.2-11 through 5.2-13 for Suisun Bay, Rock Slough, and Clifton Court Forebay, respectively. These data show that based on the 30-year sequence of flows, the increase in TDS (salinity) at Suisun Bay could be expected to exceed 30 ppm with an approximate probability of 58 percent, and exceed 60 ppm with an approximate probability of 11 percent. For the CCWD intake at Rock