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B Appendix – Fact Sheets for Recommended Changes to the 303(d) List

Regional Board staff developed "Fact Sheets" to describe the basis for recommended changes to California's Clean Water Act 303(d) list (303(d) list). Separate Fact Sheets were developed for each recommended change to the 303(d) list, except for recommended changes in priority and schedule, which are discussed in the main staff report. The Fact Sheets for recommended additions or deletions include descriptions of watershed characteristics, water quality objectives not attained, evidence of impairment, extent of impairment, and potential sources. Fact Sheets supporting recommended changes in total water body size or size affected contain include descriptions of watershed characteristics and the relevant information supporting the recommended change.

B.1 Fact Sheets Supporting Addition to the 303(d) List

B.1.1 Arcade Creek, Copper

Summary of Proposed Action

The California Regional Water Quality Control Board, Central Valley Region, (Regional Board) recommends the addition of Arcade Creek to California's Clean Water Act Section 303(d) list due to impairment by copper. Information available to the Regional Board on copper levels in water samples indicates that water quality objectives are not being attained in Arcade Creek. The description of the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Arcade Creek	**Pollutants/Stressors**	Copper
Hydrologic Unit	519.21	**Sources**	Urban runoff/Storm sewers
Total Waterbody Size	10 miles	**TMDL Priority**	
Size Affected	10 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	All of Arcade Creek	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	38° 40' 28"	**Upstream Extent Longitude**	121° 13' 58"
Downstream Extent Latitude	38° 36' 11"	**Downstream Extent Longitude**	121° 30' 52"

Watershed Characteristics

The Arcade Creek watershed covers approximately 50 square miles. Arcade Creek proper generally flows from east to west starting near the intersection of Sunrise Boulevard and Greenback Lane and flowing into the Natomas East Main Drainage Canal in Sacramento (Russick, 2001). Watershed elevations range from 20 to about 270 feet above sea level.

Land use is predominately residential and commercial. The entire watershed lies within the urbanized parts of the Sacramento metropolitan area extending from the northeastern corner of the City of Citrus Heights on the east to the Natomas East Main Drain on the west. Flows and water quality in Arcade Creek are characteristic of a stream dominated by urban runoff. Typical dry weather flows at the USGS gauging station at Watt Avenue are less than 3 cubic feet per second (cfs) but may increase rapidly during rainfall events and have exceeded 1,900 cfs.

Water Quality Objectives Not Attained
The United States Environmental Protection Agency (USEPA) California Toxic Rule (CTR) freshwater aquatic life criteria for dissolved copper are not being attained. The CTR Criteria Continuous Concentration (CCC) ranges from 2.7 to 29.3 µg/L and the Criteria Maximum Concentration (CMC) ranges from 3.6 to 49.6 µg/L, depending on hardness. The USEPA numeric primary maximum contaminant levels (MCL) to protect drinking water is 1,300 µg/L (Marshack, 2000). Copper data were compared to the hardness adjusted CTR criteria, as well as the drinking water MCL.

Evidence of Impairment
Water samples collected from Arcade Creek by the US Geological Survey (USGS) and the City of Sacramento indicate that Arcade Creek is impaired by copper. These data are summarized in Table 2, below. The USGS collected water samples from Arcade Creek from February 1996 through April 1998. Of the 28 samples collected by the USGS in that time period, 4 samples (approximately 14 %) exceeded the CTR Criteria Continuous Concentration for dissolved copper and 2 samples (approximately 7%) exceeded CTR Criteria Maximum Concentration (USGS, 2001). The City of Sacramento, as a participant in the Sacramento River Watershed Program (SRWP), collected copper samples from Arcade creek from June 1999 through May 2000. Of the 12 samples collected during that time period[1], 4 samples (approximately 33%) exceeded the CTR Criteria Continuous Concentration for dissolved copper and one sample (approximately 8%) exceeded the CTR Criteria Maximum Concentration (Larry Walker Associates, 2001A). Of the 40 total samples from both of these data sources, 8 (20 %) exceeded the CTR Criteria Continuous Concentration for dissolved copper (Larry Walker Associates, 2001B) and 3 samples (approximately 8%) exceeded the CTR Criteria Maximum Concentration. None of the samples exceeded the USEPA drinking water MCL.

Table B-2. Summary of Copper Data for Arcade Creek

Data Source	*USGS*	*SRWP*	*Total*
Dates of Sampling	2/96 – 4/98	8/99 – 5/00	2/96 – 5/00
Number of Samples	28	12[1]	40[1]
Median Cu Concentration (µg/L)	4.0	2.3	4.0
Range of Cu Concentrations (µg/L)	1.8-9.0	0.2-9.0	0.2-9.0
Number Above USEPA CCC	4 (14%)	4 (33%)	8 (20%)
Number Above USEPA CMC	2 (7%)	1 (8%)	3 (8%)

[1] There were 13 samples collected by the City of Sacramento for the SRWP. One of the 13 samples from the SRWP data was excluded from this analysis due to a lack of the hardness data needed to assess compliance with Water Quality Standards.

Potential Sources
The most likely source of copper to Arcade Creek is urban runoff. Urban runoff has been shown to contain copper from automotive sources (brakes and tires), urban source water and water delivery systems, and atmospheric emissions (Woodward-Clyde, 1992).

B.1.2 Avena Drain, Ammonia

Summary of Proposed Action
The California Regional Water Quality Control Board, Central Valley Region, (Regional Board) recommends the addition of the Avena Drain to California's Clean Water Act Section 303(d) list due to impairment by ammonia. Information available to the Regional Board on ammonia levels indicates that water quality objectives are not being attained. The basis for this recommendation is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Avena Drain	**Pollutants/Stressors**	Ammonia
Hydrologic Unit		**Sources**	Agriculture/Dairies
Total Length	10 Miles	**TMDL Priority**	Low
Size Affected	2.5 Miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment		**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude		**Upstream Extent Longitude**	
Downstream Extent Latitude		**Downstream Extent Longitude**	

Watershed Characteristics
Avena Drain is a modified natural channel approximately 10 miles in length. The Avena Drain is tributary to Lone Tree Creek, which is tributary to the Delta. Storm water runoff (mainly from cropland) and irrigation tail water are the main sources of water. Due to the flow of tail water, the drain is no longer ephemeral during the dry season. Although there are few trees growing along the drain, there is some riparian vegetation.

Water Quality Objectives Not Attained
The narrative objectives toxicity are not being attained for ammonia in the Avena Drain. The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf)."

Ammonia levels in Avena Drain frequently exceed the Basin Plan objective for toxicity. To maintain healthy aquatic life in fresh water, the California Department of Fish and Game (CDFG) has determined that ammonia levels (measured as NH_3) should not exceed 0.02 mg/L undissociated ammonia (CRWQCB-CVR, 2001). Acute toxicity (96 hour LC_{50}) of ammonia to various freshwater fish ranges from 0.1 to 4.0 mg/L (McKee and Wolf, 1971).

Evidence of Impairment
There are 12 dairies that have the potential and propensity to discharge wastewater containing manure into Avena Drain. These discharged arise from the inability to retain wastewater during the winter months, and from irrigation with wastewater during the spring, summer and fall. Over a period of 10 years, samples collected from water entering the drain have shown undissociated ammonia levels ranging from 0.97 to 3.03 mg/L, with an average undissociated ammonia level of 1.73 mg/L (CRWQCB-CVR, 2001). Samples collected from the drain at Van Allen Road in 1998 contained undissociated ammonia levels of 0.24 and 0.31 mg/L (CRWQCB-CVR, 2001). A sample taken from the drain near Brennan Avenue in 1999 showed an undissociated ammonia level of 0.54 mg/L (CRWQCB-CVR, 2001). All of the samples contained undissociated ammonia levels above the CDFG criterion, and all of the samples exceed some to most of the LC_{50}'s for various freshwater fish species.

Extent of Impairment
Avena Drain begins on a dairy farm east of Brennan Avenue in San Joaquin County. Ten of the 12 dairies along the drain are located on the first 2 ½ miles. Most of the sampling has been done in that upper 2 ½ miles.

Potential Sources
The source of the ammonia in Avena Drain is from manure carried in dairy wastewater. The samples were taken during known discharges of wastewater.

B.1.3 Bear Creek, Mercury

Summary of Proposed Action
The California Regional Water Quality Control Board, Central Valley Region (Regional Board) recommends the addition of Bear Creek to California's Clean Water Act Section 303(d) list due to impairment by mercury. Information available to the Regional Board on mercury levels in water indicates that water quality objectives are not being attained in Bear Creek. The description for the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Bear Creek	**Pollutants/Stressors**	Mercury
Hydrologic Unit	513.20	**Sources**	Resource extraction (abandoned mines)
Total Waterbody Size	39 miles	**TMDL Priority**	
Size Affected	28 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	From the unnamed creeks to Cache Creek	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude		**Upstream Extent Longitude**	
Downstream Extent Latitude		**Downstream Extent Longitude**	

Watershed Characteristics
Bear Creek is in Colusa County, east of Clear Lake. The creek is approximately 39 miles long from its headwaters (just north of Indian Valley Reservoir) to its confluence with Cache Creek (Foe and Croyle, 1998; Montoya and Pan, 1992). It receives water from numerous tributaries, including Sulfur Creek (the largest tributary) and Hamilton Creek.

The Bear Creek watershed receives inflow from several mines, including the Sulfur Creek Mining District. Six inactive mercury mines are located in the Bear Creek watershed: Elgin Mine along the upper West Fork tributary of Sulfur Creek, Rathburn Mercury Mine along an unnamed tributary to Bear Creek, and Central, Wide Awake, Empire, and Manzanita mines along the main stem of Sulfur Creek (Montoya and Pan, 1992; Foe and Croyle, 1998). In addition, the area has several active geothermal springs that also may be sources of mercury (Foe and Croyle, 1998). These waters flow directly into Bear Creek, impacting the water quality.

Water Quality Objectives Not Attained
The United States Environmental Protection Agency (USEPA) California Toxic Rule (CTR) criterion for mercury is not being attained. The California Toxics Rule (CTR) lists a criterion of 50 nanograms per liter (ng/L, or parts per trillion [ppt]) of mercury for freshwater sources of drinking water (for human consumption of water and/or aquatic organisms) (USEPA, 2000a).

Evidence of Impairment
Water quality data indicates that Bear Creek is impacted by mercury. Water samples were collected on thirteen days between April 1996 and February 1998. Four locations were sampled along Bear Creek: (1) at Culvert Road (above the confluence with any of the unnamed creeks or Sulfur or Hamilton Creeks), (2) between the confluence of Hamilton and Sulfur Creeks (below the confluence with the unnamed and Hamilton Creeks and above the confluence with Sulfur Creek), (3) at Highway 20 (downstream from the confluence with Sulfur Creek and above the confluence with Thompson Creek), and (4) just upstream from the confluence with Cache Creek (the furthest downstream point). Table 2 summarizes the data.

Table B-2. Mercury Concentrations in Bear Creek Water[1]

Sampling Location (Listed from upstream to downstream.)	Number of Samples	Range in Concentrations (Total Hg, ng/L)	Percent of Samples with Mercury Concentrations above USEPA Criterion (50 ng/L)
1. At Culver Road	2	13.29 – 30.09	0%
2. Between Hamilton and Sulfur Creeks	3	62.65 – 254.0	100%
3. Highway 20	2	328.2 – 1,595.9	100%
4. Just upstream of Cache Creek	12	18.53 – 1,290.2	67%

[1] Data from Foe C. and W. Croyle, 1998.

Table 2 indicates that above the unnamed creeks (sampling location #1), mercury concentrations are relatively low. By sampling location #2, mercury concentrations increase to levels above the CTR criterion. This indicates that mercury enters Bear Creek at or above Hamilton Creek, most likely at the unnamed creek that passes along Rathburn Mercury Mine. The levels of mercury increase between locations #2 and #3, by approximately 50 times, indicating that high levels of mercury enter Bear Creek at Sulfur Creek. Below Sulfur Creek, mercury concentrations decrease due to the inflow of additional water. Water quality data indicate that mercury enters Bear Creek primarily from Sulfur Creek and, to a lesser degree, from the unnamed upstream creeks and possibly other creeks.

Extent of Impairment
Water quality data indicate that mercury concentrations exceed the criteria at or above Hamilton Creek, most likely beginning at the unnamed creek that passes along Rathburn Mercury Mine. This indicates that, although Sulfur Creek probably contributes the most mercury, Bear Creek is listed as impaired from its confluence with the unnamed creek that flows along Rathburn Mercury Mine to its confluence with Cache Creek.

Potential Sources
The primary source of mercury is resource extraction (abandoned mines) from the mines located in the Sulfur Creek watershed and along the unnamed creek upstream from Bear Creek.

B.1.4 Lower Bear River, Diazinon

Summary of Proposed Action
The California Regional Water Quality Control Board, Central Valley Region, (Regional Board) recommends the addition of the lower Bear River to California's Clean Water Act Section 303(d) list due to impairment by diazinon. Information available to the Regional Board on diazinon levels indicates that water quality objectives are not being attained. The basis for this recommendation is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Lower Bear River	**Pollutants/Stressors**	Diazinon
Hydrologic Unit	516.33	**Sources**	Agriculture
Total Length	18 miles	**TMDL Priority**	
Size Affected	18 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	From Camp Far West Reservoir to the mouth of the Bear River.	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	39° 08' 02"	**Upstream Extent Longitude**	120° 57' 14"
Downstream Extent Latitude	39° 01' 52"	**Downstream Extent Longitude**	121° 01' 48"

Watershed Characteristics
The Bear River basin comprises more than 232,800 acres. Water uses include recreation, agriculture, municipal, and others. The Bear River basin is bounded by the Yuba River basin on the north, the Little Truckee River basin on the east, and the American River basin on the south. The headwaters are located in the Sierra Nevada snowfields at elevations ranging up to 9,100 feet above sea level. The lower section of the Bear River flows from Camp Far West Reservoir to its confluence with the Feather River south of Marysville. Extensive acreage in this lower part of the watershed is used to grow almonds and stone fruits, especially south of the Bear River downstream from State Highway 65.

Water Quality Objectives Not Attained
The narrative objectives for pesticides and toxicity are not being attained for diazinon in the Bear River. The narrative objective for pesticides states, "No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses." The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf)." The California Department of Fish and Game has established freshwater numeric acute (1-hour average) and chronic (4-day average) criteria for diazinon of 0.08µg/L and 0.05 µg/L, respectively, for the protection of aquatic life (Siepmann and Finlayson, 2000).

Evidence of Impairment
Between 1994 and 2000, two studies analyzed a total of 14 ambient water samples collected in the Bear River for diazinon. The results indicate that the CDFG chronic criteria was exceeded 29% of the time overall and the acute criteria was exceeded 21% of the time. Samples were collected during the dormant spray season. Table 2 summarizes the available data.

Table B-2. Diazinon in Water Samples Collected from the Lower Bear River at Berry Road

Data Source	Sample Years	Number of Samples	Range of Diazinon Concentration	Criteria[a]		Number of Samples Equal to or	Percent Samples Equal to or Above
Holmes et al., 2000	1994	8	nd - 0.14 µg/L	chronic	0.05 µg/L	3	37.5%
				acute	0.08 µg/L	2	25%
Dileanis et al, 2000	2000	6	nd - 0.195 µg/L	chronic	0.05 µg/L	1	17%
				acute	0.08 µg/L	1	17%
Summary	1994 & 2000	14	nd – 0.195 µg/L	chronic	0.05 µg/L	4	29%
				acute	0.08 µg/L	3	21%

a) California Department of Fish and Game Water Quality Criteria for Diazinon (Siepmann and Finlayson, 2000)
nd = not detected

Extent of Impairment
The lower Bear River runs for approximately eighteen miles between Camp Far West Reservoir and its confluence with the Feather River. Samples were collected at Berry Road near the confluence of the Bear and Feather Rivers. The lower section of the Bear River watershed contains extensive acreage of almond and stone fruit orchards. Diazinon is commonly used as a dormant spray on almonds and stonefruits during the winter months, and these applications are the most likely source of diazinon in the lower Bear River. Grasshopper and Yankee Sloughs, and Dry Creek flow into the lower Bear River, and these tributaries also drain orchard lands and are likely to contribute diazinon to the lower Bear River.

Potential Sources
The almond and stone fruit orchards are the most likely sources of diazinon runoff to the Bear River, therefore, agriculture has been identified as the source of diazinon.

B.1.5 Upper Bear River, Mercury

Summary of Proposed Action
The California Regional Water Quality Control Board, Central Valley Region (Regional Board) recommends the addition of the upper Bear River to California's Clean Water Act Section 303(d) list due to impairment by mercury. Information available to the Regional Board on mercury levels in fish tissue samples indicates that water quality objectives are not being attained in the upper Bear River between Rollins Reservoir and Lake Combie. The description for the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Upper Bear River	**Pollutants/Stressors**	Mercury
Hydrologic Unit	516.33	**Sources**	Resource Extraction (abandoned mines)
Total Length	70 miles	**TMDL Priority**	
Size Affected	8 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	Rollins Reservoir to Lake Combie	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	N 39° 08' 02"	**Upstream Extent Longitude**	W 120° 57' 14"
Downstream Extent Latitude	N 39° 01' 52"	**Downstream Extent Longitude**	W 121° 01' 48"

Watershed Characteristics
The Bear River basin has over 232,800 watershed acres. The river extends approximately 70 miles from its headwaters near Emigrant Gap in the Sierra Nevada Mountains to its confluence with the Feather River north of the town of Nicholaus. From upstream to downstream, the Bear River is intersected by three reservoirs: Rollins Reservoir, Lake Combie, and Camp Far West Reservoir. Water uses include hydroelectric generation, recreational, agricultural, and municipal uses, among others. The Bear River basin is bound by the Yuba River basin on the north, the Little Truckee River basin on the east, and the American River basin on the south. The headwaters are located in the Sierra Nevada snowfields at elevations ranging up to 9,100 feet above sea level. The impaired section of the upper Bear River extends approximately eight miles, from Rollins Reservoir to Lake Combie.

Water Quality Objectives Not Attained
The narrative objective for toxicity is not being attained for mercury in the upper Bear River between Rollins Reservoir and Lake Combie. The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services (OEHHA), the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective" (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf).

Numeric criteria for mercury in fish tissue have been developed for both human health and wildlife protection. The U.S. Environmental Protection Agency (USEPA) recently established a human health protection criterion of 0.3 milligrams per kilogram (mg/kg; equivalent to parts per million [ppm]) methylmercury in the edible portions of fish (USEPA, 2001b). This criterion is used to determine attainment with the narrative toxicity objective.

Evidence of Impairment
The U.S. Geological Survey (USGS) collected fish tissue samples on September 23, 1999 from the upper Bear River at Dog Bar Road (May et al., 2000). Only trophic level 3 fish were collected by the study. Trophic level 3 fish feed on zooplankton, phytoplankton, and benthic invertebrates. Trophic level 4 fish consume trophic level 3 fish as part of their diet. Methylmercury and total mercury bioaccumulates in aquatic organisms and tends to increase with increasing trophic levels (USEPA, 1997a). The USGS sampled three trophic level 3 fish (two brown trout and one rainbow trout). The TL3 fish had a range of mercury concentrations from 0.38 to 0.43 ppm, and an average mercury concentration of 0.40 ppm, which exceeds the USEPA criterion of 0.3 ppm. Placer, Yuba, and Nevada counties have issued an interim public health notification for all lakes and watercourses within these counties based on the USGS data. OEHHA is in the process of developing a state advisory (Nevada County, 2000).

Extent of Impairment
The upper Bear River flows for eight miles between Rollins Reservoir and Lake Combie. The entire eight-mile section is impaired by mercury.

Potential Sources
The upper Bear River watershed was historically mined extensively for its hardrock and placer gold deposits and has been affected by hydraulic mining (Alpers, 2000). Several inactive gold mines exist upstream of Rollins Reservoir in the upper Bear River watershed (Montoya and Pan, 1992).

B.1.6 Black Butte Reservoir, Mercury

Summary of Proposed Action
The California Regional Water Quality Control Board, Central Valley Region (Regional Board) recommends the addition of Black Butte Reservoir to California's Clean Water Act Section 303(d) list due

to impairment by mercury. Information available to the Regional Board on mercury levels in fish tissue samples indicates that water quality objectives are not being attained in Black Butte Reservoir. The description for the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Black Butte Reservoir	**Pollutants/Stressors**	Mercury
Hydrologic Unit	522.12	**Sources**	Resource Extraction (abandoned mines)
Total Waterbody Size	4,500 acres	**TMDL Priority**	
Size Affected	4,500 acres	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	All of Black Butte Reservoir	**TMDL End Date (Mo/Yr)**	

Watershed Characteristics
Black Butte Reservoir is located on Stony Creek along the eastern side of the California Coast Ranges. The reservoir straddles Glenn and Tehama Counties, which are primarily agricultural counties in the Central Valley. Black Butte Reservoir is operated by the U.S. Army Corps of Engineers. Water storage in this reservoir began in 1963. The reservoir covers a maximum of about 4,500 acres of water (Brodberg and Pollock, 1999). This is a warm water reservoir that supports primarily largemouth bass, crappie, catfish, and bluegill. Sport fishing is popular on the reservoir.

Water Quality Objectives Not Attained
The narrative objective for toxicity is not being attained for mercury in Black Butte Reservoir. The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective" (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf).

Numeric criteria for mercury in fish tissue have been developed for both human health and wildlife protection. The U.S. Environmental Protection Agency (USEPA) recently established a human health protection criterion of 0.3 milligrams per kilogram (mg/kg; equivalent to parts per million [ppm]) methylmercury in the edible portions of fish (USEPA, 2001a). This criterion is used to determine attainment of the narrative toxicity objective.

Evidence of Impairment
The Office of Environmental Health Hazard Assessment (Brodberg and Pollock, 1999) collected trophic level 3 (carp, crappie and channel catfish) and level 4 (largemouth bass) fish tissue samples for Black Butte Reservoir. Trophic level 3 fish feed on zooplankton, phytoplankton, and benthic invertebrates. Trophic level 4 fish consume trophic level 3 fish as part of their diet. Methylmercury and total mercury bioaccumulate in aquatic organisms and tend to be present in higher concentrations with increasing trophic levels (USEPA, 1997a).

Fish were collected from three regions of the reservoir: Burris Creek Arm, Stony Creek Arm, and Angler's Cove (the area including Fisherman's Cove and extending to the dam). Samples were collected on November 25, and December 4 and 5, 1997. Muscle tissues from individual fish were combined into composite samples for chemical analysis. One composite sample of carp (three fish) and one composite sample of crappie (three fish) were prepared. Nine composite samples of largemouth bass (three fish each) were prepared- two from Angler's Cove, four from Stony Creek Arm and three from Burris Creek Arm. Eight composite samples of channel catfish (four fish each) were prepared-- one was from Angler's Cove, four were from Stony Creek Arm, and three were from Burris Creek Arm.

Mercury concentrations in the carp and crappie composite samples were 0.3 and 0.34 ppm, respectively. The average mercury concentration in the channel catfish composite samples was 0.4 ppm. The eight catfish composite samples had mercury values ranging from 0.34 to 0.5 ppm. The average mercury concentration in the largemouth bass composite samples was 0.7 ppm. The nine bass composite samples had mercury values ranging from 0.37 to 1.3 ppm (Brodberg and Pollock, 1999). See Table 2 for a summary of mercury concentrations in the composite samples based on trophic level.

In 2000, OEHHA issued a draft health advisory for Black Butte Reservoir and guidelines for fish consumption due to elevated mercury levels in fish (OEHHA, 2000).

Table B-2. Summary of Mercury Concentrations in Fish Tissue Composite Samples from Black Butte Reservoir

Data Source	Brodberg and Pollock, 1999
Sample Date	11/25/97, 12/4-5/97
Trophic Level 3 Fish	
Number of Composite Samples	38
Mean Mercury Concentration (ppm)	0.39
Range of Mercury Concentrations (ppm)	0.30 – 0.50
Percent of Samples at or above USEPA Criterion (0.3 ppm)	100%
Trophic Level 4 Fish	
Number of Composite Samples	27
Mean Mercury Concentration (ppm)	0.70
Range of Mercury Concentrations (ppm)	0.37 – 1.3
Percent of Samples at or above USEPA Criterion (0.3 ppm)	100%

Extent of Impairment
Since fish were sampled in various parts of the reservoir and all samples were above the USEPA mercury criterion (0.3 ppm), the evidence suggests the entire waterbody (4,500 acres) is impaired by mercury.

Potential Sources
The predominant sources of mercury in Black Butte Reservoir were from cinnabar deposits, which were mined for mercury in the Black Butte Reservoir watershed.

B.1.7 Butte Slough, Diazinon

Summary of Proposed Action
The California Regional Water Quality Control Board, Central Valley Region, (Regional Board) recommends the addition of Butte Slough to California's Clean Water Act Section 303(d) list due to impairment by diazinon. Information available to the Regional Board on concentrations of these pesticides indicates that water quality objectives are not being attained. The basis for this recommendation is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Butte Slough	**Pollutants/Stressors**	Diazinon
Hydrologic Unit	520.30	**Major Sources**	Agriculture
Total Length	7.5 miles	**TMDL Priority**	
Size Affected	7.5 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	The entire slough	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	39º 11' 55"	**Upstream Extent Longitude**	121º 55' 42"
Downstream Extent Latitude	39º 08' 53"	**Downstream Extent Longitude**	121º 50' 18"

Watershed Characteristics

The drainage basin of Butte Slough lies east of the Sacramento River, south of Big Chico Creek, and north of the Sutter Buttes. Natural streams in the area either originate in the Sierra foothills or are former flood channels for the Sacramento River. Historically, all the streams were ephemeral and only carried runoff or flood flows for two to four months of the year. As these channels reached the low-lying areas along the east side of the Sacramento River, they branched into numerous sloughs and meandering waterways, creating extensive wetland habitat. All flows converged in the southwest corner of the basin and drained into Butte Slough (Chilcott, 1992).

Currently, the majority of the low-lying land within this basin is in rice production, and the sloughs and channels have been extensively reconstructed to carry irrigation water. Almond and stonefruit orchards, pasture, and rangeland dominate the uplands along the northern and eastern edges of the basin. However, important wetland habitat still exists in the basin, including the Butte Sink and the Gray Lodge Waterfowl Management Area, just north of the Sutter Buttes.

Butte Slough begins near the confluence of Butte Creek and the Sacramento River, and flows approximately six miles before it empties into the Sutter Bypass, just south of State Highway 20. Butte Slough receives large volumes of agricultural runoff during winter storm events and during rice field releases in April and May. During the summer irrigation season for orchard crops, Butte Slough is dominated by agricultural return flows (Chilcott, 1992).

The interconnected waterway and wetland system that includes Butte Creek, Butte Sink, Butte Slough , and the Sutter Bypass are part of the main migration corridor for spring-run salmon, and also provide habitat for numerous other aquatic and wetland species, particularly waterfowl. The Nature Conservancy and several reclamation districts and irrigation companies have formed the Lower Butte Creek Project to reduce fish passage and entrainment problems because of this waterway's key habitat values (NCWA, 2001; http://norcalwater.org/lower_butte_creek_project.htm).

Water Quality Objectives Not Attained

The narrative objectives for pesticides and toxicity are not being attained for diazinon in Butte Slough. The narrative objective for pesticides states, "No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses." The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf)." The California Department of Fish and Game has established freshwater numeric acute (1-hour average) and chronic (4-day average) water quality criteria for diazinon of 0.08 µg/L and 0.05 µg/L, respectively, for the protection of aquatic life (Siepmann and Finlayson, 2000).

Evidence of Impairment

Table 2 summarizes the results from two key studies conducted by the Regional Board (Holmes et al, 2000) and the US Geological Survey (Dileanis et al., 2000). Samples were collected during January and February in each year.

Table B-2. Diazinon Concentrations in Water Samples Collected from Butte Slough at Lower Pass Road

Data Source	Sample Years	Number of Samples	Range of Diazinon Concentration	Criteria[a]		Number of Samples Equal to or Above Criteria	Percent Samples Equal to or Above Criteria
Holmes et al, 2000	1994	27	nd to 1.0 µg/L	chronic	0.05 µg/L	24	89%
				acute	0.08 µg/L	17	63%
Dileanis, 2001	2000	9	nd to 0.082 µg/L	chronic	0.05 µg/L	3	33%
				acute	0.08 µg/L	0	0%
Sum	1994 – 2000	36	nd to 1.0 µg/L	chronic	0.05 µg/L	27	75%
				acute	0.08 µg/L	17	47%

a) California Department of Fish and Game Water Quality Criteria for the Protection of Aquatic Life (Siepmann and Finlayson, 2000)
nd = not detected

Extent of Impairment
Butte Slough extends for approximately six miles, from the confluence of Butte Creek and the Sacramento River to the Sutter Bypass. Samples were collected at one site only, at Lower Pass Road near Meridian. However, the Butte Slough watershed contains extensive acreage of almonds and stonefruits, and Butte Slough receives substantial amounts of runoff from these orchards during winter storm events. Therefore, the entire six miles are proposed for listing on the 303(d) list.

Potential Sources
Diazinon is commonly used as a dormant spray on almonds and stonefruits during the winter months, and these applications are the most likely source of diazinon in Butte Slough.

B.1.8 Butte Slough, Molinate

Summary of Proposed Action
The California Regional Water Quality Control Board, Central Valley Region (Regional Board) recommends the addition of Butte Slough to California's Clean Water Act Section 303(d) list due to impairment by molinate. Information available to the Regional Board on concentrations of this pesticide indicates that water quality objectives are not being attained. The basis for this recommendation is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Butte Slough	**Pollutants/Stressors**	Molinate
Hydrologic Unit	520.30	**Major Sources**	Agriculture
Total Length	7.5 miles	**TMDL Priority**	
Size Affected	7.5 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	The entire slough	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	N 39° 11' 55"	**Upstream Extent Longitude**	W 121° 55' 42"
Downstream Extent Latitude	N 39° 08' 53"	**Downstream Extent Longitude**	W 121° 50' 18"

Watershed Characteristics
The drainage basin of Butte Slough lies east of the Sacramento River, south of Big Chico Creek, and north of the Sutter Buttes. Natural streams in the area either originate in the Sierra foothills or are former flood channels for the Sacramento River. Historically, all the streams were ephemeral and only carried runoff or flood flows for two to four months of the year. As these channels reached the low-lying areas along the east side of the Sacramento River, they branched into numerous sloughs and meandering waterways, creating extensive wetland habitat. All flows converged in the southwest corner of the basin and drained into Butte Slough (Chilcott, 1992).

Currently, the majority of the low-lying land within this basin is in rice production, and the sloughs and channels have been extensively reconstructed to carry irrigation water. The uplands along the northern and eastern edges of the basin are dominated by almond and stonefruit orchards, pasture, and rangeland. However, important wetland habitat still exists in the basin, including the Butte Sink and the Gray Lodge Waterfowl Management Area, just north of the Sutter Buttes.

Butte Slough begins near the confluence of Butte Creek and the Sacramento River, and flows approximately six miles before it empties into the Sutter Bypass, just south of State Highway 20. Butte Slough receives large volumes of agricultural runoff during winter storm events and during rice field releases in April and May. During the summer irrigation season for orchard crops, Butte Slough is dominated by agricultural return flows (Chilcott, 1992).

The interconnected waterway and wetland system that includes Butte Creek, Butte Sink, Butte Slough , and the Sutter Bypass are part of the main migration corridor for spring-run salmon, and also provide habitat for numerous other aquatic and wetland species, particularly waterfowl. The Nature Conservancy and several reclamation districts and irrigation companies have formed the Lower Butte Creek Project to reduce fish passage and entrainment problems because of this waterway's key habitat values (NCWA, 2001. http://norcalwater.org/lower_butte_creek_project.htm).

Water Quality Objectives Not Attained

The narrative objective for pesticides and toxicity are not being attained for molinate in Butte Slough. The narrative objective for pesticides states, "No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses." The narrative objective for toxicity states, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states "The Regional Water Board will also consider…numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective." (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/rwqcb5/bsnplnab.pdf). The Regional Board performance goal to protect freshwater habitat is 10 µg/L or 10 ppb (micrograms per liter or parts per billion) (CRWQCB-CVR, 1998).

Evidence of Impairment

Between 1994 and 2000, multiple studies analyzed a total of 93 ambient water samples collected in Butte Slough for molinate. Samples were generally collected during the time period of application of molinate to rice (generally May and June). Sixteen of 93 samples (about 17%) exceeded the Regional Board performance goal of 10 ppb.

Table B-2. Molinate in Water Samples Collected from Butte Slough at Lower Pass Road

Study	Sample Years	Number of Samples	Range of Molinate Concentrations	Criteria	Number of Samples Equal to or Above Criteria	Percent Samples Equal to or Above Criteria
Gorder et al, 1995	1994	16	nd - 0.15 ppb	10 ppb	0	0.00%
Gorder et al, 1995	1995	18	nd - 8.5 ppb	10 ppb	0	0.00%
Gorder et al, 1996	1996	19	nd - 15.7 ppb	10 ppb	7	37%
Gorder et al, 1997	1997	17	nd - 16.42 ppb	10 ppb	6	35%
Gorder et al, 1999	1998	17	nd - 12.17 ppb	10 ppb	1	7%
Newhart et al, 2000	2000	6	nd - 11.5 ppb	10 ppb	2	33%
Sum	1994 - 2000	93	nd - 16.42 ppb	10 ppb	16	17%

Extent of Impairment
Butte Slough extends approximately 7.5 miles, from the confluence of Butte Creek and the Sacramento River to the Sutter Bypass. Samples were collected from one site only, at Lower Pass Road near Meridian. However, the Butte Slough watershed contains extensive rice acreage, and Butte Slough flows are frequently dominated by runoff from these fields, particularly during April and May. Therefore, the entire 7.5 miles is proposed for listing on the 303(d) list. The most likely source of molinate is from rice fields draining into the Butte Slough waterways.

Potential Sources
Molinate is applied on rice fields to control broad-leaved and grassy weeds (WHO, 1993). Agricultural runoff from rice fields and drift of molinate during aerial application onto rice fields contributes to surface water contamination adjacent rice fields (California Rice Commission, 2001). The occurrence of molinate in Butte Slough water column samples indicates that the most likely source of molinate is from agriculture, specifically rice fields.

B.1.9 Lower Calaveras River, Diazinon

Summary of Proposed Action
The California Regional Water Quality Control Board, Central Valley Region (Regional Board) recommends the addition of the lower Calaveras River to California's Clean Water Act Section 303(d) list due to impairment by diazinon. Information available to the Regional Board on diazinon concentrations in the lower Calaveras River indicates that water quality objectives are not being attained. The basis for this recommendation is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Lower Calaveras River	**Pollutants/Stressors**	Diazinon
Hydrologic Unit	531.30	**Sources**	Agriculture, Urban
Total Waterbody Size	50 miles	**TMDL Priority**	
Size Affected	30 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	Lower Calaveras River	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	37° 59' 38"	**Upstream Extent Longitude**	121° 16' 47"
Downstream Extent Latitude	37° 57' 59"	**Downstream Extent Longitude**	121° 22' 5"

Watershed Characteristics
The Calaveras River flows out of New Hogan Lake in western Calaveras County, and joins the San Joaquin River approximately 40 miles downstream in Stockton. A major portion of the river is located in San Joaquin County, and flows through extensive acreage dominated by orchards. The lower portion of the Calaveras River flows through the City of Stockton, and is dominated by urban runoff.

Water Quality Objectives Not Attained
The narrative objectives for pesticides and toxicity are not being attained for diazinon in the lower Calaveras River. The narrative objective for pesticides states, "No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses." The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective" (California Regional Water Quality Control Board, Central Valley Region, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf). The California Department of Fish and Game has established freshwater numeric acute (1-hour average) and chronic (4-day average) criteria for diazinon of 0.08µg/L and 0.05 µg/L, respectively, for the protection of aquatic life (Siepmann and Finlayson, 2000).

Evidence of Impairment
Between 1994 and 1998, 22 samples from the lower Calaveras River were analyzed for diazinon; most of these samples were collected during or immediately after wet weather events (Table 2). Eighteen of the 23 samples (78%) exceeded the acute and chronic criteria for diazinon developed by the California Department of Fish and Game for the protection of aquatic organisms (Lee, G.F., and A. Jones-Lee, 2000; CDM, 1999; Lee and Jones-Lee, 2001).

Table B-2. Diazinon in Water Samples Collected from the Lower Calaveras River

Data Source	Location	Sample Years	Number of Samples	Range of Diazinon Concentrations	Criteria[a]		Number of Samples Equal to or Above Criteria	Percent Samples Equal to or Above Criteria
Lee, G.F., and A. Jones-Lee. 2000	Pacific Ave	1996	1	0.036 µg	chronic	0.05 µg/L	0	0%
					acute	0.08 µg/L	0	0%
CDM, 1999; Lee and Jones-Lee, 2001	Sutter Street	1996 - 1998	8	nd - 1.7 µg	chronic	0.05 µg/L	6	75%
					acute	0.08 µg/L	6	75%
CDM, 1999; Lee and Jones-Lee, 2001	West Lane	1996 - 1998	9	nd - 1.3 µg	chronic	0.05 µg/L	4	44%
					acute	0.08 µg/L	4	44%
Lee and Jones-Lee, 2001	Not identified	1994 - 1998	5	nd - 0.45 µg	chronic	0.05 µg/L	4	80%
					acute	0.08 µg/L	4	80%
Sum	Sum	1994 - 1998	23	nd - 1.7 µg	chronic	0.05 µg/L	18	78%
					acute	0.08 µg/L	18	78%

a) California Department of Fish and Game Water Quality Criteria for Diazinon (Siepmann and Finlayson, 2000)
nd = not detected

Extent of Impairment
Approximately 30 miles of the Calaveras River lies in San Joaquin County and receives orchard and urban runoff. Most of the samples were collected from sites within the City of Stockton, but it is likely that the entire lower Calaveras River is impaired by diazinon.

Potential Sources
Diazinon is commonly used as a dormant spray on almonds and stonefruits during the winter months, and on urban landscapes year-round. It is likely that these applications are the source of diazinon in the lower Calaveras River.

B.1.10 Lower Calaveras River, Low Dissolved Oxygen

Summary of Proposed Action
The California Regional Water Quality Control Board-Central Valley Region, Regional Board, recommends the addition of the lower Calaveras River to California's Clean Water Act Section 303(d) list due to impairment by low dissolved oxygen. Information available to the Regional Board on dissolved oxygen levels in the lower Calaveras River indicates that water quality objectives are not being attained. A description for the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Lower Calaveras River	**Pollutants/Stressors**	Low Dissolved Oxygen
Hydrologic Unit	531.30	**Sources**	Urban Runoff/Storm Sewers
Total Waterbody Size	50 river miles	**TMDL Priority**	
Size Affected	5 miles	**TMDL Start Date (Mo Yr)**	
Extent of Impairment	Between the Stockton Diversion Canal and the San Joaquin River	**TMDL End Date (Mo Yr)**	
Upstream Extent Latitude	37° 59' 38.5"	**Upstream Extent Longitude**	121° 16' 47.9"
Downstream Extent Latitude	37° 57' 59.6"	**Downstream Extent Longitude**	121° 22' 5.4"

Watershed Characteristics
The lower Calaveras River is located within the San Joaquin Delta Hydrologic Unit, flows through central Stockton, California, and joins the San Joaquin River near Rough and Ready Island.

Water Quality Objectives Not Attained
The Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins contains a numeric objective applicable to the Calaveras River which requires dissolved oxygen (DO) not be reduced below 5 milligrams per liter (mg/l) (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf).

Evidence of Impairment
A report of DeltaKeeper data collected between 8 November 1999 and 7 February 2000 found DO concentrations in the lower Calaveras River below the Basin Plan objective in 10 of 32 samples. Data in the same report collected between 15 October 1996 and 8 November 1996 found DO concentrations below the Basin Plan objective in 8 of 12 samples (Lee and Jones-Lee, 2000).

Table B-2. Dissolved Oxygen Concentrations in Water Samples Collected from Lower Calaveras River

Data Source	Sample Years	Number of Samples	Range of DO Concentrations	Number of Samples Below Criterion
Lee and Jones-Lee, 2000 (DeltaKeeper)	October/November 1996; November 1999 to February 2000	44	0.9 – 11.7 mg/L	18

Extent of Impairment
Dissolved oxygen concentrations in the lower Calaveras River (measured in Stockton, California) have been documented to fall below the Basin Plan objective of 5 mg/l, as demonstrated by the DeltaKeeper data discussed above. Data for the lower Calaveras River is limited to one sampling point approximately in the middle of the Stockton urban area. The sampling point is likely representative of DO levels in the portion of the Calaveras River surrounded by Stockton. The Regional Board is therefore recommending listing the lower Calaveras River for DO between the Stockton Diversion Canal and the San Joaquin River.

Potential Sources
The impaired reach of the lower Calaveras River is wholly within the Stockton urban area. The most likely source of oxygen demanding substances is from runoff from the urban area.

B.1.11 Lower Calaveras River, Pathogens

Summary of Proposed Action

The California Regional Water Quality Control Board, Central Valley Region, (Regional Board) recommends the addition of the lower Calaveras River to California's Clean Water Act Section 303(d) list due to impairment by pathogens. Information available to the Regional Board on pathogens levels in the lower reach of the Calaveras River indicates that water quality objectives are not being attained. A description for the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Lower Calaveras River	**Pollutants/Stressors**	Pathogens
Hydrologic Unit	531.30	**Sources**	Urban runoff, Recreation
Total Waterbody Size	50 miles	**TMDL Priority**	
Size Affected	8 Miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	The lower 8 miles of the Calaveras River (urban Stockton)	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	38º 00' 45"	**Upstream Extent Longitude**	121º 14' 22"
Downstream Extent Latitude	37º 58' 00"	**Downstream Extent Longitude**	121º 22' 04"

Watershed Characteristics

The Delta is characterized by tidal waters with limited flushing flows during the dry seasons. The lower Calaveras River has much of its flow diverted upstream of Stockton and the downstream area is dominated by urban runoff. The lower Calaveras River supports recreational uses, including boating, fishing, water skiing and swimming. The predominant land use in this portion of the watershed is urban. Additionally, there are recreational uses of the waters, including boating facilities near the confluence with the San Joaquin River.

Water Quality Objectives Not Attained

The narrative objective for toxicity is not being attained for pathogens in the lower Calaveras River. The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states the " the Regional Water Board will also consider…numerical criteria and guidelines developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services…the U.S. Environmental Protection Agency, and other organizations to evaluate compliance with this objective." The Basin Plan also contains a specific objective for fecal coliform bacteria (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/rwqcb5/bsnplnab.pdf).

Guidelines and criteria have been developed for the protection of human health. The California Department of Health Services (CDHS) has adopted regulations for recreational waters and beaches for single samples of total coliform bacteria of 10,000 Most Probable Number (MPN) per 100 milliliters and of 1,000 MPN per 100 ml for 30-day log mean of sample levels (Title 17 California Code of Regulation section 7958). CDHS has also published draft guidelines that include limits for single samples of *E. coli* of 235 MPN per 100 milliliters (CDHS, July 2000 http://www.dhs.ca.gov/ps/ddwem/beaches/freshwater.htm). USEPA guidelines for bacteria contained in *Ambient Water Quality Criteria for Bacteria* (USEPA, 1986a) state "Based on a statistically sufficient number of samples (generally not less than 5 samples equally spaced over a 30-day period), the geometric mean of the indicated bacterial densities should not exceed one or the other of the following: *E. coli* 126 MPN per 100 ml; or Enterococci 33 MPN per 100 ml." A methodology for determining exceedances based on single samples is also included in the standards.

Evidence of Impairment
DeltaKeeper submitted bacteria data for water samples collected from two locations on the lower Calaveras River (Jennings, 2001). One sampling location is near the mouth of the river and the other is approximately four miles upstream. A total of 26 samples collected at the upstream location over during 10 months in 2000-2001, and a total of 11 samples collected at the downstream location during seven months in 2000, were analyzed. Geometric means of the bacteria counts have been calculated using the data submitted by DeltaKeeper. The geometric mean for *E. coli* is 322 MPN per 100 ml for samples collected at the upstream location (exceeding the USEPA criterion of 126 MPN per 100 ml). The geometric mean for *E. coli* for samples collected at the downstream location is 76 MPN per 100 ml. However, individual *E. coli* measurements at the downstream site have exceeded the USEPA single sample criterion of 235 MPN per 100 ml.

Extent of Impairment
The lower eight miles of the Calaveras River is recommended for listing as impaired due to pathogen contamination. The extent of impairment is extrapolated upstream from the sampling location based on land use patterns. Both sampling locations are within the urban Stockton area. The lower eight miles of the Calaveras River have similar land use patterns and it is expected that sampling will show high levels of bacteria in the urban portion of the river.

Potential Sources
In urban settings, the USEPA has identified sources of pathogen pollution to include urban litter, contaminated refuse, domestic pet and wildlife excrement and failing sewer lines (USEPA 2001a). In their pathogen TMDL Guide, the USEPA states "In a study of bacterial loading in urban streams, Young and Thackston (1999) found that fecal bacteria densities were directly related to the density of housing, population, development, percent impervious area, and domestic animal density. Additionally, recreational areas may have high bacteria counts. This can be due to improper disposal of waste from boats, lack of sanitary facilities in the area of recreation and children in diapers using the water."

B.1.12 Camp Far West Reservoir, Mercury

Summary of Proposed Action
The California Regional Water Quality Control Board, Central Valley Region (Regional Board) recommends the addition of Camp Far West Reservoir to California's Clean Water Act Section 303(d) list due to impairment by mercury. Information available to the Regional Board on mercury levels in fish tissue samples indicates that water quality objectives are not being attained in Camp Far West Reservoir. The description for the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Camp Far West Reservoir	**Pollutants/Stressors**	Mercury
Hydrologic Unit	516.31	**Sources**	Resource extraction (historic mines)
Total Length	2,002 surface acres	**TMDL Priority**	
Size Affected	2,002 surface acres	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	All of Camp Far West Reservoir	**TMDL End Date (Mo/Yr)**	

Watershed Characteristics
The Bear River flows into Rollins Reservoir and Lake Combie before reaching Camp Far West Reservoir. The South Sutter Water District constructed Camp Far West Reservoir as a partial surface water supply in response to declining ground water resources. The Bear River basin has covers over 232,800 acres. Water usage in the basin includes recreational, agricultural, municipal, and hydroelectric generation. The Bear River basin is bounded by the Yuba River basin on the north, the Little Truckee River basin on the east,

and the American River basin on the south. The headwaters are located in the Sierra Nevada snowfields at elevations ranging up to 9,100 feet above sea level.

Water Quality Objectives Not Attained
The narrative objective for toxicity is not being attained for mercury in Camp Far West Reservoir. The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective" (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf).

Numeric criteria for mercury in fish tissue have been developed for both human health and wildlife protection. The U.S. Environmental Protection Agency (USEPA) recently established a human health protection criterion of 0.3 milligrams per kilogram (mg/kg; equivalent to parts per million [ppm]) methylmercury in the edible portions of fish (USEPA, 2001b). This criterion is used to determine attainment with the narrative toxicity objective.

Evidence of Impairment
The U.S. Geological Survey (USGS) and Toxic Substances Monitoring Program (TSMP) collected fish tissue samples from the midsection, the dam area, and the Bear River and Rock Creek Arms of Camp Far West Reservoir. Both studies collected trophic level 3 and 4 fish. Trophic level 3 fish feed on zooplankton, phytoplankton, and benthic invertebrates. Trophic level 4 fish consume trophic level 3 fish as part of their diet. Methylmercury and total mercury bioaccumulate in aquatic organisms and tend to increase with increasing trophic levels (USEPA, 1997a). The TSMP and USGS sampled 36 trophic level (TL) 4 fish (largemouth bass, smallmouth bass, spotted bass, and channel catfish) between 1987 and 1999. The TL4 fish had an average mercury concentration of 0.69 ppm, which exceeds the USEPA criterion of 0.3 ppm. Placer, Yuba, and Nevada counties have issued an interim public health notification for all lakes and watercourses within these counties based on the USGS data. OEHHA is in the process of developing a state advisory (Nevada County, 2000).

Extent of Impairment
Camp Far West Reservoir covers 2,002 surface acres. Fish collected throughout the reservoir had mercury levels exceeding the USEPA criterion. The entire waterbody is impaired by mercury.

Potential Sources
The Bear River watershed was historically mined extensively for its hardrock and placer gold deposits and has been affected by hydraulic mining (Alpers and Hunerlach, 2000). Several inactive gold and copper mines exist upstream of Camp Far West Reservoir in the Bear River watershed. The Dairy Farm Mine is located along the reservoir's southern shoreline. It is an inactive copper, gold, and silver mine that used underground and open pit mining methods. An open adit has been observed when reservoir levels are low (Montoya and Pan, 1992). Despite being associated with acid mine drainage, Dairy Farm Mine does not discharge perennially.

B.1.13 Clover Creek, Fecal Coliform

Summary of Proposed Action
The California Regional Water Quality Control Board-Central Valley Region, Regional Board, recommends the addition of Clover Creek to California's Clean Water Act Section 303(d) list due to impairment by fecal coliform. Information available to the Regional Board on pathogens levels in Clover Creek indicates that water quality objectives are not being attained. A description for the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Clover Creek	**Pollutants/Stressors**	Fecal Coliform
Hydrologic Unit	507.33	**Sources**	Human and/or livestock sources
Total Waterbody Size	27.5 miles	**TMDL Priority**	
Size Affected	10.5 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	The lower 10.5 miles	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	N 40° 38' 46"	**Upstream Extent Longitude**	W 122° 01' 10"
Downstream Extent Latitude	N 40° 33' 17"	**Downstream Extent Longitude**	W 122° 11' 15"

Watershed Characteristics
Clover Creek is located in Shasta County and flows from the foothills of Mount Lassen southwest to the Sacramento River, east of Anderson. Clover Creek is part of the Cow Creek watershed. Land use within the Cow Creek watershed previously included use by indigenous peoples and historic mining, and currently includes ranches, timberlands, and towns (Montoya and Pan, 1992; Hannaford and North State Institute for Sustainable Communities, 2000).

Water Quality Objectives Not Attained
The numeric objective for bacteria is not being attained in Clover Creek. The bacteria objective in the Basin Plan states, in part, "In waters designated for contact recreation (REC-1), the fecal coliform concentration based on a minimum of not less than five samples for any 30-day period shall not exceed a geometric mean of 200/100 ml, nor shall more than ten percent of the total number of samples taken during any 30-day period exceed 400/100 ml (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf)." The bacteria objectives are presented in terms of Most Probable Number (MPN) per 100 milliliters (ml). The bacteria objectives were evaluated for Clover Creek by comparing fecal coliform concentrations measured in Clover Creek to Basin Plan objectives.

Evidence of Impairment
Water samples were collected from the lower reach of Clover Creek between June and October 1999. The average fecal coliform levels in the water samples were above 300 MPN/100ml. The fecal coliform levels exceeded the geometric mean Basin Plan criterion (200 MPN/100ml) for at least five months in 1999. Many of samples were also above the 30-day Basin Plan criterion (400 MPN/100 ml) (Hannaford and North State Institute for Sustainable Communities, 2000).

Extent of Impairment
Clover Creek flows for approximately 27.5 miles. The lower reach of Clover Creek, from 10 miles upstream of its confluence to its confluence with the main stem of Cow Creek, is impacted by fecal coliform.

Potential Sources
Hannaford and North State Institute for Sustainable Communities (2000) concluded that Clover Creek contained "at least the wildlife input" and potentially low levels of livestock and human inputs of bacteria. The levels contributed by these sources are considered to be the background levels for the area. Since the impaired Clover Creek site is not known to contain more wildlife than the other areas, the excess bacteria "probably originated from livestock or human sources," including septic systems and/or sewage lines leaching into the streams (Hannaford and North State Institute for Sustainable Communities, 2000).

B.1.14 Colusa Basin Drain, Azinphos-methyl

Summary of Proposed Action

The California Regional Water Quality Control Board, Central Valley Region, (Regional Board) recommends the addition of the Colusa Basin Drain (CBD) to California's Clean Water Act Section 303(d) list due to impairment by azinphos-methyl. Information available to the Regional Board on azinphos-methyl concentrations in the CBD indicates that water quality objectives are not being attained. The basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Colusa Basin Drain	**Pollutants/Stressors**	Azinphos-methyl
Hydrologic Unit	520.21	**Sources**	Agriculture
Total Waterbody Size	70 miles	**TMDL Priority**	
Size Affected	70 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	The entire waterbody	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	39º 37' 31"	**Upstream Extent Longitude**	122º 04' 07"
Downstream Extent Latitude	38º 48' 6.4"	**Downstream Extent Longitude**	121º 43' 18.1"

Watershed Characteristics

The CBD flows for approximately 70 miles along the west side of the Sacramento River, from Colusa to the CBD's confluence with the Sacramento River at Knights Landing. The CBD receives runoff from hundreds of thousands of acres of agricultural fields during rain events and from irrigation return flow.

Water Quality Objectives Not Attained

The narrative objectives for pesticides and toxicity are not being attained for azinphos-methyl in the CBD. The narrative objective for pesticides states. "No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses." The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective" (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf). The US Environmental Protection Agency (USEPA) has established an ambient water quality criterion for azinphos-methyl for the protection of freshwater aquatic life of 0.01 µg/L (USEPA, 1976).

Evidence of Impairment

The CBD was sampled at least once a month between November 1996 and April 1998 and a total of 21 water samples were analyzed for azinphos-methyl (Table 2). Seven of the 21 samples (about 33%) contained azinphos-methyl concentrations at or above US Environmental Protection Agency instantaneous maximum water criterion of 0.01 ug/L (USEPA, 1976). The highest concentrations were generally detected between December and April, and during August and September. High levels of azinphos-methyl often co-occurred with high levels of diazinon.

Table B-2. Azinphos-methyl in Water Samples from the Colusa Basin Drain at Road 99E near Knight's Landing

Data Source	Sample Years	Number of Samples	Range of Azinphos -methyl Concentrations	Criteria[a]	Number of Samples Equal to or Above Criteria	Percent Samples Equal to or Above Criteria
Domagalski, 2000	1996	2	nd	0.01 µg/L	0	0%
Domagalski, 2000	1997	15	nd - 0.05 µg/L		6	40%
Domagalski, 2000	1998	4	nd - 0.01 µg/L		1	25%
Sum	1996-1998	21	nd - 0.05 µg/L		7	33%

a) USEPA, 1976
nd = not detected

Extent of Impairment
Azinphos-methyl is used to control insects on almonds, walnuts and other crops grown throughout the region drained by the CBD. Therefore, it is likely that the entire length of the CBD is impaired by azinphos-methyl.

Potential Sources
The extensive agricultural areas drained by the CBD are the most likely sources of azinphos-methyl.

B.1.15 Colusa Basin Drain, Diazinon

Summary of Proposed Actions
The California Regional Water Quality Control Board, Central Valley Region (Regional Board) recommends the addition of the Colusa Basin Drain (CBD) to California's Clean Water Act Section 303(d) list due to impairment by diazinon. Information available to the Regional Board on diazinon concentrations in the Colusa Basin Drain (CBD) indicates that water quality objectives are not being attained. The basis for this recommendation is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Colusa Basin Drain	**Pollutants/Stressors**	Diazinon
Hydrologic Unit	520.21	**Sources**	Agriculture
Total Waterbody Size	70 miles	**TMDL Priority**	
Size Affected	70 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	The entire Drain	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	39º 37' 31"	**Upstream Extent Longitude**	122º 04' 07"
Downstream Extent Latitude	38º 48' 6.4"	**Downstream Extent Longitude**	121º 43' 18.1"

Watershed Characteristics
The CBD flows for approximately 70 miles along the west side of the Sacramento River, from Colusa to the CBD's confluence with the Sacramento River at Knights Landing. The CBD receives runoff from hundreds of thousands of acres of agricultural fields during rain events, and from irrigation return flow in the dry season.

Water Quality Objectives Not Attained

The narrative objectives for pesticides and toxicity are not being attained for diazinon in the CBD. The narrative objective for pesticides states "No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses." The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective." (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf) The California Department of Fish and Game has established freshwater numeric acute (1-hour average) and chronic (4-day average) criteria for diazinon of 0.08µg/L and 0.05 µg/L, respectively, for the protection of aquatic life (Siepmann and Finlayson, 2000).

Evidence of Impairment

Between 1994 and 1998, multiple studies analyzed a total of 59 ambient water samples collected in the CBD for diazinon (Table 2). Most samples were collected during the orchard dormant spray season. Overall, 17 of 59 samples (about 29%) contained diazinon concentrations at or above CDFG chronic water quality criterion of 0.050 µg/L and 11 of 59 (about 19%) samples exceeded CDFG acute water quality criterion of 0.080 µg/L.

Table B-2. Diazinon Concentrations in Water Samples from Colusa Basin Drain near Knight's Landing

Data Source	Sample Years	Number of Samples	Range of Diazinon Concentrations	Criteria[a]		Number of Samples Equal to or Above Criteria	Percent Samples Equal to or Above Criteria
Domagalski, 2000	1994	29	nd - 0.33 µg/L	chronic	0.05 µg/L	11	38%
				acute	0.08 µg/L	8	27%
Holmes et al., 2000	1996	2	nd	chronic	0.05 µg/L	0	0%
				acute	0.08 µg/L	0	0%
Holmes et al., 2000	1997	15	nd - 0.07 µg/L	chronic	0.05 µg/L	2	13%
				acute	0.08 µg/L	0	0%
Holmes et al., 2000	1998	4	0.01 - 0.1 µg/L	chronic	0.05 µg/L	1	25%
				acute	0.08 µg/L	1	25%
Dileanis, et al., 2001	2000	9	nd - 1.02 µg/L	chronic	0.05 µg/L	3	33%
				acute	0.08 µg/L	2	22%
Sum	1994 - 2000	59	nd - 1.02 µg/L	chronic	0.05 µg/L	17	29%
				acute	0.08 µg/L	11	19%

a) California Department of Fish and Game Water Quality Criteria for the Protection of Aquatic Life (Siepmann and Finlayson, 2000)

nd = not detected

Extent of Impairment

Diazinon is used to control insects on almonds, walnuts, stone fruits and other crops grown throughout the region drained by the CBD. Therefore, it is likely that the entire length of the CBD is impaired by diazinon.

Potential Sources

The extensive agricultural areas drained by the CBD are the most likely sources of diazinon.

B.1.16 Colusa Basin Drain, Molinate

Summary of Proposed Action

The California Regional Water Quality Control Board, Central Valley Region (Regional Board) recommends the addition of the Colusa Basin Drain (CBD) to California's Clean Water Act Section 303(d) list due to impairment by molinate. Information available to the Regional Board on concentrations of this pesticide indicates that water quality objectives are not being attained. The basis for this recommendation is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Colusa Basin Drain	**Pollutants/Stressors**	Molinate
Hydrologic Unit	520.21	**Sources**	Agriculture
Total Waterbody Size	70 miles	**TMDL Priority**	
Size Affected	70 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	The entire Drain	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	39º 37' 31"	**Upstream Extent Longitude**	122º 04' 07"
Downstream Extent Latitude	38º 48' 06"	**Downstream Extent Longitude**	121º 43' 18"

Watershed Characteristics

The Colusa Basin Drain (CBD) flows for approximately 70 miles along the west side of the Sacramento River, from close to the Sacramento River, at Colusa, to its confluence with the Sacramento River at Knights Landing. The CBD receives runoff from hundreds of thousands of acres of agricultural fields during rain events and from irrigation return flow.

Water Quality Objectives Not Attained

The narrative objective for pesticides and toxicity are not being attained for molinate in the CBD. The narrative objective for pesticides states, "No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses." The narrative objective for toxicity states, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states "The Regional Water Board will also consider…numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective." (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/rwqcb5/bsnplnab.pdf). The Regional Board performance goal to protect freshwater habitat is 10 ug/L or 10 ppb (micrograms per liter or parts per billion) (CRWQCB-CVR, 1998).

Evidence of Impairment

Between 1994 and 2000, multiple studies analyzed a total of 138 ambient water samples collected in the CBD for molinate. Samples were collected during the time period of application of molinate to rice (generally May/June). Forty-eight of 138 samples (about 35%) exceeded the Regional Board performance goal of 10 ppb (Gorder et al, 1995 through 1998; Domagalski, 2000; Holmes et al., 2000; Newhart et al, 2000). Table 2 summarizes the available data.

Table B-2. Molinate in Water Samples Collected from Colusa Basin Drain

Sample Years	Number of Samples	Range of Molinate Concentrations	Criteria	Number of Samples Equal to or Above Criteria	Percent Samples Equal to or Above Criteria
1994	21	nd - 0.153 µg/L	10 µg/L	0	0.00%
1995	21	nd - 28.95 µg/L	10 µg/L	11	52%
1996	23	nd - 41.25 µg/L	10 µg/L	13	57%
1997	21	nd - 27.335 µg/L	10 µg/L	9	43%
1998	21	nd - 44.09 µg/L	10 µg/L	8	38%
1996 - 1998	20	0.009 - 19.2 µg/L	10 µg/L	1	5%
2000	11	nd - 22.0 µg/L	10 µg/L	6	33%
1994 - 2000	138	nd - 44.09 µg/L	10 µg/L	48	35%

Extent of Impairment
Molinate is used to control aquatic weeds on rice grown throughout the region drained by the CBD. Therefore, it is likely that the entire length of the CBD is impaired by molinate.

Potential Sources
The extensive agricultural areas drained by the CBD are the most likely sources of molinate.

B.1.17 Del Puerto Creek, Chlorpyrifos

Summary of Proposed Action
The California Regional Water Quality Control Board, Central Valley Region, (Regional Board) recommends the addition of the lower portion of Del Puerto Creek to California's Clean Water Act Section 303(d) list due to impairment by chlorpyrifos. Information available to the Regional Board on chlorpyrifos levels indicates that water quality objectives are not being attained. The basis for this recommendation is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Del Puerto Creek	**Pollutants/Stressors**	Chlorpyrifos
Hydrologic Unit	541.10	**Sources**	Agriculture
Total Length	27 miles	**TMDL Priority**	
Size Affected	5 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	Lower 5 miles, from Rogers Road to the SJR	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	37° 29' 56"	**Upstream Extent Longitude**	121° 10' 37"
Downstream Extent Latitude	37° 32' 29"	**Downstream Extent Longitude**	121° 06' 56"

Watershed Characteristics
Del Puerto Creek originates on the eastern slope of the Coast Range, near the intersection of San Joaquin, Stanislaus, and Alameda Counties. The creek flows northeast approximately 27 miles to its confluence with the San Joaquin River, south of Laird Park. Extensive acreage in the lower part of the watershed is used to grow orchard and field crops, especially southeast of Interstate Highway 5. Several lateral drains that carry tailwater from fields located along the west side of the San Joaquin Valley also drain into Del Puerto Creek.

Water Quality Objectives Not Attained

The narrative objectives for pesticides and toxicity are not being attained for chlorpyrifos in Del Puerto Creek. The narrative objective for pesticides states, "No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses." The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective" (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf). The California Department of Fish and Game (CDFG) has established freshwater numeric acute (1-hour average) and chronic (4-day average) criteria for chlorpyrifos of 0.02µg/L and 0.014 µg/L, respectively, for the protection of aquatic life (Siepmann and Finlayson, 2000).

Table B-2. Chlorpyrifos in Water Samples Collected from Del Puerto Creek

Data Source	Sample Years	Number of Samples	Range of Chlorpyrifos Concentrations	Criteria[a]		Number of Samples Equal to or Above Criteria	Percent Samples Equal to or Above Criteria
Ross 1992, 1993; Ross et al., 1996, 1999; Fujimura, 1991a,b, 1993a,b,c,d	1991-1993	8	nd	chronic	0.014 µg/L	0	0%
				acute	0.02 µg/L	0	0%
Foe, 1995	1991	8	nd - 0.063 µg/L	chronic	0.014 µg/L	2	25%
				acute	0.02 µg/L	2	25%
Foe, 1995	1992	14	nd - 0.023 µg/	chronic	0.014 µg/L	3	21%
				acute	0.02 µg/L	1	7%
Sum	1991-1993	30	nd - 0.063 µg/	chronic	0.014 µg/L	5	17%
				acute	0.02 µg/L	3	10%

a) California Department of Fish and Game Water Quality Criteria for Diazinon and Chlorpyrifos (Siepmann and Finlayson, 2000)
nd = not detected

Extent of Impairment

The lower section of Del Puerto Creek extends for approximately five miles between Interstate 5 and the San Joaquin River. Extensive acreage in the lower part of the watershed is used to grow orchard and field crops, and chlorpyrifos is used as on these crops during the dormant and the growing seasons.

Potential Sources

Applications of chlorpyrifos to orchards and field crops are the most likely source of chlorpyrifos in Del Puerto Creek.

B.1.18 Del Puerto Creek, Diazinon

Summary of Proposed Action

The California Regional Water Quality Control Board, Central Valley Region, (Regional Board) recommends the addition of the lower portion of Del Puerto Creek to California's Clean Water Act Section 303(d) list due to impairment by diazinon. Information available to the Regional Board on diazinon concentrations in Del Puerto Creek indicates that water quality objectives are not being attained. The basis for this recommendation is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Del Puerto Creek	**Pollutants/Stressors**	Diazinon
Hydrologic Unit	541.10	**Sources**	Agriculture
Total Length	27 miles	**TMDL Priority**	
Size Affected	5 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	Lower 5 miles, from Rogers Road to the SJR	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	37° 29' 56"	**Upstream Extent Longitude**	121° 10' 37"
Downstream Extent Latitude	37° 32' 29"	**Downstream Extent Longitude**	121° 06 '56"

Watershed Characteristics

Del Puerto Creek originates on the eastern slope of the Coast Range, near the intersection of San Joaquin, Stanislaus, and Alameda Counties. The creek flows northeast approximately 27 miles to its confluence with the San Joaquin River, south of Laird Park. Extensive acreage in the lower part of the watershed is used to grow almonds and stone fruits, especially southeast of Interstate Highway 5. Several lateral drains that carry tailwater from orchards located along the west side of the San Joaquin Valley also drain into Del Puerto Creek.

Water Quality Objectives Not Attained

The narrative objectives for pesticides and toxicity are not being attained for diazinon in Del Puerto Creek. The narrative objective for pesticides states, "No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses." The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective" (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf). The California Department of Fish and Game (CDFG) has established freshwater numeric acute (1-hour average) and chronic (4-day average) criteria of 0.08µg/L and 0.05 µg/L, respectively, for the protection of aquatic life (Siepmann and Finlayson, 2000).

Evidence of Impairment

Several studies have measured diazinon concentrations in Del Puerto Creek (Table 2). The samples analyzed for these studies were collected between January and June, 1991 to 1993. Ten of the 30 samples (33%) analyzed for diazinon exceeded the CDFG chronic water quality criterion for diazinon, and six of the 30 samples (20%) exceeded the CDFG acute criterion.

Table B-2. Diazinon in Water Samples Collected from Del Puerto Creek

Data Source	Sample Years	Number of Samples	Range of Diazinon Concentrations	Criteria[a]		Number of Samples Equal to or Above Criteria	Percent Samples Equal to or Above Criteria
Ross 1992, 1993; Ross et al., 1996, 1999; Fujimura, 1991a,b, 1993a,b,c,d	1991-1993	8	nd	Chronic	0.05 µg/L	0	0%
				Acute	0.08 µg/L	0	0%
Foe, 1995	1991	8	nd - 0.2 µg/L	Chronic	0.05 µg/L	3	37.5%
				Acute	0.08 µg/L	1	12.5%
Foe, 1995	1992	14	0.007 - 1.3 µg/L	Chronic	0.05 µg/L	7	50%
				Acute	0.08 µg/L	5	36%
Sum	1991-1993	30	nd - 1.3 µg/L	Chronic	0.05 µg/L	10	33%
				Acute	0.08 µg/L	6	20%

a) California Department of Fish and Game Water Quality Criteria for Diazinon (Siepmann and Finlayson, 2000)
nd = not detected

Extent of Impairment
The lower section of Del Puerto Creek extends for approximately five miles between Interstate 5 and the San Joaquin River. Extensive acreage in the lower part of the watershed is used to grow almonds and stone fruits, and diazinon is applied to many of these orchards during the winter dormant season.

Potential Sources
The application of diazinon to orchards is the most likely source of diazinon in Del Puerto Creek.

B.1.19 Del Puerto Creek, Parathion

Summary of Proposed Action
The California Regional Water Quality Control Board, Central Valley Region, (Regional Board) recommends the addition of the lower portion of Del Puerto Creek to California's Clean Water Act Section 303(d) list due to impairment by parathion. Information available to the Regional Board on parathion concentrations in Del Puerto Creek indicates that water quality objectives are not being attained. The basis for this recommendation is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Del Puerto Creek	**Pollutants/Stressors**	Parathion
Hydrologic Unit	541.10	**Sources**	Agriculture
Total Length	27 miles	**TMDL Priority**	
Size Affected	5 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	Lower 5 miles, from Rogers Road to the SJR	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	37° 29' 56"	**Upstream Extent Longitude**	121° 10' 37"
Downstream Extent Latitude	37° 32' 29"	**Downstream Extent Longitude**	121° 06' 56"

Watershed Characteristics
Del Puerto Creek originates on the eastern slope of the Coast Range, near the intersection of San Joaquin, Stanislaus, and Alameda Counties. The creek flows northeast approximately 27 miles to its confluence

with the San Joaquin River, south of Laird Park. Extensive acreage in the lower part of the watershed is dominated by agriculture, including orchard crops. Several lateral drains that carry tailwater from agricultural land located along the west side of the San Joaquin Valley also drain into Del Puerto Creek.

Water Quality Objectives Not Attained
The narrative objectives for pesticides and toxicity are not being attained for parathion in Del Puerto Creek. The narrative objective for pesticides states, "No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses." The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective" (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf). The US Environmental Protection Agency (EPA) has established freshwater numeric acute (1-hour average) and chronic (4-day average) criteria of 0.065µg/L and 0.013 µg/L, respectively, for the protection of aquatic life (Marshack, 2000).

Evidence of Impairment
Several studies have measured parathion concentrations in Del Puerto Creek (Table 2). The samples analyzed for these studies were collected between January and June, 1991 to 1993. Nine of the 30 samples (30%) analyzed for parathion exceeded the EPA continuous water quality criterion for parathion, and eight of the 30 samples (27%) exceeded the EPA maximum criterion.

Table B-2. Parathion in Water Samples Collected from Del Puerto Creek

Data Source	Sample Years	Number of Samples	Range of Parathion Concentrations	Criteria[a]		Number of Samples Equal to or Above Criteria	Percent Samples Equal to or Above Criteria
Ross 1992, 1993; Ross et al., 1996, 1999; Fujimura, 1991a,b, 1993a,b,c,d	1991-1993	8	nd	continuous	0.013 µg/L	0	0%
				maximum	0.065 µg/L	0	0%
Foe, 1995	1991	8	nd - 2.1	continuous	0.013 µg/L	5	62.5%
				maximum	0.065 µg/L	4	50%
Foe, 1995	1992	14	nd - 0.51 µg/L	continuous	0.013 µg/L	4	29%
				maximum	0.065 µg/L	4	29%
Sum	1991 - 1993	30	nd - 2.1 µg/L	continuous	0.013 µg/L	9	30%
				maximum	0.065 µg/L	8	27%

a) US EPA maximum and continuous criteria for parathion for the protection of freshwater aquatic life (Marshack, 2000)
nd = not detected

Extent of Impairment
The lower section of Del Puerto Creek extends for approximately five miles between Interstate 5 and the San Joaquin River. Extensive acreage in the lower part of the watershed is used to grow almonds and stone fruits, and parathion is applied to some of these orchards during the winter dormant season.

Potential Sources
The source of parathion is from agricultural use.

B.1.20 Don Pedro Lake, Mercury

Summary of Proposed Action

The California Regional Water Quality Control Board, Central Valley Region (Regional Board) recommends the addition of Don Pedro Lake to California's Clean Water Act Section 303(d) list due to impairment by mercury. Information available to the Regional Board on mercury levels in fish tissue samples indicates that water quality objectives are not being attained in Don Pedro Lake. The description for the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Don Pedro Lake	**Pollutants/Stressors**	Mercury
Hydrologic Unit	536.32	**Sources**	Resource Extraction (abandoned mines)
Total Waterbody Size	12,960 acres	**TMDL Priority**	
Size Affected	12,960 acres	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	Entire reservoir	**TMDL End Date (Mo/Yr)**	

Watershed Characteristics

The New Don Pedro Dam creates Don Pedro Lake on the Tuolumne River in Tuolumne County, approximately 54 miles upstream from the Tuolumne River – San Joaquin River confluence (USGS, 1958-2000). The Don Pedro Dam was constructed in 1971 with a reservoir area of 12,960 acres; the Turlock Irrigation District operates the dam (CDWR, 1993). Numerous abandoned gold mines and other historic mine features are present in the watershed upstream of the Don Pedro Dam (OMR, 2000).

Water Quality Objectives Not Attained

The narrative objective for toxicity is not being attained for mercury in Don Pedro Lake. The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective." (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf).

Numeric criteria for mercury in fish tissue have been developed for both human health and wildlife protection. The U.S. Environmental Protection Agency (USEPA) recently established a human health protection criterion of 0.3 milligrams per kilogram (mg/kg; equivalent to parts per million [ppm]) methylmercury in the edible portions of fish (USEPA, 2001b). This criterion is used to determine attainment with the narrative toxicity objective.

Evidence of Impairment

The Toxic Substances Monitoring Program (TSMP) analyzed composite samples of trophic level 3 and 4 fish from the northernmost arms of Don Pedro Lake (Moccasin Creek, Tuolumne River, and Woods Creek) (SWRCB, 1995). Trophic level (TL) 3 fish (e.g., bluegill, carp, and sucker) feed on zooplankton, phytoplankton, and benthic invertebrates. Trophic level 4 fish (e.g., largemouth bass) consume trophic level 3 fish as part of their diet. The TSMP sampled 32 TL 4 fish (largemouth bass) between 1981 and 1987. The TL4 fish had an average mercury concentration of 0.54 ppm, which exceeds the USEPA criterion of 0.3 ppm.

Extent of Impairment
Data are available only for the northernmost arms of Don Pedro Lake. However, the entire 12,960-acre lake is probably impaired because there are other tributaries to the lake that may act as mercury inputs.

Potential Sources
The principal source of mercury in the Tuolumne River watershed is historic gold mining sites (OMR, 2000).

B.1.21 Five Mile Slough, Low Dissolved Oxygen

Summary of Proposed Action
The California Regional Water Quality Control Board-Central Valley Region, Regional Board, recommends the addition of Five Mile Slough to California's Clean Water Act Section 303(d) list due to impairment by low dissolved oxygen. Information available to the Regional Board on dissolved oxygen levels in Five Mile Slough indicates that water quality objectives are not being attained. A description for the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Five Mile Slough	**Pollutants/Stressors**	Low Dissolved Oxygen
Hydrologic Unit	544.00	**Sources**	Urban Runoff/Storm Sewers
Total Waterbody Size	5 miles	**TMDL Priority**	
Size Affected	1 mile	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	From Plymouth Road bridge to the confluence with Fourteen-Mile Slough.	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	38° 0' 49"	**Upstream Extent Longitude**	121° 21' 08"
Downstream Extent Latitude	38° 0' 49"	**Downstream Extent Longitude**	121° 22' 10"

Watershed Characteristics
Five Mile Slough is located within the San Joaquin Delta Hydrologic Unit, in the primarily residential northwest side of Stockton, California and is tributary to Fourteen-Mile Slough at the western edge of the city limits.

Water Quality Objectives Not Attained
The Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins contains a numeric objective applicable to Five Mile Slough which requires dissolved oxygen (DO) not be reduced below 5 milligrams per liter (mg/l). (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf).

Evidence of Impairment
A report of DeltaKeeper data collected between 8 November 1999 and 7 February 2000 found DO concentrations in Five Mile Slough below the Basin Plan objective in 19 of 32 samples. Data collected between 15 October 1996 and 8 November 1996 found DO concentrations below the Basin Plan objective (5 mg/l) in 5 of 9 samples (Lee and Jones-Lee, 2000a).

Table B-2. Dissolved Oxygen Concentrations in Water Samples Collected from Five Mile Slough

Data Source	Sample Years	Number of Samples	Range of DO Concentrations	Number of Samples Below Criterion
Lee and Jones-Lee, 2000 (DeltaKeeper)	October/November 1996; November 1999 to February 2000	41	0.25 – 10.6 mg/L	24

Extent of Impairment
The available data for Five Mile Slough is limited to the area near the transition of Five Mile Slough from an urban creek (relatively narrow) to a slough (relatively wide). The sampling point may, therefore, not be representative of DO levels in the narrower portion of the Slough. The Regional Board is therefore recommending listing Five Mile Slough from near the sampling point at Plymouth Road bridge to the confluence with Fourteen-Mile Slough.

Potential Sources
The impaired reach of Five Mile Slough receives runoff from the Stockton urban area. The most likely source of oxygen demanding substances is from runoff from the urban area.

B.1.22 Five Mile Slough, Pathogens

Summary of Proposed Action
The California Regional Water Quality Control Board, Central Valley Region, (Regional Board) recommends the addition of Five Mile Slough in the Delta to California's Clean Water Act Section 303(d) list due to impairment by pathogens. Information available to the Regional Board on pathogens levels in Five Mile Slough indicates that water quality objectives are not being attained. A description for the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Five Mile Slough	**Pollutants/Stressors**	Bacteria
Hydrologic Unit	544.00	**Sources**	Urban runoff, Recreation
Total Waterbody Size	5 Miles	**TMDL Priority**	
Size Affected	2 Miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	From the head of the slough to the confluence with Fourteen Mile Slough.	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	38° 00' 51"	**Upstream Extent Longitude**	121° 19' 52"
Downstream Extent Latitude	38° 00' 50"	**Downstream Extent Longitude**	121° 22' 10"

Watershed Characteristics
Five Mile Slough is located in the Delta and extends through urban Stockton and is bordered by residential housing, schools, a park, and a golf course. The Delta is characterized by tidal waters with limited flushing flows during the dry seasons. Five Mile Slough supports recreational uses, including boating, fishing, and swimming.

Water Quality Objectives Not Attained
The narrative objective for toxicity is not being attained for pathogens in Five Mile Slough. The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life."

The narrative toxicity objective further states the " the Regional Water Board will also consider…numerical criteria and guidelines developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services…the U.S. Environmental Protection Agency, and other organizations to evaluate compliance with this objective." The Basin Plan also contains a specific objective for fecal coliform bacteria (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/rwqcb5/bsnplnab.pdf).

Guidelines and criteria have been developed for the protection of human health. The California Department of Health Services (CDHS) has adopted total coliform bacteria guidelines, applicable to recreational waters and beaches, of 10,000 Most Probable Number (MPN) per 100 milliliters (ml) for single samples and of 1,000 MPN per 100 ml for 30-day log mean of sample levels (Title 17 California Code of Regulation section 7958). CDHS has also published draft guidelines that include limits for single samples of *E. coli* of 235 MPN per 100 milliliters (CDHS, July 2000 http://www.dhs.ca.gov/ps/ddwem/beaches/freshwater.htm). U.S. EPA guidelines for bacteria are contained in *Ambient Water Quality Criteria for Bacteria* (USEPA, 1986a). The U.S. EPA standards are stated as "Based on a statistically sufficient number of samples (generally not less than 5 samples equally spaced over a 30-day period), the geometric mean of the indicated bacterial densities should not exceed one or the other of the following: *E. coli* 126 MPN per 100 ml; or Enterococci 33 MPN per 100 ml." A methodology for determining exceedances based on single samples is also included in the standards.

Evidence of Impairment
DeltaKeeper submitted bacteria data for Five Mile Slough from two sampling locations (DeltaKeeper, 2001a). One sampling location (downstream) is near the mouth of the slough (at the confluence with Fourteen Mile Slough) and the other sampling location (upstream) is near the beginning of the constructed portion of the slough, approximately five miles upstream of the mouth of the slough. A total of 29 samples collected from Five Mile Slough during 10 months in 2000-2001 were analyzed for *E. coli* and total coliform. Geometric means of the bacteria counts have been calculated using the data submitted by DeltaKeeper. The geometric means for *E. coli* and total coliform levels measured at the downstream sampling location are 38 MPN per 100 ml and 8,728 MPN per 100 ml, respectively. However, the sampling at the downstream sampling location was limited to three sampling events (one each month for April 2000, August 2000 and February 2001). One *E. coli* measurement at the downstream site was 244 MPN per 100 ml, which exceeds the CDHS single-sample criterion of 235 MP per 100 ml. The geometric mean for *E. coli* levels measured at the upstream sampling location is 147 MPN per 100 ml, which exceeds the U.S. EPA criterion of 126 MPN per 100 ml.

Extent of Impairment
Regional Board staff recommends listing Five Mile Slough as impaired due to pathogen contamination. Both sampling locations are within the urban Stockton area. The entire reach of Five Mile Slough has similar land use patterns and it is expected that sampling would show high levels of bacteria throughout the urban portion of the slough.

Potential Sources
In urban settings, the U.S. EPA has identified sources of pathogen pollution to include urban litter, contaminated refuse, domestic pet and wildlife excrement and failing sewer lines (USEPA, 2001). In their pathogen TMDL Guide, the U.S. EPA states "In a study of bacterial loading in urban streams, Young and Thackston (1999) found that fecal bacteria densities were directly related to the density of housing, population, development, percent impervious area, and domestic animal density. Additionally, recreational areas may have high bacteria counts. This can be due to improper disposal of waste from boats, lack of sanitary facilities in the area of recreation and children in diapers using the water."

B.1.23 Ingram/Hospital Creek, Chlorpyrifos

Summary of Proposed Action
The California Regional Water Quality Control Board, Central Valley Region (Regional Board) recommends the addition of the Ingram/Hospital Creek to California's Clean Water Act Section 303(d) list

due to impairment by chlorpyrifos. Information available to the Regional Board on chlorpyrifos concentrations in Ingram/Hospital Creek indicates that water quality objectives are not being attained. The basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Ingram/Hospital Creek	**Pollutants/Stressors**	Chlorpyrifos
Hydrologic Unit	541.10	**Sources**	Agriculture
Total Waterbody Size	2 miles	**TMDL Priority**	
Size Affected	2 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	2 miles	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	37° 05' 61"	**Upstream Extent Longitude**	121° 12' 08"
Downstream Extent Latitude	37° 38' 10"	**Downstream Extent Longitude**	121° 12' 17"

Watershed Characteristics
Ingram and Hospital Creeks are ephemeral streams that originate in the Coast Range and flow northeast from Ingram Canyon and Hospital Canyon, respectively, to the San Joaquin Valley west of Modesto. The creeks join near Dairy Road and subsequently flow into the San Joaquin River. Upstream of Interstate 5, in Ingram and Hospital Canyons, the creeks are open waterways that transport rainwater runoff during the winter. However, in the agricultural region downstream of Interstate 5 and in the Valley, Ingram and Hospital Creeks are dominated by agricultural return flows. (Westcot et al., 1991).

Water Quality Objectives Not Attained
The narrative objectives for pesticides and toxicity are not being attained for chlorpyrifos in the Ingram/Hospital Creek. The narrative objective for pesticides states, "No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses." The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective" (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf). The California Department of Fish and Game (CDFG) has established freshwater numeric acute (1-hour average) and chronic (4-day average) criteria of 0.014 µg/L and 0.02 µg/L, respectively, for the protection of aquatic life (Siepmann and Finlayson, 2000).

Evidence of Impairment
Between 1991 and 1993, multiple studies analyzed a total of 33 water samples collected from Ingram/Hospital Creek for chlorpyrifos. Samples were collected from December through June. In 1991 and 1992, three of ten (about 30%) and two of 14 (about 14%), respectively, contained chlorpyrifos concentrations at or above the CDFG chronic water quality criterion (Table 2). The CDFG acute water quality criterion of 0.020 ug/l was exceeded in two of 10 (20%) and two of 14 (14%) samples in 1991 and 1992, respectively. Overall, more than 12% of the samples analyzed for chlorpyrifos exceeded the CDFG acute and chronic water quality criteria (Ross 1992, 1993; Ross et al., 1996, 1999; Fujimura, 1991a,b, 1993a,b,c,d).

Table B-2. Chlorpyrifos in Water Samples Collected from Ingram/Hospital Creek

Data Source	Sample Years	Number of Samples	Range of Chlorpyrifos Concentrations	Criteria[a]		Number of Samples Equal to or Above Criteria	% Samples Equal to or Above Criteria
Ross 1992, 1993; Ross et al., 1996, 1999; Fujimura, 1991a,b, 1993a,b,c,d	1991-1993	9	nd	Chronic	0.014 µg/L	0	0%
				Acute	0.02 µg/L	0	0%
Foe, 1995	1991	10	nd - 0.29 µg/L	Chronic	0.014 µg/L	3	30%
				Acute	0.02 µg/L	2	20%
Foe, 1995	1992	14	nd - 0.03 µg/L	Chronic	0.014 µg/L	2	14%
				Acute	0.02 µg/L	2	14%
Sum	1991 - 1993	33	nd - 0.24 µg/L	Chronic	0.014 µg/L	5	15%
				Acute	0.02 µg/L	4	12%

Extent of Impairment
Chlorpyrifos impairment exists in Ingram/Hospital Creek from their confluence, east of Dairy Road, to the San Joaquin River, due to chlorpyrifos in agricultural return flows (Foe, 1995). Ingram Creek and Hospital Creek also receive agricultural return flows upstream from their confluence and west toward Interstate 5, however the extent of chlorpyrifos impairment upstream from their confluence is not currently known.

Potential Sources
Agricultural return flows are the most likely source of chlorpyrifos in Ingram/Hospital Creek.

B.1.24 Ingram/Hospital Creek, Diazinon

Summary of Proposed Action
The California Regional Water Quality Control Board, Central Valley Region (Regional Board) recommends the addition of the Ingram/Hospital Creek to California's Clean Water Act Section 303(d) list due to impairment by diazinon. Information available to the Regional Board on diazinon concentrations in Ingram/Hospital Creek indicates that water quality objectives are not being attained. The basis for this recommendation is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Ingram/Hospital Creek	**Pollutants/Stressors**	Diazinon
Hydrologic Unit	541.10	**Sources**	Agriculture
Total Waterbody Size	2 miles	**TMDL Priority**	
Size Affected	2 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	2 miles	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	37° 05' 61"	**Upstream Extent Longitude**	121° 12' 08"
Downstream Extent Latitude	37° 38' 10"	**Downstream Extent Longitude**	121° 12' 17"

Watershed Characteristics
Ingram and Hospital Creeks are ephemeral streams that originate in the Coast Range and flow northeast from Ingram Canyon and Hospital Canyon, respectively, to the San Joaquin Valley west of Modesto. The creeks join near Dairy Road and subsequently flow into the San Joaquin River. Upstream of Interstate 5, in

Ingram and Hospital Canyons, the creeks are open waterways that transport rainwater runoff during the winter. However, in the agricultural region downstream of Interstate 5 and in the Valley, Ingram and Hospital Creeks are dominated by agricultural return flows (Westcot et al., 1991).

Water Quality Objectives Not Attained

The narrative objectives for pesticides and toxicity are not being attained for diazinon in Ingram/Hospital Creek. The narrative objective for pesticides states, "No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses." The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective" (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf). The California Department of Fish and Game (CDFG) has established acute and chronic water quality criteria for diazinon for the protection of aquatic life of 0.08 and 0.05 µg/L, respectively (Siepmann and Finlayson, 2000).

Evidence of Impairment

Between 1991 and 1993, several studies analyzed a total of 34 water samples collected in Ingram/Hospital Creek for diazinon (Table 2). The sampling was distributed throughout the year, except for the month of November. Thirteen out of 34 (about 38%) exceeded the CDFG chronic criterion of 0.05µg/L, and 12 out of 34 (about 35%) exceeded the CDFG acute criterion of 0.08 µg/L. Overall, diazinon concentrations in samples collected from Ingram/Hospital Creek ranged from less than one to more than 18 times the CDFG chronic water quality criterion and exceeded chronic and acute water quality criterion in more than 35% of the samples.

Table B-2. Diazinon Concentrations in Ingram/Hospital Creek

Data Source	Sample Years	Number of Samples	Range of Diazinon Concentrations	Criteria		Number of Samples Equal to or Above Criteria	Percent Samples Equal to or Above Criteria
Foe, 1995; Ross 1992, 1993; Ross et al., 1996, 1999; Fujimura, 1991a,b, 1993a,b,c,d	1991	13	nd - 0.41 µg/L	Chronic	0.05 µg/L	4	31%
				Acute	0.08 µg/L	4	31%
Foe, 1995; Ross et al., 1999, 1996, 1993, 1992; Fujimura, 1993a,b,c,d, 1991a,b	1992	19	nd - 0.903 µg/L	Chronic	0.05 µg/L	7	37%
				Acute	0.08 µg/L	6	32%
Ross et al., 1999, 1996, 1993, 1992; Fujimura, 1993a,b,c, d, 1991a,b	1993	2	0.16 - 0.41 µg/L	Chronic	0.05 µg/L	2	100%
				Acute	0.08 µg/L	2	100%
Sum	1991 - 1993	34	nd - 0.903 µg/L	Chronic	0.05 µg/L	13	38%
				Acute	0.08 µg/L	12	35%

Extent of Impairment

Diazinon impairment exists in Ingram/Hospital Creek from their confluence, east of Dairy Road, to the San Joaquin River, due to diazinon in agricultural return flows. Ingram Creek and Hospital Creek also receive

agricultural return flows upstream from their confluence and west toward Interstate 5, however the extent of diazinon impairment upstream from their confluence is not currently known.

Potential Sources
Agricultural return flows are the most likely source of diazinon in Ingram/Hospital Creek.

B.1.25 Ingram/Hospital Creek, Parathion

Summary of Proposed Actions
The California Regional Water Quality Control Board, Central Valley Region (Regional Board) recommends the addition of the Ingram/Hospital Creek to California's Clean Water Act Section 303(d) list due to impairment by parathion. Information available to the Regional Board on parathion levels indicates that water quality objectives are not being attained. The basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Ingram/Hospital Creek	**Pollutants/Stressors**	Parathion
Hydrologic Unit	541.10	**Sources**	Agriculture
Total Waterbody Size	2 miles	**TMDL Priority**	
Size Affected	2 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	The entire creek	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	37° 05' 61"	**Upstream Extent Longitude**	121° 12' 08"
Downstream Extent Latitude	37° 38' 10"	**Downstream Extent Longitude**	121° 12' 17"

Watershed Characteristics
Ingram and Hospital Creeks are ephemeral streams that originate in the Coast Range and flow northeast from Ingram Canyon and Hospital Canyon, respectively, to the San Joaquin Valley west of Modesto. The creeks join near Dairy Road and subsequently flow into the San Joaquin River. Upstream of Interstate 5, in Ingram and Hospital Canyons, the creeks are open waterways that transport rainwater runoff during the winter. However, in the agricultural region downstream of Interstate 5 and in the Valley, Ingram and Hospital Creeks are dominated by agricultural return flows. (Westcot et al., 1991).

Water Quality Objectives Not Attained
The narrative objective for toxicity is not being attained for parathion in the Ingram/Hospital Creek. The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective" (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf). The US Environmental Protection Agency (EPA) has established water quality criteria for parathion for the protection of freshwater aquatic life of 0.013 µg/L for a continuous (4-day average) concentration and 0.065 µg/L for a maximum (1-hour average) concentration (Marshack, 2000).

Evidence of Impairment
Between 1991 and 1993, several studies analyzed a total of 33 water samples collected in Ingram/Hospital Creek for parathion (Table 2). The sampling was distributed throughout the year, except for the month of November. Thirteen of the 33 samples (about 38%) exceeded the EPA chronic criterion of 0.013 µg/L, and 12 (about 35%) exceeded the EPA acute criterion of 0.065 µg/L.

Table B-2. Parathion Concentrations in Ingram/Hospital Creek

Data Source	Sample Years	Number of Samples	Range of Parathion Concentrations	Criteria[a]		Number of Samples Equal to or Above Criteria	Percent Samples Equal to or Above Criteria
Ross, 1993, 1992; Ross et al 1996, 1999; Fujimura, 1991 a,b, 1993a,b,c,d	1991-1993	9	nd	Chronic	0.013 µg/L	0	0%
				Acute	0.065 µg/L	0	0%
Foe, 1995	1991	10	nd - 0.91 µg/L	Chronic	0.013 µg/L	4	40%
				Acute	0.065 µg/L	3	30%
Foe, 1995	1992	14	nd - 0.12 µg/L	Chronic	0.013 µg/L	3	21%
				Acute	0.065 µg/L	1	7%
Sum	1991 - 1993	33	nd - 0.91 µg/L	Chronic	0.013 µg/L	7	21%
				Acute	0.065 µg/L	4	12%

a) EPA water quality criteria for the protection of freshwater aquatic life (Marshack, 2000)
nd = not detected

Extent of Impairment
Ingram/Hospital Creek is impaired from the confluence of the two creeks, east of Dairy Road, to the San Joaquin River due to parathion in agricultural return flows and tailwater (Foe, 19995). Upstream of the confluence and west toward Interstate 5, Ingram Creek and Hospital Creek also receive agricultural return flows and tailwater; therefore, parathion impairment is likely in Ingram Creek and in Hospital Creek but its extent is currently unknown.

Potential Sources
Because other pesticides, such as diazinon and chlorpyrifos, are known to enter surface waters from agricultural return flows and tailwater, the main source of parathion in Ingram/Hospital Creek is likely agriculture.

B.1.26 Jack Slough, Diazinon

Summary of Proposed Actions
The California Regional Water Quality Control Board, Central Valley Region (Regional Board) recommends the addition of the Jack Slough to California's Clean Water Act Section 303(d) list due to impairment by diazinon. Information available to the Regional Board on diazinon levels in Jack Slough indicates that water quality objectives are not being attained. A description for the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Jack Slough	**Pollutants/Stressors**	Diazinon
Hydrologic Unit	515.40	**Sources**	Agriculture
Total Waterbody Size	17 miles	**TMDL Priority**	
Size Affected	13 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	13 miles	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	39º 14' 59"	**Upstream Extent Longitude**	121º 29' 01"
Downstream Extent Latitude	39º 10' 06"	**Downstream Extent Longitude**	121º 35' 24"

Watershed Characteristics

Located in the Feather River watershed, Jack Slough originates in the foothills of northern Yuba County and flows south/southwest to its confluence with the Feather River, northwest of Marysville. Jack Slough meanders as a natural channel, through riparian zones, in the upstream portion of the watershed and is channelized in the downstream portion of the watershed, where intensive agriculture and year-round irrigation management occurs. In the Sacramento Valley, land use adjacent Jack Slough is predominately agriculture with rice fields located near the upper part of Jack Slough drainage and dense fruit and nut orchards located near the lower part of Jack Slough drainage.

Water Quality Objectives Not Attained

The narrative objectives for pesticides and toxicity are not being attained for diazinon in the Jack Slough. The narrative objective for pesticides states, "No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses." The narrative toxicity objective in the Basin Plan states "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." It further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective…As a minimum, compliance with this objective…shall be evaluated with a 96-hour bioassay (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf)." The California Department of Fish and Game has established freshwater numeric acute (1-hour average) and chronic (4-day average) criteria for diazinon of 0.08µg/L and 0.05 µg/L, respectively, for the protection of aquatic life (Siepmann and Finlayson, 2000).

Evidence of Impairment

Between 1994 and 2000, the Regional Board and the USGS monitoring studies analyzed a total of 26 ambient water samples collected in Jack Slough, during rain events, for diazinon. Overall, 26 out of 26 samples (100%) exceeded the CDFG chronic water quality criteria of 0.05 parts per billion (ppb) and the acute water quality criteria of 0.08 ppb in January and February, coinciding with the orchard dormant spray season. Pollutant concentrations in ambient water samples collected from Jack Slough ranged up to more than 22 times the CDFG chronic water quality criteria. Table 2 summarizes the available data.

Table B-2. Diazinon in Water Samples Collected from Jack Slough

Data Source	Sample Years	Number of Samples	Range of Diazinon Concentrations	Criteria		Number of Samples Equal to or Above Criteria	Percent Samples Equal to or Above Criteria
Holmes et al., 2000	1994	9	0.137 - 0.803 µg/L	Chronic	0.05 µg/L	9	100%
				Acute	0.08 µg/L	9	100%
Dileanis et al, 2000	2000	17	0.167 - 1.108 µg/L	Chronic	0.05 µg/L	17	100%
				Acute	0.08 µg/L	17	100%
Sum	1994 - 2000	26	0.137 - 1.108 µg/L	Chronic	0.05 µg/L	26	100%
				Acute	0.08 µg/L	26	100%

Extent of Impairment

Based on California Department of Pesticide Regulation preliminary 2000 Pesticide Use Report (PUR) data, diazinon use (primarily on peach, prune and cherry trees and less on walnut trees) occurs as far as 11 miles upstream from the Regional Board and USGS Jack Slough monitoring study sites (near Highway 70), where 100% of the collected ambient water samples equaled or exceeded CDFG acute and chronic water quality criteria during the orchard dormant spray season. Therefore, diazinon impairment in Jack Slough is likely to extend approximately 11 miles upstream from the two monitoring study sites and also

approximately 2 miles downstream from the monitoring study sites, prior to the confluence of Jack Slough and the Feather River.

Potential Sources
Agriculture is the predominant land use near Jack Slough, specifically fruit and nut orchards and rice fields. Diazinon is applied to orchards, primarily during the dormant spray season to control pests. Seasonal rainfall events in the Sacramento Valley coincide with the orchard dormant spray season and, as a result, residual diazinon migrates with surface runoff from orchards and enters Jack Slough during winter rainstorms. Irrigation return water can also transport diazinon to Jack Slough. Since agriculture is the predominant land use near Jack Slough and diazinon is the primary pesticide used on nearby orchards, the main source of diazinon in Jack Slough is likely from agriculture, particularly from orchards during the orchard dormant spray season.

B.1.27 Lake Combie, Mercury

Summary of Proposed Action
The California Regional Water Quality Control Board, Central Valley Region (Regional Board) recommends the addition of Lake Combie to California's Clean Water Act Section 303(d) list due to impairment by mercury. Information available to the Regional Board on mercury levels in fish tissue samples indicates that water quality objectives are not being attained in Lake Combie. The description for the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Lake Combie	**Pollutants/Stressors**	Mercury
Hydrologic Unit	516.33	**Sources**	Resource Extraction (abandoned mines)
Total Length	360 acres	**TMDL Priority**	
Size Affected	360 acres	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	All of Lake Combie	**TMDL End Date (Mo/Yr)**	

Watershed Characteristics
The Bear River basin has over 232,800 watershed acres. Water uses include hydroelectric generation, recreational, agricultural, and municipal uses, among others. The basin is bound by the Yuba River on the north, the Little Truckee River basin on the east, and the American River basin on the south. The headwaters are located in the Sierra Nevada snowfields at elevations ranging up to 9,100 feet above sea level. The Bear River flows into Rollins Reservoir before reaching Lake Combie.

Water Quality Objectives Not Attained
The narrative objective for toxicity is not being attained for mercury in Lake Combie. The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective." (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf).

Numeric criteria for mercury in fish tissue have been developed for both human health and wildlife protection. The U.S. Environmental Protection Agency (USEPA) recently established a human health protection criterion of 0.3 milligrams per kilogram (mg/kg; equivalent to parts per million [ppm]) methylmercury in the edible portions of fish (USEPA, 2001b). This criterion is used to determine attainment with of the narrative toxicity objective.

Evidence of Impairment
The U.S. Geological Survey (USGS) collected trophic level 3 and 4 fish tissue samples for Lake Combie. Trophic level 3 fish feed on zooplankton, phytoplankton, and benthic invertebrates. Trophic level 4 fish consume trophic level 3 fish as part of their diet. Methylmercury and total mercury bioaccumulates in aquatic organisms and tends to increase with increasing trophic levels (USEPA, 1997a). The USGS sampled nine trophic level 4 fish (largemouth bass) in 1999. The trophic level 4 fish had an average mercury concentration of 0.91 ppm, which exceeds the USEPA criterion of 0.3 ppm. Placer, Yuba, and Nevada counties have issued an interim public health notification for all lakes and watercourses within these counties based on the USGS data. OEHHA is in the process of developing a state advisory (Nevada County, 2000).

Extent of Impairment
Lake Combie covers 360 surface acres. The entire waterbody is impaired by mercury.

Potential Sources
The Bear River watershed was historically mined extensively for its hardrock and placer gold deposits and has been affected by hydraulic mining (Alpers and Hunerlach, 2000). Several inactive gold mines exist upstream of Lake Combie in the Bear River watershed (Montoya and Pan, 1992).

B.1.28 Lake Englebright, Mercury

Summary of Proposed Action
The California Regional Water Quality Control Board, Central Valley Region (Regional Board) recommends the addition of Lake Englebright to California's Clean Water Act Section 303(d) list due to impairment by mercury. Information available to the Regional Board on mercury levels in fish tissue samples indicates that water quality objectives are not being attained in Lake Englebright. The description for the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Lake Englebright	**Pollutants/Stressors**	Mercury
Hydrologic Unit	517.14	**Sources**	Resource extraction (abandoned mines)
Total Length	815 acres	**TMDL Priority**	
Size Affected	815 acres	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	All of Lake Englebright	**TMDL End Date (Mo/Yr)**	

Watershed Characteristics
The Yuba River basin has over 12,700 watershed acres and over 1,900 total river miles. Water usage includes recreational, agricultural, hydroelectric generation, and municipal uses, among others. The basin is bound by the Feather River basin on the north, by the Little Truckee River basin on the east, and by the Bear River and American River basins on the south. The headwaters are in the Sierra Nevada snowfields at elevations ranging up to 9,100 feet above sea level. The North Fork of the Yuba River flows into Bullard's Bar Reservoir. Water is released at the Bullard's Bar Dam and goes downstream to join flows from the Middle and South Forks of the Yuba River, which flow into Lake Englebright. From the Englebright Dam some water is diverted to a North and South Irrigation ditch but the majority of discharge continues downstream through Marysville and flows into the Feather River. Englebright Dam is located in the Sierra foothills 21 miles east of Marysville on State Highway 20. Englebright Dam was constructed primarily to prevent upstream hydraulic mining debris from moving downstream into the Yuba River floodplain.

Water Quality Objectives Not Attained
The narrative objective for toxicity is not being attained for mercury in Lake Englebright. The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California

Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective." (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf).

Numeric criteria for mercury in fish tissue have been developed for both human health and wildlife protection. The U.S. Environmental Protection Agency (USEPA) recently established a human health protection criterion of 0.3 milligrams per kilogram (mg/kg; equivalent to parts per million [ppm]) methylmercury in the edible portions of fish (USEPA, 2001b). This criterion is used to determine attainment with the narrative toxicity objective.

Evidence of Impairment
The U.S. Geological Survey (USGS) and University of California, Davis Division of Environmental Studies (UCD) collected fish tissue samples from the midsection, the South Yuba River Arm, and Hogsback Ravine Arm of Lake Englebright (May et al., 2000; Slotton et al., 1996b). Both studies collected trophic level 3 and 4 fish. Trophic level 3 fish feed on zooplankton, phytoplankton, and benthic invertebrates Trophic level 4 fish consume trophic level 3 fish as part of their diet. Methylmercury and total mercury bioaccumulates in aquatic organisms and tends to increase with increasing trophic levels (USEPA, 1997a). The USGS and UCD sampled 21 trophic level 4 fish (largemouth bass, smallmouth bass, and spotted bass) and 9 trophic level 3 fish (carp, green sunfish, hardhead, and Sacramento sucker) between 1996 and 1999. The TL4 fish and TL3 fish had average mercury concentrations of 0.55 ppm and 0.51 ppm, respectively, which exceed the USEPA criterion of 0.3 ppm. Placer, Yuba, and Nevada counties have issued an interim public health notification for all lakes and watercourses within these counties based on the USGS data. OEHHA is in the process of developing a state advisory (Nevada County, 2000).

Extent of Impairment
Lake Englebright is about 227 feet deep at the dam and covers 815 surface acres. It is 9 miles in length and has 24 miles of shoreline. Fish collected throughout the lake had mercury levels above the USEPA criterion. The entire waterbody is impaired by mercury.

Potential Sources
Several inactive and partially active gold mines exist upstream of Englebright Dam in the Yuba River watershed. The Yuba watershed was historically mined extensively for its hardrock and placer gold deposits and has been affected by hydraulic mining (Alpers and Hunerlach, 2000).

B.1.29 Little Deer Creek, Mercury

Summary of Proposed Action
The California Regional Water Quality Control Board, Central Valley Region (Regional Board) recommends the addition of Little Deer Creek to California's Clean Water Act Section 303(d) list due to impairment by mercury. Information available to the Regional Board on mercury levels in fish tissue samples indicates that water quality objectives are not being attained in Little Deer Creek. The description for the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Little Deer Creek	**Pollutants/Stressors**	Mercury
Hydrologic Unit	517.20	**Sources**	Resource extraction (abandoned mines)
Total Length	4 miles	**TMDL Priority**	
Size Affected	4 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	All of Little Deer Creek	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	N 39° 15' 13"	**Upstream Extent Longitude**	W 120° 57' 00"
Downstream Extent Latitude	N 39° 15' 44"	**Downstream Extent Longitude**	W 121° 00' 58"

Watershed Characteristics
Little Deer Creek is in the Sierra foothills directly east of Nevada City within the Yuba River basin. The Yuba River basin has over 12,700 watershed acres and over 1,900 total river miles. Water usage ranges from recreational to agricultural and municipal to hydroelectric generation, among others. The Yuba River basin is bound by the Feather River basin on the north, by the Little Truckee River basin on the east, and by the Bear River and American River basins on the south. Little Deer Creek flows for approximately 4 miles from its headwaters at approximately 3,500 feet above mean sea level (msl) to its confluence with Deer Creek at approximately 2,600 feet above msl in Nevada City. Deer Creek flows into the Yuba River downstream of Lake Englebright.

Water Quality Objectives Not Attained
The narrative objective for toxicity is not being attained for mercury in Little Deer Creek. The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services (OEHHA), the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective" (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf).

Numeric criteria for mercury in fish tissue have been developed for both human health and wildlife protection. The U.S. Environmental Protection Agency (USEPA) recently established a human health protection criterion of 0.3 milligrams per kilogram (mg/kg; equivalent to parts per million [ppm]) methylmercury in the edible portions of fish (USEPA, 2001b). This criterion is used to determine attainment with the narrative toxicity objective.

Evidence of Impairment
The U.S. Geological Survey (USGS) collected fish tissue samples from Little Deer Creek at Pioneer Park. Only trophic level 3 fish were collected in the study. Trophic level 3 fish feed on zooplankton, phytoplankton, and benthic invertebrates. Methylmercury and total mercury bioaccumulates in aquatic organisms and tends to increase with increasing trophic levels (USEPA, 1997a). The USGS sampled six brown trout on October 6, 1999. These TL3 fish had an average mercury concentration of 0.32 ppm, which exceeds the USEPA criterion of 0.3 ppm. Placer, Yuba, and Nevada counties have issued an interim public health notification for all lakes and watercourses within these counties based on the USGS data. OEHHA is in the process of developing a state advisory (Nevada County, 2000).

Extent of Impairment
Little Deer Creek runs for approximately 4 miles and drains into the mainstem of Deer Creek. The entire waterbody is impaired by mercury.

Potential Sources
The inactive Banner Mine is within the watershed of Little Deer Creek, about 2.5 miles upstream from the confluence with Deer Creek. Several inactive and partially active gold mines exist within the Yuba River watershed. The Yuba watershed was historically mined extensively for its hardrock and placer gold deposits and has been affected by hydraulic mining (Alpers and Humerlach, 2000).

B.1.30 Lower Mokelumne River, Aluminum

Summary of Proposed Action
The California Regional Water Quality Control Board, Central Valley Region, (Regional Board) recommends the addition of the lower Mokelumne River to California's Clean Water Act Section 303(d) list due to impairment by aluminum. Information available to the Regional Board on aluminum levels in water samples indicates that water quality objectives are not being attained in the lower Mokelumne River. A description for the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Mokelumne River, Lower	**Pollutants/Stressors**	Aluminum
Hydrologic Unit	535.00	**Sources**	Resource extraction (abandoned mines)
Total Waterbody Size	28 miles	**TMDL Priority**	
Size Affected	28 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	Camanche Dam to Delta	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	38° 13' 35"	**Upstream Extent Longitude**	121° 1' 21"
Downstream Extent Latitude	38° 12' 36"	**Downstream Extent Longitude**	121° 21' 55"

Watershed Characteristics
The lower Mokelumne River flows 28 miles from Camanche Dam to the legal Sacramento-San Joaquin Delta boundary in San Joaquin County. Camanche Reservoir, working in tandem with the upstream Pardee Reservoir, stores water for irrigation and stream-flow regulation, providing flood control, water to the meet the needs of downstream water rights holders, and water for fisheries and riparian habitat (EBMUD, 2000). The East Bay Municipal Utility District (EBMUD) completed the Camanche Reservoir Project (downstream of Pardee) in 1964. EBMUD built a fish hatchery (the Mokelumne River Fish Installation) immediately downstream of Camanche Dam on the lower Mokelumne River, which the California Department of Fish and Game operates. In addition, a power plant at the base of the dam was placed in service in 1983.

Water Quality Objectives Not Attained
The narrative objective for toxicity is not being attained for aluminum in the lower Mokelumne River. The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf)."

The toxicity objective was evaluated for the lower Mokelumne River by comparing aluminum concentrations measured in the lower Mokelumne River downstream of Camanche Dam to water quality guidelines and criteria developed for human health and wildlife protection. Available data were compared to the numeric United States Environmental Protection Agency (USEPA) National Recommended Ambient Water Quality Criteria (NRAWQ) maximum (1-hour average) total recoverable aluminum criterion for freshwater aquatic life protection of 750 micrograms per liter (µg/L) (Marshack, 2000). The USEPA maximum contaminant level (MCL) for drinking water protection is 1,000 µg/L of total recoverable aluminum (Marshack, 2000).

Evidence of Impairment
Between 1988 and 1992, EBMUD measured total recoverable aluminum concentrations at three locations on the Mokelumne River downstream of Camanche Dam (USFWS, 1992). Table 2 summarizes the available EBMUD aluminum data. The 1988-1992 data indicate that exceedances of the MCL and NRAWQ criteria occurred in the lower Mokelumne River immediately downstream of Camanche Dam. More recent aluminum data are not available.

Table B-2. Summary of Available Total Recoverable Aluminum Concentration Data for the Lower Mokelumne River (Data source: USFWS, 1992)

Location [a]	# of Samples (Dates Collected)	Range of Concentrations (µg/L)	# (%) of Samples Exceeding Objectives [b]	
			MCL (1,000 µg/L)	NRAWQ Maximum Criterion (750 µg/L)
CamC	146 (9/88 – 11/92)	<10 – 4,800	12 [8%] [c]	19 [13%] [d]
CamD	90 (5/88 – 11/92)	<10 –2,900	10 [11%]	14 [16%]
VAPK	21 (6/88-11/92)	20 – 1,900	2 [10%]	2 [10%]

(a) CamC: Discharge from Camanche Dam to the Mokelumne River.
CamD: Camanche Reservoir lower outlet to the Mokelumne River
VAPK: Mokelumne River at Van Assen Park, downstream of Camanche Dam.
(b) MCL: California Drinking Water Standards Maximum Contaminant Level (MCL) of 1,000 µg/l for total recoverable aluminum concentrations.
NRAWQ: U.S. Environmental Protection Agency National Recommended Ambient Water Quality Criteria (NRAWQ) for Freshwater Aquatic Life Protection; maximum criterion is a 1-hour average, for pH values of 6.5 to 9.
(c) The twelve samples with aluminum concentrations above 1,000 µg/l were collected within a 7-day period in March 1989.
(d) Eighteen of the 19 samples with aluminum concentrations above 750 µg/l were collected within an 8-day period in March 1989.

Extent of Impairment
The lower Mokelumne River flows 28 miles from Camanche Dam to the Delta. Data are available only for approximately one mile downstream of Camanche Dam. However, the entire 28-mile reach is probably impaired because there are no substantial input flows.

Potential Sources
Several historic copper and gold mines (including Argonaut, Newton, and Penn) are within the lower Mokelumne River watershed. Penn Mine, which historically operated for copper extraction from 1861 to 1956, impacted the water quality of both Camanche Reservoir and the lower Mokelumne River downstream of Camanche Dam. The Penn Mine site occupies a 22-acre area near the southeastern shore of Camanche Reservoir approximately 1.5 miles from the town of Campo Seco in Calaveras County. Penn Mine historically discharged to the reservoir via Mine Run Creek. Metal loading from Penn Mine led to fishery declines and fish kills in Camanche Reservoir, in the Mokelumne River Fish Installation

downstream of Camanche Dam, and in the lower Mokelumne River; problems with toxic discharges from the Penn Mine continued through the 1960s and 1970s (Buer et al., 1979; SRWCB, 1990; CDFG, 1991; EDAW, Inc., 1992; EBMUD, 2000). Beginning in 1978, several abatement and restoration projects were conducted to decrease the impact of Penn Mine on Camanche Reservoir and the lower Mokelumne River; the most recent abatement project was completed in late 1999 (Buer et al., 1979; SCH EIR, 1996; CH2MHill, 2000a and 2000b).

B.1.31 Mormon Slough, Low Dissolved Oxygen

Summary of Proposed Action

The California Regional Water Quality Control Board-Central Valley Region, Regional Board, recommends the addition of Mormon Slough to California's Clean Water Act Section 303(d) list due to impairment by low dissolved oxygen. Information available to the Regional Board on dissolved oxygen levels in Mormon Slough indicates that water quality objectives are not being attained. A description for the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Mormon Slough	**Pollutants/Stressors**	Low Dissolved Oxygen
Hydrologic Unit	544.00	**Sources**	Urban Runoff/Storm Sewers
Total Waterbody Size	6 miles	**TMDL Priority**	
Size Affected	1 mile	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	From Commerce Street to the Stockton Deep Water Ship Channel.	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	37° 56' 43"	**Upstream Extent Longitude**	121° 17' 26"
Downstream Extent Latitude	37° 57' 09"	**Downstream Extent Longitude**	121° 18' 22"

Watershed Characteristics

Mormon Slough is located within the San Joaquin Delta Hydrologic Unit in south-central Stockton, California and flows into the Stockton Deep Water Ship Channel near the Port of Stockton.

Water Quality Objectives Not Attained

The Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins contains a numeric objective applicable to Mormon Slough which requires dissolved oxygen (DO) not be reduced below 5 milligrams per liter (mg/l). (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf).

Evidence of Impairment

A report of DeltaKeeper data collected between 8 November 1999 and 7 February 2000 found DO concentrations in Mormon Slough below the Basin Plan objective in 27 of 30 samples (Lee and Jones-Lee, 2000).

Table B-2. Dissolved Oxygen Concentrations in Water Samples Collected from Mormon Slough

Data Source	Sample Years	Number of Samples	Range of DO Concentrations	Number of Samples Below Criterion
Lee and Jones-Lee, 2000a (DeltaKeeper)	November 1999 to February 2000	30	0.5 – 9.6 mg/L	27

Extent of Impairment
Dissolved oxygen concentrations in Mormon Slough near Stockton have been documented to fall below the Basin Plan objective of 5 mg/l as demonstrated by the DeltaKeeper data discussed above. The data is limited to a sampling point in Mormon Slough near the transition of Mormon Slough from an urban creek (relatively narrow) to a slough (relatively wide). The sampling point may, therefore, not be representative of DO levels in the narrower portion of the Slough. Based on this evidence, Mormon Slough, between Commerce St. (the approximate transition point from urban creek to slough) and the Stockton Deep Water Ship Channel is being recommended for addition to the 303(d) list due to low DO.

Potential Sources
The impaired reach is within the Stockton urban area. The most likely source of oxygen demanding substances is from runoff from the urban area.

B.1.32 Mormon Slough, Pathogens

Summary of Proposed Action
The California Regional Water Quality Control Board, Central Valley Region, (Regional Board) recommends the addition of Mormon Slough to California's Clean Water Act Section 303(d) list due to impairment by pathogens. Information available to the Regional Board on pathogens levels in Mormon Slough indicates that water quality objectives are not being attained. A description for the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Mormon Slough	**Pollutants/Stressors**	Bacteria
Hydrologic Unit	544.00	**Sources**	Urban runoff, Recreation
Total Waterbody Size	6 Miles	**TMDL Priority**	
Size Affected	4 Miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	From the confluence with the Deep Water Channel to the confluence with the Stockton Diverting Canal.	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	37º 57' 25"	**Upstream Extent Longitude**	121º 20' 53"
Downstream Extent Latitude	37º 58' 02"	**Downstream Extent Longitude**	121º 18' 25"

Watershed Characteristics
Mormon Slough is a tributary to the Stockton Deep Water Channel in the Delta. The Delta is characterized by tidal waters with limited flushing flows during the dry seasons. The area around Mormon Slough is highly urbanized and supports recreational uses, including boating, fishing, water skiing and swimming.

Water Quality Objectives Not Attained
The narrative objective for toxicity is not being attained for pathogens in the predominantly urban stretches of various Delta waterways (including Mormon Slough). The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states the " the Regional Water Board will also consider…numerical criteria and guidelines developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services…the U.S. Environmental Protection Agency, and other organizations to evaluate compliance with this objective." The Basin Plan also contains a specific objective for fecal coliform bacteria (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/rwqcb5/bsnplnab.pdf).

Guidelines and criteria have been developed for the protection of human health. Guidelines and criteria have been developed for the protection of human health. The California Department of Health Services (CDHS) has adopted a total coliform bacteria guideline, applicable to recreational waters and beaches, of 10,000 Most Probable Number (MPN) per 100 milliliters for single samples and of 1,000 MPN per 100 ml for 30-day log mean of sample levels (Title 17 California Code of Regulation section 7958). CDHS has also published draft guidelines that include limits for single samples of *E. coli* of 235 MPN per 100 milliliters (CDHS, July 2000 http://www.dhs.ca.gov/ps/ddwem/beaches/freshwater.htm). U.S. EPA guidelines for bacteria are contained in *Ambient Water Quality Criteria for Bacteria* (USEPA, 1986a). The U.S. EPA standards are stated as "Based on a statistically sufficient number of samples (generally not less than 5 samples equally spaced over a 30-day period), the geometric mean of the indicated bacterial densities should not exceed one or the other of the following: *E. coli* 126 MPN per 100 ml; or Enterococci 33 MPN per 100 ml." A methodology for determining exceedances based on single samples is also included in the standards.

Evidence of Impairment
DeltaKeeper submitted bacteria data for Mormon Slough from one sampling location, approximately one mile upstream from the confluence with the Stockton Deep Water Channel (DeltaKeeper, 2001). A total of 31 samples collected during 10 months in 2000-2001 were analyzed. The calculated geometric mean for the *E. coli* levels is 1,272 MPN per 100 ml, which exceeds the U.S. EPA criterion of 126 MPN per 100 ml.

Extent of Impairment
Regional Board staff recommends listing the portion of Mormon Slough between the Stockton Deep water Channel and the Stockton Diverting Canal as impaired for pathogens due to bacterial contamination. The entire area around Mormon Slough is urban and has similar land use patterns and it is anticipated that sampling along other portions of Mormon Slough would show similar bacteria levels.

Potential Sources
In urban settings, the U.S. EPA has identified sources of pathogen pollution including urban litter, contaminated refuse, domestic pet and wildlife excrement and failing sewer lines (USEPA, 2001a). In their pathogen TMDL Guide, the U.S. EPA states "In a study of bacterial loading in urban streams, Young and Thackston (1999) found that fecal bacteria densities were directly related to the density of housing, population, development, percent impervious area, and domestic animal density. Additionally, recreational areas may have high bacteria counts. This can be due to improper disposal of waste from boats, lack of sanitary facilities in the area of recreation and children in diapers using the water."

B.1.33 Mosher Slough, Low Dissolved Oxygen

Summary of Proposed Action
The California Regional Water Quality Control Board-Central Valley Region, Regional Board, recommends the addition of Mosher Slough to California's Clean Water Act Section 303(d) list due to impairment by low dissolved oxygen. Information available to the Regional Board on dissolved oxygen levels in Mosher Slough indicates that water quality objectives are not being attained. A description for the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Mosher Slough	**Pollutants/Stressors**	Low Dissolved Oxygen
Hydrologic Unit	544.00	**Sources**	Urban Runoff/Storm Sewers
Total Waterbody Size	5 miles	**TMDL Priority**	
Size Affected	2 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	From I-5 bridge to confluence with Bear Creek.	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	38° 1' 57.3"	**Upstream Extent Longitude**	121° 21' 51.0"
Downstream Extent Latitude	38° 2' 35.2"	**Downstream Extent Longitude**	121° 23' 11.8"

Watershed Characteristics
Mosher Slough is located within the San Joaquin Delta Hydrologic Unit, in the primarily residential north side of Stockton, California, and joins Bear Creek in the northwest corner of the city limits.

Water Quality Objectives Not Attained
The Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins contains a numeric objective applicable to Mosher Slough which requires dissolved oxygen (DO) not be reduced below 5 milligrams per liter (mg/l) (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf).

Evidence of Impairment
A report of DeltaKeeper data collected between 8 November 1999 and 7 February 2000 found DO concentrations in Mosher Slough below the Basin Plan objective in 18 of 32 samples. Data collected between 15 October 1996 and 8 November 1996 found DO concentrations below the Basin Plan objective in 1 of 11 samples (Lee and Jones-Lee, 2000a).

Table B-2. Dissolved Oxygen Concentrations in Water Samples Collected from Mosher Slough

Data Source	Sample Years	Number of Samples	Range of DO Concentrations	Number of Samples Below Criterion
Lee and Jones-Lee, 2000a (DeltaKeeper)	October/November 1996; November 1999 to February 2000	43	1.3 – 9.3 mg/L	19

Extent of Impairment
Dissolved oxygen concentrations in Mosher Slough near Stockton have been documented to fall below the Basin Plan objective of 5 mg/l, as demonstrated by the DeltaKeeper data discussed above. Just above the sampling point in Mosher Slough, the characteristics of the Slough change from a narrow urban creek to a much wider Slough. The sampling point may, therefore, not be representative of DO levels in the narrower portion of the Slough. Based on this evidence, Mosher Slough between the I-5 bridge (the approximate transition point from urban creek to slough) and its confluence with Bear Creak is being 303(d) listed due to low DO.

Potential Sources
The impaired reach of Mosher Slough receives runoff from the Stockton urban area. The most likely source of oxygen demanding substances is from runoff from the urban area.

B.1.34 Mosher Slough, Pathogens

Summary of Proposed Action

The California Regional Water Quality Control Board, Central Valley Region, (Regional Board) recommends the addition of Mosher Slough in the Delta to California's Clean Water Act Section 303(d) list due to impairment by pathogens. Information available to the Regional Board on pathogens levels in Mosher Slough indicates that water quality objectives are not being attained. A description for the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Mosher Slough	**Pollutants/Stressors**	Bacteria
Hydrologic Unit	544.00	**Sources**	Urban runoff, Recreation
Total Waterbody Size	5 miles	**TMDL Priority**	
Size Affected	5 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	From Mosher Creek to the confluence with Bear Creek	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	38° 01' 45"	**Upstream Extent Longitude**	121° 16 45'
Downstream Extent Latitude	38° 02' 35"	**Downstream Extent Longitude**	121° 23' 11"

Watershed Characteristics

Mosher Slough flows through urban portion of Stockton, in the Delta. The Delta is characterized by tidal waters with limited flushing flows during the dry seasons. The lower portion of the slough is near, and is likely also used for, recreational uses including boating, fishing, water skiing and swimming. The predominant land uses in the watershed that encompasses Mosher Slough are agricultural, urban (the city of Stockton), and a deepwater port.

Water Quality Objectives Not Attained

The narrative objective for toxicity is not being attained for pathogens in Mosher Slough. The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states the " the Regional Water Board will also consider…numerical criteria and guidelines developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services…the U.S. Environmental Protection Agency, and other organizations to evaluate compliance with this objective." The Basin Plan also contains a specific objective for fecal coliform bacteria (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/rwqcb5/bsnplnab.pdf).

Guidelines and criteria have been developed for the protection of human health. The California Department of Health Services (CDHS) has adopted a total coliform bacteria guideline, applicable to recreational waters and beaches, of 10,000 Most Probable Number (MPN) per 100 milliliters for single samples and of 1,000 MPN per 100 ml for 30-day log mean of sample levels (Title 17 California Code of Regulation section 7958). CDHS has also published draft guidelines that include limits for single samples of *E. coli* of 235 MPN per 100 milliliters (CDHS, July 2000; http://www.dhs.ca.gov/ps/ddwem/beaches/freshwater.htm). The U.S. EPA guidelines for bacteria are contained in *Ambient Water Quality Criteria for Bacteria* (USEPA, 1986a). The U.S. EPA standards are stated as, "Based on a statistically sufficient number of samples (generally not less than 5 samples equally spaced over a 30-day period), the geometric mean of the indicated bacterial densities should not exceed one or the other of the following: *E. coli* 126 per 100 ml; or Enterococci 33 per 100 ml." A methodology for determining exceedances based on single samples is also included in the standards.

Evidence of Impairment
DeltaKeeper submitted bacteria data for Mosher Slough from three sampling locations (DeltaKeeper, 2001). Although geometric means have not been calculated for the data, all 31 samples submitted exceed the CDHS 30 day criterion for total coliform and 29 of the 31 samples exceed the recommended *E. coli* criterion. The measured bacteria densities in the samples were high during the entire sampling period, which includes samples collected during an entire year (May, August, September, October, November, December, January, and February).

Extent of Impairment
Regional Board staff recommends listing Mosher Slough as impaired due to pathogen contamination. The sampling location is within the urban Stockton area. The area around Mosher Slough is heavily urbanized and it is likely that samples collected from other portions of Mosher Slough would show similar high levels of bacteria.

Potential Sources
In urban settings, U.S. EPA has identified sources of pathogen pollution to include urban litter, contaminated refuse, domestic pet and wildlife excrement and failing sewer lines (USEPA, 2001a). In their pathogen TMDL Guide, the U.S. EPA states "In a study of bacterial loading in urban streams, Young and Thackston (1999) found that fecal bacteria densities were directly related to the density of housing, population, development, percent impervious area, and domestic animal density. Additionally, recreational areas may have high bacteria counts. This can be due to improper disposal of waste from boats, lack of sanitary facilities in the area of recreation and children in diapers using the water."

B.1.35 Newman Wasteway, Chlorpyrifos

Summary of Proposed Actions
The California Regional Water Quality Control Board, Central Valley Region (Regional Board) recommends the addition of the Newman Wasteway to California's Clean Water Act Section 303(d) list due to impairment by chlorpyrifos. Information available to the Regional Board on chlorpyrifos concentrations indicates that water quality objectives are not being attained. The basis for this recommendation is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Newman Wasteway	**Pollutants/Stressors**	Chlorpyrifos
Hydrologic Unit	541.20	**Sources**	Agriculture
Total Waterbody Size	8.5 miles	**TMDL Priority**	
Size Affected	8.5 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	The entire Wasteway	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	37° 17' 27"	**Upstream Extent Longitude**	121° 05' 17"
Downstream Extent Latitude	37° 20' 16"	**Downstream Extent Longitude**	120° 58' 20"

Watershed Characteristics
The Newman Wasteway originates at the Delta Mendota Canal in Stanislaus County and flows east into Merced County, past Route 33, to the north of Preston Road and continues northeast to the San Joaquin River, just south of Hills Ferry. The Newman Wasteway, owned by the U.S. Bureau of Reclamation and operated by the San Luis and Delta-Mendota Water Authority, was built to carry emergency releases of water from the Delta-Mendota Canal to the San Joaquin River. Local agricultural drainage is allowed to enter the wasteway.

Water Quality Objectives Not Attained

The narrative objectives for pesticides and toxicity are not being attained for chlorpyrifos in the Newman Wasteway. The narrative objective for pesticides states, "No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses." The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective." (CRWQCB-CVR, 1998; www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf) The California Department of Fish and Game has established freshwater numeric acute (1-hour average) and chronic (4-day average) criteria for chlorpyrifos of 0.02 µg/L and 0.014 µg/L, respectively, for the protection of aquatic life (Siepmann and Finlayson, 2000).

Evidence of Impairment

Between 1991 and 1993, a total of ten ambient water samples collected from the Newman Wasteway were analyzed for chlorpyrifos (Table 2). Most samples were collected between January and April. Two of the ten (20%) samples contained chlorpyrifos concentrations at or above the CDFG chronic water quality criterion of .014 ug/l, and one of the ten (10%) was above the CDFG acute water quality criterion of .020 ug/l. Overall, chlorpyrifos concentrations in samples collected from Newman Wasteway ranged from less than 1 to 15 times the CDFG chronic water quality criteria (Foe, 1995; Ross, 1992, 1993; Ross et al., 1996, 1999; Fujimura, 1991a,b, 1993a,b,c,d).

Table B-2. Chlorpyrifos Concentrations in Water Samples from the Newman Wasteway

Data Source	Sample Years	Number of Samples	Range of Chlorpyrifos Concentrations	CDFG Criteria[a]		Number of Samples Equal to or Above Criteria	Percent Samples Equal to or Above Criteria
Foe, 1995; Ross, 1992, 1993; Ross et al., 1996, 1999; Fujimura, 1991a,b, 1993a,b,c,d	1991-1993	10	nd - 0.21 µg/L	chronic	0.014 µg/L	2	20%
				acute	0.02 µg/L	1	10%

a) California Department of Fish and Game Water Quality Criteria for the Protection of Aquatic Life (Siepmann and Finlayson, 2000)

nd = not detected

Extent of Impairment

Because the Newman Wasteway is surrounded by agricultural land from which it receives runoff, it is likely that the entire Wasteway is impaired by chlorpyrifos.

Potential Sources

Agriculture is the likely source of chlorpyrifos in the Newman Wasteway.

B.1.36 Newman Wasteway, Diazinon

Summary of Proposed Action

The California Regional Water Quality Control Board, Central Valley Region (Regional Board) recommends the addition of the Newman Wasteway to California's Clean Water Act Section 303(d) list due to impairment by diazinon. Information available to the Regional Board on diazinon concentrations in

the Newman Wasteway indicates that water quality objectives are not being attained. The basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Newman Wasteway	**Pollutants/Stressors**	Diazinon
Hydrologic Unit	541.20	**Sources**	Agriculture
Total Waterbody Size	8.5 miles	**TMDL Priority**	
Size Affected	8.5 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	The entire wasteway	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	37° 17' 27"	**Upstream Extent Longitude**	121° 05' 17"
Downstream Extent Latitude	37° 20' 16"	**Downstream Extent Longitude**	120° 58' 20"

Watershed Characteristics

The Newman Wasteway originates at the Delta Mendota Canal in Stanislaus County and flows east into Merced County, past Route 33, to the north of Preston Road and continues northeast to the San Joaquin River, just south of Hills Ferry. The Newman Wasteway, owned by the U.S. Bureau of Reclamation and operated by the San Luis and Delta-Mendota Water Authority, was built to carry emergency releases of water from the Delta-Mendota Canal to the San Joaquin River. Local agricultural drainage is allowed to enter the wasteway.

Water Quality Objectives Not Attained

The narrative objectives for pesticides and toxicity are not being attained for diazinon in the Newman Wasteway. The narrative objective for pesticides states, "No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses." The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective." (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf) The California Department of Fish and Game has established freshwater numeric acute (1-hour average) and chronic (4-day average) criteria for diazinon of 0.08µg/L and 0.05 µg/L, respectively, for the protection of aquatic life (Siepmann and Finlayson, 2000).

Evidence of Impairment

Between 1991 and 1993, multiple studies analyzed a total of ten water samples collected in Newman Wasteway for diazinon (Table 2). Four out of ten (40%) exceeded the CDFG chronic criterion of 0.05 µg/L, and three out of ten (30%) exceeded the CDFG acute criterion of 0.08 µg/L. Diazinon concentrations ranged from less than 1 time to more than 700 times the CDFG chronic criterion.

Table B-2. Diazinon Concentrations in Water Samples from Newman Wasteway

Data Source	Sample Years	Number of Samples	Range of Diazinon Concentrations	Criteria[a]		Number of Samples Equal to or Above Criteria	Percent Samples Equal to or Above Criteria
Ross, 1992, 1993; Ross et al., 1996, 1999; Fujimura, 1991a,b, 1993a,b,c,d	1991-1993	10	nd - 36.82 µg/L	chronic	0.05 µg/L	4	40%
				acute	0.08 µg/L	3	30%

a) CDFG water quality criteria for the protection of aquatic organisms (Siepmann and Finlayson, 2000)
nd = none detected

Extent of Impairment
Diazinon is used on agricultural crops, especially nut and stone fruit orchards during the dormant season. Because the Newman Wasteway is surrounded by agricultural land, including orchards, and receives agriculture runoff, it is likely that the entire Wasteway is impaired by diazinon.

Potential Sources
Since diazinon is applied to crops in the area surrounding the Newman Wasteway and runoff from agriculture enters surface waters that flow to the Newman Wasteway, the main source of diazinon is likely agriculture.

B.1.37 Oak Run Creek, Fecal Coliform

Summary of Proposed Action
The California Regional Water Quality Control Board-Central Valley Region (Regional Board) recommends the addition of Oak Run Creek to California's Clean Water Act Section 303(d) list due to impairment by fecal coliform. Information available to the Regional Board on pathogens levels in Oak Run Creek indicates that water quality objectives are not being attained. A description for the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Oak Run Creek	**Pollutants/Stressors**	Fecal Coliform
Hydrologic Unit	507.33	**Sources**	Human and/or livestock sources
Total Waterbody Size	23.5 miles	**TMDL Priority**	
Size Affected	4.5 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	From 16.5 miles before the confluence to 12 miles from the confluence.	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	N 40° 41' 41"	**Upstream Extent Longitude**	W 122° 02' 21"
Downstream Extent Latitude	N 40° 39' 19"	**Downstream Extent Longitude**	W 122° 04' 23"

Watershed Characteristics
Oak Run Creek is located in Shasta County, and flows from the foothills of Mount Lassen southwest to the Sacramento River, east of Anderson. Oak Run Creek is part of the Cow Creek watershed. Land use within the Cow Creek watershed previously included use by indigenous peoples and historic mining, and currently includes ranches, timberlands, and towns (Montoya and Pan, 1992; Hannaford and North State Institute for Sustainable Communities, 2000).

Water Quality Objectives Not Attained
The numeric objective for bacteria is not being attained in Oak Run Creek. The bacteria objective in the Basin Plan states, in part, "In waters designated for contact recreation (REC-1), the fecal coliform concentration based on a minimum of not less than five samples for any 30-day period shall not exceed a geometric mean of 200/100 ml, nor shall more than ten percent of the total number of samples taken during any 30-day period exceed 400/100 ml (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf)." The bacteria objectives are presented in terms of Most Probable Number (MPN) per 100 milliliters (ml). The bacteria objectives were evaluated for Oak Run Creek by comparing fecal coliform concentrations measured in Oak Run Creek to Basin Plan objectives.

Evidence of Impairment
Water samples were collected from the middle reach of Oak Run Creek between June and October 1999. The average fecal coliform levels in the water samples collected from Oak Run Creek were approximately 400 MPN/100ml. The fecal coliform levels exceeded the geometric mean Basin Plan criterion (200 MPN/100ml) for at least five months in 1999. The maximum fecal coliform count ranged up to almost 1,800 MPN/100ml. Many of samples were also above the 30-day Basin Plan criterion (400 MPN/100 ml) (Hannaford and North State Institute for Sustainable Communities, 2000).

Extent of Impairment
Oak Run Creek flows for approximately 23.5 miles. The middle reach, approximately 6 miles long, is impacted by fecal coliform.

Potential Sources
Hannaford and North State Institute for Sustainable Communities (2000) concluded that Oak Run Creek contained "at least the wildlife input" and potentially low levels of livestock and human inputs of bacteria. The levels contributed by these sources are considered to be the background levels for the area. Since the impaired Oak Run Creek site is not known to contain more wildlife than the other areas, the excess bacteria "probably originated from livestock or human sources," including septic systems and/or sewage lines leaching into the streams (Hannaford and North State Institute for Sustainable Communities, 2000).

B.1.38 Orestimba Creek, Azinphos-methyl

Summary of Proposed Action
The California Regional Water Quality Control Board-Central Valley Region (Regional Board) recommends the addition of Orestimba Creek to California's Clean Water Act Section 303(d) list due to impairment by azinphos-methyl. Information available to the Regional Board on azinphos-methyl concentrations in Orestimba Creek indicates that water quality objectives are not being attained. The basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Orestimba Creek	**Pollutants/Stressors**	Azinphos-methyl
Hydrologic Unit	541.10	**Sources**	Agriculture
Total Waterbody Size	30 miles	**TMDL Priority**	
Size Affected	10 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	The lower 10 miles, from the foothills to the SJR	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	37° 19' 31"	**Upstream Extent Longitude**	121° 06' 58"
Downstream Extent Latitude	37° 25' 17.4"	**Downstream Extent Longitude**	121° 0' 12.7"

Watershed Characteristics
Orestimba Creek is an ephemeral stream draining a relatively small basin (6,904 acres) on the west side of the San Joaquin Valley. Orestimba Creek flows result from stormwater runoff in the winter and irrigation return flow in the spring and summer. During the winter the creek can receive flow from Coastal Ranges as well as from the area that drains into the main canal of the Central California Irrigation District, depending on the intensity and duration of storms, thus increasing the drainage area to 125,102 acres.

Water Quality Objectives Not Attained
The narrative objectives for pesticides and toxicity are not being attained for parathion in Orestimba Creek. The narrative objective for pesticides states, "No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses." The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective" (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf). The US Environmental Protection Agency (USEPA) has established an ambient water quality criterion for azinphos-methyl for the protection of freshwater aquatic life of 0.01 µg/L (USEPA, 1976).

Evidence of Impairment
Between 1992 and 1993, a total of 54 water samples collected from Orestimba Creek at River Road were analyzed for azinphos-methyl (Table 1). Between February 1992 and November 1993, two of the six samples analyzed (33%) contained azinphos-methyl concentrations at or above the USEPA criterion. The highest concentrations generally occurred between June and November; concentrations were also high in February (Ross, 1992, 1993; Ross et al., 1996, 1999; Fujimura, 1991a,b, 1993a,b,c,d). In a second study conducted in 1993, nine of 48 samples collected throughout the year (19%) contained azinphos-methyl concentrations at or above the USEPA criterion (Ross, 1992, 1993; Ross et al., 1996, 1999; Fujimura, 1991a,b, 1993a,b,c,d).

Table B-2. Azinphos-methyl in Water Samples Collected from Orestimba Creek

Data Source	Sample Years	Number of Samples	Range of Azinphos-methyl Concentrations	Criteria[a]	Number of Samples Equal to or Above Criteria	Percent Samples Equal to or Above Criteria
Ross, 1992, 1993; Ross et al., 1996, 1999; Fujimura, 1991a,b, 1993a,b,c,d	1992-1993	6	nd - 0.1 µg/L	0.01 µg/L	2	33%
Panshin et al, 1998	1993	48	nd - 0.39 µg/L		9	19%
Sum	1992-1993	54	nd - 0.39 µg/L		11	20%

a) USEPA instantaneous maximum ambient water quality criteria (USEPA, 1976)
nd not detected

Extent of Impairment
Orestimba Creek is already on the 303(d) list because of impairment by chlorpyrifos and diazinon, and is proposed for listing for parathion. Because the source (agriculture) is the same for all of these pesticides, it

is likely that agricultural runoff containing azinphos-methyl also impairs the lower 10 miles of Orestimba Creek.

Potential Sources
Azinphos-methyl is used to control insects on many agricultural crops, including almonds and field crops. Therefore the likely source of azinphos-methyl is agriculture.

B.1.39 Orestimba Creek, DDE

Summary of Proposed Action
The California Regional Water Quality Control Board-Central Valley Region, Regional Board, recommends the addition of Orestimba Creek to California's Clean Water Act Section 303(d) list due to impairment by DDE. Information available to the Regional Board on DDE levels in Orestimba Creek indicates that water quality objectives are not being attained. The basis for this recommendation is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Orestimba Creek	**Pollutants/Stressors**	DDE
Hydrologic Unit	541.10	**Sources**	Historical Agriculture
Total Waterbody Size	30 miles	**TMDL Priority**	
Size Affected	10 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	The lower 10 miles, from the foothills to the SJR	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	37° 19' 31"	**Upstream Extent Longitude**	121° 06' 58"
Downstream Extent Latitude	37° 25' 17"	**Downstream Extent Longitude**	121° 0' 12"

Watershed Characteristics
Orestimba Creek is an ephemeral stream in a relatively small basin (6,904 acres) within the San Joaquin Valley floor on the west side of the valley. Stream flow in Orestimba Creek results from storm runoff in the winter and irrigation return flows in the spring and summer. During the winter, the creek can receive flow from the Coast Range as well as from the area that drains into the main canal of the Central California Irrigation District, depending on the intensity and duration of storms, thus increasing the drainage area to 125,102 acres.

Water Quality Objectives Not Attained
The United States Environmental Protection Agency (USEPA) California Toxic Rule (CTR) criterion for DDE for the protection of human health is not being attained. The USEPA criterion for DDE for the protection of human health through consumption of drinking water and aquatic organisms is 0.00059 µg/L. DDE is a breakdown product of DDT, which was used as an insecticide on agricultural crops and insects that carry diseases. DDT was banned for use as a pesticide in the United States in 1972 because of its potentially harmful effects on humans and wildlife. DDT is relatively insoluble in water, binds strongly to soil, and breaks down into DDD and DDE (US Department of Health and Human Services-Agency for Toxic Substances and Disease Registry [USDHHS-ATSDR], 1995). DDT, DDD, and DDE are known to have detrimental health effects on humans and other animals (USDHHS-ATSDR, 1994).

Evidence of Impairment
During a 1993 monitoring study conducted by the US Geological Survey (USGS), 96 water samples were collected in Orestimba Creek (Table 2). Thirty-two of these samples (33%) exceeded the USEPA Guideline. DDE concentrations ranged from less than 1 to more than 100 times the USEPA Guideline. Samples were collected primarily January thru March, with additional sampling in May and June, and minimal sampling throughout the rest of the year. Concentrations exceeding the USEPA guideline occurred primarily in January and February.

Table B-2. DDE Concentrations in Water Samples from Orestimba Creek

Data Source	Sample Years	Number of Samples	Range of DDE Concentrations	Guideline[a]	Number of Samples Equal to or Above Guideline	Percent Samples Equal to or Above Guideline
Panshin et al, 1998	1993	96	nd - 0.06 µg/L	0.00059 µg/L	32	33%

a) USEPA Cancer Risk Guideline for Drinking Water (USEPA, 1991)

Extent of Impairment
Orestimba Creek is already listed on the 303(d) list for diazinon and chlorpyrifos (SWRCB, 1999), and is proposed for listing for azinphos-methyl. Because the source (agriculture) is the same for all of these pesticides, it is likely that agricultural runoff containing DDE also impairs the lower ten miles of Orestimba Creek.

Potential Sources
DDT was widely used to control insects on agricultural crops before it was banned nationwide in 1972. The most likely source of DDE, a breakdown product of DDT, is from historical agricultural use of DDT.

B.1.40 Orestimba Creek, Parathion

Summary of Proposed Action
The California Regional Water Quality Control Board-Central Valley Region, Regional Board, recommends the addition of Orestimba Creek to California's Clean Water Act Section 303(d) list due to impairment by parathion. Information available to the Regional Board on parathion levels in Orestimba Creek indicates that water quality objectives are not being attained. The basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Orestimba Creek	**Pollutants/Stressors**	Parathion
Hydrologic Unit	541.10	**Sources**	Agriculture
Total Waterbody Size	30 miles	**TMDL Priority**	
Size Affected	10 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	The lower 10 miles, from the foothills to the SJR	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	37º 19' 31"	**Upstream Extent Longitude**	121º 06' 58"
Downstream Extent Latitude	37° 25' 17.4"	**Downstream Extent Longitude**	121° 0' 12.7"

Watershed Characteristics
Orestimba Creek is an ephemeral stream in a relatively small basin (6,904 acres) within the San Joaquin Valley floor on the west side of the valley. Stream flow in Orestimba Creek results from storm runoff in

the winter, and irrigation return flows in the spring and summer. During the winter, the creek can receive flow from Coastal Ranges as well as from the area that drains into the main canal of the Central California Irrigation District, depending on the intensity and duration of storms, thus increasing the drainage area to 125,102 acres.

Water Quality Objectives Not Attained

The narrative objectives for pesticides and toxicity are not being attained for parathion in Orestimba Creek. The narrative objective for pesticides states, "No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses." The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective" (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf). The US Environmental Protection Agency (EPA) has established water quality criteria for parathion for the protection of freshwater aquatic life of 0.013 µg/L for the continuous concentration (4-day average) and 0.065 µg/L for the maximum concentration (1-hour average) (Marshack, 2000).

Evidence of Impairment

Between 1991 and 1993, a total of 78 water samples collected from Orestimba Creek were analyzed for parathion (Table 2). Samples were collected throughout the year. Five of the 78 samples (6%) contained concentrations of parathion that exceed the EPA continuous concentration and three samples (4%) exceeded the EPA maximum concentration. Parathion concentrations ranged from less than one to more than 23 times the USEPA continuous criterion. The highest concentrations were generally measured between February and March (Ross, 1992, 1993; Ross et al., 1996, 1999; Fujimura, 1991a,b, 1993a,b,c,d).

Table B-2. Parathion Concentrations in Orestimba Creek

Data Source	Sample Years	Number of Samples	Range of Parathion Concentration	Criteria		Number of Samples Equal to or Above Criteria	Percent Samples Equal to or Above Criteria
Ross, 1992, 1993; Ross et al., 1996, 1999; Fujimura, 1991a,b, 1993a,b,c,d	1991-1993	7	nd - 0.05 µg/L	Chronic	0.013 µg/L	1	14%
				Acute	0.065 µg/L	0	0%
Foe, 1995	1991-1993	69	nd - 0.31 µg/L	Chronic	0.013 µg/L	4	6%
				Acute	0.065 µg/L	3	4%
Sum	1991-1993	78	nd - 0.31 µg/L	Chronic	0.013 µg/L	5	6%
				Acute	0.065 µg/L	3	4%

Extent of Impairment

Other pesticides such as diazinon, chlorpyrifos, and azinphos-methyl impair the lower ten miles of Orestimba Creek, from the foothills to the San Joaquin River. Because the source (agriculture) is the same for all of these pesticides, it is likely that agricultural runoff containing parathion also impairs the lower ten miles of Orestimba Creek.

Potential Sources

Because diazinon, chlopyrifos, and azinphos-methyl are also introduced into surface water from agriculture runoff the main source of parathion is likely agriculture.

B.1.41 Lower Putah Creek, Mercury

Summary of Proposed Action

The California Regional Water Quality Control Board, Central Valley Region, (Regional Board) recommends the addition of Putah Creek to California's Clean Water Act Section 303(d) list due to impairment by mercury. Information available to the Regional Board on mercury levels in fish tissue samples indicates that water quality objectives are not being attained in Putah Creek. The description for the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Lower Putah Creek	**Pollutants/Stressors**	Mercury
Hydrologic Unit	511.20	**Sources**	Mining, source unknown
Total Waterbody Size	30 miles	**TMDL Priority**	
Size Affected	24 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	Lake Solano to Putah Sinks	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	N 38° 30' 48"	**Upstream Extent Longitude**	W 122° 06' 15"
Downstream Extent Latitude	N 38° 30' 57"	**Downstream Extent Longitude**	W 121° 36' 46"

Watershed Characteristics

Lower Putah Creek is located in Yolo and Solano counties. The creek extends approximately 30 miles from Lake Berryessa to its mouth (the Putah Creek Sinks) at the Yolo Bypass. During low flow periods, Putah Creek is not contiguous with the Yolo Bypass. The land and water uses for the area are diverse (e.g., municipal, agricultural, recreational uses and freshwater habitat) and impact the water quality of Putah Creek in a variety of ways. The lower Putah Creek watershed is farmed and surrounded by towns.

Water Quality Objectives Not Attained

The narrative objective for toxicity is not being attained for mercury in lower Putah Creek. The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services (OEHHA), the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf)."

Numeric criteria for mercury in fish tissue have been developed for both human health and wildlife protection. The U.S. Environmental Protection Agency (USEPA) recently established a human health protection criterion of 0.3 milligrams per kilogram (mg/kg; equivalent to parts per million [ppm]) methylmercury in the edible portions of fish (USEPA, 2001b). This criterion is used to determine attainment with of the narrative toxicity objective.

Evidence of Impairment

The Agency for Toxic Substance and Disease Registry (USDHHS-ATSDR) and the Department of Environmental Science and Policy, University of California, Davis (UCD) collected fish tissue samples from Putah Creek at multiple locations between Lake Berryessa and the Putah Creek Sinks (USDHHS-ATSDR, 1997 & 1998; Slotton et al, 1999). In 1997 and 1998, the USDHHS-ATSDR and UCD sampled 204 trophic level 3 fish from multiple locations downstream of Lake Berryessa and 67 trophic level 4 fish from multiple locations downstream of Lake Solano, which is approximately 6 miles downstream from

Lake Berryessa. Trophic level (TL) 3 fish feed on zooplankton, phytoplankton, and benthic invertebrates. Trophic level (TL) 4 fish consume TL 3 fish as part of their diet. Methylmercury and total mercury bioaccumulate in aquatic organisms and tend to increase with increasing trophic levels (USEPA, 1997a). The TL4 fish had an average mercury concentration of 0.28 ppm, which is slightly less than the USEPA criterion of 0.3 ppm. However, several of the TL 4 fish species (black crappie, largemouth bass, Sacramento pike minnow, and smallmouth bass) from Putah Creek had average mercury concentrations that exceeded the USEPA criterion. Table 2 summarizes the available mercury concentration data for TL 4 fish. In addition, several of the TL 3 fish sampled also had mercury concentrations greater than 0.3 ppm. For example, five Sacramento sucker and one hitch were sampled from Lake Solano; five of these six TL 3 fish had mercury concentrations greater than 0.3 ppm.

Table B-2. Summary of Mercury Data for Putah Creek Trophic Level 4 Fish

Fish Species[a]	Mean Mercury Concentration (ppm)[a]	# of Fish Sampled
Black Crappie	**0.33**	1
Channel Catfish	0.14	14
Largemouth Bass	**0.35**	30
Sacramento Pike Minnow	**0.44**	6
Smallmouth Bass	**0.30**	2
White Catfish	0.18	10
White Crappie	0.28	4
Trophic Level 4 Fish Summary:	0.28	67

Bold text indicates fish species with average mercury concentrations equal to or greater than the USEPA criterion of 0.3 ppm.

Extent of Impairment
Available fish tissue data suggest that Putah Creek is impaired by mercury from Lake Solano to the Putah Creek Sinks. Trophic level 4 fish collected from Putah Creek downstream of Lake Solano had mercury concentrations that frequently exceeded the USEPA criterion of 0.3 ppm.

Potential Sources
Mercury sources likely include mining-related wastes and possible unknown sources. Extensive historic mercury mining occurred within the Lake Berryessa/Putah Creek watershed.

B.1.42 Lower Putah Creek, Unknown Toxicity

Summary of Proposed Action
The California Regional Water Quality Control Board-Central Valley Region, Regional Board, recommends the addition of lower Putah Creek to California's Clean Water Act Section 303(d) list due to impairment by an unknown toxicity. Information available to the Regional Board on an unknown toxin in lower Putah Creek indicates that water quality objectives are not being attained. A description for the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Putah Creek, lower	**Pollutants/Stressors**	Unknown Toxicity
Hydrologic Unit	511.20	**Sources**	Source Unknown
Total Waterbody Size	30 miles	**TMDL Priority**	
Size Affected	30 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	The entire waterbody	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	N 38° 30' 48"	**Upstream Extent Longitude**	W 122° 06' 15"
Downstream Extent Latitude		**Downstream Extent Longitude**	

Watershed Characteristics
Lower Putah Creek is located in Yolo and Solano counties. It flows for approximately 30 miles, from Lake Berryessa to the Yolo Bypass. However, during low flow periods, lower Putah Creek is not contiguous with Yolo Bypass. The land and water use for the area is diverse, and impacts the water quality in a variety of ways. The lower Putah Creek watershed is farmed and surrounded by towns. An unknown toxicity, from an unknown source, impairs lower Putah Creek.

Water Quality Objectives Not Attained
The narrative objective for toxicity is not being attained for lower Putah Creek. The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that, "Compliance with this objective will be determined by analyses of…biotoxicity tests of appropriate duration... (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf)."

The toxicity objective was evaluated for Putah Creek by comparing toxicity test results of ambient water grab samples collected from Putah Creek with laboratory control results. These toxicity test procedures estimate the acute and chronic responses of aquatic test species from three phyla (representing three trophic levels) as an assessment of the toxicity of the ambient water samples. The tests include fathead minnow (a fish, *Pimephales promelas*) larval survival (mortality) and growth tests, zooplankton (a cladoceran, *Ceriodaphnia dubia*) survival and reproduction (offspring counts) tests, and algal (*Selenastrum capricornutum*) growth (chlorophyll a production) tests. The test results produced by the ambient creek water samples were compared to test results of the laboratory control water samples, to identify ambient creek water samples that caused statistically significant test species impairment.

Evidence of Impairment
Between 1998 and 1999, routine (monthly) and rain event (based on a rain storm) toxicity tests, toxicity identification evaluation tests (TIEs), and water quality analysis were conducted on water samples from lower Putah Creek.

Toxicity tended to occur following rain events and occurred throughout the entire watershed (Larsen et al, 2000). Sixteen of the toxicity tests run on ambient samples resulted in impaired growth, impaired reproduction, or mortality to one or more test organisms. The sources of the toxicity may include suspended solids (including particle bound chemicals or toxicants) and diuron. However, other follow-up tests failed to pinpoint potential cause(s) (although some of the tests eliminated ammonia and pathogenicity as sources). In other cases, no follow-up tests were run and the cause of the toxicity is unknown.

Extent of Impairment
Rain event based toxicity was observed in the entire lower Putah Creek, from downstream of Lake Solano to Mace Blvd, on the three rain events in the sampling period. Therefore, an unknown toxin or toxins impairs the entire length of lower Putah Creek.

Potential Sources
Follow-up tests were conducted on some of the samples that caused toxicity. The results of the follow-up tests indicate that a variety of factors, including suspended solids (including particle bound chemicals or toxicants) and diuron, may have been partially responsible for the toxicity in a few of the cases. However, other follow-up tests failed to pinpoint potential cause(s) (although some of the tests eliminated ammonia and pathogenicity as sources) and in other cases, no follow-up tests were run. Therefore, the cause of the toxicity is unknown, in many cases.

B.1.43 Upper Putah Creek, Unknown Toxicity

Summary of Proposed Action
The California Regional Water Quality Control Board-Central Valley Region, Regional Board, recommends the addition of upper Putah Creek to California's Clean Water Act Section 303(d) list due to impairment by an unknown toxicity. Information available to the Regional Board on an unknown toxin in upper Putah Creek indicates that water quality objectives are not being attained. A description for the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Upper Putah Creek	**Pollutants/Stressors**	Unknown Toxicity
Hydrologic Unit	512.30	**Sources**	Source Unknown
Total Waterbody Size	36 miles	**TMDL Priority**	
Size Affected	27 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	The lower 27 miles	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude		**Upstream Extent Longitude**	
Downstream Extent Latitude		**Downstream Extent Longitude**	

Watershed Characteristics
Upper Putah Creek is located in Lake and Napa counties. It flows for approximately 36 miles, from its headwaters in the Cobb Mountain to Lake Berryessa. Inactive mercury-mining districts and several communities surround the upper Putah Creek watershed.

Water Quality Objectives Not Attained
The narrative objective for toxicity is not being attained for unknown toxicity in the upper Putah Creek. The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that, "Compliance with this objective will be determined by analyses of…biotoxicity tests of appropriate duration... (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf)."

The toxicity objective was evaluated for Putah Creek by comparing toxicity test results of ambient water grab samples collected from Putah Creek with laboratory control results. These toxicity test procedures estimate the acute and chronic responses of aquatic test species from three phyla (representing three trophic levels) as an assessment of the toxicity of the ambient water samples. The tests include fathead minnow (a fish, *Pimephales promelas*) larval survival (mortality) and growth tests, zooplankton (a cladoceran, *Ceriodaphnia dubia*) survival and reproduction (offspring counts) tests, and algal (*Selenastrum capricornutum*) growth (chlorophyll a production) tests. The test results produced by the ambient creek water samples were compared to test results of the laboratory control water samples, to identify ambient creek water samples that caused statistically significant test species impairment.

Evidence of Impairment
Between November 1998 and October 1999, water samples were collected once a month just upstream from Lake Berryessa. On four of the dates (January, and August through October 1999) the water samples caused reproductive impairments to *Ceriodaphnia*. The source(s) of the toxicity from the water samples collected in August and September were analyzed using TIE (toxicity identification evaluation). Neither the ambient samples (when re-tested) nor the lab water caused toxicity to *Ceriodaphnia*. However, when the eluates (the non-polar molecules from the sample[1]) of the sample were re-added to water without any pollutants, at three times the ambient sample concentration, *Ceriodaphnia* experienced significant reproductive impairments. This suggests that a non-polar, organic chemical may have caused both of the impairments. No follow-up tests, including TIEs, were conducted on the other two dates, so the cause(s) of the toxicity is unknown (Larsen *et al*, 2000).

In July 1999, the water sample cause impaired growth to *Selenastrum*. The ambient water sample was analyzed for metals, but metals could not account for the toxicity. Therefore, the cause of the toxicity is yet unknown (Larsen *et al*, 2000).

Extent of Impairment
The site selected for study was the furthest downstream site, and represents the sum of the watershed. There are several small waterbodies that flow into Putah Creek, but most (except Janche Creek) enter at least 27 miles upstream of the confluence with Lake Berryessa. It seems likely that at least the lower 27 miles is impaired.

Potential Sources
Follow-up tests were conducted on three of the samples that caused toxicity. The results of two of the follow-up tests indicate that a non-polar organic chemical may be partially responsible for the toxicity in those two samples. However, the other follow-up test failed to determine any potential cause(s), and eliminated metals as a potential source. The cause of the toxicity in that sample is unknown. In the other cases, no follow-up tests were run, so the source of the toxicity is unknown. Therefore, the cause of the toxicity is unknown, but may, in some cases, include non-polar organic chemicals.

B.1.44 Rollins Reservoir, Mercury

Summary of Proposed Action
The California Regional Water Quality Control Board, Central Valley Region (Regional Board) recommends the addition of Rollins Reservoir to California's Clean Water Act Section 303(d) list due to impairment by mercury. Information available to the Regional Board on mercury levels in fish tissue samples indicates that water quality objectives are not being attained in Rollins Reservoir. The description for the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Rollins Reservoir	**Pollutants/Stressors**	Mercury
Hydrologic Unit	516.34	**Sources**	Resource Extraction ()
Total Length	840 acres	**TMDL Priority**	
Size Affected	840 acres	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	All of Rollins Reservoir	**TMDL End Date (Mo/Yr)**	

[1] The water sample was extracted in such a way that the non-polar organic molecules stayed in the solution, but the water and every other toxin were eliminated.

Watershed Characteristics
The Bear River basin has over 232,800 watershed acres. Water usage ranges from recreational to agricultural and municipal to hydroelectric generation, among others. The basin is bound by the Yuba River on the north, the Little Truckee River basin on the east, and the American River basin on the south. The headwaters are located in the Sierra Nevada snowfields at elevations ranging up to 9,100 feet above sea level. Greenhorn Creek, Steephollow Creek and Bear River flow into Rollins Reservoir. Rollins Reservoir has twenty-six miles of shoreline and its deepest section is 270 feet deep at the dam. At full capacity the reservoir stores 66,000 acre-feet of water and covers 840 surface acres.

Water Quality Objectives Not Attained
The narrative objective for toxicity is not being attained for mercury in Rollins Reservoir. The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf)."

Numeric criteria for mercury in fish tissue have been developed for both human health and wildlife protection. The U.S. Environmental Protection Agency (USEPA) recently established a human health protection criterion of 0.3 milligrams per kilogram (mg/kg; equivalent to parts per million [ppm]) methylmercury in the edible portions of fish (USEPA, 2001b). This criterion is used to determine attainment with the narrative toxicity objective.

Evidence of Impairment
The U.S. Geological Survey (USGS) and Toxic Substances Monitoring Program (TSMP) collected fish tissue samples from the midsection, Bear River Arm, and Greenhorn Creek Arm of Rollins Reservoir (May et al., 2000; SWRCB-DWQ, 1995). The USGS collected trophic level 3 and 4 fish; the TSMP collected only trophic level 4 fish. Trophic level 3 fish feed on zooplankton, phytoplankton, and benthic invertebrates. Trophic level 4 fish consume trophic level 3 fish as part of their diet. Methylmercury and total mercury bioaccumulate in aquatic organisms and tend to increase with increasing trophic levels (USEPA, 1997a). The TSMP and USGS sampled 50 trophic level 4 fish (largemouth bass, smallmouth bass, black crappie, and channel catfish) between 1984 and 1999. The TL4 fish had an average mercury concentration of 0.32 ppm, which exceeds the USEPA criterion of 0.3 ppm. The trophic level 4 fish data from the USGS study are summarized in Table 2, below. Placer, Yuba, and Nevada counties have issued an interim public health notification for all lakes and watercourses within these counties based on the USGS data. OEHHA is in the process of developing a state advisory (Nevada County, 2000).

Table B-2. Mercury Data for Rollins Reservoir River Trophic Level 4 Fish

Sampling Location	Fish Type	# of Fish Sampled	Mean Mercury Concentration (ppm)
Bear River Arm	Largemouth Bass	2	0.25
	Channel Catfish	10	0.365
Greenhorn Creek Arm	Largemouth Bass	5	0.374
	Channel Catfish	3	0.35
	Black Crappie	3	0.31
Midsection of Reservoir	Largemouth Bass	5	0.56
	Channel Catfish	12	0.31
	Smallmouth Bass	10	0.14
SUMMARY:	Trophic Level 4 Fish	50	0.32

Extent of Impairment
Rollins Reservoir covers 840 surface acres. Fish collected throughout the reservoir had mercury levels above the USEPA criterion. The entire waterbody is impaired by mercury.

Potential Sources
The Bear River watershed was historically mined extensively for its hardrock and placer gold deposits and has been affected by hydraulic mining (Alpers and Hunerlach, 2000). Several inactive gold exist upstream of Rollins Reservoir in the Bear River watershed (Montoya and Pan, 1992).

B.1.45 Lower San Joaquin River, Mercury

Summary of Proposed Action
The California Regional Water Quality Control Board, Central Valley Region, (Regional Board) recommends the addition of the lower San Joaquin River to California's Clean Water Act Section 303(d) list due to impairment by mercury. Information available to the Regional Board on mercury levels in fish tissue samples indicates that water quality objectives are not being attained in the lower San Joaquin River. The description for the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Lower San Joaquin River	**Pollutants/Stressors**	Mercury
Hydrologic Unit	544.00	**Sources**	Resource extraction (abandoned mines)
Total Waterbody Size	330 miles	**TMDL Priority**	
Size Affected	60 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	From the confluence with Bear Creek to Vernalis	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	37º 16' 44"	**Upstream Extent Longitude**	120º 49' 39"
Downstream Extent Latitude	37º 40' 32.6"	**Downstream Extent Longitude**	121º 15' 54"

Watershed Characteristics
The San Joaquin River flows for approximately 330 miles from the headwaters to the Delta boundary near Vernalis in central California. The hydrology in the lower San Joaquin River is highly managed, with numerous tributary impoundments and extensive diversion of river flows. The lower San Joaquin River is

intermittently dry between Gravelly Ford and the Bear Creek confluence, except when Friant Dam releases water for flood control.

Water Quality Objectives Not Attained
The narrative objective for toxicity is not being attained for mercury in the lower San Joaquin River. The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective" (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf).

Numeric criteria for mercury in fish tissue have been developed for both human health and wildlife protection. The U.S. Environmental Protection Agency (USEPA) recently established a human health protection criterion of 0.3 milligrams per kilogram (mg/kg; equivalent to parts per million, [ppm]) methylmercury in the edible portions of fish (USEPA, 2001b). This criterion is used to determine attainment of the narrative toxicity objective.

Evidence of Impairment
The Toxic Substances Monitoring Program (TSMP) and San Francisco Estuary Institute (SFEI) collected numerous trophic level 3 and 4 fish samples from the San Joaquin River between 1979 and 1999 (SWRCB-DWQ, 1995; Davis and May, 2000). Trophic level 3 fish (e.g., carp and green sunfish) feed on zooplankton, phytoplankton, and benthic invertebrates. Trophic level 4 fish (e.g., channel catfish and largemouth bass) consume trophic level 3 fish as part of their diet. Methylmercury and total mercury bioaccumulates in aquatic organisms and tends to increase with increasing trophic levels (USEPA, 1997a). The trophic level 4 fish had an average mercury concentration of 0.45 ppm, which exceeds the USEPA criterion of 0.3 ppm. Table 2 summarizes the available mercury concentration data for trophic level 4 fish.

Table B-2. Summary of Mercury Data for Rollins Reservoir River Fish

Sampling Location	Fish Species	Mean Mercury Concentration (ppm)	# of Fish Sampled
Landers Ave / RT 165	Channel Catfish	0.514	3
	Largemouth Bass	0.681	22
	Sacramento Pike Minnow	0.102	24
	Striped Bass	0.491	1
	White Catfish	0.421	22
Between Crow's Landing and Las Palmas Roads	Largemouth Bass	0.665	25
	Striped Bass	0.464	1
	White Catfish	0.451	20
Near Vernalis	Channel Catfish	0.321	64
	Largemouth Bass	0.649	27
	Striped Bass	0.728	7
	White Catfish	0.415	48
SUMMARY:	Trophic Level 4 Fish	0.45	264

Extent of Impairment
Evidence suggests the lower San Joaquin River is impaired by mercury from the confluence with Bear Creek to Vernalis. Bear Creek was chosen as the upstream extent because it is both a major source of water to the San Joaquin River and is located just upstream of the Landers Avenue/Route 165 sampling site sampled by the SFEI study (Davis and May, 2000).

Potential Sources
The principal sources of mercury to aquatic ecosystems in northern California are historic mercury and gold mining sites (RWQCB- SFB et al, 1995).

B.1.46 Scotts Flat Reservoir, Mercury

Summary of Proposed Action
The California Regional Water Quality Control Board, Central Valley Region, (Regional Board) recommends the addition of Scotts Flat Reservoir to California's Clean Water Act Section 303(d) list due to impairment by mercury. Information available to the Regional Board on mercury levels in fish tissue samples indicates that water quality objectives are not being attained in Scotts Flat Reservoir. The description for the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Scotts Flat Reservoir	**Pollutants/Stressors**	Mercury
Hydrologic Unit	517.20	**Sources**	Resource extraction (abandoned mines)
Total Length	725 acres	**TMDL Priority**	
Size Affected	725 acres	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	All of Scotts Flat Reservoir	**TMDL End Date (Mo/Yr)**	

Watershed Characteristics
Scotts Flat Reservoir is located on Deer Creek in the Sierra foothills five miles east of Nevada City within the Yuba River basin. Deer Creek flows approximately 20 miles from Scotts Flat Reservoir to its confluence with the Yuba River downstream from Lake Englebright. The Yuba River basin has over 12,700 watershed acres and over 1,900 total river miles. Water usage ranges from recreational to agricultural and municipal to hydroelectric generation, among others. The Yuba River basin is bound by the Feather River basin on the north, by the Little Truckee River basin on the east, and by the Bear River and American River basins on the south. Its headwaters are located in the Sierra Nevada snowfields at elevations ranging up to 9,100 feet above sea level.

Water Quality Objectives Not Attained
The narrative objective for toxicity is not being attained for mercury in Scotts Flat Reservoir. The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services (OEHHA), the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective" (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf).

Numeric criteria for mercury in fish tissue have been developed for both human health and wildlife protection. The U.S. Environmental Protection Agency (USEPA) recently established a human health protection criterion of 0.3 milligrams per kilogram (mg/kg; equivalent to parts per million [ppm]) methylmercury in the edible portions of fish (USEPA, 2001b). This criterion is used to determine attainment with of the narrative toxicity objective.

Evidence of Impairment
The U.S. Geological Survey (USGS) sampled trophic level 3 and 4 fish from Scotts Flat Reservoir (May et al., 2000). Trophic level 3 fish feed on zooplankton, phytoplankton, and benthic invertebrates. Trophic level 4 fish consume trophic level 3 fish as part of their diet. Methylmercury and total mercury bioaccumulate in aquatic organisms and tend to increase with increasing trophic levels (USEPA, 1997a). The USGS sampled seven trophic level 4 fish (largemouth bass) on September 7 and 8, 1999. These trophic level 4 fish had an average mercury concentration of 0.38 ppm, which exceeds the USEPA criterion of 0.3 ppm. Placer, Yuba, and Nevada counties have issued an interim public health notification for all lakes and watercourses within these counties based on the USGS data. OEHHA is in the process of developing a state advisory (Nevada County, 2000).

Extent of Impairment
Scotts Flat Reservoir covers 725 surface acres with 48,500 acre-feet of storage. The entire waterbody is impaired by mercury.

Potential Sources
Several inactive and partially active gold mines exist upstream of Scotts Flat Reservoir within the Yuba River watershed. The Yuba watershed was historically mined extensively for its hardrock and placer gold deposits and has been affected by hydraulic mining (Alpers and Hunerlach, 2000).

B.1.47 Smith Canal, Low Dissolved Oxygen

Summary of Proposed Action
The California Regional Water Quality Control Board-Central Valley Region, Regional Board, recommends the addition of Smith Canal to California's Clean Water Act Section 303(d) list due to impairment by low dissolved oxygen. Information available to the Regional Board on dissolved oxygen levels in Smith Canal indicates that water quality objectives are not being attained. A description for the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Smith Canal	**Pollutants/Stressors**	Low Dissolved Oxygen
Hydrologic Unit	544.00	**Sources**	Urban Runoff/Storm Sewers
Total Waterbody Size	2 miles	**TMDL Priority**	
Size Affected	2 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	From confluence with San Joaquin River to Yosemite Lake.	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	37º 57' 25"	**Upstream Extent Longitude**	121º 20' 53"
Downstream Extent Latitude	37º 58' 02"	**Downstream Extent Longitude**	121º 18' 25"

Watershed Characteristics
The Smith Canal is a dead end slough connecting the San Joaquin River near Rough and Ready Island with Yosemite Lake at Legion Park in downtown Stockton, CA. Smith Canal is located within the San Joaquin Delta Hydrologic Unit and receives storm water discharges from 3,300 acres of urban downtown Stockton, CA area. The land uses are 50% residential, 18% commercial, and 26% street. Institutional and industrial uses occupy the remaining 6% (Chen and Tsai, 1999).

Water Quality Objectives Not Attained
The Water Quality Control Plan (Basin Plan) for the Sacramento River and San Joaquin River Basins contains a numeric objective applicable to Smith Canal which requires dissolved oxygen (DO) not be

reduced below 5 milligrams per liter (mg/l) (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf).

Evidence of Impairment
DO measurements collected from a variety of locations in Smith Canal between 1995 and 2000, have found concentrations below the Basin Plan objective of 5.0 mg/L on many occasions.

Fish kills were observed along Smith Canal by a resident in 1994, by DeltaKeeper in 1995 and 1996, and by CVRWQCB staff in 1994 and 1995. During one of the events in 1994, threadfin shad were observed floating at the surface of Smith Canal. Floating at the surface can be due to the loss of equilibrium associated with inadequate dissolved oxygen levels. These observations prompted a study by the CVRWQCB in the fall of 1995 designed to determine if low DO concentrations were responsible for the fish kills. Continuous monitoring data collected for the report in Smith Canal found DO concentrations during dry weather to be at or above Basin Plan objectives. However, during rain events between 10 and 13 December 1995 and again between 15 and 18 December 1995 DO concentrations dropped below Basin Plan objective after an initial peak during the rain events (Larsen et al, 1998).

An assessment of water quality data from Smith Canal performed by Camp Dresser & McKee Inc. for the City of Stockton between October 1997 and September 1998 found DO concentrations often below Basin Plan objectives. DO concentrations at the Pershing Ave. bridge over Smith Canal were below Basin Plan objectives many times during each month of the twelve month study and were below objectives many times per month at the Smith Canal Pedestrian Bridge in all but three months of the study. DO concentrations at the downstream Smith Canal Pedestrian Bridge were generally higher than the upstream Pershing Ave. bridge and DO concentrations overall were lower in conjunction with wet weather events (CDM, 1999).

A report of DeltaKeeper data collected between 8 November 1999 and 7 February 2000 found DO concentrations in Smith Canal below the Basin Plan objective in 25 of 31 samples. Data in the same report collected between 15 October 1996 and 8 November 1996 found DO concentrations below the Basin Plan objective in 6 of 10 samples (Lee and Jones-Lee, 2000a).

Table B-2. Dissolved Oxygen Concentrations in Water Samples Collected from Smith Canal

Data Source	Sample Years	Number of Samples	Range of DO Concentration	Number of Samples Below Criteria
Lee and Jones-Lee, 2000a (DeltaKeeper)	October/November 1996; November 1999 to February 2000	41	0.4 - 11 mg/L	31
Larsen, 1998	October to December 1995	Continuous/intermittent	1.7 - >11mg/L	n/a
CDM, 1999	October 1997 to September 1998	Continuous	0 – >11 mg/L	n/a

Extent of Impairment
Dissolved oxygen concentrations in the Smith Canal in Stockton, CA have been documented to fall below the Basin Plan objective of 5 mg/l on many occasions between 1995 and 2000. This data also indicates that some DO concentration episodes below the Basin Plan objectives have coincided with wet weather events. Due to the relatively short length of Smith Canal and uniform characteristics (straight channel surrounded by urban land), the samples collected indicate impairment of all of Smith Canal by low DO.

Potential Sources
The impaired reach of Smith Canal is wholly within the Stockton urban area. The most likely source of oxygen demanding substances is from runoff from the urban area.

B.1.48 Smith Canal, Organophosphorus Pesticides

Summary of Proposed Action

The California Regional Water Quality Control Board-Central Valley Region, Regional Board, recommends the addition of Smith Canal to California's Clean Water Act Section 303(d) list due to impairment by Organophosphorus (OP) pesticides. Information available to the Regional Board on OP pesticide levels in Smith Canal indicates that water quality objectives are not being attained. A description for the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Smith Canal	**Pollutants/Stressors**	Organophosphate pesticides
Hydrologic Unit	544.00	**Sources**	Urban runoff
Total Waterbody Size	2 miles	**TMDL Priority**	
Size Affected	2 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	All of Smith Canal	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	37º 58' 03"	**Upstream Extent Longitude**	121º 18' 24"
Downstream Extent Latitude	38º 32' 49"	**Downstream Extent Longitude**	121º 29' 04"

Watershed Characteristics

The Smith Canal is located within and receives all of its water from the City of Stockton, in San Joaquin County. It flows for approximately 2 miles, from Yosemite Lake, in Yosemite Lake Park, to the San Joaquin River-Stockton Deep Water Ship Canal, just east of Louis Park. Land use around the area is primarily urban.

Water Quality Objectives Not Attained

The narrative objectives for pesticides and toxicity are not being attained for OP pesticides in the Smith Canal. The narrative objective for pesticides states, "No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses." The narrative toxicity objective in the Basin Plan states "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." It further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective…As a minimum, compliance with this objective…shall be evaluated with a 96-hour bioassay (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf)."

The toxicity objective was evaluated for Smith Canal by comparing toxicity test results of ambient water grab samples collected from Smith Canal with laboratory control results. These toxicity test procedures estimate the acute and chronic responses of aquatic test species from three phyla (representing three trophic levels) as an assessment of the toxicity of the ambient water samples. The tests include fathead minnow (a fish, *Pimephales promelas*) larval survival (mortality) and growth tests, zooplankton (a cladoceran, *Ceriodaphnia dubia*) survival and reproduction (offspring counts) tests, and algal (*Selenastrum capricornutum*) growth (chlorophyll a production) tests. The test results produced by the ambient creek water samples were compared to test results of the laboratory control water samples, to identify ambient creek water samples that caused statistically significant test species impairment.

Additionally, the pesticide and toxicity objectives were evaluated for Smith Canal by comparing OP concentrations measured in Smith Canal to chlorpyrifos and diazinon criteria developed by the California Department of Fish and Game.

Evidence of Impairment
Between 1994 and 1998 toxicity tests, toxicity identification evaluation (TIE) tests, chemical analysis, and the toxic units (TUs) of OP pesticides (the weighted toxicity caused by the OP pesticides) calculated by GF Lee (Lee GF, and A. Jones-Lee, 2001) were conducted on water samples from Smith Canal. Four of eight ambient water samples collected from Smith Canal showed survival impairments to *Ceriodaphnia.* On all four occasions, the impairments caused complete (100%) mortality within 7 days (Lee GF, and A. Jones-Lee, 2001). The toxicity events occurred in October, November, and March (Lee GF, and A. Jones-Lee, 2001). On each occasion, TIEs were conducted, and on three of the occasions water quality tests were conducted and TUs were calculated.

On three of the four dates that TIE tests were conducted, the addition Piperonyl Butoxide (PBO), a substance that inhibits OP pesticides (Larsen *et al*, 2000), completely eliminated the previously observed toxicity. This indicates that OP pesticides caused the toxicity. On two of the three days, water quality was measured. The ambient water sample was analyzed for pesticides and found to contain detectable levels of diazinon, ranging in concentration from 0.129 to 0.166 ug/L. These levels exceed the chronic and acute CDFG levels for diazinon, indicating that the concentrations of diazinon are acutely and chronically toxic to freshwater aquatic life. Toxicity units (TUs) for the additive effects of diazinon and chlorpyrifos were also calculated. The TUs for both days was approximately .25 (25%), indicating that diazinon (and chlorpyrifos) could not account for the complete mortality of the samples. Since diazinon could not account for all of the toxicity observed, but the toxicity could be completely eliminated by adding PBO, other OP pesticides, in addition to diazinon, may cause the toxicity in Smith Canal.

On the fourth date, the addition of PBO to the water sample reduced the mortality and caused a delay in the onset of mortality, but did not completely eliminate the mortality. This indicates that OP pesticides played a role in the toxicity. The ambient water sample was analyzed for pesticides and found to contain detectable levels of diazinon (or 0.186 ug/L) and chlorpyrifos (or 0.122 ug/L). These concentrations are above the chronic and acute CDFG criteria. Since the additive concentration of diazinon and chlorpyrifos can cause high levels of mortality and the addition of PBO could reduce the mortality and delay its onset, it is likely that OP pesticides, specifically diazinon and chlorpyrifos, cause at least some of the toxicity in Smith Canal.

Extent of Impairment
Samples appear to be collected from only one location within Smith Canal. However, because the sole source of the water is the City of Stockton, it is likely that the entire waterbody is impaired.

Potential Sources
Chlorpyrifos is an OP pesticide that has been commonly used by homeowners, pest control operators for structural and garden pest control, and on agriculture, including orchards. Diazinon is one of the most commonly used home and garden pesticides. Because the sole source of the water is from Stockton, it is likely that the source of the OP pesticides is urban run-off from the Stockton area.

B.1.49 Smith Canal, Pathogens

Summary of Proposed Action
The California Regional Water Quality Control Board, Central Valley Region, (Regional Board) recommends the addition of Smith Canal in the Delta to California's Clean Water Act Section 303(d) list due to impairment by pathogens. Information available to the Regional Board on pathogen levels in the lower reach of the Smith Canal indicates that water quality objectives are not being attained. A description for the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Smith Canal	**Pollutants/Stressors**	Pathogens
Hydrologic Unit	544.00	**Sources**	Urban runoff, Recreation
Total Waterbody Size	2 miles	**TMDL Priority**	
Size Affected	2 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	From the confluence with the Deep Water Channel to the terminus in Yosemite Lake Park	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	37º 57' 25"	**Upstream Extent Longitude**	121º 20' 53"
Downstream Extent Latitude	37º 58' 02"	**Downstream Extent Longitude**	121º 18' 25"

Watershed Characteristics
The Delta is characterized by tidal waters with limited flushing flows during the dry seasons. Smith Canal is located in the Delta and is a tributary to the Stockton Deep Water Channel. The area is highly urbanized and supports recreational uses, including boating, fishing, water skiing and swimming. Additionally, the recreational uses of the waters include a park with a "lake" (Yosemite Lake) at the upper terminus of the canal.

Water Quality Objectives Not Attained
The narrative objective for toxicity is not being attained for pathogens in the predominantly urban stretches of various Delta waterways. The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states the " the Regional Water Board will also consider…numerical criteria and guidelines developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services…the U.S. Environmental Protection Agency, and other organizations to evaluate compliance with this objective." The Basin Plan also contains a specific objective for fecal coliform bacteria (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/rwqcb5/bsnplnab.pdf).

Guidelines and criteria have been developed for the protection of human health. The California Department of Health Services (CDHS) has adopted a total coliform bacteria guideline, applicable to recreational waters and beaches, of 10,000 Most Probable Number (MPN) per 100 milliliters for single samples and of 1,000 MPN per 100 ml for 30-day log mean of sample levels (Title 17 California Code of Regulation section 7958). CDHS has also published draft guidelines that include limits for single samples of *E. coli* of 235 MPN per 100 milliliters (CDHS, July 2000 http://www.dhs.ca.gov/ps/ddwem/beaches/freshwater.htm). USEPA guidelines for bacteria are contained in *Ambient Water Quality Criteria for Bacteria* (USEPA, 1986a). The USEPA standards are stated as "Based on a statistically sufficient number of samples (generally not less than 5 samples equally spaced over a 30-day period), the geometric mean of the indicated bacterial densities should not exceed one or the other of the following: *E. coli* 126 MPN per 100 ml; or Enterococci 33 MPN per 100 ml." A methodology for determining exceedances based on single samples is also included in the standards.

Evidence of Impairment
DeltaKeeper submitted bacteria data for Smith Canal from three sampling locations (Jennings, 2001). The sampling locations are located at the upper terminus of the canal at Yosemite Lake, approximately one-quarter mile downstream in the canal, and near the mouth of the canal (near Interstate 5 [I-5]). Geometric means have been calculated using the data submitted by DeltaKeeper. The calculated geometric mean for the *E. coli* levels measured in samples collected from the Yosemite Lake location is 919 MPN per 100 ml, which exceeds the USEPA criterion of 126 MPN per 100 ml. The calculated geometric mean for the *E.*

coli levels measured in samples collected from the sampling location approximately one-quarter mile downstream from the Yosemite Lake is 6,223 MPN per 100 ml, which also exceeds the USEPA criterion of 126 MPN per 100 ml. The calculated geometric mean for the *E. coli* levels measured in samples collected from the sampling location near I-5 is 88 MPN per 100 ml. However, individual *E. coli* measurements for samples collected from location near I-5 have exceeded the USEPA single sample criterion of 235 MPN per 100 ml and the geometric mean of the measured total coliform levels remains high, at 2,090 MPN per 100 ml.

Extent of Impairment
Regional Board staff recommends listing the entire reach of Smith Canal, including Yosemite Lake at the upper terminus, as impaired for pathogens due to bacterial contamination. Sampling locations are within the urban Stockton area. The entire canal is heavily urbanized and has similar land use patterns. Sampling shows high levels of bacteria in the entire length of Smith Canal.

Potential Sources
In urban settings, the USEPA has identified sources of pathogen pollution to include urban litter, contaminated refuse, domestic pet and wildlife excrement, and failing sewer lines (USEPA, 2001a). In their pathogen TMDL Guide, the USEPA states "In a study of bacterial loading in urban streams, Young and Thackston (1999) found that fecal bacteria densities were directly related to the density of housing, population, development, percent impervious area, and domestic animal density. Additionally, recreational areas may have high bacteria counts. This can be due to improper disposal of waste from boats, lack of sanitary facilities in the area of recreation and children in diapers using the water."

B.1.50 South Cow Creek, Fecal Coliform

Summary of Proposed Action
The California Regional Water Quality Control Board-Central Valley Region, Regional Board, recommends the addition of South Cow Creek to California's Clean Water Act Section 303(d) list due to impairment by pathogens. Information available to the Regional Board on pathogens levels in South Cow Creek indicates that water quality objectives are not being attained. A description for the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	South Cow Creek	**Pollutants/Stressors**	Fecal Coliform
Hydrologic Unit	507.33	**Sources**	Human and/or livestock sources
Total Waterbody Size	28.5 miles	**TMDL Priority**	
Size Affected	7 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	From approximately 14 miles from the confluence to 7 miles before the confluence	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	N 40° 35' 21"	**Upstream Extent Longitude**	W 121° 55' 13"
Downstream Extent Latitude	N 40° 34' 55"	**Downstream Extent Longitude**	W 122° 00' 51"

Watershed Characteristics
South Cow Creek is located in Shasta County and flows from the foothills of Mount Lassen southwest to the Sacramento River, east of Anderson. South Cow Creek is part of the Cow Creek watershed. Land use within the Cow Creek watershed previously included use by indigenous peoples and historic mining, and currently includes ranches, timberlands, and towns (Montoya and Pan, 1992; Hannaford and North State Institute for Sustainable Communities, 2000).

Water Quality Objectives Not Attained
The numeric objective for bacteria is not being attained in South Cow Creek. The bacteria objective in the Basin Plan states, in part, "In waters designated for contact recreation (REC-1), the fecal coliform concentration based on a minimum of not less than five samples for any 30-day period shall not exceed a geometric mean of 200/100 ml, nor shall more than ten percent of the total number of samples taken during any 30-day period exceed 400/100 ml (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf)." The bacteria objectives are presented in terms of Most Probable Number (MPN) per 100 milliliters (ml). The bacteria objectives were evaluated for South Cow Creek by comparing fecal coliform concentrations measured in South Cow Creek to Basin Plan objectives.

Evidence of Impairment
Water samples were collected from the middle reach of South Cow Creek between June and October 1999. The average fecal coliform level in the water samples was approximately 800 MPN/100ml. The fecal coliform levels exceeded the geometric mean Basin Plan criterion (200 MPN/100ml) for at least five months in 1999. Many of samples were also above the 30-day Basin Plan criterion (400 MPN/100 ml) (Hannaford and North State Institute for Sustainable Communities, 2000).

Extent of Impairment
South Cow Creek flows for approximately 28.5. The middle reach, approximately 8 miles long, is impacted by fecal coliform.

Potential Sources
Hannaford and North State Institute for Sustainable Communities (2000) concluded that the South Cow Creek site contained "at least the wildlife input" and potentially low levels of livestock and human inputs of bacteria. The levels are considered to be the background level for the area. Since the impaired South Cow Creek site is not known to contain more wildlife than the other areas, the excess bacteria "probably originated from livestock or human sources," including septic systems and/or sewage lines leaching into the streams (Hannaford and North State Institute for Sustainable Communities, 2000).

B.1.51 Lower Stanislaus River, Mercury

Summary of Proposed Action
The California Regional Water Quality Control Board, Central Valley Region (Regional Board) recommends the addition of the lower Stanislaus River to California's Clean Water Act Section 303(d) list due to impairment by mercury. Information available to the Regional Board on mercury levels in fish tissue samples indicates that water quality objectives are not being attained in the lower Stanislaus River. The description for the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Lower Stanislaus River	**Pollutants/Stressors**	Mercury
Hydrologic Unit	535.30	**Sources**	Resource extraction (abandoned mines)
Total Waterbody Size	48 miles	**TMDL Priority**	
Size Affected	48 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	Entire Lower Stanislaus River	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	37º 52' 24.6"	**Upstream Extent Longitude**	120º 36' 16.6"
Downstream Extent Latitude	37º 39' 52.7"	**Downstream Extent Longitude**	121º 14' 28.5"

Watershed Characteristics
The lower Stanislaus River flows 48 miles from the Goodwin Diversion Dam through the towns of Oakdale, Riverbank and Ripon to its confluence with the San Joaquin River. The upstream segment forms the Calaveras-Tuolumne County line, the middle segment flows through Stanislaus County, and the downstream segment forms the Stanislaus-San Joaquin County line. The Goodwin Diversion Dam serves as an after bay for hydropower and spillway releases from Tulloch Dam, which is immediately upstream. The Tulloch Dam serves as an after bay for hydropower releases from the upstream New Melones Dam. The New Melones Dam regulates the flows of the Stanislaus River. Neither the Tulloch nor Goodwin reservoirs have flood control space; large releases are passed through both reservoirs. The Oakdale and South San Joaquin Irrigation Districts operate Goodwin Diversion Dam and Tulloch Reservoir; the U.S. Bureau of Reclamation operates the New Melones Dam (USBR, 2001).

Water Quality Objectives Not Attained
The narrative objective for toxicity is not being attained for mercury in the lower Stanislaus River. The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf)."

Numeric criteria for mercury in fish tissue have been developed for both human health and wildlife protection. The U.S. Environmental Protection Agency (USEPA) recently established a human health protection criterion of 0.3 milligrams per kilogram (mg/kg; equivalent to parts per million [ppm]) methylmercury in the edible portions of fish (USEPA, 2001b). This criterion is used to determine attainment with of the narrative toxicity objective.

Evidence of Impairment
The Toxic Substances Monitoring Program (TSMP) and San Francisco Estuary Institute (SFEI) collected composite samples of trophic level 3 and 4 fish from the Stanislaus River between 1978 and 1998 (SWRCB, 1995; Davis and May, 2000). Trophic level 3 fish feed on zooplankton, phytoplankton, and benthic invertebrates. Trophic level 4 fish consume trophic level 3 fish as part of their diet. Methylmercury and total mercury bioaccumulate in aquatic organisms and tend to increase with increasing trophic levels (USEPA, 1997b). The TSMP and SFEI sampled 45 trophic level 4 fish (largemouth bass, channel catfish, and white catfish). These trophic level 4 fish had an average mercury concentration of 0.53 ppm, which exceeds the USEPA criterion of 0.3 ppm.

Extent of Impairment
The lower Stanislaus River flows 58 miles from Goodwin Diversion Dam to its confluence with the San Joaquin River. Data are available only for the downstream segment of the river. However, the entire 58-mile reach is probably impaired because there is no substantial input downstream of Goodwin Dam.

Potential Sources
The principal source of mercury to Stanislaus River is historic gold mining sites in the upper portion of the watershed (OMR, 2000).

B.1.52 Stockton Deep Water Channel, Pathogens

Summary of Proposed Action
The California Regional Water Quality Control Board, Central Valley Region, (Regional Board) recommends the addition of Stockton Deep Water Channel in the Delta to California's Clean Water Act Section 303(d) list due to impairment by pathogens. Information available to the Regional Board on

pathogens levels in Stockton Deep Water Channel indicates that water quality objectives are not being attained. A description for the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Stockton Deep Water Channel	**Pollutants/Stressors**	Bacteria
Hydrologic Unit	544.00	**Sources**	Urban runoff, Recreation
Total Waterbody Size	2 miles	**TMDL Priority**	
Size Affected	2 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	All of the channel	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	37° 57' 28"	**Upstream Extent Longitude**	121° 21' 14"
Downstream Extent Latitude	37° 57' 23"	**Downstream Extent Longitude**	121° 17' 34"

Watershed Characteristics
The California Department of Health Services (CDHS) has adopted a total coliform bacteria guideline, applicable to recreational waters and beaches, of 10,000 Most Probable Number (MPN) per 100 milliliters for single samples (Title 17 California Code of Regulation section 7958). The Stockton Deep Water Channel is located in the Delta and extends through the Port of Stockton into urban Stockton, where it is bordered by residential housing and recreation areas including Weber Point. The California Department of Health Services (CDHS) has adopted a total coliform bacteria guideline, applicable to recreational waters and beaches, of 10,000 Most Probable Number (MPN) per 100 milliliters for single samples (Title 17 California Code of Regulation section 7958). The Stockton Deep Water Channel supports recreational uses, including boating, fishing, and swimming. The predominant land uses in the area around the Stockton Deep Water Channel are industrial and urban.

Water Quality Objectives Not Attained
The narrative objective for toxicity is not being attained for pathogens in the predominantly urban stretches of various Delta waterways. The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states the " the Regional Water Board will also consider…numerical criteria and guidelines developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services…the U.S. Environmental Protection Agency, and other organizations to evaluate compliance with this objective (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/rwqcb5/bsnplnab.pdf)."

Guidelines and criteria have been developed for the protection of human health. The California Department of Health Services (CDHS) has adopted a total coliform bacteria guideline, applicable to recreational waters and beaches, of 10,000 Most Probable Number (MPN) per 100 milliliters for single samples and of 1,000 MPN per 100 ml for 30-day log mean of sample levels (Title 17 California Code of Regulation section 7958). CDHS has also published draft guidelines that include limits for single samples of *E. coli* of 235 MPN per 100 milliliters (CDHS, July 2000 http://www.dhs.ca.gov/ps/ddwem/beaches/freshwater.htm). USEPA guidelines for bacteria are contained in *Ambient Water Quality Criteria for Bacteria* (USEPA, 1986a). The USEPA standards are stated as "Based on a statistically sufficient number of samples (generally not less than 5 samples equally spaced over a 30-day period), the geometric mean of the indicated bacterial densities should not exceed one or the other of the following: *E. coli* 126 MPN per 100 ml; or Enterococci 33 MPN per 100 ml." A methodology for determining exceedances based on single samples is also included in the standards.

Evidence of Impairment
DeltaKeeper submitted bacteria data for the Stockton Deep Water Channel from two sampling locations (Jennings, 2001). One sampling location is at the lower terminus of the channel in McLeod Lake and the other is approximately one mile upstream at Morelli Park. During six months in 2000, 14 samples were collected from each location and analyzed for *E. coli*. Geometric means have been calculated using the data submitted by DeltaKeeper. The calculated geometric mean for *E. coli* in water samples collected from the Morelli Park location is 399 MPN per 100 ml, which exceeds the USEPA criterion of 126 MPN per 100 ml. The calculated geometric mean for *E. coli* in water samples collected from the McLeod Lake location is 287 MPN per 100 ml, which also exceeds the USEPA criterion.

Extent of Impairment
Regional Board staff recommends listing the Stockton Deep Water Channel as impaired due to pathogen contamination. Both sampling locations are within the urban Stockton area, which includes a deep water shipping port. The area around the entire reach of the Stockton Deep Water Channel has similar land use patterns and it is expected that sampling would show similar high levels of bacteria throughout the channel.

Potential Sources
In urban settings, the USEPA has identified sources of pathogen pollution to include urban litter, contaminated refuse, domestic pet and wildlife excrement and failing sewer lines (USEPA, 2001). In their pathogen TMDL Guide USEPA states "In a study of bacterial loading in urban streams, Young and Thackston (1999) found that fecal bacteria densities were directly related to the density of housing, population, development, percent impervious area, and domestic animal density. Additionally, recreational areas may have high bacteria counts. This can be due to improper disposal of waste from boats, lack of sanitary facilities in the area of recreation and children in diapers using the water."

B.1.53 Sutter Bypass, Diazinon

Summary of Proposed Action
The California Regional Water Quality Control Board, Central Valley Region (Regional Board) recommends the addition of the Sutter Bypass to California's Clean Water Act Section 303(d) list due to impairment by diazinon. Information available to the Regional Board on diazinon concentrations in the Sutter Bypass indicates that water quality objectives are not being attained. The basis for this recommendation is given below.

Table B-1. 303(d) Listing/TMDL Information

Water Body Name	Sutter Bypass	**Pollutants/Stressors**	Diazinon
Hydrologic Unit	520.10	**Sources**	Agriculture
Total Water Body Size	25 miles	**TMDL Priority**	
Size Affected	25 miles	**TMDL Start Date**	
Extent of Impairment	Entire length	**TMDL End Date**	
Upstream Extent Latitude	39° 08' 53"	**Upstream Extent Longitude**	121° 50' 18"
Downstream Extent Latitude	38° 46' 50"	**Downstream Extent Longitude**	121° 38' 31"

Watershed Characteristics
The Sutter Bypass is located in Butte and Sutter Counties. It flows south for approximately 25 miles, from the Sacramento River to the Feather River. The water flowing through the bypass is primarily from the Sacramento River. However, water quality in the bypass is impacted by agricultural runoff, including storm water and irrigation runoff from extensive orchard areas. A number of other waterbodies also flow into the Sutter Bypass, and many of these tributaries also drain orchards.

Water Quality Objectives Exceeded

The narrative objectives for pesticides and toxicity are not being attained for diazinon in the Sutter Bypass. The narrative objective for pesticides states, "No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses." The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective" (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf). The California Department of Fish and Game has established freshwater numeric acute (1-hour average) and chronic (4-day average) criteria for diazinon of 0.08 µg/L and 0.05 µg/L, respectively, for the protection of aquatic life (Siepmann and Finlayson, 2000).

Evidence of Impairment

Several studies have measured diazinon concentrations in water samples collected from the Sutter Bypass (Table 2). These studies were conducted between December and March, the winter orchard dormant season. A total of 78 samples were analyzed for diazinon; of these 78 samples 27 (35%) exceeded the CDFG chronic water quality criterion for diazinon, and ten (13%) exceeded the acute criterion (Nordmark, 1998, 1999, 2000).

Table B-2. Diazinon Concentrations in Water Samples Collected from the Sutter Bypass

Data Source	Sample Years	Number of Samples	Range of Diazinon Concentration	Criteria[a]		Number of Samples Equal to or Above Criteria	Percent Samples Equal to or Above Criteria
Nordmark, 1998	1996 - 1997	16	nd - 0.09 µg/L	chronic	0.05 µg/L	5	31%
				acute	0.08 µg/L	1	6%
Nordmark, 1998	1997 - 1998	20	nd - 0.1 µg/L	chronic	0.05 µg/L	5	25%
				acute	0.08 µg/L	4	20%
Nordmark, 1999	1998 - 1999	20	nd - 0.11 µg/L	chronic	0.05 µg/L	7	35%
				acute	0.08 µg/L	2	10%
Nordmark, 2000	1999 - 2000	22	nd - 0.09 µg/L	chronic	0.05 µg/L	2	9%
				acute	0.08 µg/L	1	4.5%
Sum	1996 - 2000	78	nd - 0.11 µg/L	chronic	0.05 µg/L	27	35%
				acute	0.08 µg/L	10	13%

a) California Department of Fish and Game Water Quality Criteria for Diazinon (Siepmann and Finlayson, 2000)
nd not detected

Extent of Impairment

Because of the extensive acreage of orchards drained by the Sutter Bypass and its tributaries, the entire Sutter Bypass is likely to be impaired by diazinon.

Potential Sources

Diazinon is used as a dormant spray on almonds and stonefruits, and these applications are the most likely sources of diazinon runoff to the Sutter Bypass.

B.1.54 Walker Slough, Diazinon

Summary of Proposed Actions

The California Regional Water Quality Control Board, Central Valley Region (Regional Board) recommends the addition of Walker Slough to California's Clean Water Act Section 303(d) list due to impairment by diazinon. Information available to the Regional Board on diazinon concentrations in Walker Slough indicates that water quality objectives are not being attained. The basis for this recommendation is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Walker Slough	**Pollutants/Stressors**	Diazinon
Hydrologic Unit	544.00	**Sources**	Urban
Total Waterbody Size	2 miles	**TMDL Priority**	
Size Affected	2 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	Entire waterbody	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	37º 54' 57"	**Upstream Extent Longitude**	121º 16' 31"
Downstream Extent Latitude	37º 54' 57"	**Downstream Extent Longitude**	121º 18' 03"

Watershed Characteristics

Walker Slough is located almost entirely within the urban area of the City of Stockton, and drains into French Camp Slough west of Interstate 5. Walker Slough is approximately 2 miles long.

Water Quality Objectives Not Attained

The narrative objectives for pesticides and toxicity are not being attained for diazinon in Walker Slough. The narrative objective for pesticides states, "No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses." The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective" (California Regional Water Quality Control Board, Central Valley Region, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf). The California Department of Fish and Game (CDFG) has established freshwater numeric acute (1-hour average) and chronic (4-day average) criteria for diazinon of 0.08µg/L and 0.05 µg/L, respectively, for the protection of aquatic life (Siepmann and Finlayson, 2000).

Evidence of Impairment

Between 1994 and 1998, nine samples collected from Walker Slough were analyzed for diazinon. Most of these samples were collected during wet weather events in the winter. Five of these samples (55%) exceeded the CDFG acute and chronic criteria for diazinon (Table 2).

Table B-2. Diazinon in Water Samples Collected from Walker Slough

Data Source	Location	Sample Years	# of Samples	Range of Diazinon Concentration	Criteria[a]		Number of Samples Equal to or Above Criteria	Percent Samples Equal to or Above Criteria
Lee and Jones-Lee, 2001	Manthey Road	1998	1	0.17 µg/L	chronic	0.05 µg/L	1	100%
					acute	0.08 µg/L	1	100%
Lee and Jones-Lee, 2001	Western Park Industrial Center	1996 - 1998	5	nd - 0.47 µg/L	chronic	0.05 µg/L	2	40%
					acute	0.08 µg/L	2	40%
Reyes et al, 1994	na	1994	2	nd - 0.27 µg/L	chronic	0.05 µg/L	1	50%
					acute	0.08 µg/L	1	50%
Lee and Jones-Lee, 2001	na	1998	2	0.09 - 0.17 µg/L	chronic	0.05 µg/L	2	100%
					acute	0.08 µg/L	2	100%
Sum	Sum	1994 - 1998	10	nd - 1.0 µg/L	chronic	0.05 µg/L	6	60%
					acute	0.08 µg/L	6	60%

a) CDFG water quality criteria for the protection of aquatic life (Siepmann and Finlayson, 2000)
nd = not detected

Extent of Impairment
Because of its location within an urban area the entire length of Walker Slough is likely to be impaired by diazinon.

Potential Sources
Diazinon is used for structural and landscape pest control year-round, and these are the likely sources of diazinon in Walker Slough.

B.1.55 Walker Slough, Pathogens

Summary of Proposed Action
The California Regional Water Quality Control Board, Central Valley Region, (Regional Board) recommends the addition of Walker Slough in the Delta to California's Clean Water Act Section 303(d) list due to impairment by pathogens. Information available to the Regional Board on pathogens levels in the Walker Slough indicates that water quality objectives are not being attained. A description for the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Walker Slough	**Pollutants/Stressors**	Pathogens
Hydrologic Unit	544.00	**Sources**	Urban runoff, Recreation
Total Waterbody Size	7 Miles	**TMDL Priority**	
Size Affected	7 Miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	Walker Slough	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	37º 54' 57"	**Upstream Extent Longitude**	121º 16' 31"
Downstream Extent Latitude	37º 54' 57"	**Downstream Extent Longitude**	121º 18' 03"

Watershed Characteristics
Walker Slough is located in the Delta and extends between French Camp Slough and Duck Creek. The area is highly urbanized and supports recreational uses, including boating, fishing, water skiing and swimming. The Delta is characterized by tidal waters with limited flushing flows during the dry seasons.

Water Quality Objectives Not Attained
The narrative objective for toxicity is not being attained for pathogens in Walker Slough. The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states the " the Regional Water Board will also consider…numerical criteria and guidelines developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services…the U.S. Environmental Protection Agency, and other organizations to evaluate compliance with this objective." The Basin Plan also contains a specific objective for fecal coliform bacteria (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/rwqcb5/bsnplnab.pdf).

Guidelines and criteria have been developed for the protection of human health. The California Department of Health Services (CDHS) has adopted a total coliform bacteria guideline, applicable to recreational waters and beaches, of 10,000 Most Probable Number (MPN) per 100 milliliters for single samples and of 1,000 MPN per 100 ml for 30-day log mean of sample levels (Title 17 California Code of Regulation section 7958). CDHS has also published draft guidelines that include limits for single samples of *E. coli* of 235 MPN per 100 milliliters (CDHS, July 2000 http://www.dhs.ca.gov/ps/ddwem/beaches/freshwater.htm). USEPA guidelines for bacteria are contained in *Ambient Water Quality Criteria for Bacteria* (USEPA, 1986a). The USEPA standards are stated as "Based on a statistically sufficient number of samples (generally not less than 5 samples equally spaced over a 30-day period), the geometric mean of the indicated bacterial densities should not exceed one or the other of the following: *E. coli* 126 MPN per 100 ml; or Enterococci 33 MPN per 100 ml." A methodology for determining exceedances based on single samples is also included in the standards.

Evidence of Impairment
DeltaKeeper submitted bacteria data for Walker Slough from two sampling locations (DeltaKeeper, 2001). Fourteen samples were collected from each location during six months in 2000-2001 and analyzed for *E. coli*. Geometric means of the bacteria counts have been calculated using the data submitted by DeltaKeeper. The calculated geometric mean for *E. coli* in samples collected from the downstream location is 506 MPN per 100 ml, which exceeds the USEPA criterion of 126 MPN per 100 ml. The calculated geometric mean for *E. coli* in samples collected from the upstream location is 1,182 MPN per 100 ml, which also exceeds the USEPA criterion.

Extent of Impairment
Regional Board staff recommends listing the portion of Walker Slough that occurs between French Camp Slough and Duck Creek as impaired for pathogens due to bacterial contamination. The sampling locations are within the urban Stockton area. The area around the entire slough is urbanized and has similar land use patterns. It is expected that samples collected from other portions of Walker Slough would show similar high levels of *E. coli*.

Potential Sources
In urban settings, the USEPA has identified sources of pathogen pollution to include urban litter, contaminated refuse, domestic pet and wildlife excrement and failing sewer lines (USEPA, 2001). In their pathogen TMDL Guide, the USEPA states "In a study of bacterial loading in urban streams, Young and Thackston (1999) found that fecal bacteria densities were directly related to the density of housing, population, development, percent impervious area, and domestic animal density. Additionally, recreational areas may have high bacteria counts. This can be due to improper disposal of waste from boats, lack of sanitary facilities in the area of recreation and children in diapers using the water."

B.1.56 Wolf Creek, Fecal Coliform

Summary of Proposed Action
The California Regional Water Quality Control Board, Central Valley Region, (Regional Board) recommends the addition of Wolf Creek to California's Clean Water Act Section 303(d) list due to impairment by fecal coliform. Information available to the Regional Board on pathogens levels in Wolf Creek indicates that water quality objectives are not being attained. A description for the basis for this determination is given below.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Wolf Creek	**Pollutants/Stressors**	Bacteria
Hydrologic Unit	516.30	**Sources**	Urban runoff, Recreation, Agriculture
Total Waterbody Size	14.5 miles	**TMDL Priority**	Low
Size Affected	14.5 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	All of Wolf Creek	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	39º 12' 56"	**Upstream Extent Longitude**	121º 04' 00"
Downstream Extent Latitude	39º 02' 03"	**Downstream Extent Longitude**	121º 07' 51"

Watershed Characteristics
The Wolf Creek watershed is located in the Sierra Nevada foothills. Wolf Creek runs through the urban area of Grass Valley. The Grass Valley Wastewater Treatment Plant (GVWTP) discharges into Wolf Creek below Grass Valley. Downstream from Grass Valley, the Wolf Creek watershed consists of low-density housing that typically has some associated livestock.

Water Quality Objectives Not Attained

The numeric objective for bacteria is not being attained in Wolf Creek. The bacteria objective in the Basin Plan states, in part, "In waters designated for contact recreation (REC-1), the fecal coliform concentration based on a minimum of not less than five samples for any 30-day period shall not exceed a geometric mean of 200/100 ml, nor shall more than ten percent of the total number of samples taken during any 30-day period exceed 400 /100 ml (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf)." The bacteria objectives are presented in terms of Most Probable Number (MPN) per 100 milliliters (ml). The bacteria objectives were evaluated for Wolf Creek by comparing fecal coliform concentrations measured in Wolf Creek to Basin Plan objectives.

Guidelines and criteria have been developed for the protection of human health. The California Department of Health Services (CDHS) has adopted total coliform bacteria guidelines, applicable to recreational waters and beaches, of 10,000 MPN/100 ml for single samples and of 1,000 MPN/ml for 30-day log means of sample levels (Title 17 California Code of Regulation section 7958). CDHS has also published draft guidelines that include a limit for *E. coli* in single samples of 235 MPN/100 ml (CDHS, July 2000 http://www.dhs.ca.gov/ps/ddwem/beaches/freshwater.htm). The USEPA (USEPA) guidelines for bacteria, contained in *Ambient Water Quality Criteria for Bacteria* (USEPA, 1986a), are stated as "Based on a statistically sufficient number of samples (generally not less than 5 samples equally spaced over a 30-day period), the geometric mean of the indicated bacterial densities should not exceed one or the other of the following: *E. coli* 126 MPN per 100 ml; or Enterococci 33 MPN per 100 ml." A methodology for determining exceedances based on single samples is also included in the standards.

Evidence of Impairment

Waste discharge reports and Regional Board inspection sampling results show elevated coliform levels upstream and downstream of the GVWTP (City of Grass Valley, 2000 and 2001). Geometric means were calculated from 18 sample dates during February 2000 to June 2001. Calculated geometric means for total coliform of 1,491 MPN/100 ml (upstream of the GVWTP) and 1,014 MPN/100 ml (downstream of the GVWTP), exceeding the CDHS recommended criteria of 1,000 MPN/100 ml total coliform. The calculated geometric mean for fecal coliform for samples collected upstream of the GVWTP of 238 MPN/100 ml exceeds the Basin Plan Fecal Coliform objective of 200 MPN/100 ml. The calculated geometric mean for fecal coliform for samples collected downstream of the GVWTP is 102 MPN/100 ml. The fecal coliform counts in seven of 18 monthly samples exceeded the 200 MPN/100 ml fecal coliform criterion and reached 2,300 MPN/100 ml in February 2000 (City of Grass Valley, 2000 and 2001).

Extent of Impairment

Regional Boards staff recommends that the entire Wolf Creek be listed for fecal coliform. Although only the upper reach of Wolf Creek has been monitored for coliform, land use in the lower reach is essentially the same. There are no stream segments that would be likely to have substantially lower pathogen loads.

Potential Sources

In urban settings, the USEPA has identified sources of pathogen pollution to include urban litter, contaminated refuse, domestic pet and wildlife excrement and failing sewer lines (USEPA, 2001). In their pathogen TMDL Guide, the USEPA states "In a study of bacterial loading in urban streams, Young and Thackston (1999) found that fecal bacteria densities were directly related to the density of housing, population, development, percent impervious area, and domestic animal density. Additionally, recreational areas may have high bacteria counts. This can be due to improper disposal of waste from boats, lack of sanitary facilities in the area of recreation and children in diapers using the water."

B.2 Fact Sheets Supporting Removal From the 303(d) List

B.2.1 American River, Lower, Group A Pesticides

Summary of Proposed Action

The California Regional Water Quality Control Board, Central Valley Region, (Regional Board) recommends the removal of the lower American River from California's Clean Water Act Section 303(d) list due to impairment by Group A Pesticides. Information available to the Regional Board on Group A Pesticides levels indicates that water quality objectives are being attained. The description for the basis for this determination is given below.

Watershed Characteristics

The lower American River flows from Folsom Dam, approximately 30 miles east of Sacramento, through the greater Sacramento area to its confluence with the Sacramento River, near downtown Sacramento.

Water Quality Objectives Attained

The narrative objective for pesticides and toxicity are being attained for Group A pesticides in the American River. The narrative objective for pesticides states, "No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses." It further states "discharges shall not result in pesticide concentrations in bottom sediments or aquatic life that adversely affect beneficial uses." The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf)."

The toxicity and pesticide narrative objectives were evaluated for the American River by comparing Group A pesticides concentrations measured in the American River to freshwater fish and marine organism guidelines and criteria that have been developed for both human health and wildlife protection. Group A pesticides consist of a total concentration from the following organochlorine pesticides: aldrin, dieldrin, endrin, heptachlor, heptachlor epoxide, chlordane (total), lindane, hexachlorocyclohexane (total), endosulfan (total), and toxaphene. Group A pesticides bind tightly to soil and break down slowly. They are either insoluble or have low solubility in water, but are lipid soluble thereby accumulating in the fatty tissue of consumers. The Environmental Protection Agency (USEPA) classifies Group A pesticides as toxins, carcinogens, or both (USEPA, 2000b). The National Academy of Sciences-National Academy of Engineering (NAS) numeric Group A pesticides guideline of 100 ng/g (nanograms per gram, or parts per billion (ppb)), applies to whole fish for the protection of fish-eating wildlife (NAS, 1973). The United States Food and Drug Administration (USFDA) set 300 ppb as its numeric action level for the edible portion (filet) of commercial freshwater and marine fish (USFDA, 1984).

Evidence of Attainment

The American River was originally placed on the 303(d) list based on Group A pesticide fish tissue concentrations reported by the Toxic Substances Monitoring Program (TSMP) (SWRCB, 1995). The TSMP analysis of Group A pesticides included aldrin, chlordane (total), dieldrin, endsulfan (total), endrin, hexachlorocyclohexane (total), heptachlor, heptachlor epoxide, and toxaphene. Three out of fifteen fish filet samples had total Group A pesticide concentrations greater than 100 ppb. The average Group A pesticide concentration of all samples, when weighted by the number of fish in each composite sample, was 56.2 ppb. When only considering the total dieldrin and chlordane concentration, the weighted average concentration was 55.7 ppb. Dieldrin and chlordane, therefore, account for almost all of the Group A pesticides historically found in fish in the American River.

Dieldrin and chlordane concentrations in fish tissue were recently analyzed in the American River as part of the Sacramento River Watershed Program (Larry Walker and associates, 2001b). Seven different composites of fish filets (which included a total of 33 individual fish) were analyzed for total chlordane and dieldrin. Fish tissue data was collected for the SRWP between 1997 and 1999. None of the samples analyzed exceed fish tissue criteria established by NAS and USFDA (Larry Walker and associates, 2001b). Data from the earlier TSMP studies and the more recent SRWP studies are presented in Table B-1.

Since the earlier TSMP study, upon which the original 303(d) listing was based, showed that dieldrin and chlordane were the dominant Group A pesticides found in fish tissue in the American River, a direct comparison between the TSMP studies and the more recent SRWP studies can be made. The more recent SRWP information indicates that dieldrin/total chlordane concentrations have been reduced by approximately a factor of 7 and that available criteria are not being exceeded.

Table B-1. Summary of Group A Pesticide Concentrations in Fish Tissue Samples

Data Source	Sample Years	# of Composites/ Individuals Analyzed (Total # of Fish)	Mean Dieldrin & Chlordane Pesticide Concentration	Range Dieldrin/ Chlordane Pesticide Concentration	Criteria[1]	Percent Samples Above Criteria
TSMP[2]	1979 - 1990	15 (74)	55.7 ppb	ND – 191.3 ppb	USFDA 300 ppb NAS 100 ppb	0% 20%
SRWP[3]	1997 - 1999	7 (33)	7.5 ppb	ND – 25.47 ppb	USFDA 300 ppb NAS 100 ppb	0% 0%

[1]USFDA-AL = United States Food and Drug Administration action level. NAS = National Academy of Sciences guideline

[2] Sampling locations include American River downstream of the Highway 160 Bridge and American River downstream of Watt Avenue Bridge

[3] Sampling locations include American River at Discovery Park and American River at J Street Bridge

Extent of Attainment

The entire length of the lower American River, Nimbus Dam to the Sacramento River confluence, attains water quality objectives for Group A pesticides and no longer need be identified on the 303(d) list. In the TSMP studies, fish were collected from the American River at Highway 160 (about river mile 2) and downstream of the Watt Avenue Bridge (about river mile 9.5). In the SRWP studies, fish were collected from the American River at Discovery Park (about river mile 0.2) and J Street (about river mile 6.5). The spatial coverage of the sampling sites for the two studies overlaps sufficiently so that the spatially representative of fish tissue concentrations is comparable.

B.3 Fact Sheets Supporting Changes to the 303(d) List

B.3.1 Cache Creek, Mercury and Unknown Toxicity, Change in Total Size and Size Affected

Summary of Proposed Action

The California Regional Water Quality Control Board, Central Valley Region, recommends changes to California's Clean Water Act Section 303(d) list for the impairment of Cache Creek due to impairment by mercury and unknown toxicity. The Regional Board recommends that the identified total length change from 60 to 81 miles and that the extent of impairment change from 35 miles to 81 miles. The basis for the recommended change is described below.

Watershed Characteristics

The Cache Creek watershed is located primarily within Lake and Yolo counties with a small portion in Colusa County. Cache Creek flows for approximately 80 miles from the Clear Lake dam to the Cache Creek Settling Basin adjacent to the Yolo Bypass (USGS, 1958-1992). The upper Cache Creek watershed (above Rumsey) flows through undeveloped chaparral and shrub oak habitat and is primarily used as rangeland (Foe and Croyle, 1998). The gradient of the creek in the 33-mile reach between Clear Lake (~1,320 feet above sea level [asl]) and Rumsey (420 feet asl) is steep, dropping approximately 27 feet per mile. Large areas are highly erosive. There are three inactive mercury-mining districts in the upper watershed area, Clear Lake, Sulfur Creek, and Knoxville mining districts (Montoya and Pan, 1992; Buer *et al*, 1979). The Sulfur Bank Mercury Mine at Clear Lake is a U.S. Environmental Protection Agency (USEPA) Superfund site. The Sulfur Bank Mercury Mine and other historic mercury mines located along tributaries to Cache Creek are discussed in the fact sheets for Clear Lake, Davis Creek Reservoir, Harley Gulch, and Sulfur Creek (a tributary to Cache Creek *via* Bear Creek). The lower Cache Creek watershed (downstream of Rumsey) is intensely farmed, primarily row, orchard, and rice cultivation (Foe and Croyle, 1998).

Total Waterbody Size and Extent of Impairment

Foe & Croyle (1998) indicated that the total length of Cache Creek is 81 miles. There are three inactive mercury-mining districts in the upper watershed area, Clear Lake, Sulfur Creek, and Knoxville mining districts (Montoya and Pan, 1992; Buer *et al*, 1979). Water quality and fish tissue data from the upper watershed (North and South forks, and Cache Creek Canyon) and the lower watershed (at Rumsey, Capay Dam, and Road 102) indicate mercury impairs the entire waterbody. Toxicity tests conducted using samples collected in Cache Creek at Road 102, at Rumsey, and from the North Fork were toxic to Ceriodaphnia, indicating that a toxin impairs the entire length of Cache Creek.

B.3.2 Camanche Reservoir, Copper

Summary of Proposed Action

The California Regional Water Quality Control Board, Central Valley Region, recommends changes to California's Clean Water Act Section 303(d) list for the impairment of the Camanche Reservoir by elevated dissolved copper concentrations. Camanche Reservoir was included on the 1998 303(d) list as part of the listing for the lower Mokelumne River. Regional Board staff has determined that listing reservoirs separately from their associated downstream drainages is more appropriate because watershed management strategies (and associated data needs) for reservoirs can be distinctly different from management strategies for the downstream drainages.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Camanche Reservoir*	**Pollutants/Stressors**	Copper
Hydrologic Unit	535.00	**Sources**	Resource extraction (abandoned mines)
Total Waterbody Size	7,622 acres	**TMDL Priority**	Low
Size Affected	7,622 acres	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	Entire lake.	**TMDL End Date (Mo/Yr)**	
Original 303(d) Listing Year	1992		

* Previously listed as part of the lower Mokelumne River; TMDL priority, start date, and end date are the same as those listed for the lower Mokelumne River.

Watershed Characteristics

The Camanche Reservoir is approximately 10 miles downstream from Pardee Dam on the Mokelumne River at the intersection of Amador, Calaveras, and San Joaquin Counties. The Camanche Reservoir has a surface area of 7,622 acres and a 63-mile shoreline (EBMUD, 2000). When the reservoir is at full capacity, it extends upstream to Pardee Dam (USGS, 1958-1992). Camanche Reservoir, working in tandem with Pardee Reservoir, stores water for irrigation and stream-flow regulation, providing flood control, water to the meet the needs of downstream water rights holders, and water for fisheries and riparian habitat (EBMUD, 2000). The East Bay Municipal Utility District (EBMUD) completed the Camanche Reservoir Project (downstream of Pardee) in 1964. EBMUD built a fish hatchery (the Mokelumne River Fish Installation) immediately downstream of Camanche Dam, which the California Department of Fish and Game operates. In addition, a power plant at the base of the dam was placed in service in 1983.

Several historic copper and gold mines are within the lower Mokelumne River watershed upstream of Camanche Reservoir. Penn Mine, which historically operated for copper extraction from 1861 to 1956, impacted the water quality of Camanche Reservoir. The Penn Mine site occupies a 22-acre area near the southeastern shore of Camanche Reservoir approximately 1.5 miles from the town of Campo Seco in Calaveras County. Penn Mine historically discharged to the reservoir via Mine Run Creek. Metal loading from Penn Mine led to fishery declines and fish kills in Camanche Reservoir, in the Mokelumne River Fish Installation downstream of Camanche Dam, and in the lower Mokelumne River; problems with toxic discharges from the Penn Mine continued through the 1960s and 1970s (Buer et al., 1979; SRWCB, 1990; CDFG, 1991; EDAW, Inc., 1992; EBMUD, 2000). Beginning in 1978, several abatement and restoration projects were conducted to decrease the impact of Penn Mine on Camanche Reservoir and the lower Mokelumne River; the most recent abatement project was completed in late 1999 (Buer et al., 1979; SCH EIR, 1996; CH2MHill, 2000a and 2000b). The recent sampling results indicate that aluminum sources upstream of Penn Mine (e.g., abandoned mine sites and natural sources) contribute enough aluminum to cause water entering Camanche Reservoir to exceed toxicity criteria.

Water Quality Objectives Not Attained

The narrative objective for toxicity is not being attained for copper in Camanche Reservoir. The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf)."

The toxicity objective was evaluated for Camanche Reservoir by comparing copper concentrations measured in Camanche Reservoir to water quality guidelines and criteria developed for human health and wildlife protection. The numeric United States Environmental Protection Agency (USEPA) California Toxics Rule (CTR) hardness-dependent continuous (4-day average) and maximum (1-hour average) dissolved copper criteria for freshwater aquatic life protection are 2.3 micrograms per liter (µg/L) and 2.9 µg/L, respectively, based on an assumed hardness of 20 milligrams per liter (mg/L) of calcium carbonate ($CaCO_3$) (Marshack, 2000). Hardness is assumed to be 20 mg/l of $CaCO_3$ because numerous studies (e.g., CH2MHill, 2000b & Buer et al., 1979) have indicated that Camanche Reservoir/Mokelumne River water has hardness values typical ranging from 10 to 25 mg/L. The USEPA primary maximum contaminant level (MCL) for drinking water protection is 1,300 µg/L of total recoverable copper (Marshack, 2000).

Evidence of Impairment

Elevated copper concentrations in water samples collected since 1958 indicate that copper impairs Camanche Reservoir. The data also indicate a strong seasonality to the copper loading; Penn Mine historically discharged more copper during wet seasons than during dry seasons. As illustrated by the data summaries below, a series of remediation projects at Penn Mine conducted in 1978, 1993, and 1999-2000 have significantly decreased the amount of copper leaving the mine site.

Water samples collected in Camanche Reservoir upstream of the Penn Mine discharge before the first remediation project had total copper concentrations of 10 µg/L (February 1958, wet season) and less than 10 µg/L (October 1977, dry season) (Buer et al., 1979). Downstream from the mine discharge, total copper concentrations were 3,800 µg/L and 40 µg/L, in 1958 and 1977, respectively (Buer et al., 1979). The downstream concentrations exceeded the toxicity criteria promulgated at that time, and were four to 380 times the upstream copper concentrations. Between February 1993 and February 1996 (after the start up period of the treatment plant at Mine Run Creek), EBMUD analyzed samples collected throughout Camanche Reservoir for total and dissolved copper concentrations (SCH EIR, 1996). Table 2 summarizes the EBMUD data for Camanche Reservoir.

As a result of the most recent remediation activities at Penn Mine that took place in 1999, the copper load from Penn Mine decreased from approximately 19,372 to 23,122 pounds per year (before the 1999 project) to approximately 190.4 pounds per year, a decrease of approximately 99% (CH2MHill, 2000b). Recent data indicate that both the frequency and magnitude of CTR exceedances in Camanche Reservoir have decreased since 1992, and that dissolved copper concentrations in Camanche Reservoir now appear to be at or below the CTR criteria. However, future samples should be analyzed using a lower method detection limit (MDL) to determine long-term compliance with the CTR criteria. Between September 1999 and August 2000, EBMUD collected 12 samples from Camanche Reservoir, approximately 1,000 feet downstream from the inflow of Mine Run Creek (CH2MHill, 2000b). One sample, collected in February 2000, had a dissolved copper concentration of 3.54 µg/L (hardness, 18 mg/l), which slightly exceeds the hardness-adjusted CTR continuous and maximum criteria. The five samples collected in September 1999 through January 2000 contained dissolved copper concentrations below their method detection limit (MDL) of 2.08 µg/L (hardness, 10-25 mg/L), indicating that dissolved copper concentrations probably did not exceed the CTR criteria. However, the MDL for samples collected in February through August 2000 was 3.12 µg/L, which is slightly higher than the hardness-dependent CTR criteria for dissolved copper; therefore, dissolved copper concentrations in these samples may or may not have slightly exceeded the CTR criteria. Table 2 includes a summary of these results.

Table B-2. Summary of Available Copper Concentration Data for Camanche Reservoir (Data sources: SCH EIR, 1996; CH2MHill, 2000b)

	Total Copper Concentrations			Dissolved Copper Concentrations			
						# [%] of Samples Exceeding CTR Criteria [b]	
Location [a] (upstream to downstream)	# of Samples (Dates Collected)	Range of Concentrations (µg/l)	# [%] of Samples Exceeding MCL (1,300 µg/l) [b]	# of Samples (Dates Collected)	Range of Concentrations (µg/l) [c]	Maximum Criterion (2.9 µg/l)	Continuous Criterion (2.3 µg/l)
Site A	47 (2/93 – 2/96)	< 2 – 9	0 [0%]	18 (2/93 – 2/96)	< 1.5 – 5	5 [%]	5 [%]
Site Q	48 (2/93 – 2/96)	< 1 – 17	0 [0%]	16 (2/93 – 2/96)	< 2 – 17	7 [%]	8 [%]
Site D	43 (2/93 – 2/96)	< 1.5 – 14	0 [%]	17 (2/93 – 2/96)	< 2 – 7	4 [%]	4 [%]
Other	131 (2/93 – 2/96)	< 1 – 16, 140 [d]	0 [%]	41 (2/93 – 2/96)	< 2 – 5	8 [%]	8 [%]
CAMA				12 (9/99 – 8/00)	< 2 – < 3.12	0 [%]	0 [%]
PENN20				12 (9/99 – 8/00)	< 2 – 3.54	1 [%]	1 [%]

(a) Site A: Camanche Reservoir, 0.5 miles upstream of Penn Mine.
Site Q: Point of discharge of Mine Run Creek to Camanche Reservoir.
Site D: Camanche Reservoir, 0.8 miles downstream of Penn Mine.
Other: Camanche Reservoir, 2 miles, 3 miles, and 10 miles downstream of Penn Mine.
CAMA: Camanche Reservoir, 0.57 miles upstream of Penn Mine (slightly upstream of Site A).
PENN20: Camanche Reservoir, 0.2 miles downstream of Penn Mine (downstream of Site D, slightly upstream of Site Q).
(b) MCL: USEPA primary maximum contaminant level for drinking water protection.
CTR: United States Environmental Protection Agency's California Toxics Rule (CTR) hardness-dependent continuous (4-day average) and maximum (1-hour average) dissolved copper criteria for freshwater aquatic life protection, based on an assumed hardness of 20 mg/L of $CaCO_3$ if hardness data were not available.
Many samples were analyzed using methods with detection limits below the level needed to evaluate compliance with the CTR criteria; therefore, the actual number of exceedances may be greater than indicated by this table.
On February 22, 1993, a total copper concentration of 140 µg/l was measured at the site 3 miles downstream of Penn Mine in the EBMUD data set. No high values were measured for other metals at this site or for total copper concentrations at other sites, on this date.

B.3.3 Camanche Reservoir, Zinc

Summary of Proposed Action

The California Regional Water Quality Control Board, Central Valley Region, recommends changes to California's Clean Water Act Section 303(d) list for the impairment of the Camanche Reservoir by elevated dissolved zinc concentrations. Camanche Reservoir was included on the 1998 303(d) list as part of the listing for the lower Mokelumne River. Regional Board staff has determined that listing reservoirs separately from their associated downstream drainages is more appropriate because watershed management strategies (and associated data needs) for reservoirs can be distinctly different from management strategies for the downstream drainages.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Camanche Reservoir*	**Pollutants/Stressors**	Zinc
Hydrologic Unit	535.00	**Sources**	Resource extraction (abandoned mines)
Total Waterbody Size	7,622 acres		Low
Size Affected	7,622 acres		
Extent of Impairment	Entire lake.	**TMDL End Date (Mo/Yr)**	
Original 303(d) Listing Year	1992		

* Previously listed as part of the lower Mokelumne River; TMDL priority, start date, and end date are the same as those listed for the lower Mokelumne River.

Watershed Characteristics

The Camanche Reservoir is approximately 10 miles downstream from Pardee Dam on the Mokelumne River at the intersection of Amador, Calaveras, and San Joaquin Counties. The Camanche Reservoir has a surface area of 7,622 acres and a 63-mile shoreline (EBMUD, 2000). When the reservoir is at full capacity, it extends upstream to Pardee Dam (USGS, 1958-2000). Camanche Reservoir, working in tandem with Pardee Reservoir, stores water for irrigation and stream-flow regulation, providing flood control, water to the meet the needs of downstream water rights holders, and water for fisheries and riparian habitat (EBMUD, 2000). The East Bay Municipal Utility District (EBMUD) completed the Camanche Reservoir Project (downstream of Pardee) in 1964. EBMUD built a fish hatchery (the Mokelumne River Fish Installation) immediately downstream of Camanche Dam, which the California Department of Fish and Game operates. In addition, a power plant at the base of the dam was placed in service in 1983.

Several historic copper and gold mines are within the lower Mokelumne River watershed upstream of Camanche Reservoir. Penn Mine, which historically operated for copper extraction from 1861 to 1956, impacted the water quality of Camanche Reservoir. The Penn Mine site occupies a 22-acre area near the southeastern shore of Camanche Reservoir approximately 1.5 miles from the town of Campo Seco in Calaveras County. Penn Mine historically discharged to the reservoir via Mine Run Creek. Metal loading from Penn Mine led to fishery declines and fish kills in Camanche Reservoir, in the Mokelumne River Fish Installation downstream of Camanche Dam, and in the lower Mokelumne River; problems with toxic discharges from the Penn Mine continued through the 1960s and 1970s (Buer et al., 1979; SRWCB, 1990; CDFG, 1991; EDAW, Inc., 1992; EBMUD, 2000). Beginning in 1978, several abatement and restoration projects were conducted to decrease the impact of Penn Mine on Camanche Reservoir and the lower Mokelumne River; the most recent abatement project was completed in late 1999 (Buer et al., 1979; SCH EIR, 1996; CH2MHill, 2000a and 2000b). The recent sampling results indicate that aluminum sources upstream of Penn Mine (e.g., abandoned mine sites and natural sources) contribute enough aluminum to cause water entering Camanche Reservoir to exceed toxicity criteria.

Water Quality Objectives Not Attained

The narrative objective for toxicity is not being attained for zinc in Camanche Reservoir. The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf)."

The toxicity objective was evaluated for Camanche Reservoir by comparing zinc concentrations measured in reservoir to water quality guidelines and criteria developed for human health and wildlife protection. The numeric United States Environmental Protection Agency (USEPA) California Toxics Rule (CTR)

hardness-dependent continuous (4-day average) and maximum (1-hour average) dissolved zinc criteria for freshwater aquatic life protection are both 30 micrograms per liter (µg/L), based on an assumed hardness of 20 milligrams per liter (mg/L) of calcium carbonate ($CaCO_3$) (Marshack, 2000). The CTR continuous and maximum criteria adjusted for total recoverable zinc are both 31 µg/L, based on an assumed hardness of 20 mg/L of $CaCO_3$ (Marshack, 2000). (Hardness is assumed to be 20 mg/l of $CaCO_3$ because numerous studies (e.g., CH2MHill, 2000b & Buer et al., 1979) have indicated that Camanche Reservoir/Mokelumne River water has hardness values typical ranging from 10 to 25 mg/L.) The USEPA maximum contaminant level (MCL) for drinking water protection is 5,000 µg/L of total recoverable zinc (Marshack, 2000).

Evidence of Impairment

Elevated zinc concentrations in water samples collected since 1958 indicate that zinc impairs Camanche Reservoir. The data indicate a strong seasonality to the zinc loading; Penn Mine historically discharged more zinc during wet seasons than during dry seasons. As illustrated by the data summaries below, a series of remediation projects at Penn Mine conducted in 1978, 1993, and 1999-2000 have significantly decreased the amount of zinc leaving the mine site.

Water samples collected in Camanche Reservoir upstream of the Penn Mine discharge before the first remediation project had total zinc concentrations of 10 µg/L (February 1958, wet season) and 250 µg/L (October 1977, dry season) (Buer et al., 1979). Downstream from the mine discharge, total zinc concentrations were 37,600 µg/L and 1,120 µg/L, in 1958 and 1977, respectively (Buer et al., 1979). The downstream concentrations exceeded the toxicity criteria promulgated at that time, and were 4.5 to 3,760 times the upstream zinc concentrations. Between February 1993 and February 1996 (after the start up period of the treatment plant at Mine Run Creek), EBMUD analyzed samples collected throughout Camanche Reservoir for total and dissolved zinc concentrations (SCH EIR, 1996). Table 2 summarizes the EBMUD data for Camanche Reservoir.

As a result of the most recent remediation activities at Penn Mine that took place in 1999, the zinc load from Penn Mine decreased from approximately 35,875 to 43,035 pounds per year (before the 1999 project) to approximately 1,907 pounds per year, a decrease of approximately 95% (CH2MHill, 2000b). Between September 1999 and August 2000, EBMUD collected samples from two locations at Camanche Reservoir, 1,000 feet downstream from the inflow of Mine Run Creek into Camanche Reservoir, and 3,000 feet upstream of the inflow. One downstream sample, collected in November 1999, had a dissolved zinc concentration of 31.9 µg/L (hardness, 16 mg/l), which slightly exceeds the hardness-adjusted CTR continuous and maximum criteria. Table 2 includes a summary of these results.

Table B-2 Summary of Available Zinc Concentration Data for Camanche Reservoir (Data sources: SCH EIR, 1996; CH2MHill, 2000b)

	Total Zinc Concentrations			Dissolved Zinc Concentrations		
Location [(a)] (upstream to downstream)	# of Samples (Dates Collected)	Range of Concentrations (µg/l)	# [%] of Samples Exceeding MCL (1,300 µg/l) [(b)]	# of Samples (Dates Collected)	Range of Concentrations (µg/l)	# [%] of Samples Exceeding CTR Criteria [(c)] (30 µg/L)
Site A	47 (2/93 – 2/96)	< 6 – 110	0 [0%]	18 (2/93 – 2/96)	< 3 – 63	1 [6%]
Site Q	48 (2/93 – 2/96)	3 – 180	0 [0%]	16 (2/93 – 1/96)	3 – 95	8 [50%]
Site D	43 (2/93 – 2/96)	< 3.3 – 100	0 [%]	17 (2/93 – 2/96)	< 5 – 97	4 [24%]
Other	133 (2/93 – 2/96)	4 - 59	0 [%]	41 (2/93 – 2/96)	< 3 - 24	0 [0%]
CAMA				12 (9/99 – 8/00)	< 0.8 – 9.29	0 [0%]
PENN20				12 (9/99 – 8/00)	2.12 – 31.9	1 [8%]

(a) Site A: Camanche Reservoir, 0.5 miles upstream of Penn Mine.
Site Q: Point of discharge of Mine Run Creek to Camanche Reservoir.
Site D: Camanche Reservoir, 0.8 miles downstream of Penn Mine.
Other: Camanche Reservoir, 2 miles, 3 miles, and 10 miles downstream of Penn Mine.
CAMA: Camanche Reservoir, 0.57 miles (3,000 feet) upstream of Penn Mine (slightly upstream of Site A).
PENN20: Camanche Reservoir, 0.2 miles (1,000 feet) downstream of Penn Mine (downstream of Site D, slightly upstream of Site Q).
(b) MCL: USEPA primary maximum contaminant level for drinking water protection.
(c) CTR: United States Environmental Protection Agency's California Toxics Rule (CTR) hardness-dependent continuous (4-day average) and maximum (1-hour average) dissolved copper criteria for freshwater aquatic life protection, based on an assumed hardness of 20 mg/L of $CaCO_3$ if hardness data were not available.

B.3.4 Delta Waterways, Dissolved Oxygen— Change in Total Size and Size Affected

Summary of Proposed Actions

The California Regional Water Quality Control Board, Central Valley Region, recommends a change to California's Clean Water Act Section 303(d) list for the impairment of the Delta due to impairment organic enrichment/low dissolved oxygen. The Regional Board recommends that the identified total size change from 480,000 acres to 48,000 acres and that the size affected be changed from 75 acres to 1,461 acres. The basis for the recommended change is described below.

Watershed Characteristics

The Delta waterways (Sacramento-San Joaquin Delta) encompass 1,153 square miles, with approximately 1,000 linear miles of waterway and a total waterbody size of approximately 48,000 acres. The Delta waterways form the lowest part of the Central Valley, lying between the Sacramento and San Joaquin Rivers and extending from the confluence of the two rivers inland as far as Sacramento and Stockton. Incoming flows vary widely from season to season and year to year, greatly affecting hydrology and habitat.

Total Waterbody Size and Extent of Impairment
The total waterbody size of the Delta is approximately 48,000 acres. This was misprinted in the final listing of the 1998 303(d) list as 480,000 acres. Therefore, the total size of the Delta should be changed to 48,000 acres for all pollutants. The area of the Delta impacted by low dissolved oxygen is the San Joaquin River from the Stockton Deep Water Ship Channel to Disappointment Slough (Lee and Jones-Lee, 2000b). This area is 1,461 acres.

B.3.5 Delta Waterways, Chlorpyrifos, DDT, Diazinon, Group A pesticides, Mercury, and Unknown Toxicity — Change in Total Size and Size Affected

Summary of Proposed Actions
The California Regional Water Quality Control Board, Central Valley Region, recommends changes to California's Clean Water Act Section 303(d) list for the Delta due to impairment by Chlorpyrifos, DDT, Diazinon, Group A pesticides, Mercury, and Unknown Toxicity. The Regional Board recommends that the identified total size change from 480,000 acres to 48,000 acres and that the extent of impairment change 480,000 acres to 48,000 acres. The identified total size of the Delta associated with all other pollutants should be changed to 48,000 acres. The basis for the recommended change is described below.

Watershed Characteristics
The Delta waterways (Sacramento-San Joaquin Delta) encompass 1,153 square miles, with approximately 1,000 linear miles of waterway and a total waterbody size of approximately 48,000 acres. The Delta waterways form the lowest part of the Central Valley, lying between the Sacramento and San Joaquin Rivers and extending from the confluence of the two rivers inland as far as Sacramento and Stockton. Incoming flows vary widely from season to season and year to year, greatly affecting hydrology and habitat.

Total Waterbody Size and Extent of Impairment
The total waterbody size of the Delta is approximately 48,000 acres. This was misprinted in the final listing of the 1998 303(d) list as 480,000 acres. Therefore, the total size of the Delta should be changed to 48,000 acres for all pollutants. Chlorpyrifos, DDT, diazinon, Group A pesticides, mercury, and an unknown toxicity impair the entire area of the Delta, and their extent of impairment should be changed from 480,000 acres to 48,000 acres.

B.3.6 Dunn Creek, Mercury and Metals - Change in Total Size and Size Affected

Summary of Proposed Action
The California Regional Water Quality Control Board, Central Valley Region, recommends changes to California's Clean Water Act Section 303(d) list for the impairment of Dunn Creek due to impairment by mercury and metals. The Regional Board recommends that the identified total length change from 9 to 3 miles and that the extent of impairment change from 9 miles to 1 mile. The basis for the recommended change is described below.

Watershed Characteristics
Dunn Creek is located along the east slope of Mount Diablo in Contra Costa County. It flows for approximately 3 miles before entering Marsh Creek, which flows into the San Joaquin Delta. The Mount Diablo Mine (Mt Diablo Mine), which was historically operated for mercury extraction, is located between Dunn Creek and Horse Creek (a tributary to Dunn Creek). The tailings from the Mt. Diablo Mine are highly acidic and contain numerous metals and mercury.

Total Waterbody Length and Extent of Impairment
Slotten *et al* (1996) and Iovenitti *et al* (1989) indicated that the total length of Dunn Creek is approximately 3 miles. Mt. Diablo Mine, which was historically operated for mercury extraction, is located between Dunn Creek and Horse Creek (a tributary to Dunn Creek), approximately 1 mile upstream from the

confluence of Dunn and Marsh Creeks (Iovenitti, *et al* 1989; Slotten et al, 1996; Buer *et al*, 1979). Water quality data indicates that mercury and metals impair Dunn Creek downstream Mt Diablo Mine.

B.3.7 Fall River, Sediment/Siltation – Change in Size Affected

Summary of Proposed Action

The California Regional Water Quality Control Board, Central Valley Region, recommends changes to California's Clean Water Act Section 303(d) list for the impairment of Fall River due to impairment by sediment and silt. The Regional Board recommends that the identified impaired length change from 25 to 9.5 miles. The basis for the recommended change is described below.

Watershed Characteristics

Fall River flows for approximately 25 miles, from Thousand Springs (in the southeast portion of Siskiyou County) to its confluence with Fall River (in Shasta County). The Upper Fall River (8.3 miles) meanders through a broad, flat floodplain, and receives inflow, plus sediment and silt, from numerous creeks and springs (including Bear, Spring, and Dry Creeks in wet years). Overall, the water quality and volume (for all areas) is influenced by agricultural uses (including irrigation returns to the river, water collected for irrigation uses, and grazing), tributary inflows, silviculture, and highway, road, and bridge construction. These sources have resulted in sediment and silt entering the river, covering the natural riverbed (composed primarily of clay, hardpan, and exposed volcanic cobbles) with sand, and impairing the water quality of Fall River.

Extent of Impairment

Fall Creek is impaired from its headwaters to just downstream of Spring Creek Bridge, a total distance of approximately 9.5 miles. This is demonstrated by 3 types of studies—identification of erosion sites, sediment studies, and studies of organisms within Fall Creek (including aquatic vegetation, aquatic macroinvertibrates, and fish). Because the studies generally compared upper and lower Fall Creek, most of the evidence suggests that upper Fall Creek is impaired relative to lower Fall Creek (CRWQCB-CVR, 1982; DWR, 1998; North State Resources and T Holmes, 1997; Tetra Tech, Inc, 1998; USDA, 1983).

B.3.8 French Ravine, Bacteria - Change in Total Size and Size Affected

Summary of Proposed Action

The California Regional Water Quality Control Board, Central Valley Region, recommends changes to California's Clean Water Act Section 303(d) list for the impairment of French Ravine due to impairment by bacteria. The Regional Board recommends that the identified total length change from 1 mile to 4 miles. The basis for the recommended change is described below.

Watershed Characteristics

French Ravine is located in western Nevada County, approximately 4 miles southwest of Grass Valley. It flows for approximately 4 miles before entering Wolf Creek, a tributary to Bear River. McCourtney Road Landfill is located along two drainages approximately ½ mile upslope from French Ravine. The drainages enter French Ravine approximately 2.5 miles upstream from the confluence of French Ravine and Wolf Creek. McCourtney Road Landfill operated as a burn dump from 1950 to 1973, as a landfill for residential and commercial solid refuse and for septic tank pumping from 1973 to 1992, and as a transfer station between 1992 and 1998. The landfill was closed and effectively sealed in 1998, so bacteria no longer impair French Ravine.

Total Waterbody Size Extent of Impairment

French Ravine has a length of approximately 4 miles from its headwaters to its confluence with Wolf Creek (Horizons Technology, Inc., 1997). The historic McCourtney Road Landfill is located along French Ravine approximately half way between its headwaters and its confluence. Water samples tested for bacteria indicate that high levels of bacteria would be present for approximately one mile below the inflow of water from McCourtney Road Landfill.

B.3.9 Horse Creek, All Metals - Change in Size Affected

Summary of Proposed Action

The California Regional Water Quality Control Board, Central Valley Region, recommends changes to California's Clean Water Act Section 303(d) list for the impairment of Horse Creek due to impairment by metals (cadmium, copper, lead, and zinc). The Regional Board recommends that the identified extent of impairment change from 2 miles to 1 mile, and that the Hydrologic Unit be changed from 526.20 to 506.20. The basis for the recommended change is described below.

Watershed Characteristics

Horse Creek is located in Shasta County, south of the city of Lakehead. It flows for approximately 2 miles before entering the East Squaw Creek Arm of Shasta Lake. Rising Star Mine, which was historically operated for multiple metal extraction, is located along Horse Creek. Rising Star Mine is surrounded by reactive, highly acidic waste rock on steeply graded slopes, and discharges cadmium, copper, lead, and zinc into the Horse Creek.

Total Waterbody Length, and Extent of Impairment

Montoya and Pan (1992) indicate that Horse Creek is located in Shasta County, south of the city of Lakehead. It flows for approximately 2 miles before entering the East Squaw Creek Arm of Shasta Lake.

Rising Star Mine, which was historically operated for multiple metal extraction, is located approximately 1 mile downstream from the headwater of Horse Creek. Water quality data indicates that metals impair Horse Creek downstream from Rising Star Mine.

B.3.10 Humbug Creek, Sedimentation/Siltation, Mercury, Copper and Zinc - Change in Size Affected

Summary of Proposed Action

The California Regional Water Quality Control Board-Central Valley Region (Regional Board) recommends changes to California's Clean Water Act Section 303(d) list for the impairment of Humbug Creek due to impairment by sediment and silt, mercury, copper, and zinc. The Regional Board recommends that the identified extent of impairment change from 9 miles to 3 miles. The basis for the recommended change is described below.

Watershed Characteristics

Humbug Creek is located in the Sierra foothills, approximately 8 miles northeast of Nevada City in Nevada County. It flows for approximately 9 miles before entering South Yuba River. Malakoff Diggins, an historic hydraulic mine (currently a State Historic Park), is located along Humbug Creek. Hydraulic mining has left barren slopes and unstable soil (primarily clay) exposed to erosional forces for the past hundred years. Erosion of soil materials from the Malakoff Diggins area results in the discharge of sediment into Humbug Creek. Discharges of sediment and silt and metals from Malakoff Diggins impair the water quality of Humbug Creek.

Extent of Impairment

Montoya and Pan (1992) indicated that the total length of Humbug Creek is approximately 9 miles. Malakoff Diggins, a historically operated mine, is located approximately 3 miles upstream Humbug Creek's confluence with the Yuba River. Water quality data indicates that metals impair Humbug Creek downstream Malakoff Diggins (Montoya and Pan, 1992), and several studies indicate that sediment and silt impair Humbug Creek downstream Malakoff.

B.3.11 James Creek, Nickel and Mercury - Change in Total Size and Size Affected

Summary of Proposed Action

The California Regional Water Quality Control Board, Central Valley Region, recommends changes to California's Clean Water Act Section 303(d) list for the impairment of James Creek due to impairment by nickel and mercury. The Regional Board recommends that the identified total length change from 6 mile to 9 miles, and the impaired length from 6 to 8.5 miles. The basis for the recommended change is described below.

Watershed Characteristics

James Creek is located in Napa County, approximately 10 miles northwest of Lake Berryessa. James Creek flows for approximately 9 miles before joining with Swartz Creek to form Pope Creek, an eight-mile creek that flows into Lake Berryessa (USGS, 1958-2000). The creek has a steep gradient, falling from approximately 2,400 feet above sea level at its headwaters to approximately 720 feet at its confluence with Pope Creek – a drop of approximately 1,680 feet over 6 miles. A fish survey reported both trout and suckers as present inhabitants of the creek in the impacted area (Montoya and Pan, 1992). Several historic mercury mines are located within the James Creek watershed. Corona, Oat Hill, Oat Hill Extension, Aetna Extension, Grenada, and Toyon mines are all located within the watershed. In addition, Twin Peaks Mine is located on Bateman Creek, a tributary to James Creek. Corona Mine is considered to contribute the highest amount of mercury to James Creek. It is located in the headwaters area of the James Creek watershed (Buer et al, 1979; Montoya and Pan, 1982). During the late 1980s, James Creek was coated with an orange gelatinous floc that extending up to 2 miles downstream from Corona Mine (Montoya and Pan, 1992). Discharges of nickel and mercury from Corona Mine impair the water quality of James Creek (SWRCB, 1999).

Total Waterbody Length and Extent of Impairment

Buer et al (1979), Montoya and Pan (1992), and the USGS (1980, 1987a, 1987b, & 1997) indicate that the total length of James Creek is approximately 9 miles. Several historic mercury mines are located within the James Creek watershed. Corona, Oat Hill, Oat Hill Extension, Aetna Extension, Grenada, and Toyon mines are all located within the watershed. In addition, Twin Peaks Mine is located on Bateman Creek, a tributary to James Creek. The inflow of mine drainage originates approximately 0.5 miles downstream from the headwaters of James Creek (Buer et al, 1979; and Montoya and Pan, 1992).

B.3.12 Lower Mokelumne River, Copper - Change in Extent of Impairment

Summary of Proposed Action

The California Regional Water Quality Control Board, Central Valley Region, recommends changes to California's Clean Water Act Section 303(d) list for the impairment of the lower Mokelumne River by elevated dissolved copper concentrations. Camanche Reservoir was included on the 1998 303(d) list as part of the listing for the lower Mokelumne River. Regional Board staff has determined that listing reservoirs separately from their associated downstream drainages is more appropriate because watershed management strategies (and associated data needs) for reservoirs can be distinctly different from management strategies for the downstream drainages.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Mokelumne River, Lower	**Pollutants/Stressors**	Copper
Hydrologic Unit	535.00	**Sources**	Resource extraction (abandoned mines)
Total Waterbody Size	28 miles	**TMDL Priority**	Low
Size Affected	28 miles	**TMDL Start Date (Mo/Yr)**	
Extent of Impairment	~~All of lower Mokelumne River.~~ Camanche Dam to Delta.	**TMDL End Date (Mo/Yr)**	
Upstream Extent Latitude	38° 13' 35"	**Upstream Extent Longitude**	121° 1' 21"
Downstream Extent Latitude	38° 12' 36"	**Downstream Extent Longitude**	121° 21' 55"
Original 303(d) Listing Year	1992		

Watershed Characteristics

The lower Mokelumne River flows 28 miles from Camanche Dam to the legal Sacramento-San Joaquin Delta boundary in San Joaquin County. Camanche Reservoir, working in tandem with the upstream Pardee Reservoir, stores water for irrigation and stream-flow regulation, providing flood control, water to the meet the needs of downstream water rights holders, and water for fisheries and riparian habitat (EBMUD, 2000). The East Bay Municipal Utility District (EBMUD) completed the Camanche Reservoir Project (downstream of Pardee) in 1964. EBMUD built a fish hatchery (the Mokelumne River Fish Installation) immediately downstream of Camanche Dam on the lower Mokelumne River, which the California Department of Fish and Game operates. In addition, a power plant at the base of the dam was placed in service in 1983.

Several historic copper and gold mines (including Argonaut, Newton, and Penn) are within the lower Mokelumne River watershed. Penn Mine, which historically operated for copper extraction from 1861 to 1956, impacted the water quality of both Camanche Reservoir and the lower Mokelumne River downstream of Camanche Dam. The Penn Mine site occupies a 22-acre area near the southeastern shore of Camanche Reservoir approximately 1.5 miles from the town of Campo Seco in Calaveras County. Penn Mine historically discharged to the reservoir via Mine Run Creek. Metal loading from Penn Mine led to fishery declines and fish kills in Camanche Reservoir, in the Mokelumne River Fish Installation downstream of Camanche Dam, and in the lower Mokelumne River; problems with toxic discharges from the Penn Mine continued through the 1960s and 1970s (Buer et al., 1979; SRWCB, 1990; CDFG, 1991; EDAW, Inc., 1992; EBMUD, 2000). Beginning in 1978, several abatement and restoration projects were conducted to decrease the impact of Penn Mine on Camanche Reservoir and the lower Mokelumne River; the most recent abatement project was completed in late 1999 (Buer et al., 1979; SCH EIR, 1996; CH2MHill, 2000a and 2000b).

Water Quality Objectives Not Attained

The narrative objective for toxicity is not being attained for copper in the lower Mokelumne River. The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf)."

The toxicity objective was evaluated for the lower Mokelumne River by comparing copper concentrations measured in the lower Mokelumne River downstream of Camanche Dam to water quality guidelines and criteria developed for human health and wildlife protection. The numeric United States Environmental Protection Agency (USEPA) California Toxics Rule (CTR) hardness-dependent continuous (4-day average) and maximum (1-hour average) dissolved copper criteria for freshwater aquatic life protection are 2.3 micrograms per liter (µg/L) and 2.9 µg/L, respectively, based on an assumed hardness of 20 milligrams per liter (mg/L) of calcium carbonate ($CaCO_3$) (Marshack, 2000). Hardness is assumed to be 20 mg/l of $CaCO_3$ because numerous studies (e.g., CH2MHill, 2000b & Buer et al., 1979) have indicated that Camanche Reservoir/Mokelumne River water has hardness values typical ranging from 10 to 25 mg/L. The USEPA primary maximum contaminant level (MCL) for drinking water protection is 1,300 µg/L of total recoverable copper (Marshack, 2000).

Evidence of Impairment

Elevated copper concentrations in water samples collected since 1958 indicate that copper impairs the lower Mokelumne River. The data also indicate a strong seasonality to the copper loading; Penn Mine historically discharged more copper during wet seasons than during dry seasons. As illustrated by the data summaries below, a series of remediation projects at Penn Mine conducted in 1978, 1993, and 1999-2000 have significantly decreased the amount of copper leaving the mine site.

Between 1988 and 1992, EBMUD measured dissolved copper concentrations at three locations on the Mokelumne River downstream of Camanche Dam (USFWS, 1992). In addition, EBMUD collected monthly samples from the Mokelumne River immediately downstream of the Camanche Dam between August 1997 and June 2001 and analyzed the samples for dissolved copper using a method with a detection limit low enough to evaluate compliance with the hardness-dependent CTR criteria (EBMUD, 2001). Table 2 summarizes the EBMUD dissolved copper data for the lower Mokelumne River. Although exceedances of the CTR criteria still occur each year in the lower Mokelumne River immediately downstream of Camanche Dam, both the frequency and magnitude of exceedances have decreased since 1992.

Table B-2. Summary of Available Copper Concentration Data for the Lower Mokelumne River Downstream of Camanche Dam (Data source: USFWS, 1992; EBMUD, 2001)

	Total Copper Concentrations			Dissolved Copper Concentrations			
						# [%] of Samples Exceeding CTR Criteria	
Location [(a)]	# of Samples (Dates Collected)	Range of Concentrations (µg/l)	# [%] of Samples Exceeding MCL (1,300 µg/l) [(b)]	# of Samples (Dates Collected)	Range of Concentrations (µg/l)	Maximum Criterion (2.9 µg/l)	Continuous Criterion (2.3 µg/l)
CamC	138 (9/88 – 11/92)	<2 – 88	0 [0%]	141 (2/89 – 11/92)	<2 – 50	70 [50%]	70 [50%]
CamD	92 (5/88 – 11/92)	<2 – 18	0 [0%]	84 (3/89 – 11/92)	<2 – 7, 320 [(c)]	15 [18%]	15 [18%]
VAPK	23 (5/88 – 11/92)	<1 – 4	0 [0%]	17 (8/91 – 11/92)	<2 – 3	1 [6%]	1 [6%]
CamC				25 (8/97 – 8/99)	0.62 – 7.8 [(d)]	6 [24%]	7 [28%]
CamD				25 (8/97 – 8/99)	0.8 – 9.1 [(d)]	4 [16%]	5 [20%]
CamC				22 (9/99 – 6/01)	<0.3 – 5.8 [(d)]	3 [14%]	3 [14%]
CamD				22 (9/99 – 6/01)	<0.3 – 4.2, 14 [(d. e)]	2 [9%]	5 [23%]

(a) CamC: Discharge from Camanche Dam to the Mokelumne River.
CamD: Camanche Reservoir lower outlet to the Mokelumne River.
VAPK: Mokelumne River at Van Assen Park, downstream of Camanche Dam.
(b) MCL: USEPA primary maximum contaminant level for drinking water protection.
CTR: United States Environmental Protection Agency's California Toxics Rule (CTR) hardness-dependent continuous (4-day average) and maximum (1-hour average) dissolved copper criteria for freshwater aquatic life protection, based on an assumed hardness of 20 mg/L of $CaCO_3$ if hardness data were not available.
On October 4, 1989, a dissolved copper concentration of 320 µg/l was listed for CamD in the EBMUD data set. Dissolved iron and zinc concentrations measured on that day were also more than a magnitude higher than any recorded during that period; total and dissolved aluminum concentrations were not unusually high. Total copper, iron, and zinc concentrations were not available for comparison. The dissolved and total copper concentrations measured at CamC on October 4, 1989 were less than 2 µg/l, and dissolved aluminum, iron, and zinc levels were also low; only the total aluminum and iron were unusually high at CamC on that day.
Thirty-seven of the 47 samples collected at CamC between August 1997 and June 2001 had dissolved copper concentrations less than 2 µg/l. Thirty-five of the 47 samples collected at CamD between August 1997 and June 2001 had dissolved copper concentrations less than 2 µg/l.
On March 1, 2000, a dissolved copper concentration of 14 µg/l was listed for CamD in the EBMUD data set; no other data were available for comparison to determine the nature of the outlier.

B.3.13 Lower Mokelumne River, Zinc - Change in Extent of Impairment

Summary of Proposed Action

The California Regional Water Quality Control Board, Central Valley Region, recommends changes to California's Clean Water Act Section 303(d) list for the impairment of the lower Mokelumne River by elevated dissolved zinc concentrations. Camanche Reservoir was included on the 1998 303(d) list as part of the listing for the lower Mokelumne River. Regional Board staff has determined that listing reservoirs separately from their associated downstream drainages is more appropriate because watershed management strategies (and associated data needs) for reservoirs can be distinctly different from management strategies for the downstream drainages.

Table B-1. 303(d) Listing/TMDL Information

Waterbody Name	Mokelumne River, Lower	**Pollutants/Stressors**	Zinc
	535.00	**Sources**	Resource extraction (abandoned mines)
Total Waterbody Size	28 miles	**TMDL Priority**	Low
Size Affected	28 miles	**TMDL Start Date (Mo/Yr)**	01/04
Extent of Impairment	~~All of lower Mokelumne River.~~ Camanche Dam to Delta.	**TMDL End Date (Mo/Yr)**	12/11
Upstream Extent Latitude	38° 13' 35"	**Upstream Extent Longitude**	121° 1' 21"
Downstream Extent Latitude	38° 12' 36"	**Downstream Extent Longitude**	121° 21' 55"
Original 303(d) Listing Year	1992		

Watershed Characteristics

The lower Mokelumne River flows 28 miles from Camanche Dam to the legal Sacramento-San Joaquin Delta boundary in San Joaquin County. Camanche Reservoir, working in tandem with the upstream Pardee Reservoir, stores water for irrigation and stream-flow regulation, providing flood control, water to the meet the needs of downstream water rights holders, and water for fisheries and riparian habitat (EBMUD, 2000). The East Bay Municipal Utility District (EBMUD) completed the Camanche Reservoir Project (downstream of Pardee) in 1964. EBMUD built a fish hatchery (the Mokelumne River Fish Installation) immediately downstream of Camanche Dam on the lower Mokelumne River, which the California Department of Fish and Game operates. In addition, a power plant at the base of the dam was placed in service in 1983.

Several historic copper and gold mines (including Argonaut, Newton, and Penn) are within the lower Mokelumne River watershed. Penn Mine, which historically operated for copper extraction from 1861 to 1956, impacted the water quality of both Camanche Reservoir and the lower Mokelumne River downstream of Camanche Dam. The Penn Mine site occupies a 22-acre area near the southeastern shore of Camanche Reservoir approximately 1.5 miles from the town of Campo Seco in Calaveras County. Penn Mine historically discharged to the reservoir via Mine Run Creek. Metal loading from Penn Mine led to fishery declines and fish kills in Camanche Reservoir, in the Mokelumne River Fish Installation downstream of Camanche Dam, and in the lower Mokelumne River; problems with toxic discharges from the Penn Mine continued through the 1960s and 1970s (Buer et al., 1979; SRWCB, 1990; CDFG, 1991; EDAW, Inc., 1992; EBMUD, 2000). Beginning in 1978, several abatement and restoration projects were conducted to decrease the impact of Penn Mine on Camanche Reservoir and the lower Mokelumne River; the most recent abatement project was completed in late 1999 (Buer et al., 1979; SCH EIR, 1996; CH2MHill, 2000a and 2000b).

Water Quality Objectives Not Attained

The narrative objective for toxicity is not being attained for zinc in the lower Mokelumne River. The narrative toxicity objective in the Basin Plan states, in part, "All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life." The narrative toxicity objective further states that "The Regional Water Board will also consider … numerical criteria and guidelines for toxic substances developed by the State Water Board, the California Office of Environmental Health Hazard Assessment, the California Department of Health Services, the U.S. Food and Drug Administration, the National Academy of Sciences, the U.S. Environmental Protection Agency, and other appropriate organizations to evaluate compliance with this objective (CRWQCB-CVR, 1998; http://www.swrcb.ca.gov/~rwqcb5/bsnplnab.pdf)."

The toxicity objective was evaluated for the lower Mokelumne River by comparing zinc concentrations measured in the lower Mokelumne River downstream of Camanche Dam to water quality guidelines and criteria developed for human health and wildlife protection. The numeric United States Environmental Protection Agency (USEPA) California Toxics Rule (CTR) hardness-dependent continuous (4-day average) and maximum (1-hour average) dissolved zinc criteria for freshwater aquatic life protection are both 30 micrograms per liter (µg/L), based on an assumed hardness of 20 milligrams per liter (mg/L) of calcium carbonate ($CaCO_3$) (Marshack, 2000). The CTR continuous and maximum criteria adjusted for total recoverable zinc are both 31 µg/L, based on an assumed hardness of 20 mg/L of $CaCO_3$ (Marshack, 2000). (Hardness is assumed to be 20 mg/l of $CaCO_3$ because numerous studies (e.g., CH2MHill, 2000b & Buer et al., 1979) have indicated that Camanche Reservoir/Mokelumne River water has hardness values typical ranging from 10 to 25 mg/L.) The USEPA maximum contaminant level (MCL) for drinking water protection is 5,000 µg/L of total recoverable zinc (Marshack, 2000).

Evidence of Impairment

Elevated zinc concentrations in water samples collected since 1958 indicate that zinc impairs the lower Mokelumne River. The data indicate a strong seasonality to the zinc loading; Penn Mine historically discharged more zinc during wet seasons than during dry seasons. As illustrated by the data summaries below, a series of remediation projects at Penn Mine conducted in 1978, 1993, and 1999-2000 have significantly decreased the amount of zinc leaving the mine site.

Between 1988 and 1992, EBMUD measured dissolved zinc concentrations at three locations on the Mokelumne River downstream of Camanche Dam (USFWS, 1992). Table 1 summarizes the available EBMUD dissolved zinc data. The 1988-1992 data indicate that exceedances of the CTR criteria still occurred in the lower Mokelumne River immediately downstream of Camanche Dam after the remediation activities conducted in the late 1970s. Dissolved zinc data for the period after the remediation activities conducted in the mid-late 1990s are not available.

Table B-2. Summary of Available Zinc Concentration Data for the Lower Mokelumne River Downstream of Camanche Dam (Data source: USFWS, 1992)

Location [(a)]	Total Zinc Concentrations			Dissolved Zinc Concentrations		
	# of Samples (Dates Collected)	Range of Concentrations (µg/l)	# [%] of Samples Exceeding MCL (5,000 µg/l) [(b)]	# of Samples (Dates Collected)	Range of Concentrations (µg/l)	# [%] of Samples R Criteria g/L)
CamC	136 (9/88 – 11/92)	<2 – 230	0 [0%]	141 (2/89 – 11/92)	<3 – 450	15 [11%]
CamD	92 (5/88 – 11/92)	<2 – 200	0 [0%]	84 (3/89 – 11/92)	<3 – 140	4 [5%]
VAPK	23 (5/88 – 11/92)	<2 – 100; 2,000 [(c)]	0 [0%]	17 (8/91 – 11/92)	<4 – 9	0 [0%]

[(a)]CamC: Discharge from Camanche Dam to the Mokelumne River.
CamD: Camanche Reservoir lower outlet to the Mokelumne River
VAPK: Mokelumne River at Van Assen Park, downstream of Camanche Dam.
[(b)] MCL: USEPA primary maximum contaminant level for drinking water protection.
CTR: United States Environmental Protection Agency's California Toxics Rule (CTR) hardness-dependent continuous (4-day average) and maximum (1-hour average) dissolved zinc criteria for freshwater aquatic life protection, based on an assumed hardness of 20 mg/L of $CaCO_3$.
[(c)]On May 31, 1989, the EBMUD data set listed a total zinc concentration of 2,000 µg/l for VAPL. Total aluminum, cadmium, copper, and iron concentrations measured on that day were not unusually high. Dissolved zinc, aluminum, cadmium, copper, and iron concentrations were not available for comparison.

B.2.14 Marsh Creek, Mercury – Change in Total Size and Size Affected

Summary of Proposed Action

The California Regional Water Quality Control Board, Central Valley Region, recommends changes to California's Clean Water Act Section 303(d) list for the impairment of Marsh Creek due to impairment by mercury. The Regional Board recommends that the identified impaired length change from 24 mile to 16.5 miles and the extent of impairment from all of Marsh Creek to Marsh Creek, from Dunn Creek to Marsh Creek Reservoir. The basis for the recommended change is described below.

Watershed Characteristics

Marsh Creek is located in Contra Costa County. It flows for approximately 24 miles, with its water ultimately entering the San Joaquin Delta. The Mount Diablo Mine (Mt Diablo Mine), which was historically operated for mercury extraction, is located between Dunn Creek and Horse Creek (a tributary to Dunn Creek), approximately 7.5 miles downstream from the headwaters of Marsh Creek. The tailings and outflow from the Mt. Diablo Mine are highly acidic and contain numerous metals, including mercury.

Extent of Impairment

Mt. Diablo Mine, which was historically operated for mercury extraction, is located between Dunn Creek and Horse Creek (a tributary to Dunn Creek) (Iovenitti, *et al* 1989; Slotten et al, 1996; Buer *et al*, 1979). Dunn Creek discharges into Marsh Creek approximately 7.5 miles downstream from the headwaters of Marsh Creek. Water quality, fish tissue, and invertebrate data collected above and below the inflow of Dunn Creek indicate that Marsh Creek is impaired downstream of Dunn Creek. The impaired length of Marsh Creek is approximately 16.5 miles, from Dunn Creek through Marsh Creek Reservoir to the furthest extent of Marsh Creek.

B.3.14 Marsh Creek, Metals - Change in Total Size and Size Affected

Summary of Proposed Action

The California Regional Water Quality Control Board, Central Valley Region, recommends changes to California's Clean Water Act Section 303(d) list for the impairment of Marsh Creek due to impairment by metals. The Regional Board recommends that the identified impaired length change from 24 mile to 8.5 miles and the extent of impairment from all of Marsh Creek to Marsh Creek, from Dunn Creek to Marsh Creek Reservoir. The basis for the recommended change is described below.

Watershed Characteristics

Marsh Creek is located in Contra Costa County. It flows for approximately 24 miles, with its water ultimately entering the San Joaquin Delta. The Mount Diablo Mine (Mt Diablo Mine), which was historically operated for mercury extraction, is located between Dunn Creek and Horse Creek (a tributary to Dunn Creek), approximately 7.5 miles downstream from the headwaters of Marsh Creek. The tailings and outflow from the Mt. Diablo Mine are highly acidic and contain numerous metals (CRWQCB-CVR, 1978).

Extent of Impairment

Mt. Diablo Mine, which was historically operated for mercury extraction, is located between Dunn Creek and Horse Creek (a tributary to Dunn Creek) (Iovenitti, *et al* 1989; Slotten et al, 1996; Buer *et al*, 1979). Dunn Creek discharges into Marsh Creek approximately 7.5 miles downstream from the headwaters of Marsh Creek. Water quality data was collected upstream and downstream from the Dunn Creek inflow to Marsh Creek contains high levels of metals below the confluence of Dunn Creek. However, downstream of Marsh Creek Reservoir, there is no data to indicate that metals impair Marsh Creek (Iovenitti, *et al* 1989; Slotten et al, 1996; Buer *et al*, 1979). The impaired length of Marsh Creek is approximately 8.5 miles, from Dunn Creek to Marsh Creek Reservoir.

B.3.15 Mosher Slough, Diazinon and Chlorpyrifos - Change in Total Size

Summary of Proposed Action

The California Regional Water Quality Control Board, Central Valley Region, recommends changes to California's Clean Water Act Section 303(d) list for the impairment of Mosher Slough due to impairment by diazinon and chlorpyrifos. The Regional Board recommends that the identified total length change from 3 to 5 miles. The basis for the recommended change is described below.

Watershed Characteristics

Mosher Slough is a small urban creek located entirely within San Joaquin County in the northern part of Stockton. The confluence of Mosher Slough, Bear Creek, and Pixley Slough flows west and converges with Disappointment Slough, which flows to the Sacramento-San Joaquin Delta (Horizons Technology, Inc., 1997). Land use in the Mosher Slough watershed is predominately commercial and residential.

Total Waterbody Length

Mosher Slough is approximately 5 miles in length (Horizons Technology, Inc., 1997; DeLorme, 1998).

B.3.16 San Carlos Creek, Mercury - Change in Total Size and Size Affected

Summary of Proposed Action

The California Regional Water Quality Control Board, Central Valley Region, recommends changes to California's Clean Water Act Section 303(d) list for the impairment of San Carlos Creek due to impairment by mercury. The Regional Board recommends that the identified total length change from 1 mile to 9 miles and that the extent of impairment change from 1 mile to 4 miles. The basis for the recommended change is described below.

Watershed Characteristics

San Carlos Creek is located in the Tulare Lake Basin in San Benito County (USGS, 1969-1981). It is a tributary to Panoche Creek (*via* Silver Creek). San Carlos Creek has a length of approximately 9 miles from its headwaters at San Benito Mountain to its confluence with Silver Creek. It derives from marine sediments, is highly mineralized, and is intermittent, with sustained flows only after extended wet periods (CRWQCB-CVR, 1995). Several small historic mines (such as the San Carlos, Aurora, and Molina mines) are located in the upper portion of the San Carlos watershed. However, the historic New Idria Mine, located along San Carlos Creek approximately 4 miles upstream of the San Carlos Creek – Silver Creek confluence, is by far the largest mine in the region (USGS, 1958-2000). The New Idria Mine has acid mine drainage containing mercury that likely impairs the water quality of the downstream segment of San Carlos Creek (CRWQCB-CVR, 1995).

Total Waterbody Length and Extent of Impairment

San Carlos Creek has a length of approximately 9 miles from its headwaters at San Benito Mountain to its confluence with Silver Creek (CRWQCB-CVR, 1995; USGS, 1958-2000). The historic New Idria Mine is located along San Carlos Creek approximately 4 miles upstream of the San Carlos Creek – Silver Creek confluence (USGS, 1958-2000). Water quality samples indicate that high levels of mercury are present below the mine, indicating that that the lower four miles are impaired by mercury.

B.3.17 Lower Stanislaus River - Change in Total Size and Size Affected

Summary of Proposed Action

The California Regional Water Quality Control Board, Central Valley Region, recommends changes to California's Clean Water Act Section 303(d) list for the impairment of the Stanislaus River due to impairment by diazinon, Group A pesticides, and unknown toxicity. The Regional Board recommends that the identified total length change from 48 to 58 miles and the size affected from 48 to 58 miles. The basis for the recommended change is described below.

Watershed Characteristics

The Stanislaus River is located on the east side of the San Joaquin River Basin and has a total basin area of 1,144 square miles. The Lower Stanislaus River subbasin, covering the area from Goodwin Dam to the San Joaquin River, encompasses approximately 102,550 acres, of which around 52,151acres is used for agriculture.

Total Waterbody Length and Extent of Impairment

USGS topographic maps indicate that the total length of the lower Stanislaus River is approximately 58 miles, from Goodwin Dam to San Joaquin River (USGS, 1958-2000). The Regional Board had previously indicated on the 303(d) list that the entire length is impaired by diazinon, Group A pesticides, and unknown toxicity. The size affected should also be changed to 58 miles for those pollutants.

B.3.18 Lower Tuolumne River, Diazinon - Change in Total Size and Size Affected

Summary of Proposed Actions

The California Regional Water Quality Control Board, Central Valley Region, recommends changes to California's Clean Water Act Section 303(d) list for the impairment of the lower Tuolumne River due to impairment by diazinon. The Regional Board recommends that the identified total length change from 32 to 54 miles and the size affected from 32 to 42 miles. The basis for the recommended change is described below.

Watershed Characteristics

The lower Tuolumne River flows for approximately 54 miles, from New Don Pedro Dam and drains into the San Joaquin River west of Modesto. This sub-basin encompasses approximately 161,268 acres, of which 52,715 acres is used for agriculture.

Total Waterbody Length and Extent of Impairment

Topographic maps provided by the USGS indicate that the total length of the lower Tuolumne River is approximately 54 miles, from New Don Pedro Dam to San Joaquin River (USGS, 1958-2000). Chemical analysis of water samples and land use along the Tuolumne River (the presence of crops) indicate that the lower 42 miles (from Turlock Lake State Park to the San Joaquin River) is impaired by diazinon.

B.3.19 Lower Tuolumne River, Group A pesticides and Unknown Toxicity - Change in Total Size and Size Affected

Summary of Proposed Actions

The California Regional Water Quality Control Board, Central Valley Region, recommends changes to California's Clean Water Act Section 303(d) list for the impairment of the lower Tuolumne River due to impairment by Group A pesticides and unknown toxicity. The Regional Board recommends that the identified total length change from 32 to 54 miles and the size affected from 32 to 54 miles. The basis for the recommended change is described below.

Watershed Characteristics

The lower Tuolumne River flows for approximately 54 miles, from New Don Pedro Dam and drains into the San Joaquin River west of Modesto. This subbasin encompasses approximately 161,268 acres, of which 52,715 acres is used for agriculture.

Total Waterbody Length and Extent of Impairment

USGS topographic maps indicate that the total length of the lower Tuolumne River is approximately 54 miles, from New Don Pedro Dam to San Joaquin River (USGS, 1958-2000). Chemical analysis of water samples from the lower Tuolumne River indicate that the entire length is impaired by Group A pesticides. Toxicity tests, using water from lower Tuolumne River, indicate that the entire length is impaired by an unknown toxin.