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4.6 SURFACE WATER QUALITY

This section discusses Project impacts on water quality constituents that will result from each project component. The water quality characteristics of Project reclaimed water, other wastewater discharges and potentially affected surface waters are also described in this section to provide a basis for the evaluation.

IMPACTS EVALUATED IN OTHER SECTIONS

Some issues that may affect surface water quality have been evaluated in other sections. Potential surface water quality impacts addressed in other sections are:

- Water Quality Related to Human Health. These issues are addressed in Section 4.7, Public Health and Safety.
- Water Quality Impacts on Aquatic Life. These issues are addressed in Section 4.9, Aquatic Biological Resources.
- Erosion Due to Construction. Erosion caused by construction within designated construction zones (e.g., dams and reservoirs) and outside of the aquatic environment (i.e., not in or adjacent to waterways) is addressed in Section 4.3, Geology, Soils, and Seismicity.
- Impacts Due to Dam Failure, are addressed in Section 4.19, Inundation Due to Dam Failure.

AFFECTED ENVIRONMENT (SETTING)

This section describes water quality conditions and regulations in waterways that are potentially affected by Project alternatives. The waterways within the Project area and potentially affected by the Project appear in Figures 4.4-1a and 4.4.1b (in the Surface Water Hydrology Section). Water quality conditions in the Russian River/Santa Rosa Plain, South County, West County, and the geysers area are described in distinct subsections below. The same water quality regulations relate to waterways in each of these areas, except for the Pacific Ocean. Water quality regulations for inland and ocean waters are described separately.

Water Quality Regulation

Surface water quality is regulated to protect aquatic life and human health according to the provisions of the Federal Clean Water Act (and associated federal regulations) and the California Porter-Cologne Water Quality Control Act, referred to respectively as the Federal and State Acts. The State Act established the nine Regional Water Quality Control Boards (Regional Boards) and the State Water Resources Control Board (State

Board). In California, the discharge permitting provisions of the Federal Act have been delegated by U.S. EPA to the State and Regional Boards. The Federal Act has led to the development of aquatic life water quality criteria (enforceable) and water quality guidelines (non-enforceable); the State Act has led to water quality objectives (enforceable) to protect aquatic life from adverse impacts for numerous water quality constituents. The criteria, guidelines, and objectives are hereinafter referred to collectively as criteria.

Water quality standards have also been developed to protect human health. Drinking water standards are established in federal regulations and in Title 22 of the California Code of Regulations, and requirements for wastewater reuse are established in Title 22. These regulations and water quality impacts are addressed in Section 4.7, Public Health and Safety.

Numeric and narrative water quality criteria have been developed by EPA and other agencies to protect aquatic life and to protect against aesthetic water quality impacts (see Merritt Smith Consulting 1996f for a detailed description of numeric and narrative criteria). Impacts of water quality on aquatic life and aesthetics that are addressed by the criteria are as follows:

- Biostimulation. Substances such as inorganic nutrients can stimulate plant production. This growth, known as biostimulation, of algae and other plant material can result in a fluctuation of dissolved oxygen in the surrounding waters. Dissolved oxygen is produced by photosynthesis and is consumed by plant and animal respiration and decay. Plant respiration and decay functions during the night often consume more oxygen that is supplied from transfer from the atmosphere to water and daytime photosynthesis. Dissolved oxygen is required for aquatic plants and animals, so the depletion that occurs in association with heavy algae blooms or other plant respiration is undesirable. Nitrogen is a plant growth nutrient and can be found in the form of nitrate and ammonia and incorporated in organic matter. No numeric criteria have been established by federal or state authorities for nitrogen compounds to prevent biostimulation, rather a narrative criterion has been established to limit biostimulatory effects and to control algae. Biochemical oxygen demand (often called BOD) is a measure of the amount of oxygen that is consumed by substances in water such as organic matter (which includes animal waste and algae).
- Toxicity and Bioaccumulation. Metals (e.g., copper and chromium) and organic compounds (e.g., pesticides, PCBs and petroleum products) can be toxic to aquatic life due to exposure to the compound in water or in food. Bioaccumulation occurs when a constituent accumulates in biological tissue to levels that exceed the concentration in the surrounding water. Some substances are toxic but do not bioaccumulate (e.g., salt and ammonia). Some substances are not toxic at the concentrations found normally in water, but are toxic at concentrations that can develop in prey (e.g., PCBs). Many metals for which criteria have been developed are required for normal plant or animal growth and

are toxic only at higher concentrations. Dissolved metals are generally more bioavailable (and thus toxic) than total metals. Therefore, most EPA water quality criteria for metals to protect aquatic life are based on dissolved metals concentrations rather than total metals concentrations.

- Physical and Habitat Effects. Some substances have damaging effects on habitat and/or organisms. For example, silt can affect fish and invertebrate gills and accumulate in the bottom of a creek rendering the creek unsuitable for organisms that require sand or gravel substrate. No numeric criteria have been established for physical substances, but narrative criteria have been established for turbidity, oil and grease, suspended matter, settleable matter, floating material, and color.
- Aesthetics. The narrative criteria cited above for physical and habitat effects also protect against aesthetic impacts.

This Surface Water Quality section focuses on water quality constituents that affect biostimulation, toxicity/bioaccumulation, physical/habitat and aesthetics of waters in the Project area.

Specific regulations that relate to inland and ocean surface waters are described below.

Inland Water Regulation

The inland surface waters in the Project area are within the jurisdiction of either the North Coast and the San Francisco Bay Regional Water Quality Control Boards (North Coast Regional Board and Bay Regional Board, respectively). Each Regional Board has a Water Quality Control Plan for basins within its jurisdiction (Basin Plan). The Basin Plans identify beneficial uses of waters, establish numeric and narrative objectives for protection of beneficial uses, and set forth policies to guide the implementation of programs to attain the objectives. In addition, federal criteria and guidelines for particular water quality constituents apply to waters to the extent that the Basin Plans do not include criteria for the constituents. The current Basin Plans used for this report are the Water Quality Control Plan for the North Coast Region dated August 1994 (North Coast Regional Board 1994) and the Water Quality Control Plan for the San Francisco Bay Basin Region dated December 1995 (Bay Regional Board 1995).

The North Coast Regional Board has established a Waste Reduction Policy (North Coast Regional Board 1995) for total nitrogen and ammonia for the Laguna de Santa Rosa in compliance with Section 303(d) of the federal Act. Dissolved oxygen and ammonia criteria are not currently attained in the Laguna and the Waste Reduction Policy sets load reduction goals for nitrogen and ammonia sources, including the Subregional System, such that the criteria will be attained.

The EPA and State Water Resources Control Board have established antidegradation policies. The federal policy, which is set forth in 40 CFR 131.12, states that:

- Existing instream water uses and the water quality necessary to protect existing uses (e.g., fish spawning, municipal water supply, and warm water aquatic habitat) shall be maintained and protected; and
- Where the quality of waters exceeds levels necessary to support beneficial uses, that quality shall be maintained and protected unless the State finds that allowing water quality degradation is necessary to accommodate important economic or social development in the area in which the waters are located. In allowing water quality degradation, the State shall assure water quality is adequate to fully protect beneficial uses.

As required by 40 CFR 131.12, the State has developed an Antidegradation Policy that is consistent with the federal policy described above; the state policy is described in the Administrative Procedures Update of 2, July 1990 entitled *Antidegradation Policy Implementation for NPDES Permitting*. The Antidegradation Policy applies to inland surface waters, ocean waters, and groundwaters.

The State Antidegradation Policy includes a technical (water quality and beneficial use impacts) and a non-technical component (necessity for socioeconomic development, maximum public benefit).

- Technical. According to the Antidegradation Policy, the evaluation of Project impacts on many water quality constituents is necessary to evaluate impacts on water quality relative to appropriate water quality objectives and impacts on beneficial uses. The State Antidegradation Policy guidelines state that, for NPDES permitting, the antidegradation analysis is the responsibility of the Regional Board and that the Regional Board shall comment on notices of preparation (NOPs) to ensure that it has sufficient information to conduct the appropriate antidegradation analysis. The Regional Board provided comments to the City of Santa Rosa in response to the NOP, and these comments were an important basis for the study plan that was implemented. Ongoing consultation with the North Coast Regional Board through the study process occurred so that the study program could be adjusted as needed to meet their information needs. The study plan and resulting technical reports produced the technical information that is described in the State Antidegradation Policy as being needed by the Regional Board for their analysis and related finding.
- Non-technical. Determinations as to whether the proposed Project "is necessary to accommodate important economic or social development"

and whether "maximum public benefit" is not within the scope of this EIR/EIS.

Thus, a complete analysis of the consistency of proposed alternatives with the Antidegradation Policy is not possible in this EIR/EIS, nor is it necessary according to the State Antidegradation Policy. Therefore, a specific antidegradation policy evaluation criterion was not developed. However, the technical information in this document is intended to provide the basis for any findings that the Regional Board may be required to make.

Ocean Water Regulation

The State Board has established a Water Quality Control Plan for Ocean Waters of California (Ocean Plan). The Ocean Plan identifies beneficial uses of ocean waters, numeric and narrative objectives for protection of beneficial uses, and policies to guide the implementation of programs to attain the objectives. The numeric objectives in the Ocean Plan are the same as the applicable federal criteria and guidelines for saltwater. The current Ocean Plan to be used for this report is the Water Quality Control Plan - Ocean Waters of California dated March 1990.

Reclaimed Water Discharges

Permit Compliance

The quality of reclaimed water is regulated in the discharge permit issued by the Regional Board. The discharge permit imposes limits on biochemical oxygen demand, suspended solids, settleable solids, total coliform organisms, chlorine residual, pH, turbidity and acute toxicity. The discharge permit also establishes a treatment effectiveness requirement. During the three-year period from 1992 through 1994, more than 18,920 determinations of compliance with the effluent limits and treatment effectiveness requirements were made by the Regional Board. Although 15 violations were reported during this period, the Regional Board found none of the violations to be significant and took no enforcement action. Each of the 15 violations related to pH or coliform. The rate of compliance with the effluent limits and treatment effectiveness requirements during the three-year period was 99.92% (18,905/18,920), which indicates a very reliable treatment system.

Reclaimed Water Quality

This section describes the quality of reclaimed water from the Laguna Treatment Plant. Water quality data collected and analyzed from 1988 through January 1995 (metals) and 1991 through January 1995 (organic and other compounds) were used in the evaluation of water quality impacts and are presented in Tables 4.6-1 (chemical constituents) and 4.6-2 (biological constituents). Generally, the data used for impact evaluations were from fresh effluent samples. The exception to this is the evaluation of nitrogen compounds (organic nitrogen and ammonia). The concentration of these compounds is greatly affected by biological activity in the storage ponds, so the concentration in storage ponds was used for evaluation of impacts. The concentration of ammonia used was the average Delta Pond concentration from 1992 through February 1996. Samples for analysis of organic nitrogen in Delta Pond were begun in December 1995. Organic nitrogen from December 1995 through February 1996 averaged 1.25 mg/L. A concentration of 2 mg/L for organic nitrogen was used for waste load calculations to allow for uncertainty due to the short time frame for organic nitrogen data from Delta Pond. The concentration of nitrate-nitrogen used for the waste load reduction analysis was 14 mg /L which is estimated to be the concentration that will be obtained with proposed plant upgrades (CH2M Hill 1995b). The concentrations reported in Table 4.6-1 differ slightly from those reported in other sections of the EIR/EIS (Groundwater and Public Health and Safety) because collection of additional data for these compounds was conducted too recently to be included in the other sections. These slight differences do not affect analyses in other sections. Constituents that have been analyzed in reclaimed water and have not been detected are not included in Table 4.6-1.

Table 4.6-1

Detectable[1] Chemical Constituents of Reclaimed Water

Chemical	Concentration Range (mg/L)	Mean Concentration (mg/L)	Reporting Limit(s)[2] (mg/L)	Number of Detects	Number of Samples
Inorganics					
Total aluminum	N.D. - 0.15	0.032	0.01 - 0.10	20	27
Dissolved aluminum	N.D. - 0.04	0.011	0.01	2	8
Total ammonia-nitrogen (Delta Pond)	N.D. - 5.7	0.99 (as N)	0.1	70[3]	71[3]
Total arsenic	N.D. - 0.0040	0.0024	0.001 - 0.005	25	30
Dissolved arsenic	0.001 - 0.0030	0.0025	N/A	8	8
Asbestos, MFL[4]	N.D. - 0.56	0.25	0.05 - 0.28	2	4
Total barium	N.D. - 0.11	0.023	0.02 - 0.05	4	27
Boron	N.D. - 0.60	0.48	0.10	17	18
Total cadmium	N.D. - 0.007	0.0007	0.0002 - 0.01	6	89
Calcium	22 - 63	31	N/A	19	19
Total chromium	N.D. - 0.014	0.0023	0.001 - 0.02	49	90
Total copper	N.D. - 0.04	0.012	0.005 - 0.10	88	90
dissolved copper	0.006 - 0.013	0.010	N/A	8	8
Cyanide	N.D. - 0.03	0.01	0.005 - 0.01	6	11
Fluoride	0.18 - 0.31	0.22	N/A	4	4

Table 4.6-1

Detectable[1] Chemical Constituents of Reclaimed Water

Chemical	Concentration Range (mg/L)	Mean Concentration (mg/L)	Reporting Limit(s)[2] (mg/L)	Number of Detects	Number of Samples
Total lead	N.D. - 0.020[5]	0.0045	0.001 - 0.04	19	90
Magnesium	15 - 23	19	N/A	18	18
Total mercury	N.D. - 0.0002	0.00037	0.0002 - 0.001	1	91
Total nickel	N.D. - 0.025[5]	0.0042	0.002 - 0.02	56	90
Dissolved nickel	N.D. - 0.0050	0.0034	0.005	6	8
Nitrate-nitrogen	0.3-50.5	14, 16.3[6]	N/A	49	49
Organic nitrogen (Delta Pond)	0.7 - 1.8	approx. 2	N/A	11	11
Nitrite	N.D. - 7.3	0.3 (as N)	0.01	45[3]	48[3]
Phosphate	0.1 - 8.4	4.3 (as P)	N/A	49[3]	49[3]
total potassium	6.6 - 24	11	N/A	28	28
Dissolved potassium	5.6 - 12	10	N/A	6	8
Total silver	N.D. - 0.010	0.0012	0.0001 - 0.01	40	88
Dissolved silver	N.D. - .005	.00072	.0001 - .0002	2	8
Total sodium	58 - 150	80	N/A	28	28
Total zinc	N.D. - 0.28	0.03	0.01 - 0.10	82	90
Dissolved zinc	0.01 - 0.058	0.032	N/A	8	8
Volatile Organics					
Acetone	N.D. - 0.0060	0.0042	0.002 - 0.01	2	14
Carbon disulfide	N.D. - 0.0370	0.0039	0.0005 - 0.005	3	14
Chlorobenzene	N.D. - 0.0001	0.00006	0.0001	1	19
1,4-dichlorobenzene	N.D. - 0.00090	0.00064	0.0005	10	13
Ethylbenzene	N.D. - 0.0010	0.00024	0.0001 - 0.0005	1	19
Methylene chloride	N.D. - 0.0060	0.00082	0.0001 - 0.003	5	19
Tetrachloroethylene	N.D. - 0.0006	0.00023	0.0001 - 0.0005	2	19
Toluene	N.D. - 0.0004	0.00023	0.0001 - 0.0005	2	19
1,1,1-trichloroethane	N.D. - 0.0002	0.00021	0.0001 - 0.0005	1	19
Xylenes	N.D. - 0.0002	0.00022	0.0001 - 0.0005	1	18
Halomethanes					
Bromomethane	N.D. - 0.0014	0.00026	0.0001 - 0.0005	1	19
Chloromethane	N.D. - 0.0050	0.00046	0.0001 - 0.001	1	19
Bromodichloromethane	N.D. - 0.0110	0.0022	0.0005	22	23
Chloroform	0.0024 - 0.0440	0.0099	0.0005	22	23
Dibromochloromethane	N.D. - 0.0021	0.00041	0.0001 - 0.0005	4	22
Total trihalomethanes[7]	0.0036 - 0.057	0.0129	N/A	23	23

Table 4.6-1

Detectable[1] Chemical Constituents of Reclaimed Water

Chemical	Concentration Range (mg/L)	Mean Concentration (mg/L)	Reporting Limit(s)[2] (mg/L)	Number of Detects	Number of Samples
Total halomethanes[7]		0.0134			
Phthalates[8]					
Di-n-butyl phthalate	N.D. - 0.0019	0.00116	0.001 - 0.005	2	23
Bis (2-ethylhexyl) phthalate	N.D. - 0.0060	0.00249	0.0006 - 0.005	5	23
diethyl phthalate	N.D. - 0.021	0.00193	0.0005 - 0.002	4	23
Total phthalates		0.00558			
Pesticides					
Aldicarb sulfone	N.D. - 0.0018	0.0011	0.0008	2	4
Aldicarb sulfoxide	N.D. - 0.0019	0.00081	0.0005	2	4
Aldrin	N.D. - 0.00003	0.0000086	0.00001 - 0.00005	3	19
DCPA (Dacthal)	N.D. - 0.0003	0.00021	0.0002	2	4
Endosulfan II	N.D. - 0.00001	0.0000059	0.00001-0.00002	1	19
α-BHC	N.D. - 0.00003	0.0000094	0.00001 - 0.00005	2	19
γ-BHC (Lindane)	N.D. - 0.00009	0.000022	0.00001 - 0.00002	8	19
Heptachlor	N.D. - 0.00003	0.0000083	0.00001 - 0.00005	1	19
Radioactivity					
Gross alpha, GPV[9]	1.3 - 5.5 pCi/L[10]	2.8 pCi/L	N/A	4	4
Gross beta, GPV	11.9 - 12.7 pCi/L	12.3 pCi/L	N/A	4	4

Source: *Reclaimed Water Quality*, Merritt Smith Consulting 1996k.

Period of record: Metals 1988 - Jan 1995, Organic and other compounds 1991 - Jan 1995.
N/A - not available
N.D. - not detected

1 Analysis has been conducted for 21 total or dissolved metals and over 100 organic compounds in reclaimed water and each was below detection.

2 Reporting limit is the lowest concentration that has been reported by the laboratories providing this data. Some of the listed reporting limits are not the lowest that can be reliably detected. The reporting limit is variable for specific compounds because analytical methods, laboratory technique, and presence of interfering compounds vary.

3 Numbers shown are the number of monthly averages; these constituents are routinely measured several times per month

4 Asbestos values are reported as millions of fibers per liter (MFL).

5 The maximum concentration for these substances was half the detection limit of a non-detectable value. This differs from *Human Health Risks from Chemical and Biological Components of Reclaimed Water* (Parsons Engineering Science, Inc. 1996c) which gives the maximum detectable value as the maximum.

6 The two values for nitrate are the value estimated to be the concentration that will be obtained with proposed plant upgrades, and the long-term average reclaimed water concentration, respectively (Merritt Smith Consulting 1996k).

[7] Trihalomethanes include chloroform, bromoform, bromodichloromethane, and dibromochloromethane. Bromoform was not detected at or above the reporting limit for any sample. One half the reporting limit for bromoform was used to calculate the maximum and mean concentrations of trihalomethanes. Total halomethanes includes total trihalomethanes (as above) plus bromomethane and chloromethane.

[8] Phthalate numbers given here differ from those given in the *Human Health Risks from Chemical and Biological Components of Reclaimed Water* (Parsons Engineering Science, Inc. 1996c) because these numbers include additional data (See Appendix 5) collected while that technical report was prepared.

[9] Radioactivity values are reported as greatest probable value (GPV).

[10] pCi/L = pico Curies /L

Table 4.6-2

Biological Constituents of Reclaimed Water

Biological Constituent	Units	Concentration Range	Mean Concentration	Reporting Limits	Number of Detects	Number of Samples
BOD	mg/L	1.5 - 19	3.4		49[1]	49[1]
Total Coliform	MPN[2]/ 100 ml	ND - 170	2.2	2.2	49[1]	49[1]
Viruses	PFU[3]/#L	ND	N/A	1/~150 mL	0	7
Giardia lamblia	#cysts/ #L	ND - 28/203	10/223	1/~200 mL	2	4
Cryptosporidium	#oocysts/ #L	ND	N/A	1/~200 mL	0	4
Legionella sp.	MPN[2]/ 100 mL	ND	N/A	7840	0	4
Salmonella sp.	MPN[2]/ 100 mL	ND	N/A	2.2	0	4
Shigella	MPN[2]/ 100 mL	ND	N/A	2.2	0	4
Heterotrophic Bacteria Plate Count	CFU[4]/mL	ND - 2	1.25	2	1	4

Source: *Reclaimed Water Quality*, Merritt Smith Consulting 1996k

Period of record: 1991 - Jan 1995.
N/A - not available
N.D. - not detected
BOD - Biological Oxygen Demand

[1] Numbers shown are the number of monthly averages; these constituents are routinely measured several times per month.

[2] MPN - Most Probable Number

[3] PFU - Plaque-Forming Units

[4] Colony-Forming Units

Russian River and Santa Rosa Plain

This section describes water quality conditions and regulations in waterways that are potentially affected by this Project. The waterways (see Figure 4.4-1a, b, c) addressed in this section are as follows:

- Russian River. Includes the Russian River from Healdsburg to the mouth at the town of Jenner.
- Laguna de Santa Rosa. Includes the Laguna de Santa Rosa from Stony Point Road to its confluence with the Russian River, Santa Rosa Creek from Willowside Road to its confluence with the Laguna, and Mark West Creek from Slusser Road to its confluence with the Laguna.
- Mark West Creek. Water quality information is summarized for Mark West Creek at Slusser Road.
- Pacific Ocean. The Pacific Ocean is the ultimate recipient of river wastewater discharge and so is included in this section.

Creeks in the Sebastopol area are discussed under Sebastopol below.

Russian River

The Russian River from Healdsburg to the Pacific Ocean has several functions: habitat, potable water supply, aesthetics and recreation. It provides habitat for a variety of organisms, including migrating steelhead trout and coho as discussed in *Anadromous Fish Migration Study Program 1991-1995* Technical Report (Merritt Smith Consulting 1996b). To augment this resource, a steelhead coho hatchery is located downstream of Warm Springs Dam on Dry Creek, a tributary of the Russian River below Healdsburg. The Russian River is also a source of drinking water. Sonoma County Water Agency's primary source of water is a series of five Ranney collectors located in the gravel beneath the Russian River (City of Santa Rosa 1993). The Ranney collectors withdraw groundwater from the gravel beneath the River to provide drinking water for Sonoma County and portions of Marin County. The Russian River is also a major recreational resource. Many vacation homes are located along its banks, primarily below Wohler Bridge. It is also a popular destination for swimming, canoeing, fishing, and other water sports.

Water Quality

The following describes some of the main factors controlling water quality in the Russian River:

- Wastewater discharge. Between Healdsburg and Jenner, the Russian River receives treated wastewater from the cities of Healdsburg, Windsor, Occidental, Forestville, Graton, Guerneville, and Santa Rosa. The City of

Ukiah also discharges reclaimed water to the Russian River. Some of these discharges occur to percolation ponds located adjacent to the River.

- Warm Springs Dam. Water released from Warm Springs Dam on Dry Creek, a major tributary of the Russian River, at times comprises a large portion of the Russian River below Dry Creek.
- Summer check dams. In addition to the summer dam at Wohler operated by the Sonoma County Water Agency to provide water for their collectors, there are several other dams along the Russian River that are operated during the summer. The purpose of these dams is to provide recreational swimming areas. They result in a conversion of areas of the Russian River from a riverine habitat to a pond-like habitat.
- Watershed land uses. Uses of developed land in the Russian River watershed are primarily low density residential, recreation, agriculture, and gravel quarries. Among the potential water quality impacts from these land uses are coliforms, fertilizers, and pesticides (North Coast Regional Board 1995, CH2M Hill 1994a).

Water quality data collected on the Russian River by the Regional Board between September 1985 and October 1993 and by the HBA Team from May 1994 through February 1995 are summarized in Table 4.6-3. Additional bacteriological data have been obtained from the Sonoma County Water Agency (1993) and from the County of Sonoma Public Health Department. Data in Table 4.6-3 that are representative of conditions in the River above the Laguna are from Healdsburg Memorial Beach and Wohler Bridge. Data in Table 4.6-3 that are representative of conditions in the River below the Laguna are from Oddfellows Bridge and Johnson’s Beach. Collections of samples for metals analysis were begun in May 1994. Metals data are summarized in Table 4.6-4. The complete data sets are available in the *Russian River Water Quality Monitoring Results* Technical Report (Merritt Smith Consulting 1996n).

Table 4.6-3

Average Seasonal Water Quality in the Russian River

	Above Laguna				Below Laguna			
	Winter	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**
Conductivity (µmhos/cm)	247	244	268	235	289	257	261	234
Turbidity (NTU)	4.45	8.86	3.28	0.88	9.16	9.38	3.90	1.13
Dissolved oxygen (mg/L)	11.6	9.8	8.8	9.4	11.8	9.5	8.7	9.4
Nitrate-Nitrogen (mg/L)	0.29	0.32	0.07	0.04	0.56	0.41	0.08	0.04
Ammonia-Nitrogen (mg/L)	0.04	0.03	0.04	0.04	0.12	0.05	0.03	0.07
TKN (mg /L)	0.25	0.18	0.23	0.23	0.28	1.15	0.26	0.21
Dissolved orthophosphate Phosphorous (mg/L)	0.02	0.03	0.01	0.01	0.20	0.10	0.04	0.03
Chlorophyll *a* (mg/L)	0.002	0.008	0.031	0.003	0.005	0.012	0.022	0.002
Total coliforms (MPN/100 mL)	706	306	248	104	737	210	292	302
Fecal coliforms (MPN/100 mL)	52.7	46.0	146.6	17.9	169.3	28.1	43.7	17.0

Source*: Russian River Water Quality Monitoring Results*, Merritt Smith Consulting 1996n

Period of record: 1985 - October 1993 and May 1994 - February 1995
µmhos/cm = micro mhos per centimeter
NTU = Nephelometric Turbidity Units
TKN = Total Kjeldahl Nitrogen = sum of organic nitrogen and ammonia concentrations
MPN = most probable number. The means are calculated as geometric means.

Table 4.6-4

Concentrations of Detectable[1] Metals in the Russian River (mg/L)

Constituent	Above Laguna	Below Laguna	EPA Criteria[2]
Total aluminum	0.15	not analyzed	0.087
Total barium	0.073	not analyzed	none
Total chromium	0.0081	0.0060	none
Total copper	0.0082	0.0076	none
Total lead	0.0020	0.0024	none
Total nickel	0.017	0.011	none
Dissolved nickel	ND (0.005)[3]	0.0028	0.182
Total silver	0.0014	0.0006	none
Total zinc	0.015	0.015	none
Dissolved zinc	ND (0.01- 0.05)[3]	0.090	0.121

Source: *Russian River Water Quality Monitoring Results*, Merritt Smith Consulting 1996n

1 Metals analyzed for but not detectable at concentrations above the reporting limit include total antimony, total and dissolved arsenic, total beryllium, total and dissolved cadmium, dissolved chromium, dissolved copper, dissolved lead, total and dissolved mercury, dissolved nickel, total and dissolved selenium, dissolved silver, and total thallium.

2 EPA criteria are for dissolved metals and are hardness related. The values shown are for a hardness (the sum of calcium and magnesium concentrations as $CaCO_3$) of 119 mg/L which is the long-term average for the Russian River.

3 ND indicates all values were below reporting limit. Reporting limits are in parentheses.

Two samples were collected from the Russian River above the Laguna in fall of 1994 for analysis of viruses. The results of these analyses were 1 plaque-forming unit (PFU) in 45 liters and 0 PFU in 153 liters.

The concentration of various organic compounds in the Russian River has been measured in samples collected by the Regional Board at several stations above and below the Laguna during 1985-86 and by the HBA Team above the Laguna in 1994. There were no detectable levels of organic compounds in the 1985-86 study. In the 1994 study, over 100 organic compounds were analyzed on four occasions. Only two, di(2-ethylhexyl)phthalate (a common laboratory contaminant from plastics) and simazine (a pesticide), were found at detectable concentrations on one occasion. These concentrations were 0.7 µg/L and 0.08 µg/L, respectively. Samples for analysis of pesticides were also collected weekly on the Russian River near Guerneville between August 1994 and January 1995 by the California EPA Department of Pesticide Regulation. Out of the 26 samples collected during this study, only one sample had a detectable pesticide, diazinon, which was detected at a concentration of 0.076 µg/L.

Benthic Algae and Macrophytes

The aquatic plant growth in the Russian River can be categorized into four types:

- Planktonic algae (small algae suspended in the water). The biomass of this component is estimated by chlorophyll a analysis. Chlorophyll data are included with chemical and physical water quality parameters described in Table 4.6-3.
- Benthic algae. This type consists of algae such as small diatoms and large filamentous *Cladophora* that are attached to the substrate (sand, gravel or cobble).
- Submergent macrophytes. This type consists of rooted higher plants which are mostly or completely below the surface of the water. In the Russian River there are three primary genera: *Elodea*, *Myriophyllum*, and *Ruppia* (*Ruppia* occurred only below Duncan's Mill). Submergent macrophytes were rare above Monte Rio during the 1994 study.
- Emergent macrophytes. This component consists of rooted higher plants which are mostly above the surface of the water. In the Russian River, this category is entirely water primrose. This plant grows along banks but sends out runners into the water. These runners have roots which take up water and nutrients from the water column.

The biomass of benthic algae and macrophytes was estimated in 1994 and the data are summarized in Table 4.6-5 through Table 4.6-7. Details on sample collection and a complete data set can be found in the *Russian River Algae and Macrophytes Assessment* (Merritt Smith Consulting 1996n). Samples were variable, and the averages have a high degree of variance.

Table 4.6-5

Biomass of Benthic Algae in Russian River

		Average Biomass (in mg chlorophyll *a* / m²)	
Sampling Date	**Substrate[1]**	**Stations Above Laguna[2]**	**Stations Below Laguna[2]**
May/June, 1994	sand	16 (n=2)	8 (n=1)
	gravel	2 (n=1)	11 (n=2)
	cobble	2 (n=1)	25 (n=6)
July, 1994	sand	17 (n=1)	101 (n=1)
	gravel	79 (n=2)	15 (n=4)

Table 4.6-5

Biomass of Benthic Algae in Russian River

Sampling Date	Substrate[1]	Average Biomass (in mg chlorophyll *a* / m^2)	
		Stations Above Laguna[2]	**Stations Below Laguna[2]**
	cobble	2 (n=1)	30 (n=7)
September, 1994	sand	10 (n=1)	8 (n=1)
	gravel	39 (n=2)	7 (n=3)
	cobble	5 (n=1)	15 (n=7)
May, 1995	sand	0 (n=0)	0.7 (n=1)
	gravel	0.2 (n=1)	2 (n=1)
	cobble	0.2 (n=1)	2 (n=2)
July, 1995	sand	21 (n=1)	18 (n=1)
	gravel	97 (n=3)	9 (n=3)
	cobble	3 (n=2)	11 (n=5)
August, 1995	sand	12 (n=2)	19 (n=3)
	gravel	8 (n=2)	12 (n=5)
	cobble	5 (n=1)	24 (n=5)

Source: *Russian River Algae and Macrophytes Assessment*, Merritt Smith Consulting 1996m

n Number of samples.

1 Substrate was defined for sampling locations as "sand" if only sand, as "gravel" if gravel-sized rocks (<1-inch diameter) occurred with sand, and "cobble" if cobble-sized rocks (>1-inch diameter) occurred with sand or gravel.

2 Benthic algae average biomass (in mg chlorophyll *a*/m2) for different substrate types above and below the confluence with the Laguna. Replicates were collected at various locations to represent cross-sections of the River. These replicates appear as averages in the table for like substrates.

Table 4.6-6

Biomass of Submergent Macrophytes in the Russian River below the Laguna

Sampling Date	Average Percent Cover	Average Wet Weight (g/m^2)
June, 1994	10 (n=6)	3700 (n=6)
September, 1994	23 (n=10)	2400 (n=7)
May, 1995	0[1]	0[1]
July, 1995	0[1]	0[1]
August, 1995	0[1]	0[1]

Source: *Russian River Algae and Macrophytes Assessment*, Merritt Smith Consulting 1996m

1 Visual observations made for submerged macrophytes detected none.

Table 4.6-7

Average Biomass of Emergent Macrophytes in Russian River (ft^2/River mile)

Sampling Date	Stations Above Laguna[1]	Stations Below Laguna[1]
June, 1994	1623	484
September, 1994	3283	1298
May, 1995	0[2]	0[2]
July, 1995	0[2]	0[2]
August, 1995	1946	861

Source: *Russian River Algae and Macrophytes Assessment*, Merritt Smith Consulting 1996m

1 Biomass average coverage in square feet per River mile.
2 Visual observations made for emergent macrophytes detected none.

Sediment Quality

Sediment quality data were collected in the Russian River during 1994 by the HBA Team and during 1985-86 by the Regional Board. The 1994 data (n=1) are presented in Table 4.6-8. Complete data and a more detailed data analysis are found in the *Sediment Quality Characterization for the Russian River, Laguna de Santa Rosa, Santa Rosa Creek, and Wastewater Storage Ponds* Technical Report (Merritt Smith Consulting 1996o). All organic compounds analyzed were below detection limits with the exception of some phenolic compounds found in detectable concentrations above the confluence with the Laguna.

Table 4.6-8

Summary of Sediment Quality in the Russian River
(mg/kg or ppm wet weight)

Constituent	Above Laguna[1]	Below Laguna[1]	EPA Guidelines[2]
INORGANICS			
Antimony	ND (0.5)	ND (0.5)	
Arsenic	2.0	1.6	
Cadmium	ND (0.05)	ND (0.05)	
Chromium	51	50	
Cobalt	10	10	
Copper	13	12	
Lead	3.3	3.3	
Mercury	0.2	0.1	
Nickel	75	84	
Silver	ND (0.1)	ND (0.1)	
Zinc	36	34	
ORGANICS			
Chlorinated Dioxins and PCBs			
PCB-1016	ND (1.0)	ND (1.0)	
PCB-1248	ND (1.0)	ND (1.0)	
PCB-1254	ND (0.5)	ND (0.5)	
PCB-1260	ND (0.5)	ND (0.5)	
Semi-Volatiles			
Benzoic Acid	ND (1.6)	ND (1.6)	
Benzyl Alcohol	ND (0.33)	ND (0.33)	
Dibenzofuran	ND (0.33)	ND (0.33)	
Semi-Volatile, Organochlorines			
Aldrin	ND (0.012)	ND (0.012)	
Chlordane	ND (0.025)	ND (0.025)	

Table 4.6-8

Summary of Sediment Quality in the Russian River
(mg/kg or ppm wet weight)

Constituent	Above Laguna[1]	Below Laguna[1]	EPA Guidelines[2]
p,p'-DDD	ND (0.03)	ND (0.03)	
p,p'-DDE	ND (0.03)	ND (30.0)	
Dieldrin	ND (0.03, 0.011)[3]	ND (0.03, .015)[3]	0.011
Endrin	ND (0.03, 0.011)[3]	ND (0.03, .015)[3]	0.0042
Heptachlor	ND (1.0)	ND (1.6)	
Heptachor epoxide	ND (0.03)	ND (0.03)	
Hexachlorobenzene	ND (0.33)	ND (0.33)	
Hexachlorobutadiene	ND (0.33)	ND (0.33)	
g-BHC (Lindane)	ND (0.012)	ND (0.012)	
a-BHC	ND (0.003)	ND (0.003)	
b-BHC	ND (0.003)	ND (0.003)	
Semi-Volatile, Organophosphates			
Methyl Parathion	ND (0.0067)	ND (0.0067)	
Semi-Volatile, Phenolics			
2,4-Dimethylphenol	ND (0.33)	ND (0.33)	
2-Methyl Phenol	ND (0.33)	ND (0.33)	
4-Methyl Phenol	ND (0.33)	ND (0.33)	
Pentachlorophenol	2.0	ND (1.6)	
Phenol	1.2	ND (0.33)	
Semi-Volatile, Phthalates			
Butylbenzylphthalate	ND (0.33)	ND (0.33)	
Diethyl phthalate	ND (0.33)	ND (0.33)	
Dimethyl phthalate	ND (0.33)	ND (0.33)	
Di-n-octylphthalate	ND (0.33)	ND (0.33)	
Di-n-Butylphthalate	ND (0.33)	ND (0.33)	
Semi-Volatile, PAHs			
Acenaphthene	ND (0.33, 0.12)[3]	ND (0.33, 0.17)[3]	0.13

Table 4.6-8

Summary of Sediment Quality in the Russian River
(mg/kg or ppm wet weight)

Constituent	Above Laguna[1]	Below Laguna[1]	EPA Guidelines[2]
Acenaphthylene	ND (0.33)	ND (0.33)	
Anthracene	ND (0.33)	ND (0.33)	
Benzo(k)fluoranthene	ND (0.33)	ND (0.33)	
Benzo-a-pyrene	ND (0.33)	ND (0.33)	
Benzo(B)fluoranthene	ND (0.33)	ND (0.33)	
Benzo(g,h,i)perylene	ND (0.33)	ND (0.33)	
Chrysene	ND (0.33)	ND (0.33)	
Dibenzo (a,h)anthracene	ND (0.33)	ND (0.33)	
Fluoranthene	ND (0.33, 0.12)[3]	ND (0.33, 0.17)[3]	0.62
Fluorene	ND (0.33)	ND (0.33)	
Indeno(1,2,3-CD)pyrene	ND (0.33)	ND (0.33)	
2-Methylnaphthalene	ND (0.33)	ND (0.33)	
Naphthalene	ND (0.33)	ND (0.33)	
Phenanthrene	ND (0.33, 0.12)[3]	ND (0.33, 0.17)[3]	0.18
Pyrene	ND (0.33)	ND (0.33)	
Volatile, Aromatic & Halogenated			
1,2-Dichlorobenzene	ND (0.33)	ND (0.33)	
1,3-Dichlorobenzene	ND (0.33)	ND (0.33)	
1,2,4-Trichlorobenzene	ND (0.33)	ND (0.33)	

Source: *Sediment Quality Characterization for the Russian River, Laguna de Santa Rosa, Santa Rosa Creek, and Reclaimed Water Storage Ponds*, Merritt Smith Consulting 1996j

[1] ND = concentration was below detection. Numbers in parentheses are reporting limits.
[2] Blanks under EPA Guidelines indicate that there are no developed EPA guidelines, criteria or standards. Values given in this column are all guidelines, and guidelines are not considered enforceable by EPA.
[3] Numbers in parentheses are reporting limits in mg/kg and reporting limits per gram organic carbon, respectively. EPA criteria are in units of mg/g organic carbon.

Wastewater Discharges Into the Russian River

Several community wastewater treatment plants discharge treated effluent directly into the Russian River; or indirectly to tributaries; or via subsurface flow from percolation ponds or quarries. Eight treatment plants (in addition to the Subregional System, which is described in Section 3.2, Description of Existing Conditions and Alternatives) operate within or upstream of the Project area:

- City of Ukiah
- City of Cloverdale
- City of Healdsburg
- Town of Windsor
- Occidental County Sanitation District
- Graton County Service Area
- Forestville County Sanitation District
- Russian River County Sanitation District (Guerneville)

A summary of the eight dischargers appears in Table 4.6-9. Discharge to the River and tributaries is prohibited in the dry season from May 15 through September 30. Discharge during the wet season ranges from 0.02 mgd (million gallons per day) from the Occidental plant to 2.43 mgd from the Ukiah plant. Five of the eight plants treat their wastewater to a secondary level. Windsor, Guerneville, and Ukiah treat their wastewater to a tertiary level before discharge. Cloverdale and Healdsburg discharge their treated effluent to ponds for percolation into the groundwater adjacent to the River. Discharges from the remaining six treatment plants enter the Russian River directly or via tributaries. Table 4.6-10 provides a summary of selected discharger monitoring data reported to the North Coast Regional Board.

Table 4.6-9

Wastewater Dischargers to the Russian River

Discharger	Avg Dry Weather Flow (mgd)[1]	Design Wastewater Flow (mgd)	Treatment	Receiving Water	Type of Discharge	Discharge Season	Facilities
Ukiah	2.4	2.8	secondary	Russian River	direct, limited to 1% of Russian River flow	Oct 1 - May 14	primary and secondary sedimentation, trickling filters, chlorination, oxidation/percolation ponds, dechlorination, sludge digestion
Cloverdale	0.5	0.7	secondary	percolation pond	indirect, percolation from pond	N/A	primary and secondary oxidation ponds, disinfection, percolation pond
Healdsburg	1.0	1.4	secondary	open pit quarry	indirect, percolation from quarry	N/A	four aerated ponds, two oxidation/sedimentation ponds, disinfection
Windsor	1.1	1.5	tertiary	Laguna at Trenton-Healdsburg	direct, limited to 1% of Laguna de Santa Rosa flow	Oct 1 - May 14	aerated ponds, settling, coagulation, flocculation, disinfection, storage
Occidental	0.02	0.05	secondary	Dutch Bill Creek	direct, limited to 1% of Dutch Bill Creek flow	Oct 1 - May 14	aerated pond, settling pond, disinfection
Graton	0.08	0.14	secondary	Atascadero Creek	direct, limited to 1% of Atascadero Creek flow	Oct 1 - May 14	aerated ponds, disinfection, storage
Forestville	0.05	0.1	secondary	Green Valley Creek	direct, limited to 1% of Green Valley Creek flow	Oct 1 - May 14	aerated ponds, disinfection, storage
Guerneville	0.35	0.71	tertiary	Russian River	direct, limited to 1% of Russian River flow	Oct 1 - May 14	aeration, clarification, coagulation, filtration, disinfection, solids dewatering

Source: North Coast Regional Water Quality Control Board. Data collected by dischargers 1994-1995

[1] 1994 data - average of 3 consecutive months of lowest flow.

Table 4.6-10

Russian River Wastewater Dischargers Monitoring Data[1]

Constituent [2]	Discharger							
	Ukiah	Cloverdale	Healdsburg	Windsor	Occidental	Graton	Forestville	Guerneville
BOD (mg/L)	NA	10, n=7	7, n=31	NA	18, n=20	6, n=1	7, n=1	6, n=20
Nitrate-Nitrogen (mg/L)	NA	NA	NA	7.1, n=12	NA	NA	NA	NA
Total coliform (MPN/100ml)	NA	25, n=7	44, n=38	ND (2), n=12	2, n=20	ND (2), n=1	ND (2), n=1	2, n=20
Chloroform (mg/L)	ND (0.0005), n=1	NA	NA	0.009, n=12	NA	0.026, n=1	0.001, n=1	0.034, n=5
Bromochloromethane (mg/L)	NA	NA	NA	NA	NA	0.110, n=1	0.101, n=1	NA
Dibromochloromethane (mg/L)	ND (0.0005), n=1	NA	NA	0.0012, n=12	NA	NA	NA	NA
Total Chromium (mg/L)	ND (0.020), n=1	NA	NA	ND (0.007), n=12	NA	NA	ND (0.005), n=1	NA
Copper (mg/L)	0.092, n=1	NA	NA	ND (0.050), n=12	NA	ND (0.005), n=1	0.010, n=1	NA
Lead (mg/L)	ND (0.005), n=1	NA	NA	ND (0.005), n=12	NA	NA	NA	NA
Mercury (mg/L)	ND (0.001), n=1	NA	NA	ND (0.001), n=12	NA	ND (0.0002), n=1	ND (0.0002), n=1	NA
Nickel (mg/L)	ND (0.050), n=1	NA	NA	NA	NA	ND (0.030), n=1	ND (0.030), n=1	NA
Silver (mg/L)	ND (0.010), n=1	NA	NA	NA	NA	ND (0.005), n=1	ND (0.005), n=1	NA
Zinc (mg/L)	ND (0.020), n=1	NA	NA	ND (0.050), n=12	NA	0.028, n=1	0.024, n=1	39, n=5

Table 4.6-10

Russian River Wastewater Dischargers Monitoring Data[1]

Constituent [2]	Discharger							
	Ukiah	Cloverdale	Healdsburg	Windsor	Occidental	Graton	Forestville	Guerneville
Hardness (mg/L)	122, n=1	NA	NA	140, n=12	NA	96, n=1	96, n=1	NA

Source: North Coast Regional Water Quality Control Board. Data collected by dischargers 1993-1995.

1 Effluent data were reported for sampling locations representative of the water quality entering the Russian River.
ND indicate the value is non-detectable (below the method detection limit) for that constituent. Value in parentheses is reporting limit.
Data set size is indicated by "n=__".

2 Constituents were selected to reflect the most prevalent constituents sampled for.

Laguna de Santa Rosa, Santa Rosa Creek, and Mark West Creek

The Laguna de Santa Rosa flows north across the Santa Rosa Plain to the Russian River. The dominant land use in the watershed is agricultural (30%) with open space and rural residential comprising 23 and 19% respectively (City of Santa Rosa 1994a). The lower portions of the Laguna, Santa Rosa Creek, and Mark West Creek serve as migration corridors for steelhead and coho salmon to spawning grounds in the upper reaches of Santa Rosa Creek and Mark West Creek (Merritt Smith Consulting 1995a).

Water Quality

Laguna water quality is affected by a number of factors, including the flow and quality of water in its tributaries, wastewater discharge from the City of Santa Rosa, runoff from urban and agricultural activities, and natural processes such as erosion, sedimentation, and algal growth. Water quality in the Laguna was found by the Regional Board to be impaired pursuant to Section 303(d) of the Federal Clean Water Act in 1982. The Regional Board found that water quality objectives, particularly for ammonia and dissolved oxygen, have been routinely exceeded. The Laguna de Santa Rosa Water Quality Objective Attainment Plan (City of Santa Rosa 1994a) identifies activities in the watershed that potentially affect ammonia and dissolved oxygen in the Laguna and quantified their load. The Plan concludes:

> Storm runoff from dairies was identified as the primary cause of ammonia exceedences in the Laguna. Storm runoff from dairies and urban areas was found to contribute organic matter and nutrients to the Laguna directly that result in algal growth and oxygen depletion. Discharges of groundwater carrying nutrients from septic systems and discharges of reclaimed water that occur late in the discharge season are believed to contribute nutrients that stimulate aquatic plant growth which leads to oxygen depletion. The relative importance of these nutrient and organic matter sources in determining Laguna water quality is unknown.

The Regional Board developed a waste reduction strategy for the Laguna de Santa Rosa (Regional Board 1995) as part of the process to bring the Laguna into attainment.

Water quality data for the Laguna, Santa Rosa Creek, and Mark West Creek are summarized in Tables 4.6-11-15. Data on the concentration of organic chemicals in the Laguna are not provided in these tables because the only detectable organic compound was gamma BHC (Lindane), which was found at a concentration of 1.1 µg/L on one occasion in Santa Rosa Creek at Stony Point Road. Details and complete data sets can be found in the *Laguna de Santa Rosa Water Quality Monitoring Results* Technical Report (Merritt Smith Consulting 1996j).

Table 4.6-11

Summary of Water Quality in the Laguna de Santa Rosa

	Above Santa Rosa Creek				Below Santa Rosa Creek			
	Winter	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**
Conductivity (µmhos/cm)	565	670	733	634	328	417	598	534
Turbidity (NTU)	20.2	27.4	28.9	24.5	8.8	22.1	21. 8	5.7
Dissolved oxygen (mg/L)	7.5	8.3	7.1	6.8	9.1	7.3	6.1	6.5
Nitrate-Nitrogen (mg/L)	4.23	1.60	0.25	0.52	1.95	0.95	1.06	0.59
Ammonia-Nitrogen (mg/L)	1.72	1.49	0.24	0.24	0.28	0.08	0.12	0.12
TKN (mg/L)	2.62	5.13	2.27	2.05	no data	no data	1.07	no data
Dissolved orthophosphate-phosphorous (mg/L)	1.47	1.48	1.13	0.74	0.93	0.63	0.41	0.21
Chlorophyll *a* (mg/L)	0.42	0.096	0.232	0.059	0.013	0.048	0.055	0.006

Source*: Laguna de Santa Rosa Water Quality Monitoring Results*, Merritt Smith Consulting 1996j

Period of record: August 1989 - August 1995
NTU = Nephelometric Turbidity Unit
TKN - Total Kjeldahl Nitrogen = sum of organic nitrogen and ammonia concentrations

Table 4.6-12

Concentrations of Detectable[1] Metals In the Laguna de Santa Rosa (mg/L)

Constituent	Above Santa Rosa Creek	Below Santa Rosa Creek	EPA Criteria[2]
Total arsenic	0.0042	0.0036	None
Total cadmium	ND (0.0005-0.005)[3]	0.0020	None
Total chromium	0.005	0.0059	None
Total copper	ND (0.005-0.02)[3]	0.012	None
Total lead	0.0018	0.0028	None
Total nickel	0.010	0.013	None
Dissolved nickel	0.0070	0.0059	0.198
Total silver	ND (0.01-0.001)[3]	0.0026	None
Total zinc	0.015	0.023	None

Source: *Laguna de Santa Rosa Water Quality Monitoring Results*, Merritt Smith Consulting 1996j

Period of record: June 1985 - May 1995

1 Metals analyzed for but not detected at concentrations above the reporting limit include dissolved arsenic, dissolved cadmium, dissolved chromium, dissolved copper, dissolved lead, total and dissolved mercury, total and dissolved selenium, dissolved silver, dissolved zinc.

2 EPA criteria are for dissolved metals and are hardness related. The value shown is for a hardness of 131 mg/L which is the average for the Laguna.

3 ND indicates all values were below the reporting limit. Reporting limits are in parentheses.

Table 4.6-13

Summary of Water Quality in Santa Rosa Creek

	Santa Rosa Creek at Willowside			
	Winter	**Spring**	**Summer**	**Fall**
Conductivity (µmhos/cm)	392	488	599	556
Turbidity (NTU)	16.0	8.5	2.3	2.0
Dissolved oxygen (mg/L)	10.7	11.8	9.1	10.0
Nitrate-nitrogen (mg /L)	2.16	0.98	0.15	0.45
Ammonia-nitrogen (mg /L)	0.12	0.19	0.07	0.12
TKN (mg /L)	0.38	1.07	0.57	1.59
Dissolved orthophosphate-Phosphorous (mg/L)	0.41	0.26	0.11	0.10
Chlorophyll *a* (mg/L)	0.005	0.010	0.016	0.003

Source*: Laguna de Santa Rosa Water Quality Monitoring Results*, Merritt Smith Consulting 1996j

Table 4.6-14

Concentrations of Detectable[1] Metals in Santa Rosa Creek (mg/L)

Constituent	Average Concentration at Willowside	EPA Criteria[2]
Total chromium	0.005	None
Total copper	0.004	None
Total lead	0.003	None
Total nickel	0.006	None
Dissolved nickel	0.004	0.183
Total zinc	0.033	None

Source*: Laguna de Santa Rosa Water Quality Monitoring Results*, Merritt Smith Consulting 1996j

1 Metals analyzed for but not detected at concentrations above the reporting limit include total and dissolved arsenic, total and dissolved cadmium, dissolved chromium, dissolved copper, dissolved lead, total and dissolved mercury, total and dissolved selenium, total and dissolved silver, and dissolved zinc.

2 EPA criteria are for dissolved metals and are hardness related. The value shown is for a hardness of 120 mg/L which is the average for Santa Rosa Creek.

Table 4.6-15

Summary of Water Quality in Mark West Creek at Slusser Road

	Winter	Spring	Summer	Fall
Conductivity (µmhos/cm)	228	274	492	461
Turbidity (NTU)	41.5	19.3	4.83	5.0
Dissolved oxygen (mg/L)	9.8	9.6	5.0	7.2
Nitrate-Nitrogen (mg/L)	5.8	0.30	1.11	0.15
Ammonia-Nitrogen (mg/L)	0.19	0.053	0.12	0.055
TKN (mg/L)	0.88	0.19	0.45	0.17
Dissolved orthophosphate phosphorus (mg/L)	0.016	0.13	0.12	0.22
Chlorophyll a (mg/L)	0.007	0.013	0.012	0.045

Source: *Laguna de Santa Rosa Water Quality Monitoring Results*, Merritt Smith Consulting 1996j

NTU = Nephelometric Turbidity Units
TKN = Total Kjeldahl Nitrogen = sum of organic nitrogen and ammonia concentrations

Sediment Quality

Sediment quality data have been collected in the Laguna and Santa Rosa Creek during 1994 by the Long-Term EIR/EIS Project Team and during 1985-86 by the Regional Board and are summarized in Tables 4.6-16 and 4.6-17. Complete data, including storage pond sediment quality data, and a more detailed data analysis thereof are found in the *Sediment Quality Characterization for the Russian River, Laguna de Santa Rosa, Santa Rosa Creek, and Wastewater Storage Ponds* Technical Report (Merritt Smith Consulting 1996o).

Table 4.6-16

Summary of Sediment Quality in the Laguna de Santa Rosa (mg/kg)

Constituent	Above Santa Rosa Creek[1]	Below Santa Rosa Creek[1]	EPA Guidelines[2]
INORGANICS			
Antimony	ND (0.5)	ND (0.5)	
Arsenic	1	1.7	
Cadmium	0.06	0.06	
Chromium	8.2	33	
Cobalt	3	8.2	
Copper	6.6	13	
Lead	3	7.9	
Mercury	ND (0.1)	ND (0.1)	
Nickel	11	38	
Silver	ND (0.1)	ND (0.1)	
Zinc	39	33	
ORGANICS			
Chlorinated Dioxins and PCBs			
PCB-1016	ND (1.0)	ND (0.5)	
PCB-1248	ND (1.0)	ND (0.5)	
PCB-1254	ND (0.5)	ND (0.2)	
PCB-1260	ND (0.5)	ND (0.2)	
Semi-Volatiles			
Benzoic Acid	ND (3.0)	ND (3.0)	
Benzyl Alcohol	ND (0.7)	ND (0.7)	
Dibenzofuran	ND (0.7)	ND (0.7)	
Semi-Volatile, Organochlorines			
Aldrin	ND (0.012)	ND (0.006)	
Chlordane	ND (0.25)	ND (0.10)	
p,p’-DDD	ND (0.030)	ND (0.020)	
p,p’-DDE	ND (0.030)	ND (0.020)	
Dieldrin	ND (0.030, 0.008)[3]	ND (0.020, 0.006)[3]	0.011
Endrin	ND (0.030 (0.008)[3]	ND (0.020 (0.006)[3]	0.0042
Heptachlor	ND (0.030)	ND (0.020)	
Heptachlor epoxide	ND (0.30)	ND (0.020)	

Table 4.6-16

Summary of Sediment Quality in the Laguna de Santa Rosa (mg/kg)

Constituent	Above Santa Rosa Creek[1]	Below Santa Rosa Creek[1]	EPA Guidelines[2]
Hexachlorobenzene	ND (0.70)	ND (0.70)	
Hexachlorobutadiene	ND (0.70)	ND (0.70)	
g-BHC (Lindane)	ND (0.012)	ND (0.006)	
a-BHC	ND (0.003)	ND (0.002)	
b-BHC	ND (0.003)	ND (0.002)	
Semi-Volatile, Organophosphates			
Methyl Parathion	ND (0.067	ND (0.067)	
Semi-Volatile, Phenolics			
2,4-Dimethylphenol	ND (0.70)	ND (0.70)	
2-Methyl Phenol	ND (0.70)	ND (0.70)	
4-Methyl Phenol	ND (0.70)	ND (0.70)	
Pentachlorophenol	ND (3.00)	ND (3.00)	
Phenol	12.00	ND (0.70)	
Semi-Volatile, Phthalates			
Butylbenzylphthalate	ND (0.70)	ND (0.70)	
Diethyl phthalate	ND (0.70)	ND (0.70)	
Dimethyl phthalate	ND (0.70)	ND (0.70)	
Di-n-octylphthalate	ND (0.70)	ND (0.70)	
Di-n-Butylphthalate	ND (0.70)	ND (0.70)	
Semi-Volatile, PAHs			
Acenaphthene	ND (0.70, 0.18)[3]	ND (0.70, 0.19)[3]	0.13
Acenaphthylene	ND (0.70)	ND (0.70)	
Anthracene	ND (0.70)	ND (0.70)	
Benzo(k)fluoranthene	ND (0.70)	ND (0.70)	
Benzo-a-pyrene	ND (0.70)	ND (0.70)	
Benzo(B)fluoranthene	ND (0.70)	ND (0.70)	
Benzo(g,h,i)perylene	ND (0.70)	ND (0.70)	
Chrysene	ND (0.70)	ND (0.70)	
Dibenzo (a,h)anthracene	ND (0.70)	ND (0.70)	
Fluoranthene	ND (0.70, 0.18)[3]	ND (0.70, 0.19)[3]	0.62
Fluorene	ND (0.70)	ND (0.70)	

Table 4.6-16

Summary of Sediment Quality in the Laguna de Santa Rosa (mg/kg)

Constituent	Above Santa Rosa Creek[1]	Below Santa Rosa Creek[1]	EPA Guidelines[2]
Indeno(1,2,3-CD)pyrene	ND (0.70)	ND (0.70)	
2-Methylnaphthalene	ND (0.70)	ND (0.70)	
Naphthalene	ND (0.70)	ND (0.70)	
Phenanthrene	ND (0.70, 0.18)[3]	ND (0.70, 0.19)[3]	0.18
Pyrene	ND (0.70)	ND (0.70)	
Volatile, Aromatic & Halogenated			
1,2-Dichlorobenzene	ND (0.70)	ND (0.70)	
1,3-Dichlorobenzene	ND (0.70)	ND (0.70)	
1,2,4-Trichlorobenzene	ND (0.70)	ND (0.70)	

Source: *Sediment Quality Characterization for the Russian River, Laguna de Santa Rosa, Santa Rosa Creek, and Reclaimed Water Storage Ponds*, Merritt Smith Consulting 1996o. EPA guidelines from EPA 1993 a-e.

1. ND = concentration was below detection. Numbers in parentheses are reporting limits.
2. EPA 1993a-e. Blanks under EPA Guidelines indicate that there are no developed EPA guidelines, criteria or standards. Values given in this column are all guidelines, and guidelines are not considered enforceable by EPA.
3. Numbers in parentheses are reporting limits in mg/kg and reporting limits per gram organic carbon, respectively. EPA criteria are in units of mg/g organic carbon.

Table 4.6-17

Summary of Sediment Quality in Santa Rosa Creek (mg/kg)

Constituent	Willowside	EPA Guidelines[1]
Inorganics		
Antimony	ND (0.5)	
Arsenic	1.1	
Cadmium	0.1	
Chromium	35	
Cobalt	8	
Copper	15	
Lead	13	
Mercury	ND (0.1)	

Table 4.6-17

Summary of Sediment Quality in Santa Rosa Creek (mg/kg)

Constituent	Willowside	EPA Guidelines[1]
Nickel	50	
Silver	ND (0.1)	
Zinc	47	
Organics		
Chlorinated Dioxins and PCBs		
PCB-1016	ND (1.0)	
PCB-1248	ND (1.0)	
PCB-1254	ND (0.5)	
PCB-1260	ND (0.5)	
Semi-Volatiles		
Benzoic Acid	ND (3.0)	
Benzyl Alcohol	ND (0.70)	
Dibenzofuran	ND (0.70)	
Semi-Volatile, Organochlorines		
Aldrin	ND (0.012)	
Chlordane	ND (0.25)	
p,p’-DDD	ND (0.030)	
p,p’-DDE	ND (0.030)	
Dieldrin	ND (0.030, 0.007)[3]	0.011
Endrin	ND (0.030, 0.007)[3]	0.0042
Heptachlor	ND (0.030)	
Heptachlor epoxide	ND (0.020)	
Hexachlorobenzene	ND (0.70)	
Hexachlorobutadiene	ND (0.70)	
g-BHC (Lindane)	ND (0.012)	
a-BHC	ND (0.003)	
b-BHC	ND (0.003)	
Semi-Volatile, Organophosphates		
Methyl Parathion	ND (0.067)	
Semi-Volatile, Phenolics		
2,4-Dimethylphenol	ND (0.70)	
2-Methyl Phenol	ND (0.70)	
4-Methyl Phenol	ND (0.70)	
Pentachlorophenol	ND (3.0)	
Phenol	ND (0.70)	

Table 4.6-17

Summary of Sediment Quality in Santa Rosa Creek (mg/kg)

Constituent	Willowside	EPA Guidelines[1]
Semi-Volatile, Phthalates		
Butylbenzylphthalate	ND (0.70)	
Diethyl phthalate	ND (0.70)	
Dimethyl phthalate	ND (0.70)	
Di-n-octylphthalate	ND (0.70)	
Di-n-Butylphthalate	ND (0.70)	
Semi-Volatile, PAHs		
Acenaphthene	ND (0.70, 0.15)[3]	0.013
Acenaphthylene	ND (0.70)	
Anthracene	ND (0.70)	
Benzo(k)fluoranthene	ND (0.70)	
Benzo-a-pyrene	ND (0.70)	
Benzo(B)fluoranthene	ND (0.70)	
Benzo(g,h,i)perylene	ND (0.70)	
Chrysene	ND (0.70)	
Dibenzo (a,h)anthracene	ND (0.70)	
Fluoranthene	ND (0.70, 0.15)[3]	0.62
Fluorene	ND (0.70)	
Indeno(1,2,3-CD)pyrene	ND (0.70)	
2-Methylnaphthalene	ND (0.70)	
Naphthalene	ND (0.70)	
Phenanthrene	ND (0.70, 0.15)[3]	0.18
Pyrene	ND (0.70)	
Volatile, Aromatic & Halogenated		
1,2-Dichlorobenzene	ND (0.70)	
1,3-Dichlorobenzene	ND (0.70)	
1,2,4-Trichlorobenzene	ND (0.70)	

Source: *Sediment Quality Characterization for the Russian River, Laguna de Santa Rosa, Santa Rosa Creek, and Reclaimed Water Storage Ponds*, Merritt Smith Consulting 1996o

1. ND = concentration was below detection. Numbers in parentheses are reporting limits.
2. EPA 1993a-e. Blanks under EPA Guidelines indicate that there are no developed EPA guidelines, criteria or standards. Values given in this column are all guidelines, and guidelines are not considered enforceable by EPA.
3. Numbers in parentheses are reporting limits in mg/kg and reporting limits per gram organic carbon, respectively. EPA criteria are in units of mg/g organic carbon.

Pacific Ocean

The Pacific Ocean is approximately 35 river miles from Santa Rosa by way of the Russian River. The character of seawater in the vicinity of Bodega Bay and the Russian River is influenced by large-scale water movements in the northern Pacific Ocean. Waters from the Subarctic and North Pacific water masses are carried into the area by the southward flowing California Current. The coastal waters are cool, as might be expected considering their northern origin. The highest water temperatures usually occur in August or September, and are near 55º F. Periods of minimum water temperatures often occur in the spring, when upwelling takes place. Upwelling is a phenomenon caused by strong winds that drive surface waters away from the coast. Cold, nutrient-rich waters from the bottom of the ocean rise, replacing the surface waters. In November and December, the effects of the Davidson Current, a weak, warm, northward-flowing current, are usually felt in the area.

Localized eddies are reported to exist south of Bodega Head. Current measurements made by the National Oceanic and Atmospheric Administration, off the mouth of the Russian River and near Sea Ranch, indicate that current reversals occur frequently along an axis parallel to the coastline (EIP 1991). These data suggest that nearshore eddies are probably occurring along the Sonoma coast.

An evaluation of the circulation of water and sediments to provide baseline information in the Bodega Bay region was conducted by Bodega Research Associates. The study reached the following conclusions (EIP 1991):

- The circulation of ocean waters seaward of Bodega Bay is highly dynamic; short-term variability is superimposed over seasonal shifts in current direction and velocity. Nearshore circulation patterns are influenced by numerous factors, including seasonal and daily wind patterns, tides, and local topography.
- Water circulation within Bodega Bay undergoes rapid changes under the influence of wind and tidal forces. Under some conditions, rapid mixing of Bodega Bay waters can occur, while at other times, poor mixing conditions exist. The degree of mixing is important to the dispersion of wastewater plumes. The reasons for the high variability of mixing conditions within Bodega Bay are complex and not fully understood.
- Water and sediments exiting from the Estero Americano become entrained into the circulation of Bodega Bay. Water movement is highly variable, depending on wind and tidal influences. The Estero plume has been observed to move in all possible directions at different times from the mouth of the Estero, including north or south along the eastern coast of Bodega Bay or west into Bodega Bay. The dispersion of the Estero plume is dependent on its volume and velocity, the velocity of Bodega Bay

currents, the relative temperatures and salinities of plume and Bay waters, and the degree of wind- and wave-induced turbulence.

Water quality in the Bodega Bay region is influenced during the winter months by freshwater outflow from the Russian River, Salmon Creek, and numerous small creeks.

Beneficial uses of the Pacific Ocean include recreation, aesthetic enjoyment, navigation, industrial water supply, commercial fishing, preservation and enhancement of fish, wildlife, and other marine resources. An Area of Special Biological Significance is located at Tomales Point, at the south end of Bodega Bay. The Bodega Marine Life Refuge was designated as an Area of Special Biological Significance by the State Water Resources Control Board. The Gulf of the Farallones National Marine Sanctuary includes the waters surrounding the Farallon Islands and Point Reyes including Estero Americano and Estero de San Antonio. The Sanctuary was designated by the National Oceanic and Atmospheric Administration in 1981 (15 CFR 936). The Cordell Bank National Marine Sanctuary includes the waters surrounding the Bank approximately 20 miles west of Point Reyes, and just north of the Farallone Islands (15 CFR 922-1000).

Sebastopol

Water bodies in the Sebastopol study area include Atascadero Creek and Green Valley Creek, the Laguna de Santa Rosa, and the Russian River. The affected environment of the Laguna and the River are described in the Santa Rosa Plain/Russian River section. Water bodies of the Sebastopol study area are shown in Figure 4.6-1.

Creeks

Atascadero Creek is a tributary to Green Valley Creek, which flows to the Russian River. Both creeks drain relatively large areas west of Sebastopol. The creeks are perennial and low gradient with large stretches without vegetative canopy. Water quality in the creeks of the Sebastopol study area is generally poor and is influenced by three major contributors in the watersheds that drain the area. The contributors are wastewater discharge, agriculture and livestock, and residential development.

Wastewater Discharges

Both creeks receive secondary-treated wastewater from local treatment plants. Atascadero Creek receives wastewater from the community of Graton. Green Valley Creek receives wastewater from Forestville. Discharges to the creeks occur in the winter and directly affect water quality. In the summer reclaimed water is used for irrigation, and irrigation can potentially influence water quality if reclaimed water is overapplied. Wastewater primarily contributes nutrients and suspended solids to the creeks.

Agriculture and Livestock

Much of the land in the Sebastopol study area is used for agriculture. Orchards and crop fields drain to both creeks. These practices potentially introduce herbicides and insecticides to the creeks during rainstorms. Influences from livestock grazing and feedlots are less significant than in West County owing to the small number of ranches and dairies. However, impacts from these activities include erosion, contributions of ammonia, lower dissolved oxygen, and, potentially, water diversions.

Residential Development

Although the creeks primarily drain rural areas, influences from residences, commercial businesses, and roads exist. Influences from residential development include stormwater runoff and illegal dumping into the creeks and tributaries. These impacts potentially introduce metals, oil and grease, fertilizers, insecticides, and solvents to the creeks.

Water quality data collected in September and May 1994, and May 1995 in Atascadero Creek and Green Valley Creek are shown in Table 4.6-18. Sampling was conducted in Atascadero Creek 1/4 mile west of Highway 101 on Occidental Road and in Green Valley Creek at Green Valley Road (between Graton and Harrison Grade Road).

Table 4.6-18

Summary of Water Quality Data in Sebastopol Area Creeks
(mg/L unless otherwise noted)

Constituent	Green Valley Creek [1]	Atascadero Creek [1]
Conductivity (µmhos)	280	284
pH	7.2	7.2
Total dissolved solids	258	255
Total suspended solids	12.3	22.2
Dissolved oxygen	7.0	5.7
Temperature (°C)	15.8	16.4
Chlorophyll *a*	ND (0.01)	0.28
Ammonia - Nitrogen	0.061	0.057
Nitrate - Nitrogen	0.086	0.106
Orthophosphate - Phosphorus	0.094	0.15
Total Organic Carbon	6.7	8.3
Arsenic, dissolved	ND (0.005)	ND (0.005)
Cadmium, dissolved	ND (0.005)	ND (0.005)

Table 4.6-18

Summary of Water Quality Data in Sebastopol Area Creeks
(mg/L unless otherwise noted)

Constituent	Green Valley Creek [1]	Atascadero Creek [1]
Chromium, dissolved	ND (0.005)	ND (0.005)
Copper, dissolved	ND (0.005)	ND (0.005)
Lead, dissolved	ND (0.003)	ND (0.003)
Mercury, dissolved	ND (0.0002)	ND (0.0002)
Nickel, dissolved	0.006	0.004
Selenium, dissolved	ND (0.005)	ND (0.005)
Silver, dissolved	ND (0.001)	ND (0.001)
Zinc, dissolved	0.030	0.045

Source: *Irrigation/Storage Streams Water Quality Monitoring Results*, Merritt Smith Consulting 1996i

1. Data are averaged for three dates (5/6/94, 9/20/94, 5/25/95). Data reported below the reporting limit (ND) are shown as the detection limit.

South County

The types of waterways in the South County Project area are as follows:

- **Creeks.** Creeks flow from hills across the Petaluma Plain or historic baylands to the Petaluma River or directly to San Pablo Bay.
- **Tidal Sloughs.** Petaluma River, Sonoma Creek and Tolay Creek each have a tidal segment and associated marsh.
- **San Pablo Bay.** San Pablo Bay is part of the San Francisco Bay Delta system.

Figures 4.4-1a and 4.4-1b shows the location of South County waterways, and the water quality setting of each is described below.

Creeks

Numerous seasonal creeks flow through the Project area, and water quality has been assessed in some of these creeks, as indicated in Table 4.6-19. Water quality in the portion of these creeks that is within the Project area is influenced by adjacent land uses (e.g., dairies and agriculture), but much less so than in the West County study area. The creeks are not known to have any particular water quality problem or unusual characteristics. The data described in Table 4.6-19 were collected as described in the *Irrigation/Storage Stream Water Quality Monitoring Results* Technical Report (Merritt Smith Consulting 1996i).

Table 4.6-19

Summary of Water Quality in South County Creeks

Constituent (in mg/L unless otherwise noted)	Tolay Creek at Sears Point	Tolay Creek at Hwy 121		Lakeville Storage Site (unnamed creek)	Adobe Creek at Adobe Road	Petaluma River at Corona Road	Crane Creek at Petaluma Hill Road
Date	**May 25 1995**	**May 4 1994**	**May 24 1995**	**May 23 1995**	**May 4 1994**	**May 5 1994**	**May 4 1994**
Ammonia - Nitrogen	0.06	0.16	0.07	0.07	ND[1] (0.05)	ND (0.05)	ND (0.05)
Un-ionized Ammonia - Nitrogen							
Chlorophyll	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)	ND (0.010)
Total Dissolved Solids	450	610	480	600	260	860	260
Total Suspended Solids	5	25	4.4	11	ND (4)	4.4	ND (4)
Dissolved Oxygen		7.4			8.65	9.7	7.4
Temperature (°C)		17.9			17.9	21	17
Nitrate-Nitrogen	ND (0.03)	ND (0.03)	ND (0.03)	ND (0.03)	ND (0 .03)	0.24	1.4
Arsenic, dissolved	0.007		0.010	0.006			
Cadmium, dissolved	ND (0.0005)	ND (0.0005)[2]	ND (0.0005)	ND (0.0005)	ND (0.0005)[2]	ND (0.0005)[2]	ND (0.0005)[2]
Chromium, dissolved	ND (0.005)	ND (0.005)[2]	ND (0.005)	ND (0.005)	ND (0.005)[2]	ND (0.005)[2]	ND (0.005)[2]
Copper, dissolved	ND (0.005)	ND (0.005)[2]	ND (0.005)	ND (0.005)	ND (0.005)[2]	ND (0.005)[2]	ND (0.005)[2]
Lead, dissolved	ND (0.002)	ND (0.002)[2]	ND (0.002)	ND (0.002)	ND (0.002)[2]	ND (0.004)[2]	ND (0.002)[2]
Mercury, dissolved	ND (0.0002)		ND (0.0002)	ND (0.0002)			

Table 4.6-19

Summary of Water Quality in South County Creeks

Constituent (in mg/L unless otherwise noted)	Tolay Creek at Sears Point	Tolay Creek at Hwy 121		Lakeville Storage Site (unnamed creek)	Adobe Creek at Adobe Road	Petaluma River at Corona Road	Crane Creek at Petaluma Hill Road
Nickel, dissolved	ND (0.005)	0.015[2]	0.007	0.008	ND (0.005)[2]	0.010[2]	ND (0.005)[2]
Selenium, dissolved	ND (0.005)		ND (0.005)	ND (0.005)			
Silver, dissolved	ND (0.001)	ND (0.001)[2]	ND (0.001)	ND (0.001)	ND (0.001)[2]	ND (0.001)[2]	ND (0.001)[2]
Zinc, dissolved	0.020	ND (0.01)[2]	ND (0.01)	ND (0.01)	ND (0.01)[2]	ND (0.01)[2]	ND (0.01)[2]

Source: *Irrigation/Storage Streams Water Quality Monitoring Results*, Merritt Smith Consulting 1996i

[1] ND = concentration was below detection. Numbers in parentheses are reporting limits.
[2] Denotes total metal analyzed, not dissolved metal

Tidal Sloughs

Water quality conditions in tidal sloughs in the South County study area are influenced by freshwater inflow and, in the Petaluma River, by wastewater discharges. Freshwater inflow interacts with Bay water in the sloughs to create seasonally variable salinity conditions. In summer and fall, salinity in the sloughs is similar to that of San Pablo Bay. In winter and spring, Bay water can be completely flushed from the sloughs by high freshwater inflows or, under lower inflow conditions, Bay water may remain in the slough and mix with freshwater inflow to create brackish conditions.

The City of Petaluma discharges wastewater to the Petaluma River from December to April. The City of Petaluma treats its wastewater to the secondary stage prior to discharge; however, plans for an alternative treatment system are being considered (City of Petaluma 1994). Table 4.6-20 summarizes the quality of effluent that is discharged.

Table 4.6-20

Summary of City of Petaluma Wastewater Quality

Constituent[1]	Mean	Standard Deviation
Flow (mgd)	5.2	
Ammonia - Nitrogen	7.77	5.033
Un-ionized Ammonia - Nitrogen	0.035	0.027
Chlorophyll	0.078	0.089
TDS	705.2	182.2
Dissolved Oxygen	7.46	3.32
Temperature (°C)	11.01	3.30
Cyanide	0.012	not available
Chromium	0.0046	not available
Copper	0.020	not available
Lead	0.0044	not available
Mercury	0.0003	not available
Nickel	0.016	not available
Selenium	ND (0.005)[2]	not available
Silver	ND (0.002)[2]	not available
Zinc	0.042	not available

Source: City of Santa Rosa Technical Memorandum P8.(1990), City of Petaluma (1994)

1 All units in mg/L unless noted otherwise. Period of record: 1993 - 1994 for metals and cyanide and 1985 - April 1989 for other constituents.

2 ND = concentration was below detection. Numbers in parentheses are reporting limits.

The City of Petaluma collects water quality data in the Petaluma River in compliance with Regional Board monitoring requirements. Water quality data were also collected in the Petaluma River at the Petaluma Marina near Highway 101 by the Long-Term Project Team on 18 May 1994. Petaluma River water quality data are summarized in Table 4.6-21.

Table 4.6-21

Summary of Petaluma River Water Quality

Constituent (in mg/L unless otherwise noted)	Marina 18 May 1994[1]	Station C2-A mean/SD[2]	Station C2-B mean/SD[2]
Ammonia-Nitrogen	0.21	1.16 / 0.082	1.23 / 0.850
Un-ionized Ammonia - Nitrogen		0.0045 / 0.0032	0.0051 / 0.0036
Chlorophyll	ND (0.010)	0.014 / 0.026	0.015 / 0.029
TDS	10,000	12,242/11,896	12,905 / 12,865
Dissolved Oxygen	6.3	7.1 / 1.7	7.1 / 1.7
Temperature (°C)	18.0	11.5 / 3.9	11.4 / 3.8
Nitrate-Nitrogen	0.42	NA	NA
Cadmium, total	ND (0.0005)	NA	NA
Chromium, total	ND (0.005)	NA	NA
Copper, total	ND (0.005)	NA	NA
Lead, total	ND (0.002)	NA	NA
Nickel, total	0.010	NA	NA
Silver, total	ND (0.001)	NA	NA
Zinc, total	0.040	NA	NA

Source: City of Santa Rosa Technical Memorandum P8. (1990)

ND = concentration was below detection. Numbers in parentheses are reporting limits.
NA = Not analyzed
TDS = Total Dissolved Solids

1 Collected by HBA Team at Marina entrance near Hwy 101 bridge

2 Station locations appear in *Draft Environmental Impact Report - Petaluma Wastewater Treatment and Storage Facilities Project,* and are described as follows: C2-A is located 500 feet upstream of Petaluma discharge. C2-B is located 500 feet downstream of Petaluma discharge. Petaluma discharge location is approximately 2 miles downstream of Hwy 101 bridge.

San Pablo Bay

Water quality in San Pablo Bay is dominated by regional factors such as the Sacramento-San Joaquin River inflow and quality. San Pablo Bay is shallow, and wind-induced turbulence suspends sediment and creates turbidity. Water quality in San Pablo Bay is measured several times each year by the San Francisco Estuary Regional Monitoring Program for Trace Substances, a cooperative program managed and administered by the San Francisco Estuary Institute. Data reported in the Program's 1993 Annual Report (SFEI, 1994) from Station BD 20 are summarized in Table 4.6-22. Station BD 20 is located centrally in San Pablo Bay where mean depth is approximately 8 feet.

Table 4.6-22

Summary of Water Quality in San Pablo Bay

Constituent (in mg/L unless otherwise noted	2 March 1993	26 May 1993	15 September 1993
Ammonia-Nitrogen	0.1	0.05	0.01
Chlorophyll *a*	0.0030	0.0035	0.0023
Dissolved Oxygen	10.00	8.30	7.20
Nitrate-Nitrogen	0.4	0.3	0.2
pH (no units)	7.8	7.6	7.8
Salinity (ppt)	6.08	16.27	25.73
Temperature (°C)	12.5	18.0	20.5
Total suspended solids	7.2	190.7	58.9
Cadmium, dissolved	0.000029	0.000068	0.000092
Chromium, dissolved	0.00022	0.00019	0.00014
Copper, dissolved	0.0025	0.0019	0.0013
Lead, dissolved	0.000021	0.000006	0.000010
Mercury, dissolved	0.0000024	0.0000012	0.0000033
Nickel, dissolved	0.0037	0.0019	0.0014
Zinc, dissolved	0.00078	0.00041	0.00046

Source: San Francisco Estuary Institute Annual Report (1994)

West County

The waterways of the West County Project area addressed in this section are shown in Figures 4.4-1a, b, and c.

The types of waterways in the West County Project area are as follows:

- **Creeks**. Creeks in each of the Americano and Stemple watersheds flow from east to west, and discharge into waterways called esteros.
- **Esteros**. The two esteros in the West county area, Estero Americano and Estero de San Antonio, can be considered tidal embayments or estuaries depending on inflow from the creek. The esteros are part of the Gulf of the Farallones National Marine sanctuary.

Creeks

Water quality in Americano Creek and Stemple Creek is affected by the quality of groundwater that discharges to the creek, inputs of water and other material, and internal physical, chemical, and biological processes. Assessments of the Stemple and Americano watershed have identified manure and livestock management as major factors affecting water quality (California Coastal Commission 1987; City of Santa Rosa 1989, 1990a, d; Gold Ridge Conservation District 1995, Marin County Resources Conservation District 1994).

Manure Management

For many years, manure has been recycled onto pastures each fall. A portion of the pasture-spread manure is transported into Americano and Stemple Creeks, then into the esteros when manure application is followed by rainfall of sufficient magnitude to cause runoff. Manure decreases the dissolved oxygen in the creeks and contributes ammonia and substantial nutrients. Dissolved oxygen is required for aquatic life, and ammonia is toxic to fish and other aquatic life as pH increases above about 7.5. Data from existing studies show that conditions of ammonia toxicity and dissolved oxygen depletion are common in Americano and Stemple creeks.

Livestock Management

Livestock are not excluded from most segments of Americano and Stemple creeks. This affects water quality in three ways. First, livestock prevent development of a riparian canopy, which shades the creek to maintain cooler water. Second, livestock trample the creek bank, which accelerates bank erosion and transport of sediment downstream. Third, livestock urinate and defecate directly in or adjacent to the creeks. One cow urinating in a small creek can cause the water quality objective for ammonia to be exceeded. Livestock tend to congregate in creekbeds during summer because the cooler, moist conditions are attractive to them. Through the efforts of the Marin and Gold Ridge Resource Conservation Districts, land owner awareness has been raised, and remedial action is being taken.

Summary of Existing Water Quality Conditions

Water quality in the upper reaches of Americano and Stemple Creeks exhibits relatively little impact from agricultural practices in the watersheds. However, the effects of agricultural practices on creek water quality become more evident with increasing proximity to the Esteros. Table 4.6-23 summarizes water quality in the main stem of Americano and Stemple Creeks and tributary creeks.

Table 4.6-23

Summary of Water Quality In West County Creeks[1]
(mg/L unless otherwise noted)

	Americano Creek		Stemple Creek	
Constituent	**Main Stem**	**Tributaries**	**Main Stem**	**Tributaries**
Total dissolved solids	2027 / 290-75,000	270	697 / 280-1300	240
Turbidity (NTU)	20.2 / 3.1-93	-	44.4 / 6.3-260	-
Dissolved Oxygen	8.07 / 0.7-20	13.6	5.42 / 1.10-14	9.5
Nitrate-Nitrogen	1.00 / ND-8.70	0.43	0.967 / ND-3.10	ND (0.03)
Ammonia-Nitrogen	16.0 / ND-268	0.40	4.17 / ND-21	0.07
Un-ionized Ammonia-N	0.225 / ND-2.82	-	0.049 / ND-0.424	-
Dissolved Orthophosphate-P	2.99 / ND-13	0.17	1.60 / ND-3.70	0.03
Total Copper	0.0158 / ND-0.091	ND (0.005)	0.0086 / ND-0.026	ND (0.005)
Total Lead	0.010 / ND-0.1	ND (0.002)	0.0030 / ND-0.0073	ND (0.002)
Total Zinc	0.052 / ND-0.3	ND (0.01)	0.032 / ND-0.11	ND (0.01)
Planktonic Chlorophyll *a*	0.807 / 0.000017-16.8	0.00001	0.262 / 0.000029-0.987	ND (0.00001)

Source: *Environmental Conditions in West County Waterways* and *Irrigation/Storage Streams Water Quality Monitoring Results*, Merritt Smith Consulting 1996f, i

NTU = Nephelometric Turbidity Units

[1] The average values and the range of observed values are summarized in each cell of the table as follows: average/minimum-maximum. When the value is below the reporting limit (ND), 1/2 of the reporting limit is used for calculations. When all data are below detection, the reporting limit is shown in parentheses. Data from the main stems were collected in 1988 through 1990. Data from the tributaries were collected in May 1995.

Esteros

Estero Americano and Estero de San Antonio are tidal embayments to which Americano Creek and Stemple Creek discharge, respectively. The esteros are each several miles long and vary in width from more than 1,000 feet to just a few feet. The depth of each estero is also variable, but three to six feet at mean tide is typical. Tidal influence extends to Middle Road in Estero Americano and to Highway 1 in Estero de San Antonio. The progressive accumulation of sediment and water quality changes are documented in several key reports including California Department of Fish and Game (1977), California Coastal Commission (1988), City of Santa Rosa (1988, 1989, 1990), and Marin County Resource Conservation District (1994). This section describes the existing water quality and hydrology conditions in the esteros and key controlling factors. The esteros are part of the Gulf of the Farallones National Marine Sanctuary and the Central California Coast Biosphere Reserve.

Sand Bar

Tidal energy in the ocean controls water movement in the esteros, and thus it also controls water quality in the esteros. Sand can accumulate in the inlet of each estero as a result of wind-induced turbulence in Bodega Bay. During spring tide conditions, ebb tide flows are typically sufficient to erode the accumulated sand. If sand accumulates during a neap tide condition, outflow may be insufficient to erode the accumulated sand, and the inlet is blocked. Sand can continue to accumulate, hydraulically isolating the esteros from Bodega Bay. The sand bar may remain until rainfall runoff accumulates in the esteros behind the sand bar, then overtops and quickly cuts through the sand bar. This process does not occur every year in the esteros. The accumulation of sediment in the esteros from watershed erosion during the past 100 years has reduced the volume of tidal water moving between Bodega Bay and the esteros, which likely results in more frequent bar closure than occurred prior to sediment accumulation. Bar closure is described in Marin County Resource Conservation District (1994).

The Estero Americano bar was maintained in an open condition during the 1980s by the owners of a fish farm near the Estero Americano inlet. Manipulation of the Americano bar by the fish farm operators no longer occurs, but both bars are occasionally opened by local land owners to relieve flooding.

Mixing and Salinity

Salinity in the esteros is influenced by the amount of freshwater inflow from the creeks, the amount of tidal inflow from Bodega Bay, and evaporation. During and after a large rainfall event, freshwater inflow can flush virtually all seawater from the esteros. As inflow decreases, seawater replaces freshwater in the estero. During summers when the bar is open and freshwater inflow is negligible, evaporation leads to salinity levels in excess of seawater (hypersalinity). During summers when the bar is closed, salinity is determined by salinity at the time of bar closure, any continued inflow, and evaporation. Freshwater inflow can float on top of seawater, and if the bar closes during a period of stratification, wind mixing of the two layers also influences salinity. Hypersaline conditions have not been observed during bar-closed conditions, probably because freshwater was present when the bar closed and was retained in, rather than flushed from the esteros by tidal action.

Existing Water Quality Conditions

Table 4.6-24 summarizes the range of water quality conditions in each estero under bar-open and bar-closed conditions. A three-year study of the esteros (Merritt Smith Consulting 1996g) and other studies (Department of Fish and Game 1977, Marin County Resource Conservation District 1994) show how water quality in the esteros is affected by the quality and quantity of freshwater inflow, tidal inflow, and natural physical, chemical and biological processes that occur in the esteros. In addition to serving as a source of organic matter, manure is a source of nutrients and toxic ammonia. Dissolved oxygen is sometimes nearly depleted when organic matter, such as manure from the watershed and aquatic plants that grow in the estero, is oxidized by bacteria. Excessive growth of planktonic algae and aquatic plants, which are dependent upon the availability of nutrients such as nitrate and ammonia, is another important process that can contribute to oxygen depletion. Table 4.6-24 shows that dissolved oxygen is at times nearly depleted in the esteros, and that nitrate and ammonia are, at times, elevated.

The extreme dissolved oxygen and nutrient (including ammonia) conditions occur in the upper esteros, where the influence of creek flow is greatest. Nutrients and dissolved oxygen are much less variable in the lower end of each estero, because the sea moderates the influence of inflow from the watersheds. Copper has been found in Americano Creek at levels that exceed what is typically found in natural waters.

Table 4.6-24

Summary of Estero Water Quality
(mg/L unless otherwise noted)

	Estero Americano		Estero de San Antonio	
	Bar-Open[1]	**Bar-Closed[2]**	**Bar-Open[1]**	**Bar-Closed[2]**
Salinity (parts/thousand)	27.0 / 0-38.8		17.6 / 1.1-38	12.2 / 0.5-18.7
Turbidity (NTU)	17.6 / 1.3-120		12.7 / 2.1-51	12.3 / 2.7-52

Table 4.6-24

Summary of Estero Water Quality
(mg/L unless otherwise noted)

	Estero Americano		Estero de San Antonio	
	Bar-Open[1]	Bar-Closed[2]	Bar-Open[1]	Bar-Closed[2]
Dissolved Oxygen	8.1 / 3-16.8		8.2 / 2.1-20	10.3 / 3.2-20
Nitrate-Nitrogen	0.37 / ND-8.7		0.31 / ND-1.2	0.27 / ND-1.5
Ammonia-Nitrogen	0.60 / ND-10		0.71 / ND-3.3	0.5 / ND-2.8
Un-ionized Ammonia-N	0.004 / ND-0.046		ND	ND
Phosphate-P	0.46 / ND-3.5		0.86 / 0.24-2	1.5 / 0.58-2.2
Copper	0.0058 / ND-0.036		0.0028 / ND-0.006	0.004 / ND-0.012
Lead	0.015 / ND-0.1		0.0005 / ND-0.0007	0.0004 / ND-0.001
Zinc	0.034 / ND-0.36		0.007 / ND-0.01	0.007 / ND-0.024
Planktonic Chlorophyll *a*	0.026 / 0.000014-0.56		0.035 / 0.00083-0.242	0.062 / 0.0039-0.169

Source: *Environmental Conditions in West County Waterways*, Merritt Smith Consulting 1996g

NTU = Nephelometric Turbidity Units

1 The average values and the range of observed values are summarized in each cell of the table as follows: average/minimum-maximum.

2 No data are yet available for bar-closed conditions in Estero Americano since the bar has not been closed when water quality data were being collected.

Geysers

The Geysers Alternative will potentially affect creeks adjacent to the pipeline alignment that extends from Delta Pond north to the geysers steamfield area, and creeks in the steamfield area. Water bodies of the geysers study area are shown in Figure 4.4-1a, b, and c.

Creeks

Water quality in the creeks of the geysers study area is influenced by several types of land use in the watersheds that drain the area. Much of the land in the area is grazed for beef and dairy cattle. Influences to the water quality of creeks associated with livestock include runoff of manure, cattle wading in creeks, and erosion. Residential development may also affect the area. These influences are due to runoff of stormwater over paved and unpaved roads and through residential and commercial areas. In addition, septic systems may affect water quality. Water quality along the northern alignment of the pipeline (from Pine Flat Road north to the steamfield) is also potentially influenced by the natural soil geology, abandoned mine tailings and geothermal industry activities. Natural geology and mine tailings may introduce heavy metals into creeks. Geothermal industry activities may introduce pollutants from drilling and maintenance operations at wells, pump stations, and pipelines. Water quality is also influenced by water diversions that occur at three locations in Big Sulphur Creek from October through June.

The descriptions of the creeks in the geysers study area, in some cases, reflect only the section of those creeks near the alignment. Field observations were made as far upstream and downstream from the proposed pipeline crossings as feasible (Merritt Smith Consulting 1996p).

Existing Water Quality Conditions

Water quality has been sampled for three creeks:

- Big Sulphur Creek
- Cobb Creek
- Squaw Creek

Cobb Creek and Squaw Creek are tributary to Big Sulphur Creek, which drains to the Russian River. They are cold-water, high-gradient creeks with significant in-creek shelter and vegetative canopy. Their physical characteristics imply conditions of good water quality. Data collected from a two-year water quality monitoring study conducted in 1981 to 1983 for these creeks (McMillan 1985) are shown in Table 4.6-25. These data averages generally indicate good water quality in all three creeks relative to creeks with heavier urban and/or agricultural influences.

Table 4.6-25

Summary of Water Quality in Geysers Creeks

Constituent[1] (in mg/L unless otherwise noted)	Big Sulphur Creek BiS-26.2		Big Sulphur Creek BiS-16.1		Cobb Creek Co-0.1		Squaw Creek Sq-8.1	
	Range	Average[2]	Range	Average[2]	Range	Average[2]	Range	Average[2]
Alkalinity (as $CaCO_3$)	62-246	132	71-180	127	66-198	119	103-180	145
Aluminum	ND (0.020)-0.13	<0.081	0.21-0.95	0.50	ND (0.030)-0.25	<0.109	ND (0.030)-1.2	<0.500
Arsenic	ND (0.002-0.002)	ND (0.002)	ND (0.002)-0.020	<0.0039	ND (0.002)-0.011	<0.0028	ND (0.002-0.002)	ND (0.002)
Boron	ND (0.05)-1.4	<0.45	0.42-3.90	1.53	0.29-1.2	0.57	ND (0.05)-0.40	<0.26
Cadmium	ND (0.0005-0.001)	<0.00083	ND (0.0005-0.001)	<0.00083	ND (0.0005-0.001)	<0.00083	ND (0.0005-0.001)	<0.00083
Chromium	0.0015-.0002	<0.0018	0.0014-0.012	0.0055	ND (0.001)-0.002	<0.0014	ND (0.001)-0.0029	<0.0020
Chromium Hexavalent	ND (0.001-0.002)	<0.002	ND (0.001-0.002)	<0.002	ND (0.001-0.002)	<0.002	ND (0.001-0.002)	<0.002
Copper	0.003-0.0088	0.0053	ND (0.002)-0.005	<0.0033	ND (0.002-0.003)	<0.0023	ND (0.002)-0.006	<0.0037
Dissolved Oxygen	7.6-11.3	9.4	8.7-11.4	10.0	8.0-10.8	9.6	8.3-10.9	9.6
Conductivity (µmhos/cm)	150-570	300	185-660	391	148-395	250	215-345	287
Flow (cu ft/sec)	0.7-87.0	19.4	2.3-239.9	54.2	0.5-44.6	12.4	0.1-21.1	6.2
Hardness (as $CaCO_3$)	75-170	123	100-190	145	83-130	107	100-150	125
Iron	0.060-0.18	0.109	0.11-1.1	540	0.060-0.200	0.111	0.12-1.00	0.447

Table 4.6-25

Summary of Water Quality in Geysers Creeks

Constituent[1] (in mg/L unless otherwise noted)	Big Sulphur Creek BiS-26.2		Big Sulphur Creek BiS-16.1		Cobb Creek Co-0.1		Squaw Creek Sq-8.1	
	Range	Average[2]	Range	Average[2]	Range	Average[2]	Range	Average[2]
Lead	ND (0.01)-0.03	<0.017	ND (0.01)-0.014	<0.011	ND (0.01-0.01)	<0.010	ND (0.01)-0.017	<0.012
Manganese	0.01-0.025	0.017	ND (0.010)-0.050	<0.023	ND (0.01)-0.015	<0.012	0.010-0.049	0.026
Mercury	ND (0.00005-0.00005)	ND (0.00005)	ND (0.00005)-0.00034	<0.00007	ND (0.00005-0.00005)	ND (0.00005)	ND (0.00005-0.00005)	ND (0.00005)
Nickel	ND (0.010)-0.016	<0.013	ND (0.010)-0.031	<0.018	ND (0.010)-0.010	ND (0.01)	ND (0.010)-0.014	<0.012
Ammonia-Nitrogen	ND (0.0050)-0.54	<0.174	ND (0.050)-1.2	<0.505	ND (0.0050)-0.47	<0.111	0.037-0.27	<0.068
Un-ionized Ammonia (as NH_3)	ND (0.020-0.020)	ND (0.020)	ND (0.020)-0.040	<0.022	ND (0.020-0.020)	ND (0.020)	ND (0.020)-0.060	<0.024
Nitrate-nitrogen	ND (0.030)-1.10	<0.294	0.18-10.0	2.66	ND (0.030)-0.42	<0.197	0.058-0.41	<0.162
Orthophosphate	ND (0.001)-0.018	<0.0077	ND (0.001)-0.030	<0.0098	ND (0.001)-0.025	<0.013	ND (0.001)-0.037	<0.017
pH	7.7-8.4	8.0	7.9-8.6	8.1	7.8-8.1	8.0	7.9-8.3	8.0
Selenium	ND (0.002-0.002)	ND (0.002)	ND (0.002-0.002)	ND (0.002)	ND (0.002-0.002)	ND (0.002)	ND (0.002-0.002)	ND (0.002)
Sulfate	7.6-42.0	20.8	13.0-170.0	62.6	5.2-17.0	10.3	4.3-11.0	7.5

Table 4.6-25

Summary of Water Quality in Geysers Creeks

Constituent[1] (in mg/L unless otherwise noted)	Big Sulphur Creek BiS-26.2		Big Sulphur Creek BiS-16.1		Cobb Creek Co-0.1		Squaw Creek Sq-8.1	
	Range	Average[2]	Range	Average[2]	Range	Average[2]	Range	Average[2]
Suspended Solids)	1.0-16.0	<3.7	ND (2.0)-500.0	<51.1	1.0-580	<50.6	1.0-17.0	<4.1
Temperature (°C)	10.0-27.5	16.2	10.0-26.4	15.6	10.6-20.5	14.1	7.8-17.8	12.5
Total Organic Carbon	ND (1)-78	<10	ND (2)-37	<7	ND (1)-48	<8	1-14	<4
Turbidity (NTU)	0.25-4.2	1.28	1.2-310	31.3	0.20-380	32.57	0.20-18.0	2.98
Vanadium	ND (0.01-0.01)	ND (0.01)	ND (0.01-0.01)	ND (0.01)	ND (0.01-0.01)	ND (0.01)	ND (0.01-0.01)	ND (0.01)
Zinc	ND (0.005)-0.020	<0.014	ND (0.005)-0.018	<0.010	ND (0.005)-0.015	<0.010	0.005-0.023	0.013

Source: KGRA-ARM Program, 1982-1983 Annual Report, March 1985

NTU = Nephelometric Turbidity Unit

1. Data shown are for monthly samples were taken of all constituents except metals (3 times/year for metals, except monthly for mercury) from January 1982 through September 1983.
2. < used in report to indicate some of the values in the average were indeterminate

These creeks flow through the geysers steamfield and are subject to potential geothermal development impacts (e.g., water diversions, erosion, cooling tower drift, accidental spills of chemicals) and dissolution of minerals from natural deposits and abandoned mines. In addition, creek temperatures may be influenced by geothermal activity. For example, Little Geysers Creek (30°C) is a tributary to Big Sulphur Creek (13°C upstream, 18°C downstream) with the confluence just upstream of the pipeline crossing.

Estimated Water Quality Conditions

Creeks along the alignment that do not have measured water quality data are described based on knowledge of the area and the physical characteristics observed during field surveys. These 12 creeks can be divided into two general groups.

Creeks further north along the geyser pipeline alignment can be expected to exhibit relatively good water quality based on land use influences and physical characteristics. These creeks exist along Pine Flat Road and Chalk Hill Road and include:

- Anna Belcher Creek;
- Hurley Creek;
- Little Sulphur Creek;
- Unnamed Creek at Bear Canyon;
- Deer Creek;
- Maacama Creek (Chalk Hill Road); and
- Franz Creek (Chalk Hill Road).

These are clear, higher gradient, faster moving creeks with significant stretches of canopy that maintain lower water temperature. While all may be seasonal creeks, flows appear to be sufficient to maintain lower temperatures and higher dissolved oxygen. These creeks are not influenced by urban runoff (locations are remote) and can be expected to exhibit lower concentrations of the associated pollutants such as metals, oil, and grease. Land uses in the area include ranching and mining. Influences from mining appear to be minimal given the location and small size of the abandoned mines. Cattle have access to the creeks and their influence on water quality is unknown, however nutrients and suspended solids are potentially higher in those creeks.

Based on land uses and physical characteristics, creeks further south along the pipeline alignment (south of Highway 128) can be expected to exhibit poorer water quality. These creeks include:

- Sausal Creek;
- Hoot Owl Creek;
- Brooks Creek;

- Unnamed Creek tributary to Pool Creek; and
- Pool Creek.

These creeks are small, or wide and shallow, and probably all are seasonal. They have little if any canopy to maintain lower water temperatures. The substrate for these creeks is predominantly silt and sand indicating erosion upstream and lower velocities. In-stream shelter (root wads, emergent plants, boulders) for aquatic life is generally non-existent. All of these creeks appear influenced by cattle grazing. Grazing animals appear to have access to the creeks and banks are noticeably eroded in many areas. Urban influences from roads and nearby businesses and residences appear to impact water quality in these creeks as evidenced by the presence of trash, water diversions, and channelization.

Santa Rosa Creek and Mark West Creek are located along the proposed geysers pipeline alignment. These creeks were addressed in the Santa Rosa Plain/Russian River section.

Surface Water Quality Goals, Objectives, and Policies

Table 4.6-26 identifies goals, objectives, and policies which provide guidance for development in relation to surface water quality. The table also indicates which criteria in the Surface Water Quality Section are responsive to each set of policies.

Table 4.6-26

General Plan Goals, Objectives, and Policies - Surface Water Quality

Adopted Plan Document	Document Section	Document Numeric Reference	Policy	Relevant Evaluation Criteria[1]
Sonoma County General Plan	Resource Conservation Element	Policy RC-3d Policy RC-3e	Encourage the construction of wastewater disposal systems designed to reclaim and reuse treated wastewater on agricultural crops,and which minimizes discharges into natural waterways to protect water quality	1,2,4
Marin Countywide Plan	Environmental Quality Element	Policy EQ-2.31	Water qulity should be maintained or enhanced to promote the continued environmental health of natural waterway habitats	1,2,4

Table 4.6-26

General Plan Goals, Objectives, and Policies - Surface Water Quality

Adopted Plan Document	Document Section	Document Numeric Reference	Policy	Relevant Evaluation Criteria[1]
Santa Rosa General Plan	Open Space and Conservation Element	Goal OSC-6	Maintain high levels of water quality for human consumption and other life systems in the region	1,2,4
Petaluma General Plan	Community Health and Safety Element	Policy 38	Runoff-induced sedimentation and pollution resulting from new development and from agricultural areas should be reduced	1,2,4

Source: Harland Bartholomew and Associates, Inc. 1995

Notes:
1. The evaluation criteria are in Table 4.6-27.

EVALUATION CRITERIA WITH POINT OF SIGNIFICANCE

Potential surface water quality impacts of the Project are evaluated according to specific criteria to identify significant impacts. The evaluation criteria are numerous and are organized into those that relate to the following:

1. Numeric-based Criteria. Exceedence or non-attainment of numeric water quality objectives, criteria, standards, Basin Plan, or other policies for the protection of aquatic organisms, hereafter called criteria
2. Narrative-based Criteria. Exceedence or non-attainment of narrative water quality objectives, criteria, standards, Basin Plan, or other policies for the protection of aquatic organisms, hereafter called criteria
3. Special Sites. Any alteration of water quality in an Area of Special Biological Significance or National Marine Sanctuary.
4. Sediment Criteria. Exceedence or non-attainment of numeric sediment quality guidelines for the protection of benthic organisms

Details about the criteria are provided in the *Development of Evaluation Criteria for Potential Water Quality Impacts* Technical Report (Merritt Smith Consulting 1996f). A summary of the criteria is provided below and in Table 4.6-27.

Table 4.6-27 lists each of the 118 evaluation criteria for the protection of aquatic and benthic organisms for surface water and sediment quality that were identified in the

Development of Evaluation Criteria for Potential Water Quality Impacts Technical Report (Merritt Smith Consulting 1996f). These criteria are based on water quality regulations, objectives, and guidelines that have been developed by regulatory authorities to protect aquatic life. As described in the *Water Quality Impacts Analysis* Technical Report (Merritt Smith Consulting 1996r), the Project has the potential to cause the point of significance to be exceeded (which, if exceeded, will result in a determination that the effect is significant) in a total of 55 evaluation criteria. In the case of the 60 criteria, the analysis indicates no significant effects of any Project component could occur, and, therefore, these 60 criteria are not considered further in this EIR/EIS section. Three of the criteria are addressed in other sections or duplicative of other surface water quality evaluation criteria. Table 4.6-27 lists the 55 criteria for which significant effects could occur. Table 4.6-27 also lists each of the other 60 screened criteria; they appear in groups according to the rationale why significant effects will not occur. Table 4.6-27 also identifies the three criteria that are addressed in other sections of the EIR/EIS.

Table 4.6-27

Evaluation Criteria with Point of Significance - Surface Water Quality

Evaluation Criteria	As Measured by	Point of Significance		Justification[1]
		Fresh-water	Salt-water	
1. The Project may cause numeric-based criteria to be exceeded				
Aluminum	mg/L	0.087	none	EPA criteria
Dissolved Arsenic (all valence states)	mg/L	0.19	0.036	EPA criteria
Dissolved Cadmium	mg/L	0.0012	0.0093	EPA criteria
Dissolved Chromium III	mg/L	0.21	none	EPA criterion
Dissolved Chromium VI	mg/L	0.01	0.050	EPA criteria
Dissolved Copper	mg/L	0.013[1]	0.0024	EPA criteria
Dissolved Lead	mg/L	0.003	0.0081	EPA criteria
Total Mercury[2]	mg/L	0.0013	0.0011	EPA final chronic values
Dissolved Nickel	mg/L	0.182[3]	0.0082	EPA criteria
Total Selenium	mg/L	0.005	0.071	EPA criteria
Dissolved Silver	mg/L	0.0019[3]	0.0019	EPA criteria
Dissolved Zinc	mg/L	0.121[3]	0.081	EPA criteria
Aldrin	mg/L	0.0030	0.0013	EPA criteria
BHC-gamma (Lindane)	mg/L	0.00008	0.00016	EPA and Basin Plan criteria
Chlorinated benzenes	mg/L	0.050	0.129	EPA criteria
Chloroform	mg/L	1.24	none	EPA criteria
Dichlorobenzenes	mg/L	0.763	1.97	EPA criteria
Endosulfan-beta	mg/L	0.000056	0.0000087	EPA and Basin Plan criteria
Ethylbenzene	mg/L	32.0	0.43	EPA criteria

Table 4.6-27

Evaluation Criteria with Point of Significance - Surface Water Quality

Evaluation Criteria	As Measured by	Point of Significance: Fresh-water	Point of Significance: Salt-water	Justification[1]
Halomethanes (bromodichloromethane, bromoform, bromomethane, chloromethane, dibromochloromethane)	mg/L	11.0	6.4	EPA criteria
Heptachlor	mg/L	0.0000038	0.0000036	EPA and Basin Plan criteria
Tetrachloroethylene	mg/L	0.84	0.45	EPA criteria
Trichloronated ethanes	mg/L	18.0	none	EPA criteria
Toluene	mg/L	17.5	5.0	EPA criteria
Phthalate Esters	mg/L	0.008	0.0034	The freshwater criterion for phthalates is different from the number cited in *Development of Evaluation Criterion for Potential Water Quality Impacts* Technical Report (Merritt Smith Consulting 1996). *See Water Quality Impacts* Technical Report (Merritt Smith Consulting 1996) for explanation.
Total Ammonia-nitrogen - Sensitive Species Absent[5]	mg/L	0.76	0.90	EPA criteria (For Russian River only. For Laguna and Santa Rosa Creek see Waste Reduction Strategy)
Total Ammonia-nitrogen - Sensitive Species Present[5]	mg/L	0.76	0.90	EPA criteria (For Russian River only. For Laguna and Santa Rosa Creek see Waste Reduction Strategy)
Chloride	mg/L	230	none	EPA criterion
Conductivity	µmhos/cm	250, 285	none	Basin Plan criteria[6]. (Shown are the upper 50th percentile (median) monthly values for the Russian River above and below the Laguna, respectively)

Table 4.6-27

Evaluation Criteria with Point of Significance - Surface Water Quality

Evaluation Criteria	As Measured by	Point of Significance: Fresh-water	Point of Significance: Salt-water	Justification[1]
Cyanide	mg/L	0.0052/0.022[7]	0.001	EPA and Basin Plan criteria
Dissolved Oxygen	mg/L	5.0-10	5.0-10.0	Basin Plans criteria. (Values shown are the range of minimum, lower 50th and 90th percentiles for different water bodies)
Hydrogen sulfide	mg/L	0.002	0.002	EPA criteria
pH		6.5-8.5	6.5-8.5	EPA and Basin Plan criteria
Total dissolved solids	mg/L	150-170 170-200	none	Basin Plan criteria. (Values shown are the range for the upper 50th and 90th percentiles for the Russian River above and below the Laguna)
Phosphorus Elemental	-	Not evaluated for significance or range of impacts-	-	The EPA guideline for elemental phosphorus was developed to prevent toxicity and/or bioaccumulation of only the elemental form of phosphorus. Phosphorus in reclaimed water is primarily as phosphate which is not expected to be converted to elemental phosphorus under normal environmental conditions.
Acrylonitrile, antimony, beryllium, chlorine, iron, selenium, thallium, 1,1,2,2-tetrachloroethane, 1,1,1-trichloroethane, 1,1,2-trichloroethane, 1,2-dichloroethane, 1,2-diphenylhydrazine, 2,3,5,6-tetrachlorophenol, 2,4,6-tricholorphenol, 2,4-dichlorophenol, 2,4-dimethylphenol, 2-chlorophenol, benzene, benzidine, carbon tetrachloride, chloroalkyl ethers, chloro-4 methyl-3 phenol, chlordane, chlorinated	-	Not evaluated for significance or range of impacts-	-	These substances are not considered further in this document because they have been analyzed and not detected in reclaimed water, and the detection limit is less than the Federal and State aquatic life criteria. It is not expected that the Project will provide any other source of the substance.

Table 4.6-27

Evaluation Criteria with Point of Significance - Surface Water Quality

Evaluation Criteria	As Measured by	Point of Significance: Fresh-water	Point of Significance: Salt-water	Justification[1]
napthalenes, dichloroethylene, dichloropropane, dichloropropene, dieldrin, dinitrotoluene, endrin, endosulfan (alpha), haloethers, heptachlor epoxide, hexachlorobutadiene, hexachlorocyclopentadiene, hexachloroethane, isophorone, methoxychlor, mirex, nitrobenzene, nitrophenol, nitrosamines, PAHs, PCB's pentachlorophenol, pentachlorinated ethanes, phenol, tetrachloroethane, tributyl tin, trichloroethylene,				
Acrolein, chlorpyrifos, demeton, guthion, malathion, parathion, toxaphene[2]	-	Not evaluated for significance or range of impacts	-	These substances have been analyzed for but not detected in reclaimed water, but the current EPA-approved method provides a detection limit that is greater than the Federal and State aquatic life criteria. Aquatic Biological Resource impacts are evaluated in Section 4.10.
Alkalinity	-	Not evaluated for significance	-	The Evaluation criterion for alkalinity (20,000 µg/L) is a minimum which is always exceeded in reclaimed water. It is not predicted that the Project alternatives will cause a decrease in alkalinity in receiving waters to below the point of significance.

Table 4.6-27

Evaluation Criteria with Point of Significance - Surface Water Quality

Evaluation Criteria	As Measured by	Point of Significance: Fresh-water	Point of Significance: Salt-water	Justification[1]
Chlorophenyl 4	-	None	Not evaluated for significance or range of impacts--	Substance not analyzed for in effluent but EPA criterion (saltwater, 29.7 mg/L) is greater than the average total organic carbon in effluent (9.3 mg/L). Chlorophenyl-4 is a compound that will be detected in a total organic carbon analysis. Therefore, the concentration of chlorophenyl 4 could not exceed the point of significance.
2. The Project may cause narrative-based criteria to be exceeded				
Color	A change in apparent color lasting more than a day	0 occurrences	0 occurrences	Basin Plans narrative criterion
Floating Material	Accumulation of visible floating material, including solids, liquids, foams, film or coating, and scum	0 occurrences	0 occurrences	Basin Plans narrative criterion
Settleable Matter	mL/L	0.1 for 30-day average and 0.2 for daily maximum in Laguna plant effluent	0.1 for 30-day average and 0.2 for daily maximum in Laguna plant effluent	Basin Plans narrative criteria. Discharge permit limit used as point of significance, because the permit limit established was to protect beneficial uses.

Table 4.6-27

Evaluation Criteria with Point of Significance - Surface Water Quality

Evaluation Criteria	As Measured by	Point of Significance: Fresh-water	Point of Significance: Salt-water	Justification[1]
Biostimulatory Substances - Adverse. An increase in benthic or planktonic algae.	Benthic algae biomass and planktonic algae biomass as monthly average of chlorophyll *a*	10% increase	10% increase	Basin Plans narrative criteria. 10%, established by professional judgment, for identifying impacts on creeks. Ecological impacts on benthic or planktonic algae are also addressed by the dissolved oxygen criterion.
Biostimulatory Substances - Beneficial. A decrease in benthic or planktonic algae will be considered beneficial.	Benthic algae biomass and planktonic algae biomass as monthly average of chlorophyll *a*	10 % decrease	10% decrease	10%, established by professional judgment, for identifying impacts on creeks. Ecological impacts on benthic or planktonic algae are also addressed by the dissolved oxygen criterion.
Sediment	Suspended sediment in waterways	any increase	any increase	Basin Plans narrative criterion
Salinity. The discharge to San Pablo Bay or its tributaries may cause an increase in salinity.	ppt		any increase above background	Basin Plan narrative criterion
Temperature	°F	5 °F increase in monthly average temperature	4 °F increase in monthly average temperature in estuaries	Basin Plans narrative criteria
Turbidity - Adverse	monthly average planktonic algal biomass as chlorophyll *a*	20% increase	20% increase	Basin Plans narrative criterion. 20%, established by professional judgment, to protect visual-related beneficial uses (i.e., aesthetics and fish feeding).

Table 4.6-27

Evaluation Criteria with Point of Significance - Surface Water Quality

Evaluation Criteria	As Measured by	Point of Significance		Justification[1]
		Fresh-water	Salt-water	
Turbidity - Beneficial	monthly average planktonic algal biomass as chlorophyll *a*	20% decrease		20%, established by professional judgment, to protect visual-related beneficial uses (i.e., aesthetics and fish feeding).
Waste Reduction Strategy - Adverse a) Discharge to the Laguna may increase the concentration of ammonia. Discharge to the Laguna may cause ammonia-nitrogen load to the Laguna not to be reduced by 21,500 pounds per year	Pounds ammonia-nitrogen/year	a) If ammonia-nitrogen load in the Laguna is not reduced by 21,500 pounds per year.		This criterion applies only to the Laguna a) The North Coast Regional Water Quality Control Board Waste Reduction Strategy establishes an ammonia-nitrogen load reduction goal of 21,500 pounds per year for the Subregional System (see Table 4 in North Coast Regional Board 1995) The waste reduction strategy for ammonia was developed to bring the Laguna into attainment with EPA and Basin Plan ammonia water quality objective.
b) Discharge to the Laguna may cause total nitrogen load to the Laguna not to be reduced by 159,000 pounds per year	Pounds total nitrogen/year	b) If total nitrogen load in the Laguna is not reduced by 159,000 pounds per year.		b) The North Coast Regional Board Waste Reduction Strategy establishes a total nitrogen reduction goal of 159,000 pounds per year for the Subregional System (see Table 4 in North Coast Regional Board 1995).is the basis for the adverse impact criterion and point of significance.

Table 4.6-27

Evaluation Criteria with Point of Significance - Surface Water Quality

Evaluation Criteria	As Measured by	Point of Significance: Fresh-water	Point of Significance: Salt-water	Justification[1]
Waste Reduction Strategy - Beneficial	a) Pounds ammonia-nitrogen/year b) Pounds total nitrogen/year	a) If ammonia-nitrogen is reduced by more than 21,500 pounds per year b) If total nitrogen is reduced by more than 159,000 pounds per year		a)Exceeding the Waste Reduction Strategy goal for ammonia-nitrogen is the basis for the beneficial impact criterion . b) Exceeding the Waste Reduction Strategy goal for total nitrogen is the basis for the beneficial impact criterion
Toxicity (lethal effects)	frequency of toxic conditions	any increase	any increase	Basin Plan Criterion
Pesticides (see Aquatic Biological Resources Section 4.9) Suspended matter (addressed above with sediment and biostimulatory substances) Oil and grease (addressed above with floating material)				.
3. Special site criteria				
The Project may cause water quality change to occur in the Area of Special Biological Significance or in the Sanctuary.		Any change	Any change	Special Site Criteria
4. The Project may cause sediment quality evaluation criteria to be exceeded.				
Acenaphthene	µg/g organic carbon	130	230	EPA criteria
Dieldrin	µg/g organic carbon	11	20	EPA criteria
Endrin	µg/g organic carbon	4.2	0.76	EPA criteria

Table 4.6-27

Evaluation Criteria with Point of Significance - Surface Water Quality

Evaluation Criteria	As Measured by	Point of Significance		Justification[1]
		Fresh-water	Salt-water	
Fluoranthene	µg/g organic carbon	620	300	EPA criteria
Phenanthrene	µg/g organic carbon	180	240	EPA criteria

Source: *Development of Evaluation Criteria for Potential Water Quality Impacts*, Merritt Smith Consulting 1996f

1 Two types of justification are provided in this column: justification for further consideration and justification for no further consideration. For substances that are considered further, the justification column contains the source of the criteria that are potentially exceeded as a result of component implementation. For substances that are not considered further, the justification column states why they are not further considered.

2 EPA Final Chronic Values used because EPA criteria are based on the FDA action level for human consumption of fish. The EPA is uncertain whether the Final Chronic Values are completely protective of all fish species

3 Criteria of significance are hardness dependent. Value shown is for a hardness of 119 (average hardness of the Russian River).

4 EPA concluded that the available data on freshwater acute-chronic ratios do not allow calculation of a freshwater Final Chronic Value, but if one could be calculated it will have to be less than the 0.039 µg/L that adversely affected brook trout.

5 Criteria are temperature and pH dependent. Values shown are for 20°C and pH = 8 which reflect the long-term averages in the lower Russian River (Merritt Smith Consulting 1996n)

6 Basin Plan also has a 90th percentile criterion for conductivity which is based on all values for a calendar year. The 50th percentile upper limit point of significance for conductivity is more stringent than the 90th percentile upper limit point of significance. Therefore, compliance with the 50th percentile upper limit point of significance was evaluated.

7 EPA has established criteria to protect aquatic life against short- and long-term cyanide exposure (22 and 5.2 µg/L, respectively). 5.2 µg/L is used in this analysis to evaluate the significance of effects of component that result in long-term exposure (i.e., discharge) and 22 µg/L is used to evaluate the significance of effects of component that result in short-term exposure (i.e., pipeline rupture).

Numeric Water Quality Objectives

EPA and the Regional Boards have established numeric water quality standards, guidelines, objectives, and policies to protect aquatic life and human health. Potential human health impacts of water quality are addressed in Section 4.7 of the EIR/EIS. Typically, the water quality objectives for the protection of aquatic life were developed by EPA to protect the environment against toxicity (adverse physiological effect) and bioaccumulation (accumulation of pollutants in organisms). There are generally two numeric criteria for a given substance: one that protects aquatic life when exposed to the substance for a short time period (criterion maximum concentration or CMC) and one that protects aquatic life when exposed to the substance for a longer time period (criterion continuous concentration or CCC).

Neither the reclaimed water nor the potential receiving water exceeded any CMC for which data are available. Therefore, the points of significance for each evaluation criterion and impacts are based on CCCs. Use of the CCCs for evaluation criteria is conservative since the CCCs are usually much more stringent than the CMCs. The evaluation of impacts relative to the CCCs is described in the *Water Quality Impacts Analysis* Technical Report (Merritt Smith Consulting 1996r).

Applicable numeric water quality objectives for the protection of aquatic life are described in Table 1 of the *Development of Evaluation Criteria for Potential Water Quality Impacts* Technical Report (Merritt Smith Consulting 1996f).

A potential water quality impact is considered significant and adverse if applicable numeric water quality criteria will be exceeded as a result of the Project, or if a water quality criterion is currently being exceeded and implementation of the Project will increase the magnitude of the exceedence.

Narrative Water Quality Objectives

Narrative objectives have been established by the Regional Boards to protect beneficial uses and thus apply to receiving waters. The narrative objectives have been used as a basis for evaluation criteria. For example the North Coast Regional Board's narrative objective for floating material is:

> Waters shall not contain floating material, including solids, liquids, foams, and scum in concentrations that cause nuisance or adversely affect beneficial uses.

The corresponding evaluation criterion used in this section is:

> The Project may cause floating material, including solids, liquids, foams, and scum in concentrations that cause nuisance or adversely affect beneficial uses.

The majority of the narrative-based criteria are established to evaluate for adverse impacts. Evaluation criteria to evaluate for potential beneficial impacts have been established for Biostimulatory Substances, Turbidity and Waste Reduction Strategy.

Each of the narrative-based criteria is described in the *Development of Evaluation Criteria for Potential Water Quality Impacts* Technical Report, (Merritt Smith Consulting 1996f).

Special Sites Criteria

The Management Plan of the Gulf of the Farallones National Marine Sanctuary and the regulations (15 CFR 936) indicate that the Sanctuary was created to protect an unusual site. The policy of the Bay Regional Board regarding the State-designated Area of Special Biological Significance at Tomales Point is that no Project shall affect water quality in the Area. Therefore, a higher standard is applied to water quality impacts potentially affecting these resources. Any water quality change in the Area of Special Biological Significance or in the Sanctuary is considered significant.

Sediment Criteria

The EPA has proposed sediment quality criteria under Section 304(a) of the Clean Water Act for the following five nonionic organic chemicals: acenaphthene, dieldrin, endrin, fluoranthene, and phenanthrene. The proposed sediment quality criteria have been used to develop Project evaluation criteria.

METHODOLOGY

Surface water quality impacts were evaluated based on water quality data that characterize the receiving water environment and reclaimed water. The approach used to evaluate potential impacts from Project components that potentially affect surface water quality is described below.

Potential impacts for three components (headworks expansion, pump stations, and geysers steamfield) are not addressed in detail throughout the following section, because they will not affect surface water quality. No methodology is presented for analysis of these components.

Urban Irrigation

Section 2.2 of this EIR/EIS and the *Urban Irrigation Management Guidelines* Technical Report describe conditions under which urban irrigation will occur (Questa Engineering Corporation, Inc. 1996d). The potential for effects on surface water was evaluated based on the Project description and an assessment of potential impacts was made.

Pipelines

Potential impacts of pipeline construction and rupture on water quality were evaluated by inspecting each location where a pipeline will cross a distinct waterway. Waterways were evaluated for substrate type (which relates to erosion and sediment transport potential) and other characteristics that were used to evaluate for potential aquatic life impacts (e.g., vegetation, in-stream shelter). The results of the creek crossing surveys are reported in the *Stream Crossings Assessment* Technical Report (Merritt Smith Consulting 1996p).

Potential impacts of a pipeline rupture on water quality related to numeric criteria were evaluated by comparing undiluted reclaimed water to the appropriate numeric criteria, assuming no dilution of reclaimed water by ambient water. Due to the short duration of exposure from a pipeline rupture, the acute EPA guidelines (one hour) were used to evaluate for potential impacts. Potential impacts from pipeline construction related to narrative criteria were evaluated by considering the type of construction (jack and bore or open trench) at each crossing.

Storage Reservoirs

Storage reservoirs potentially affect surface waters by seepage of reclaimed water through soil, discharge via the spillway due to rainfall runoff, and dam failure. Seepage impacts were evaluated for each storage site by estimating the mixing of reservoir seepage with groundwater and using the groundwater and effluent quality data. This method is described in the *Water Quality and Flow Model for Irrigation/Storage Area Streams* Technical Report (Resource Management Associates 1996a).

The quality of reclaimed water that may seep from reservoirs is not necessarily the same as that described in Table 4.6-1, since biological activity in a thermally stratified storage reservoir affects reclaimed water quality. In particular, dissolved oxygen can depleted, nitrate can be converted to ammonia, and sulfur compounds can be converted to hydrogen sulfide in the bottom layer of a thermally stratified reservoir. Thermal stratification can exist from mid-spring through summer. For purposes of the surface water quality impacts analysis, maximum ammonia and hydrogen sulfide formation was assumed because ammonia is of more concern for aquatic biota than nitrate. The groundwater impacts evaluation assumed that nitrate levels in reclaimed water are not reduced by conversion to ammonia, because drinking water standards for nitrate are the primary concern for groundwater.

Agricultural Irrigation

Agricultural irrigation potentially affects surface waters through subsurface seepage with subsequent discharge (subflow). Subflow quantity and quality were characterized by estimating the mixing of irrigation-related flow and groundwater using the groundwater and effluent quality data. This method is described in the following Technical Reports:

- *Estimation of Nitrogen, Salts, Pesticides in Surface Waters* (Questa Engineering Corporation, Inc. 1996c)
- *Baseline Hydrology and Irrigation Drainage Evaluation for West and South County Reclamation Alternatives* (Questa Engineering Corporation, Inc. 1996b)
- *Estimation of Metals Concentrations in Surface and Groundwater* (Questa Engineering Corporation, Inc. 1996a)
- *Water Quality and Flow Model for Irrigation/Storage Area Streams* (Resource Management Associates 1996a)

Information about background surface and groundwater flow rates and quality, reservoir seepage rate and quality, irrigation subflow rate and quality was input to a model that was established for each watershed. The model was developed to estimate flow and water quality at key locations in the watersheds. Average flow and quality at each location was estimated for each storage option in the watershed (e.g., for Stemple watershed the storage options are Two Rock, Huntley, and no storage). The flow and quality impacts were estimated as average spring and summer conditions. The effect on surface water of irrigating lands located outside of the Tolay watershed and outside of Bay Flats area was evaluated in the *Baseline Hydrology and Irrigation Drainage Evaluation for West and South County Reclamation Alternative* (Questa Engineering Corporation, Inc. 1996b).

Bay Flats were addressed separately from other Project areas because the soils and drainage characteristics of Bay Flats soils are fundamentally different from other Project areas. Project irrigation drainage from the bay flats area will be pumped into the Petaluma River Estuary during the fall/winter season, as managed by Novato Sanitation District. This management approach and potential effects of irrigation of Bay Flats areas on surface water quality are described in *Hydrologic/Water Quality Evaluation of Irrigation of Baylands (Reyes Soils) with Reclaimed Water*, (Questa Engineering Corporation, Inc. 1996e) and *Water Quality Impact Analysis* Technical Report (Merritt Smith Consulting 1996r).

Discharge

Several different methods were used to evaluate the impacts of discharge. Impacts on water quality constituents affected by biological activity were estimated with a water quality simulation model; impacts on conservative constituents were estimated with a dilution model; impacts on waste load reduction were evaluated with a nutrient load model, and impacts on sediment quality were estimated with a partition coefficient model. These methods of impact evaluation are described in the following sections.

Constituents Affected by Biological Activity - Water Quality Simulation Model

The potential impacts of design and contingency discharge on biologically reactive constituents in the Laguna de Santa Rosa and the Russian River were evaluated using a hydraulic and water quality model (Resource Management Associates 1996b). This model was developed from the earlier adaptation of EPA's QUAL2e model by the North Coast Regional Board. North Coast Regional Board staff and other interested parties provided input to establish needs for further model refinement. The model simulates reclaimed water dilution, uptake of nutrients by planktonic and benthic algae, growth of planktonic and benthic algae, dissolved oxygen, ammonia, and temperature with different discharge scenarios.

Design discharge scenarios are described in Table 4.6-28.

Table 4.6-28

Design Discharge Scenarios

Discharge Scenarios	Receiving Water	Alternative
Discharge associated with the No Action Alternative	Laguna	Alt 1
1% design discharge	Laguna	Alt 2, Alt 3
Discharge associated with the Geysers Alternative	Laguna	Alt 4
20% design discharge	Russian River (with a small fraction discharging to the Laguna)	Alt 5A
20% design discharge	Laguna	Alt 5B

Source: Merritt Smith Consulting

Discharge scenarios are named in the above table based on the maximum design monthly average discharge rate (e.g., 20%) expressed as a percentage of Russian River flow at Hacienda Bridge. The median discharge rate is considerably less than the maximum. For example, the median discharge rate for the 1 and 20% design discharge components is 0 and 3%, respectively.

Contingency discharge is defined as the discharge of reclaimed water in excess of the design discharge rate after the education-conservation and winter irrigation contingency programs have been implemented. Contingency discharge is associated only with the 20% design discharge scenarios (River and Laguna). The *Water Balance Contingency Plan* Technical Report (Parsons Engineering Science, Inc. 1996b) shows that the 1% design discharge alternatives do not include contingency discharge. By definition, the No Action and geysers alternatives do not have contingency discharge phases.

Design Discharge

The model was run to simulate conditions for a very dry year, a very wet year, and a normal year as defined over the past 70 years of Russian River flow data available. The actual years were chosen to represent these conditions. Estimated hourly streamflows were used to represent the extreme and normal flows.

Table 4.6-29

Russian River Flows

Condition	Russian River Flows	Year
Very Dry	10th percentile	1976
Normal	50th percentile	1961
Very Wet	90th percentile	1982

The 10th percentile water year (1976) is the year in which total annual Russian River flow was less than 90% of the total annual Russian River flow values during the period of record (see Surface Hydrology section). Operations of the Subregional System, including reclaimed water design discharge, for each of the design discharge components cited above in this paragraph were based on the *Water Balance Contingency Plan* Technical Reports (Parsons Engineering Science, Inc. 1996b). Daily flow estimates for 1976, 1961, and 1982 are based on actual River flow measurements that were adjusted to reflect future diversions, consistent with the method described in the *Water Balance Contingency Plan* Technical Report (Parsons Engineering Science, Inc. 1996b).

The model simulates reclaimed water dilution, uptake of nutrients by planktonic and benthic algae, growth of planktonic and benthic algae, dissolved oxygen, temperature, and other water quality characteristics using an hourly time step. From this information, the model estimates the mean, minimum, and maximum monthly biomass of benthic and planktonic algae, temperature, dissolved oxygen concentrations, and ammonia concentrations at locations in Santa Rosa Creek, the Laguna de Santa Rosa, and the Russian River for each of the three hydrologic years. These estimates are made for baseline conditions (without design discharge) and with design discharge.

The model simulates fundamental relationships between physical (e.g., temperature, sunlight, and flow) and chemical conditions (e.g., nutrient concentrations and dissolved oxygen), and algae growth. Like most water quality models, QUAL2E was originally developed so that the rate at which various phenomena occur (e.g., flux of nutrients from sediment and nutrient uptake rate) can be adjusted to most closely represent conditions in the waterway that is the subject of the simulation. The process of fine-tuning the model to represent local conditions is called calibration.

The Laguna/Russian River model application was calibrated against measured water quality conditions in three years (fall 1992 through summer 1995). The calibration process and the comparison of estimated to observed water quality values are presented in the *Russian River Water Quality Model* Technical Report (Resource Management Associates 1996b). The calibration is considered to be very good in that the estimated water quality trends follow those of the observed values. Models are necessarily simplifications of natural systems; therefore, the model does not perfectly duplicate observed conditions. The model is a tool to evaluate the potential range of impacts of Project alternatives for which no other means of impact assessment is suitable. For example, discharge at a design rate of 20% for purposes of evaluating Project impacts is not possible because the Subregional System does not yet have sufficient flow to implement the design discharge alternative nor a discharge permit allowing them to do so.

The model output (estimated water quality conditions) is used consistent with the expected precision based on the model calibration and other model applications. Model output that is used to evaluate potential Project impacts is integrated over space and time to provide a robust indicator of water quality. The model is considered to be sufficiently precise to show differences in estimated algae biomass of 10% (which is the point of significance for the evaluation criterion for biostimulatory substances). The model is insufficiently precise to conclude that model-predicted differences in dissolved oxygen and ammonia nitrogen of less than 0.5 mg/L will actually occur. Therefore, a predicted impact on dissolved oxygen and ammonia nitrogen of less than 0.5 mg/L was considered insignificant due to insufficient model precision.

Two water quality baseline conditions were simulated using the model: existing condition and no (zero) discharge. The impact of the existing (1994) Subregional System discharge on dissolved oxygen, ammonia, algae, and temperature was estimated for each of the three hydrologic years (dry, normal, and wet). The water quality impacts of this existing condition baseline were compared to the estimated impacts of each design discharge scenario, which provided the basis for evaluating the significance of impacts of each proposed design discharge scenarios. Potential Project impacts are compared to the no discharge baseline in the *Water Quality Impacts Analysis* technical report (Merritt Smith Consulting 1996r), and not considered further in this EIR/EIS section.

Estimates of dissolved oxygen, ammonia, algae, turbidity, and temperature impacts were developed and used as follows:

- **Dissolved oxygen.** In each of the three simulation years (1976, 1961, and 1982), the monthly average dissolved oxygen concentration was calculated in the following locations:
  - The reach of Santa Rosa Creek between Delta Pond discharge and the Laguna,

- The Laguna between Santa Rosa Creek and the Russian River,
- The Russian River between the proposed discharge location above the Wohler intakes and the Laguna (SCWA reach),
- The Russian River between the Laguna and a point seven miles downstream (Hacienda reach), and
- The Russian River in the seven-mile reach below the Hacienda reach (Guerneville reach).

Table 3-1 of the North Coast Regional Board Basin Plan states that the 50th and 90th percentile objectives of 10 and 7.5 mg/L (which apply to the Laguna and Russian River) are being attained if 50 and 90% of the monthly averages are equal to or greater than the respective objectives (10 and 7.5 mg/L). The Regional Board has also established a minimum dissolved oxygen objective of 7.0 mg/L; thus if any value in the Laguna or Russian River is less than 7.0 mg/L then the water is not in attainment. The monthly average dissolved oxygen values estimated by the model were calculated in each reach to determine attainment of the objectives under the existing condition baseline and under each design discharge scenario. If the minimum, the 50th, or the 90th percentile objective was not in attainment under the existing condition baseline, then any decrease in monthly average dissolved oxygen was considered significant. If each of the dissolved oxygen objectives was attained under the existing condition baseline but the design discharge alternative caused nonattainment of the minimum, the 50th, or the 90th percentile objective, then the impact was considered significant. Model-predicted changes in dissolved oxygen of less than 0.5 mg/L were not considered significant due to model uncertainty.

- **Ammonia**. There are two ammonia criteria: a numeric criterion for protection of aquatic organisms from potential toxic effects, and a narrative criterion for ammonia load reduction. The numeric criterion applies to the Russian River and the narrative criterion applies to the Laguna and Santa Rosa Creek. Model estimates of the monthly maximum total ammonia were made for the Russian River creek reaches defined above; estimates were made for dry, normal, and wet conditions. The numeric ammonia criterion is temperature and pH dependent. To evaluate for significant impacts in the Russian River with respect to the numeric-based ammonia criterion, the monthly maximum total ammonia was compared to the criterion for the long-term average temperature and pH of the lower Russian River. Average temperatures and average pH values were obtained from data reported in the *Russian River Water Quality Monitoring Results* Technical Report (Merritt Smith Consulting 1996n). The approach used for evaluating for ammonia waste load changes (which applies only to the Laguna de Santa Rosa and Santa Rosa Creek) is described below.

- **Algae.** The monthly average algae biomass (mass per area) and plankton density (mass per water volume) were calculated by averaging all of the estimates for a particular location within a reach during the month and all the locations with a reach. Thus, the monthly average is a temporally- and spatially-averaged value.

- **Turbidity.** Turbidity in the Laguna and Russian River results from the presence of suspended sediment and algae. Suspended sediment can be derived from high storm flows and from resuspension of sediment in the river bottom. The potential impact of reclaimed water design discharge on suspended sediment is addressed in the Surface Water Hydrology section. Turbidity due to planktonic algae that results from reclaimed water design discharge was estimated using the water quality model by assuming a direct relationship of planktonic algae density to turbidity.

- **Temperature**. Average monthly temperatures were calculated in each of the reaches defined above and compared to the point of significance for temperature.

Contingency Discharge

The Daily Water Balance Model indicates that the contingency discharge is expected under only Alternatives 5A and 5B (Laguna and River Discharge alternatives). However, continuous discharge will not occur in any of the three hydrologic years in which design discharge impacts were evaluated using the Daily Water Balance Model. Therefore, the Daily Water Balance Model and water quality model was run using hydrologic conditions that will cause the contingency discharge phase to be implemented. Hydrologic data from 1977 (driest year on record) were found to produce contingency discharges of a volume and discharge rate that are considered typical of contingency discharges (Resource Management Associates 1996b), and so the water quality model was run using 1977 hydrologic conditions. Otherwise, the impacts evaluation approach was similar to that described above for design discharges. Using the daily operations simulation model, contingency discharge was estimated to occur in January, February, and April of 1977 for the Laguna and River Discharge alternatives (Alternatives 5A and 5B). Water quality impacts of contingency discharge were evaluated these three months only.

Conservative Constituents - Dilution Model

The concentration of most constituents in reclaimed water was assumed, for the purposes of water quality impacts evaluation, to be affected only by; and such constituents are considered to be conservative. Thus the effect on water quality was estimated by calculating the final concentration in the receiving water using a dilution calculation. Impacts of the proposed design discharge scenarios on constituents identified in the list of numeric-based criteria in Table 4.6-27 (except dissolved oxygen and ammonia) were evaluated using the following:

- The reclaimed water dilution estimates of the model

- Background water quality data described in the *Russian River Water Quality Monitoring Results* and the *Laguna de Santa Rosa Water Quality Monitoring Results* Technical Reports (Merritt Smith Consulting 1996j and n); and
- Effluent quality data described in the *Reclaimed Water Quality* Technical Report (Merritt Smith Consulting 1996k and l).

Impacts of the design discharge that were evaluated using the numeric-based evaluation criteria were evaluated using the 95th percentile reclaimed water concentration for the water year that contained the highest reclaimed water concentration (usually the driest year). The 95th percentile reclaimed water concentration is the daily average concentration that is estimated to be greater than 95% of all daily average values at a location in the particular water year. Thus, the evaluation of water quality impacts for significance was done under nearly worst-case conditions. In addition, the estimates are made based on existing conditions which already contains reclaimed water. Therefore, this approach is conservative.

Waste Load Reduction

The Regional Board has established a goal for the Subregional System to reduce the annual ammonia-nitrogen load to the Laguna system by 21,500 pounds per year from their 1994 estimated annual load of 56,600 pounds per year. The Regional Board has also established a goal for the Subregional System to reduce the annual total nitrogen load to the Laguna system by 159,000 pounds per year from their 1994 estimated annual load of 424,700 pounds per year. The ammonia-nitrogen and total nitrogen loads to the Laguna were estimated for each discharge scenario using a dilution model (calculated using the average annual design discharge to the Laguna multiplied by the expected concentration of total nitrogen, organic nitrogen, and ammonia-nitrogen in reclaimed water [14 mg /L, 2 mg/L, and 1 mg/L, respectively]). The estimated ammonia-nitrogen and total nitrogen loads to the Laguna for each discharge scenario were compared with the current total nitrogen and ammonia loads to the Laguna. If the load reduction did not meet or exceed the Regional Board's goal, the impact was considered to be adverse. If the load reduction exceeded the Regional Board's goal, the impact was considered to be beneficial.

Other Narrative Criteria

Impacts of the proposed design discharge scenario on the constituents addressed with the discharge-applicable narrative-based criteria for color, floating material, and settleable matter were evaluated using historical information about the occurrence of impacts from reclaimed water design discharges.

Sediment Quality Criteria

The potential impacts of design discharge on sediment in the Laguna de Santa Rosa and the Russian River were evaluated using a partition coefficient model. Using reclaimed water quality and Laguna and River background quality, the sediment concentrations were predicted for the five compounds for which sediment quality criteria exist. Details of the model are summarized in the *Sediment Quality Characterization for the Russian River, Laguna de Santa Rosa, Santa Rosa Creek, and Reclaimed Water Storage Ponds* Technical Report, (Merritt Smith Consulting 1996o).

ENVIRONMENTAL CONSEQUENCES (IMPACTS) AND RECOMMENDED MITIGATION

Potential impacts are evaluated for the four types of surface water quality criteria: numeric-based evaluation criteria, narrative-based evaluation criteria, impacts on special sites, and sediment criteria. Each impact identified as "significant" is described in this section. In contrast to other *Environmental Consequences (Impacts) and Recommended Mitigation* sections in this EIR/EIS, each less-than-significant impact and its associated criterion is not listed. The authors concluded that a listing of each of the large number of evaluation criteria (55) under each Project component will create a section of impractical length. However, the impact of each component on each criterion has been analyzed and is available in the *Water Quality Impacts Analysis* Technical Report (Merritt Smith Consulting 1996r).

The presentation of the potential impacts is organized differently than other parts of Section 4 in response to the complexity of the analysis as follows:

- A narrative description of the Project impacts is provided to help the reader identify impacts that are considered significant according to the evaluation criteria. A description of the impacts that are considered less than significant is provided in the *Water Quality Impacts Analysis* technical report (Merritt Smith Consulting 1996r).
- Only significant impacts are identified throughout Section 4.6 due to the large number of evaluation criteria. However, less-than-significant impacts in the component impact tables, are identified in cases where a significant impact on a particular constituent will result from another discharge scenario.
- A summary of Project and cumulative impacts is provided.

No Action (No Project) Alternative

Impact: **6.1.1-4. Will the No Action Alternative impact water quality based on evaluation criteria 1 through 4?**

Analysis: *Significant; Alternative 1.*

Except for the continued discharge associated with the No Action Alternative, there will be no impact on water quality. Discharge will cause significant impacts and these are described in the discharge section below. To facilitate comparison with the effects of other discharge options, impacts of the discharge component of the No Action Alternative are reported in the Discharge section below.

Mitigation: No mitigation is proposed.

Headworks Expansion Component

Impact: 6.2.1-4. Will the headworks expansion component impact water quality based on evaluation criteria 1 through 4?

Analysis: *No Impact; All Alternatives.*

The proposed pumps are inside a building and therefore will not affect surface water quality.

Alternative 1 does not have a headworks expansion component.

Mitigation: No mitigation is needed.

Urban Irrigation Component

Impact: 6.3.1-4. Will the urban irrigation component impact water quality based on evaluation criteria 1 through 4?

Analysis: *No Impact; All Alternatives.*

Urban irrigation will be conducted on lands that are currently being irrigated, and irrigation practices on these lands are such that irrigation supply is not now reaching surface waters (Questa Engineering 1996e). Measures adopted as part of the Project (see Section 2.2.1 to 2.2.7) preclude management changes upon conversion to reclaimed water for irrigation supply, without additional environmental review. Thus, adding urban irrigation land will be expected to have no impact on surface water quality.

Alternatives 1, 4, and 5 do not have an urban irrigation component.

Mitigation: No further mitigation is needed.

Pipeline Component

Pipelines cause impacts in the following ways:

- Construction. Pipeline construction techniques (both jack and bore, and open trench) have the potential to disturb soil in waterways and exceed the suspended sediment criterion. However, implementation of erosion control practices (refer to Measures 2.2.5, Avoid Sensitive Biological Resources and 2.2.10, Storm Water

Pollution Prevention Plan, adopted as part of the Project) and the temporary effects associated with construction result in less than significant impacts.

- Ruptures. Pipeline ruptures have the potential to exceed water quality criteria with the introduction of reclaimed water into waterways. An acute (short-term) criterion is applicable due to the limited exposure to reclaimed water from a rupture. Since the acute criteria are not exceeded in reclaimed water, this impact is considered less than significant.

Table 4.6-30

Surface Water Quality Impacts by Component - Pipelines

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
6.4.1. Will the pipeline component cause numeric-based criteria to be exceeded?				
All numeric criteria	Varies	No exceedence	C, O&M	❍
6.4.2. Will the pipeline component cause narrative-based criteria to be exceeded?				
All narrative criteria	Varies	No exceedence	C, O&M	❍
6.4.3. Will the pipeline component impact special sites?				
• The Project may cause water quality changes to occur in an Area of Special Biological Significance or in the Sanctuary.	Any water quality change	No change	C, O&M	==
6.4.4. Will the pipeline component cause sediment quality evaluation criteria to be exceeded?				
All sediment criteria	Varies	No exceedence	C, O&M	❍

Source: *Water Quality Impacts Analysis*, Merritt Smith Consulting 1996r

Notes: [1] Type of Impact:
C Construction
O&M Operation and Maintenance

[2] Level of Significance codes:
❍ Less than significant impact; no mitigation proposed

Impact: **6.4.1. Will the pipeline component cause numeric-based criteria to be exceeded?**

Analysis: *Less than Significant; Alternatives 2, 3, 4, and 5A.*

Measures adopted by the City as part of the Project insure that pipeline component construction will occur such that impacts are less than significant. These measures are as follows:

2.2.5. Avoid Sensitive Biological Resources.

2.2.10 Storm Water Pollution Prevention Plan.

2.2.11. Protect Creeks from Toxic Discharge.

2.2.12. Concrete Waste Management.

As described in Measure 2.2.5, two methods will be used for constructing pipelines across streams: jack and bore and open trench. Jack and bore will not disturb the streambed and will therefore not affect water quality. The open trench method will only be used in dry streambeds, and surface sediment will be preserved during construction and replaced. This procedure will prevent introduction of fine sediment (clay and silt) that can adversely affect water quality and aquatic habitat. Thus, the streambed will be restored so that, when flow occurs at the site, sediment overlying the trench will be no different than that prior to construction, and any water quality effect will be minor and short-lived (Merritt Smith Consulting 1996r). Therefore, this impact is considered less than significant.

Pipeline rupture events (described in Section 3.4) will result in the introduction of reclaimed water into local waterways for a short period (hours). Acute (short-term) criteria are applicable due to the short duration of exposure to reclaimed water from a rupture. Numeric-based evaluation criteria will not be exceeded by surface water quality impacts related to pipelines. Since the acute criteria are not exceeded in reclaimed water, this impact is considered less than significant (Merritt Smith Consulting 1996r).

No Impact; Alternatives 1 and 5B.

These alternatives do not have a pipeline component.

Mitigation: No further mitigation is proposed.

Impact: **6.4.2. Will the pipeline component cause narrative-based criteria to be exceeded?**

Analysis: *Less than Significant; Alternatives 2, 3, 4, and 5A.*

See analysis of impact 6.4.1 above.

Pipeline ruptures could cause a short-term (hours) localized water quality impact due to turbidity that results from erosion (Merritt Smith Consulting 1996r). This impact is considered to be less than significant under the narrative-based evaluation criteria due to the short duration of the impact.

No Impact; Alternatives 1 and 5B.

These alternatives do not have a pipeline component.

Mitigation: No mitigation is proposed.

Impact: 6.4.3. Will the pipeline component impact special sites?

Analysis: *No Impact; All Alternatives.*

Pipeline construction will occur in the Stemple and Americano watersheds, which are tributary to the Gulf of the Farallones National Marine Sanctuary (a special site). Several pipelines will cross waterways that are very near or within the Sanctuary (i.e., Americano Creek at Marsh Road, Estero Americano at Franklin School Road, and Ebabias Creek at Highway 1). Construction impacts at these sites would not affect water quality because the pipeline will be constructed using the jack and bore method or the pipeline will be attached to an existing bridge.

For alternatives 2 and 4, there are no special sites in watersheds affected by these alternatives. Alternatives 1 and 5B do not have a pipeline component.

Mitigation: No mitigation is needed.

Impact: 6.4.4. Will the pipeline component cause sediment quality criteria to be exceeded?

Analysis: *Less than Significant; Alternatives 2, 3, 4, and 5A.*

Sediment quality criteria will not be exceeded due to pipeline construction because sediment quality will not be affected. Pipeline rupture will not cause sediment quality criteria to be exceeded (based on the analysis of continuous reclaimed water discharge impacts on sediment quality described below in the Discharge section).

No Impact; Alternatives 1 and 5B.

These alternatives do not have a pipeline component.

Mitigation: No mitigation is proposed.

Storage Reservoir Component

Storage reservoirs impact surface water quality in the following ways:

- Seepage of stored reclaimed water through the dam and through the bottom of the reservoir. The seepage may go into the ground and then discharge into the creek at the base of the dam. The seepage may be anoxic (without any dissolved oxygen) because the reservoir will stratify during part of the year. Influence on surface water quality from dam seepage will be limited to a short section of creek immediately below the dam sites, but will be a significant impact.

- Discharge from spillways. Spillways are intended to provide for emergency release of water only in the event of watershed runoff from a severe storm or series of storms entering the reservoir when it is full. Spillway discharge (spill) are not expected to occur. If a spill does occur, reclaimed water may impact ammonia, dissolved oxygen, biostimulatory substances, and turbidity in waters below the dam. The impact will be less than significant due to dilution and the timing of overtopping. Spills will only occur during rare and very large storm events when dilution of reclaimed water within the reservoir and dilution of the spill in the receiving waters will be high. In addition, spills will only occur in winter when the concentration in reservoirs of ammonia is low and dissolved oxygen is high, receiving water turbidity is high, and response to biostimulatory substances is low.

- Construction. The impact from construction on suspended sediment or other water quality constituents will be less than significant because of implementation of erosion control practices (see Measure 2.2.5 and 2.2.10).

- Change in flow in surface waterways. The presence of a reservoir will intercept runoff and affect streamflow. The change in streamflow is expected to cause a water quality change in the esteros.

Table 4.6-31

Surface Water Quality Impacts by Component - Storage Reservoirs

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
6.5.1. Will the storage reservoir component cause numeric-based criteria to be exceeded?				
Ammonia				
• West County, Tolay, and Sears Point storage sites	> numeric criteria which are temperature and pH dependent	up to 11 mg/L	O&M C	⊙ ==

Table 4.6-31

Surface Water Quality Impacts by Component - Storage Reservoirs

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
• Other storage sites			O&M C	❍ ==
Dissolved Oxygen • West County, Tolay, and Sears Point storage sites	< 5 mg/L minimum	< 5 mg/L	O&M C	⊙ ==
• Other storage sites			O&M C	❍ ==
Hydrogen Sulfide • West County, Tolay, and Sears Point storage sites	> 2 mg/L	> 2 mg/L	O&M C	⊙ ==
• Other storage sites			O&M C	❍ ==
All other numeric criteria			O&M C	❍ ==
6.5.2. Will the storage reservoir component cause narrative-based criteria to be exceeded?			O&M C	❍ ==
6.5.3. Will the storage reservoir component impact special sites?				
Will the storage reservoir component cause water quality changes to occur in an Area of Special Biological Significance or in the Sanctuary. • West County reservoirs	Any water quality change	The concentration of water quality constituents will change	C O&M	== ●
• South County reservoirs		No Sanctuary or Area of Special Biological Significance in South County	O&M, C	==

Table 4.6-31

Surface Water Quality Impacts by Component - Storage Reservoirs

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
6.5.4. Will the storage reservoir component cause sediment quality evaluation criteria to be exceeded?				
All sediment criteria			O&M C	❍ ==

Source: *Water Quality Impacts Analysis*, Merritt Smith Consulting 1996r

Notes:
[1]. Type of Impact:
- C Construction
- O&M Operation and Maintenance

[2]. Level of Significance codes:
- ● Significant impact before and after mitigation, except for the No Action component for which the symbol represents significant impact and no mitigation is proposed
- ⊙ Significant impact before mitigation; less than significant impact after mitigation
- ❍ Less than significant impact; no mitigation proposed
- == No impact

Impact: **6.5.1. Ammonia. Will the storage reservoir component cause numeric-based criteria to be exceeded?**

Analysis: *Significant; Alternatives 2A, 2C, 2D, and 3.*

Americano Creek, Stemple Creek, and Tolay Creek Watersheds. Each of the storage reservoirs will become thermally stratified and the lower layer will quickly become anoxic (depleted of oxygen). Inorganic nitrogen will be converted to ammonia during the oxygen depletion process. Seepage from reservoirs will contain inorganic nitrogen at concentrations up to 11 mg/L in the summer. The majority of this inorganic nitrogen may be ammonia and the concentration of ammonia in waters below the storage reservoirs may be greater than the point of significance.

Less than Significant; Alternative 2B.

Watersheds of the Lakeville and Adobe Road storage sites. Seepage is not expected to reach surface water in watersheds of the Lakeville and Adobe Road storage sites because of local hydrogeological conditions (Questa Engineering Corporation, Inc. 1996b).

No Impact; Alternatives 1, 4, and 5.

These alternatives do not have a storage reservoir component.

Mitigation: *Alternatives 2A, 2C, 2D, and 3.*

2.5.3 Control Program for Hydrogen Sulfide, Ammonia, and Dissolved Oxygen

Alternatives 1, 2B, 4, and 5. No mitigation is proposed.

After Mitigation: *Less than Significant after Mitigation; Alternatives 2A, 2C, 2D, and 3.*

If ammonia is detected in the storage reservoir and the creek below the dam, a system of wells will be installed between the reservoirs and downstream receiving waters that will be operated to intercept shallow groundwater seeping from the storage site. Intercepted groundwater will be returned to the storage reservoir and, therefore, ammonia will be prevented from entering the creek below the dam.

Impact: 6.5.1. Dissolved Oxygen. Will the storage reservoir component cause numeric-based criteria to be exceeded?

Analysis: *Significant; Alternatives 2A, 2C, 2D, and 3.*

Americano Creek, Stemple Creek, and Tolay Creek Watersheds. Seepage of this lower layer of anoxic water from any of the storage reservoirs could suppress dissolved oxygen in surface waters to levels that are less than 5 mg/L (the applicable regulatory standard). Dissolved oxygen levels could remain below the standard in reaches of creek up to 120 feet below the dam.

Less than Significant; Alternative 2B

Watersheds of the Lakeville and Adobe Road storage sites. Seepage is not expected to reach surface water in watersheds of the Lakeville and Adobe Road storage sites (Questa Engineering Corporation, Inc. 1996b).

No Impact; Alternatives 1, 4, and 5.

These alternatives do not have a storage reservoir component.

Mitigation: *Alternative 2A, 2C, 2D, and 3.*

2.5.3. Control Program Hydrogen Sulfide, and Ammonia, and Dissolved Oxygen

Alternative 1, 2B, 4, and 5. No mitigation is proposed.

After Mitigation: *Less than Significant after Mitigation; Alternatives 2A, 2C, 2D, and 3.*

See discussion under Impact 6.5.1. Ammonia above.

Impact: 6.5.1. Hydrogen Sulfide. Will the storage reservoir component cause numeric-based criteria to be exceeded?

Analysis: *Significant; Alternatives 2A, 2C, 2D, and 3.*

Americano Creek, Stemple Creek, and Tolay Creek Watersheds. Seepage of this lower layer of hypolimnetic water from any of the storage reservoirs could result in hydrogen sulfide levels in excess of 2 mg/L (the applicable regulatory standard). Hydrogen sulfide levels could remain above the standard in reaches of creek up to 120 feet below the dam.

Less than Significant; Alternative 2B.

Watersheds of the Lakeville and Adobe Road storage sites. Seepage is not expected to reach surface water in watersheds of the Lakeville and Adobe Road storage sites (Questa Engineering Corporation 1996b).

No Impact; Alternatives 1, 4, and 5.

These alternatives do not have a storage reservoir component.

Mitigation: *Alternative 2A, 2C, 2D, and 3.*

2.5.3 Control Program for Hydrogen Sulfide, and Ammonia, and Dissolved Oxygen

Alternative 1, 4, and 5. No mitigation is proposed.

After Mitigation: *Less than Significant after Mitigation; Alternatives 2A, 2C, 2D, and 3.*

See discussion under Impact 6.5.1 Ammonia above.

Impact: 6.5.2. Will the storage reservoir component cause narrative-based criteria to be exceeded?

Analysis: *Less than Significant; Alternatives 2 and 3.*

As indicated in the *Water Quality Impacts Analysis* technical report (Merritt Smith Consulting 1996r), other impacts are considered to be less than significant.

No Impact; Alternatives 1, 4, and 5.

These alternatives do not have a storage reservoir component.

Mitigation: No mitigation is proposed.

Impact: 6.5.3. Will the storage reservoir component impact special sites?

Analysis: *Significant; Alternative 3.*

Seepage from storage reservoirs is expected to affect flow in West County streams, which is considered to be a significant impact under the special site criterion. West County streams flow into the esteros, which are part of the Gulf of the Farallones National Marine Sanctuary (a special site).

Impacts on water quality in the esteros are described in the Agricultural Irrigation section below.

No Impact; Alternatives 1, 2, 4, and 5.

Alternatives 1, 4, and 5 do not have a storage reservoir component. Alternative 2 does not have a storage component near special sites.

Mitigation: *Alternative 3.* No feasible mitigation has been identified, although mitigation was considered and evaluated (*see Water Quality Impacts Analysis Report, Volume I*, Merritt Smith Consulting 1996r).

Alternatives 1, 2, 4, and 5. No mitigation is needed.

Impact: 6.5.4. Will the storage reservoir component cause sediment quality criteria to be exceeded?

Analysis: *Less than Significant; Alternatives 2 and 3.*

Organic compounds for which criteria have been established are not expected to be present in storage-affected waters. Thus, the potential impact is considered to be less than significant.

No Impact; Alternatives 1, 4, and 5.

These alternatives do not have a storage reservoir component.

Mitigation: No mitigation is proposed.

Pump Station Component

Impact: 6.6.1-4. Will the pump station component impact water quality based on evaluation criteria 1 through 4?

Analysis: *No Impact; All Alternatives.*

Pump stations are not located near surface waters. Pump station construction is not expected to affect surface water quality based Measures 2.2.5 and 2.2.10, adopted as part of the Project.

Mitigation: No further mitigation is needed.

Agricultural Irrigation Component

Agricultural irrigation will impact surface water quality in the following ways:

- Accidental runoff from fields. If accidental agricultural runoff should occur, the maximum flow will be 0.1 cfs (see Hydrology section). Because of the small amount of flow and the short duration (estimated to be 12 hours), the impact on creek water quality will be less than significant.

- Agricultural irrigation percolate subflow discharging to surface waters. When irrigation percolate discharges to creeks it potentially alters the water quality of the creeks. Impacts of agricultural irrigation from the commingling of percolate and surface water are discussed in this section.

Table 4.6-32

Surface Water Quality Impacts by Component - Agricultural Irrigation

Evaluation Criteria	Point of Significance	Impact	Type of Impact[1]	Level of Significance[2]
6.7.1. Will the agricultural irrigation component cause numeric-based criteria to be exceeded? **Dissolved copper** • West County irrigation	14 μg/L	up to 15 μg/L	O&M O&M-CP	⊙ ⊙
• South County and Sebastopol irrigation		Less than 14 μg/L	O&M O&M-CP	❍ ❍
All other numeric criteria			O&M O&M-CP	❍ and ==
6.7.2. Will the agricultural component cause narrative-based criteria to be exceeded?				
All narrative criteria			O&M O&M-CP	❍ ❍
6.7.3. Will the agricultural irrigation component impact special sites?				
The Project may cause water quality changes to occur in an Area of Special Biological Significance or in the Sanctuary. • West County Irrigation	Any water quality change	The concentration of water quality constituents will be affected in the esteros	O&M O&M-CP	● ●
• South County and Sebastopol Irrigation		None	O&M	==
6.7.4. Will the agricultural irrigation component cause sediment quality evaluation criteria to be exceeded?				
All sediment criteria			O&M O&M-CP	❍ and == ❍ and ==

Source: *Water Quality Impacts Analysis*, Merritt Smith Consulting 1996r

Notes: [1]. Type of Impact:
O&M Operation and Maintenance
O&M-CP Operation and Maintenance - Contingency Plan

[2]. Level of Significance codes:
● Significant impact before and after mitigation,
⊙ Significant impact before mitigation; less than significant impact after mitigation
❍ Less than significant impact; no mitigation proposed

Impact: **6.7.1. Dissolved copper. Will the agricultural irrigation component cause numeric-based criteria to be exceeded?**

Analysis: *Significant; Alternative 3.*

Americano Creek Agricultural Irrigation Area. A combination of agricultural irrigation within the Bloomfield Valley (Bloomfield reservoir site) and operation of the Valley Ford, Carroll Road, Two Rock or Huntley reservoirs (any storage site but Bloomfield) will cause the concentration of dissolved copper in the Americano Creek tributary in the Bloomfield valley (but not Americano Creek) to exceed the point of significance. This is because more irrigation could occur at the Bloomfield storage site without a reservoir there than with the reservoir at the Bloomfield storage site. If irrigation were to occur at the Bloomfield storage site, the amount of irrigated land will be sufficiently large relative to the total area of the subwatershed (37%) that irrigation drainage will not be sufficiently diluted to avoid the exceedence.

Stemple Creek Agricultural Irrigation Area. Agricultural irrigation will cause exceedences of the point of significance for dissolved copper in Stemple Creek and in the tributaries in Huntley and Two Rock valleys, regardless of which storage site might be built.

The maximum concentration of dissolved copper predicted in both the Stemple and Americano watersheds with design agricultural irrigation is 0.015 mg/L. Assuming a hardness of 130 mg/L (the value measured in upper tributaries of both watersheds on one occasion), the point of significance for dissolved copper is 0.014 mg/L.

Winter irrigation at these sites will cause the concentration of dissolved copper in Americano Creek, the Americano Creek tributary at the Bloomfield reservoir, and the Americano Creek tributary at the Valley Ford reservoir to exceed the point of significance under some operating scenarios.

Stemple Creek Agricultural Irrigation Area. Exceedences of the point of significance for dissolved copper will occur throughout the watershed.

The maximum concentration of dissolved copper predicted in either the Stemple and Americano watersheds with contingency winter irrigation is 0.016 mg/L. Assuming a hardness of 130 mg/L, the point of significance for dissolved copper is 0.014 mg/L.

No Impact; Alternatives 1, 2, 4, and 5.

Sebastopol and South County Irrigation Areas. Extensive lands with shallow impermeable layers that will cause root zone saturation and lateral flow to surface waters generally do not occur in the Sebastopol or South County irrigation areas. Therefore, no measurable impact of summer and winter irrigation on Sebastopol or South County irrigation area lands on surface water quality is expected (Questa Engineering Corporation, Inc. 1996b).

Alternatives 1, 4, and 5 do not have an agricultural irrigation component.

Mitigation: *Alternative 3.*

2.5.2. Control program for dissolved copper.

Alternative 1, 2, 4, and 5. No mitigation is needed.

After Mitigation: *Less than Significant after Mitigation; Alternative 3.*

Americano Creek and Stemple Creek Agricultural Irrigation Areas. Winter irrigation acreage will initially be limited to 4,500 acres in the Stemple watershed. Winter irrigation will be limited to 360 acres in the subwatershed in which the Bloomfield reservoir is located. These limitations are based on assumptions that will be verified by monitoring. Creeks in the Stemple and Americano watersheds will be monitored monthly for dissolved copper and hardness. With the monitoring information, the irrigation acreage limitations can then be adjusted to a size that will prevent exceedences of the dissolved copper criterion.

The concentrations of dissolved copper in Americano and Stemple Creeks and their tributaries with irrigation were estimated using an average reclaimed water concentration of dissolved copper from 1991 through January 1995 (0.010 mg/L) (Merritt Smith Consulting 1996k). In September 1995, the Sonoma County Water Agency began balancing the pH in drinking water for the purposes of reducing corrosion in water supply pipes. Reducing corrosion of copper water supply pipes will potentially reduce the concentration of dissolved copper in reclaimed water. The concentration of copper in reclaimed water since September 1995 is 0.08 mg/L (n = 2 samples), indicating a potential long-term reduction in dissolved copper (Merritt Smith Consulting 1996l). Therefore, the concentration of dissolved copper in irrigation water may also be reduced.

Contingency irrigation in the Stemple or Americano irrigation areas will not occur prior to collection of dissolved copper and hardness data (in association with design irrigation specified above), and an evaluation of the data to calculate the appropriate contingency irrigation acreage to avoid significant impacts. Contingency irrigation of the indicated acreage could be initiated based on the results of the evaluation. Monitoring of contingency irrigation impacts should be conducted to verify the impacts analysis that is based on the post-design irrigation monitoring data.

Impact: **6.7.2. Will the agricultural irrigation component cause narrative-based criteria to be exceeded?**

Analysis: *Less than Significant; Alternatives 2 and 3.*

Measures 2.2.1, 2.2.3, 2.2.4, 2.2.5, 2.2.6, and 2.2.7 will minimize the impact of irrigation and agriculture on streams. The technical analysis (Merritt Smith Consulting 1996r), shows that sediment and nutrient loads will be reduced by the Project. Thus, attainment of narrative objectives will be enhanced by the Project. This impact is considered to be less than significant.

No Impact; Alternatives 1, 4, and 5.

Alternatives 1, 4, and 5 do not have an agricultural irrigation component.

Mitigation: No further mitigation is proposed.

Impact: **6.7.3. Salinity, ammonia, dissolved oxygen, planktonic algae, benthic algae, and metals. Will the agricultural irrigation component cause the special site criterion to be exceeded?**

Analysis: *Significant; Alternative 3.*

Americano Creek and Stemple Creek Agricultural Irrigation Areas. Salinity, ammonia, dissolved oxygen, planktonic algae, benthic algae, and metals will be affected. Other constituents, such as algal growth nutrients, individual inorganic minerals (e.g., chloride), and organic compounds (e.g., naturally occurring organic acids) will also be affected in the esteros. The analysis shows that water quality throughout much of the esteros will potentially be affected, although the magnitude of the effect is usually small. The magnitude of the effect is dependent on time of year, estero inlet condition (open vs. closed), and hydrology (e.g., wet year).

No Impact; Alternatives 1, 2, 4, and 5.

Sebastopol and South County Irrigation Areas. There are no Areas of Special Biological Significance or Sanctuaries in the Sebastopol or South County Agricultural Irrigation Areas, and so no significant impacts have been identified.

Alternatives 1, 2, 4, and 5 do not have an agricultural irrigation component.

Mitigation: *Alternative 3.* No feasible mitigation has been identified (Merritt Smith Consulting 1996r).

Alternatives 1, 2, 4, and 5. No mitigation is needed.

Impact: **6.7.4. Will the agricultural irrigation component cause sediment quality criteria to be exceeded?**

Analysis: *Less than Significant; Alternatives 2 and 3.*

Organic compounds for which criteria have been established are not expected to be present in irrigation percolate from areas irrigated with reclaimed water. Thus, the potential impact is considered to be less than significant.

No Impact; Alternatives 1, 4, and 5.

Alternatives 1, 4, and 5 do not have an agricultural irrigation component.

Mitigation: No mitigation is proposed.

Geysers Steamfield Component

Impact: **6.8.1-4. Will the geysers steamfield component impact water quality under evaluation criteria 1 through 4?**

Analysis: *No Impact; All Alternatives.*

Geysers injection will not result in discharge to surface water. Within the steamfield, all reclaimed water will be used for subsurface injection, which is discussed in Section 4.5, Groundwater.

Alternatives 1, 2, 3, and 5 do not have a geysers steamfield component.

Mitigation: No mitigation is needed.

Discharge Component

The analysis of discharge impacts involved evaluation of five discharge scenarios (see Table 4.6-28) in four waters (Santa Rosa Creek, Laguna de Santa Rosa, Russian River above the Laguna, and Russian River below the Laguna) under three different hydrologic conditions (dry, normal, and wet) for 55 constituents identified in Table 4.6-27. The analysis was necessarily complex for the sake of thoroughness.

Reclaimed water discharge impacts were evaluated using a model that simulated dilution of reclaimed water (and thus the concentration of constituents such as metals) and biological processes of algal growth, sediment uptake and release of nutrients, and dissolved oxygen. The following characteristics of reclaimed water and the receiving waters interact to produce the results predicted by the model:

- Reclaimed water quality. The quality of reclaimed water affects the quality of receiving waters such as Santa Rosa Creek, the Laguna, and the Russian River directly and indirectly. Direct impacts include the effect of reclaimed water on the concentration of a constituent in the receiving water. Some reclaimed water quality constituents, such as nitrogen, can have an indirect effect. Since algae in the receiving waters are often nitrogen limited, an increase in nitrogen loading often (though not always) produces an increase in algal growth. Toxicity and bioaccumulation are also potential indirect effects. Toxicity is addressed in this section, and bioaccumulation is addressed in Section 4.9, Aquatic Biological Resources.

- Volume of discharge. The effect of reclaimed water constituents depends in part on the amount of reclaimed water discharged relative to creek flow. As reclaimed water discharge increases, it has an increasing influence on receiving water quality. In addition, the flow resulting from the discharge can affect receiving water quality. For example, light can, at times, limit growth of benthic algae. Changes in the volume of reclaimed water discharged can change the depth of the receiving waters and thus, change light availability. For example, the reduction in discharge associated with the geysers discharge component is predicted to, in some cases, increase benthic algal growth through a reduction in creek depth and the consequent increase in light availability. Also, increased reclaimed water discharge will tend to decrease the residence time of water in the Laguna and reduce the estimated planktonic algal growth.

- River flow. The potential impacts of each Project alternative and the existing condition were simulated using the hourly river flow conditions for a dry, normal, and wet year. The potential effect of reclaimed water on receiving water quality varied substantially between types of hydrologic year because of the effect of hydrology on reclaimed water concentration, flushing, water depth, and light penetration.

- Discharge operations. The timing of discharge affects water quality impacts. For example, reclaimed water discharge during winter will have a less dramatic effect on algae than will discharge in fall or spring due to conditions of reduced light and temperature. Each discharge scenario is defined in terms of a unique set of characteristics, including storage volume, monthly storage objectives, maximum allowable discharge rate relative to river flow, hydraulic capacity of conveyance facilities such as pipes and pumps, and reclaimed water production. In addition, the simulated operation of each Project alternative differed from the simulated existing condition in that the existing condition discharge does not commence until the 1000 cfs threshold is achieved in the Russian River. No such restriction is associated with the Project alternatives (North Coast Regional Board 1994).

Significant adverse and significant beneficial impacts of discharge scenarios are described below and summarized in Table 4.6-33.

Table 4.6-33

Significant Adverse and Beneficial Impacts of Each Alternative[1] Before and After Mitigation[2]

Constituent	Santa Rosa Creek	Laguna	Russian River Below Laguna	Russian River Above Laguna
Conductivity				*5A*
Cyanide	*1*, ~~5B~~	*1*, ~~5B~~		
Dissolved Oxygen	*5B*	*5B*		
Benthic Algae				
• Adverse	*1*, 2&3, 4, 5A, 5B	*1*, 2&3, 4, 5A, 5B	*1*, 5A, 5B	5A
• Beneficial	*1*, 2&3, 4, 5A, **5B**	*1*, 2&3, 4, 5A, **5B**	*1*, 2&3, 4, 5A, **5B**	
Planktonic Algae				
• Adverse		2&3, 5A	5B	5A
• Beneficial	*1*, 5B	*1*, 5B	5A	
Turbidity				
• Adverse				~~5A~~
• Beneficial	*1*, ~~5B~~	*1*, ~~5B~~	5A	
Waste Reduction Strategy				
• Total Nitrogen				
♦ Adverse	*1*, ~~5B~~			
♦ Beneficial	2&3, 4, 5A			
• Ammonia N				
♦ Adverse	*1*, ~~5B~~		Criterion applies only to Laguna system	
♦ Beneficial	2&3, 4, 5A			
Toxicity	*1*, ~~5B~~			

Source: Section 4, *Water Quality Impacts Analysis*, Merritt Smith Consulting 1996r

1. Components causing a significant adverse or beneficial impact are shown. Overstriking indicates impact avoided with mitigation, italics indicates no mitigation proposed, bold indicates impacts that are significant after mitigation that are not significant before mitigation. Components are identified as follows:
   1 = (Alt 1) - No Action discharge scenario
   2&3 = (Alts 2&3) - 1% design discharge scenario
   4 = (Alt 4) - Geysers discharge scenario
   5A = (Alt 5A) - 20% design discharge scenario to River
   5B = (Alt 5B) - 20% design discharge scenario to Laguna
2. Mitigation of benthic algae, planktonic algae, and dissolved oxygen involves revising discharge operations to minimize discharge during fall and spring. Mitigation for waste reduction strategy (total nitrogen load and ammonia load) is to reduce nitrogen load to the Laguna at appropriate sources. Mitigation for the No Action discharge scenario (Alt 1) is not considered in this EIR/EIS.

Summary of Significant Adverse Impacts

Significant adverse impacts of reclaimed water discharge scenarios have been identified for particular constituents and are summarized in Table 4.6-33. In addition to the discharge impacts identified in Table 4.6-33, contingency discharge associated with the 20% discharge scenarios was found to have the same significant adverse impacts as the 20% design discharge scenarios except that the magnitude of algal biostimulation was reduced (because of increased flushing to reduce phytoplankton growth and increased water depth to limit benthic algal growth).

Summary of Significant Beneficial Impacts

Discharge of reclaimed water has the potential to alter water quality in a fashion that is considered beneficial under the evaluation criteria for benthic algae, planktonic algae, turbidity, and load reduction strategy criteria. In the case of benthic algae, planktonic algae, and turbidity, a discharge scenario could cause both adverse and beneficial impacts depending on month and location. For example, the 20% design discharge scenario in the Laguna could stimulate benthic algal growth in Santa Rosa Creek while simultaneously flushing the Laguna to reduce planktonic algae biomass. Significant beneficial impacts are summarized in Table 4.6-33.

Comparison of Significant Adverse and Beneficial Impacts

Criteria have been established to identify adverse and beneficial impacts for benthic algae, planktonic algae, turbidity, and waste load reduction strategy. Potential impacts of each discharge scenario were evaluated in several creek reaches during each month of each of three hydrologic years. Thus, in any particular reach during any particular month, the impact could be significant beneficial, significant adverse, or less than significant. A comparison of the number of significant adverse to the number of significant beneficial impacts shows that the 20% design discharge scenarios and the No Action Alternative generally cause more adverse than beneficial impacts. Mitigation is proposed for the 20% design discharge scenarios that results in more beneficial than adverse impacts, but mitigation has not been identified that will eliminate all potential adverse impacts.

Table 4.6-34 presents significant impacts due to discharge for each criterion.

Table 4.6-34

Surface Water Quality Impacts by Component - Discharge

		Russian River			Laguna de Santa Rosa and Santa Rosa Creek		
Evaluation Criteria	**Point of Significance[1]**	**Impact**	**Type of Impact[2]**	**Level of Signifi-cance[3]**	**Impact**	**Type of Impact[2]**	**Level of Signifi-cance[3]**
6.9.1. Will the discharge component cause numeric-based criteria to be exceeded?							
Conductivity	50th percentile (median) of monthly average in the Russian River above the Laguna> 250 µmhos/cm or 50th percentile (median) of monthly average in the Russian River below the Laguna> 285 µmhos/cm	Median monthly average values given in µmhos/cm for River above Laguna (Uppr Rvr) or below Laguna (Lwr Rvr)			Not applicable to the Laguna and Santa Rosa Creek		
• Alt 1 - No Action discharge		Uppr Rvr = no change Lwr Rvr = 272	O&M	❍			
• Alt 2 and 3 - 1% design discharge		Uppr Rvr = no change Lwr Rvr = 263	O&M	❍			
• Alt 4 - Geysers discharge		Uppr Rvr = no change Lwr Rvr = 262	O&M	❍			
• Alt 5A - 20% design discharge to the Russian River		Uppr Rvr= 265 Lwr Rvr = 272	O&M	●			
		Uppr Rvr=270 Lwr Rvr=264	O&M-CP	●			

Table 4.6-34

Surface Water Quality Impacts by Component - Discharge

		Russian River			Laguna de Santa Rosa and Santa Rosa Creek		
Evaluation Criteria	**Point of Significance[1]**	**Impact**	**Type of Impact[2]**	**Level of Signifi-cance[3]**	**Impact**	**Type of Impact[2]**	**Level of Signifi-cance[3]**
• Alt 5B - 20% design discharge to the Laguna		Uppr Rvr = no change Lwr Rvr = 277 Lwr Rvr=260	O&M O&M-CP	❍ ❍			
Cyanide • Alt 1 - No Action discharge	>0.0052 mg/L	0.0033 mg/L	O&M	❍	0.0075 mg/L	O&M	●
• Alt 2 and 3 - 1% design discharge		0.0025 mg/L	O&M	❍	0.0009 mg/L	O&M	❍
• Alt 4 - Geysers discharge		0.0025 mg/L	O&M	❍	0.0006 mg/L	O&M	❍
• Alt 5A - 20% design discharge to the Russian River		0.0033 mg/L 0.0035 mg/L	O&M O&M-CP	❍ ❍	0.0002 mg/L 0.0000 mg/L	O&M O&M-CP	❍ ❍
• Alt 5B - 20% design discharge to the Laguna		0.0036 mg/L 0.0041 mg/L	O&M O&M-CP	❍ ❍	0.0081 mg/L 0.0080 mg/L	O&M O&M-CP	⊙ ⊙

Table 4.6-34

Surface Water Quality Impacts by Component - Discharge

		Russian River			Laguna de Santa Rosa and Santa Rosa Creek		
Evaluation Criteria	**Point of Significance[1]**	**Impact**	**Type of Impact[2]**	**Level of Signifi-cance[3]**	**Impact**	**Type of Impact[2]**	**Level of Signifi-cance[3]**
Dissolved Oxygen	> 7 mg/L minimum and 10 mg/L 50^{th} percentile monthly average or any decrease if receiving water not in compliance						
• Alt 1 - No Action discharge	Upper row shows the lowest minimum monthly	8.8 mg/L, 9.5 mg/L <0.5 mg/L decrease	O&M	❍	7.0 mg/L, 8.2 mg/L <0.5 mg/L decrease	O&M	❍
• Alt 2 and 3 - 1% design discharge	average and lowest median monthly average	8.6 mg/L, 9.6 mg/L <0.5 mg/L decrease	O&M	❍	7.0 mg/L, 8.3 mg/L <0.5 mg/L decrease	O&M	❍
• Alt 4 - Geysers discharge	value of the 3 hydrologic years. Lower row shows	8.9 mg/L, 9.6 mg/L <0.5 mg/L decrease	O&M	❍	7.0 mg/L, 8.3 mg/L <0.5 mg/L decrease	O&M	❍
• Alt 5A - 20% design discharge to the Russian River	change from existing conditions.	9.0 mg/L, 9.5 mg/L <0.5 mg/L decrease	O&M	❍	7.0 mg/L, 8.3 mg/L <0.5 mg/L decrease	O&M	❍
		<0.5 mg/L decrease	O&M-CP	❍	<0.5 mg/L decrease	O&M-CP	❍

Table 4.6-34

Surface Water Quality Impacts by Component - Discharge

		Russian River			Laguna de Santa Rosa and Santa Rosa Creek		
Evaluation Criteria	**Point of Significance[1]**	**Impact**	**Type of Impact[2]**	**Level of Significance[3]**	**Impact**	**Type of Impact[2]**	**Level of Significance[3]**
• Alt 5B - 20% design discharge to the Laguna	Less than 0.5 mg/L change not considered significant.	8.8 mg/L, 9.5 mg/L <0.5 mg/L decrease	O&M	❍	7.0 mg/L, 8.2 mg/L 0.5 mg/L decrease	O&M	●
		<0.5 mg/L decrease	O&M-CP	❍	<0.5 mg/L decrease	O&M-CP	❍
All other numeric-based criteria.			C P O&M O&M-CP	❍ == ❍ ❍		C P O&M O&M-CP	❍ == ❍ ❍
6.9.2. Will the discharge component cause narrative-based criteria to be exceeded?							
Biostimulatory substances - Adverse	> 10% increase in chlorophyll *a*, monthly average	(number shown for higher of benthic algae or planktonic algae)			(number shown for higher of benthic algae or planktonic algae)		
• Alt 1 - No Action discharge		69% increase	O&M	●	134% increase	O&M	●
• Alt 2 and 3 - 1% design Discharge		<1% increase	O&M	❍	29% increase	O&M	●
• Alt 4 - Geysers		3% increase	O&M	❍	40% increase	O&M	●

Table 4.6-34

Surface Water Quality Impacts by Component - Discharge

		Russian River			Laguna de Santa Rosa and Santa Rosa Creek		
Evaluation Criteria	**Point of Significance[1]**	**Impact**	**Type of Impact[2]**	**Level of Signifi-cance[3]**	**Impact**	**Type of Impact[2]**	**Level of Signifi-cance[3]**
discharge							
• Alt 5A - 20% design discharge to the Russian River		147% increase	O&M	●	25% increase	O&M	●
		29% increase	O&M-CP	●	91% increase	O&M-CP	●
• Alt 5B - 20% design discharge to the Laguna		80% increase	O&M	●	134% increase	O&M	●
		10% increase	O&M-CP	●	27% increase	O&M-CP	●
Biostimulatory substances - Beneficial	>10% decrease in chlorophyll *a*, monthly average (from non-toxic factors)						
• Alt 1 - No Action discharge		2% decrease	O&M	❍	27% decrease	O&M	+
• Alt 2 and 3 - 1% design discharge		20% decrease	O&M	+	36% decrease	O&M	+
• Alt 4 - Geysers discharge		23% decrease	O&M	+	23% decrease	O&M	+

Table 4.6-34

Surface Water Quality Impacts by Component - Discharge

		Russian River			Laguna de Santa Rosa and Santa Rosa Creek		
Evaluation Criteria	**Point of Significance[1]**	**Impact**	**Type of Impact[2]**	**Level of Signifi-cance[3]**	**Impact**	**Type of Impact[2]**	**Level of Signifi-cance[3]**
• Alt 5A - 20% design discharge to the Russian River		34% decrease	O&M	+	33% decrease	O&M	+
		<1% decrease	O&M-CP	❍	5% decrease	O&M-CP	❍
• Alt 5B - 20% design discharge to the Laguna		2% decrease	O&M	❍/+	32% decrease	O&M	+
		<1% decrease	O&M-CP	❍	4% decrease	O&M-CP	❍/+
Turbidity - Adverse	>20% increase						
• Alt 1 - No Action discharge		8% increase	O&M	❍	3% increase	O&M	❍
• Alt 2 and 3 - 1% design Discharge		<1% increase	O&M	❍	10% increase	O&M	❍
• Alt 4 - Geysers discharge		<1% increase	O&M	❍	7% increase	O&M	❍
• Alt 5A - 20% design discharge to the Russian River		20% increase	O&M	⊙	10% increase	O&M	❍
		29% increase	O&M-CP	⊙	91% increase	O&M-CP	●
• Alt 5B - 20%		12% increase	O&M	❍	2% increase	O&M	❍

Table 4.6-34

Surface Water Quality Impacts by Component - Discharge

		Russian River			Laguna de Santa Rosa and Santa Rosa Creek		
Evaluation Criteria	**Point of Significance[1]**	**Impact**	**Type of Impact[2]**	**Level of Signifi-cance[3]**	**Impact**	**Type of Impact[2]**	**Level of Signifi-cance[3]**
dDesign discharge to the Laguna		10% increase	O&M-CP	❍	27% increase	O&M-CP	●
Turbidity -Beneficial • Alt 1 - No Action discharge	>20% decrease	2% decrease	O&M	❍	27% decrease	O&M	+/❍
• Alt 2 and 3 - 1% design Discharge		7% decrease	O&M	❍	<1% decrease	O&M	❍
• Alt 4 - Geysers discharge		7% decrease	O&M	❍	<1% decrease	O&M	❍
• Alt 5A - 20% design discharge to the Russian River		34% decrease	O&M	+	<1% decrease	O&M	❍
		<1% decrease	O&M-CP	❍	<1% decrease	O&M-CP	❍
• Alt 5B - 20% design discharge to the Laguna		2% decrease	O&M	❍	32% decrease	O&M	+/❍
		<1% decrease	O&M-CP	❍	4% decrease	O&M-CP	❍
Waste Reduction Strategy **Total Nitrogen -**	< 159,000 lb/yr total Nitrogen reduction in the Laguna	Not applicable to the Russian River					

Table 4.6-34

Surface Water Quality Impacts by Component - Discharge

		Russian River			Laguna de Santa Rosa and Santa Rosa Creek		
Evaluation Criteria	**Point of Significance[1]**	**Impact**	**Type of Impact[2]**	**Level of Signifi-cance[3]**	**Impact**	**Type of Impact[2]**	**Level of Signifi-cance[3]**
Adverse • Alt 1 - No Action discharge					252,000 lb/yr increase	O&M	●
• Alt 2 and 3 - 1% design discharge					329,000 lb/yr decrease	O&M	❍
• Alt 4 - Geysers discharge					361,000 lb/yr decrease	O&M	❍
• Alt 5A - 20% design discharge to the Russian River					352,000 lb/yr decrease	O&M	❍
• Alt 5B - 20% design discharge to the Laguna					223,000 lb/yr increase	O&M	⊙
Waste Reduction Strategy **Total Nitrogen-Beneficial** • Alt 1 - No Action discharge	>159,000 lb/yr total Nitrogen reduction in the Laguna	Not applicable to the Russian River			252,000 lb/yr increase	O&M	❍
• Alt 2 and 3 - 1% design discharge					329,000 lb/yr decrease	O&M	+
• Alt 4 - Geysers discharge					361,000 lb/yr decrease	O&M	+

Table 4.6-34

Surface Water Quality Impacts by Component - Discharge

		Russian River			Laguna de Santa Rosa and Santa Rosa Creek		
Evaluation Criteria	**Point of Significance[1]**	**Impact**	**Type of Impact[2]**	**Level of Signifi-cance[3]**	**Impact**	**Type of Impact[2]**	**Level of Signifi-cance[3]**
• Alt 5A - 20% design discharge to the Russian River					352,000 lb/yr decrease	O&M	+
• Alt 5B - 20% design discharge to the Laguna					223,000 lb/yr increase	O&M	❍/+
Waste Reduction Strategy **Ammonia-Nitrogen - Adverse**	< 21,500 lb/yr Ammonia-Nitrogen reduction in the Laguna	Not applicable to the Russian River					
• Alt 1 - No Action discharge					16,800 lb/yr decrease	O&M	●
• Alt 2 and 3 - 1% design discharge					51,000 lb/yr decrease	O&M	❍
• Alt 4 - Geysers discharge					52,900 lb/yr decrease	O&M	❍
• Alt 5A - 20% design discharge to the Russian River					52,300 lb/yr decrease	O&M	❍

Table 4.6-34

Surface Water Quality Impacts by Component - Discharge

		Russian River			Laguna de Santa Rosa and Santa Rosa Creek		
Evaluation Criteria	**Point of Significance[1]**	**Impact**	**Type of Impact[2]**	**Level of Signifi-cance[3]**	**Impact**	**Type of Impact[2]**	**Level of Signifi-cance[3]**
• Alt 5B - 20% design discharge to the Laguna					18,500 lb/yr decrease	O&M	⊙
Waste Reduction Strategy **Ammonia-Nitrogen-Beneficial** • Alt 1 - No Action discharge	>21,500 lb/yr Ammonia-Nitrogen reduction in the Laguna	Not Applicable to the Russian River			16,800 lb/yr decrease	O&M	❍
• Alt 2 and 3 - 1% design discharge					51,000 lb/yr decrease	O&M	+
• Alt 4 - Geysers discharge					52,900 lb/yr decrease	O&M	+
• Alt 5A - 20% design discharge to the Russian River					52,300 lb/yr decrease	O&M	+
• Alt 5B - 20% design discharge to the Laguna					18,500 lb/yr decrease	O&M	❍/+
Toxicity (lethal effects)	any increase in frequency above 6.1%	Evaluated in Santa Rosa Ck only, where worst-case conditions will occur					
• Alt 1 - No Action discharge					7.9% frequency	O&M	●

Table 4.6-34

Surface Water Quality Impacts by Component - Discharge

		Russian River			Laguna de Santa Rosa and Santa Rosa Creek		
Evaluation Criteria	**Point of Significance[1]**	**Impact**	**Type of Impact[2]**	**Level of Signifi-cance[3]**	**Impact**	**Type of Impact[2]**	**Level of Signifi-cance[3]**
• Alt 2 and 3 - 1% design discharge					0% frequency	O&M	❍
• Alt 4 - Geysers discharge					0% frequency	O&M	❍
• Alt 5A - 20% design discharge to the Russian River					0% frequency 0% frequency	O&M O&M-CP	❍ ❍
• Alt 5B - 20% Design discharge to the Laguna					8.4% frequency 9.0% frequency	O&M O&M-CP	⊙ ⊙
All other narrative-based criteria.			C P O&M O&M-CP	❍ == ❍ ❍		C P O&M O&M-CP	❍ == ❍ ❍
6.9.3. Special site criteria							
Will the discharge component cause water quality changes to occur in an Area of Special Biological Significance		--	--			--	--

Table 4.6-34

Surface Water Quality Impacts by Component - Discharge

		Russian River			Laguna de Santa Rosa and Santa Rosa Creek		
Evaluation Criteria	**Point of Significance[1]**	**Impact**	**Type of Impact[2]**	**Level of Signifi-cance[3]**	**Impact**	**Type of Impact[2]**	**Level of Signifi-cance[3]**
or in the Sanctuary?							
6.9.4. Will the discharge component cause sediment quality evaluation criteria to be exceeded?							
Sediment			C	❍		C	==
			P	==		P	==
			O&M	❍		O&M	❍
			O&M-CP	❍		O&M-CP	❍

Source: *Water Quality Impacts Analysis* and *Sediment Quality Characterization for the Russian River, Laguna de Santa Rosa , Santa Rosa Creek, and Reclaimed Water Storage Ponds*, Merritt Smith Consulting 1996o, r

1. As described in the *Development of Water Quality Criteria for Potential Water Quality Impacts* Technical Report, (Merritt Smith Consulting 1996f), effects of water quality on aquatic life may be significant even if water quality significance criteria are not exceeded. Water quality effects on aquatic life are described in Chapter 4.9, Aquatic Biological Resources.

2. Type of Impact:

C	Construction
O&M	Operation and Maintenance
O&M-CP	Operation and Maintenance - Contingency Plan
P	Permanent
--	Not Applicable

3. Level of Significance:

--	Not Applicable
==	No impact
❍	Less than significant impact; no mitigation proposed
⊙	Significant impact before mitigation; less than significant impact after mitigation
●	Significant impact before and after mitigation, except for the No Action component for which the symbol represents significant impact and no mitigation is proposed
❍/●	Impact less than significant before mitigation but significant after mitigation
❍/+	Impact less than significant before mitigation and beneficial after mitigation
+/❍	Impact beneficial before mitigation and less than significant after mitigation
+	Beneficial impact before and after mitigation

Impact: **6.9.1. Conductivity. Will the discharge component cause numeric-based criteria to be exceeded?**

Analysis: *Laguna and Santa Rosa Creek*

The conductivity evaluation criterion does not apply to the Laguna or Santa Rosa Creek.

Russian River

Significant; Alternative 5A.

Discharge to the Russian River may cause exceedence of the conductivity criterion in the Russian River. Conductivity is dependent upon the salt content of the water. Reclaimed water always contains more electro-conductive salts than the River, since reclaimed water derives from the River and salts are among the contaminants added as water is converted to sewage. Salts are not removed in the treatment process. Therefore, any discharge elevates the conductivity of the River. The Regional Board has established a 50th percentile water quality objective for conductivity of 250 µmhos/cm in the River above the confluence with the Laguna de Santa Rosa. This standard is the point of significance for conductivity evaluation criterion. The 50th percentile standard is met in the River currently. The attainment of the 50th percentile standard is determined using the average monthly conductivity in a calendar year. If the average monthly conductivity exceeds 250 µmhos/cm in six or more months, the River will be considered to be in non-attainment of the standard (i.e., the standard is attained if the median of twelve monthly average values is less than 250 µmhos/cm).

The 20% design discharge to the Russian River could cause conductivity in the Russian River above the Laguna to increase by as much as about 45 µmhos/cm. This estimate is conservative since lack of data in the upper River required the use of conductivity data from the Russian River below the confluence with the Laguna to estimate impacts (Merritt Smith Consulting 1996r). Since the Russian River below the confluence contains reclaimed water, conductivity in the Russian River above the confluence is likely to be lower. In some months during the discharge season that do not currently exceed the 250 µmhos/cm point of significance, this increment is sufficient to cause the average to exceed 250 µmhos/cm. The average conductivity is predicted to exceed the point of significance in nine of the twelve months.

The 20% design discharge to the Russian River with contingency discharge could cause conductivity in the Russian River above the Laguna to increase by as much as about 50 µmhos/cm. In some months during the discharge season that do not currently exceed the 250 µmhos/cm point of significance, this increment is sufficient to cause the average to exceed

250 µmhos/cm. The average conductivity is predicted to exceed the point of significance in nine of the twelve months. Thus, according to the conductivity evaluation criterion, this will be considered a significant impact.

Less than Significant; Alternatives 1, 2, 3, 4, and 5B.

These alternatives do not result in discharge to the Russian River above the Laguna, where the more stringent water quality objective of 250 µmhos/cm is applicable. These alternatives will not cause the less stringent conductivity objective of 285 µmhos/cm to be exceeded in the Russian River below the Laguna.

None of the Laguna discharge scenarios will cause the 50th percentile objective to be exceeded with contingency discharge.

Mitigation: *Alternative 5A.* No feasible mitigation has been identified.

Alternative 1, 2, 3, 4, and 5B. No mitigation is proposed.

Impact: 6.9.1. Cyanide. Will the discharge component cause numeric-based criteria to be exceeded?

Analysis: ***Operation and Maintenance***

Laguna and Santa Rosa Creek

Significant; Alternative 1 and 5B.

These discharge scenarios may cause total cyanide to exceed the water quality criterion for cyanide (0.0052 mg/L) in the Laguna and Santa Rosa Creek (Table 4.6-35). The average concentration of cyanide in reclaimed water is 0.010 mg/L, which exceeds the point of significance for cyanide and, if discharged directly, could cause significant impacts to the Laguna and Santa Rosa Creek with the No Action and 20% design discharge to the Laguna alternatives. However, reclaimed water is stored prior to discharge. Recent cyanide data collected from reclaimed water storage ponds (Delta and Meadowlane Ponds) indicate that, with storage, cyanide volatilizes and/or complexes with other compounds. The resulting total cyanide concentration in stored reclaimed water (n = 8 samples) was below detection (<0.0005 mg/L) and less than the point of significance for cyanide.

Less than Significant; Alternatives 2, 3, 4, and 5A.

None of these discharge scenarios will cause total cyanide to exceed the water quality criterion for cyanide in the Laguna or Santa Rosa Creek, even if reclaimed water is discharged directly (without storage).

Russian River

Less than Significant; All Alternatives

None of the discharge scenarios are predicted to cause total cyanide to exceed the water quality criterion for cyanide in the Russian River above or below the confluence with the Laguna.

Operation and Maintenance - Contingency Plan

Laguna and Santa Rosa Creek

Significant; Alternative 5B.

Discharge of reclaimed water under this scenario will cause the concentration of cyanide in the Laguna and/or Santa Rosa Creek to exceed the criterion for cyanide. The 95th percentile reclaimed water concentration during the driest year on record (1977) will result in an estimated cyanide concentration of 0.008 mg/L, which is greater than the 0.0052 mg/L point of significance.

Less than Significant; Alternative 5A.

The discharge scenario for Alternative 5A will not cause the concentration of cyanide in the Laguna and/or Santa Rosa Creek to exceed the criterion for cyanide.

No Impact; Alternatives 1, 2, 3, and 4.

These alternatives do not have contingency discharge.

Table 4.6-35

Effects of Unstored Design Discharge on Cyanidein the Laguna (in mg/L)

Discharge Scenarios	Effect[1,2]
Alt -1 No Project discharge	0.0075
Alt 2 & 3 - 1% Design discharge	0.0009
Alt 4 - Geysers discharge	0.0006
Alt 5A - 20% Design discharge to the Russian River	0.0002
Alt 5B - 20% Design discharge to the Laguna	0.0081

Source: *Water Quality Impacts Analysis*, Merritt Smith Consulting 1996r

Notes:
1. Value shown is for Santa Rosa Creek or the Laguna, whichever is higher.
2. Existing conditions data are not available so these numbers were calculated using a receiving water cyanide concentration of 0 mg/L, plant effluent (unstored) cyanide concentration of 0.010mg/L, and the 95th percentile reclaimed water concentration in a dry year. Data from storage ponds indicate actual discharged reclaimed water concentration will be lower than that in plant effluent.

Russian River

Less than Significant; Alternative 5.

Contingency discharge is not predicted to cause total cyanide to exceed the water quality criterion for cyanide in the Russian River above or below the confluence with the Laguna.

No Impact; Alternatives 1, 2, 3, and 4.

These alternatives do not have contingency discharge.

Mitigation: *Alternative 5B.*

2.5.6. Cyanide Monitoring and Source Control Program

Alternatives 1, 2, 3, 4, and 5A. No mitigation is proposed.

After Mitigation: *Significant; Alternative 1.*

The No Action (No Project) Alternative, by definition, does not include mitigation.

Less than Significant after Mitigation; Alternative 5B.

Monitoring will determine if source control is needed. If the concentration of cyanide in a storage pond exceeds the concentration determined to cause no impact for three consecutive samples or if the annual average cyanide concentration in a storage pond exceeds the concentration determined to cause no impact, the City shall implement a cyanide source control program.

Cyanide is known to be introduced into the Subregional System sewer at only a few locations. With implementation of the source control program, cyanide levels will be reduced to a level below significance by enforcement of limits for industrial dischargers of cyanide as needed to avoid exceeding the cyanide point of significance in receiving waters.

Impact: 6.9.1. Dissolved oxygen. Will the discharge component cause numeric-based criteria to be exceeded?

Analysis: ***Operation and Maintenance***

Laguna and Santa Rosa Creek

Significant; Alternative 5B

The Laguna is rarely in attainment of the Basin Plan objectives for dissolved oxygen. Nutrients that derive from reclaimed water and other sources (North Coast Regional Board 1995) stimulate growth of algae (see 6.9.2, Narrative-based Evaluation Criteria section below), and the increase in algae consumes dissolved oxygen at night (when no photosynthesis can occur) more rapidly than oxygen is replenished from the atmosphere. Therefore, a contribution to a reduction of dissolved oxygen on the part of the Project would be considered significant, because it will worsen an existing exceedence of the standards. The 20% discharge scenario will reduce dissolved oxygen in the Laguna and/or Santa Rosa Creek by up to 0.5 mg/L (a difference of less than 0.5 mg/L was considered insignificant due to insufficient model precision). This reduction in dissolved oxygen will be from 9.61 mg/L to 9.10 mg/L.

Less than Significant; Alternatives 1, 2, 3, 4, and 5A.

The impacts of discharge on dissolved oxygen in the Laguna and Santa Rosa Creek are less than significant for all discharge scenarios except 20% design discharge to the Laguna (see Table 4.6-36).

Table 4.6-36

Effects of Discharge on Dissolved Oxygenin the Laguna and Santa Rosa Creek (mg/L)

Discharge Scenarios	Lowest Monthly Average of 3 Hydrologic Years[1]	Lowest Median Monthly Average Value of 3 Hydrologic Years[2]	Maximum Effects Relative to Existing Conditions Baseline[3]
Alt 1 - No Action discharge	7.0	8.2	<0.5
Alt 2 & 3 - 1% Design discharge	7.0	8.3	<0.5
Alt 4 - Geysers discharge	7.0	8.3	<0.5
Alt 5A - 20% Design discharge to the Russian River	7.0	8.3	<0.5
Alt 5 B 20% Design discharge to the Laguna	7.0	8.2	0.5[4]
Existing Conditions	7.0	8.3	-

Source: *Water Quality Impacts Analysis*, Merritt Smith Consulting 1996r

1. Value shown is the lowest model predicted monthly average dissolved oxygen concentration of the three hydrologic years (normal dry, wet) for Santa Rosa Creek and the Laguna. The lowest value was identified from among 72 possible values (12 months x 3 years x 2 location).
2. Value shown is the lowest of the six median monthly average dissolved oxygen concentration (one median of 12 monthly average dissolved oxygen values for each of the hydrologic years for Santa Rosa Creek and the Laguna).
3. Value shown is the largest difference between existing monthly average dissolved oxygen concentrations and predicted monthly average dissolved oxygen for discharge scenario. The largest difference was identified from among 72 possible values (see footnote 1).
4. The maximum difference between existing monthly average dissolved oxygen and predicted monthly average dissolved oxygen with Alternative 5 B occurred in a month that was not the lowest of the three hydrologic years nor the lowest median monthly average.

Russian River

Less than Significant; All Alternatives.

The impacts of discharge on dissolved oxygen in the Russian River are less than significant because predicted dissolved oxygen concentrations for all discharge scenarios are not different from existing conditions (<0.5 mg/L difference between predicted dissolved oxygen and existing dissolved oxygen).

Operation and Maintenance - Contingency Plan

Laguna and Santa Rosa Creek

Less than Significant; Alternatives 5.

The impacts of contingency discharge on dissolved oxygen in the Laguna and Santa Rosa Creek are less than significant.

No Impact; Alternatives 1, 2, 3, and 4.

These alternatives are not expected to have a contingency discharge.

Russian River

Less than Significant; Alternative 5.

The impacts of contingency discharge on dissolved oxygen in the Russian River are less than significant.

No Impact; Alternatives 1, 2, 3, and 4.

These alternatives are not expected to have a contingency discharge.

Mitigation: *Alternative 5B.* No feasible mitigation has been identified.

Alternatives 1, 2, 3, 4, and 5B. No mitigation is proposed.

Impact: 6.9.1. Acrolein, chlorpyrifos, demeton, guthion (azinphos-methyl), malathion, parathion, and toxaphene. Will discharge scenario cause numeric-based criteria to be exceeded?

Analysis: *Laguna, Santa Rosa Creek, and Russian River*

Less than Significant; All Alternatives.

These substances are not detectable in reclaimed water but the detection limit is greater than the evaluation criterion. Recognized analytical methods that are routinely available to wastewater discharges do not provide sufficiently low detection limits to evaluate attainment of EPA’s water quality standard. This impact is considered less than significant, but mitigation is required to assure that periodic monitoring for these substances is conducted.

Mitigation: *All Alternatives.*

2.5.1. Control program for pesticides

After Mitigation: *Less than Significant; All Alternatives.*

If these constituents are found to exceed water quality criteria, a source identification and control program shall be implemented by the City within 30 days to reduce or avoid impacts.

Impact: 6.9.2. Biostimulatory Substances - Adverse. Will the discharge component cause narrative-based criteria to be exceeded?

Analysis: ***Operation and Maintenance***

Laguna and Santa Rosa Creek

Significant; All Alternatives.

The discharge scenarios may cause up to a 134 percent increase in monthly average benthic algae biomass and up to a ten percent increase in monthly average planktonic algae biomass for one or more months of the year in the Laguna and/or Santa Rosa Creek (see Table 4.6-37).

Russian River

Significant; Alternatives 1, 5A, 5B.

These discharges may cause up to a 147% increase in monthly average benthic algae biomass and up to a 20% increase in monthly average planktonic algae biomass in the Russian River during one or more months of the year (see Table 4.6-38).

Less than Significant; Alternatives 2, 3, and 4.

Table 4.6-38 shows that the effect of Alternatives 2, 3 and 4 on algae in the Russian River is less than the point of significance (greater than 10% biomass increase).

Operation and Maintenance - Contingency Plan

Laguna and Santa Rosa Creek

Significant; Alternative 5.

Monthly average benthic algae biomass may increase by as much as 26% and monthly average planktonic algae biomass may increase by as much as 27% in the Laguna and/or Santa Rosa Creek during the period of contingency discharge. Contingency discharge does not increase the magnitude of the exceedence that will occur as a result of the design discharge alone. Table 4.6-39 summarizes the impact of contingency discharge on algal biomass relative to that of design discharge alone.

No Impact; Alternatives 1, 2, 3, and 4.

These alternatives do not have contingency discharge.

Table 4.6-37

Maximum Adverse Effects on Algæ Biomass (as a measure of Biostimulatory Substances) from Discharge - Laguna and Santa Rosa Creek[1]

Discharge Scenarios	Benthic Algae	Planktonic Algae
Alt 1- No Action discharge	134%	3%
Alt 2 & 3 - 1% Design discharge	29%	10%
Alt 4 - Geysers discharge	40%	7%
Alt 5A - 20% Design discharge to the River	25%	10%
Alt 5B - 20% Design discharge to the Laguna	134%	2%

Source: *Water Quality Impacts Analysis*, Merritt Smith Consulting 1996r

Notes:
1. Value shown is for Santa Rosa Creek or the Laguna, whichever is higher

Table 4.6-38

Maximum Adverse Effects on Algæ Biomass (as a measure of Biostimulatory Substances) from Discharge - Russian River

Discharge Scenarios	Benthic Algae	Planktonic Algae
Alt 1 - No Action discharge	69%	8%
Alt 2 & 3 - 1% Design discharge	<1%	<1%
Alt 4 - Geysers discharge	3%	<1%
Alt 5A - 20% Design discharge to the River		
River above the Laguna	147%	20%
River below the Laguna	47%	<1%
Alt 5B - 20% Design discharge to the Laguna	80%	12%

Source: *Water Quality Impacts Analysis*, Merritt Smith Consulting 1996r

Table 4.6-39

Maximum Adverse Effects on Algæ Biomass from Contingency Discharge[1] - Laguna and Santa Rosa Creek

	Benthic Algae		Planktonic Algae	
Discharge Scenarios	**Design + Contingency Discharge**	**Design Discharge Alone[2]**	**Design + Contingency Discharge**	**Design Discharge Alone[2]**
Alt 5A - 20% Design discharge to the River	26%	26%	91%	91%
Alt 5B - 20% Design discharge to the Laguna	4%	5%	27%	35%

Source: *Water Quality Impacts Analysis,* Merritt Smith Consulting 1996r

Notes:
1. Value shown is for Santa Rosa Creek or the Laguna, whichever is higher
2. Values represent estimated impact in a very low flow year that will cause contingency discharge. The values in Table 4.6-37 represent estimated impact in years of less extreme flow conditions. Therefore, values in Table 4.6-37 and Table 4.6-39 are not necessarily the same.

Russian River

Significant; Alternative 5.

Monthly average benthic algae biomass may increase by as much as 22% in the Russian River during the period of contingency discharge. Monthly average planktonic algae biomass may increase by as much as 29% in the Laguna during the period of contingency discharge. Contingency discharge does not substantially increase the magnitude of the exceedence that will occur as a result of the design discharge alone. Table 4.6-40 summarizes the impact of contingency discharge on algal growth relative to that of design discharge alone. Table 4.6-40 addresses only 20% discharge scenarios because these are the only scenarios that include contingency discharge.

No Impact; Alternatives 1, 2, 3, and 4.

These alternatives do not have contingency discharge.

Table 4.6-40

Maximum Adverse Effects on Algæ Biomass from Contingency Discharge - Russian River

	Benthic Algae		Planktonic Algae	
Discharge Scenarios	**Design + Contingency Discharge**	**Design Discharge Alone[1]**	**Design + Contingency Discharge**	**Design Discharge Alone[1]**
Alt 5A - 20% Design discharge to the River				
River above the Laguna	22%	22%	29%	25%
River below the Laguna	5%	6%	5%	6%
Alt 5B - 20% Design discharge to the Laguna	5%	6%	10%	13%

Source: *Water Quality Impacts Analysis*, Merritt Smith Consulting 1996r

1. Values represent estimated impact in a very low flow year that will cause contingency discharge. The values in Table 4.6-38 represent estimated impact in years of less extreme flow conditions. Therefore, values in Table 4.6-38 and Table 4.6-40 are not necessarily the same.

Mitigation: *All Alternatives.*

2.5.4. Discharge Operations.

After Mitigation: *Significant; Alternative 1.*

The No Action (No Project) Alternative by definition, does not include mitigation.

Significant after Mitigation; Alternatives 2 and 5.

The Mitigation Discharge Operating Scenario will reduce the frequency of significant adverse impacts of biostimulatory substances for all alternatives except the 1% discharge scenario. Mitigation increases the frequency of beneficial impacts of biostimulatory substances for all discharge scenarios except the No Action alternative (for which no mitigation is proposed). Secondary impacts of this mitigation measure will occur for turbidity, dissolved oxygen, and the Waste Reduction Strategy - some beneficial and some adverse. The following text describes the effectiveness of the Mitigation Discharge Operating Scenario.

Table 4.6-41 shows the number of exceedences of points of significance for adverse benthic algae, planktonic algae, turbidity, and dissolved oxygen impacts that are potentially caused by each discharge scenario expressed as a percentage of the total number of scenarios that have been analyzed. For example, the 1% design discharge scenario will cause exceedence of the benthic algae point of significance in 4 of 108 cases (4%). The number of scenarios equals creek segments times hydrologic conditions times 12 months per year.

Table 4.6-41 also shows the effect of the Mitigation Discharge Operating Scenario on the number of exceedences resulting from design discharges. Mitigation will not reduce significant impacts for the 1% discharge scenario. Therefore, mitigation is not recommended for the 1% discharge scenario. The mitigation that has been specified for the geysers, 20% Laguna, and 20% River design discharge scenarios will reduce, but not eliminate, significant impacts. Mitigation is not effective at reducing the frequency of adverse impacts on dissolved oxygen. In fact, the mitigation discharge operating scenario will cause a slight increase in the frequency of significant adverse dissolved oxygen impacts (see Table 4.6-41).

Table 4.6-41

Number of Significant Adverse Impacts of Project and Mitigation Operating Scenario (Discharge Impacts)

		Percent of Analyses with Significant Impacts							
		Benthic Algae		Planktonic Algae		Turbidity		Dissolved Oxygen	
Discharge Scenario	No.[1] of Analyses	Project	Mitig	Project	Mitig	Project	Mitig	Project	Mitig
Alt 1	108	45%	--	0%	--	0%	--	0%	--
Alts 2 & 3	108	4%	6%	1%	1%	0%	0%	0%	0%
Alt 4	108	9%	4%	0%	0%	0%	0%	0%	0%
Alt 5A	144	24%	11%	2%	1%	1%	0%	0%	0%
Alt 5B	108	46%	11%	1%	0%	0%	0%	1%	2%[2]

Source: *Water Quality Impacts Analysis*, Merritt Smith Consulting 1996r

Notes:

1. This column shows the number of scenarios that were analyzed using the evaluation approach described in this report (108 = 3 creek segments *x* 3 types of years *x* 12 months/year). Twelve months are evaluated instead of 7.5 discharge season months because of the potential for reclaimed water discharges to have a residual impact in summer after discharge ceases in May.
2. Decreases in dissolved oxygen concentration with mitigation as a result of decreases in oxygen-producing benthic algae.

No significant impacts are predicted from contingency discharge that are not also predicted from design discharge with one exception. The only exception is for contingency discharge with mitigation discharge operating scenario. In the case of Alternative 5B, contingency discharge with mitigation operations (Measure 2.5.4) is predicted to cause increases in the maximum ammonia concentration in one month of the year that exceed the point of significance .

Significant beneficial impacts of reclaimed water discharge scenarios have been identified for particular constituents in particular creek reaches and are summarized in Table 4.6-42. Table 4.6-42 summarizes the number of beneficial impacts of each discharge scenario with and without mitigation. The Mitigation Discharge Operating Scenario generally increases the number of significant beneficial impacts.

Table 4.6-43 illustrates the net impact of discharge scenarios on benthic algae, planktonic algae, turbidity and waste reduction strategy. Net impact is calculated by subtracting the percent of significant adverse impacts shown in Table 4.6-41 from the percent of significant beneficial impacts shown in Table 4.6-42. Thus, a positive value in Table 4.6-43 indicates more beneficial than adverse impacts on benthic algae, planktonic algae and turbidity. Table 4.6-43 shows that mitigation will provide a net beneficial impact for the discharge scenarios for which mitigation is proposed (Alternatives 4, 5A, 5B). Net impact can be so calculated only for benthic algae, planktonic algae, turbidity and waste reduction strategy because these are the only surface water quality evaluation criteria for which significant beneficial impacts could be identified.

Table 4.6-42

Number of Significant Beneficial Impacts of Project and Mitigation Discharge Operating Scenario

		Percent of Analyses with Significant Impacts							
		Benthic Algae		Planktonic Algae		Turbidity		Waste Reduction Strategy	
Discharge Scenario	**No.[1] Analyses**	**Project**	**Mitig**	**Project**	**Mitig**	**Project**	**Mitig**	**Project**	**Mitig**
Alt 1	108	0%		4%		4%		0%	
Alts 2 & 3	108	14%	14%	0%	0%	0%	0%	100%	100%
Alt 4	108	13%	12%	0%	0%	0%	0%	100%	100%
Alt 5A	144	9%	17%	12%	15%	8%	8%	100%	100%
Alt 5B	108	0%	16%	4%	2%	4%	0%	0%	0%

Source: *Water Quality Impacts Analysis*, Merritt Smith Consulting 1996R

[1] This column shows the number of scenarios that were analyzed using the evaluation approach described in this report (108 = 3 creek segments *x* 3 types of years *x* 12 months/year).

Table 4.6-43

Net Impact[1] of Project and Mitigation Discharge Operating Scenario[2]

Discharge Component	No. Analyses[3]	Percent of Analyses with Significant Impacts: Benthic Algae Project	Benthic Algae Mitig	Planktonic Algae Project	Planktonic Algae Mitig	Turbidity Project	Turbidity Mitig	Waste Reduction Strategy Project	Waste Reduction Strategy Mitig
Alt 1	108	-45%		+4%		+4%		-100%	
Alts 2 & 3	108	+10%	+8%	-1%	-1%	0%	0%	+100%	+100%
Alt 4	108	+4%	+8%	0%	0%	0%	0%	+100%	+100%
Alt 5A	144	-15%	+6%	+10%	+14%	+7%	+8%	+100%	+100%
Alt 5B	108	-46%	+5%	+3%	+2%	+4%	0%	-100%	0%

Source: *Water Quality Impacts Analysis*, Merritt Smith Consulting 1996R

1. Values in this table represent the number (in percent of total analyses) of significant beneficial impacts minus the number of significant adverse impacts. Thus, a value greater than zero indicates more significant beneficial impacts than adverse impacts.
2. Dissolved oxygen not included in this table because no criteria for beneficial impact have been developed. Since beneficial dissolved oxygen impacts cannot be characterized, net dissolved oxygen impact cannot be calculated.
3. This column shows the maximum number of significant impacts that could be identified for benthic algae, planktonic algae and turbidity using the evaluation approach described in this report (108 = 3 creek segments *x* 3 types of years *x* 12 months/year). The maximum number of significant waste reduction strategy impacts is 1.

Impact: 6.9.2. Biostimulatory Substances - Beneficial. Will the discharge component result in beneficial impacts based on narrative based criteria?

Analysis: ***Operation and Maintenance***

Laguna and Santa Rosa Creek

Beneficial; All Alternatives.

Discharge scenarios may cause up to a 36% decrease in monthly average benthic algae biomass and up to a 32% decrease in monthly average planktonic algae biomass during one or more months of the year in the Laguna and/or Santa Rosa Creek (see Table 4.6-44).

Russian River

Beneficial; Alternatives 2, 3, 4, and 5A.

These discharge scenarios may cause up to a 23% decrease in monthly average benthic algae biomass and up to a 34% decrease in monthly average planktonic algae biomass in the Russian River during one or more months of the year (see Table 4.6-45).

Less than Significant, (Beneficial); Alternatives 1 and 5B.

These discharge scenarios will decrease monthly average benthic and planktonic algae biomass in the Russian River somewhat, but not as much as 10%, the point of significance.

Operation and Maintenance - Contingency Discharge

Laguna and Santa Rosa Creek and Russian River

Less than Significant (Beneficial); Alternatives 5.

Contingency discharge will not cause a significant beneficial impact on algae in the Laguna and/or Russian River.

No Impact; Alternatives 1, 2, 3, and 4.

These alternatives do not have contingency discharge.

Table 4.6-44

Maximum Beneficial Effects on Algæ Biomass from Discharge - Laguna and Santa Rosa Creek[1]

Discharge Scenarios	Benthic Algae	Planktonic Algae
Alt 1- No Action discharge	<-1%	-27%
Alt 2 & 3 - 1% Design discharge	-36%	<-1%
Alt 4 - Geysers discharge	-23%	<-1%
Alt 5A - 20% Design discharge to the River	-33%	<-1%
Alt 5B - 20% Design discharge to the Laguna	-7%	-32%

Source: *Water Quality Impacts Analysis*, Merritt Smith Consulting 1996r

1. Value shown is for Santa Rosa Creek or the Laguna, whichever is highest

Table 4.6-45

Maximum Beneficial Effects on Algæ Biomass from Discharge - Russian River

Discharge Scenarios	Maximum Effect Relative to Existing Conditions Baseline	
	Benthic Algae	Planktonic Algae
Alt 1 - No Action discharge	<-1%	-2%
Alt 2 & 3 - 1% Design discharge	-20%	-7%
Alt 4 - Geysers discharge	-23%	-7%
Alt 5A - 20% Design discharge to the Russian River		
River above the Laguna	-3%	<-1%
River below the Laguna	-16%	-34%
Alt 5B - 20% Design discharge to the Laguna	<-1%	-2%

Source: *Water Quality Impacts Analysis*, Merritt Smith Consulting 1996r

Mitigation: *All Alternatives.* No mitigation is proposed. Mitigation operations that are proposed for adverse impacts on biostimulatory substances will increase the number of beneficial impacts.

Impact: 6.9.2. Turbidity - Adverse. Will the discharge component cause narrative-based criteria to be exceeded?

Analysis: ***Operation and Maintenance***

Laguna and Santa Rosa Creek

Less than Significant; All Alternatives.

The adverse impact of discharge on turbidity due to planktonic algae is predicted to be less than significant in the Laguna de Santa Rosa and Santa Rosa Creek for all discharge scenarios. The ranges of adverse impacts from discharge on turbidity due to planktonic algae with an existing conditions baseline are shown above in Table 4.6-37.

Russian River

Significant; Alternative 5A.

The adverse impact of discharge to the Russian River on turbidity due to planktonic algae may be significant in the Russian River above the confluence with the Laguna for a 20% design discharge to the River. The range of adverse impacts on turbidity due to planktonic algae compared to an existing conditions baseline are shown above in Table 4.6-38.

Less than Significant; Alternatives 1, 2, 3, 4, and 5B.

The adverse impact of discharge on turbidity due to planktonic algae is predicted to be less than significant in the Russian River for all discharge scenarios, except that associated with Alternative 5A. The range of adverse impacts from discharge on turbidity due to planktonic algae are shown above in Table 4.6-39.

Operation and Maintenance - Contingency Plan

Laguna and Santa Rosa Creek

Significant; Alternative 5.

Planktonic algae biomass, and thus turbidity, may increase by as much as 27% in the Laguna during the period of contingency discharge. Contingency discharge does not increase the magnitude of the exceedence that will occur as a result of the normal discharge alone, as described in Table 4.6-39.

No Impact; Alternatives 1, 2, 3, and 4.

These alternatives do not have contingency discharge.

Russian River

Significant; Alternative 5A.

Planktonic algae biomass, and thus turbidity, may increase by as much as 29% in the Russian River during the period of contingency discharge. Contingency discharge slightly increases the magnitude of the exceedence that will occur as a result of the normal discharge alone, as described in Table 4.6-40.

Less than Significant; Alternative 5B.

The adverse impact of discharge on turbidity due to planktonic algae is predicted to be less than significant in the Russian River for Alternative 5B, as described in Table 4.6-40.

No Impact; Alternatives 1, 2, 3, and 4.

These alternatives do not have contingency discharge.

Mitigation: *Alternative 5.*

2.5.4. Discharge Operations

Alternative 1, 2, 3, and 4. No mitigation is proposed.

After Mitigation: *Significant after Mitigation; Alternative 5.*

The Mitigation Discharge Operating Scenario will eliminate significant adverse impacts from normal discharge scenarios (except Alt 2 & 3). This mitigation is effective at eliminating the significant turbidity impact of contingency discharge in the Russian River, but not the Laguna.

Impact: **6.9.2. Turbidity - beneficial. Will the discharge component result in beneficial impacts based on narrative based criteria?**

Analysis: ***Operation and Maintenance***

Laguna and Santa Rosa Creek

Beneficial. Alternatives 1 and 5B.

The beneficial impact of discharge on turbidity due to planktonic algae may be significant in the Laguna de Santa Rosa and/or Santa Rosa Creek. The ranges of beneficial impacts from discharge on turbidity due to planktonic algae with an existing conditions baseline are shown above in Table 4.6-44.

Less than Significant (Beneficial); Alternatives 2, 3, 4, and 5A.

These discharge scenarios will not cause a significant beneficial impact on turbidity in the Laguna and/or Santa Rosa Creek.

Russian River

Beneficial; Alternative 5A.

The beneficial impact of discharge on turbidity due to planktonic algae may be significant in Russian River. The ranges of beneficial impacts from discharge on turbidity due to planktonic algae with an existing conditions baseline are shown above in Table 4.6-45.

Less than Significant (Beneficial); Alternatives 1, 2, 3, 4, and 5B.

These discharge scenarios will not cause a significant beneficial impact on turbidity in the Russian River.

Operation and Maintenance - Contingency Plan.

Laguna and Santa Rosa Creek

Less than Significant (Beneficial); Alternative 5.

Contingency discharge will not cause a significant beneficial impact on turbidity in the Laguna and/or Santa Rosa Creek.

No Impact; Alternatives 1, 2, 3, and 4.

These alternatives not have contingency discharge.

Russian River

Less than Significant (Beneficial); Alternative 5.

Contingency discharge will not cause a significant beneficial impact on turbidity in the Russian River.

No Impact; Alternatives 1, 2, 3, and 4.

These alternatives do not have contingency discharge.

Mitigation: No mitigation is proposed.

Impact: 6.9.2. Waste Reduction Strategy - Total Nitrogen-Adverse. Will the discharge component cause narrative-based criteria to be exceeded?

Analysis: *Laguna and Santa Rosa Creek*

Significant; Alternatives 1 and 5B.

The Regional Board has established a goal for the Subregional System to reduce total nitrogen load in the Laguna de Santa Rosa by 159,000 pounds per year from their 1994 estimated load of 424,000 pounds per year. No Action discharge and 20% design discharge to the Laguna will increase the total nitrogen load by 252,000 and 223,000 pounds per year, respectively, and thus not attain the load reduction goal (Table 4.6-46). If the 20% design discharge to the Laguna will be implemented, the Subregional System will need to reduce the total nitrogen load by 159,000 + 223,000 pounds per year, or 382,000 pounds per year, to be in attainment of the total nitrogen waste reduction goal.

Table 4.6-46

Effects of Discharge on Total Nitrogen Load Reduction - Laguna de Santa Rosa

Discharge Scenario	Total Nitrogen
Alt 1 - No Action discharge	+252,000 lbs/year
Alt 2&3 - 1% Design discharge	-329,000 lbs/year
Alt 4 - Geysers discharge	-361,000 lbs/year
Alt 5A - 20% Design discharge to the Russian River	-352,000 lbs/year
Alt 5B - 20% Design discharge to the Laguna	+223,000 lbs/year

Source: *Water Quality Impacts Analysis*, Merritt Smith Consulting 1996r

Less than Significant; Alternatives 2, 3, 4, and 5A.

These alternatives will reduce the estimated annual total nitrogen load to the Laguna more than that necessary to meet the point of the significance, which is 159,000 pounds per year (see Table 4.6-46). Therefore, the impact of these alternatives is considered to be less than significant.

Russian River

Not Applicable. The Waste Load Reduction Strategy - Total Nitrogen is not applicable to the Russian River.

Mitigation: *Alternative 5B.*

2.5.7 Total and Ammonia Nitrogen Source Control Program

Alternatives 2, 3, 4, and 5A. No mitigation is proposed.

After Mitigation: *Significant; Alternative 1.*

The No Action (No Project) alternative, by definition, does not include mitigation.

Less than Significant after Mitigation; Alternative 5B.

Nitrogen sources to the Laguna are known (North Coast Regional Board 1995), and the technology to mitigate their potential impacts has been demonstrated locally (Gold Ridge RCD 1995). With implementation of the source control programs, nitrogen sources will be reduced as follows:

20% Laguna design discharge: The total nitrogen load will be reduced by 382,000 pounds per year.

Impact: 6.9.2. Waste Reduction Strategy - Total Nitrogen - Beneficial. Will the discharge component result in beneficial impacts based on narrative criteria?

Analysis: *Laguna and Santa Rosa Creek*

Beneficial; Alternatives 2, 3, 4, and 5A.

These discharge scenarios are predicted to reduce the nitrogen load to the Laguna by more than 159,000 lbs/year (Table 4.6-46) because discharge to the Laguna will be reduced from existing conditions..

Less than Significant (Beneficial); Alternatives 1 and 5B.

These discharge scenarios are not predicted to reduce the nitrogen load to the Laguna by more than 159,000 lbs/year (see Impact 6.9.2 Waste Reduction Strategy - Total Nitrogen - Adverse) because reclaimed water discharge to the Laguna will not be reduced by these alternatives.

Russian River

No Impact; All Alternatives.

The Waste Load Reduction Strategy - Total Nitrogen is not applicable to the Russian River.

Mitigation: *All Alternatives.* No mitigation is proposed.

Impact: 6.9.2. Waste Reduction Strategy - Ammonia Nitrogen - Adverse. Will the discharge component cause narrative-based criteria to be exceeded?

Analysis: *Laguna and Santa Rosa Creek*

Significant; Alternatives 1 and 5B.

The Regional Board has established a goal for the Subregional System to reduce ammonia-nitrogen load in the Laguna de Santa Rosa by 21,500 pounds per year from their 1994 estimate of 56,100 pounds per year. These discharge scenarios will not attain the load reduction goal (Table 4.6-47). The 20% Laguna design discharge represents increased annual volume of reclaimed water discharge relative to existing conditions, yet the annual ammonia load is expected to decrease. This is because the concentration of ammonia in storage ponds (which is the source of reclaimed water that is discharged) has decreased relative to the concentration upon which the Regional Board's 1994 estimate of 56,100 pounds per year is based (Merritt Smith Consulting 1996r).

Table 4.6-47

Effects on Ammonia-Nitrogen Load Reduction from Discharge - Laguna de Santa Rosa

Discharge Scenarios	Ammonia-Nitrogen
Alt 1 - No Action discharge	-16,800 lbs/year
Alt 2&3 - 1% Design discharge	-51,000 lbs/year
Alt 4 - Geysers discharge	-52,900 lbs/year
Alt 5A - 20% Design discharge to the Russian River	-52,300 lbs/year
Alt 5B - 20% Design discharge to the Laguna	-18,500 lbs/year

Source: *Water Quality Impacts Analysis*, Merritt Smith Consulting 1996r

The Regional Board established the ammonia reduction goals for each ammonia source such that the ammonia water quality objective for aquatic life protection will be met. The ammonia load reduction goal is the basis of the significance evaluation criterion for ammonia in the Laguna. Nonetheless, reclaimed water discharge will affect the concentration of ammonia in the Laguna and Santa Rosa Creek, as described in Table 4.6-48. The estimates of discharge scenario impacts on ammonia concentration are not evaluated for significance, but are provided to more fully describe potential Project impacts. Table 4.6-48 shows that the maximum ammonia-nitrogen concentration is expected to increase despite the reduced ammonia load indicated in Table 4.6-47. This is because the maximum ammonia concentration increase resulting from Project alternatives will occur as a result of discharge at time when the 1000 cfs restriction limits reclaimed water discharge under the existing condition.

Table 4.6-48

Effects on Ammonia-Nitrogen Concentration
Laguna de Santa Rosa from Discharge[1] - Laguna de Santa Rosa

Discharge Scenarios	Percent Change in Concentration
Alt 1 - No Action discharge	+636%
Alt 2&3 - 1% Design discharge	+<5%
Alt 4 - Geysers discharge	+66 %
Alt 5A - 20% Design discharge to the Russian River (upper River)	+<5%
Alt 5B - 20% Design discharge to the Laguna	+692%

Source: *Water Quality Impacts Analysis* Merritt Smith Consulting 1996r

[1] value shown is for Santa Rosa Creek or the Laguna, whichever is higher

Less than Significant; Alternatives 2, 3, 4, and 5A.

Table 4.6-47 shows that the ammonia load decrease resulting from Alternatives 2, 3, 4, and 5A is greater than the point of signficance, which is a 21,500 pounds per year decrease. Therefore, the adverse impact is considered to be less than significant.

Russian River

Not Applicable. The Waste Load Reduction Strategy - Ammonia-Nitrogen is not applicable to the Russian River.

Mitigation: *Alternative 5B.*

2.5.6 Total and Ammonia Nitrogen Source Control Program

Alternative 2, 3, 4, and 5A. No mitigation is proposed.

After Mitigation: *Significant after Mitigation; Alternative 1.*

The No Action alternative, by definition, does not include mitigation.

Less than Significant after Mitigation; Alternative 5B.

The sources of nitrogen in the Laguna are known (North Coast Regional Board 1995), and the technology to mitigate their potential impacts has been demonstrated locally (Gold Ridge RCD 1995). With implementation of the source control programs, nitrogen sources will be reduced as follows:

20% Laguna design discharge: The ammonia-nitrogen load will be reduced by 3,000 pounds per year.

Impact: **6.9.2. Waste Reduction Strategy. Ammonia Nitrogen. Beneficial. Will the discharge component result in beneficial impacts based on narrative criteria?**

Analysis: *Laguna and Santa Rosa Creek*

Beneficial; Alternatives 2, 3, 4, and 5A.

These discharge scenarios are predicted to reduce the nitrogen load to the Laguna by more than 21,500 lbs/year (Table 4.6-47).

Less than Significant; Alternatives 1 and 5B.

These discharge scenarios are predicted to reduce the nitrogen load to the Laguna by less than 21,500 lbs/year (Table 4.6-47).

Russian River

Not Applicable. The Waste Load Reduction Strategy - Nitrogen is not applicable to the Russian River.

Mitigation: No mitigation is needed.

Impact: **6.9.2. Toxicity (lethal effects). Will the discharge component cause narrative-based criteria to be exceeded.**

Analysis: ***Operation and Maintenance***

Laguna and Santa Rosa Creek

Significant; Alternatives 1 and 5B.

Lethal toxicity was found once in 11 tests, or in 9% of the tests (Merritt Smith Consulting 1996l), and the lowest, or worst-case concentration of reclaimed water at which no observable effect occurred (NOEC) was 25%. Table 4.6-49 shows the frequency of days that reclaimed water concentration will exceed 25% (the worst-case no-effects concentration) in Santa Rosa Creek (section of Laguna system subject to highest concentrations) using output of the water quality model as described in *Russian River Water Quality Model* Technical Report, (Resource Management Associates 1996b). These frequencies of potentially toxic concentrations are then multiplied by the worst-case toxicity frequency (9%), to give the expected occurrence of toxic conditions in Santa Rosa

Creek. These calculations are given for a dry year, an average year, and a wet year. The impact is considered significant if the frequency that toxic conditions will occur in the receiving water is greater for a discharge component than for existing conditions. Although Table 4.6-49 addresses Santa Rosa Creek only, the concentration of reclaimed water in the Laguna will also exceed 25% for the 20% Laguna design discharge and No Action discharge.

Table 4.6-49

Calculated Probability of Toxic Conditions In Santa Rosa Creek Resulting From Discharge

Discharge Component	Days Reclaimed Water Concentration is Greater than 25%[1]	Frequency of Lethally Toxic Concentration[2]
Alt 1 - No Action Discharge	88.4	7.9%
Alt 2, 3 - 1% Design Discharge	0	0
Alt 4 - Geysers Discharge	0	0
Alt 5A - 20% Design Discharge to Russian River	0	0
Alt 5B - 20% Design Discharge to Laguna	93.7	8.4%
Existing Conditions	67.6	6.1%

1. Values in this column represent the frequency (percentage) of days that the daily average reclaimed water concentration in Santa Rosa Creek will exceed 25%. This frequency was estimated using water quality model output. Model is described in the *Russian River Water Quality Model* Technical Report, (Resource Management Associates 1996b). Model output is graphically presented in the *Water Quality Impacts Analysis* Technical Report, (Merritt Smith Consulting 1996r). 25% reclaimed water concentration was selected because it represents the lowest no effects concentration of the worst case lethal toxicity episode.
2. Values in this column represent the percentage of days in the discharge season that toxic conditions may occur in Santa Rosa Creek. These values are calculated by multiplying the frequencies of reclaimed water concentrations over 25% (which is the worst-case NOEC) by 1/11, or 0.09 (which is the proportion of fish toxicity tests which resulted in lethal toxicity), as reported in the *Reclaimed Water Quality Update* Technical Report, (Merritt Smith Consulting 1996l).

Less than Significant; Alternatives 2, 3, 4, and 5A.

These discharge scenarios will not produce lethal toxicity in the Laguna and/or Santa Rosa Creek (see Table 4.6-49).

Russian River

Less than Significant; All Alternatives.

Discharge scenarios are not predicted to produce lethal toxicity in the Russian River.

Operation and Maintenance - Contingency Plan

Laguna and Santa Rosa Creek

Significant; Alternative 5B.

Contingency discharge to the Laguna is predicted to produce lethal toxicity in the Laguna and/or Santa Rosa Creek at a frequency similar to design discharge (see Table 4.6-49).

Less than Significant; Alternative 5A.

Contingency discharge to the Russian River is predicted to produce lethal toxicity in the Laguna and/or Santa Rosa Creek at a frequency similar to design discharge (see Table 4.6-49).

No Impact; Alternatives 1, 2, 3, and 4.

These alternatives do not have contingency discharge.

Russian River

Less than Significant; Alternative 5.

Contingency discharge is not predicted to produce lethal toxicity in the Russian River.

No Impact; Alternatives 1, 2, 3, and 4.

These alternatives do not have contingency discharge.

Mitigation: *Alternative 5B.*

2.5.8 Toxicity Control Program.

Alternatives 2, 3, 4, and 5A. No mitigation is proposed.

After Mitigation: *Significant; Alternative 1.*

The No Action alternative, by definition, does not include mitigation.

Less than Significant after Mitigation; Alternative 5B.

This mitigation program shall consist of increased monitoring, toxicity identification (TIE) and reduction (TRE) and is recommended regardless of which alternative is implemented. The TIE/TRE process, developed by EPA, has been proven to successfully identify and control toxicity-causing constituents in effluents exhibiting consistent toxicity. Therefore, this mitigation measure is considered to be effective.

Impact: 6.9.3. Will the discharge component impact special sites?

Analysis: *No Impact; All Alternatives.*

No special sites addressed with this evaluation criterion are located in the Russian River or Santa Rosa Plain. The discharge component will not affect watersheds with special sites in West County.

Mitigation: No mitigation is needed.

Impact: 6.9.4. Will the discharge component cause sediment quality criteria to be exceeded?

Analysis: *Less than Significant; All Alternatives.*

Evaluation criteria with points of significance have been established for 5 constituents: acenaphthene, dieldrin, endrin, fluoranthene, and phenanthrene. The discharge does not contain any of these constituents in detectable amounts. Modeling of the impacts of the discharge on sediment (assuming that these constituents are present in reclaimed water and receiving water at a concentration equal to the analytical detection limit) indicates that the point of significance will not be exceeded for any of the discharge rate scenarios being considered. Thus, this impact is considered to be less than significant.

Mitigation: No mitigation is proposed.

CUMULATIVE IMPACTS

Storage Reservoirs and Agricultural Irrigation

Sebastopol

The Project will not affect water quality in the surface waters of the Sebastopol area. No cumulative projects were identified that will cause the Project impact to change. Thus, no impacts of cumulative projects on surface water quality are expected to occur.

West County

The Stemple Creek/Estero de San Antonio Watershed Enhancement Plan (Prunuske Chatham 1994) is the one cumulative project that has been identified which may have a nexus with surface water quality impacts potentially resulting from West County irrigation and storage. The Stemple Creek/Estero de San Antonio Watershed Enhancement Plan recommends measures to conserve and improve the natural resources of the watershed, while maintaining the agricultural economy. Recommended measures include the following:

- Encourage public involvement
- Reduce pollutants to Stemple Creek and the Estero
- Restore the riparian corridor

These measures are consistent with the Long-Term Project description and mitigation (see Section 2.2) and, as such, will tend to reduce impacts of the West County irrigation and storage components. However, the measures recommended in the Stemple Creek/Estero de San Antonio Watershed Enhancement Plan will result in changes to the flow and quality of Stemple Creek that will cause water quality changes in Estero de San Antonio. Under the evaluation criteria established to evaluate the significance of potential impacts in the Esteros, the impact of the Stemple Creek/Estero de San Antonio Watershed Enhancement Plan, Santa Rosa's irrigation and storage components, or both will be considered significant. The Stemple Creek/Estero de San Antonio Watershed Enhancement Plan was developed to provide a beneficial impact on Estero de San Antonio.

South County

Cumulative projects with a potential nexus with water quality impacts of Project components are shown in Table 4.6-50. Potential impacts of cumulative projects (projects listed in Table 4.6-50) plus irrigation and storage components of the Long-Term Project on surface water quality are evaluated below.

Tolay Creek. As noted in Section 7.1.1 of the *Water Quality Impacts Analysis* technical report (Merritt Smith Consulting 1996r), obstructions in the Tolay Creek channel are expected to limit the effect of the Project to Tolay Creek above Highway 121. These obstructions will not be eliminated by the cumulative projects cited in Table 4.6-50. The cumulative projects cited in Table 4.6-50 will enhance tidal circulation in the slough downstream of the obstructions. Thus, the impact of cumulative projects is considered to be less than significant.

Petaluma River. The Petaluma Wastewater Facilities Project has a potential water quality nexus with Project irrigation in the Petaluma watershed. Chapter 2 of the *Petaluma Wastewater Treatment and Storage Facilities Project* Draft EIR 1994 indicates that Petaluma's wastewater discharge into the Petaluma River will have similar quality but less quantity (due to increased storage and irrigation) than current discharge. Any impacts on the Petaluma River of future Petaluma discharge will be reduced from current impacts. The concentration of some metals in undiluted Petaluma wastewater exceeds applicable water quality criteria (see Table 4.6-20). These criteria may also be exceeded in the Petaluma River near Petaluma's outfall. With the exception of copper, the concentrations of detectable constituents in Santa Rosa's reclaimed water and in ditch water (estimated concentration) from Bay Flats irrigation are less than the applicable points of significance. The estimated concentration of copper in ditch water from bay flats Long-Term Project irrigation (11.8 mg/l) is less than the concentration of copper in Petaluma's wastewater (20 mg/L - see Table 4.6-20). Therefore, discharge of Bay Flats irrigation water could only lessen any impacts of Petaluma's discharge. Thus, the Project cannot cause an exceedence, or cause the magnitude of an existing exceedence to increase, despite any impacts of cumulative projects on water quality and cumulative projects impact is considered to be less than significant.

Table 4.6-50

Summary of Cumulative Projects With Potential Water Quality Nexus in the South County Area

Type of Project	Project Title	Location	Reporting Agency	Water-shed	Assessment	To Be Considered in Cumulative Impacts Evaluation?
Habitat Restoration/ Environmental Mitigation Project	Watershed restoration project	Tolay Creek	U.S. Department of Agriculture; Natural Resources Conservation Service	Tolay Creek	Project will enhance tidal exchange and tend to reduce any impacts of Subreg. System Project impacts	Yes
Habitat Restoration/ Environmental Mitigation Project	Environmental Mitigation	Route 121, Hwy. 37 to Tolay Green Bridge	Caltrans	Tolay Creek	Project will enhance tidal exchange and tend to reduce any impacts of Subreg. System Project impacts	Yes
Changes in Wastewater Discharges	Petaluma Wastewater Facilities Project	Petaluma River	City of Petaluma	Petaluma River	The Project will reduce the quantity of wastewater discharged to the Petaluma River. Potential effects of this projects on flow and water quality is evaluated for cumulative impacts	Yes

Source: Merritt Smith Consulting 1996

Geysers Steamfield

The Subregional System's geysers injection alternative is not expected to affect surface water quality in the geysers area, and no planned projects with a nexus to surface water quality have been identified. Thus, no cumulative impacts on surface water quality are expected to occur.

Discharge

Identification of Projects with the Potential for Cumulative Impacts

A list of projects in Sonoma County with the potential to interrelate with Long-Term Project impacts is provided as the Cumulative Projects List (Appendix D-31).

Proposed projects with a potential nexus with water quality impacts of Subregional System Project components are shown in Table 4.6-51. Proposed projects were selected (and included in Table 4.6-51) that:

- Potentially involve discharge.
- Are directly adjacent to waterways and thus could affect aquatic habitat and, thereby, water quality.

Projects involving diversions (reduction in Russian River flow) located above the Sonoma County Water Agency intakes are already factored into the analysis of design discharge, because the River flows used to estimate Subregional System Project effects are based on Sonoma County Water Agency estimate of future diversions. No water quality impacts are expected from the new intakes other than those which might be flow related, and any such impacts have already been included in the analysis.

Table 4.6-51

Summary of Cumulative Projects With Potential Water Quality Nexus in the Russian River Watershed

Type of Project	Project Title	Location	Reporting Agency	Water-shed	Assessment	Considered in Cumulative Impacts Evaluation?
Commercial Development Project	SYAR Industries-Terrace Pit Mining	Westside Road	Sonoma County, Corps	RR	River riparian area not affected, water quality not affected because Project located away from River	No
Commercial Development Project	Kaiser Sand & Gravel - Terrace Gravel Pit Reclamation	Sonoma County	Sonoma County, Corps	RR	Process plant relocation project, no aquatic habitat impacts	No
Commercial Development Project	Dewitt Sand and Gravel-Gravel Extraction Operations along the Russian River	Sonoma County	Corps	RR	Gravel skimming proposed, which is an existing practice. Project will not affect water quality or riparian habitat. Governed by County ARM.	No
Drainage Project	Russian River Breaching - Obstruction Removal and Sandbar Clearing	Jenner, Sonoma County	Sonoma County Public Works, Corps	RR	Not a new Project, Sandbar clearing is part of existing condition	No
Drainage Project	Prokopakis Irrigation Users	Guerneville Rd.	Corps of Engineers	RR	Project involves installing wells to evaluated groundwater effects of Subregional System irrigation.	No
Drainage Project	Silt Removal Water Storage Pond	Santa Rosa Creek	City of Santa Rosa Public	RR	Silt removal from channel on south side of Delta Pond. Not directly	No

Table 4.6-51

Summary of Cumulative Projects With Potential Water Quality Nexus in the Russian River Watershed

Type of Project	Project Title	Location	Reporting Agency	Water-shed	Assessment	Considered in Cumulative Impacts Evaluation?
			Works, Corps		connected to Laguna or SR Ck	
Habitat Restoration/ Environmental Mitigation Project	Laguna Restoration Project of Braided Channels, Smith Property	Laguna de Santa Rosa	Dept. of Fish and Game	RR	Implementation unlikely	No
Habitat Restoration/ Environmental Mitigation Project	Laguna Restoration Project	Laguna de Santa Rosa	Dept. of Fish and Game	RR	Implementation unlikely	No
Water System Projects	New wells (9) at Wohler Aquifer Site	Near Wohler Pumping Plant on Wohler Rd, east of the Russian River	Sonoma County Water Agency	RR	No water quality impacts of construction. Impact of wells on flow is already included in analysis	No
Water System Projects	New Russian River Well Field	Between Mirabel Site and Wohler Road north of Russian River	Sonoma County Water Agency	RR	No water quality impacts of construction. Impact of wells on flow is already included in analysis	No
Water System Projects	Laguna de Santa Rosa Widening and Revegetation	From 1000' west of Stony Point Rd to Hinebaugh Creek Channel	Sonoma County Water Agency	RR	Project is located upstream of waters affected by the Subregional System Project. Downstream impact of SCWA project on water quality will be	No

Table 4.6-51

Summary of Cumulative Projects With Potential Water Quality Nexus in the Russian River Watershed

Type of Project	Project Title	Location	Reporting Agency	Water-shed	Assessment	Considered in Cumulative Impacts Evaluation?
					minor.	
Water System Projects	Potter Valley Project	Mendocino and Lake Counties	Sonoma County Water Agency	RR	This Project potentially affects River flow, and is thus already factored into analysis	No
Water System Projects	Russian River Estuary Management Plan	Russian River from Duncans Mills to Jenner	Sonoma County Water Agency	RR	This Project potentially affects River flow, and is thus already factored into analysis	No
-	Waste Load Reduction	Laguna	RWQCB, City of Santa Rosa	RR	This Project involves reducing the total and ammonia nitrogen loads to the Laguna such that the dissolved oxygen and ammonia objectives are attained.	Yes
Increased Wastewater Discharges	-	Russian River, Laguna	Ukiah, Cloverdale, Healdsburg, Windsor, Forestville, Graton, Guerneville, Occidental	RR	The potential effect of these projects on flow and water quality is evaluated for cumulative impacts	Yes

Source: Merritt Smith Consulting 1996

Projects Eliminated From Further Evaluation

Many of the projects in the Appendix D-31 list could, if implemented, affect the quality and quantity of wastewater discharges and stormwater runoff. Each of these potential situations is considered below.

Wastewater Quality

The general plans in the cumulative projects area identify increased residential and commercial/industrial development in the Long-Term Project area and other wastewater system service areas. This development could affect the quality of wastewater produced were it not for federal pretreatment regulations (40 CFR 400-424) that require publicly-owned treatment works (POTWs) to prevent commercial/industrial development from adversely affecting effluent quality. Reclaimed water quality is thus controlled by residential inputs, and no change in residential sewage effluent quality will be expected due to future growth. Some of the smaller jurisdictions in the Long-Term Project area may not have pretreatment programs, but the wastewater from any such jurisdictions is assumed to have an insignificant commercial/ industrial component. Pretreatment regulations dictate that a POTW implement a pretreatment program when commercial/industrial sources that potentially affect effluent quality are being served by the POTW. Therefore, future changes in wastewater quality due to commercial/industrial development are assumed to be insignificant and are not evaluated further.

Wastewater Quantity

Cumulative projects could increase the quantity of wastewater discharged to surface waters in the Long-Term Project area. Wastewater discharges occur in the Russian River and Petaluma River basins. The following discussion shows why cumulative impacts do not need to be evaluated for most water quality constituents, except those that affect nutrients/algae/ dissolved oxygen in the Russian River and possibly in the Petaluma River.

Cumulative impacts of other (non-Project) reclaimed water irrigation projects and septic system projects will not be evaluated for reasons described as follows:

Irrigation Projects. Such projects are assumed to have no impact on surface water quality. This assumption is based on the expectation that strict irrigation management requirements that are similar to those imposed by the Regional Board on the Subregional System will be imposed on future reclamation systems. With strict irrigation management requirements in place, future irrigation projects are not expected to affect surface waters.

Septic Systems. New septic systems will not be evaluated because they are assumed to have no impact on surface water quality. This assumption is based on the understanding that existing failed systems adversely affect surface water quality because they were constructed close to waterways, and current regulations prevent siting of systems in locations where surface water quality will be affected. The number of failed existing septic systems and their impacts are assumed to be the same in the future as in the present. Therefore, the cumulative impacts analysis will not consider existing septic system impacts. The impacts of existing septic systems have been included in Subregional System Project impacts relative to the existing condition.

Stormwater Quality

Land development can increase the concentration of water quality constituents in stormwater runoff from the site. Stormwater runoff from some of the cumulative projects could, in turn, affect the quality of the Russian River, the Laguna de Santa Rosa, and other waterways. However, such cumulative projects are not expected to result in any significant Subregional System reclaimed water discharge impacts that were not identified in the analysis of impacts of the discharge alternatives alone. This is because the significant water quality impacts of the Project's reclaimed water discharge components that have been identified will occur during dry weather, low flow conditions (when relatively little dilution of reclaimed water occurs) and usually involve constituents that are not associated with stormwater runoff. Dilution of reclaimed water during storm events is much greater than during dry weather.

Cumulative Impacts Evaluation Approach

The cumulative impacts evaluation approach for the Santa Rosa Plain and Russian River areas are described below.

Potential impacts of reclaimed water discharge alternatives have been evaluated using two methods as follows:

- Estimates of dilution
- Using a water quality model to simulate biological interactions with reclaimed water constituents.

Dilution Model

The method for identifying impacts of design discharge with respect to many of the numeric-based evaluation criteria involved using estimates of reclaimed water dilution (95th percentile reclaimed water concentration in a dry year), constituent concentration in reclaimed water, and the background constituent concentration in Santa Rosa Creek/Laguna to estimate the potential Project impact on constituent concentration. None of the design discharge rates was predicted to cause numeric points of significance to be exceeded for any constituents in reclaimed water except conductivity and cyanide. No criterion for significance exists for conductivity in the Laguna or Santa Rosa Creek. No cumulative projects have been identified that will change background water quality conditions in the Laguna or Santa Rosa Creek, which are not affected by any wastewater discharges except that of the Subregional System and the City of Windsor. The City of Windsor discharges to the Laguna at Trenton Healdsburg Road. Increased total annual volume was evaluated, but no changes in its maximum discharge rate (because of Basin Plan restrictions) or quality (because of pretreatment regulations) are included in cumulative projects. Thus, the Project cannot cause an exceedence, or cause the magnitude of an existing exceedence (e.g. cyanide) to increase, despite any impacts of cumulative projects on water quality. Therefore, the cumulative impacts analysis will not address any of the constituents evaluated using the dilution method, other than conductivity in the Russian River.

The Project design discharge alternatives caused an exceedence of the conductivity point of significance in the Russian River above the Laguna, and conductivity in the Russian River is potentially affected by other discharges. The potential for cumulative projects to cause significant conductivity impacts in the River above and below the Laguna has been evaluated as described below.

Conductivity Evaluation above the Laguna

For purposes of this analysis, the incremental (cumulative Project) discharge from other communities was assumed not to lower the baseline conductivity in the Russian River above the Laguna, and will probably cause conductivity to increase. Since the 20% design discharge to the Russian River above the Laguna is estimated to cause a significant impact on conductivity, this impact of cumulative projects will also be considered significant.

Conductivity Evaluation below the Laguna

The impact of cumulative projects on conductivity in the Russian River below the Laguna was assessed by assuming that all the conductivity in the River is due to reclaimed water (a conservative approach). The flow in the River in each month of an average year (1961) was obtained from the monthly water balance model, and the proportion of the monthly flow that will be due to the incremental flow from non-Santa Rosa reclaimed water discharge was determined then multiplied by the existing monthly conductivity to get a predicted monthly increase in conductivity due to non-Santa Rosa reclaimed water discharge. The estimated incremental monthly conductivity value was added to the monthly conductivity values predicted for a 20% design discharge to the Laguna and 20% design discharge to the River (see Table 4.6-12) to estimate monthly conductivity under the cumulative project condition. If the median of twelve monthly average conductivity values exceeded the point of significance, then the impact will be considered to be significant.

Toxicity

A 20% design discharge to the Laguna and discharge related to the No Project alternative will cause an increase in the frequency of toxicity in the Laguna and Santa Rosa Creek. The only cumulative project identified for the Laguna and Santa Rosa Creek is reduction of total nitrogen and ammonia to the Laguna. Reduction of ammonia and nitrogen will not cause an increase in toxicity and, since the toxicity was found in effluent alone (not receiving water), reduction of ammonia and nitrogen will not cause a decrease in toxicity. Therefore, the impact of cumulative projects was not evaluated for toxicity in the Laguna and Santa Rosa Creek since it will be the same as the impacts predicted for design discharge.

Toxicity in the Russian River from all design discharge rates that were evaluated is predicted to be less than significant. The toxicity of discharges from other communities discharging into the Russian River is not known. However, since all other dischargers must adhere to a regulatory limit of zero acute and chronic toxicity in their discharge, it is assumed that there will be no toxicity. Therefore, the impact of cumulative projects on toxicity will be less than significant.

Water Quality Model

The effect of Project discharge is potentially affected by the changes in other wastewater discharges to the Laguna and Russian River. The Regional Board estimated the change in the discharges of other permitted discharges in the Russian River basin, and these are summarized Table 4.6-52. The flows and effluent quality described therein are being used to evaluate for cumulative impacts. The Regional Board's flow estimates are based on the general plan growth as of the time of the Regional Board's assessment (1994). Since then, Ukiah and Windsor have proposed general plan amendments that will further increase reclaimed water flows from existing conditions.

Table 4.6-52

Estimated Future Wastewater Discharges to the Russian River Basin

	Average Dry Weather Flow (mgd)				
Community	**Regional Board Flow Estimate[1]**	**Additional Flow Due to Growth[2]**	**Total Future Flow[3]**	**Existing Flow[4]**	**Incremental Flow[5]**
Ukiah	3.4	0.14	3.54	2.4	1.14
Cloverdale	2.00	0	2	0.5	1.5
Healdsburg	1.80	0	1.8	1.0	0.8

Table 4.6-52

Estimated Future Wastewater Discharges to the Russian River Basin

Community	Average Dry Weather Flow (mgd)				
	Regional Board Flow Estimate[1]	Additional Flow Due to Growth[2]	Total Future Flow[3]	Existing Flow[4]	Incremental Flow[5]
Windsor	2.7	2.1	4.8	1.1	3.7
Forestville	0.12	0	0.12	0.05	0.07
Graton	0.14	0	0.14	0.08	0.06
Guerneville	0.71	0	0.71	0.35	0.36
Occidental	0.05	0	0.05	0.02	0.03

[1] General Plan projections reported in Regional Board (1994)
[2] Based on proposed general plan changes since 1994
[3] Sum of two column to the left
[4] Based on reports submitted by dischargers to Regional Board, also summarized in Table 4.6-9
[5] Flow used for cumulative impacts analysis

The North Coast Regional Board has established total nitrogen and ammonia load reduction goals for the Laguna watershed to improve Laguna water quality (North Coast Regional Board 1995). The Regional Board has established load reduction goals for urban nonpoint source discharges, agriculture and the Subregional System. Attainment of the load reduction goals for urban nonpoint source discharges and agriculture are considered a cumulative project for this analysis. The total nitrogen load reduction goals for urban and agriculture are 23,000 and 132, 000 pounds per year, respectively. The ammonia nitrogen load reduction goals for urban and agricultural sources are 2,300 and 23,000 pounds per year, respectively. The attainment of the load reduction goal for the Subregional System was not included in the cumulative project because attainment of the Subregional System goal was evaluated in the Project analysis.

The nutrient/algae/dissolved oxygen interactions that occur in the Laguna and Russian River as a result of reclaimed water discharges and other discharges and as a result of non-Subregional System waste load reductions were evaluated with the water quality model that was used to evaluate design discharge (Merritt Smith Consulting 1996r). The same approach was used to evaluate cumulative projects impacts with the following exceptions:

- Cumulative project impacts were evaluated for a normal hydrological year (1961). Design Project discharges were evaluated in a dry (1976), normal (1961) and wet (1982) year simulation.

- Cumulative project impacts were evaluated for significance relative to existing conditions, and the potential cumulative impacts are also described relative to impacts of design discharge.

- The potential impacts of cumulative discharge on benthic algae, planktonic algae, dissolved oxygen, and ammonia in Santa Rosa Creek, the Laguna de Santa Rosa, and the Russian River were evaluated as for design discharge. Cumulative project impacts on temperature, however, were not evaluated using the model. The temperature point of significance is that a 5 °F increase in monthly average temperature will be considered significant. The greatest effect of the Santa Rosa discharge on receiving water temperature occurs in Santa Rosa Creek, and any downstream effects attenuate rapidly (see Figure 4-17 of the *Water Quality Impacts Analysis* technical report) (Merritt Smith Consulting 1996r). None of the cumulative projects are expected to affect temperature. Thus, since no significant impacts of design discharge components will occur (see Figure 4-17 of the *Water Quality Impacts Analysis* technical report) (Merritt Smith Consulting 1996r), no significant impacts of the cumulative projects will occur either.

Results of Cumulative Impacts Assessment for Discharge

Significant adverse and beneficial impacts of cumulative projects (projects listed in Table 4.6-50 plus the Project) are summarized in Tables 4.6-53 through 4.6-55. Table 4.6-53 presents the frequency of adverse impacts (as a percentage of the total possible adverse impacts) of cumulative projects and cumulative projects plus mitigation for biostimulatory substances. Table 4.6-54 presents the frequency of beneficial impacts (as a percentage of the total possible beneficial impacts) of cumulative projects and cumulative projects plus mitigation for biostimulatory substances. Table 4.6-55 presents the net number of impacts (the number of significant beneficial impacts minus the number of significant adverse impacts). Tables 4.6-53 and 4.6-54 do not include conductivity, cyanide, or toxicity because only one opportunity for exceedence is possible, except for ammonia in the Russian River. No significant cumulative project impacts of ammonia occurred in the Russian River. No significant adverse impacts are estimated to occur as a result of cumulative projects that are not also estimated to occur as a result of the Santa Rosa reclaimed water design discharge (Project) alone. However, the combination of cumulative projects (which in the Laguna involves substantial nutrient load reduction) and mitigation of the operations avoids all significant water quality impacts of Alternative 5B in the normal hydrologic year. Because wet and dry years were not evaluated for the cumulative scenario, it is not possible to say that Alternative 5B will always be without significant impacts. However, this analysis illustrates the fact that there are few significant impacts of Alternative 5B, and they are reduced by implementation of the Regional Board's nutrient load reduction strategy in the Laguna.

Impacts are further described below.

Table 4.9-53

Frequency of Significant Adverse Impacts of Cumulative Projects, the Project, and Mitigation Operations

		Percent of the Total Number of Analyses With Signficant Impact							
		Benthic Algae		Planktonic Algae		Turbidity		Dissolved Oxygen	
Discharge Component	No. of Analyses[1]	Project	Mitig	Project	Mitig	Project	Mitig	Project	Mitig
Alt. 1	36	55%	-	0%	-	0%	-	0%	-
Alts. 2&3	36	3%	6%	0%	0%	0%	0%	0%	0%
Alt. 4	36	3%	3%	0%	0%	0%	0%	0%	0%
Alt. 5A	48	27%	15%	0%	0%	0%	0%	0%	0%
Alt. 5B	36	58%	0%	3%	0%	0%	0%	3%	0%

[1] This column shows the maximum number of significant impacts that could be identified using the evaluation approach described in this report (36 = 3 stream segments *x* 12 months/year, 48 = 4 stream segments x 12 months/year).

Table 4.6-54

Frequency of Significant Beneficial Impacts of Cumulative Projects and Mitigation Operations

Discharge Component	No. of Analyses[1]	Percent of the Total Number of Analyses With Signficant Impact					
		Benthic Algae		Planktonic Algae		Turbidity	
		Project	Mitigation	Project	Mitigation	Project	Mitigation
Alt. 1	36	0%	-	6%	-	6%	-
Alts. 2&3	36	8%	6%	0%	0%	0%	0%
Alt. 4	36	3%	8%	0%	0%	0%	0%
Alt. 5A	48	3%	3%	0%	0%	0%	0%
Alt. 5B	36	0%	14%	8%	0%	6%	0%

1 This column shows the maximum number of significant impacts that could be identified using the evaluation approach described in this report (36 = 3 stream segments *x* 12 months/year, 48 = 4 stream segments x 12 months/year).

Table 4.6-55

Net Impact[1] of Cumulative Projects and Mitigation Operations

Discharge Component	No. Analyses[2]	Number of Analyses[1]					
		Benthic Algae		Planktonic Algae		Turbidity	
		Project	Mitigation	Project	Mitigation	Project	Mitigation
Alt. 1	36	-20	-	+2	-	0	-
Alts. 2&3	36	+2	0	0	0	0	0
Alt. 4	36	0	+2	0	0	0	0
Alt. 5A	48	-12	-6	0	0	0	0
Alt. 5B	36	-21	+5	+2	0	+2	0

1 Values in this table represent the number of significant beneficial impacts minus the number of significant adverse impacts. Thus, a value greater than zero indicates more significant beneficial impacts than adverse impacts.

2 This column shows the maximum number of significant impacts that could be identified for benthic algae, planktonic algae, and turbidity using the evaluation approach described in this report (36 = 3 stream segments *x* 12 months/year, 48 = 4 stream segments x 12 months/year).

Table 4.6-56

Significant Adverse and Beneficial Impacts of Project and Cumulative Projects for each Alternative[1]

Constituent	Santa Rosa Creek	Laguna	Russian River Below Laguna	Russian River Above Laguna
Conductivity				*5A*
Dissolved Oxygen		~~5B~~		
Benthic Algae				
Adverse	*1*, **2&3, 5A,** ~~5B~~	*1*, 2&3, 4, 5A, ~~5B~~	*1*, ~~5A~~, ~~5B~~	5A
Beneficial	2&3, **4**, ~~5A~~, **5B**	**5B**	2&3, 4, **5A, 5B**	
Planktonic Algae				
Adverse			~~5B~~	
Beneficial	*1*, ~~5B~~	*1*, ~~5B~~		
Turbidity				
Adverse				
Beneficial	*1*, ~~5B~~	*1*, ~~5B~~		

[1] Components causing a significant adverse or beneficial impact are shown. Cumulative project impacts were evaluated for a normal hydrologic year. Since impacts were evaluated for all months, both beneficial and adverse impacts can result for some parameters at different times from the same component. Overstriking indicates impact avoided with mitigation or measures that need to be considered by the city for the No Project component, italics indicates no mitigation proposed, bold indicates impacts that are significant after mitigation that are not significant before mitigation. Components are identified as follows:
1 - Alt 1, No Action
2&3 = Alts 2&3, 1% design discharge component
4 = Alt 4, Geysers discharge component
5A = Alt 5A, 20% design discharge component to River
5B = Alt 5B, 20% design discharge component to Laguna

Cumulative project impacts were evaluated for a normal hydrologic year.

Impact: **6.1.C and 6.2C. Will the Project plus cumulative projects cause numeric- narrative-based criteria to be exceeded?**

Analysis: ***Conductivity***

Russian River above The Laguna

Alternative 5A is estimated to cause a significant impact on conductivity. With the assumption that cumulative projects will not lower and may increase baseline conductivity, the impact of cumulative projects on conductivity in the River above the Laguna will also be considered significant.

Russian River below The Laguna

Attainment of the evaluation criterion for conductivity requires that the median of 12 monthly average conductivity values must be less than or equal to the point of significance, which is 285 µmhos/cm for the Russian River below the Laguna). The monthly average conductivity values estimated to occur with cumulative projects (Table 4.6-57) were compared to the point of significance. The median of the 12 estimated monthly average conductivity values did not exceed the point of significance for the lower River for either Alternative 5A or 5B. Therefore, cumulative projects are expected to have a less than significant impact on conductivity in the lower Russian River.

Table 4.6-57

Estimated Conductivity in the Lower Russian River with Cumulative Projects and 20% Design Discharge to the Laguna and the River

	Lower Russian River (point of significance = 285 µmhos/cm)	
	Alternative 5B	**Alternative 5A**
October	290	272
November	288	269
December	278	277
January	301	298
February	283	282
March	241	240
April	283	280
May	269	268
June	292	292
July	262	262
August	255	255
September	261	261
Median	280	270

Source: Table 4-46 in Water Quality Impacts technical report (Merritt Smith Consulting 1996)

Dissolved Oxygen

The impact of cumulative projects on dissolved oxygen during a normal hydrological year is estimated to be similar to that of the Subregional System Project (Merritt Smith Consulting 1996r). Cumulative projects are estimated to cause exceedence of the point of significance (> 0.5 mg/L decrease) just once (3% of the total possible impacts), and this will occur in the Laguna as a result of Alternative 5B. This significant adverse impact of cumulative projects is reduced by mitigation for biostimulatory substances to below significance (Table 4.6-52).

Biostimulatory Substances

Benthic Algae

The impact of cumulative projects on benthic algae biomass, during a normal hydrological year, is estimated to be similar to that of the Project, as shown in Figure 4-49 of the *Water Quality Impacts Analysis* technical report (Merritt Smith Consulting 1996r). The number of significant adverse impacts estimated to result from cumulative projects is the same as that from the Project for each discharge component except for Alternative 4, in which case cumulative projects caused two fewer significant impacts than that estimated for the Project alone (8% of the total possible impacts with the Subregional System roject alone versus 3% for cumulative projects). Table 4.6-53 shows that the predicted frequency of significant adverse impacts on benthic algae of cumulative projects range from 3 to 58% of the total number of possible significant adverse impacts. As is the case for the Project impacts, mitigation reduces the frequency of impacts of the Project plus cumulative project impacts for some discharge scenarios, but not Alternatives 2 and 3. In contrast to the mitigated Project impact (which caused significant impacts after mitigation, depending on discharge scenarios), cumulative projects with mitigation of Project impacts will cause no significant benthic algae impacts for Alternative 5B. Impacts persist in the Laguna even with mitigation for Alternatives 2, 3, 4, and 5A due to reduced flow relative to existing condition. Reduced flow favors benthic algal growth.

The number of significant beneficial impacts estimated to result from cumulative projects is the same as from the Project for each discharge component (Merritt Smith Consulting 1996r). The predicted frequency of significant beneficial impacts of cumulative projects on benthic algae range from zero to 8% of the total number of possible significant beneficial impacts (Table 4.6-54). The frequency of significant beneficial impacts on benthic algae increases with mitigation for Alternatives 4, and 5B.

Planktonic Algae

The impact of cumulative projects on planktonic algae biomass, during a normal hydrological year, is estimated to be similar to that of the Project (Merritt Smith Consulting 1996r). The single significant adverse impact estimated to result from cumulative projects (on the Russian River below the Laguna with Alternative 5B) is the same as that from the Project. Mitigation for biostimulatory substances is predicted to reduce the single adverse impact on benthic algae resulting from cumulative projects to less than significant levels (Table 4.6-53).

The number of significant beneficial impacts estimated to result from cumulative projects is the same as that from the Project for each discharge component, except for Alternative 5A in the lower Russian River and Alternative 5B in the Laguna. In the lower Russian River with a 20% River discharge, the number of significant beneficial effects of the Project is reduced by cumulative projects from seven to zero. In the Laguna with Alternative 5B, the number of significant beneficial effects of the Project is reduced by cumulative projects from 4 to 3 (from 11% to 8% of the total possible impacts in the normal year). The beneficial impacts on planktonic algae resulting from cumulative projects are predicted to be reduced by mitigation to below significance (Table 4.6-52). The nutrient load from increased wastewater discharges to the Russian River that is associated with cumulative projects is possibly the cause of the reduced number of beneficial Subregional System Project impacts.

Turbidity

The impact of cumulative projects on turbidity, during a normal hydrological year, is estimated to be similar to that of the Project (Merritt Smith Consulting 1996r). The cumulative projects are not predicted to cause significant adverse impacts on turbidity (Table 4.6-53). Significant beneficial impacts of cumulative projects are predicted to occur with Alternative 5B (Table 4.6-54). These beneficial impacts are reduced by mitigation to below significance.

Ammonia-Nitrogen Concentration

The impact of cumulative projects on the concentration of ammonia nitrogen, during a normal hydrological year, is estimated to be similar to that of the Project (Merritt Smith Consulting 1996r). No significant impacts are expected from cumulative projects or for the cumulative projects with predicted mitigation for biostimulatory substances.

SUMMARY OF SIGNIFICANT IMPACTS AND MITIGATION MEASURES

Table 4.6-58

Summary of Impacts and Mitigation Measures - Surface Water Quality

Impact	Level of Significance	Mitigation Measure
No Action Alternative		
6.1.1. The No Action Alternative may cause numeric-based criteria to be exceeded. (See 6.9.1 for detailed description).	Alt 1 - ●	No mitigation
6.1.2. The No Action Alternative may cause narrative-based criteria to be exceeded. (see 6.9.2 for detailed description).	Alt 1 - ●	No mitigation
Storage Reservoir Component		
6.5.1 Ammonia. The storage reservoir component may cause numeric-based criteria to be exceeded.	Alt 2A - ⊙ Alt 2C - ⊙ Alt 2D - ⊙ Alt 3 - ⊙	2.5.3 Control Program for Hydrogen Sulfide, Ammonia, and Dissolved Oxygen.
6.5.1 Dissolved oxygen. The storage reservoir component may cause numeric-based criteria to be exceeded.	Alt 2A - ⊙ Alt 2C - ⊙ Alt 2D - ⊙ Alt 3 - ⊙	2.5.3 Control Program for Hydrogen Sulfide, Ammonia, and Dissolved Oxygen.
6.5.1 Hydrogen sulfide. The storage reservoir component may cause numeric-based criteria to be exceeded.	Alt 2A - ⊙ Alt 2C - ⊙ Alt 2D - ⊙ Alt 3 - ⊙	2.5.3 Control Program for Hydrogen Sulfide, Ammonia, and Dissolved Oxygen.
6.5.3. The storage reservoir component may impact special sites.	Alt 3 - ●	No feasible mitigation has been identified.
Agricultural Irrigation Component		
6.7.1 Dissolved copper. The agricultural irrigation component may cause numeric-based criteria to be exceeded.	Alt 3 - ⊙	2.5.2 Control Program for Dissolved Copper Levels in West County Creeks.

Table 4.6-58

Summary of Impacts and Mitigation Measures - Surface Water Quality

Impact	Level of Significance	Mitigation Measure
6.7.3. Salinity, ammonia, dissolved oxygen, planktonic algae, benthic algae, and metals. The agricultural irrigation component may cause the special site criterion to be exceeded.	Alt 3 - ●	No feasible mitigation has been identified.
Discharge Component		
6.9.1. Conductivity. The discharge component may cause numeric-based criteria to be exceeded.	Alt 5A - ●	No feasible mitigation has been identified.
6.9.1. Cyanide. The discharge component may cause numeric-based criteria to be exceeded.	Alt 1 - ● Alt 5B - ⊙	2.5.5. Cyanide Monitoring and Source Control Program.
6.9.1. Dissolved oxygen. The discharge component may cause numeric-based criteria to be exceeded.	Alt 5B - ●	No feasible mitigation has been identified.
6.9.2. Biostimulatory Substances. The discharge component may cause narrative based criteria to be exceeded.	Alt 1 - ● Alt 2 - ● Alt 3 - ● Alt 4 - ● Alt 5 - ●	2.5.4 Discharge Operations.
6.9.2. Biostimulatory Substances. Beneficial. The discharge component may cause narrative-based criteria to be exceeded.	Alt 1 - + Alt 2 - + Alt 3 - + Alt 4 - + Alt 5 - +	None required.
6.9.2. Turbidity-Adverse. The discharge component may cause narrative-based criteria to be exceeded.	Alt 5 - ●	2.5.4 Discharge Operations.
6.9.2. Turbidity. Beneficial. The discharge component may cause narrative-based criteria to be exceeded.	Alt 1 - + Alt 5A - + Alt 5B - +/❍	None required.

Table 4.6-58

Summary of Impacts and Mitigation Measures - Surface Water Quality

Impact	Level of Significance	Mitigation Measure
6.9.2. Waste Reduction Strategy - Total Nitrogen-Adverse. The discharge component may cause narrative-based criteria to be exceeded..	Alt 1 - ● Alt 5B - ⊙	2.5.6 Total and Ammonia Nitrogen Source Control Program.
6.9.2. Waste Reduction Strategy-Total Nitrogen-Beneficial. The discharge component may cause narrative-based criteria to be exceeded.	Alt 2 - + Alt 3 - + Alt 4 - + Alt 5A - + Alt 5B - ❍/+	None required.
6.9.2. Waste Reduction Strategy-Ammonia-Nitrogen-Adverse. The discharge component scenarios may cause narrative-based criteria to be exceeded.	Alt 1 - ● Alt 5B - ⊙	2.5.6 Total and Ammonia Nitrogen Source Control Program.
6.9.2. Waste Reduction Strategy-Ammonia-Nitrogen-Beneficial. The discharge component may cause narrative-based criteria to be exceeded.	Alt 2 - + Alt 3 - + Alt 4 - + Alt 5A - + Alt 5B - ❍/+	None required.
6.9.2. Toxicity (lethal effects). The discharge component may cause narrative-based criteria to be exceeded.	Alt 1 - ● Alt 5B - ⊙	2.5.7 Toxicity Control Program.

Source: Merritt Smith Consulting 1996

Notes: Level of significance codes:

- ❍ Less than significant impact; no mitigation proposed
- ⊙ Significant impact before mitigation; less than significant impact after mitigation
- ● Significant impact before and after mitigation, except for the No Action component for which the symbol represents significant impact and no mitigation is proposed
- ❍/+ Significant beneficial impact occurs only as a result of mitigation to address adverse impact.
- +/❍ Significant beneficial impact does not occur after mitigation is implemented to address adverse impact.

SUMMARY OF IMPACTS BY ALTERNATIVE

Table 4.6-59 summarizes the impacts by alternative.

Table 4.6-59

Summary of Impacts by Alternative -Surface Water Quality

Component	Alt 1	Alt 2A	Alt 2B	Alt 2C	Alt 2D	Alt 3A	Alt 3B	Alt 3C	Alt 3D	Alt 3E	Alt 4	Alt 5A	Alt 5B
No Action (No Project) Alternative	+●	--	--	--	--	--	--	--	--	--	--	--	--
Headworks Expansion	--	==	==	==	==	==	==	==	==	==	==	==	==
Urban Irrigation	--	==	==	==	==	==	==	==	==	==	--	--	--
Pipelines	--	○	○	○	○	○	○	○	○	○	○	○	--
Storage Reservoirs	--	⊙	○	⊙	⊙	●	●	●	●	●	--	--	--
Pump Stations	--	==	==	==	==	==	==	==	==	==	==	==	--
Agricultural Irrigation	--	○	○	○	○	●	●	●	●	●	--	--	--
Geysers Steamfield	--	--	--	--	--	--	--	--	--	--	==	--	--
Discharge	--	+●	+●	+●	+●	+●	+●	+●	+●	+●	+●	+●	●
Cumulative Impacts	==	==	==	==	==	==	==	==	==	==	==	==	1

Source: Merritt Smith Consulting 1996

Notes: Level of Significance Codes:

--	Not applicable	==	No impact
○	Less than significant impact; no mitigation proposed	⊙	Significant impact; less than significant after mitigation
●	Significant impact before and after mitigation, except for the No Action component for which the symbol represents significant impact and no mitigation is proposed	+	Beneficial impact

1. Water quality impacts from the Project plus cumulative projects will decrease resulting in all impacts being mitigable to a level below significance.

Table 4.6-60 summarizes the significant adverse and beneficial impacts of Project components on surface water quality, and the level of significance after implementation of mitigation. Storage, irrigation, and discharge components were found to have a significant impact, and other components were found to cause a less-than-significant impact or no impact. The impacts of the storage, irrigation, and discharge components are discussed below.

Storage Reservoir Component

Construction of a storage reservoir is included in Alternatives 2 and 3. Storage reservoirs will have a significant effect on water quality immediately downstream of a dam due to seepage from the reservoir. This will be mitigated by intercepting any seepage that discharges to surface water and pumping it back to the reservoir.

Storage will also affect flow, and, in West County, changes in flow are considered to result in a significant impact on water quality in the Estero de San Antonio or the Estero Americano (part of the Gulf of the Farallones National Marine Sanctuary). Any water quality impact in the Sanctuary is considered to be significant. Measures have been adopted as part of the Project which will reduce this significant impact, but no mitigation has been identified which will avoid impacts in the esteros altogether.

Agricultural Irrigation Component

Subflow from irrigation that discharges to streams in West County (Alternative 3) will cause a significant impact in Stemple and Americano creeks with respect to the concentration of dissolved copper. Mitigation involves reducing irrigation acreage to avoid a significant impact.

Irrigation, like storage, is projected to affect the flow in West County streams. Although storage alone will slightly decrease stream flow, the combined effect of storage and irrigation is to increase flow into the esteros by up to about 2.5 cfs. Measures have been adopted as part of the Project to improve management of animal waste and other agricultural materials in the watershed. The combined effect of reduced animal waste and slightly increased flow will have a small, but significant impact on water quality in the esteros. No mitigation has been identified which will completely avoid impacts in the esteros.

Discharge Component

The No Action Alternative (Alternative 1) will involve continued discharge to the Laguna, but if the City takes no action on a Long-Term Project, CEQA does not require mitigation for impacts. Therefore, Alternative 1 is considered to have a greater impact than the 20% design discharge (Alternative 5). The impact of cumulative projects plus the discharge under the No Action Alternative component is similar to the impact of the No Action discharge alone.

Discharge to the Laguna at the 1% design discharge rate (Alternatives 2 and 3) was found to have significant beneficial and adverse impacts on biostimulatory substances (algal growth). The quarter-mile reach of Santa Rosa Creek downstream of the Delta Pond discharge is an ideal habitat for growth of attached algae under particular conditions, and a 1% design discharge will occasionally (once every 18 months) cause an increase in attached algae relative to existing conditions. The 1% design discharge will more often (in five of 18 months) cause a beneficial decrease in attached algae. The 1% design discharge will cause planktonic algae to increase in the Laguna because flows will be reduced (which favors buildup of planktonic algae) relative to existing conditions. Mitigation has not been identified which will reduce the frequency of adverse impacts on attached or planktonic algae due to the 1% design discharge. Implementation of the 1% design discharge will also meet the Regional Board's waste load reduction goals because the quantity of nitrogen being discharged to the Laguna will be reduced relative to existing conditions. The combination of reduced nutrient loads in the Laguna (as a result of the cumulative projects) with the 1% design discharge further reduces the frequency of adverse impacts and increases the frequency of beneficial impacts.

Discharge to the Laguna at the 20% design discharge rate (Alternative 5B) was found to have many more adverse impacts than the 1% design discharge, but mitigation (including emphasizing discharge in winter relative to fall and spring) will reduce the number of impacts on algae in Santa Rosa Creek and the Laguna to a level that is only slightly greater than that of the 1% design discharge. The mitigated 20% design discharge to the Laguna will occasionally (once every 12 months) cause significant impacts in the Russian River that will not occur with the 1% design discharge. The mitigated 20% design discharge to the Laguna results in more beneficial than adverse impacts. With mitigation, the 20% design discharge will very rarely cause a significant impact with respect to dissolved oxygen. This impact will only occur because the 20% design discharge alternative beneficially reduces algae under certain conditions, and reduced algae paradoxically leads to less production of dissolved oxygen. The 20% design discharge will cause significant impacts on turbidity, cyanide, toxicity and waste load reduction, all of which could be mitigated to a less-than-significant or even beneficial level. The impact of cumulative projects plus the mitigated 20% Laguna discharge component is less than significant.

The 20% design discharge to the Russian River (Alternative 5A) will cause growth of attached algae in the River similar to that caused by the 20% design discharge to the Laguna via Santa Rosa Creek. With mitigation, the 20% design discharge to the River results in more beneficial than adverse impacts. Discharge to the Laguna will occur occasionally under Alternative 5A, and the frequency and amount of this Laguna discharge is similar to that under Alternative 4 (Geysers). Even under Alternatives 4, and 5A, occasional significant impacts on attached algae in lower Santa Rosa Creek will occur. Such impacts will also occur with implementation of cumulative projects.

Table 4.6-60

Summary of Significant Adverse and Beneficial Surface Water Quality Impacts[1]

Evaluation Criterion	Santa Rosa Creek	Laguna	Russian River	West Co. Creeks	Esteros	Tolay Creek	Petaluma River	Other Waters
Dissolved Copper	None	None	None	~~Irrig~~	*Irrigation & Storage (any water quality change is significant, and changes in many parameters are predicted)*	None	None	None
Ammonia	See Waste Red. Strategy	See Waste Red. Strategy	None	~~Storage~~		~~Storage~~	None	None
Conductivity	Criterion not applicable		*20% River*	Criterion NA		Criterion not applicable		
Cyanide	~~20%,~~ *NP*	~~20%~~, *NP*	None	None		None	None	None
Dissolved Oxygen	**20%**	20%	None	~~Storage~~		~~Storage~~	None	None
Hydrogen Sulfide	None	None	None	~~Storage~~	None	~~Storage~~	None	None

Table 4.6-60

Summary of Significant Adverse and Beneficial Surface Water Quality Impacts[1]

Evaluation Criterion	Santa Rosa Creek	Laguna	Russian River	West Co. Creeks	Esteros	Tolay Creek	Petaluma River	Other Waters
Biostimulatory Substances - Benthic algae					*Irrigation & Storage (any water quality change is significant, and changes in many parameters are predicted)*			
• Adverse	1%,20%, 20% River, *NP*, G	1%, 20%, 20% River, *NP*, G	20%, 20% River, *NP*	None		None	None	None
• Beneficial	1%, **20%,** 20%River, G, *NP*	1%, **20%,** 20%River, G, *NP*	1%, **20%,** 20%River, G, *NP*	None		None	None	None
Biostimulatory Substances Planktonic algae								
• Adverse		1%, 20%River	20%, 20% River	None		None	None	None
• Beneficial	20%, *NP*	20%, *NP*	20% River	None		None	None	None
Turbidity								
• Adverse			~~20% River~~					
• Beneficial	*NP*, ~~20%~~	*NP*, ~~20%~~	20% River					
Waste Reduction Strategy			Criterion not applicable					
• Total Nitrogen								
♦ Adverse	~~20%~~, *NP*							

Table 4.6-60

Summary of Significant Adverse and Beneficial Surface Water Quality Impacts[1]

Evaluation Criterion	Santa Rosa Creek	Laguna	Russian River	West Co. Creeks	Esteros	Tolay Creek	Petaluma River	Other Waters
♦ Beneficial	1%, 20% River, G							
• Ammonia N								
♦ Adverse	~~20%,~~ *NP*							
♦ Beneficial	1%, 20% River, G							
Lethal Toxicity (Lethal)	~~20%,~~ *NP*	Evaluated in Santa Rosa Creek, where worst-case conditions occur		None	None	None	None	None
Other criteria	None	None	None	None	See top note	None	None	None

1. Components causing a significant adverse or beneficial impact are shown. Since impacts were evaluated for all months and three hydrologic years, both beneficial and adverse impacts can result for some parameters at different times from the same component. Overstriking indicates impact avoided with mitigation or measures that need to be considered by the city for the No Project component, italics indicates no mitigation proposed, bold indicates impacts significant after mitigation that are not significant before mitigation. Components are identified as follows:
   1% = 1% design discharge component (Alts 2&3)
   NP = No Project discharge component (Alt 1)
   Irrigation=irrigation in related Project area
   20% River = 20% design discharge component to River (Alt 5A)
   G = Geysers discharge component (Alt 4)
   20% = 20% design discharge component to Laguna (Alt 5B)
   Storage = Storage reservoir

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