Santa Rosa Subregional Long-Term Wastewater Project

WATER QUALITY IMPACT ANALYSIS REPORT

SANTA ROSA SUBREGIONAL LONG-TERM WASTEWATER PROJECT

Prepared for
City of Santa Rosa
and
U.S. Army Corps of Engineers

July 1996

Prepared by
Merritt Smith Consulting
Environmental Science and Communication
3675 Mt. Diablo Blvd. #120 Lafayette, CA 94549

For
HARLAND BARTHOLOMEW & ASSOCIATES, INC.

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1.0 SUMMARY

The potential effect of components of reclaimed water management alternatives on surface water quality was evaluated for significance and to describe the range of potential effects. Evaluation criteria with points of significance that provided the basis of the significance evaluation are described in the *Development of Evaluation Criteria for Potential Water Quality* Impacts Technical Report (MSC 1996). The evaluation criteria provide for identification of significant adverse impacts for 118 constituents for which water quality criteria have been established by Federal and State authorities. The evaluation criteria also provide for identification of significant beneficial impacts for algae, turbidity and nitrogen load (as described in the Waste Reduction Strategy evaluation criterion).

Table 1-1 identifies significant adverse and beneficial impacts, and their level of significance after mitigation is implemented. Mitigation is identified for specific impacts as described in Table 1-2. Table 1-2 also includes measures for the City’s consideration to avoid significant impacts of the No Project discharge component. Mitigation is estimated to avoid significant adverse impacts of irrigation, except in the Esteros. Mitigation is estimated to reduce, but not completely avoid impacts of each discharge component (1, 5 and 10 percent design discharge, the 20 percent design Laguna discharge component, the 20 percent design River discharge component and the discharge components associated with the Geysers alternative).

The number of significant beneficial impacts of discharge components on each of algae, turbidity and nitrogen load is less than the respective number of significant adverse impacts. However, mitigation would reverse this situation and create a greater number of significant beneficial than adverse impacts.

Table 1-1.

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

Evaluation Criterion	Santa Rosa Creek	Laguna	Russian River	West Co. Creeks	Esteros	Tolay Creek	Petaluma River	Other Waters
Biostimulatory Substances (Benthic algae)					*Irrigation (any water quality change is significant, and changes in many parameters are predicted)*			
Adverse	1%, 5%, 10%, 20%, 20% River, NP, G	1%, 20%, 20% River, NP, G	20%, 20% River, NP	None		None	None	None
Beneficial	1%, 5%, 10%, **20%,** 20%River, G, **NP**	1%, 5%, 10%, **20%,**20%River, G, **NP**	1%, 5%, 10%, **20%,** 20%River, G, **NP**	None		None	None	None
Biostimulatory Substances (Planktonic algae)								
Adverse		1%, 5%, 10%, 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	~~20%~~	~~20%~~	20% River					
Ammonia	See Waste Red. Strategy	See Waste Red. Strategy	None	~~Storage~~		~~Storage~~	None	None

Table 1-1.

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

Dissolved Copper	None	None	None	~~Irrig~~		None	None	None
Cyanide	~~10%, 20%, NP~~	~~20%, NP~~	None	None		None	None	None
Conductivity	Criterion not applicable		*20% River*	Criterion NA		Criterion not applicable		
Dissolved Oxygen	**20%, NP**	20%, **NP**	None	~~Storage~~		~~Storage~~	None	None
Hydrogen Sulfide	None	None	None	~~Storage~~	None	~~Storage~~	None	None
Lethal Toxicity	~~20%, NP~~	~~20%, NP~~		None	None	None	None	None
Waste Red. Strategy Adverse Total Nitrogen Ammonia Beneficial Total Nitrogen Ammonia	 ~~10%, 20%,~~ NP ~~20%, NP~~ 1%, 5%, 20%River, G 1%, 5%, 10%, 20% River, G	 ~~10%, 20%, NP~~ ~~20%, NP~~ 1%, 5%, 20%River, G 1%, 5%, 10%, 20% River, G	Criterion not applicable					
Other criteria	None	None	None	None	See top note	None	None	None

[a] 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 that are significant after mitigation that are not significant before mitigation. Components are identified as follows:

1% = 1% design discharge component
5% = 5% design discharge component
10% = 10% design discharge component
20% = 20% design discharge component to Laguna
20% River = 20% design discharge component to River
Storage = Storage reservoir
NP = No Project discharge component
G = Geysers discharge component
Irrig = Irrigation e

Table 1-2.

Summary of Proposed Mitigation[a]

Component	Affected Water	Impacts Mitigated[b]	Mitigation
Discharge	Santa Rosa Creek, Laguna, Russian River	*Algae, Diss. Oxygen*	Modify operations to discharge more in the winter, and less in the fall and spring
	Santa Rosa Ck, Laguna	Nitrogen load	Control other sources of nitrogen
	Santa Rosa Ck, Laguna	Ammonia load	Control other sources of ammonia
	Santa Rosa Ck, Laguna	Cyanide	Implement source identification and control program
	Russian River	*Conductivity*	None (although discharge to Laguna would avoid impact)
	Santa Rosa Ck, Laguna	Toxicity	Increased monitoring, toxicity reduction program
Storage	All streams below dams	Ammonia, H_2S, Dissolved Oxygen	Monitor for impact, then intercept seepage and pump back to reservoir as needed
Irrigation	Stemple Creek, Americano Creek	Dissolved Copper	Reducing irrigation land in the Bloomfield storage site watershed would avoid significant impacts in the Americano watershed, and reducing irrigation area throughout the Stemple watershed to about 4,500 acres (out of a total of 5,500 available acres) would avoid significant impacts
	Esteros	*Many constituents, including salinity, algae, dissolved oxygen*	No mitigation is proposed specifically to address Estero impacts, but above mitigation will reduce impacts

a Includes measures that need to be considered by the City for the No Project component. Impacts shown in italics are considered significant even with mitigation.

2.0 INTRODUCTION

The purpose of this report is to describe potential impacts of project components on surface water quality. Surface water quality components that potentially affect surface waters and are addressed in this report are as follows:

- Discharge
- Pipelines
- Urban Irrigation
- Agricultural Irrigation
- Storage

This report is organized by project area (as shown in Figure 2-1) because several components potentially affect the same waters in particular project areas (e.g., storage and irrigation affect local creeks). Each component is evaluated according to the applicable subset of the evaluation criteria to identify significant impacts. The range of impacts on surface water quality is also described. The impact of project components on aquatic sediments is addressed in the *Sediment Quality Characterization for the Russian River, Laguna de Santa Rosa, Santa Rosa Creek, and Reclaimed Water Storage Ponds* Technical Report (MSC 1996).

3.0 SCREENING OF EVALUATION CRITERIA

Evaluation criteria for the protection of aquatic and benthic life with points of significance are described in the *Development of Evaluation Criteria for Potential Water Quality Impacts* Technical Report (MSC 1996). The evaluation criteria in Section 3.1 are numerous and are organized into those that relate to the following:

1. Numeric water quality objectives, criteria, standards, Basin Plan or other State or Federal policies for the protection of aquatic life, hereafter called criteria.
2. Narrative water quality objectives, criteria, standards, Basin Plan or other State or Federal policies for the protection of aquatic life, hereafter called criteria.
3. Alteration of water quality in an Area of Special Biological Significance or National Marine Sanctuary.
4. Numeric sediment quality criteria for the protection of aquatic life.

Details about the criteria are provided in the *Development of Evaluation Criteria for Potential Water Quality Impacts* Technical Report (MSC 1996). A summary of the criteria is in Table 3-1.

The purpose of this section is to screen evaluation criteria in these four categories. Table 3-1 in Section 3.1 summarizes the criteria. The screening process is summarized in Section 3.2 and described for major groups in Sections 3.2 through 3.6. Substances for which the screening is specifically related to a Project component or location are discussed in the appropriate section of this report.

3.1 EVALUATION CRITERIA

Table 3-1 lists each of the 118 evaluation criteria for surface water and sediment quality for the protection of aquatic and benthic life that were identified in the *Development of Evaluation Criteria for Potential Water Quality Impacts* Technical Report (MSC 1996). These criteria are based on water quality regulations, objectives and guidelines that have been developed by regulatory authorities to protect aquatic and benthic life. The project has the potential to cause the point of significance to be exceeded (which, if exceeded, would result in a determination that the effect is significant) in a total of 55 evaluation criteria. In the case of the 60 criteria, no significant effects of any project component are projected to occur, and, therefore, these 60 criteria are not considered further in this report. Three of the criteria are addressed in other sections of the EIR/EIS are duplicative of other surface water quality evaluation criteria. Table 3-1 lists the 55 criteria for which significant effects are projected to occur. Table 3-1 also lists each of the 60 screened criteria; they appear in groups according to the rationale why significant effects would not occur. Table 3-1 also identifies the three criteria that are addressed in other sections of the EIR/EIS.

Table 3-1.

Evaluation Criteria for the Protection of Aquatic and Benthic Life with Criteria of Significance - Surface Water Quality and Sediment Quality

Evaluation Criteria	Point of Significance			Justification[a]
	Fresh-water	Salt-water	As Measured By	
1. Numeric-based criteria				
Aluminum	0.087	none	mg/L	EPA criterion
Dissolved Arsenic (all valence states)	0.19	0.036	mg/L	EPA criteria
Dissolved Cadmium	0.0012[b]	0.0093	mg/L	EPA criteria
Dissolved Chromium III	0.21[b]	none	mg/L	EPA criterion
Dissolved Chromium VI	0.01	0.050	mg/L	EPA criteria
Dissolved Copper	0.013[ab]	0.0024	mg/L	EPA criteria
Dissolved Lead	0.003[b]	0.0081	mg/L	EPA criteria
Total Mercury	0.0013[c]	0.0011[c]	mg/L	EPA final chronic values
Dissolved Nickel	0.182[b]	0.0082	mg/L	EPA criteria
Total Selenium	0.005	0.071	mg/L	EPA criteria
Dissolved Silver	0.0019[b]	0.0019	mg/L	EPA criteria
Dissolved Zinc	0.121[b]	0.081	mg/L	EPA criteria
Aldrin	3.0	1.3	µg/L	EPA criteria
BHC-gamma (Lindane)	0.08	0.16	µg/L	EPA and Basin Plan criteria
Chlorinated benzenes	50	129	µg/L	EPA criteria
Chloroform	1,240	none	µg/L	EPA criterion
Dichlorobenzenes	763	1970	µg/L	EPA criteria
Endosulfan-beta	0.056	0.0087	µg/L	EPA and Basin Plan criteria

Table 3-1.

Evaluation Criteria for the Protection of Aquatic and Benthic Life with Criteria of Significance - Surface Water Quality and Sediment Quality

Evaluation Criteria	Point of Significance			Justification[a]
	Fresh-water	Salt-water	As Measured By	
Ethylbenzene	32,000	430	µg/L	EPA criteria
Halomethanes (bromodichloromethane, bromoform, bromomethane, chloromethane, dibromochloromethane)	11,000	6400	µg/L	EPA criteria
Heptachlor	0.0038	0.0036	µg/L	EPA and Basin Plan criteria
Tetrachloroethylene	840	450	µg/L	EPA criteria
Trichloronated ethanes	18,000	none	µg/L	EPA criteria
Toluene	17,500	5000	µg/L	EPA criteria
Phthalate Esters	8	3.4	µg/L	Based on EPA criterion. The freshwater value is different from that in the Development of Evaluation Criteria for Potential Water Quality Impacts Technical Report, as explain on page 112 of this report
Total Ammonia - Sensitive Species Absent	0.76[e]	0.90[e]	mg-N/L	EPA criteria (For Russian River only. For Laguna and Santa Rosa Creek see Waste Reduction Strategy)
Total Ammonia - Sensitive Species Present	0.76[e]	0.90[e]	mg-N/L	EPA criteria (For Russian River only. For Laguna and Santa Rosa Creek see Waste Reduction Strategy)
Chloride	230	None	mg/L	EPA criterion

Table 3-1.

Evaluation Criteria for the Protection of Aquatic and Benthic Life with Criteria of Significance - Surface Water Quality and Sediment Quality

Evaluation Criteria	Point of Significance			Justification[a]
	Fresh-water	Salt-water	As Measured By	
Conductivity	250, 285	None	µmhos/cm	Basin Plan criteria[f]. (Shown are the upper 50th percentile (median) monthly values for the Russian River above and below the Laguna, respectively)
Cyanide	5.2/22[f]	1	µg/L	EPA and Basin Plan criteria
Dissolved Oxygen	5.0-10.0	5.0-10.0	mg/L	Basin Plans criteria. (Values shown are the range of minimum, lower 50 and 90 percentiles for different water bodies)
Hydrogen sulfide	2	2	µg/L	EPA criteria
Total dissolved solids	150-170 170-200	None	mg/L	Basin Plan criteria. (Values shown are the range for the upper 50th and 90th percentiles for the Russian River above and below the Laguna)
pH	Not evaluated for significance or range of impacts			The average pH of reclaimed water is within the points of significance for pH.
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.

Table 3-1.

Evaluation Criteria for the Protection of Aquatic and Benthic Life with Criteria of Significance - Surface Water Quality and Sediment Quality

Evaluation Criteria	Point of Significance			Justification[a]
	Fresh-water	Salt-water	As Measured By	
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 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	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 reporting 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 3-1.

Evaluation Criteria for the Protection of Aquatic and Benthic Life with Criteria of Significance - Surface Water Quality and Sediment Quality

Evaluation Criteria	Point of Significance			Justification[a]
	Fresh-water	Salt-water	As Measured By	
Acrolein, chlorpyrifos, demeton, guthion, malathion, parathion, toxaphene[b]	Not evaluated for significance or range of impacts			These substances have been analyzed in reclaimed water and have not been detected, but the current EPA-approved method provides a reporting limit that is greater than the aquatic life criterion.
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.
Chlorophenyl 4	Not evaluated for significance or range of impacts	-	-	Substance not measured in effluent but EPA criterion (saltwater, 29.7 mg/L) . is larger than the average total organic carbon in effluent (9.3 mg/L). Chlorophenyl-4 is a compound that would be detected in a total organic carbon analysis.. Therefore, it is very unlikely that, if chlorophenyl 4 is present in effluent, it exceeds the point of significance.
2. Narrative-based criteria				
Color.	0 occurrences	0 occurrences	A change in apparent color lasting more than a day.	Basin Plans narrative criterion

Table 3-1.

Evaluation Criteria for the Protection of Aquatic and Benthic Life with Criteria of Significance - Surface Water Quality and Sediment Quality

Evaluation Criteria	Point of Significance			Justification[a]
	Fresh-water	Salt-water	As Measured By	
Floating Material.	0 occurrences	0 occurrences	Accumulation of visible floating material, including solids, liquids, foams, film or coating, and scum.	Basin Plans narrative criterion
Settleable Matter.	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	mL/L	Basin Plans narrative criterion. Discharge permit limit used as point of significance, since permit limit established to protect beneficial uses.
Biostimulatory Substances - Adverse. An increase in attached or planktonic algae.	10 % increase	10 % increase	Benthic (attached) algae biomass and planktonic algae density as monthly average of chlorophyll *a*	Basin Plans narrative criterion. 10%, established by professional judgment, is the criterion for identifying impacts on streams. Ecological impacts on attached or planktonic algae are also addressed by the dissolved oxygen criterion.
Biostimulatory Substances - Beneficial. A decrease in attached or planktonic algae would be considered beneficial.	10% decrease	10% decrease	Benthic algae biomass and planktonic algae density as monthly average of chlorophyll *a*	10%, established by professional judgment, is the criterion for identifying impacts on streams. Ecological impacts on attached or planktonic algae are also addressed by the dissolved oxygen criterion.

Table 3-1.

Evaluation Criteria for the Protection of Aquatic and Benthic Life with Criteria of Significance - Surface Water Quality and Sediment Quality

Evaluation Criteria	Point of Significance			Justification[a]
	Fresh-water	Salt-water	As Measured By	
Sediment.	any increase	any increase	Suspended sediment in the waterways.	Basin Plans narrative criterion
Salinity. The discharge to San Pablo Bay or its tributaries may cause an increase in salinity.		any increase above background	ppt	Basin Plan narrative criterion
Temperature.	5 °F increase in monthly average temperature	4 °F increase in monthly average temperature in estuaries	° F	Basin Plans narrative criterion
Turbidity - Adverse.	20% increase	20% increase	Monthly average planktonic algal biomass as chlorophyll *a*	Basin Plans narrative criterion 20%, established by professional judgment, is the criterion intended to protect visual-related beneficial uses (i.e., aesthetics and fish feeding).
Turbidity - Beneficial.	20% decrease	20% decrease	Monthly average planktonic algal biomass as chlorophyll *a*	20%, established by professional judgment, is the criterion intended to protect visual-related beneficial uses (i.e., aesthetics and fish feeding).

Table 3-1.

Evaluation Criteria for the Protection of Aquatic and Benthic Life with Criteria of Significance - Surface Water Quality and Sediment Quality

Evaluation Criteria	Point of Significance			Justification[a]
	Fresh-water	Salt-water	As Measured By	
Waste Reduction Strategy - Adverse			Pounds ammonia-nitrogen/year	This objective applies only to the Laguna
a). Discharge to the Laguna may cause ammonia nitrogen load to the Laguna not to be reduced by 21,500 pounds per year, the objective listed by the North Coast Regional Board (Table D-5 Waste Reduction Strategy Report 1995).	a) If ammonia nitrogen load in the Laguna is not reduced by 21,500 pounds per year.			a) The NCRWQCB Waste Reduction Strategy establishes an ammonia nitrogen load reduction goal of 21,500 pounds per year for the Subregional System (see Table 4 in NCRWQCB 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, the objective listed by the North Coast Regional Board	b) If total nitrogen load in the Laguna is not reduced by 159,000 pounds per year.		Pounds total nitrogen /year	b) The NCRWQCB Waste Reduction Strategy establishes a total nitrogen reduction goal of 159,000 pounds per year for the Subregional System (see Table 4 in NCRWQCB 1995).
Waste Reduction Strategy - Beneficial	a) If total nitrogen is reduced by more than 159,000 pounds per year		Pounds ammonia-nitrogen/year	a) Exceeding the Waste Reduction Strategy goal for total nitrogen is the basis for the beneficial impact criterion.
	b) If ammonia nitrogen is reduced by more than 21,500 pounds per year		Pounds total nitrogen /year	Exceeding the Waste Reduction Strategy goal for ammonia nitrogen is the basis for the beneficial impact criterion

Table 3-1.

Evaluation Criteria for the Protection of Aquatic and Benthic Life with Criteria of Significance - Surface Water Quality and Sediment Quality

Evaluation Criteria	Point of Significance			Justification[a]
	Fresh-water	Salt-water	As Measured By	
Toxicity (lethal effects)	any increase	any increase	frequency of toxic conditions	Basin Plan criterion
Tastes and Odors (see Public Safety section 4.7). 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 changes in the Area of Special Biological Significance or in the Sanctuary.	Any change	Any change		Special Site Criteria

Table 3-1.

Evaluation Criteria for the Protection of Aquatic and Benthic Life with Criteria of Significance - Surface Water Quality and Sediment Quality

Evaluation Criteria	Point of Significance			Justification[a]
	Fresh-water	Salt-water	As Measured By	
4. Sediment quality evaluation criteria				
Acenaphthene	130	230	µg/g organic carbon	EPA criteria
Dieldrin	11	20	µg/g organic carbon	EPA criteria
Endrin	4.2	0.76	µg/g organic carbon	EPA criteria
Fluoranthene	620	300	µg/g organic carbon	EPA criteria
Phenanthrene	180	240	µg/g organic carbon	EPA criteria

Source: Development of Evaluation Criteria for Potential Water Quality Impacts Technical Report (MSC 1996)

[a] 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.

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

[c] 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

[d] 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 would have to be less than the 0.039 µg/L that adversely affected brook trout.

[e] 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 (*Russian River Water Quality Monitoring Results* Technical Report, MSC 1996)

[f] 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.

[g] 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).

EPA Criteria for the protection of aquatic life are described in EPA (1986). Basin Plan references is NCRWQCB (1994) and SFRWQCB (1995).

The water quality impact of each project component is evaluated in this report for a) significance and b) the range of potential impacts regardless of significance. Reclaimed water constituents were screened for evaluation according to the following criteria:

- If the constituent was not detected in reclaimed water, the compound is not considered further in this evaluation (i.e., the range of potential impacts nor impact significance was evaluated).

- If the compound is detectable in reclaimed water, but no evaluation criterion with a point of significance has been identified, the range of potential impacts for the compound is described but any potential impacts are not evaluated for significance.

- If the compound has been analyzed in reclaimed water and has not been detected, but the current EPA-approved method provides a detection limit that is greater than the point of significance, the compound is not considered further in this evaluation.

- If the maximum concentration in reclaimed water was always lower than the point of significance, the compound was included only in the evaluation of the range of potential impacts.

- If the point of significance relates to the total concentration of a group of compounds, the total concentration was estimated then evaluated according to the above criteria.

- If a compound is no longer available for use in the United States (banned) then the compound was presumed to represent no long-term threat to the environment as a result of reclaimed water discharge or use, and the substance was not evaluated for the range of potential impacts and impact significance was not evaluated.

The potential impact of remaining reclaimed water constituents is evaluated for the range of potential impacts and impact significance. Constituents for which evaluation criteria with points of significance were identified in the criteria technical report that are potentially indirectly affected by project components (such as algae in the Russian River as a result of discharge) are also evaluated in this report for the range of potential impacts and impact significance.

The results of screening criteria application are described below. Reclaimed water concentrations and points of significance are provided in the *Reclaimed Water Quality Monitoring Results* and *Reclaimed Water Quality Monitoring Results Update* Technical Reports (MSC 1996).

3.2 CONSTITUENTS NOT DETECTABLE

The following constituents have been analyzed but not detected in reclaimed water:

- Antimony
- Beryllium
- Iron

- Selenium
- Thallium
- 1,1,1-Trichloroethane
- 1,1,2,2-Tetrachloroethane
- 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
- Acenaphthene
- Acrylonitrile
- Benzene
- Benzidine
- Carbon Tetrachloride
- Chloride
- Chlorinated napthalenes (2-chloronapthalene)
- Chlorine
- Chloro-4methyl-3phenol
- Chloroalkyl ethers (bis-2-chloroethyl ether, bis(2-chloroisopropyl)ether, 2-chloroethylvinyl ether)
- Dichloroethylene (1,1 dichloroethylene)
- Dichloropropane (1,2 dichloropropane)
- Dichloropropene (cis- and trans- 1,3 dichloropropene and 1.1 dichloropropene)
- Dinitrotoluene (2,4 dinitrotoluene and 2,6 dinitrotoluene)
- Endosulfan (alpha)
- Fluoranthene
- Haloethers (bis-2-chloroethyl ether, bis(2-chloroisopropyl)ether, 4-chlorophenyl phenyl ether, 2-chloroethylvinyl ether, 4-bromophenyl ether)
- Hexachlorobutadiene
- Hexachlorocyclopentadiene
- Hexachloroethane
- Isophorone
- Methoxychlor
- Naphthalene
- Nitrobenzene
- Nitrophenol (2,4-dinitrophenol, 2-methyl-4,6 dinitrophenol, 2-nitrophenol, and 4-nitrophenol)
- Nitrosamines (n-nitroso-di-n-propylamine, n-nitrosodimethylamine, n-nitrosodiphenylamine)
- PAHs (At least 15 PAHs have been measured in reclaimed water, all below detection)
- Pentachlorinated ethanes

- Pentachlorophenol - see below
- Phenol
- Tetrachloroethane (1,1,2,2 tetrachloroethane)
- Tributyl tin
- Trichloroethylene

These compounds are not considered further in this report because their concentrations are unknown but less than any applicable point of significance.

pH was removed from consideration of significant impacts since the average pH of reclaimed water (6.9) is within the points of significance for pH (6.5-8.5). The average of treatment plant reclaimed water quality measurements made from 1991 through January 1995 (as summarized in the *Reclaimed Water Quality* Technical Report, MSC 1996) is assumed to be representative of the quality of reclaimed water discharged from storage ponds. The large capacity of Laguna storage relative to discharge volume assures that variations in plant reclaimed water quality will be dampened and the quality of the discharge will be much more constant. Indirect impacts of the Project on pH may occur through effects of algal growth and dissolved oxygen on pH. Potential indirect impacts on pH are addressed with the dissolved oxygen and algae evaluations.

3.3 COMPOUND DETECTABLE, NO EVALUATION CRITERION WITH POINT OF SIGNIFICANCE

The compounds that have been detected in reclaimed water but have no aquatic life surface water quality point of significance are as follows:

- Acetone
- Carbon disulfide
- Methylene chloride
- Total xylenes
- DCPA
- Aldicarb sulfoxide

The range of potential impacts of these compounds is described in this report but any potential impacts are not evaluated for significance.

3.4 COMPOUND NOT DETECTABLE, BUT REPORTING LIMIT GREATER THAN POINT OF SIGNIFICANCE

The following compounds have not been detected but the EPA-approved reporting limit is greater than the point of significance for the following compounds:

- Acrolein
- Chlorpyrifos
- Demeton
- Guthion
- Malathion
- Parathion
- Toxaphene

The effect of these compounds cannot be evaluated against their respective points of significance because their concentration is unknown. However, continued monitoring of these compounds is proposed as mitigation in the draft EIR/S to provide the project proponent with information about the impacts when/if the concentration of any of these compounds increases and is detectable and/or improved methods are developed that provide lower reporting limits.

3.5 CONCENTRATION DOES NOT EXCEED POINT OF SIGNIFICANCE

The point of significance for alkalinity (20 mg/L)is a minimum concentration. Average alkalinity in reclaimed water ranges from 107 to 138 mg/L and, therefore, exceeds the point of significance. It is not expected that the Project will cause alkalinity in receiving waters to be decreased below the point of significance.

3.6 GROUPS

If the point of significance relates to the total concentration of a group of compounds, the total concentration was estimated and evaluated according to the screening criteria. Criteria have been established for three groups that consist of compounds that are analyzed individually in reclaimed water. Groups were removed from further consideration of significant impacts if the sum of the maximum detectable values were less than the point of significance. Since the large capacity of Laguna storage relative to discharge volume assures that variations in plant reclaimed water quality will be dampened, the sum of the average concentrations of detectable compounds within a group were used to evaluate significance and range of impacts.

- Halomethanes. Halomethanes consist of bromoform, bromomethane, chloromethane, chlorodibromomethane and dichlorobromomethane. All of these compounds were detected in reclaimed water except bromoform. The sum of the maximum detectable values for halomethanes (19.5 µg/L) is less that the point of significance (11,000 µg/L).
- Total dichlorobenzenes. The point of significance for total dichlorobenzenes is 763 µg/L. 1,2 dichlorobenzene, 1,3 dichlorobenzene, and 1,4 dichlorobenzene have been measured in reclaimed water. The sum of the maximum concentrations in reclaimed water of these three compounds is 1.9 µg/L. Therefore dichlorobenzenes were removed from further consideration of significant impacts, but the range of impacts is evaluated to provide an estimate of less than significant impacts.

- Phthalate esters. Phthalate esters that have been detected in reclaimed water include bis-2-ethylhexyl phthalate, diethyl phthalate, butylbenzyl phthalate, and di-N-butyl phthalate. The range of potential impacts and the potential significance is evaluated for phthalate esters using the sum of the average concentrations (7.6 µg/L see *Reclaimed Water Quality Update* Technical Report MSC 1996).

4.0 RUSSIAN RIVER AND SANTA ROSA PLAIN

This section evaluates potential project impacts on water quality in the Russian River and Santa Rosa Plain.

4.1 DESIGN DISCHARGE

4.1.1 Screening of Evaluation Criteria for Direct Discharge

This section evaluates substances that were not eliminated from further consideration in Table 3-1 and screens some from consideration of significance of impacts and range of impacts due to direct discharge.

The points of significance for some metals are related to hardness. The metals listed below were removed from consideration of significant impacts and range of impacts of direct discharge because they were always below detection in reclaimed water and the reporting limits were lower than the point of significance as calculated for the receiving water (Russian River and Santa Rosa Creek average hardness of 119 mg/L):

- Dissolved cadmium
- Dissolved chromium

The criteria for chromium are for dissolved chromium (III) and dissolved chromium (VI). These individual metal ions are not routinely measured in reclaimed water. However, total dissolved chromium, which encompasses both forms of chromium, is measured and is always below detection and the reporting limit was below the point of significance as calculated for the receiving water. Therefore, dissolved chromium was eliminated from consideration of significant impacts of direct discharge.

Dissolved lead was removed from consideration of significant impacts because its concentration in reclaimed water is always below detection. Reporting limits for dissolved lead vary, but are often below the point of significance as calculated for the receiving water.

TDS was removed from consideration of significant impacts and range of impacts of discharge because of lack of sufficient information on TDS in the receiving waters to enable an adequate analysis. Conductivity, which also reflects dissolved solids, was used instead of TDS.

Hydrogen sulfide was removed from consideration of significant impacts and range of impacts of direct discharge since hydrogen sulfide can only exist in an anoxic environment and reclaimed water is oxygenated in the discharge season. Indirect impacts of the project on hydrogen sulfide production may occur if dissolved oxygen is totally depleted. Therefore, potential indirect impacts on hydrogen sulfide are covered under dissolved oxygen.

Chloride was removed from consideration of significant impacts and range of impacts of direct discharge since the average concentration in reclaimed water (120 mg/L) is lower than the point of significance for chloride (230 mg/L).

Color and floating material in reclaimed water have been monitored monthly since 1991. Color and floating material have not been reported in Santa Rosa's reclaimed water and are, therefore, considered non-detectable. The operations of the treatment plant are not expected to change in such a way that would cause color or floating matter to occur. Therefore, they were removed from consideration of significant impacts.

Settleable matter in reclaimed water has been monitored monthly since 1991. Values exceeding the point of significance for settleable matter have not been reported in Santa Rosa's reclaimed water. The operations of the treatment plant are not expected to change in such a way that would cause settleable matter to increase. Therefore, they were removed from consideration of significant impacts.

The following organic chemicals were removed from consideration of significant impacts and range of impacts of direct discharge because their maximum concentration detected in reclaimed water is lower than their respective points of significance (*Reclaimed Water Quality Monitoring* Technical Report, MSC 1996).

- Chlorinated benzenes
- Chloroform
- Dichlorobenzenes
- Endosulfan (beta)
- Ethylbenzene
- Halomethanes (bromoform, bromodichloromethane, bromomethane, chloromethane, and dibromochloromethane - bromoform was not detected in reclaimed water)
- Tetrachloroethylene
- Trichloronated ethanes
- Toluene

4.1.2 Discharge Scenarios Evaluated

Reclaimed water discharge to the Laguna de Santa Rosa (Laguna) and/or the Russian River is a component of several alternatives being evaluated in the EIR/S. Discharge components of alternatives are as follows:

- One percent design discharge to the Laguna is a component of the South County and West County alternatives. As described *in Water Balance Model - Overall Summary and Results* Technical Report (Parsons ES 1995), a "1 percent" discharge reflects the maximum monthly average discharge rate (expressed as a function of Russian River flow at the USGS gage at Hacienda). No contingency discharge (reclaimed water discharge in excess of design discharge) is associated with the 1 percent alternative.
- Twenty percent design discharge to the Laguna is the primary component of the Twenty Percent Laguna Discharge alternative. As described in *the Water Balance*

Model - Overall Summary and Results Technical Report (Parsons ES 1995), a "20 percent" discharge reflects the maximum discharge rate (expressed as a function of Russian River flow at the USGS gage at Hacienda) exclusive of any contingency discharge.

- Twenty percent design discharge to the Russian River is the primary component of the River Discharge Alternative. The pipeline from Delta Pond to the Russian River has been sized to accommodate approximately 95 percent of the flow to be discharged, and the remainder would be discharged at Delta Pond. As described in the *Water Balance Model - Overall Summary and Results* Technical Report (Parsons ES 1995), a "20 percent" discharge reflects the maximum discharge rate (expressed as a function of River flow at the USGS gage at Hacienda) exclusive of any contingency discharge. This component differs from the 20 percent design discharge to the Laguna in that the discharge goes directly to the Russian River above the confluence with the Laguna. Reclaimed water input to the Russian River with the 20 percent design discharge to the River will be located above the Sonoma County Water Agency (SCWA) drinking water intake, so some of the reclaimed water will be removed before reaching the Russian River below the Laguna. Therefore, the predicted concentration of reclaimed water in the Russian River below the Laguna is actually less for the 20 percent design discharge to the River component than for the 20 percent design discharge to the Laguna component.
- Discharge to the Laguna is a component of the Geysers Injection alternative. The pipeline from Delta Pond to the Geysers area has been sized to accommodate approximately 750 MG/month, and the remainder would be irrigated or discharged to the Laguna. No contingency discharge is associated with the Geysers alternative.
- Discharge to the Laguna is a component of the No Project alternative. Discharge associated with a No Project alternative consists of discharge at a similar rate to existing conditions scaled for population growth to the population estimates for 1997. For water quality impact assessing purposes, average dry weather flow in 1997 was assumed to be 17.42 mgd (City of Santa Rosa, 1995) and it was assumed that Treatment Plant improvements are in effect. With Treatment Plant improvements, the average nitrate concentration in reclaimed water is expected to be 14 mg-N/L (down from the current 18 mg-N/L - see *Reclaimed Water Quality* Technical Report MSC 1996). A monthly water balance was developed prior to the development of the daily water balance model for the purpose of sizing facilities. The two models (monthly and daily) provide consistent results (see *Water Balance Model - Overall Summary and Results* Technical Report, Parsons ES 1995).

The discharge components described above were evaluated for water quality impacts according to the Evaluation Criteria described above in this report. In addition to evaluating the impacts of the above discharge scenarios, 5 and 10 percent design discharges to the Laguna (5 and 10 percent maximum discharge rate as a function of Russian River flow) were evaluated. These scenarios were evaluated because all of the irrigation acreage and/or storage necessary to assure a 1 percent maximum discharge rate may not ultimately be available, or because such facilities may be unaffordable. An understanding of the impacts of discharge rates between 1 and 20 percent is a necessary part of evaluating the environmental impact of any such reduced irrigation/storage alternative. The selection of the 5 and 10 percent Laguna discharge scenarios for evaluation does not indicate any expectation that the respective storage capacity and irrigation acreage will be implemented; rather these discharge scenarios were selected to cover the range of possible irrigation/storage and storage alternatives.

Contingency discharge is addressed in a separate section of this report.

4.1.3 Sediment

The potential impacts of 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 and the data input to 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, MSC 1996.

4.1.4 Impact Evaluation Approach

Evaluation of some aspects of the water quality impacts of discharge was conducted with the assistance of a computer simulation model, which is described in the *Russian River Water Quality Model* Technical Report, (RMA 1996). The model simulated daily operation of the reclaimed water discharge system, and incorporated reclaimed water dilution through the Laguna and River system, and biological interactions of algae, nutrients, and dissolved oxygen.

The water quality impacts of each of the discharge scenarios identified above was evaluated over a range of hydrologic conditions. Actual daily River flows from a dry, normal and wet year were adjusted to simulate future diversion conditions as described in the *Russian River Water Quality Model* Technical Report, (RMA 1996). The dry, normal and wet years (1976, 1961 and 1982, respectively) approximately represent the 10th, 50th and 90th percentile flow years from the 70-year period of record from 1923 to 1992.

Key assumptions that were used in the evaluation are as follows:

- **Reclaimed Water Quality.** The average of treatment plant reclaimed water quality measurements made from 1991 (1988 for metals) through January 1995 (as summarized in the *Reclaimed Water Quality Monitoring Results* Technical Report, MSC 1996) is assumed to be representative of the quality of reclaimed water discharged from storage ponds. The large capacity of Laguna storage relative to discharge volume assures that variations in plant reclaimed water quality will be dampened and the quality of the discharge will be much more constant.
- **Ambient Water Quality.** Ambient water quality was estimated from data collected in Santa Rosa Creek, the Laguna de Santa Rosa, and the Russian River above and below the confluence with the Laguna as described in *Laguna de Santa Rosa Water Quality Monitoring Results* and *Russian River Water Quality Monitoring Results* Technical Reports (MSC 1996). Data used to calibrate the Russian River model are described in the *Russian River Water Quality Model* Technical Report, RMA 1996
- **Operations.** The Subregional System is operated to maximize discharge at Delta Pond before discharge occurs at Meadowlane Pond. The daily operations model was established to discharge up to the hydraulic capacity of the Delta Pond outfall each day. The balance of discharge was assumed to then be released at Meadowlane Pond. Discharge from other locations was not simulated since almost all reclaimed water discharge occurs from Delta and Meadowlane ponds.

Discharge impacts on water quality were evaluated using two methods, depending on the constituent. Each method is described below.

Constituents Affected by Biological Activity - Water Quality Simulation Model

The potential impacts of discharge on the Laguna de Santa Rosa and the Russian River were evaluated using a hydraulic and water quality model (see the *Russian River Water Quality Model* Technical Report, RMA 1996). Reclaimed water discharge as defined under the 1 percent design Laguna discharge alternatives (Alternatives 2 and 3), Laguna discharge associated with Geysers alternative (Alternative 4), 20 percent design River discharge alternative (Alternative 5a), and 20 percent design Laguna discharge alternative (Alternative 5b) was simulated on a daily time step for the 10^{th}, 50^{th} and 90^{th} percentile water years (1976, 1961 and 1982, respectively). A “water year” starts in October of the previous year (e.g. the 1976 water year starts on 1 October 1975). The 10th percentile water year (1976) is the water year in which total annual Russian River flow (adjusted for future diversions) is less than 90 percent of the total annual Russian River flow values during the period of record (see Surface Hydrology section of EIR/S). Operations of the Subregional System, including reclaimed water discharge, for each of the discharge components cited above in this paragraph were assumed per the *Water Balance Model - Overall Summary and Results* and *Water Balance Contingency Plan* s (Parsons ES 1995). 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 Model* and *Water Balance Contingency Plan* Technical

Reports (Parsons ES 1995) and *Russian River Water Quality Model* Technical Report (RMA 1996).

The model simulates reclaimed water dilution, uptake of nutrients by planktonic and benthic (attached) algae, growth of planktonic and benthic algae, dissolved oxygen, temperature and other water quality characteristics using an hourly time step.

Impacts were assessed for receiving water locations that were spatially averaged stream reaches. These locations were as follows (see also Figure 2-1): 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).

Impacts of the proposed discharge components on dissolved oxygen, ammonia (based on the numeric-based criteria for the Russian River and the Waste Reduction Strategy criteria for the Laguna and Santa Rosa Creek), algae (based on the Biostimulatory Substances criterion), temperature, and turbidity were based on the water quality model estimate of impacts.

Two water quality baseline conditions were simulated using the model. The existing (1994) Subregional System discharge baseline for dissolved oxygen, ammonia, algae, and temperature was estimated in dry, normal and wet conditions (1976, 1961, and 1982, respectively). The existing condition baseline provided the basis for evaluating the significance of impacts due to each proposed discharge component. In addition, dissolved oxygen, ammonia, algae, and temperature conditions were estimated assuming no Subregional System reclaimed water discharge. The impacts of each proposed discharge component relative to this no discharge baseline are also included in the EIR/S. The no discharge baseline was developed so that the impact of existing discharges plus proposed discharges could be estimated. The two baseline water quality conditions were developed with the model to provide a basis for comparing the impacts of each discharge component.

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

- **Dissolved oxygen.** Model estimates of the monthly average dissolved oxygen for 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) in 1976, 1961 and 1982 were used to evaluate for significant impacts. If any estimated monthly average dissolved oxygen value under the proposed discharge component did not attain the point of significance *and* the estimated dissolved oxygen under the existing condition attained the Regional Board’s point of significance, the impact was considered significant. If the estimated dissolved oxygen under the existing condition was not in attainment of the Regional Board’s point of significance, then any further decrease of the monthly average dissolved oxygen concentration was considered a significant adverse impact.

Monthly average dissolved oxygen values were used in this evaluation to be consistent with the Regional Board's objective and for reasons related to model precision. The Regional Board's dissolved oxygen objective includes a component that is based on monthly means and a component that is based on an instantaneous minimum. The instantaneous minimum dissolved oxygen concentration caused by any of the discharge components cannot be reliably assessed. Model-predicted changes in dissolved oxygen of less than 0.5 mg/L were not considered significant due to model uncertainty.

- **Ammonia**. Impact significance is being evaluated with respect to two ammonia criteria:

    - <u>A numeric criterion for protection of aquatic organisms from potential toxic effects which applies to the Russian River</u>. To evaluate for significant impacts, model estimates of the monthly maximum total ammonia for the stream reaches described above in 1976, 1961 and 1982 were determined. Since the numeric ammonia criterion is temperature and pH dependent, monthly maximum total ammonia concentrations were compared to the point of significance for the long-term average temperature and pH of the lower Russian River. An impact was considered significant if any monthly maximum total ammonia exceeded the total ammonia point of significance. In the Russian River below the confluence with the Laguna, the average temperature and pH in the water quality database (*Russian River Water Quality Monitoring* Technical Report, MSC 1996) are 16.7°C and 8.0, respectively. The EPA point of significance (CCC) for total ammonia (sensitive species present) for a temperature of 20°C and a pH of 8.0 is 0.76 mg-N/L.
    - <u>A narrative waste load reduction criterion for ammonia which applies to the Laguna and Santa Rosa Creek</u>. The impact of the proposed discharge components on ammonia load were evaluated by comparing the average annual ammonia load for each discharge component (calculated using the average annual discharge to the Laguna multiplied by the expected concentration of ammonia in reclaimed water [1 mg-N/L]) to the estimated load in 1994 (56,610 pounds).
- **Algae.** The monthly average benthic (attached) algae biomass (mass per area) and plankton density (mass per volume) was calculated in the stream reaches described above by averaging all of the estimates in the reach during the month. Thus, the monthly average is a temporally- and spatially-averaged value. The impact on benthic algae and planktonic algae are described in this report. If the estimated monthly average algae concentration resulting from a discharge component in any reach was more than 10 percent greater than that estimated to result from existing conditions, then the impact was considered to be significant. If the estimated monthly average algae concentration resulting from a discharge component in any reach was more than

10 percent less than that estimated to result from existing conditions, then the impact was considered to be beneficial.

- **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 discharge on suspended sediment is addressed in the Surface Water Hydrology section of the EIR/S. Turbidity due to planktonic algae that results from reclaimed water discharge was estimated using the water quality model by assuming a direct relationship of planktonic algae density to turbidity. If the estimated monthly average planktonic algae density resulting from a discharge component in any reach was more than 20 percent greater than that estimated to result from existing conditions, then the impact on turbidity was considered to be significant. If the estimated monthly average planktonic algae density resulting from a discharge component in any reach was more than 20 percent less than that estimated to result from existing conditions, then the impact on turbidity was considered to be beneficial. (*see Development of Evaluation Criteria for Potential Water Quality Impacts* Technical Report MSC 1996)

Impacts of the proposed discharge components 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 discharges. The impact of the proposed discharge components on nitrogen load (as evaluated with the Waste Reduction Strategy evaluation criterion) were evaluated by comparing the average annual nitrogen load for each discharge component (calculated using the average annual discharge to the Laguna multiplied by the expected concentration of nitrogen in reclaimed water [14 mg-N/L]) to the estimated load in 1994 (424,000 pounds).

Conservative Constituents - Dilution Model

Conservative constituents are defined in this report as constituents unaffected by biological activity. Most constituents in reclaimed water were assumed (for purposes of this water quality impacts analysis) to be unaffected by biological activity; and thus the effect on water quality was estimated by calculating the final concentration (C_w) in the receiving water using a dilution calculation as follows:

$$C_w = (C_{rw} \times P_{rw}) + (C_{reci} \times (1 - P_{rw}))$$

where:

C_{rw}= concentration of each constituent in reclaimed water

P_{rw} = Percent reclaimed water in the receiving water

C_{reci} = background ambient concentration in receiving water

As indicated in the above equation, the concentration of reclaimed water constituents in receiving water was estimated using the concentration of the constituent in reclaimed water, the concentration of reclaimed water in the receiving water and the background constituent concentration in receiving water. Each is addressed below.

- **Reclaimed water quality.** Reclaimed water quality data used as a basis for this analysis are described the *Reclaimed Water Quality* Technical Report (MSC 1996).

- **Daily average reclaimed water concentration.** The daily average reclaimed water concentration in receiving waters was estimated using the water quality simulation model. For each discharge component, the concentration of each constituent in receiving water was estimated using the 50th percentile daily average reclaimed water concentration in the normal year (1961) and 95th percentile concentration in the dry year (1976). The 50th percentile reclaimed water concentration is the percent of reclaimed water that was exceeded 50 percent of the time. The 95th percentile concentration is the daily average concentration of reclaimed water that was exceeded just 5 percent of the time. The maximum 95th percentile daily average reclaimed water concentration at a particular location generally occurred during the dry year, but in some cases the highest percent discharge occurred in the average year. In such cases, the highest 95th percentile daily average reclaimed water concentration from the three years was used.

  Final constituent concentrations were estimated in the Laguna watershed in the Laguna de Santa Rosa below the confluence with Santa Rosa Creek and in Santa Rosa Creek. Final constituent concentrations were estimated in the Russian River below the confluence with the Laguna and in the Russian River above the Laguna for the 20 percent design discharge to the River, which is the only discharge component in which reclaimed water enters this section of the River.

- **Background constituent concentration in receiving water.** The background constituent concentration in receiving water is generally based on receiving water quality monitoring data, as described further below.

Two types of impacts analysis were conducted as follows.

- **Significance of impacts**. In this analysis, the effect of reclaimed water was evaluated for significance under extreme discharge conditions. The simulated 95th percentile daily average reclaimed water concentration in the dry year of 1976 (which is the 10th percentile water year in terms of total river flow) was used to estimate concentrations of constituents of concern. The 95th percentile concentration is the concentration of reclaimed water that would be exceeded just 5 percent of the time during the year. If, for a particular location and design discharge, the maximum reclaimed water did not occur in the dry year simulation, the year with the maximum reclaimed water was used. Thus, this approach is conservative because the evaluation of water quality impacts for significance was done under conditions that occur very infrequently. The estimated concentrations of constituents in the receiving water were compared to points of significance (described in *Development of Evaluation Criteria for Potential Water Quality*

Impacts Technical Report, MSC 1996) for those constituents. If the estimated concentration of a constituent in the receiving water exceeded the point of significance, the impact was considered significant. The significance of impacts was analyzed relative to an existing conditions baseline.

- **Range of impacts**. In this analysis, a range of potential water quality impacts was estimated. For the mid-point of the range, the 50th percentile daily average reclaimed water concentrations in a normal year (1961) were used to predict the receiving water concentrations of constituents. For the high end of the range, the maximum 95th percentile concentration of the three modelled years was used. In most cases the maximum 95th percentile reclaimed water occurred in the dry year (1976).

The range and significance of reclaimed water discharge impacts on conservative constituents was estimated relative to an existing conditions baseline. Existing conditions were estimated from data collected in Santa Rosa Creek, the Laguna de Santa Rosa, and the Russian River above and below the confluence with the Laguna as described in *Laguna de Santa Rosa Water Quality Monitoring Results* and *Russian River Water Quality Monitoring Results* Technical Reports (MSC 1996). These background receiving water concentrations are shown in Table 4-1. When there were no data from below the discharge, data from above the discharge were used. In the case of Santa Rosa Creek, the metals data from below the discharge were older and had high reporting limits so data from both above and below the discharge were used. These are indicated in Table 4-1. When concentrations were below detection, one half the reporting limit was used in averages. When a concentration was below detection and the reporting limit was very high (more than four times the maximum detectable concentration), the value was not used in an average.

The range of impacts of reclaimed water on conservative constituents was also estimated relative to a zero Subregional System reclaimed water discharge baseline. This was done by using receiving water data from above the discharge to estimate conditions without Santa Rosa’s reclaimed water discharge and comparing it to receiving water data from below the discharge. For all constituents that were the same concentration (or below detection) above and below the discharge, it was concluded that the impacts of reclaimed water on the receiving water with a zero discharge baseline would be the same as predicted impacts using an existing conditions baseline. For all constituents that were different above and below the discharge, a statistical analysis was conducted to ascertain whether the differences were significantly different. Tests conducted were either a t-test for normal data with equal variances or a Mann-Whitney Rank Sum Test. If the differences above and below the discharge were not significantly different, it was concluded that the impacts of reclaimed water on the receiving water with a zero discharge baseline would be the same as predicted impacts using an existing conditions baseline. If the differences above and below the discharge were significantly different, the predicted impacts using a zero discharge baseline were determined as described above for an existing conditions baseline.

Table 4-1.

Average Existing Background Receiving Water Concentrations of Conservative Constituents

Constituent	Santa Rosa Creek	Laguna de Santa Rosa	Lower Russian River	Upper Russian River
Aluminum (mg/L)	N/A	N/A	0.15	0.15
Arsenic (mg/L)	0.0028[a,b]	0.0036	0.0025[a]	0.0025[a]
Dissolved Arsenic (mg/L)	0.0025[a,c]	0.0025[a]	0.0025[a]	0.0025[a]
Total Barium (mg/L)	N/A	N/A	0.073	0.073
Total Cadmium (mg/L)	0.0003[a,c]	0.0003[a]	0.0015[a]	0.0014[a]
Total Calcium (mg/L)	21[c]	18	18	21
Total Chromium (mg/L)	0.0048[c]	0.0059	0.0060	0.008
Total Copper (mg/L)	0.0060[b]	0.0119	0.0076	0.0080
Dissolved Copper (mg/L)	0.0025[a,c]	0.0025[a]	0.0025[a]	0.0025[a]
Total Lead (mg/L)	0.0028[c]	0.0028	0.0024	0.0020
Total Magnesium (mg/L)	17[c]	14	12	13
Total Mercury (mg/L)	0.0004[a,b]	0.0004[a]	0.0002[a]	0.0003[a]
Total Nickel (mg/L)	0.006[c]	0.013	0.011	0.017
Dissolved Nickel (mg/L)	0.0039[c]	0.0059	0.0028	0.0025
Total Silver (mg/L)	0.0005[a,c]	0.0026	0.0010	0.0014
Dissolved Silver (mg/L)	0.0005[a,c]	0.0005[a]	0.0005[a]	0.0005[a]
Total Zinc (mg/L)	0.020[a,b]	0.023	0.015	0.015
Dissolved Zinc (mg/L)	0.025[a,c]	0.025[a]	0.037	0.024
Total Cyanide (mg/L)	N/A	N/A	0.0025[a,c]	0.0025[a]
Bromodichloromethane (μg/L)	N/A	0.20[a]	0.25[a,c]	0.25[a]
Bromomethane (μg/L)	N/A	0.20	0.25[a,c]	0.25[a]
Bromoform (μg/L)	N/A	0.20[a]	0.25[a,c]	0.25[a]
Chloromethane (μg/L)	N/A	0.20[a]	0.25[a,c]	0.25[a]
Dibromochloromethane (μg/L)	N/A	0.20[a]	0.25[a,c]	0.25[a]
Total Halomethanes (sum of bromodichloromethane, bromomethane, bromoform, chloromethane, and dibromochloromethane)	N/A	1[a]	1.25[a,c]	1.25
Carbon Disulfide (μg/L)	N/A	N/A	0.25[a,c]	0.25[a]
Chlorobenzene (μg/L)	N/A	0.20[a]	0.25[a,c]	0.25[a]

Table 4-1.

Average Existing Background Receiving Water Concentrations of Conservative Constituents

Constituent	Santa Rosa Creek	Laguna de Santa Rosa	Lower Russian River	Upper Russian River
Chloroform (µg/L)	N/A	0.20[a]	0.25[a,c]	0.25[a]
1,4 Dichlorobenzene (µg/L)	N/A	0.20[a]	0.25[a,c]	0.25[a]
Ethyl Benzene (µg/L)	N/A	0.30[a]	0.25[a,c]	0.25[a]
Methylene Chloride (µg/L)	N/A	5.0[a]	0.25[a,c]	0.25[a]
Tetrachloroethene (µg/L)	N/A	0.20[a]	0.25[a,c]	0.25[a]
Toluene (µg/L)	N/A	0.25[a]	0.25[a,c]	0.25[a]
1,1,1-Trichloroethane (µg/L)	N/A	0.20[a]	0.25[a,c]	0.25[a]
Total Xylenes (µg/L)	N/A	0.30[a]	0.25[a,c]	0.25[a]
Aldrin (µg/L)	0.015[a]	0.014[a]	0.015[a]	0.015[a]
a-BHC (µg/L)	0.015[a]	0.013[a]	0.014[a]	0.015[a]
g-BHC (Lindane) (µg/L)	0.015[a]	0.013[a]	0.010[a]	0.005[a]
Endosulfan II (µg/L)	0.015[a]	0.017[a]	0.016[a]	0.013[a]
Heptachlor (µg/L)	0.015[a]	0.017[a]	0.016[a]	0.025[a]
Bis (2-Ethylhexyl) Phthalate (µg/L)	N/A	N/A	0.40[a,c]	0.4
Diethyl Phthalate (µg/L)	N/A	N/A	0.25[a,c]	0.25[a]
Butylbenzyl Phthalate (µg/L)	N/A	N/A	0.25[a,c]	0.25[a]
Di-N-Butyl Phthalate (µg/L)	N/A	N/A	0.25[a,c]	0.25[a]
Total Phthalate Esters (µg/L)	N/A	N/A	1.15[a,c]	1.15[a]
Aldicarb sulfone (µg/L)	N/A	N/A	0.36[a,c]	0.36[a]
DCPA (Dacthal) (µg/L)	N/A	N/A	0.10[a,c]	0.1[a]
Aldicarb sulfoxide (µg/L)	N/A	N/A	0.25[a,c]	0.25[a]
Conductivity (µmhos/cm)	337	485	263	248

N/A = no data available

[a] Indicates all measurements were below detection. In these cases, the average values are the averages of half the detection limits

[b] Data from both above and below the discharge.

[c] No data from below the discharge. Data shown are from above the discharge.

Thus, receiving water concentrations for all conservative constituents found in detectable concentrations in reclaimed water were calculated for each discharge alternative (1 percent, 5 percent, 10 percent, 20 percent Laguna discharge, 20 percent Russian River discharge, No Project, and Geysers discharge) and for the following combinations of percent reclaimed water and receiving water concentration:

- 50th percentile percent reclaimed water (average year) with average background concentration
- 95th percentile percent reclaimed water (maximum percent year) with average background concentration

Significance of impacts were determined for the following constituents that were not screened out as described above in the Screening of Evaluation Criteria section:

Aluminum
Dissolved Copper
Mercury
Dissolved Nickel
Dissolved Silver
Dissolved Zinc
Acrolein
Gamma BHC (Lindane)
Chlorpyrifos
Guthion
Malathion
Demeton
Parathion
Phthalate Esters
Toxaphene
Conductivity
Cyanide

Constituents in italics are organic compounds which are not detectable in reclaimed water but the reporting limit is greater than the point of significance.

All other constituents routinely measured in reclaimed water were screened out from the significant impacts evaluation because the impacts of their discharge on receiving waters were *a priori* determined not to be significant (as described in the Screening of Evaluation Criteria section).

The ranges of potential impacts of all conservative constituents for which Evaluation Criteria exist were estimated with the dilution model. This was done by estimating the concentration of each constituent in the receiving waters. A different approach was used to evaluate conductivity, nitrogen load, and toxicity, as described below.

Conductivity

The points of significance for conductivity, which apply only to the Russian River, are dependent on monthly mean conductivity and percentiles rather than an estimated maximum concentration. Average monthly conductivities in the Russian River at Oddfellows were calculated and used as ambient conductivity. Simulated daily average reclaimed water concentrations, averaged for each month, for the 20 percent design discharge to the River component were used, selecting for each month the year (1961, 1976, 1981) with the highest average discharge concentration. Conductivity for each month was estimated using the average monthly conductivities and the average monthly reclaimed water concentrations in the dilution calculation. These "worst-case" conductivities were examined to determine if six or more months exceeded the 50th percentile value and thus the point of significance. 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.

Total Nitrogen and Ammonia Nitrogen Loads to the Laguna de Santa Rosa

The Regional Board has established a goal for the Subregional System to reduce total nitrogen load to the Laguna system by 159,000 pounds per year from their 1994 estimate of 424,700 pounds per year (NCRWQCB 1995). The Regional Board has also established a goal for the Subregional System to reduce ammonia nitrogen load to the Laguna system by 21,500 pounds per year from their 1994 estimate of 56,600 pounds per year.

The total nitrogen load to the Laguna was estimated for each discharge component using a dilution model as follows:

$$L = C_{rw} \times V$$

where:

L_n = total nitrogen load to the Laguna in pounds per year

C_{rw} = Concentration of nitrogen in reclaimed water in pounds per million gallons

V = Average reclaimed water discharge to the Laguna in million gallons per year

The concentration of total nitrogen in reclaimed water (C_{rw}) was 142 pounds per million gallons (17 mg-N/L). 17 mg-N/L is the sum of nitrate (14 mg-N/L,- estimated to be the concentration that will be obtained with proposed plant upgrades *Future Nutrient Removal at the Laguna Facility* CH2M Hill 1995), ammonia (1 mg-N/L - see below), and organic nitrogen (2 mg-N/L = the average concentration of organic nitrogen in reclaimed water storage ponds - see Appendix 4 of the *Reclaimed Water Quality* Technical Report (MSC 1996).

The average annual reclaimed water discharge volume to the Laguna (V) for each discharge component was calculated from daily water balance output. The monthly water balance model is summarized in *Water Balance Model Summary and Results* (Parsons Engineering Science September 1995) and *Analysis of Results from Daily and Monthly Water Balance Models* (Parsons Engineering Science 1996).

The estimated total nitrogen loads to the Laguna (L_n) for each discharge component were compared with the current total nitrogen load to the Laguna of 424,700 pounds per year (NCRWQCB 1995).

The ammonia nitrogen load to the Laguna was estimated for each discharge component using the same dilution model as for total nitrogen load with L_a = ammonia nitrogen load to the Laguna and C_{rw} = concentration of ammonia nitrogen in reclaimed water which was 8.3 pounds per million gallons or 1 mg-N/L (1 mg-N/L = the average concentration of ammonia nitrogen in reclaimed water storage ponds - see Appendix 4 of the *Reclaimed Water Quality* Technical Report (MSC 1996).

The estimated ammonia nitrogen loads to the Laguna (L_a) for each discharge component were compared with the current nitrogen load to the Laguna of 56,600 pounds per year (NCRWQCB 1995).

Toxicity

Chronic toxicity testing of reclaimed water follows the US EPA freshwater "three species" short-term sensitive life stage toxicity tests (EPA 1991 a,b), which consist of the following elements:

- 96-hour algal growth test with the green alga *Selenastrum capricornutum*;
- Three-brood (7-day) survival and reproduction test with the crustacean *Ceriodaphnia dubia*; and,
- 7-day survival and growth test with larval fathead minnows, *Pimephales promelas.*

The algal growth, crustacean reproduction, and fish growth tests measure sublethal toxicity; crustacean and fish survival measure lethal effects. Each test is performed on a series of five effluent concentrations: 100, 50, 25, 10, and 5 percent. A toxic effect is indicated when the test response of a given treatment is significantly less than a control (a parallel test without effluent).

Toxicity results are described in terms of the concentration of effluent in which "no effect" is observed, and the concentration in which the "lowest effect" is observed. For example, if in a test the 100 percent effluent sample had a toxic effect (was significantly less than control), but the other dilutions (50, 25, 10, and 5 percent) had no effect (no significant difference from control), the "lowest effect" level would be 100 percent, and the "no effect" level would be 50 percent (the actual threshold of toxic effect could be 75 percent--or even 99 percent--but since no dilutions between 100 percent and 50 percent were tested, it can only be concluded that the lowest no-effect level *tested* was 50 percent. The "no effect" concentration is also called the NOEC (no observed effect concentration). and the "lowest effect" concentration is also called the LOEC (lowest observed effect concentration).

The frequency that lethal effects occur in reclaimed water was determined by dividing the number of test in which lethal toxicity was observed by the total number of tests from the time testing began in 1992 until the April 1996. The potential for lethal effects in the receiving water was estimated by multiplying the frequency that lethal effects occur in reclaimed water by the frequency that the lowest NOEC would occur in Santa Rosa Creek in a dry year, an average year, and a wet year.

4.1.5 Impact Evaluation Results

The results of the water quality simulation model for constituents affected by biological activity and the dilution model for conservative constituents are presented in this section. The concentrations of reclaimed water in the receiving waters for each project alternative are also presented.

Daily Average Reclaimed Water Concentrations

The estimated concentrations of reclaimed water during the discharge season in Santa Rosa Creek, the Laguna at River Road, and the Russian River at Oddfellows for each of the discharge components are shown in Figures 4-1 to 4-12 (all Figures are in Volume II). The 50th percentile and 95th percentile daily average reclaimed water concentrations are shown in Table 4-2. The concentrations shown for the 50th percentile are for the normal hydrologic model year (1961). The 95th percentile concentrations shown are the maximum 95th percentile concentration that occurred of the three model years (dry, wet, and normal). The maximum concentration of reclaimed water generally occurred in the dry year (1976). The concentration of reclaimed water in the Russian River above the confluence with the Laguna is also shown in Table 4-2 for the 20 percent design discharge to the River component.

Table 4-2.

Estimated Daily Average Reclaimed Water Concentration

	Existing discharge	1 percent design discharge	5 percent design discharge	10 percent design discharge	20 percent design Laguna discharge	20 percent design Russian River discharge	No Project	Geysers
Santa Rosa Creek								
50th percentile[a]	19	0	6	11	35	0	29	0
95th percentile[b]	62	9[c]	49	67	81[c]	2[c]	75[c]	6
Laguna at River Rd								
50th percentile[a]	8	0	3	5	17	0	13	0
95th percentile[b]	38	4[c]	26	43	61[c]	0.6[c]	53[c]	2
Russian River at Oddfellows								
50th percentile[a]	1	0	0.3	0.6	3	2	2	0
95th percentile[b]	7	0.5[c]	5	10	15	10	10	0.4
Russian River at SCWA Wohler intakes								
50th percentile[a]						3		
95th percentile[b]						11		

[a] 50th percentile concentration in normal hydrologic year (1961) is given.
[b] The maximum of the three 95th percentile concentrations (dry, normal, wet) is shown. The maximum occurred in the dry year (1976) unless noted otherwise.
[c] highest 95th percentile value occurred in 1961, not 1976

Water Quality Simulation Model Results - Existing Conditions Baseline

The results of the water quality simulation model, using existing conditions as a baseline for benthic algae, planktonic algae, dissolved oxygen, and ammonia are presented in this section. These results are presented as changes from the existing conditions baseline which is presented in Table 4-3.

The water quality impacts of reclaimed water discharges on benthic algae, planktonic algae, dissolved oxygen, and ammonia in Santa Rosa Creek, Laguna, Russian River above the confluence with the Laguna, and Russian River below the Laguna confluence are shown in Figures 4-13 to 4-17. Model results from the two reaches in which water quality was simulated were quite similar, so results were numerically combined in the "Russian River below the Laguna" reach. The impacts vary depending on location, time of year, design discharge rate and other factors. The following description of physical, chemical and biological factors affecting benthic algae, planktonic algae, dissolved oxygen, and ammonia provides an explanation of the impacts:

- Impacts due to reclaimed water are influenced by both the frequency of discharge rates (the shape of the cumulative frequency distribution) and the seasonal timing of discharges. 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 long-term project alternatives (see Regional Board's Basin Plan). The frequency distribution of reclaimed water discharge at key locations is discussed and presented graphically in the Daily Average Reclaimed Water Concentrations portion of section 4.1.5. Water quality model simulations of daily average reclaimed water concentration by month and location are presented in the *Russian River Water Quality Model* Technical Report (RMA 1996).

- Benthic algae are attached to bottom sediments. When nutrients are available (from reclaimed water or other sources), benthic algae biomass will increase if light and growth substratum are also available. When water gets deeper or more turbid, benthic algal biomass will be depressed due to light limitation, even in the presence of abundant nutrients. Insufficient light is available for benthic algal growth regardless of nutrients, water depth, or turbidity when sun angle is lowest (November, December, and January). Benthic algae biomass can carry over from fall to winter, and increased late winter and spring flows can delay the timing and/or reduce the magnitude of the spring benthic algae bloom. Benthic algae growth in shallow areas (such as Santa Rosa Creek between the Delta Pond discharge and the Laguna) is especially sensitive to stimulation by reclaimed water nutrients. Benthic algae is also sensitive to increased water depth that results from higher design discharge rates. Deeper water limits light penetration which reduces benthic algae growth.

- Planktonic algae are suspended in water and carried downstream by the current. Planktonic algae biomass increases at a particular location when their growth rate exceeds the flushing rate. Reclaimed water can prevent planktonic algae growth by increasing flushing rate or it can increase the growth rate by introducing nutrients if the flushing rate remains less than the growth rate. Wide and/or deep segments of the Laguna (such as upstream of Occidental Road and upstream of River Road) tend to have elevated planktonic algae biomass because flushing rates are low in such reaches.

- In temperate regions like California, the algae bloom of greatest magnitude typically occurs in spring each year. In the Russian River, the initial benthic algae bloom can occur as early as February in a dry year (when water is shallow and clear), and as late as June in a wet year (after water depth and turbidity have decreased). Algae blooms typically come to an end because algal filaments get long relative to their tensile strength and are broken by the current, and because the population of grazing insect larvae increases and consumes the benthic algae.

- The concentration of dissolved oxygen is increased by algal photosynthesis and decreased by algal respiration, and decay of dead algae and other organic matter such as manure. The 24-hour (diel) variation in photosynthesis results in a diel dissolved oxygen variation. Cool water is capable of dissolving more oxygen than warm water. Biological processes produce and consume oxygen at a faster rate as water temperature increases.

Benthic Algae

The predicted average monthly percent changes from the existing conditions baseline for benthic algae for the different discharge alternatives are shown in Figure 4-13. The point of significance for changes in benthic algae is ten percent (*Development of Evaluation Criteria for Potential Water Quality Impacts* Technical Report, MSC 1996).

One Percent Design Discharge to the Laguna. Predicted impacts from a 1 percent design discharge on benthic algae in Santa Rosa Creek range from a 36 percent decrease from baseline (January wet year) to a 29 percent increase from baseline (April wet year). The model predicts that with a 1 percent design discharge there will be significant increases in benthic algae in Santa Rosa Creek in February (dry year) and April (wet year). The model also predicts there will be a significant decrease in benthic algae in November, February (wet year), December, January (wet and normal years), and May and June (dry year). Predicted impacts from a 1 percent design discharge on benthic algae in the Laguna de Santa Rosa range from a 23 percent decrease from baseline (June dry year) to a 12 percent increase from baseline (March normal year). The model predicts that a 1 percent design discharge will cause significant increases in benthic algae in the Laguna in February and March (normal year). The model also predicts a significant decrease in benthic algae in the Laguna in May and June (dry year) and November and December (wet year). Predicted impacts from a 1 percent design discharge on benthic algae in the Russian River below the confluence with the Laguna range from a 20 percent decrease from baseline (April normal year) to no change from baseline (several month, all years). The model predicts that with a 1 percent design discharge, there will be significant decreases in benthic algae in the Russian River below the Laguna in January, February and March (dry year), April (normal year) and November and December (wet year). No significant increases in benthic algae are predicted to occur in the Russian River with a 1 percent design discharge.

Table 4-3.

Existing Conditions Baseline in Santa Rosa Creek , Lower Laguna, and the Russian River (above and below the confluence with the Laguna)

	Dry Year (based on 1976)					Normal Year (based on 1961)					Wet Year (based on 1982)				
	Benthic Algae mg/ft^2	Planktonic Algae mg/L	Dissolved Oxygen mg/L	Ammonia mg-N/L	Temp ºF	Benthic Algae mg/ft^2	Planktonic Algae mg/L	Dissolved Oxygen mg/L	Ammonia mg-N/L	Temp ºF	Benthic Algae mg/ft^2	Planktonic Algae mg/L	Dissolved Oxygen mg/L	Ammonia mg-N/L	Temp ºF
	Santa Rosa Creek														
Oct	525	2.1	8.5	0.2	60.7	493	2.1	8.1	0.2	60.5	529	2.0	8.4	1.0	60.7
Nov	880	1.1	8.7	0.2	52.7	705	1.1	8.4	1.1	52.2	888	1.0	8.6	1.0	53.8
Dec	682	0.5	9.0	1.4	44.0	591	0.6	9.3	1.0	43.6	341	0.6	9.0	0.4	43.4
Jan	472	0.5	9.2	1.3	42.8	408	0.5	9.1	1.2	42.6	107	0.5	9.2	0.5	42.5
Feb	682	0.6	9.0	1.5	44.6	267	0.6	9.1	0.8	44.5	60	0.6	9.0	0.7	44.4
Mar	1419	1.2	8.6	1.1	49.0	1042	1.2	8.9	0.9	48.9	101	1.2	9.0	0.5	48.8
Apr	1804	2.7	8.4	1.0	56.6	1788	2.7	8.6	0.9	56.5	247	2.7	8.9	0.5	56.3
May	1408	4.4	7.3	0.9	64.2	1654	4.4	8.2	0.1	64.5	1615	4.4	8.9	0.2	64.7
Jun	545	4.7	7.2	0.2	69.7	704	5.3	7.4	0.1	70.1	1102	5.5	8.3	0.1	70.8
Jul	448	4.3	7.0	0.2	71.7	381	4.8	7.4	0.2	72.0	447	5.6	8.2	0.1	73.3
Aug	447	4.8	7.2	0.2	72.2	415	4.9	7.4	0.2	72.2	364	5.3	8.1	0.1	72.9
Sep	514	3.6	7.7	0.2	67.3	508	3.5	7.9	0.2	67.3	521	3.8	8.4	0.1	67.9

Table 4-3.

Existing Conditions Baseline in Santa Rosa Creek , Lower Laguna, and the Russian River (above and below the confluence with the Laguna)

	Dry Year (based on 1976)					Normal Year (based on 1961)					Wet Year (based on 1982)				
	Benthic Algae mg / ft^2	Planktonic Algae mg / L	Dissolved Oxygen mg / L	Ammonia mg-N / L	Temp °F	Benthic Algae mg / ft^2	Planktonic Algae mg / L	Dissolved Oxygen mg / L	Ammonia mg-N / L	Temp °F	Benthic Algae mg / ft^2	Planktonic Algae mg / L	Dissolved Oxygen mg / L	Ammonia mg-N / L	Temp °F
	Lower Laguna														
Oct	413	3.5	9.0	0.3	60.1	431	2.9	8.8	0.3	59.8	425	3.2	8.9	0.7	60.1
Nov	631	2.0	9.6	0.4	51.3	582	1.9	9.3	0.8	50.8	468	1.4	8.8	0.6	53.3
Dec	388	0.7	10.0	1.2	43.7	214	0.6	9.7	0.7	43.7	73	0.6	9.3	0.4	43.8
Jan	293	0.7	10.6	1.0	43.7	143	0.6	10.0	0.9	43.2	24	0.5	9.7	0.4	42.8
Feb	483	0.8	9.9	1.3	45.2	70	0.6	9.5	0.6	44.8	20	0.6	9.6	0.5	44.7
Mar	876	1.9	9.1	1.2	50.5	255	1.3	9.3	0.7	49.8	21	1.2	9.4	0.4	49.4
Apr	1215	5.3	9.1	0.9	57.8	930	4.0	9.4	0.6	57.4	21	3.0	8.9	0.4	56.8
May	949	6.3	8.4	0.6	64.1	1042	6.0	8.6	0.1	64.6	249	6.0	9.1	0.2	64.9
Jun	477	4.9	7.9	0.1	68.7	475	5.8	8.2	0.1	69.2	497	7.1	8.4	0.1	70.4
Jul	407	4.2	7.8	0.2	70.0	310	4.5	8.1	0.1	70.3	233	6.6	8.4	0.1	71.7
Aug	364	4.7	8.0	0.2	70.7	355	4.7	8.0	0.2	70.7	187	5.8	8.4	0.1	71.5
Sep	389	3.8	8.4	0.2	66.2	387	3.8	8.5	0.2	66.3	362	4.7	8.7	0.1	66.9

Table 4-3.

Existing Conditions Baseline in Santa Rosa Creek , Lower Laguna, and the Russian River (above and below the confluence with the Laguna)

	Dry Year (based on 1976)					Normal Year (based on 1961)					Wet Year (based on 1982)				
	Benthic Algae mg/ft^2	Planktonic Algae mg/L	Dissolved Oxygen mg/L	Ammonia mg-N/L	Temp ºF	Benthic Algae mg/ft^2	Planktonic Algae mg/L	Dissolved Oxygen mg/L	Ammonia mg-N/L	Temp ºF	Benthic Algae mg/ft^2	Planktonic Algae mg/L	Dissolved Oxygen mg/L	Ammonia mg-N/L	Temp ºF
	Russian River Above Laguna														
Oct	402	1.7	9.4	0.2	61.0	356	0.9	9.5	0.1	61.3	355	1.0	9.6	0.1	61.4
Nov	335	0.8	9.8	0.2	54.0	479	0.6	10.0	0.1	54.3	306	0.6	10.2	0.1	54.4
Dec	45	0.4	10.5	0.2	45.8	233	0.3	11.0	0.1	45.9	47	0.3	10.9	0.1	46.4
Jan	24	0.4	10.7	0.2	43.8	110	0.3	11.1	0.1	44.0	20	0.3	11.0	0.1	44.0
Feb	24	0.4	10.6	0.2	45.3	39	0.3	11.0	0.1	45.2	20	0.3	10.9	0.1	45.5
Mar	24	0.6	10.4	0.2	50.3	43	0.4	10.8	0.1	50.6	20	0.4	10.8	0.1	50.7
Apr	24	1.2	9.9	0.1	57.7	352	0.8	10.2	0.1	57.6	20	0.7	10.2	0.1	57.9
May	129	2.9	9.7	0.1	65.7	1135	1.3	9.5	0.1	65.9	218	1.4	9.7	0.1	66.1
Jun	432	4.5	9.4	0.1	71.0	724	1.8	9.2	0.1	70.9	652	2.1	9.4	0.1	71.5
Jul	179	4.2	9.2	0.1	72.1	425	1.9	9.3	0.1	71.9	384	2.2	9.3	0.1	72.4
Aug	309	3.7	9.1	0.1	72.1	371	1.9	9.2	0.1	72.1	393	2.1	9.2	0.1	72.4
Sep	465	3.0	9.1	0.1	68.2	387	1.4	9.2	0.1	69.0	407	1.6	9.2	0.1	69.1

Table 4-3.

Existing Conditions Baseline in Santa Rosa Creek , Lower Laguna, and the Russian River (above and below the confluence with the Laguna)

	Dry Year (based on 1976)					Normal Year (based on 1961)					Wet Year (based on 1982)				
	Benthic Algae mg / ft^2	Planktonic Algae mg / L	Dissolved Oxygen mg / L	Ammonia mg-N / L	Temp ºF	Benthic Algae mg / ft^2	Planktonic Algae mg / L	Dissolved Oxygen mg / L	Ammonia mg-N / L	Temp ºF	Benthic Algae mg / ft^2	Planktonic Algae mg / L	Dissolved Oxygen mg / L	Ammonia mg-N / L	Temp ºF
	Russian River Below Laguna														
	402	1.7	9.4	0.2	61.0	429	1.5	9.3	0.1	60.9	402	1.7	9.4	0.2	61.0
	335	0.8	9.8	0.2	54.0	593	0.9	9.8	0.3	53.1	335	0.8	9.8	0.2	54.0
Oct	45	0.4	10.5	0.2	45.8	192	0.4	10.8	0.2	45.4	45	0.4	10.5	0.2	45.8
Nov	24	0.4	10.7	0.2	43.8	73	0.4	11.0	0.3	43.9	24	0.4	10.7	0.2	43.8
Dec	24	0.4	10.6	0.2	45.3	32	0.4	10.8	0.2	45.1	24	0.4	10.6	0.2	45.3
Jan	24	0.6	10.4	0.2	50.3	35	0.5	10.5	0.2	50.5	24	0.6	10.4	0.2	50.3
Feb	24	1.2	9.9	0.1	57.7	342	1.7	10.1	0.2	57.7	24	1.2	9.9	0.1	57.7
Mar	129	2.9	9.7	0.1	65.7	1320	2.5	9.4	0.1	65.6	129	2.9	9.7	0.1	65.7
Apr	432	4.5	9.4	0.1	71.0	864	3.5	9.1	0.1	70.5	432	4.5	9.4	0.1	71.0
May	179	4.2	9.2	0.1	72.1	502	3.0	9.3	0.1	71.7	179	4.2	9.2	0.1	72.1
Jun	309	3.7	9.1	0.1	72.1	446	3.1	9.1	0.1	71.9	309	3.7	9.1	0.1	72.1
Jul	465	3.0	9.1	0.1	68.2	482	2.4	9.1	0.1	68.3	465	3.0	9.1	0.1	68.2
Aug															
Sep															

Five Percent Design Discharge to the Laguna. Predicted impacts from a 5 percent design discharge on benthic algae in Santa Rosa Creek range from a 36 percent decrease from baseline (January wet year) to a 28 percent increase from baseline (April wet year). The model predicts that with a 5 percent design discharge there will be significant increases in benthic algae Santa Rosa Creek in April (wet year). The model also predicts a significant decrease in benthic algae in November and February (wet year), December, January (wet and normal years), and May and June (dry year). Predicted impacts from a 5 percent design discharge on benthic algae in the Laguna de Santa Rosa range from a 19 percent decrease from baseline (June dry year) to a 8 percent increase from baseline (March normal year). The model predicts a significant decrease in benthic algae in the Laguna in May and June (dry year) and November and December (wet year). No significant increases in benthic algae are predicted to occur in the Laguna with a 5 percent design discharge. Predicted impacts from a 5 percent design discharge on benthic algae in the Russian River below the confluence with the Laguna range from a 15 percent decrease from baseline (November wet year) to no change from baseline (several month, all years). The model predicts that with a 5 percent design discharge, there will be significant decreases in benthic algae in the Russian River below the Laguna in April (normal year) and November and December (wet year). No significant increases in benthic algae are predicted to occur in the Russian River with a 5 percent design discharge.

Ten Percent Design Discharge to the Laguna. Predicted impacts from a 10 percent design discharge on benthic algae in Santa Rosa Creek range from a 38 percent decrease from baseline (January wet year) to a 13 percent increase from baseline (April wet year). The model predicts that with a 10 percent design discharge there will be significant increases in benthic algae in Santa Rosa Creek in April (wet year). The model also predicts there will be a significant decrease in benthic algae in November, December, January, February, and March (wet year), and May and June (dry year). Predicted impacts from a 10 percent design discharge on benthic algae in the Laguna de Santa Rosa range from a 18 percent decrease from baseline (June dry year) to a six percent increase from baseline (March normal year). The model predicts a significant decrease in benthic algae in the Laguna in May and June (dry year) and November and December (wet year). No significant increases in benthic algae are predicted to occur in the Laguna with a 10 percent design discharge. Predicted impacts from a 10 percent design discharge on benthic algae in the Russian River below the confluence with the Laguna range from a 15 percent decrease from baseline (November wet year) to a three percent increase from baseline (December dry year). The model predicts that with a 10 percent design discharge, there will be significant decreases in benthic algae in the Russian River below the Laguna in November and December (wet year). No significant increases in benthic algae are predicted to occur in the Russian River with a 10 percent design discharge.

Twenty Percent Design Discharge to the Laguna. Predicted impacts from a 20 percent design discharge to the Laguna on benthic algae in Santa Rosa Creek range from a seven percent decrease from baseline (February dry year) to a 134 percent increase from baseline (November normal year). The model predicts a significant increase in benthic algae in Santa Rosa Creek with a 20 percent design discharge to the Laguna in October, November, December, and January, (all years), February and March (wet and normal years), and April (wet year). Predicted impacts from a 20 percent design discharge to benthic algae in the Laguna de Santa Rosa range from a 0.2 percent decrease from baseline (September normal year) to a 74 percent increase from baseline (November normal year). The model predicts a significant increase in benthic algae in the Laguna in October, November, December, and January (all years), February, March, and July (normal year), and May and June (wet year). Predicted impacts from a 20 percent design discharge on benthic algae in the Russian River below the confluence with the Laguna range from no change from baseline (several months and years) to a 80 percent increase from baseline (January normal year). The model predicts that with a 20 percent design discharge, there will be significant increases in benthic algae in the Russian River in October, November and December (all years) and January, February, and March (dry and normal years). No significant decreases in benthic algae are predicted to occur in the Santa Rosa Creek, the Laguna, or the Russian River with a 20 percent design discharge to the Laguna. The large increase in benthic algae with a 20 percent design discharge to the Laguna relative to the 10 percent design discharge can be explained by the frequency distribution of reclaimed water discharge (See Daily Average Reclaimed Water Concentrations in section 4.1.5). Most of the time the 10 percent design discharge frequency curves are lower than the existing conditions curves. When the 10 percent design discharge frequency curves do exceed the existing conditions curves, it is likely during times when algae are relatively unresponsive (winter). By contrast, the curves of the frequency distribution of reclaimed water with the 20 percent design discharge to the Laguna are generally higher than the existing conditions curves.

Twenty Percent Design Discharge to the Russian River. Predicted impacts from a 20 percent design discharge to the Russian River on benthic algae in Santa Rosa Creek range from a 33 percent decrease from baseline (December wet year) to a 25 percent increase from baseline (February dry year). The model predicts a significant decrease in benthic algae in Santa Rosa Creek with a 20 percent design discharge to the Russian River in November, January, and February (wet year), December (normal and wet years) and May and June (dry years). The model predicts a significant increase in benthic algae in Santa Rosa Creek in February (dry year), and April (wet year). Predicted impacts from a 20 percent design discharge to the Russian River on benthic algae in the Laguna de Santa Rosa range from a 23 percent decrease from baseline (June dry year) to a 13 percent increase from baseline (March normal year). The model predicts a significant decrease in benthic algae in the Laguna in November and December (wet year), and May and June (dry year). The model also predicts a significant increase in benthic algae in the Laguna in February and March (normal year). Predicted impacts from a 20 percent design discharge to the River on benthic algae in the Russian River below the confluence with the Laguna range from a 16 percent decrease from baseline (June wet year) to a 47 percent increase from baseline (November normal year). The model predicts that with a 20 percent design discharge, there will be significant increases in benthic algae in the Russian River below the confluence with the Laguna in October, November and December (all years), January (dry and normal years), February (normal year), and August (wet year). The model also predicts that with a 20 percent design discharge, there will be significant decrease in benthic algae in the Russian River below the confluence with the Laguna in April (normal year), and May and June (wet year). The impacts to the Russian River below the confluence with the Laguna are less for the 20 percent design discharge to the River than with the 20 percent design discharge to the Laguna because the concentration of reclaimed water in the lower River (below the confluence) is greater with discharge to the Laguna (see section 4.1.2 Discharge Scenarios Evaluated and Daily Average Reclaimed Water Concentrations in section 4.1.5). Predicted impacts from a 20 percent design discharge on benthic algae in the Russian River above the confluence with the Laguna range from a three percent decrease from baseline (July wet year) to a 147 percent increase from baseline (March normal year). The model predicts that with a 20 percent design discharge to the River, there will be significant increases in benthic algae in the Russian River above the confluence with the Laguna in October, November and December (all years), January, February and March (dry and normal years), April (normal year), and May (wet year). The model predicts that with a 20 percent design discharge to the River, there will be no significant decreases in benthic algae in the Russian River above the confluence with the Laguna.

No Project. Predicted impacts from discharge related to a No Project alternative on benthic algae in Santa Rosa Creek range from no change from baseline (September all years and April and August dry year) to a 134 percent increase from baseline (November normal year). The model predicts a significant increase in benthic algae in Santa Rosa Creek in October, November, December, and January (all years), February and March (normal and wet years), and April (wet year). Predicted impacts from No Project discharge on benthic algae in the Laguna de Santa Rosa range from a 0.2 percent decrease from baseline (September normal year) to a 70 percent increase from baseline (November normal year). The model predicts a significant increase in benthic algae in the Laguna in October, November, December, and January (all years), February, March and July (normal years) and May and June (wet years). Predicted impacts from No Project discharge on benthic algae in the Russian River below the confluence with the Laguna range from a 0.2 percent decrease from baseline (April normal and May dry years) to a 69 percent increase from baseline (January normal year). The model predicts that with No Project discharge, there will be significant increases in benthic algae in the Russian River below the confluence with the Laguna in October, November and December (all years), and January, February, and March (dry and normal years). No significant decreases in benthic algae are predicted to occur in the Santa Rosa Creek, the Laguna, or the Russian River below the Laguna with No Project related discharge to the Laguna.

The predicted increase in growth of benthic algae for the No Project alternative is high relative to existing conditions because the operating conditions are different. The simulated operation of each project alternative, including No Project, 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 long-term project alternatives (see Regional Board's Basin Plan). Furthermore, the addition of irrigation lands during the dictated a revised storage curve for the No Project alternative (see *Russian River Water Quality Model* Technical Report, RMA 1996).

Geysers. Predicted impacts from discharge related to a Geysers alternative on benthic algae in Santa Rosa Creek range from a 22 decrease from baseline (June dry year) to a 40 percent increase from baseline (February dry year). The model predicts a significant decrease in benthic algae in Santa Rosa Creek in November, December, and January (wet year) and May and June (dry year). The model also predicts a significant increase in benthic algae in Santa Rosa Creek in November, December, and January (dry year), February (dry and normal years), and March and April (wet year). Predicted impacts from Geysers discharge on benthic algae in the Laguna de Santa Rosa range from a 23 percent decrease from baseline (June dry year) to a 14 percent increase from baseline (March normal year). The model predicts a significant decrease in benthic algae in the Laguna in November and December (wet year) and in May and June (dry year). The model also predicts a significant increase in benthic algae in the Laguna in January (dry year) and in February and March (normal year). Predicted impacts from Geysers discharge on benthic algae in the Russian River below the confluence with the Laguna range from a 23 percent decrease from baseline (April normal year) to a 3 percent increase from baseline (November dry year). The model predicts that with Geysers discharge, there will be significant decreases in benthic algae in the Russian River below the confluence with the Laguna in November and December (wet year), and February, and March (dry year) and April (normal year). No significant increases in benthic algae are predicted to occur the Russian River below the Laguna with Geysers related discharge to the Laguna.

Planktonic Algae

The predicted average monthly percent changes from existing conditions baseline for planktonic algae for the different discharge alternatives are shown in Figure 4-14. The point of significance for changes in planktonic algae is ten percent (*Development of Evaluation Criteria for Potential Water Quality Impacts* Technical Report, MSC 1966). Impacts to planktonic algae differ from those to benthic algae because the receiving waters are generally riverine systems that are dominated by benthic algae. Residence time is generally short, which limits growth of planktonic algae but not benthic algae. Increased reclaimed water discharge can enhance this effect by increasing flushing rate and thus decreasing planktonic algae concentrations.

One Percent Design Discharge to the Laguna. Predicted impacts from a 1 percent design discharge to planktonic algae in Santa Rosa Creek range from a 0.5 percent decrease from baseline (May dry year) to an 8 percent increase from baseline (November wet year). The model does not predict any significant increases or decreases in planktonic algae in Santa Rosa Creek with a 1 percent design discharge to the Laguna. Predicted impacts from a 1 percent design discharge on planktonic algae in the Laguna de Santa Rosa range from a 0.5 percent decrease from baseline (May dry year) to a ten percent increase from baseline (November wet year). The ten percent increase from baseline in November of wet years is the only significant impact predicted by the model to occur in the Laguna with a 1 percent design discharge to the Laguna. Predicted impacts from a 1 percent design discharge on planktonic algae in the Russian River below the confluence with the Laguna range from a seven percent decrease from baseline (May dry year) to a 0.7 percent increase from baseline (June dry year). No significant increases or decreases in planktonic algae are predicted to occur in the Russian River with a 1 percent design discharge.

Five Percent Design Discharge to the Laguna. Predicted impacts from a 5 percent design discharge on planktonic algae in Santa Rosa Creek range from a 0.5 percent decrease from baseline (May dry year) to an 8 percent increase from baseline (November wet year). The model does not predict any significant increases or decreases in planktonic algae in Santa Rosa Creek with a 5 percent design discharge to the Laguna. Predicted impacts from a 5 percent design discharge on planktonic algae in the Laguna de Santa Rosa range from a four percent decrease from baseline (April dry year) to a ten percent increase from baseline (November wet year). The ten percent increase from baseline in November of wet years is the only significant impact predicted by the model to occur in the Laguna with a 5 percent design discharge to the Laguna. Predicted impacts from a 5 percent design discharge on planktonic algae in the Russian River below the confluence with the Laguna range from a 7 percent decrease from baseline (May dry year) to a 0.1 percent increase from baseline (November normal year). No significant increases or decreases in planktonic algae are predicted to occur in the Russian River with a 5 percent design discharge.

Ten Percent Design Discharge to the Laguna. Predicted impacts from a 10 percent design discharge on planktonic algae in Santa Rosa Creek range from a three percent decrease from baseline (November dry year) to a seven percent increase from baseline (November wet year). The model does not predict any significant increases or decreases in planktonic algae in Santa Rosa Creek with a 10 percent design discharge to the Laguna. Predicted impacts from a 10 percent design discharge on planktonic algae in the Laguna de Santa Rosa range from a four percent decrease from baseline (January dry year) to a ten percent increase from baseline (November wet year). The ten percent increase from baseline in November of wet years is the only significant impact predicted by the model to occur in the Laguna with a 10 percent design discharge to the Laguna. Predicted impacts from a 10 percent design discharge on planktonic algae in the Russian River below the confluence with the Laguna range from a seven percent decrease from baseline (May dry year) to a 1 percent increase from baseline (January dry year). No significant increases in planktonic algae are predicted to occur in the Russian River below the Laguna with a 10 percent design discharge.

Twenty Percent Design Discharge to the Laguna. Predicted impacts from a 20 percent design discharge to the Laguna on planktonic algae in Santa Rosa Creek range from a 26 percent decrease from baseline (November normal year) to a 0.9 percent increase from baseline (May normal year). The model predicts a significant decrease in planktonic algae in Santa Rosa Creek with a 20 percent design discharge to the Laguna in October (normal year) and November (dry and normal years). No increases in planktonic algae in Santa Rosa Creek are predicted with a 20 percent design discharge to the Laguna. Predicted impacts from a 20 percent design discharge on planktonic algae in the Laguna de Santa Rosa range a 32 percent decrease from baseline (November normal year) to a two percent increase from baseline (April normal year). The model predicts a significant decreases in planktonic algae in the Laguna in October (normal year) and November (dry and normal years). The model does not predict any significant increases in planktonic algae in the Laguna with a 20 percent design discharge to the Laguna. Predicted impacts from a 20 percent design discharge on planktonic algae in the Russian River below the confluence with the Laguna range from a two percent decrease from baseline (April dry year) to a 12 percent increase from baseline (October normal year). This 12 percent increase in planktonic algae in October of a normal year is the only significant change predicted by the model to occur in the Russian River below the confluence with the Laguna.

Twenty Percent Design Discharge to the Russian River. Predicted impacts from a 20 percent design discharge to the Russian River on planktonic algae in Santa Rosa Creek range from a 0.5 percent decrease from baseline (May dry year) to an 8 percent increase from baseline (November wet year). The model does not predict any significant increases or decreases in planktonic algae with a 20 percent design discharge to the Russian River. Predicted impacts from a 20 percent design discharge to the Russian River on planktonic algae in the Laguna de Santa Rosa range a 0.5 percent decrease from baseline (May dry year) to a ten percent increase from baseline (November wet year). The ten percent increase in planktonic algae in November of a wet year is the only significant change predicted to occur in the Laguna with a 20 percent design discharge to the Russian River. Predicted impacts from a 20 percent design discharge to the Russian River on planktonic algae in the Russian River below the confluence with the Laguna range from a 34 percent decrease from baseline (May dry year) to no change from baseline (January wet year). The model predicts that with a 20 percent design discharge to the River, there will be significant decreases in planktonic algae in the Russian River below the confluence with the Laguna in May, June, July, August, and September (all years), April and October (dry and normal years), and March (dry year). The model does not predict any significant increases in planktonic algae in the Russian River below the confluence with the Laguna with a 20 percent design discharge to the River. Predicted impacts from a 20 percent design discharge on planktonic algae in the Russian River above the confluence with the Laguna range from a 0.1 percent decrease from baseline (several months and years) to a 20 percent increase from baseline (April dry year). The model predicts that with a 20 percent design discharge to the River, there will be significant increases in planktonic algae in the Russian River above the confluence with the Laguna in March and April (dry year). The model predicts that with a 20 percent design discharge to the River, there will be no significant decreases in planktonic algae in the Russian River above the confluence with the Laguna.

No Project. Predicted impacts from discharge related to a No Project alternative on planktonic algae in Santa Rosa Creek range from a 24 percent decrease from baseline (November normal year) to a 1 percent increase from baseline (December normal year). The model predicts a significant decrease in planktonic algae in Santa Rosa Creek in November (dry and normal years). Predicted impacts from No Project discharge on planktonic algae in the Laguna de Santa Rosa range from a 27 percent decrease from baseline (November normal year) to a three percent increase from baseline (April normal and May dry year). The model predicts a significant decrease in planktonic algae in the Laguna in November (dry and normal years). Predicted impacts from No Project discharge on planktonic algae in the Russian River below the confluence with the Laguna range from a two percent decrease from baseline (April normal year) to an 8 percent increase from baseline (October normal year). The model predicts that with No Project discharge, there will be no significant decreases in planktonic algae in the Russian River below the confluence with the Laguna. No significant increases in planktonic algae are predicted to occur in the Santa Rosa Creek, the Laguna, or the Russian River below the Laguna with discharge associated with No Project alternative to the Laguna.

Geysers. Predicted impacts from discharge related to a Geysers alternative on planktonic algae in Santa Rosa Creek range from a two percent decrease from baseline (November dry year) to a seven percent increase from baseline (November wet year). Predicted impacts from Geysers discharge on planktonic algae in the Laguna de Santa Rosa range a seven percent decrease from baseline (May dry year) to a 0.7 percent increase from baseline (June dry year). Predicted impacts from discharge related to a Geysers alternative on planktonic algae in the Russian River below the confluence with the Laguna range from a seven percent decrease from the existing condition baseline (May dry year) to no change from baseline. No significant increases or decreases in planktonic algae are predicted to occur in Santa Rosa Creek, the Laguna, or the Russian River below the Laguna with Geysers related discharge to the Laguna.

Dissolved Oxygen

The predicted average monthly changes (in mg/L) from existing conditions baseline for dissolved oxygen for the different discharge alternatives are shown in Figure 4-15. The average monthly existing conditions baseline concentration for dissolved oxygen in Santa Rosa Creek are all less than 10 mg/L. In the Laguna, eleven out of twelve of the average monthly existing conditions baseline for dissolved oxygen are less than 10 mg/L. Since the Basin Plan 50th percentile point of significance for dissolved oxygen states that 50 percent or more of average monthly dissolved oxygen must exceed 10 mg/L, the existing baseline dissolved oxygen is not in compliance. Therefore the predicted decreases of greater than or equal to 0.5 mg/L (the minimum difference in dissolved oxygen that the water quality model can accurately distinguish is estimated to be 0.5 mg/L) would be a significant impact to the Laguna and Santa Rosa Creek. The 50th percentile point of significance is more stringent than the 90th percentile point of significance, therefore exceedances of the 90th percentile point of significance were not evaluated.

There are no significant decreases in dissolved oxygen predicted with the 1, 5, and 10 percent design discharge components, 20 percent design discharge to the River, and design discharge components associated with No Project and Geysers alternatives.

The only discharge alternative that is predicted to cause decreases in dissolved oxygen greater than or equal to 0.5 mg/L is the 20 percent design discharge to the Laguna (Figure 4-15). The predicted decrease in dissolved oxygen in Santa Rosa Creek in January of a dry year is 0.5 mg/l. The predicted decrease in dissolved oxygen in the Laguna in November is 0.5 mg/L in dry and normal years. All other decreases in dissolved oxygen predicted to occur with a 20 percent design discharge to the Laguna are less than 0.5 mg/L.

Ammonia

The predicted maximum monthly changes in ammonia as a percent of the existing conditions baseline for total ammonia for the different discharge alternatives are shown in Figure 4-16. For the Laguna and Santa Rosa Creek, the numbers are presented to provide an estimate of range of impacts. The evaluation for significance of impacts on ammonia are discussed in the Total Nitrogen and Ammonia Nitrogen Loads to the Laguna section. For the Russian River, any increase in ammonia greater than 5 percent that also exceeds the EPA point of significance for the protection of aquatic life is considered a significant impact. The EPA points of significance for total ammonia are based on temperature and pH. The higher the temperature and pH, the lower the ammonia points of significance. In the Russian River below the confluence with the Laguna, the average temperature and pH in the water quality database (*Russian River Water Quality Monitoring* Technical Report, MSC 1996) are 16.7°C and 8.0, respectively. The EPA point of significance (CCC) for total ammonia (sensitive species present) for a temperature of 20°C and a pH of 8.0 is 0.76 mg-N/L.

One Percent Design Discharge. Predicted impacts from a 1 percent design discharge on ammonia are less than a five percent increase in ammonia from the existing conditions baseline in Santa Rosa Creek, the Laguna, and the Russian River below the confluence with the Laguna. Therefore the model does not predict any significant impact to ammonia in the Russian River from a 1 percent design discharge.

Five Percent Design Discharge. Predicted impacts from a 5 percent design discharge are less than a five percent increase in ammonia from the existing conditions baseline in Santa Rosa Creek, the Laguna, and the Russian River below the confluence with the Laguna. Therefore the model does not predict any significant impact to ammonia in the Russian River from a 5 percent design discharge.

Ten Percent Design Discharge. Predicted impacts from a 10 percent design discharge on ammonia in Santa Rosa Creek range from an 82 percent decrease from existing conditions baseline (May dry year and October wet year) to a 562 percent increase from baseline (November dry year). Predicted impacts from a 10 percent design discharge on ammonia in the Laguna de Santa Rosa range from a 76 percent decrease from existing conditions baseline (May dry year) to a 117 percent increase from existing conditions baseline (November dry year). Predicted ammonia concentration in the Laguna and Santa Rosa Creek are generally lower than existing conditions for the 1, 5, and 10 percent design discharge components. This is because the percent reclaimed water frequency is generally lower for these components than for existing conditions (see Daily Average Reclaimed Water Concentrations in section 4.1.5). Predicted impacts from a 10 percent design discharge on ammonia in the Russian River below the confluence with the Laguna range from a 36 percent decrease from existing conditions baseline (May dry year) to a 77 percent increase from existing conditions baseline (January dry year). None of the predicted concentrations of ammonia in the Russian River exceed 0.76 mg-N/L. Therefore, no significant increases in ammonia are predicted to occur in the Russian River below the Laguna with a 10 percent design discharge.

Twenty Percent Design Discharge to the Laguna. Predicted impacts from a 20 percent design discharge to the Laguna on ammonia in Santa Rosa Creek range from a 17 percent decrease from existing conditions baseline (April wet year) to a 692 percent increase from existing conditions baseline (November dry year). Predicted impacts from a 20 percent design discharge on ammonia in the Laguna de Santa Rosa range from a 17 percent decrease from existing conditions baseline (March dry year) to a 266 percent increase from existing conditions baseline (October dry year). Predicted ammonia concentration in the Laguna and Santa Rosa Creek are generally higher than existing conditions for the 20 percent design discharge to the Laguna component. This is because the percent reclaimed water frequency is generally higher for these components than for existing conditions (see Daily Average Reclaimed Water Concentrations in section 4.1.5). Predicted impacts from a 20 percent design discharge to the Laguna on ammonia in the Russian River below the confluence with the Laguna range from a ten percent decrease from existing conditions baseline (April normal year) to a 146 percent increase from existing conditions baseline (October normal year). However, none of the predicted concentrations of ammonia in the Russian River exceed 0.76 mg-N/L. Therefore, no significant increases in ammonia are predicted to occur in the Russian River below the Laguna with a 20 percent design discharge to the Laguna.

Twenty Percent Design Discharge to the Russian River. Predicted impacts on ammonia in Santa Rosa Creek from a 20 percent design discharge to the Russian River range from a 86 percent decrease (December dry year) to a 0.8 percent increase (May normal year). Predicted impacts on ammonia in the Laguna from a 20 percent design discharge to the Russian River range from a 76 percent decrease (May dry year) to a 1.9 percent increase (June normal year). Predicted impacts from a 20 percent design discharge to the Russian River on ammonia in the Russian River below the confluence with the Laguna range from a 25 percent decrease (February wet year) to a 79 percent increase (October normal year). Predicted impacts from a 20 percent design discharge to the Russian River on ammonia in the Russian River above the confluence with the Laguna range from no change from the existing conditions baseline to a 205 percent increase. However, none of the predicted concentrations of ammonia in the Russian River, both above and below the confluence with the Laguna, exceed 0.76 mg-N/L. Therefore, no significant increases in ammonia are predicted to occur in the Russian River with a 20 percent design discharge to the Russian River.

No Project. Predicted impacts from discharge related to a No Project alternative on ammonia in Santa Rosa Creek range from a 26 percent decrease from existing conditions baseline (April wet year) to a 636 percent increase from existing conditions baseline (November dry year). Predicted impacts from discharge related to a No Project alternative on ammonia in the Laguna de Santa Rosa range from a 18 percent decrease from existing conditions baseline (April dry year) to a 224 percent increase from existing conditions baseline (October normal year). Predicted impacts from a discharge related to a No Project alternative on ammonia in the Russian River below the confluence with the Laguna range from a 17 percent decrease from existing conditions baseline (April normal year) to a 97 percent increase from existing conditions baseline (October normal year). None of the predicted concentrations of ammonia in the Russian River exceed 0.76 mg-N/L. Therefore, no significant increases in ammonia are predicted to occur in the Russian River below the Laguna with discharge related to a No Project alternative.

Geysers. Predicted impacts from discharge related to a Geysers alternative on ammonia in Santa Rosa Creek range from a 86 percent decrease from existing conditions baseline

(February dry year) to a 66 percent increase from existing conditions baseline (November dry year). Predicted impacts from discharge related to a Geysers alternative on ammonia in the Laguna de Santa Rosa range from a 76 percent decrease from existing conditions baseline (May dry year) to a nine percent increase from existing conditions baseline (November normal year). Predicted impacts from discharge related to a Geysers alternative on ammonia in the Russian River below the confluence with the Laguna range from a 40 percent decrease (April normal year) to a four percent increase from existing conditions baseline. None of the predicted concentrations of ammonia in the Russian River exceed 0.76 mg-N/L. Therefore, no significant increases in ammonia are predicted to occur in the Russian River below the Laguna with discharge related to a Geysers alternative.

Turbidity

The range of impacts of the discharge components on turbidity due to planktonic algae is discussed above in the planktonic algae section (see also Figure 4-14, but note that the point of significance for turbidity is a 20 percent change and a 10 percent change for planktonic algae). The water quality model predictions for planktonic algae indicate that there will be no significant increases in planktonic algae induced turbidity in Santa Rosa Creek and the Laguna with any of the discharge rates examined. A 20 percent discharge to the Laguna is predicted to result in a significant decrease in turbidity in Santa Rosa Creek and the Laguna in November (dry and normal years). Discharge associated with a No Project alternative is also predicted to result in a significant decrease in turbidity in Santa Rosa Creek and the Laguna in November (dry and normal years). The decreases in turbidity are due to the flushing effect of the reclaimed water. A 20 percent discharge to the Russian River is predicted to result in a significant increase in turbidity in the Russian River above the confluence with the Laguna in April of a dry year. A 20 percent discharge to the Russian River is predicted to result in a significant decrease in turbidity in the Russian River below the confluence with the Laguna in April and May (dry year), June (all years), and July, August, and September (dry and wet years).

Temperature

The predicted average monthly changes in temperature from the existing conditions baseline for the different discharge alternatives are shown in Figure 4-17. The point of significance for temperature is a 5 °F increase. Therefore, any increases in temperature greater than or equal to 5 °F are considered significant. Little temperature change is expected since the storage ponds are normally unstratified and therefore approximate ambient temperature

One Percent Design Discharge. Predicted impacts from a 1 percent design discharge on temperature are less than a 1 degree change from the existing conditions baseline in Santa Rosa Creek, the Laguna, and the Russian River below the confluence with the Laguna. Therefore the model does not predict any significant impact to temperature from a one percent design discharge.

Five Percent Design Discharge. Predicted impacts from a 5 percent design discharge on temperature are less than a one degree change from the existing conditions baseline in

Santa Rosa Creek, the Laguna, and the Russian River below the confluence with the Laguna. Therefore the model does not predict any significant impact to temperature from a 5 percent design discharge.

Ten Percent Design Discharge. Predicted impacts from a 10 percent design discharge on temperature are less than a one degree change from the existing conditions baseline in Santa Rosa Creek, the Laguna, and the Russian River below the confluence with the Laguna. Therefore the model does not predict any significant impact to temperature from a 10 percent design discharge.

Twenty Percent Design Discharge to the Laguna. Predicted impacts from a 20 percent design discharge to the Laguna on temperature in Santa Rosa Creek range from a 0.1 degree decrease from existing conditions baseline (January, February, March, and April dry year) to a 1.9 degree increase from existing conditions baseline (November normal year). Predicted impacts from a 20 percent design discharge on temperature in the Laguna de Santa Rosa range from a 0.3 degree decrease from existing conditions baseline (January dry year) to a 1.8 degree increase from existing conditions baseline (November normal year). Predicted impacts from a 20 percent design discharge on temperature in the Russian River below the confluence with the Laguna are all less than one degree. No significant impacts on temperature are predicted for Santa Rosa Creek, the Laguna, or the Russian River below the confluence with the Laguna with a 20 percent design discharge to the Laguna.

Twenty Percent Design Discharge to the Russian River. Predicted impacts from a 20 percent design discharge to the Russian River on temperature are less than a one degree change from the existing conditions baseline in Santa Rosa Creek, the Laguna, and the Russian River above and below the confluence with the Laguna. Therefore the model does not predict any significant impact to temperature from a 20 percent design discharge to the Russian River.

No Project. Predicted impacts from discharge related to a No Project alternative on temperature in Santa Rosa Creek range from a 0.2 degree decrease from existing conditions baseline (January dry year) to a 1.8 degree increase from existing conditions baseline (November normal year). Predicted impacts from discharge related to a No Project alternative on temperature in the Laguna de Santa Rosa range from a 0.1 degree decrease from existing conditions baseline (May normal and wet years) to a 1.5 degree increase from existing conditions baseline (November normal year). Predicted impacts from a discharge related to a No Project alternative on temperature in the Russian River below the confluence with the Laguna are all less than one degree. No significant impacts on temperature are predicted for Santa Rosa Creek, the Laguna, or the Russian River below the confluence with the Laguna with discharge related to a No Project alternative.

Geysers. Predicted impacts from discharge related to a Geysers alternative on temperature are less than a one degree change from the existing conditions baseline in Santa Rosa Creek, the Laguna, and the Russian River below the confluence with the Laguna. Therefore the model does not predict any significant impact to temperature from discharge related to a Geysers alternative.

Water Quality Simulation Model Results - Zero Discharge Baseline

Water quality conditions without Santa Rosa's discharge (zero discharge baseline conditions) were simulated, and the results of the simulation are summarized in Table 4-4. Water quality conditions relative to the zero discharge baseline are presented in this section for benthic algae, planktonic algae, dissolved oxygen, and ammonia.

Benthic Algae

The predicted average monthly percent changes from a zero discharge baseline for benthic algae for the different discharge alternatives are shown in Figure 4-18.

One Percent Design Discharge to the Laguna. Predicted impacts from a 1 percent design discharge on benthic algae in Santa Rosa Creek range from a 1 percent decrease from a zero discharge baseline (January wet year) to a 23 percent increase from a zero discharge baseline (April wet year). Predicted impacts from a 1 percent design discharge on benthic algae in the Laguna de Santa Rosa range from less than a 1 percent change (most months and years) to a two percent increase (April normal year). Predicted impacts from a 1 percent design discharge on benthic algae in the Russian River are less than a 1 percent change except in April of a normal year where a four percent increase is predicted.

Five Percent Design Discharge to the Laguna. Predicted impacts from a 5 percent design discharge on benthic algae in Santa Rosa Creek range from a 17 percent decrease from a zero discharge baseline (February dry year) to a 22 percent increase from a zero discharge baseline (April wet year). Predicted impacts from a 5 percent design discharge on benthic algae in the Laguna de Santa Rosa range from a nine percent decrease from a zero discharge baseline (February normal year) to a six percent increase from a zero discharge baseline (June dry year). Predicted impacts from a 5 percent design discharge on benthic algae in the Russian River below the confluence with the Laguna range from no change from a zero discharge baseline (several months, all years) to a 15 percent increase from a zero discharge baseline (April, normal year).

Table 4-4.

Simulated Water Quality Conditions Without Santa Rosa's Discharge (Zero Discharge Baseline Conditions)

	Dry Year (based on 1976)					Normal Year (based on 1961)					Wet Year (based on 1982)				
	Benthic Algae mg/ft²	Planktonic Algae mg/L	Dissolved Oxygen mg/L	Ammonia mg-N/L	Temp °F	Benthic Algae mg/ft²	Planktonic Algae mg/L	Dissolved Oxygen mg/L	Ammonia mg-N/L	Temp °F	Benthic Algae mg/ft²	Planktonic Algae mg/L	Dissolved Oxygen mg/L	Ammonia mg-N/L	Temp °F
	Santa Rosa Creek														
Oct	525	2.1	8.5	0.2	60.7	493	2.1	8.1	0.2	60.5	522	2.1	8.5	0.2	60.8
Nov	880	1.1	8.7	0.2	52.7	702	1.1	8.5	0.2	52.2	643	1.1	8.7	0.2	53.4
Dec	659	0.6	9.8	0.2	43.3	528	0.6	9.6	0.2	43.4	222	0.6	9.0	0.2	43.4
Jan	493	0.5	10.2	0.2	43.0	366	0.5	9.8	0.2	42.7	69	0.5	9.4	0.2	42.5
Feb	867	0.6	9.8	0.2	44.7	267	0.6	9.5	0.2	44.6	43	0.6	9.3	0.2	44.5
Mar	1502	1.2	9.1	0.2	49.4	1031	1.2	9.3	0.2	49.0	91	1.2	9.2	0.2	48.9
Apr	1751	2.8	8.6	0.2	56.8	1744	2.7	8.9	0.2	56.7	260	2.7	9.0	0.1	56.4
May	1161	4.4	7.3	0.2	64.3	1645	4.4	8.2	0.1	64.5	1606	4.4	8.9	0.1	64.7
Jun	425	4.7	7.3	0.2	69.7	693	5.3	7.4	0.1	70.1	1092	5.5	8.3	0.1	70.8
Jul	432	4.3	7.0	0.2	71.7	376	4.8	7.4	0.2	72.0	442	5.6	8.2	0.1	73.3
Aug	446	4.8	7.2	0.2	72.2	415	4.9	7.4	0.2	72.2	363	5.3	8.1	0.1	72.9
Sep	514	3.6	7.7	0.2	67.3	508	3.5	7.9	0.2	67.3	521	3.8	8.4	0.1	67.9
	Lower Laguna														

Table 4-4.

Simulated Water Quality Conditions Without Santa Rosa's Discharge (Zero Discharge Baseline Conditions)

	Dry Year (based on 1976)					Normal Year (based on 1961)					Wet Year (based on 1982)				
	Benthic Algae mg/ft^2	Planktonic Algae mg/L	Dissolved Oxygen mg/L	Ammonia mg-N/L	Temp ºF	Benthic Algae mg/ft^2	Planktonic Algae mg/L	Dissolved Oxygen mg/L	Ammonia mg-N/L	Temp ºF	Benthic Algae mg/ft^2	Planktonic Algae mg/L	Dissolved Oxygen mg/L	Ammonia mg-N/L	Temp ºF
Oct	413	3.5	9.0	0.3	60.1	431	2.9	8.8	0.3	59.8	423	3.2	8.9	0.3	60.1
Nov	631	2.0	9.6	0.4	51.3	583	1.9	9.4	0.4	50.8	394	1.6	8.9	0.3	53.1
Dec	395	0.7	10.3	0.7	43.4	213	0.6	9.8	0.4	43.6	60	0.6	9.3	0.3	43.8
Jan	308	0.7	10.8	0.5	44.1	149	0.6	10.2	0.4	43.4	22	0.5	9.8	0.3	42.8
Feb	510	0.9	10.1	0.9	45.4	78	0.6	9.6	0.4	44.9	20	0.6	9.7	0.3	44.7
Mar	918	2.0	9.2	1.0	51.0	288	1.3	9.4	0.3	49.9	21	1.2	9.5	0.3	49.5
Apr	1189	5.7	9.0	0.6	58.1	925	4.3	9.5	0.3	57.7	21	3.1	8.9	0.3	56.8
May	760	6.3	8.2	0.1	64.2	1033	6.0	8.6	0.1	64.6	248	6.0	9.1	0.2	64.9
Jun	365	4.9	8.0	0.1	68.7	472	5.8	8.2	0.1	69.2	495	7.1	8.4	0.1	70.4
Jul	394	4.2	7.8	0.2	70.0	306	4.5	8.1	0.1	70.3	233	6.6	8.4	0.1	71.7
Aug	365	4.7	8.0	0.2	70.7	355	4.7	8.0	0.2	70.7	187	5.8	8.4	0.1	71.5
Sep	390	3.8	8.4	0.2	66.2	387	3.8	8.5	0.2	66.3	362	4.7	8.7	0.1	66.9
Russian River Above Laguna															
Oct	351	0.9	9.5	0.1	61.4	356	0.9	9.5	0.1	61.3	355	1.0	9.6	0.1	61.4

Table 4-4.

Simulated Water Quality Conditions Without Santa Rosa's Discharge (Zero Discharge Baseline Conditions)

	Dry Year (based on 1976)					Normal Year (based on 1961)					Wet Year (based on 1982)				
	Benthic Algae mg / ft²	Planktonic Algae mg / L	Dissolved Oxygen mg / L	Ammonia mg-N / L	Temp °F	Benthic Algae mg / ft²	Planktonic Algae mg / L	Dissolved Oxygen mg / L	Ammonia mg-N / L	Temp °F	Benthic Algae mg / ft²	Planktonic Algae mg / L	Dissolved Oxygen mg / L	Ammonia mg-N / L	Temp °F
Nov	462	0.6	10.1	0.1	54.2	479	0.6	10.0	0.1	54.3	306	0.6	10.2	0.1	54.4
Dec	313	0.4	11.0	0.1	46.4	233	0.3	11.0	0.1	45.9	47	0.3	10.9	0.1	46.4
Jan	227	0.4	11.2	0.1	44.8	110	0.3	11.1	0.1	44.0	20	0.3	11.0	0.1	44.0
Feb	309	0.4	11.0	0.1	46.1	39	0.3	11.0	0.1	45.2	20	0.3	10.9	0.1	45.5
Mar	655	0.4	10.6	0.1	50.9	43	0.4	10.8	0.1	50.6	20	0.4	10.8	0.1	50.7
Apr	1217	0.9	9.8	0.1	58.0	352	0.8	10.2	0.1	57.6	20	0.7	10.2	0.1	57.9
May	1017	1.2	9.0	0.1	66.2	1134	1.3	9.5	0.1	65.9	218	1.4	9.7	0.1	66.1
Jun	747	1.4	9.1	0.1	70.1	724	1.8	9.2	0.1	70.9	652	2.1	9.4	0.1	71.5
Jul	495	1.5	9.4	0.1	70.7	425	1.9	9.3	0.1	71.9	384	2.2	9.3	0.1	72.4
Aug	401	1.6	9.3	0.1	70.8	371	1.9	9.2	0.1	72.1	393	2.1	9.2	0.1	72.4
Sep	400	1.3	9.2	0.1	68.5	387	1.4	9.2	0.1	69.0	407	1.6	9.2	0.1	69.1
	Russian River Below Laguna														
Oct	412	1.8	9.4	0.1	60.9	429	1.5	9.3	0.1	60.9	400	1.7	9.4	0.1	61.0
Nov	524	1.0	10.0	0.2	53.2	592	0.9	9.8	0.2	53.1	286	0.8	9.8	0.2	54.0

Table 4-4.

Simulated Water Quality Conditions Without Santa Rosa's Discharge (Zero Discharge Baseline Conditions)

	Dry Year (based on 1976)					Normal Year (based on 1961)					Wet Year (based on 1982)				
	Benthic Algae mg / ft²	Planktonic Algae mg / L	Dissolved Oxygen mg / L	Ammonia mg-N / L	Temp ºF	Benthic Algae mg / ft²	Planktonic Algae mg / L	Dissolved Oxygen mg / L	Ammonia mg-N / L	Temp ºF	Benthic Algae mg / ft²	Planktonic Algae mg / L	Dissolved Oxygen mg / L	Ammonia mg-N / L	Temp ºF
Dec	281	0.5	10.9	0.2	45.6	189	0.4	10.8	0.2	45.4	39	0.4	10.5	0.2	45.8
Jan	167	0.5	11.2	0.2	44.8	68	0.4	11.0	0.2	43.9	24	0.4	10.8	0.2	43.8
Feb	249	0.6	10.8	0.3	45.9	30	0.4	10.8	0.2	45.1	24	0.4	10.6	0.2	45.3
Mar	595	0.9	10.4	0.2	51.0	33	0.5	10.6	0.2	50.6	24	0.6	10.4	0.2	50.3
Apr	1414	3.0	9.8	0.3	58.1	264	1.6	10.2	0.1	57.7	24	1.2	9.9	0.1	57.7
May	1291	3.2	9.0	0.1	65.5	1275	2.5	9.4	0.1	65.6	128	2.9	9.7	0.1	65.7
Jun	1023	2.8	8.9	0.1	69.9	862	3.5	9.1	0.1	70.5	432	4.5	9.4	0.1	71.0
Jul	603	2.8	9.2	0.1	70.8	502	3.0	9.3	0.1	71.7	178	4.2	9.2	0.1	72.1
Aug	489	3.1	9.2	0.1	71.0	446	3.1	9.1	0.1	71.9	309	3.7	9.1	0.1	72.1
Sep	506	2.5	9.1	0.1	67.8	482	2.4	9.1	0.1	68.3	465	3.0	9.1	0.1	68.2

Ten Percent Design Discharge to the Laguna. Predicted impacts from a 10 percent design discharge on benthic algae in Santa Rosa Creek range from a 27 percent decrease from a zero discharge baseline (February dry year) to a 12 percent increase from a zero discharge baseline (December dry year). Predicted impacts from a 10 percent design discharge on benthic algae in the Laguna de Santa Rosa range from a 11 percent decrease from a zero discharge baseline (February normal year) to a seven percent increase from a zero discharge baseline (June dry year). Predicted impacts from a 10 percent design discharge on benthic algae in the Russian River below the confluence with the Laguna range from a 0.1 percent decrease from a zero discharge baseline (December wet year) to a 21 percent increase from a zero discharge baseline (April normal year).

Twenty Percent Design Discharge to the Laguna. Predicted impacts from a 20 percent design discharge to the Laguna on benthic algae in Santa Rosa Creek range from a 27 percent decrease from a zero discharge baseline (February dry year) to a 136 percent increase from a zero discharge baseline (November normal year). Predicted impacts from a 20 percent design discharge to benthic algae in the Laguna de Santa Rosa range from a three percent decrease from a zero discharge baseline (February dry year) to a 74 percent increase from a zero discharge baseline (November normal year). Predicted impacts from a 20 percent design discharge on benthic algae in the Russian River below the confluence with the Laguna range from no change from a zero discharge baseline (several months and all years) to a 91 percent increase from a zero discharge baseline (January normal year).

Twenty Percent Design Discharge to the Russian River. Predicted impacts from a 20 percent design discharge to the Russian River on benthic algae in Santa Rosa Creek range from a one percent decrease from a zero discharge baseline (February dry year) to a six percent increase from a zero discharge baseline (April wet year). Predicted impacts from a 20 percent design discharge to the Russian River on benthic algae in the Laguna de Santa Rosa are all less than one percent. Predicted impacts from a 20 percent design discharge to the River on benthic algae in the Russian River below the confluence with the Laguna range from a 16 percent decrease from a zero discharge baseline (June wet year) to a 53 percent increase from a zero discharge baseline (January normal year). Predicted impacts from a 20 percent design discharge on benthic algae in the Russian River above the confluence with the Laguna range from a three percent decrease from a zero discharge baseline (July wet year) to a 147 percent increase from a zero discharge baseline (March normal year).

No Project. Predicted impacts from discharge related to a No Project alternative on benthic algae in Santa Rosa Creek range from a 16 percent decrease from a zero discharge baseline (February dry year) to a 135 percent increase from a zero discharge baseline (November normal year). Predicted impacts from No Project discharge on benthic algae in the Laguna de Santa Rosa range a one percent decrease from a zero discharge baseline (March wet year) to a 69 percent increase from a zero discharge baseline (November normal year). Predicted impacts from No Project discharge on benthic algae in the Russian River below the confluence with the Laguna range from no change from a zero discharge baseline (several months, all years) to a 80 percent increase from a zero discharge baseline (January normal year).

Geysers. Predicted impacts from discharge related to a Geysers alternative on benthic algae in Santa Rosa Creek range from no change from a zero discharge baseline (several months all years) to a 37 percent increase from a zero discharge baseline (March wet year). Predicted impacts from Geysers discharge on benthic algae in the Laguna de Santa Rosa range from no change from a zero discharge baseline (several months all) to a seven percent increase from a zero discharge baseline (December dry year). Predicted impacts from Geysers discharge on benthic algae in the Russian River below the confluence with the Laguna range from no change to a five percent increase (January dry year).

Planktonic Algae

The predicted average monthly percent changes from a zero discharge baseline for planktonic algae for the different discharge alternatives are shown in Figure 4-19.

One Percent Design Discharge to the Laguna. Predicted impacts from a 1 percent design discharge to planktonic algae in Santa Rosa Creek, the Laguna, and the Russian River are all less than one percent.

Five Percent Design Discharge to the Laguna. Predicted impacts from a 5 percent design discharge on planktonic algae in Santa Rosa Creek range from a two percent decrease (January dry year) to no change (several months, all years). Predicted impacts from a 5 percent design discharge on planktonic algae in the Laguna de Santa Rosa range from a 6 percent decrease from a zero discharge baseline (January dry year) to a 0.1 percent increase from a zero discharge baseline (July dry year). Predicted impacts from a 5 percent design discharge on planktonic algae in the Russian River below the confluence with the Laguna range from a 0.1 percent decrease from a zero discharge baseline (June dry year) to a five percent increase from a zero discharge baseline (April dry year).

Ten Percent Design Discharge to the Laguna. Predicted impacts from a 10 percent design discharge on planktonic algae in Santa Rosa Creek range from no change from a zero discharge baseline (several months all years) to a five percent decrease from a zero discharge baseline (December dry year). Predicted impacts from a 10 percent design discharge on planktonic algae in the Laguna de Santa Rosa range from a ten percent decrease from a zero discharge baseline (January dry year) to a 0.1 percent increase from a zero discharge baseline (July dry year). Predicted impacts from a 10 percent design discharge on planktonic algae in the Russian River below the confluence with the Laguna range from a 0.2 percent decrease (June dry year) to a five percent increase (April dry year).

Twenty Percent Design Discharge to the Laguna. Predicted impacts from a 20 percent design discharge to the Laguna on planktonic algae in Santa Rosa Creek range from a 27 percent decrease from a zero discharge baseline (November normal year) to a one percent increase from a zero discharge baseline (May all years). Predicted impacts from a 20 percent design discharge on planktonic algae in the Laguna de Santa Rosa range a 33 percent decrease from a zero discharge baseline (November normal year) to a two percent increase from a zero discharge baseline (May dry year). Predicted impacts from a 20 percent design discharge on planktonic algae in the Russian River below the confluence with the Laguna range from a one percent decrease from a zero discharge baseline (June dry year) to a 12 percent increase from a zero discharge baseline (October normal year).

Twenty Percent Design Discharge to the Russian River. Predicted impacts from a 20 percent design discharge to the Russian River on planktonic algae in Santa Rosa Creek and the Laguna de Santa Rosa are all less than one percent. Predicted impacts from a 20 percent design discharge to the Russian River on planktonic algae in the Russian River below the confluence with the Laguna range from a 29 percent decrease from a zero discharge baseline (May dry year) to a 0.3 percent increase from a zero discharge baseline (January normal and wet years). Predicted impacts from a 20 percent design discharge on planktonic algae in the Russian River above the confluence with the Laguna range from a 0.1 percent decrease from a zero discharge baseline (several months and years) to a 20 percent increase from a zero discharge baseline (April dry year).

No Project. Predicted impacts from discharge related to a No Project alternative on planktonic algae in Santa Rosa Creek range from a 25 percent decrease from a zero discharge baseline (November normal year) to a one percent increase from a zero discharge baseline (May dry and normal years). Predicted impacts from No Project discharge on planktonic algae in the Laguna de Santa Rosa range a 28 percent decrease from a zero discharge baseline (November normal year) to a three percent increase from a zero discharge baseline (May dry year). Predicted impacts from No Project discharge on planktonic algae in the Russian River below the confluence with the Laguna range from a 0.6 decrease from a zero discharge baseline (June dry year) to a 9 percent increase from a zero discharge baseline (May dry year).

Geysers. Predicted impacts from discharge related to a Geysers alternative on planktonic algae in Santa Rosa Creek range from a two percent decrease (November dry year) to no change from a zero discharge baseline (several months, all years). Predicted impacts from discharge related to a Geysers alternative on planktonic algae in the Laguna de Santa Rosa and the Russian River are all less than one percent.

Dissolved Oxygen

The predicted average monthly changes (in mg/L) from a zero discharge baseline for dissolved oxygen for the different discharge alternatives are shown in Figure 4-20. The minimum difference in dissolved oxygen that the water quality model can accurately distinguish is estimated to be 0.5 mg/L.

One Percent Design Discharge. Predicted impacts from a one percent design discharge on dissolved oxygen are less than 0.5 mg/L. in Santa Rosa Creek, the Laguna, and the Russian River below the confluence with the Laguna.

Five Percent Design Discharge. Predicted impacts from a 5 percent design discharge on dissolved oxygen in Santa Rosa Creek range from a 1.0 mg/L decrease from a zero discharge baseline to no change from a zero discharge baseline. Predicted impacts from a

5 percent design discharge on dissolved oxygen in the Laguna de Santa Rosa and the Russian River are all less than 0.5 mg/L.

Ten Percent Design Discharge. Predicted impacts from a 10 percent design discharge on dissolved oxygen in Santa Rosa Creek range from a 1.3 mg/L decrease from a zero discharge baseline (January dry year) to no change from a zero discharge baseline (several months all years). Predicted impacts from a 10 percent design discharge on dissolved oxygen in the Laguna de Santa Rosa and the Russian River are all less than 0.5 mg/L.

Twenty Percent Design Discharge to the Laguna. Predicted impacts from a 20 percent design discharge to the Laguna on dissolved oxygen in Santa Rosa Creek range from a 1.5 mg/L decrease from a zero discharge baseline (January dry year) to a 0.12 mg/L increase from a zero discharge baseline (May dry year). Predicted impacts from a 20 percent design discharge on dissolved oxygen in the Laguna de Santa Rosa range from a 0.60 mg/L decrease from a zero discharge baseline (January dry year) to a 0.13 mg/L increase from a zero discharge baseline (May dry year). Predicted impacts from a 20 percent design discharge on dissolved oxygen in the Russian River below the confluence with the Laguna are all less than 0.5 mg/L.

Twenty Percent Design Discharge to the Russian River. Predicted impacts from a 20 percent design discharge to the Russian River are less than 0.5 mg/L in Santa Rosa Creek, the Laguna, and the Russian River above and below the confluence with the Laguna.

No Project. Predicted impacts from discharge related to a No Project alternative on dissolved oxygen in Santa Rosa Creek range from a 1.3 mg/L decrease from a zero discharge baseline (January dry year) to a 0.05 mg/L increase from a zero discharge baseline (May dry year). Predicted impacts from discharge related to a No Project alternative on dissolved oxygen in the Laguna de Santa Rosa and the Russian River below the confluence with the Laguna are all less than 0.5 mg/L.

Geysers. Predicted impacts from discharge related to a Geysers alternative on dissolved oxygen in Santa Rosa Creek, the Laguna de Santa Rosa, and the Russian River below the confluence with the Laguna are all less than 0.5 mg/L.

Ammonia

The predicted maximum monthly changes in ammonia as a percent of a zero discharge baseline for total ammonia for the different discharge alternatives are shown in Figure 4-21. The minimum difference in ammonia that the water quality model can accurately distinguish is estimated to be five percent.

One Percent Design Discharge. Predicted impacts from a 1 percent design discharge on ammonia in Santa Rosa Creek range from no change from a zero discharge baseline (several months all years) to a 123 percent increase from a zero discharge baseline (February normal year). Predicted impacts from a 1 percent design discharge on ammonia in the Laguna de Santa Rosa range from no change (several months all years) to a 23 percent increase from a zero discharge baseline (January wet year). Predicted impacts from a 1 percent design discharge on ammonia in the Russian River below the confluence with the Laguna range from no change (several months all years) to a 13 percent increase from a zero discharge baseline (January wet year).

Five Percent Design Discharge. Predicted impacts from a 5 percent design discharge on ammonia in Santa Rosa Creek range from no change from a zero discharge baseline (several months all years) to a 562 percent increase from a zero discharge baseline (January dry year). Predicted impacts from a 5 percent design discharge on ammonia in the Laguna de Santa Rosa range from no change (several months all years) to a 115 percent increase from a zero discharge baseline (January dry year). Predicted impacts from a 5 percent design discharge on ammonia in the Russian River below the confluence with the Laguna range from no change (several months all years) to a 45 percent increase from a zero discharge baseline (January dry year).

Ten Percent Design Discharge. Predicted impacts from a 10 percent design discharge on ammonia in Santa Rosa Creek range from no change from a zero discharge baseline (several months all years) to a 645 percent increase from a zero discharge baseline (January dry year). Predicted impacts from a 10 percent design discharge on ammonia in the Laguna de Santa Rosa range from no change (several months all years) to a 148 percent increase from a zero discharge baseline (January dry year). Predicted impacts from a 10 percent design discharge on ammonia in the Russian River below the confluence with the Laguna range from no change (several months all years) to a 92 percent increase from a zero discharge baseline (January dry year).

Twenty Percent Design Discharge to the Laguna. Predicted impacts from a 20 percent design discharge in the Laguna on ammonia in Santa Rosa Creek range from no change from a zero discharge baseline (several months all years) to a 763 percent increase from a zero discharge baseline (November wet year). Predicted impacts from a 20 percent design discharge in the Laguna on ammonia in the Laguna de Santa Rosa range from no change (several months all years) to a 304 percent increase from a zero discharge baseline (May dry year). Predicted impacts from a 20 percent design discharge in the Laguna on ammonia in the Russian River below the confluence with the Laguna range from no change (several months all years) to a 146 percent increase from a zero discharge baseline (October normal year).

Twenty Percent Design Discharge to the Russian River. Predicted impacts from a 20 percent design discharge in the River on ammonia in Santa Rosa Creek range from no change from a zero discharge baseline (several months all years) to a 261 percent increase from a zero discharge baseline (February dry year). Predicted impacts from a 20 percent design discharge in the River on ammonia in the Laguna de Santa Rosa range from no change (several months all years) to a 19 percent increase from a zero discharge baseline (January wet year). Predicted impacts from a 20 percent design discharge in the River on ammonia in the Russian River below the confluence with the Laguna range from a 22 percent decrease (July wet year) to a 79 percent increase from a zero discharge baseline (October normal year). Predicted impacts from a 20 percent design discharge in the River on ammonia in the Russian River above the confluence with the Laguna range from no change (several months all years) to 205 percent increase from a zero discharge baseline (January dry year).

No Project. Predicted impacts from discharge related to a No Project alternative on ammonia in Santa Rosa Creek range from no change from a zero discharge baseline (several months all years) to a 704 percent increase from a zero discharge baseline (November wet year). Predicted impacts from discharge related to a No Project alternative on ammonia in the Laguna de Santa Rosa range from no change (several months all years) to a 269 percent increase from a zero discharge baseline (May dry year). Predicted impacts from discharge related to a No Project alternative on ammonia in the Russian River below the confluence with the Laguna range from no change (several months all years) to a 121 percent increase from a zero discharge baseline (May dry year).

Geysers. Predicted impacts from discharge related to a Geysers alternative on ammonia in Santa Rosa Creek range from no change from a zero discharge baseline (several months all years) to a 79 percent increase from a zero discharge baseline (November wet year). Predicted impacts from discharge related to a Geysers alternative on ammonia in the Laguna de Santa Rosa range from no change (several months all years) to a nine percent increase from a zero discharge baseline (November dry year). Predicted impacts from discharge related to a Geysers alternative on ammonia in the Russian River below the confluence with the Laguna range from no change (several months all years) to a eight percent increase from a zero discharge baseline (November wet year).

Turbidity

The range of impacts of the discharge components on turbidity due to planktonic algae is discussed above in the planktonic algae section.

Temperature

The predicted average monthly changes in temperature from the zero discharge baseline for the different discharge alternatives are shown in Figure 4-22.

One Percent Design Discharge. Predicted impacts from a 1 percent design discharge on temperature are less than a one degree change from the zero discharge baseline in Santa Rosa Creek, the Laguna, and the Russian River below the confluence with the Laguna.

Five Percent Design Discharge. Predicted impacts from a 5 percent design discharge on temperature are less than a one degree change from the zero discharge baseline in Santa Rosa Creek, the Laguna, and the Russian River below the confluence with the Laguna.

Ten Percent Design Discharge. Predicted impacts from a 10 percent design discharge on temperature are less than a one degree change from the zero discharge baseline in Santa Rosa Creek, the Laguna, and the Russian River below the confluence with the Laguna.

Twenty Percent Design Discharge to the Laguna. Predicted impacts from a 20 percent design discharge to the Laguna on temperature in Santa Rosa Creek range from a 0.3 degree decrease from baseline (January dry year) to a 1.9 degree increase from baseline (November normal year). Predicted impacts from a 20 percent design discharge on temperature in the Laguna de Santa Rosa range from a 0.7 degree decrease from baseline (January dry year) to a 1.8 degree increase from baseline (November normal year). Predicted impacts from a 20 percent design discharge on temperature in the Russian River below the confluence with the Laguna are all less than one degree.

Twenty Percent Design Discharge to the Russian River. Predicted impacts from a 20 percent design discharge to the Russian River on temperature are less than a one degree change from the zero discharge baseline in Santa Rosa Creek, the Laguna, and the Russian River above and below the confluence with the Laguna.

No Project. Predicted impacts from discharge related to a No Project alternative on temperature in Santa Rosa Creek range from a 0.3 degree decrease from baseline (January dry year) to a 1.8 degree increase from baseline (November normal year). Predicted impacts from discharge related to a No Project alternative on temperature in the Laguna de Santa Rosa range from a 0.6 degree decrease from baseline (January dry year) to a 1.5 degree increase from baseline (November normal year). Predicted impacts from a discharge related to a No Project alternative on temperature in the Russian River below the confluence with the Laguna are all less than one degree.

Geysers. Predicted impacts from discharge related to a Geysers alternative on temperature are less than a one degree change from the zero discharge baseline in Santa Rosa Creek, the Laguna, and the Russian River below the confluence with the Laguna.

Dilution Model Results

The results of the dilution model used to predict the concentrations of conservative constituents (those unaffected by biological activity) in receiving waters with varying concentrations of reclaimed water discharge are described in this section.

Range of Impacts

The estimated concentrations of the remaining constituents which were not eliminated from consideration in Section 4.1.1 Screening of Evaluation Criteria for Direct Discharge in the receiving water (Laguna de Santa Rosa, Santa Rosa Creek, the upper Russian River (above the confluence with the Laguna), and the lower Russian River (below the confluence with the Laguna)) resulting from discharge, using an existing conditions baseline, are shown in Tables 4-5 through 4-11. The estimated concentrations of the these constituents in the Russian River above the confluence with the Laguna for the 20 percent design discharge to the River component are shown in Table 4-9. The concentrations shown in Tables 4-5 through 4-11 were estimated for the maximum 95th percentile daily average reclaimed water concentration of the three years examined (wet, dry, and normal).

Significance of Impacts

The concentration of acrolein, chlorpyrifos, demeton, guthion (azinphos-methyl), malathion, parathion, and toxaphene are not detectable in reclaimed water but the reporting limit is greater than the point of significance. Therefore, they may exceed the point of significance. Recognized analytical methods that are routinely available to reclaimed water discharges do not provide sufficiently low reporting limits to evaluate attainment of EPA's water quality criteria. This impact is considered less than significant, but mitigation is specified in the EIR/S to assure that periodic monitoring for these substances is conducted. The specified mitigation is to periodically evaluate analytical method developments and conduct a definitive analysis when reporting limits below the point of significance become available.

Predicted concentrations of constituents that exceed the points of significance with the 95th percentile daily average reclaimed water concentrations are, in most cases, shown in bold in Tables 4-5 through 4-11. Exceptions to this are described below.

The estimated concentrations of heptachlor in receiving waters for all discharge components exceeded the point of significance for heptachlor. This is due, in part, to the baseline receiving water concentrations of heptachlor. Heptachlor was below detection in all baseline receiving waters, but the point of significance was exceeded by the reporting limit (and half the reporting limit). Heptachlor was detectable in reclaimed water only once (in 1991) out of 19 measurements. Since the use of heptachlor is banned in the United States, the concentration of heptachlor in reclaimed water should continue to be below detection. Therefore, all discharge components are expected to have a less than significant impact on heptachlor in the receiving waters.

The average concentration and the maximum concentration in 25 of 27 measurements of aluminum in reclaimed water was lower than the point of significance. Aluminum has been measured only in the Russian River above the discharge, where the concentration was detectable on one out of four measurement and was ten times the concentration found in reclaimed water. Therefore, although the predicted concentration in the Russian River exceeds the point of significance for all discharge components, the exceedances are due to the receiving water concentration of aluminum. , not reclaimed water. All discharge components are expected to have a less than significant impact on aluminum in the receiving waters.

Table 4-5.

Range of Concentrations in Receiving Water with a 1 Percent Design Discharge to Laguna

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Aluminum (mg/L)	N/A	N/A	N/A	N/A	0.15	0.15	0.087	0.087
Dissolved Aluminum (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Arsenic (mg/L)	0.0028	0.0028	0.0036	0.0035	0.0025	0.0025		
Dissolved Arsenic (mg/L)	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.19	0.19
Total Barium (mg/L)	N/A	N/A	N/A	N/A	0.073	0.073		
Total Boron (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Total Cadmium (mg/L)	0.0003	0.0003	0.0020	0.0019	0.0015	0.0015		
Total Calcium (mg/L)	21	21.9	18.0	18.5	18.0	18.1		
Total Chromium (mg/L)	0.0048	0.0045	0.0059	0.0058	0.006	0.0060		
Total Copper (mg/L)	0.0060	0.0066	0.0119	0.0119	0.0076	0.0076		
Dissolved Copper (mg/L)	0.0025	0.0031	0.0025	0.0028	0.0025	0.0025	0.013	0.014
Total Lead (mg/L)	0.0028	0.0027	0.0028	0.0028	0.0024	0.0024		

Table 4-5.

Range of Concentrations in Receiving Water with a 1 Percent Design Discharge to Laguna

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Total Magnesium (mg/L)	16.8	16.9	13.6	13.8	12.1	12.1		
Total Mercury (mg/L)	0.0001	0.0004	0.00037	0.0004	0.0002	0.0002	0.0013	0.0013
Total Nickel (mg/L)	0.0061	0.0059	0.0128	0.0124	0.0109	0.011		
Dissolved Nickel (mg/L)	0.0039	0.0039	0.0059	0.0058	0.0028	0.0028	0.182	0.196
Total Potassium (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Dissolved Potassium (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Total Silver (mg/L)	0.0005	0.0006	0.0026	0.0025	0.0006	0.0006		
Dissolved Silver (mg/L)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0019	0.0019
Total Sodium (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Dissolved Sodium (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Total Zinc (mg/L)	0.020	0.021	0.023	0.024	0.015	0.015		

Table 4-5.

Range of Concentrations in Receiving Water with a 1 Percent Design Discharge to Laguna

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Dissolved Zinc (mg/L)	0.025	0.026	0.025	0.025	0.037	0.037	0.121	0.131
Total Cyanide (mg/L)	0	0.0009	0	0.0004	0.0025	0.0025	0.0052	0.0052
Acetone (µg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Total Halomethanes (µg/L)	N/A	N/A	1.0	1.1	1.3	1.3	11,000	11,000
Carbon Disulfide (µg/L)	N/A	N/A	N/A	N/A	0.25	0.27		
Chlorobenzene (µg/L)	N/A	N/A	0.2	0.19	0.25	0.25	50	50
Chloroform (µg/L)	N/A	N/A	0.2	0.59	0.25	0.30	1240	1240
Dichlorobenzene (µg/L)	N/A	N/A	0.20	0.26	0.25	0.26	763	763
Ethyl Benzene (µg/L)	N/A	N/A	0.3	0.30	0.25	0.25		
Methylene Chloride (µg/L)	N/A	N/A	5	4.8	0.25	0.25	11,000	11,000
Tetrachloroethene (µg/L)	N/A	N/A	0.2	0.20	0.25	0.25	2400	2400
Toluene (µg/L)	N/A	N/A	0.25	0.25	0.25	0.25	17,500	17,500

Table 4-5.

Range of Concentrations in Receiving Water with a 1 Percent Design Discharge to Laguna

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
1,1,1-Trichloroethane (μg/L)	N/A	N/A	0.2	0.20	0.25	0.25		
Total Xylenes (μg/L)	N/A	N/A	0.3	0.30	0.25	0.25		
Aldrin (μg/L)	0.015	0.014	0.014	0.014	0.015	0.015	3.0	3.0
a-BHC (μg/L)	0.015	0.0145	0.013	0.013	0.014	0.014		
g-BHC (Lindane) (μg/L)	0.015	0.016	0.013	0.013	0.01	0.010	0.080	0.080
Endosulfan II (μg/L)	0.015	0.0142	0.017	0.017	0.016	0.016	0.056	0.056
Heptachlor (μg/L)	0.015	0.014	0.017	0.017	0.016	0.016	0.0038	0.0038
Phthalates[c] (μg/L)	0	0.50	0	0.00	0.90	0.92	3.0	3.0
Aldicarb sulfone (μg/L)	N/A	N/A	N/A	N/A	0.36	0.36		
DCPA (Dacthal) (μg/L)	N/A	N/A	N/A	N/A	0.10	0.10		
Aldicarb sulfoxide (μg/L)	N/A	N/A	N/A	N/A	0.25	0.25		

Table 4-5.

Range of Concentrations in Receiving Water with a 1 Percent Design Discharge to Laguna

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Conductivity (µmhos/cm)	337	372	485	495	263	265	285,375[d]	

[a] Numbers in the 50th percentile columns are the concentrations of constituents predicted in receiving water with a daily average reclaimed water concentration equal to the 50th percentile (i.e. 50 percent of the days have less than this concentration of reclaimed water) and an average receiving water constituent concentration. The 50th percentile is for a normal hydrologic year.

[b] Numbers in the 95th percentile columns are the concentrations of constituents predicted in receiving water with a daily average reclaimed water concentration equal to the 95th percentile (i.e. 95 percent of the days have less than this concentration of reclaimed water) and an average receiving water constituent concentration. The 95th percentile is the maximum of the three hydrologic years (dry, normal, or wet).

[c] Phthalates concentrations are derived from the sum of the average of detectable phthalates (bis-2-ethylhexyl phthalate, diethyl phthalate, butylbenzyl phthalate and di-n-butyl phthalate.

[d] Criteria for lower Russian River (below confluence with Laguna). Criteria are 95th and 50th percentiles, respectively. No conductivity criteria exist for the Laguna or Santa Rosa Creek

Table 4-6.

Range of Concentrations in Receiving Water with a 5 Percent Design Discharge to Laguna de Santa Rosa (Below Discharge)

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Aluminum (mg/L)	N/A	N/A	N/A	N/A	0.15	0.14	0.087	0.087
Dissolved Aluminum (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Arsenic (mg/L)	0.0028	0.0026	0.0036	0.00339	0.0025	0.0025		
Dissolved Arsenic (mg/L)	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.19	0.19
Total Barium (mg/L)	N/A	N/A	N/A	N/A	0.073	0.071		
Total Boron (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Total Cadmium (mg/L)	0.0003	0.0005	0.0020	0.0017	0.0015	0.0015		
Total Calcium (mg/L)	21.6	26.0	18.4	21.5	18.0	18.7		

Table 4-6.

Range of Concentrations in Receiving Water with a 5 Percent Design Discharge to Laguna de Santa Rosa (Below Discharge)

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Total Chromium (mg/L)	0.0046	0.0035	0.0058	0.0049	0.0060	0.0058		
Total Copper (mg/L)	0.0064	0.0090	0.0119	0.0120	0.0076	0.0078		
Dissolved Copper (mg/L)	0.0029	0.0060	0.0027	0.0044	0.0025	0.0029	0.0130	0.0140
Total Lead (mg/L)	0.0027	0.0024	0.0028	0.0026	0.0024	0.0024		
Total Magnesium (mg/L)	17	18	13.75	14.9	12.1195	12.425		
Total Mercury (mg/L)	0.0004	0.0003	0.0004	0.0003	0.0002	0.0002	0.0013	0.0013
Total Nickel (mg/L)	0.0060	0.0050	0.0125	0.0105	0.0109	0.0106		
Dissolved Nickel (mg/L)	0.0039	0.0036	0.0058	0.0052	0.0028	0.0028	0.182	0.196
Total Potassium (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		

Table 4-6.

Range of Concentrations in Receiving Water with a 5 Percent Design Discharge to Laguna de Santa Rosa (Below Discharge)

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Dissolved Potassium (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Total Silver (mg/L)	0.0005	0.0008	0.0025	0.0022	0.0006	0.0006		
Dissolved Silver (mg/L)	0.0005	0.0006	0.0005	0.0006	0.0005	0.0005	0.0019	0.0019
Total Sodium (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Dissolved Sodium (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Total Zinc (mg/L)	0.021	0.025	0.024	0.025	0.015	0.016		
Dissolved Zinc (mg/L)	0.025	0.028	0.025	0.027	0.037	0.037	0.121	0.131
Total Cyanide (mg/L)	0.0006	0.0049	0.0003	0.0026	0.0025	0.0029	0.0052	0.0052
Acetone (μg/L)	N/A	N/A	N/A	N/A	N/A	N/A		

Table 4-6.

Range of Concentrations in Receiving Water with a 5 Percent Design Discharge to Laguna de Santa Rosa (Below Discharge)

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Total Halomethanes (µg/L)	N/A	N/A	1.1	1.7	1.3	1.4	11,000	11,000
Carbon Disulfide (µg/L)	N/A	N/A	N/A	N/A	0.26	0.44		
Chlorobenzene (µg/L)	N/A	N/A	0.20	0.16	0.25	0.24	50	50
Chloroform (µg/L)	N/A	N/A	0.49	2.72	0.28	0.73	1240	1240
Dichlorobenzene (µg/L)	N/A	N/A	0.25	0.64	0.25	0.33	763	763
Ethyl Benzene (µg/L)	N/A	N/A	0.30	0.28	0.25	0.25		
Methylene Chloride (µg/L)	N/A	N/A	4.87	3.91	0.25	0.28	11,000	11,000
Tetrachloroethene (µg/L)	N/A	N/A	0.20	0.21	0.25	0.25	2400	2400
Toluene (µg/L)	N/A	N/A	0.25	0.24	0.25	0.25	17,500	17,500

Table 4-6.

Range of Concentrations in Receiving Water with a 5 Percent Design Discharge to Laguna de Santa Rosa (Below Discharge)

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
1,1,1-Trichloroethane (µg/L)	N/A	N/A	0.20	0.20	0.25	0.25		
Total Xylenes (µg/L)	N/A	N/A	0.30	0.28	0.25	0.245		
Aldrin (µg/L)	0.015	0.012	0.0148	0.013	0.015	0.015	3.0	3.0
a-BHC (µg/L)	0.015	0.012	0.013	0.012	0.014	0.014		
g-BHC (Lindane) (µg/L)	0.015	0.019	0.013	0.015	0.010	0.011	0.08	0.08
Endosulfan II (µg/L)	0.014	0.011	0.017	0.014	0.016	0.015	0.056	0.056
Heptachlor (µg/L)	0.015	0.012	0.017	0.015	0.016	0.016	0.0038	0.0038
Phthalates[c] (µg/L)	0.33	2.73	0.17	1.45	0.91	1.13	3.0	3.0
Aldicarb sulfone (µg/L)	N/A	N/A	N/A	N/A	0.36	0.40		
DCPA (Dacthal) (µg/L)	N/A	N/A	N/A	N/A	0.105	0.11		

Table 4-6.

Range of Concentrations in Receiving Water with a 5 Percent Design Discharge to Laguna de Santa Rosa (Below Discharge)

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Aldicarb sulfoxide (µg/L)	N/A	N/A	N/A	N/A	0.25	0.28		
Conductivity (µmhos/cm)	360	527	492	547	264	286	285,375[d]	

[a] Numbers in the 50th percentile columns are the concentrations of constituents predicted in receiving water with a daily average reclaimed water concentration equal to the 50th percentile (i.e. 50 percent of the days have less than this concentration of reclaimed water) and an average receiving water constituent concentration. The 50th percentile is for a normal hydrologic year.

[b] Numbers in the 95th percentile columns are the concentrations of constituents predicted in receiving water with a daily average reclaimed water concentration equal to the 95th percentile (i.e. 95 percent of the days have less than this concentration of reclaimed water) and an average receiving water constituent concentration. The 95th percentile is the maximum of the three hydrologic years (dry, normal, or wet).

[c] Phthalates concentrations are derived from the sum of the average of detectable phthalates (bis-2-ethylhexyl phthalate, diethyl phthalate, butylbenzyl phthalate, and di-n-butyl phthalate.

[d] Criteria for lower Russian River (below confluence with Laguna). Criteria are 95th and 50th percentiles, respectively. No conductivity criteria exist for the Laguna or Santa Rosa Creek

Table 4-7.

Range of Concentrations in Receiving Water with a 10 Percent Design Discharge to the Laguna de Santa Rosa (Below Discharge)

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Aluminum (mg/L)	N/A	N/A	N/A	N/A	0.149	0.138	0.087	0.087
Dissolved Aluminum (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Arsenic (mg/L)	0.0028	0.0026	0.0035	0.0031	0.0025	0.0025		
Dissolved Arsenic (mg/L)	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.19	0.19
Total Barium (mg/L)	N/A	N/A	N/A	N/A	0.073	0.068		
Total Boron (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Total Cadmium (mg/L)	0.0003	0.0006	0.0019	0.0014	0.0015	0.0014		
Total Calcium (mg/L)	22.0	27.9	18.7	23.7	18.1	19.3		

Table 4-7.

Range of Concentrations in Receiving Water with a 10 Percent Design Discharge to the Laguna de Santa Rosa (Below Discharge)

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Total Chromium (mg/L)	0.0045	0.0031	0.0057	0.0043	0.0060	0.0056		
Total Copper (mg/L)	0.0067	0.0102	0.0119	0.0120	0.0076	0.0081		
Dissolved Copper (mg/L)	0.0033	0.0073	0.0029	0.0056	0.0025	0.0032	0.0130	0.0140
Total Lead (mg/L)	0.0027	0.0023	0.0028	0.0025	0.0024	0.0024		
Total Magnesium (mg/L)	17	18	13.85	15.75	12.139	12.75		
Total Mercury (mg/L)	0.0004	0.0002	0.0004	0.0003	0.0002	0.0002	0.0013	0.0013
Total Nickel (mg/L)	0.0059	0.0046	0.0124	0.0090	0.0109	0.0102		
Dissolved Nickel (mg/L)	0.0038	0.0035	0.0058	0.0048	0.0028	0.0029	0.182	0.196
Total Potassium (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		

Table 4-7.

Range of Concentrations in Receiving Water with a 10 Percent Design Discharge to the Laguna de Santa Rosa (Below Discharge)

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Dissolved Potassium (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Total Silver (mg/L)	0.0006	0.0009	0.0025	0.0020	0.0006	0.0007		
Dissolved Silver (mg/L)	0.0005	0.0006	0.0005	0.0006	0.0005	0.0005	0.0019	0.0019
Total Sodium (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Dissolved Sodium (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Total Zinc (mg/L)	0.021	0.027	0.024	0.026	0.015	0.017		
Dissolved Zinc (mg/L)	0.026	0.029	0.025	0.028	0.037	0.036	0.121	0.131
Total Cyanide (mg/L)	0.0011	**0.0067**	0.0005	0.0043	0.0026	0.0033	0.0052	0.0052
Acetone (µg/L)	N/A	N/A	N/A	N/A	N/A	N/A		

Table 4-7.

Range of Concentrations in Receiving Water with a 10 Percent Design Discharge to the Laguna de Santa Rosa (Below Discharge)

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Total Halomethanes (µg/L)	N/A	N/A	1.1	2.1	1.3	1.5	11,000	11,000
Carbon Disulfide (µg/L)	N/A	N/A	N/A	N/A	0.27	0.62		
Chlorobenzene (µg/L)	N/A	N/A	0.19	0.14	0.25	0.23	50	50
Chloroform (µg/L)	N/A	N/A	0.68	4.36	0.31	1.21	1240	1240
Dichlorobenzene (µg/L)	N/A	N/A	0.29	0.93	0.26	0.42	763	763
Ethyl Benzene (µg/L)	N/A	N/A	0.30	0.30	0.25	0.25		
Methylene Chloride (µg/L)	N/A	N/A	4.79	3.20	0.25	0.31	11,000	11,000
Tetrachloroethene (µg/L)	N/A	N/A	0.20	0.21	0.25	0.25	2400	2400
Toluene (µg/L)	N/A	N/A	0.25	0.24	0.25	0.25	17,500	17,500

Table 4-7.

Range of Concentrations in Receiving Water with a 10 Percent Design Discharge to the Laguna de Santa Rosa (Below Discharge)

	Santa Rosa Creek (below discharge)		**Laguna de Santa Rosa (below discharge)**		**Russian River (below confluence with Laguna)**		**SRC, RR points of significance (ave. hardness = 119)**	**Laguna points of significance (ave. hardness = 130)**
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
1,1,1-Trichloroethane (µg/L)	N/A	N/A	0.20	0.20	0.25	0.25		
Total Xylenes (µg/L)	N/A	N/A	0.30	0.27	0.25	0.25		
Aldrin (µg/L)	0.014	0.011	0.014	0.012	0.015	0.014	3.0	3.0
a-BHC (µg/L)	0.014	0.011	0.013	0.011	0.014	0.014		
g-BHC (Lindane) (µg/L)	0.016	0.020	0.013	0.017	0.010	0.011	0.080	0.080
Endosulfan II (µg/L)	0.014	0.009	0.016	0.012	0.016	0.015	0.056	0.056
Heptachlor (µg/L)	0.014	0.011	0.017	0.013	0.016	0.015	0.0038	0.0038
Phthalates[c] (µg/L)	0.61	3.74	0.28	2.40	0.93	1.37	3.0	3.0
Aldicarb sulfone (µg/L)	N/A	N/A	N/A	N/A	0.3645	0.435		
DCPA (Dacthal) (µg/L)	N/A	N/A	N/A	N/A	0.10	0.11		

Table 4-7.

Range of Concentrations in Receiving Water with a 10 Percent Design Discharge to the Laguna de Santa Rosa (Below Discharge)

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Aldicarb sulfoxide (µg/L)	N/A	N/A	N/A	N/A	0.25	0.31		
Conductivity (µmhos/cm)	380	596	497	588	266	309	285,375[d]	

a Numbers in the 50th percentile columns are the concentrations of constituents predicted in receiving water with a daily average reclaimed water concentration equal to the 50th percentile (i.e. 50 percent of the days have less than this concentration of reclaimed water) and an average receiving water constituent concentration. The 50th percentile is for a normal hydrologic year.

b Numbers in the 95th percentile columns are the concentrations of constituents predicted in receiving water with a daily average reclaimed water concentration equal to the 95th percentile (i.e. 95 percent of the days have less than this concentration of reclaimed water) and an average receiving water constituent concentration. The 95th percentile is the maximum of the three hydrologic years (dry, normal, or wet).

c Phthalates concentrations are derived from the sum of the average of detectable phthalates (bis-2-ethylhexyl phthalate, diethyl phthalate, butylbenzyl phthalate, and di-n-butyl phthalate.

d Criteria for lower Russian River (below confluence with Laguna). Criteria are 95th and 50th percentiles, respectively. No conductivity criteria exist for the Laguna or Santa Rosa Creek

Table 4-8.

Range of Concentrations in Receiving Water with a 20 Percent Design Discharge to the Laguna de Santa Rosa (Below Discharge)

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Aluminum (mg/L)	N/A	N/A	N/A	N/A	0.146	0.132	0.087	0.087
Dissolved Aluminum (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Arsenic (mg/L)	0.0027	0.0025	0.0034	0.0029	0.0025	0.0025		
Dissolved Arsenic (mg/L)	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.19	0.19
Total Barium (mg/L)	N/A	N/A	N/A	N/A	0.072	0.066		
Total Boron (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Total Cadmium (mg/L)	0.0004	0.0006	0.0018	0.0012	0.0015	0.0014		
Total Calcium (mg/L)	24.6	29.3	20.3	26.1	18.4	20.0		

Table 4-8.

Range of Concentrations in Receiving Water with a 20 Percent Design Discharge to the Laguna de Santa Rosa (Below Discharge)

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Total Chromium (mg/L)	0.0039	0.0027	0.0053	0.0037	0.0059	0.0054		
Total Copper (mg/L)	0.0082	0.0110	0.0120	0.0121	0.0077	0.0083		
Dissolved Copper (mg/L)	0.0050	0.0083	0.0037	0.0068	0.0027	0.0036	0.0130	0.0140
Total Lead (mg/L)	0.0025	0.0022	0.0027	0.0023	0.0024	0.0023		
Total Magnesium (mg/L)	17	18	14.5	16.7	12.3	13.1		
Total Mercury (mg/L)	0.0003	0.0002	0.0003	0.0002	0.0002	0.0002	0.0013	0.0013
Total Nickel (mg/L)	0.0053	0.0043	0.011287	0.0074	0.0107	0.0099		
Dissolved Nickel (mg/L)	0.0037	0.0035	0.0055	0.0044	0.0028	0.0029	0.182	0.196

Table 4-8.

Range of Concentrations in Receiving Water with a 20 Percent Design Discharge to the Laguna de Santa Rosa (Below Discharge)

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Total Potassium (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Dissolved Potassium (mg/L)	N/A	N/A	N/A	N/A	06	N/A		
Total Silver (mg/L)	0.0007	0.0010	0.0023	0.0017	0.0010	0.0007		
Dissolved Silver (mg/L)	0.0006	0.0007	0.0005	0.0006	0.0005	0.0005	0.0019	0.0019
Total Sodium (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Dissolved Sodium (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Total Zinc (mg/L)	0.023	0.028	0.025	0.028	0.015	0.017		
Dissolved Zinc (mg/L)	0.027	0.030	0.026	0.029	0.037	0.036	0.121	0.131
Total Cyanide (mg/L)	0.0035	**0.0081**	0.0017	**0.0061**	0.0027	0.0036	0.0052	0.0052

Table 4-8.

Range of Concentrations in Receiving Water with a 20 Percent Design Discharge to the Laguna de Santa Rosa (Below Discharge)

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Acetone (µg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Total Halomethanes (µg/L)	N/A	N/A	1.4	2.5	1.3	1.6	11,000	11,000
Carbon Disulfide (µg/L)	N/A	N/A	N/A	N/A	0.36	0.81		
Chlorobenzene (µg/L)	N/A	N/A	0.18	0.11	0.24	0.22	50	50
Chloroform (µg/L)	N/A	N/A	1.84	6.10	0.54	1.70	1240	1240
Dichlorobenzene (µg/L)	N/A	N/A	0.28	0.47	0.26	0.31	763	763
Ethyl Benzene (µg/L)	N/A	N/A	0.29	0.26	0.25	0.25		
Methylene Chloride (µg/L)	N/A	N/A	4.29	2.45	0.27	0.34	11,000	11,000

Table 4-8.

Range of Concentrations in Receiving Water with a 20 Percent Design Discharge to the Laguna de Santa Rosa (Below Discharge)

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Tetrachloroethene (µg/L)	N/A	N/A	0.20	0.22	0.25	0.25	2400	2400
Toluene (µg/L)	N/A	N/A	0.25	0.24	0.25	0.25	17,500	17,500
1,1,1-Trichloroethane (µg/L)	N/A	N/A	0.20	0.20	0.25	0.24		
Total Xylenes (µg/L)	N/A	N/A	0.29	0.251	0.25	0.25		
Aldrin (µg/L)	0.013	0.010	0.013	0.011	0.015	0.014	3.0	3.0
a-BHC (µg/L)	0.013	0.011	0.012	0.011	0.0139	0.013		
g-BHC (Lindane) (µg/L)	0.018	0.021	0.014	0.018	0.010	0.012	0.080	0.080
Endosulfan II (µg/L)	0.012	0.008	0.015	0.010	0.016	0.014	0.056	0.056
Heptachlor (µg/L)	0.013	0.010	0.016	0.012	0.016	0.015	0.0038	0.0038
Phthalates[c] (µg/L)	1.95	4.52	0.95	3.40	1.04	1.60	3.0	3.0

Table 4-8.

Range of Concentrations in Receiving Water with a 20 Percent Design Discharge to the Laguna de Santa Rosa (Below Discharge)

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Aldicarb sulfone (µg/L)	N/A	N/A	N/A	N/A	0.38	0.47		
DCPA (Dacthal) (µg/L)	N/A	N/A	N/A	N/A	0.10	0.12		
Aldicarb sulfoxide (µg/L)	N/A	N/A	N/A	N/A	0.27	0.33		
Conductivity (µmhos/cm)	472	650	526	631	277	332	285,375[d]	

[a] Numbers in the 50th percentile columns are the concentrations of constituents predicted in receiving water with a daily average reclaimed water concentration equal to the 50th percentile (i.e. 50 percent of the days have less than this concentration of reclaimed water) and an average receiving water constituent concentration. The 50th percentile is for a normal hydrologic year.

[b] Numbers in the 95th percentile columns are the concentrations of constituents predicted in receiving water with a daily average reclaimed water concentration equal to the 95th percentile (i.e. 95 percent of the days have less than this concentration of reclaimed water) and an average receiving water constituent concentration. The 95th percentile is the maximum of the three hydrologic years (dry, normal, or wet).

[c] Phthalates concentrations are derived from the sum of the average of detectable phthalates (bis-2-ethylhexyl phthalate, diethyl phthalate, butylbenzyl phthalate, and di-n-butyl phthalate.

[d] Criteria for lower Russian River (below confluence with Laguna). Criteria are 95th and 50th percentiles, respectively. No conductivity criteria exist for the Laguna or Santa Rosa Creek

Table 4-9.

Range of Concentrations in Receiving Water with a 20 Percent Design Discharge to the Russian River

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		Russian River (above confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Aluminum (mg/L)	N/A	N/A	N/A	N/A	0.148	0.138	0.15	0.14	0.087	0.087
Dissolved Aluminum (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Arsenic (mg/L)	0.0028	0.0028	0.0036	0.0036	0.0025	0.0025	0.0025	0.0025		
Dissolved Arsenic (mg/L)	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.19	0.19
Total Barium (mg/L)	N/A	N/A	N/A	N/A	0.072	0.068	0.072	0.068		
Total Boron (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Total Cadmium (mg/L)	0.0003	0.0003	0.0020	0.0020	0.0014	0.0015	0.0014	0.0013		
Total Calcium (mg/L)	21.0	21.2	18.0	18.1	20.0	18.3	21.3	22.1		

Table 4-9.

Range of Concentrations in Receiving Water with a 20 Percent Design Discharge to the Russian River

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		Russian River (above confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Total Chromium (mg/L)	0.0048	0.0047	0.0059	0.0059	0.0059	0.0056	0.0078	0.0074		
Total Copper (mg/L)	0.0060	0.0061	0.012	0.0119	0.0077	0.0081	0.0081	0.0085		
Dissolved Copper (mg/L)	0.003	0.003	0.0025	0.0025	0.0026	0.0032	0.0027	0.0033	0.013	0.014
Total Lead (mg/L)	0.003	0.003	0.0028	0.0028	0.0024	0.0024	0.0020	0.0020		
Total Magnesium (mg/L)	17	17	4	13.6	12.2	12.8	13.2	13.6		
Total Mercury (mg/L)	0.0004	0.0004	0.0004	0.0004	0.0002	0.0002	0.0003	0.0003	0.0013	0.0013
Total Nickel (mg/L)	0.0061	0.0061	0.013	0.0127	0.011	0.010	0.017	0.016		
Dissolved Nickel (mg/L)	0.0039	0.0039	0.0059	0.0059	0.0028	0.0029	0.0025	0.0026	0.182	0.196

Table 4-9.

Range of Concentrations in Receiving Water with a 20 Percent Design Discharge to the Russian River

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		Russian River (above confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Total Potassium (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Dissolved Potassium (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Total Silver (mg/L)	0.0005	0.0005	0.0026	0.0026	0.0006	0.0007	0.0014	0.0014		
Dissolved Silver (mg/L)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0019	0.0019
Total Sodium (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Dissolved Sodium (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Total Zinc (mg/L)	0.020	0.021	0.023	0.023	0.015	0.017	0.015	0.017		
Dissolved Zinc (mg/L)	0.025	0.025	0.025	0.025	0.037	0.036	0.024	0.024	0.121	0.131

Table 4-9.

Range of Concentrations in Receiving Water with a 20 Percent Design Discharge to the Russian River

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		Russian River (above confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Total Cyanide (mg/L)	0	0.0002	0	0.0001	0.0027	0.0033	0.0027	0.0033	0.0052	0.0052
Acetone (µg/L)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Total Halomethanes (µg/L)	N/A	N/A	1.0	1.0	1.3	1.5	1.3	1.5	11,000	11,000
Carbon Disulfide (µg/L)	N/A	N/A	N/A	N/A	0.33	0.62	0.36	0.66		
Chlorobenzene (µg/L)	N/A	N/A	0.20	0.20	0.25	0.23	0.24	0.23	50	50
Chloroform (µg/L)	N/A	N/A	0.20	0.26	0.44	1.21	0.54	1.31	1240	1240
Dichlorobenzene (µg/L)	N/A	N/A	0.20	0.21	0.28	0.42	0.30	0.43	763	763
Ethyl Benzene (µg/L)	N/A	N/A	0.30	0.30	0.25	0.25	0.25	0.25		

Table 4-9.

Range of Concentrations in Receiving Water with a 20 Percent Design Discharge to the Russian River

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		Russian River (above confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Methylene Chloride (µg/L)	N/A	N/A	5.0	5.0	0.26	0.30	0.27	0.31	11,000	11,000
Tetrachloroethene (µg/L)	N/A	N/A	0.20	0.20	0.25	0.25	0.25	0.25	2400	2400
Toluene (µg/L)	N/A	N/A	0.25	0.25	0.25	0.25	0.25	0.25	17,500	17,500
1,1,1-Trichloroethane (µg/L)	N/A	N/A	0.20	0.20	0.25	0.25	0.25	0.25		
Total Xylenes (µg/L)	N/A	N/A	0.30	0.30	0.25	0.25	0.25	0.25		
Aldrin (µg/L)	0.015	0.015	0.014	0.0140	0.015	0.014	0.015	0.014	3.0	3.0
a-BHC (µg/L)	0.015	0.015	0.013	0.013	0.014	0.014	0.015	0.014		
g-BHC (Lindane) (µg/L)	0.015	0.015	0.013	0.013	0.010	0.011	0.006	0.007	0.080	0.080
Endosulfan II (µg/L)	0.015	0.015	0.017	0.017	0.016	0.015	0.013	0.012	0.056	0.056

Table 4-9.

Range of Concentrations in Receiving Water with a 20 Percent Design Discharge to the Russian River

	Santa Rosa Creek (below discharge)		**Laguna de Santa Rosa (below discharge)**		**Russian River (below confluence with Laguna)**		**Russian River (above confluence with Laguna)**		**SRC, RR points of significance (ave. hardness = 119)**	**Laguna points of significance (ave. hardness = 130)**
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Heptachlor (µg/L)	0.015	0.015	0.017	0.017	0.016	0.015	0.025	0.023	0.0038	0.0038
Phthalates[c] (µg/L)	0	0.11	0	0.03	0.99	1.37	1.04	1.41	3.0	3.0
Aldicarb sulfone (µg/L)	N/A	N/A	N/A	N/A	0.38	0.44	0.38	0.44		
DCPA (Dacthal) (µg/L)	N/A	N/A	N/A	N/A	0.10	0.11	0.10	0.11		
Aldicarb sulfoxide (µg/L)	N/A	N/A	N/A	N/A	0.26	0.31	0.27	0.31		
Conductivity (µmhos/cm)	337	345	485	486	272	309	262	**300**	285,375[d]	

Table 4-9.

Range of Concentrations in Receiving Water with a 20 Percent Design Discharge to the Russian River

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		Russian River (above confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		

[a] Numbers in the 50th percentile columns are the concentrations of constituents predicted in receiving water with a daily average reclaimed water concentration equal to the 50th percentile (i.e. 50 percent of the days have less than this concentration of reclaimed water) and an average receiving water constituent concentration. The 50th percentile is for a normal hydrologic year.

[b] Numbers in the 95th percentile columns are the concentrations of constituents predicted in receiving water with a daily average reclaimed water concentration equal to the 95th percentile (i.e. 95 percent of the days have less than this concentration of reclaimed water) and an average receiving water constituent concentration. The 95th percentile is the maximum of the three hydrologic years (dry, normal, or wet).

[c] Phthalates concentrations are derived from the sum of the average of detectable phthalates (bis-2-ethylhexyl phthalate, diethyl phthalate, butylbenzyl phthalate and di-n-butyl phthalate.

[d] Criteria for lower Russian River (below confluence with Laguna). Criteria are 95th and 50th percentiles, respectively. No conductivity criteria exist for the Laguna or Santa Rosa Creek

Table 4-10.

Range of Concentrations in Receiving Water with Discharge Associated with a No Project Alternative

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Aluminum (mg/L)	N/A	N/A	N/A	N/A	0.15	0.14	0.087	0.087
Dissolved Aluminum (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Arsenic (mg/L)	0.0027	0.0025	0.0034	0.0034	0.0025	0.00254		
Dissolved Arsenic (mg/L)	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.19	0.19
Total Barium (mg/L)	N/A	N/A	N/A	N/A	0.072	0.068		
Total Boron (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Total Cadmium (mg/L)	0.0004	0.0006	0.0018	0.0013	0.0015	0.0014		
Total Calcium (mg/L)	24.0	28.7	19.7	25.0	18.3	19.3		
Total Chromium (mg/L)	0.0040	0.0029	0.0054	0.0054	0.0059	0.0056		

Table 4-10.

Range of Concentrations in Receiving Water with Discharge Associated with a No Project Alternative

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Total Copper (mg/L)	0.0078	0.011	0.012	0.0119	0.0077	0.0081		
Dissolved Copper (mg/L)	0.0046	0.0078	0.0034	0.0034	0.0026	0.0032	0.0130	0.0140
Total Lead (mg/L)	0.0025	0.0022	0.0027	0.0027	0.0024	0.0024		
Total Magnesium (mg/L)	17.3	18.1	14.3	14.3	12.2	12.8		
Total Mercury (mg/L)	0.0003	0.0002	0.0003	0.0003	0.0002	0.0002	0.0013	0.0013
Total Nickel (mg/L)	0.0055	0.0044	0.012	0.0126	0.011	0.010		
Dissolved Nickel (mg/L)	0.0037	0.0035	0.0056	0.0056	0.0028	0.0029	0.182	0.196
Total Potassium (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Dissolved Potassium (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		

Table 4-10.

Range of Concentrations in Receiving Water with Discharge Associated with a No Project Alternative

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Total Silver (mg/L)	0.0007	0.0010	0.0024	0.0024	0.0006	0.0007		
Dissolved Silver (mg/L)	0.0006	0.0007	0.0005	0.0005	0.0005	0.0005	0.0019	0.0019
Total Sodium (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Dissolved Sodium (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Total Zinc (mg/L)	0.023	0.028	0.024	0.0243	0.015	0.017		
Dissolved Zinc (mg/L)	0.027	0.030	0.026	0.026	0.037	0.036	0.121	0.131
Total Cyanide (mg/L)	0.0029	**0.0075**	0.0013	**0.0053**	0.0027	0.0033	0.0052	0.0052
Acetone (µg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Total halomethanes (µg/L)	N/A	N/A	1.3	2.3	1.3	1.5	11,000	11,000

Table 4-10.

Range of Concentrations in Receiving Water with Discharge Associated with a No Project Alternative

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Carbon Disulfide (µg/L)	N/A	N/A	N/A	N/A	0.32	0.62		
Chlorobenzene (µg/L)	N/A	N/A	0.18	0.18	0.25	0.23	50	50
Chloroform (µg/L)	N/A	N/A	1.5	1.5	0.44	1.2	1240	1240
Dichlorobenzene (µg/L)	N/A	N/A	0.42	1.10	0.28	0.42	763	763
Ethyl Benzene (µg/L)	N/A	N/A	0.29	0.29	0.25	0.25		
Methylene Chloride (µg/L)	N/A	N/A	4.5	4.5	0.26	0.31	11,000	11,000
Tetrachloroethene (µg/L)	N/A	N/A	0.20	0.20	0.25	0.25	2400	2400
Toluene (µg/L)	N/A	N/A	0.25	0.25	0.25	0.25	17,500	17,500
1,1,1-Trichloroethane (µg/L)	N/A	N/A	0.20	0.20	0.255	0.25		

Table 4-10.

Range of Concentrations in Receiving Water with Discharge Associated with a No Project Alternative

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Total Xylenes (µg/L)	N/A	N/A	0.29	0.29	0.25	0.25		
Aldrin (µg/L)	0.013	0.0102	0.013	0.013	0.015	0.014	3.0	3.0
a-BHC (µg/L)	0.013	0.0108	0.013	0.013	0.014	0.014		
g-BHC (Lindane) (µg/L)	0.017	0.020	0.014	0.018	0.010	0.011	0.080	0.080
Endosulfan II (µg/L)	0.012	0.0082	0.016	0.016	0.016	0.015	0.056	0.056
Heptachlor (µg/L)	0.013	0.010	0.016	0.016	0.016	0.015	0.0038	0.0038
Phthalates[c] (µg/L)	1.62	4.19	0.73	3.0	0.99	1.37	3.0	3.0
Aldicarb sulfone (µg/L)	N/A	N/A	N/A	N/A	0.38	0.44		
DCPA (Dacthal) (µg/L)	N/A	N/A	N/A	N/A	0.10	0.11		
Aldicarb sulfoxide (µg/L)	N/A	N/A	N/A	N/A	0.26	0.1		

Table 4-10.

Range of Concentrations in Receiving Water with Discharge Associated with a No Project Alternative

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Conductivity (µmhos/cm)	449	627	516	612	272	309	285,375[d]	

a Numbers in the 50th percentile columns are the concentrations of constituents predicted in receiving water with a daily average reclaimed water concentration equal to the 50th percentile (i.e. 50 percent of the days have less than this concentration of reclaimed water) and an average receiving water constituent concentration. The 50th percentile is for a normal hydrologic year.

b Numbers in the 95th percentile columns are the concentrations of constituents predicted in receiving water with a daily average reclaimed water concentration equal to the 95th percentile (i.e. 95 percent of the days have less than this concentration of reclaimed water) and an average receiving water constituent concentration. The 95th percentile is the maximum of the three hydrologic years (dry, normal, or wet).

c Phthalates concentrations are derived from the sum of the average of detectable phthalates (bis-2-ethylhexyl phthalate, diethyl phthalate, butylbenzyl, and di-n-butyl phthalate.

d Criteria for lower Russian River (below confluence with Laguna). Criteria are 95th and 50th percentiles, respectively. No conductivity criteria exist for the Laguna or Santa Rosa Creek

Table 4-11.

Range of Concentrations in Receiving Water with Discharge Associated with a Geysers Alternative

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Aluminum (mg/L)	N/A	N/A	N/A	N/A	0.15	0.15	0.087	0.087
Dissolved Aluminum (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Arsenic (mg/L)	0.0028	0.0028	0.0036	0.0036	0.0025	0.0025		
Dissolved Arsenic (mg/L)	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.19	0.19
Total Barium (mg/L)	N/A	N/A	N/A	N/A	0.073	0.073		
Total Boron (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Total Cadmium (mg/L)	0.0003	0.0003	0.0020	0.0020	0.0015	0.001497		
Total Calcium (mg/L)	21.0	21.6	18.0	18.3	18.0	18.1		

Table 4-11.

Range of Concentrations in Receiving Water with Discharge Associated with a Geysers Alternative

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Total Chromium (mg/L)	0.0048	0.0046	0.0059	0.0058	0.006	0.0060		
Total Copper (mg/L)	0.0060	0.0064	0.0119	0.012	0.0076	0.0076		
Dissolved Copper (mg/L)	0.0025	0.0029	0.0025	0.0026	0.0025	0.0025	0.0130	0.0140
Total Lead (mg/L)	0.0028	0.0027	0.0028	0.0028	0.0024	0.0024		
Total Magnesium (mg/L)	17	17	13.6	13.7	12.1	12.126		
Total Mercury (mg/L)	0.0004	0.0004	0.0004	0.0004	0.0002	0.0002	0.0013	0.0013
Total Nickel (mg/L)	0.0061	0.0060	0.013	0.013	0.0109	0.011		
Dissolved Nickel (mg/L)	0.0039	0.0039	0.0059	0.0058	0.0028	0.0028	0.182	0.196

Table 4-11.

Range of Concentrations in Receiving Water with Discharge Associated with a Geysers Alternative

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Total Potassium (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Dissolved Potassium (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Total Silver (mg/L)	0.0005	0.0005	0.0026	0.0026	0.0006	0.0006		
Dissolved Silver (mg/L)	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0019	0.0019
Total Sodium (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Dissolved Sodium (mg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Total Zinc (mg/L)	0.020	0.021	0.023	0.024	0.015	0.015		
Dissolved Zinc (mg/L)	0.025	0.025	0.025	0.025	0.037	0.037	0.121	0.131

Table 4-11.

Range of Concentrations in Receiving Water with Discharge Associated with a Geysers Alternative

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Total Cyanide (mg/L)	0	0.0006	0	0.0002	0.0025	0.0025	0.0052	0.0052
Acetone (µg/L)	N/A	N/A	N/A	N/A	N/A	N/A		
Total Halomethanes (µg/L)	N/A	N/A	1.0	1.1	1.3	1.3	11,000	11,000
Carbon Disulfide (µg/L)	N/A	N/A	N/A	N/A	0.25	0.26		
Chlorobenzene (µg/L)	N/A	N/A	0.20	0.20	0.25	0.25	50	50
Chloroform (µg/L)	N/A	N/A	0.20	0.39	0.25	0.29	1240	1240
Dichlorobenzene (µg/L)	N/A	N/A	0.20	0.23	0.25	0.26	763	763
Ethyl Benzene (µg/L)	N/A	N/A	0.30	0.30	0.25	0.25		
Methylene Chloride (µg/L)	N/A	N/A	5.0	4.9	0.25	0.25	11,000	11,000

Table 4-11.

Range of Concentrations in Receiving Water with Discharge Associated with a Geysers Alternative

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Tetrachloroethene (µg/L)	N/A	N/A	0.20	0.20	0.25	0.25	2400	2400
Toluene (µg/L)	N/A	N/A	0.25	0.25	0.25	0.25	17,500	17,500
1,1,1-Trichloroethane (µg/L)	N/A	N/A	0.20	0.20	0.25	0.25		
Total Xylenes (µg/L)	N/A	N/A	0.30	0.30	0.25	0.25		
Aldrin (µg/L)	0.015	0.015	0.014	0.014	0.015	0.015	3.0	3.0
a-BHC (µg/L)	0.015	0.015	0.013	0.013	0.014	0.014		
g-BHC (Lindane) (µg/L)	0.015	0.015	0.013	0.013	0.01	0.010	0.08	0.08
Endosulfan II (µg/L)	0.015	0.014	0.017	0.017	0.016	0.017	0.056	0.056
Heptachlor (µg/L)	0.015	0.015	0.017	0.017	0.016	0.016	0.0038	0.0038
Phthalates[c] (µg/L)	0	0.33	0	0.11	0.90	0.92	3.0	3.0

Table 4-11.

Range of Concentrations in Receiving Water with Discharge Associated with a Geysers Alternative

	Santa Rosa Creek (below discharge)		Laguna de Santa Rosa (below discharge)		Russian River (below confluence with Laguna)		SRC, RR points of significance (ave. hardness = 119)	Laguna points of significance (ave. hardness = 130)
Constituent	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**	**50th[a]**	**95th[b]**		
Aldicarb sulfone (µg/L)	N/A	N/A	N/A	N/A	0.36	0.36		
DCPA (Dacthal) (µg/L)	N/A	N/A	N/A	N/A	0.10	0.10		
Aldicarb sulfoxide (µg/L)	N/A	N/A	N/A	N/A	0.25	0.25		
Conductivity (µmhos/cm)	337	360	485	490	263	265	285,375[d]	

a Numbers in the 50th percentile columns are the concentrations of constituents predicted in receiving water with a daily average reclaimed water concentration equal to the 50th percentile (i.e. 50 percent of the days have less than this concentration of reclaimed water) and an average receiving water constituent concentration. The 50th percentile is for a normal hydrologic year.

b Numbers in the 95th percentile columns are the concentrations of constituents predicted in receiving water with a daily average reclaimed water concentration equal to the 95th percentile (i.e. 95 percent of the days have less than this concentration of reclaimed water) and an average receiving water constituent concentration. The 95th percentile is the maximum of the three hydrologic years (dry, normal, or wet).

c Phthalates concentrations are derived from the sum of the average of detectable phthalates (bis-2-ethylhexyl phthalate, diethyl phthalate, butylbenzyl phthalate, and di-n-butyl phthalate.

d Criteria for lower Russian River (below confluence with Laguna). Criteria are 95th and 50th percentiles, respectively. No conductivity criteria exist for the Laguna or Santa Rosa Creek

The estimated concentrations in the receiving waters of dissolved arsenic, copper, mercury, dissolved nickel, dissolved silver, dissolved zinc, halomethanes, chlorobenzene, chloroform, dichlorobenzene, methylene chloride, tetrachloroethene, toluene, aldrin, gamma BHC (Lindane), and conductivity (50^{th} percentile point of significance) are all less than their respective points of significance for all discharge components. Therefore, the impact of discharge of reclaimed water at the concentrations predicted for the 1 percent design discharge, 5 percent design discharge, 10 percent design discharge, 20 percent design discharge to the Laguna, 20 percent design discharge to the River, No Project, and Geysers components with respect to these compounds will be less than significant.

Conductivity, cyanide, phthalates, nitrogen load and toxicity are evaluated below.

Conductivity

Compliance with the 50th percentile criteria for conductivity requires that 50 percent or more of the monthly means must be less than or equal to the point of significance (285 µmhos/cm for the Russian River below the Laguna and 250 µmhos/cm for the Russian River above the Laguna). For the lower River, the average conductivity in the Russian River at Oddfellows for each month, the percent reclaimed water for each month for the 20 percent design discharge to the Laguna and the 20 percent design discharge to the River, and the average reclaimed water conductivity were used as input to a dilution model as described for other constituents. The resulting estimated conductivity was compared to the 50th percentile point of significance (Tables 4-4 through 4-12). Fewer than six months exceeded the 50th percentile point of significance for the lower River for both the 20 percent design discharge to the Laguna and 20 percent design discharge to the River. Therefore, all discharge components will have a less than significant impact on conductivity in the lower Russian River.

The average conductivity in the Russian River at Oddfellows for each month was also used as input to the dilution model as described above to evaluate conductivity impacts in the River above the Laguna. There were insufficient conductivity data available for the upper River to calculate monthly averages. However, using the lower River conductivity is conservative in that the conductivity in the upper River is likely to be similar or lower. The resulting estimated conductivity was compared to the 50th percentile point of significance (Table 4-12). More than six months exceeded the 50th percentile point of significance for the upper River with a 20 percent design discharge to the River component. Therefore, a 20 percent design discharge to the River component is considered to have a significant impact on conductivity in the upper Russian River.

Cyanide

A range of concentrations of cyanide due to direct discharge to Santa Rosa Creek and the Laguna cannot be determined because of lack of information of background receiving water cyanide concentrations. However, the concentration of cyanide in Santa Rosa Creek and the Laguna was predicted assuming a background receiving water concentration of

Table 4-12.

Estimated Conductivity in the Upper and Lower Russian River with 20 Percent Design Discharge to the Laguna and the River

	Lower Russian River (point of significance = 285 μmhos / cm)			Upper Russian River (point of significance = 250 μmhos / cm)
	Existing Conditions	**20 Percent Design Discharge to the Laguna**	**20 Percent Design Discharge to the River**	**20 Percent Design Discharge to the River**
October	232	268	252	255
November	227	273	260	266
December	267	299	292	296
January	280	337	319	325
February	277	321	205	309
March	233	269	259	264
April	266	310	294	301
May	255	269	262	263
June	266	266	266	266
July	239	239	239	239
August	232	232	232	232
September	238	238	238	238

0.0 mg/L, which is a reasonable estimate. The actual concentrations may be higher if cyanide is present in the receiving water. Using a background concentration of 0 mg/L, thepredicted concentrations of total cyanide in Santa Rosa Creek exceed the point of significance (0.0052 mg/L) with the 10 percent design discharge, 20 percent design discharge to the Laguna, and discharge associated with a No Project alternative. Therefore, the 10 percent design discharge, 20 percent design discharge, and discharge associated with No Project will have a significant impact on cyanide in the Santa Rosa Creek. There may be significant impacts on cyanide in Santa Rosa Creek with the 1 percent design discharge, 5 percent design discharge, and discharge associated with the Geysers alternative if the concentration of cyanide in Santa Rosa Creek is greater than zero. The predicted concentration of cyanide in the Laguna exceeds the point of significance for cyanide with the 20 percent design discharge, and discharge associated with No Project. Therefore, the 20 percent design discharge, and discharge associated with No Project will have a significant impact on cyanide in the Laguna. There may be significant impacts on cyanide in the Laguna with the 1 percent design discharge, 5 percent design discharge, 10 percent design discharge, and discharge associated with the Geysers alternative if the concentration of cyanide in the Laguna is greater than zero.

Background cyanide data are available for the Russian River. Predicted concentrations of cyanide in the Russian River above and below the confluence of the Laguna do not exceed the point of significance for cyanide for any 95th percentile reclaimed water design discharge. Therefore, all discharge components will have a less than significant impact on cyanide in the Russian River.

Total cyanide and cyanide amenable to chlorination were measured in stored reclaimed water on four occasions in Delta Pond and Meadowlane Pond (more samples were taken but earlier samples were possible subject to nitrate and nitrite interference). Free cyanide (weak dissociable cyanide) was measured eight times in Delta Pond and four times in Meadowlane Pond (see *Reclaimed Water Quality Monitoring Results* and *Reclaimed Water Quality Monitoring Results Update* Technical Reports, MSC 1996). In all samples that were not subject to nitrate/nitrite interference, the concentrations of total cyanide, weak dissociable cyanide, and cyanide amenable to chlorination were below detection (0.005 mg/L). This indicates that cyanide in stored reclaimed water is reduced through volatilization and/or complexation. Since the reporting limit for these samples was below the point of significance, it is likely that discharge of stored effluent will have a less than significant impact on the Laguna and Santa Rosa Creek.

Phthalates

Three phthalates are detectable in reclaimed water: bis (2-ethylhexyl) phthalate, diethyl phthalate, and di-n-butyl phthalate. The phthalate criterion is for phthalate esters without specifying which phthalate. Therefore, the average concentrations in reclaimed water of the three detectable phthalates were summed, and the total used for the evaluation of significant impacts. The concentration of no individual phthalate in reclaimed water exceeded the point of significance for phthalates, but the concentration of total phthalates in reclaimed water exceeded the point of significance for phthalate of 3 µg/L.

The phthalate guideline developed by the EPA is overprotective since it is based on the single lowest chronic value reported for bis (2-ethylhexyl) phthalate (EPA 1980). This value of 3 µg/L came from a 1973 study by F. L. Mayer and H. O. Sanders. F. L. Mayer, now director of the EPA Gulf Breeze Laboratory, says that the test methods and test conditions make the results of his 1973 study unsuitable for use in establishing a point of significance for phthalates. Mayer considers the appropriate point of significance for phthalates to be around 30 µg/L (F. L. Mayer, EPA Gulf Breeze Laboratory *pers. comm.* to R. Palachek, Parsons Engineering Science, Austin). After the 3 µg/L value, the next lowest chronic value for bis (2-ethylhexyl) phthalate in the literature is 8 µg/L (Suter and Mabrey 1994) which is higher than the average total concentration of phthalates in reclaimed water of 5 µg/L. The lowest chronic values for di-n-butyl phthalate and diethyl phthalate are much higher than those for bis (2-ethylhexyl) phthalate (Suter and Mabrey 1994). Therefore, although the predicted concentration of phthalates in reclaimed water exceeds 3 µg/L, the impact of direct discharge on phthalates in the Laguna and Santa Rosa Creek is considered less than significant. No risk to aquatic organisms from phthalates was identified in the Ecological Risk Assessment (*Ecological Risk Assessment for Santa Rosa Subregional Long-Term Wastewater Project* Technical Report Parsons ES 1996).

Phthalate data are available for the Russian River. The predicted concentrations of phthalates in the Russian River both above and below the confluence with the Laguna did not exceed the point of significance for phthalate with any of the discharge components. Therefore, all discharge components will have a less than significant impact on phthalates in the Russian River.

Total Nitrogen and Ammonia Nitrogen Loads to the Laguna

Total Nitrogen

The predicted total nitrogen loads to the Laguna with different discharge components are shown in Table 4-13. Total nitrogen loads range from 63,543 lbs./year for discharge related to a Geysers alternative to 676,756 lbs./year for discharged related to a No Project alternative. The changes in total nitrogen loads for each of the discharge components relative to the current total nitrogen load to the Laguna are also shown in Table 4-13.

The point of significance for a beneficial impact to the waste reduction strategy is a reduction in total nitrogen load of greater than 159,000 lbs/year. Thus a reduction in total nitrogen load greater than 159,000 lbs/year is a beneficial impact. It is predicted that the 1 percent design discharge, 5 percent design discharge, 20 percent design discharge to the River, and discharge related to a Geysers component will cause a decrease in total nitrogen load greater than 159,000 lbs/year and, therefore, will have a significant beneficial impact on the Laguna.

The point of significance for an adverse impact to the waste reduction strategy is a reduction of total nitrogen load of less than 159,000 lbs/year. Thus a reduction in total nitrogen load less than 159,000 lbs/year is a adverse impact. It is predicted that the 20 percent design discharge to the Laguna and discharge related to a No Project alternative will cause an increase in total nitrogen load to the Laguna. Therefore, the 20 percent design discharge to the Laguna and discharge related to a No Project will have a significant adverse impact on the Laguna. It is predicted that the 10 percent design discharge to the Laguna will cause a decrease in total nitrogen load to the Laguna. However, the total nitrogen load decrease predicted for a 10 percent design discharge does not meet the waste reduction strategy point of significance of a 159,000 pound reduction per year. Therefore, the 10 percent design discharge to the Laguna will have a significant adverse impact on the Laguna.

Ammonia Nitrogen

The predicted ammonia nitrogen loads to the Laguna with different discharge components is shown in Table 4-14. Ammonia nitrogen loads range from 3,738 lbs./year for discharge related to a Geysers alternative to 39,809 lbs./year for discharge related to a No Project alternative. The changes in ammonia nitrogen loads for each of the discharge components

Table 4-13.

Predicted Total Nitrogen Loads to the Laguna with Different Discharge Components and Changes in Load Relative to the Current Nitrogen Load to the Laguna.

Discharge component[a]	**Discharge volume[b] (million gallons / year)**	**Total Nitrogen concentration[c] (lbs / million gallons**	**Total Nitrogen load to the Laguna (lbs / year)**	**Change in total nitrogen load from current load (lbs / year)**
Current			424,700[d]	
1%	674	142	95,359	-329,341
5%	1,841	142	260,584	-164,116
10%	2,783	142	393,795	-30,905
20%	4,575	142	647,467	222,767
20% River	514	142	72,695	-352,005
NP	4,782	142	676,756	252,056
G	449	142	63,543	-361,157

[a] 1% = 1% design discharge component
5% = 5% design discharge component
10% = 10% design discharge component
20% = 20% design discharge component to Laguna
20% River = 20% design discharge component to River
NP = No Project discharge component
G = Geysers discharge component

[b] Average annual discharge volume from *Water Balance Model Overall Summary and Results* Technical Memorandum (Parsons ES 1995)

[c] equivalent to 17 mg-N/L, from *Reclaimed Water Quality* Technical Report (MSC 1996)

[d] From Table D-5 in NCRWQCB (1995)

relative to the current ammonia nitrogen load to the Laguna of 56,100 lb/yr, as estimated by the NCRWQCB (1995), are also shown in Table 4-14.

The point of significance for a beneficial impact to the waste reduction strategy is 21,500 lbs/year. Thus, a reduction in ammonia nitrogen load greater than 21,500 lbs/year is a beneficial impact. It is predicted that the 1 percent design discharge, 5 percent design discharge, 10 percent design discharge, 20 percent discharge to the River, and discharge related to a Geysers alternative will cause a decrease in ammonia nitrogen load greater than 21,500 lbs/year and, therefore, will have a significant beneficial impact on the Laguna.

The point of significance for an adverse impact to the waste reduction strategy is also 21,500 lbs/year. Thus, a reduction in ammonia nitrogen load less than 21,500 lbs/year is a adverse impact. It is predicted that the 20 percent design discharge to the Laguna and discharge related to a No Project alternative will cause reductions in ammonia nitrogen load to the Laguna of less than 21,500 lbs/year. Therefore, the 20 percent design discharge to the Laguna and discharge related to a No Project alternative will have a significant adverse impact on the Laguna.

Table 4-14 shows a reduced ammonia nitrogen load for the 10 and 20 percent design Laguna discharge despite the fact that more reclaimed water would be discharged than under existing conditions. This is because the NCRWQCB (1995) estimate of existing load was based on an ammonia nitrogen concentration of 2 mg/L, the long term concentration of ammonia nitrogen in plant effluent (when nitrifying). Recent data (see Appendix 4 of the *Reclaimed Water Quality* Technical Report, MSC 1996) show that the ammonia nitrogen concentration in reclaimed water discharged from storage ponds has decreased to 1 mg/L). Therefore, the loads shown in Table 4-14 are based on 1 mg/L.

Toxicity

Lethal toxicity was found once in 11 tests, or in 9 percent of the tests (see *Reclaimed Water Quality Update* Technical Report, MSC 1996), and the lowest, or worst-case NOEC of reclaimed water is 25 percent. Table 4-15 shows the frequency of days that daily average reclaimed water concentration would exceed 25 percent (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, RMA 1996). These frequencies of potentially toxic concentrations are then multiplied by the worst-case toxicity frequency (9 percent), 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 would occur in the receiving water is greater for a discharge component that for existing conditions. Thus, the impact of discharge on toxicity is considered to be significant for the 20 percent design Laguna discharge and the No Project discharge components. Table 4-15 shows that, in a wet year, reclaimed water seldom is greater than 25 percent, so the calculated frequency of a toxic effect (0.009 times this frequency) is also seldom. A toxic effect would occur in the receiving water on less than 2 percent of discharge days under any discharge component. In a dry year, the frequency that such conditions occur would be around 8 percent under some discharge components (20 percent Laguna discharge and No Project). The frequency would be 6.1 percent under existing conditions in a dry year.

Although not shown in Table 4-15, the concentration of reclaimed water in the Laguna would also exceed 25 percent for the 20 percent design Laguna discharge and No Project discharge components. However, the concentration of reclaimed water resulting from design discharge would not exceed 25 percent in the Russian River. Thus, the impact on toxicity in the Laguna is considered to be significant, and the impact on toxicity in the Russian River is considered to be less than significant.

Table 4-14.

Predicted Ammonia Nitrogen Loads to the Laguna with Different Discharge Components and Changes in Load Relative to the Current Nitrogen Load to the Laguna.

Discharge component [a]	Discharge volume[b] (million gallons / year)	Ammonia Nitrogen concentration[c] (lbs / million gallons	Ammonia Nitrogen load to the Laguna (lbs / year)	Change in ammonia nitrogen load from current load (lbs / year)
Current			56,610[d]	
1%	674	8.3	5609	-51,001
5%	1,841	8.3	15,328	-41,282
10%	2,783	8.3	23,164	-33,446
20%	4,575	8.3	38,086	-18,524
20% River	514	8.3	4276	-52,334
NP	4,782	8.3	39,809	-16,801
G	449	8.3	3738	-52,872

[a] 1% = 1% design discharge component
5% = 5% design discharge component
10% = 10% design discharge component
20% = 20% design discharge component to Laguna
20% River = 20% design discharge component to River
NP = No Project discharge component
G = Geysers discharge component

[b] Average annual discharge volume from *Water Balance Model Overall Summary and Results* Technical Memorandum (Parsons ES 1995)

[c] equivalent to 1 mg-N/L, from Appendix 4 of the *Reclaimed Water Quality* Technical Report (MSC 1996)

[d] From Table D-4 in NCRWQCB (1995)

This approach to estimating the frequency with which toxic conditions would occur in Santa Rosa Creek is dependent on several assumptions as follows:

- Cases of lethal toxicity are not one-time events, but typical of the probability of such effects in the future
- Toxicity varies independent of reclaimed water concentration. Reclaimed water concentration varies according to stream flow, and stream flow varies according to season. Insufficient data are available to determine if toxicity varies according to some seasonal factor, such as seasonal inputs to the sewage system of pesticides or industrial waste.

Observation of lethal toxicity in laboratory conditions does not necessarily mean that fish would actually be killed as a result of exposure to reclaimed water at the concentration at which toxicity was observed in the laboratory. Several factors suggest that the analysis summarized in Table 4-15 may be an overestimate of discharge impacts as follows:

- Fish and other aquatic life can avoid toxic conditions when they are sensitive to sublethal effects (e.g., olfactory irritation).
- Increased microbiological activity in receiving water (relative to storage ponds) may reduce toxicity in reclaimed water.
- No fish mortality was observed in the Laguna and Santa Rosa Creek during conditions of high reclaimed water concentrations. Trained fishery scientists were present in receiving water environment for three years conducting the fyke netting portion of the fish migration studies and never observed any sign of mortality, as summarized in *Anadromous Fish Migration Study Program, 1991- 1995* Technical Report (MSC 1996).

Range of Impacts - Existing Conditions Baseline

The range of potential impacts in receiving waters of substances found in detectable concentrations in reclaimed water were analyzed with a dilution model as described above for significant impacts. Tables 4-6 through 4-11 (above) show the range of potential impacts using existing conditions baseline.

Range of Impacts - Zero Discharge Baseline

The range of impacts from discharge of reclaimed water were also examined for a zero discharge baseline. As discussed in Section 4.1.4 Impact Evaluation Approach, the zero discharge baseline for conservative constituents was estimated from concentrations measured above Santa Rosa's reclaimed water discharge.

Russian River. Most constituents detectable in reclaimed water, for which data exist, were below detection in the Russian River both above and below the confluence with the Laguna (*Russian River Water Quality Monitoring Results* Technical Report, MSC 1996). Therefore, the range of impacts for these constituents with a zero discharge baseline would be similar to those estimated for the existing conditions baseline. Detectable constituents include calcium, total chromium, total copper, total lead, magnesium, total nickel, dissolved nickel, total silver, total zinc dissolved zinc, and conductivity. Aluminum and barium were only analyzed in the Russian River above the Laguna. The results of a comparison between constituents above and below the confluence with the Laguna are shown in Table 4-16. These comparisons are made between all available data collected between 1985 through 1995. There was no statistically significant difference in the concentrations of these constituents, with the exception of conductivity, in the Russian River above and below the confluence with the Laguna. Therefore, the range of impacts for these constituents with a zero discharge baseline would be similar to those estimated for the existing conditions baseline. Conductivity in the Russian River was significantly different above the confluence with the Laguna than below the confluence. The predicted range of impacts of the different discharge components on conductivity in the Russian River below the confluence with the Laguna with a zero discharge baseline are shown in Table 4-17.

Table 4-15.

Calculated Probability of Toxic Conditions In Santa Rosa Creek Resulting From Design Discharge
(significant impacts shown in bold)

	Dry Year		Average Year		Wet Year	
Discharge Component	**Days RW Conc. >25 percent**[a]	**Frequency of Lethally Toxic Conc.**[b]	**Days RW Conc. >25 percent**[a]	**Frequency of Lethally Toxic Conc.**[b]	**Days RW Conc. >25 percent**[a]	**Frequency of Lethally Toxic Conc.**[b]
1% Laguna	0	0	0	0	0	0
5% Laguna	26.7	2.4	14.4	1.3	0	0
10% Laguna	58.8	5.3	25.8	2.3	0	0
20% Laguna	93.7	**8.4**	70.5	**6.3**	15.5	**1.4**
20% RR	0	0	0	0	0	0
No Project	88.4	**7.9**	57.1	**5.1**	15.1	**1.4**
Geysers	0	0	0	0	0	0
Exist. Cond.	67.6	6.1	37.0	3.3	10.1	0.9

[a] Values in this column represent the frequency (percentage) of days that the daily average reclaimed water concentration in Santa Rosa Creek would exceed 25 percent. This frequency was estimated using water quality model output. Model is described in the *Russian River Water Quality Modeling* Technical Report (RMA 1996). Model output is graphically presented in the *Water Quality Impacts Analysis* Technical Report. 25 percent reclaimed water concentration was selected because it represents the lowest no effects concentration of the worst case lethal toxicity episode. Frequencies are considered significant if they exceed existing condition frequencies.

[b] 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 percent (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 (MSC 1996).

Table 4-16.

Comparison of Constituents in the Russian River Above and Below the Confluence with the Laguna (1985-1995). Comparison is for Constituents Detectable Both in Reclaimed Water and in the Russian River
All units in mg/L except conductivity which is in µmhos/cm

	Above Laguna		**Below Laguna**		**Significance**
	mean	**standard deviation**	**mean**	**standard deviation**	
Calcium	20.6	3.5	18.1	2.9	ns[a], p = 0.12
Total chromium	0.0080	0.0080	0.0060	0.0055	ns, p = 0.39
Total copper	0.0083	0.0042	0.0076	0.0035	ns, p = 0.70
Total lead	0.0020	0.0020	0.0024	0.0024	ns, p = 0.54
Total magnesium	13.1	2.2	12.1	1.8	ns, p = 0.32
Total nickel	0.017	0.015	0.011	0.014	ns, p = 0.24
Dissolved nickel	0.0025	0	0.0028	0.0009	ns, p = 0.68
Total silver	0.0014	0.0017	0.0006	0.0002	ns, p = 0.56
Total zinc	0.015	0.012	0.015	0.026	ns, p = 0.49
Dissolved zinc	0.024	0.0067	0.037	0.028	ns, p = 0.62
Conductivity	248	38	263	46	significant, p = 0.01

[a] ns = not significant (p > 0.05)

Table 4-17.

Predicted Range of Impacts on Conductivity in the Russian River below the Laguna with a Zero Discharge Baseline
(µmhos / cm)

	50th percentile	95th percentile	Maximum
1 percent discharge	248	250	414
20 percent discharge to the Russian River	258	296	443
No Project	258	296	443
Geysers	248	250	413
5 percent discharge	249	272	428
10 percent discharge	251	296	443
20 percent discharge to the Laguna	262	319	449

Laguna de Santa Rosa. Most constituents detectable in reclaimed water, for which data exist, were below detection in the Laguna de Santa Rosa both above and below the reclaimed water discharge (*Laguna Water Quality Monitoring Results* Technical Report, MSC 1996). Therefore, the range of impacts for these constituents with a zero discharge baseline would be similar to those estimated for the existing conditions baseline. Detectable constituents include total arsenic, calcium, total cadmium, total chromium, total copper, total lead, magnesium, total nickel, dissolved nickel, total silver, total zinc, and conductivity. The results of a comparison between constituents above and below the confluence with Santa Rosa Creek are shown in Table 4-18. Comparisons were made for all available data collected between 1985 through 1995. No statistically significant difference exists between the concentrations of detectable constituents in the Laguna above and below the discharge, with the exception of calcium, cadmium, copper, and conductivity. Therefore, the range of impacts for these constituents with a zero discharge baseline would be similar to those estimated for the existing conditions baseline. Calcium, cadmium, copper, and conductivity in the Laguna were significantly different above the discharge than below discharge. Calcium and conductivity were higher above the discharge than below the discharge. Copper and cadmium were lower above the discharge than below the discharge. The predicted range of impacts of the different discharge components on calcium, cadmium, copper, and conductivity in the Laguna below the discharge with a zero discharge baseline are shown in Table 4-19.

Table 4-18.

Comparison of Constituents in the Laguna de Santa Rosa Above and Below the Confluence with Santa Rosa Creek. Comparison is for Constituents Detectable in Both Reclaimed Water and in the Laguna.

	Laguna Above Santa Rosa Ck		Laguna Below Santa Rosa Ck		Significance
	mean	**standard deviation**	**mean**	**standard deviation**	
Total arsenic	0.0042	0.0023	0.0036	0.0020	ns[a], p = 0.55
Calcium	32.8	8.1	18.0	5.2	significant, p = 0.013
Total cadmium	0.00025	0	0.0020	0.0009	significant, p = 0.015
Total chromium	0.0050	0.0017	0.0060	0.0015	ns, p = 0.076
Total copper	0.0016	0.0011	0.0119	0.018	significant, p = 0.007
Total lead	0.0018	0.0008	0.0028	0.0028	ns, p = 0.45
Total magnesium	18.5	4.7	13.6	3.9	ns, p = 0.13
Total nickel	0.0098	0.0023	0.0129	0.0039	ns, p = 0.20
Dissolved nickel	0.0070	0.0027	0.0059	0.0031	ns, p = 0.61
Total silver	0.0005	0	0.0026	0.0023	ns, p = 0.12
Total zinc	0.015	0.015	0.023	0.042	ns, p =0.98
Conductivity	651	298	485	147	significant, p = <0.0001

[a] ns = not significant (p > 0.05)

Table 4-19.

Predicted Range of Impacts in the Laguna with a Zero Discharge Baseline

	Calcium (mg/L)			Cadmium (mg/L)			Copper (mg/L)			Conductivity (μmhos/cm)		
percentile	**50th reclaimed water[a]**	**95th reclaimed water[b]**	**max receiving water[c]**	**50th reclaimed water[a]**	**95th reclaimed water[b]**	**max receiving water[c]**	**50th reclaimed water[a]**	**95th reclaimed water[b]**	**max receiving water[c]**	**50th reclaimed water[a]**	**95th reclaimed water[b]**	**max receiving water[c]**
1 percent discharge	32.8	32.7	41.6	0.0003	0.0003	0.0003	0.0016	0.0020	0.0029	651	654	2064
20 percent discharge to the Russian River	32.8	32.8	35.6	0.0003	0.0003	0.0005	0.0016	0.0017	0.0083	651	651	1282
No Project	32.6	32.0	36.3	0.0003	0.0005	0.0005	0.0030	0.0072	0.0076	660	690	1380
Geysers	32.8	32.8	39.9	0.0003	0.0003	0.0003	0.0016	0.0018	0.0044	651	652	1841
5 percent discharge	32.8	32.4	39.2	0.0003	0.0004	0.0004	0.0019	0.0044	0.0050	653	670	1757
10 percent discharge	32.7	32.2	37.4	0.0003	0.0004	0.0004	0.0021	0.0062	0.0067	655	682	1520
20 percent discharge to the Laguna	32.5	31.9	35.5	0.0003	0.0005	0.0005	0.0034	0.0081	0.0084	663	696	1268

[a] Numbers in the 50th percentile columns are the concentrations of constituents predicted in receiving water with a reclaimed water concentration equal to the 50th percentile (i.e. 50 percent of the days have less than this concentration of reclaimed water) and an average receiving water concentration. The 50th percentile is for a normal hydrologic year.

[b] Numbers in the 95th percentile columns are the concentrations of constituents predicted in receiving water with a reclaimed water concentration equal to the 95th percentile (i.e. 95 percent of the days have less than this concentration of reclaimed water) and an average receiving water concentration. The 95th percentile is the maximum of the three hydrologic years (dry, normal, or wet).

[c] Numbers in the Max Receiving Water columns are the concentrations of constituents predicted in receiving water with a 95th percentile reclaimed water concentration and a maximum observed receiving water concentration.

Santa Rosa Creek. The organic compounds detectable in reclaimed water, for which data exist, were below detection in Santa Rosa Creek both above and below the discharge. Therefore, the range of impacts with a zero discharge baseline would be similar to those estimated for the existing conditions baseline. Similarly, most metals in Santa Rosa Creek were either below detection below the discharge or insufficient data were available below the discharge so above discharge data were used for the existing conditions baseline range of impacts analysis. Therefore, the range of impacts with a zero discharge baseline would be similar to those estimated for the existing conditions baseline.

4.1.6 Proposed Mitigation

Mitigation proposed for the 1, 5, and 10 percent design discharge, 20 percent design Laguna discharge, 20 percent design River discharge components, and discharge associated with the Geysers alternative are discussed in this section. In addition, measures for the City's consideration to avoid impacts from discharge associated with the No Project alternative are also discussed.

Summary of Significant Impacts to be Mitigated

Table 4-20 summarizes significant adverse and beneficial impacts (relative to an existing conditions baseline) of discharge to the Laguna and Russian River. The areas of the receiving water environment that are cited in Table 4-20 are defined at the beginning of the "Water Quality Simulation Model Results - Existing Conditions Baseline" section of this report.

Summary of Proposed Mitigation

Significant water quality impacts associated with reclaimed water discharge components in Table 4-20 can be reduced by modifying the discharge management strategy and implementing a source identification and control program. Impacts on algae and dissolved oxygen and turbidity could be reduced by the revised discharge management strategy, and impacts on waste reduction strategy (total nitrogen load and ammonia load) in receiving waters would be reduced by implementing a source identification and control program. Impacts on cyanide could be reduced by insuring that the effluent is stored prior to discharge through regular monitoring and, if necessary, source control. Toxicity impacts can be mitigated with additional monitoring and study, followed by source control. Potential mitigation for the significant impact on conductivity in the Russian River above the Laguna is also discussed below.

Conductivity

Conductivity is a measure of the dissolved salts in water. Reclaimed water derives mostly from the Russian River water that is supplied to the Subregional System service area as domestic water supply. This water supply contains dissolved salt when it is delivered to the customers, and salt is added as the water passes on to the Laguna treatment plant. Since salt is not currently removed from reclaimed water at the Laguna plant, reclaimed

Table 4-20

Significant Adverse and Beneficial Impacts of Each Design Discharge Component[a]

Constituent	Santa Rosa Creek	Laguna	Russian River Below Laguna	Russian River Above Laguna
Benthic Algae				
Adverse	1%, 5%, 10%, 20%, 20% River, NP, G	1%, 20%, 20% River, NP, G	20%, 20% River, NP	20% River
Beneficial	1%, 5%, 10%, 20% River, G	1%, 5%, 10%, 20% River, G	1%, 5%, 10%. 20% River, G	
Planktonic Algae				
Adverse		1%, 5%, 10%, 20% River	20%	20% River
Beneficial	20%, NP	20%, NP	20% River	
Turbidity				
Adverse				20% River
Beneficial	20%	20%	20% River	
Dissolved Oxygen		20%		
Conductivity				20% River
Cyanide	10%, 20%, NP	20%, NP		
Toxicity	20%, NP	20%, NP		
Waste Red. Strat.			Criterion applies only to Laguna system	
Adverse				
Total Nitrogen	10%, 20%, NP			
Ammonia	20%, NP			
Beneficial				
Total Nitrogen	1%, 5%, 20% River, G			
Ammonia	1%, 5%, 10%, 20% River, G			

[a] 1% = 1% design discharge component
20% = 20% design discharge component to Laguna
20% River = 20% design discharge component to River
NP = No Project discharge component
G = Geysers discharge component

water that is discharged to the Russian River has a higher average conductivity than does the River.

An impact that is considered significant would occur as a result of discharge to the Russian River above the Laguna as proposed. Alternatives for mitigation and avoidance of this potential impact were considered as follows:

1. **Remove salt.** Desalination involves the construction of a facility that uses reverse osmosis to force water through a permeable membrane while retaining salt. Desalination plants produce a salty wastewater called brine that must be disposed of as waste. Since the objective of the mitigation/avoidance alternative is to avoid salt disposal in the Russian River, brine would need to be injected into a deep (already salty) groundwater aquifer, or piped to the ocean or San Pablo Bay. This option was considered in CH2M Hill (1990), and the physical constraints on brine disposal lead to a conclusion that desalination was infeasible.

2. **Build a pipeline to the River and discharge below the Laguna.** The Regional Water Quality Control Board's conductivity standard is less stringent below the Laguna than above. The impacts analysis shows that no exceedences of the conductivity standard would occur in the River below the Laguna for any of the discharge components. The cost of this conductivity impact avoidance alternative would be similar to the estimated cost of constructing the proposed pipeline to the River discharge site located upstream of the Laguna.

3. **Re-route discharge to the Laguna during some periods when conductivity point of significance is exceeded in the Russian River above the confluence with the Laguna.** Mitigation involving intermittantly re-routing discharge to the Laguna would require monitoring of conductivity in the Russian River above the Laguna and managing the discharge to avoid causing exceedances of the conductivity point of significance. Re-routing discharge to the Laguna would be done for a sufficient time period to insure that average monthly conductivity in the upper River is less than the point of significance for at least six months. Intermittantly re-routing the discharge is not proposed because its effectiveness cannot be ascertained prior to extensive monitoring. Pipeline construction would be delayed until the monitoring results are obtained, which implies that another alternative (i.e., Alternative 5B) would be implemented instead of 5A.

None of these mitigation options are recommended. The significant impact on conductivity can be avoided by implementing other project alternatives. The Laguna is the primary discharge location for all discharge components except the 20 percent design discharge to River. Discharge to the Laguna avoids discharge to the River above the Laguna, and no significant impact on conductivity is expected to occur.

Discharge Management Strategy

Impacts of discharge on biostimulatory substances can be reduced by modifying the strategy of discharge management to emphasize discharge in winter and reduce discharge in fall and spring. Figure 4-23 illustrates the storage strategy upon which the project descriptions and the mitigation operating strategy are based. Figures 4-24 through 4-35 show the distribution of daily average reclaimed water concentrations at key locations in the Russian River/Laguna system with mitigation operation. The 50th percentile concentration in a normal year, maximum 95th percentile from the dry, normal and wet years from the project operating mode (from Figures 4-1 through 4-12) and from the mitigation operations (Figures 4-24 through 4-35) are shown in Table 4-21. In general, this comparison shows that the median concentrations are lower and that the maximum concentration under the mitigation operations are greater than under project operations.

Source Control Program

Source control programs for cyanide and total nitrogen are described below to mitigate the potential impacts on cyanide and total nitrogen and ammonia loads (to address significant impacts identified according to the waste reduction strategy evaluation criterion).

Cyanide

A cyanide monitoring program to verify that the concentration of cyanide in storage ponds will not cause a significant impact if discharged and, if necessary, identify and control the source of cyanide as needed to avoid exceeding the cyanide point of significance in receiving waters is recommended. Mitigation operations would not cause significant impacts for additional water quality constituents.

The concentration of cyanide in plant effluent exceeds the point of significance for cyanide and, if discharged directly, would cause significant impacts to the Laguna and Santa Rosa Creek. However, reclaimed water is typically stored prior to discharge. Existing data from reclaimed water storage ponds (Delta and Meadowlane Ponds) indicate that, with storage, cyanide volatilizes and/or complexes with other compounds. The total cyanide concentration in stored reclaimed water was below detection and less than the point of significance for cyanide. Thus, monitoring may show that the cyanide concentration in pond discharge would not cause the point of significance to be exceeded, in which case source identification and reduction would be unnecessary. Cyanide is amenable to source control because discrete sources can be identified. About 84 percent of domestic hydrogen cyanide production is used to produce nitriles, which are used in the manufacture of synthetic fibers, resins, plastics, dyestuffs, vitamins, solvents, elastomers, agricultural insecticides, and high pressure lubricants (Eisler 1991). Cyanides are also widely used in the metals and electroplating industry. Secondary uses of cyanides include directly or as an intermediate to produce synthetic rubber, fumigants, rodenticides, insecticides, predator control agents, rocket fuels, paints and paint finishes, paper, nylon, pharmaceuticals, photographic chemicals, mirrors, cement, perfume, bleaches, soaps and detergents, fertilizers, and herbicides (Eisler 1991). Thus a systematic approach can be developed to identify sources and require their reduction or removal.

Table 4-21.

Estimated Percent Daily Average Reclaimed Water Concentrations in Receiving Waters Resulting from Project and Mitigation Operations

	Exist-ing	1 percent design discharge		5 percent design discharge		10 percent design discharge		20 percent design Laguna Discharge		20 percent design Russian River Discharge		No Project		Geysers	
		Project	Miti-ga-tion	Project	Miti-ga-tion	Project	Miti-ga-tion	Project	Miti-ga-tion	Project	Miti-ga-tion	Project	Measures for the City's Consideration	Project	Miti-ga-tion
Santa Rosa Creek															
50th percentile[a]	19	0	0	6	0	11	0	35	11	0	0	29	6	0	0
95th percentile[b]	62	9[c]	19[a]	49	54[a]	67	72[a]	81[c]	83	2[c]	61	75[c]	77	6	3.1[a]
Laguna at River Rd															
50th percentile[a]	8	0	0	3	0	5	0	17	5	0	0	13	3	0	0
95th percentile[b]	38	4[c]	8[a]	26	31[a]	43	49[a]	61[c]	64	0.6[c]	37	53[c]	55	2	1[a]
Russian River at Oddfellows															
50th percentile[a]	1	0	0	0.3	0	0.6	0	3	0.7	2	0.6	2	0.5	0	0

Table 4-21.

Estimated Percent Daily Average Reclaimed Water Concentrations in Receiving Waters Resulting from Project and Mitigation Operations

	Existing	1 percent design discharge		5 percent design discharge		10 percent design discharge		20 percent design Laguna Discharge		20 percent design Russian River Discharge		No Project		Geysers	
		Project	Mitigation	Project	Mitigation	Project	Mitigation	Project	Mitigation	Project	Mitigation	Project	Measures for the City's Consideration	Project	Mitigation
95th percentile[b]	7	0.5[c]	1	5	5	10	10	15	21	10	15	10	19	0.4	0.2[a]
Russian River at SCWA Wohler intakes															
50th percentile[a]	0	0	0	0	0	0	0	0	0	3	.8	0	0	0	0
95th percentile[b]	0	0	0	0	0	0	0	0	0	11	14	0	0	0	0

[a] 50th percentile concentration in normal hydrologic year (1961) is given.

[b] The maximum of the three 95th percentile concentrations (dry, normal, wet) is shown. The maximum occurred in the dry year (1976) unless noted otherwise.

[c] Highest 95th percentile value occurred in 1961, not 1976

Nitrogen

Total Nitrogen

The 10 percent design discharge and the 20 percent design discharge to the Laguna would not attain the Regional Board's total nitrogen load reduction goal of 159,000 pounds per year. Table 4-22 shows the load reduction required to attain the Regional Board's goal.

Table 4-22.

Summary of Total Nitrogen Load Reduction (Mitigation) Requirement
(pounds per year)

Discharge Component	Load Change Due to Discharge Component[a]	Reduction Goal[b]	Total Load That Would Need to Be Eliminated
10%	-30,905	159,000	128,095
20 % Laguna	222,767	159,000	381,767
No Project	252,056	159,000	411,056

[a] From Table 4-5
[b] From Table 3 in *Development of Evaluation Criteria for Potential Water Quality Impacts* (MSC 1996)
[c] Load Increase Due to Discharge Component + Reduction Goal

The Regional Board's *Laguna de Santa Rosa Waste Reduction Strategy* report (NCRWQCB 1995) identifies sources of nitrogen and establishes total nitrogen load reduction goals for each source. Sources other than the Subregional System include agriculture, urban runoff, and septic systems. The total nitrogen load reduction goals were established to attain dissolved oxygen objectives in the Laguna. After meeting the NCRWQCB's load reduction goal, each source would continue to discharge nitrogen. Table 4-23 summarizes the estimated current total nitrogen load, the load reduction goal, and the total nitrogen load that would continue to be discharged after the load reduction goal is met. Table 4-23 shows that the estimated future load from sources other than the Subregional System would be 597,821 pounds per year if the Regional Board's load reduction goals are attained. Table 4-22 shows that the Subregional System's load reduction need is 128,095 , 381,767 and 411,056 pounds per year for the 10 percent design discharge, 20 percent design discharge to the Laguna and the No Project discharge components, respectively. Sufficient total nitrogen load remains from non-Subregional System sources after the load reduction goals are accounted for that the Subregional System can theoretically meet its load reduction goal by reducing the total nitrogen load to the Laguna from these other sources. Technology for nitrogen reduction in agriculture and elsewhere is well documented (see the *Irrigation Management Guidelines For the West County and South County Alternatives* Technical Report, Questa Engineering 1996; EPA 1993, Gold Ridge RCD 1995). Nitrogen removal in the treatment plant to a final reclaimed water concentration of approximately 7 mg-N/L could also reduce total nitrogen loads from all discharge components to a level that would attain the Regional

Board's load reduction goals without source control. It may not be feasible to reduce the total nitrogen load from other sources to a level low enough to completely mitigate the increased Project loads predicted for the 10 percent design discharge, 20 percent design discharge to the Laguna and the No Project discharge components. If complete mitigation from source control is infeasible, a combination of source control and treatment plant nitrogen reduction is recommended. Alternatively, nitrogen could be reduced by modifying the Laguna treatment plant or be routing discharge through marshes (see *Treatment Wetlands Evaluation* Technical Report, MSC 1996).

Table 4-23.

Summary of Total Nitrogen Sources in the Laguna
(pounds per year)

Source	Current Annual[a]	Reduction Goal[b]	Future Load[c]
Urban	225,128	23,267	201,861
Wastewater	424,700	159,261	265,439
Non-Irrigated Lands	98,726	0	98,726
Dairy Ag	236,628	132,234	104,394
Septic Systems	153,789	0	153,789
Open Space	39,051	0	39,051
Total (excluding wastewater)	753,322	155,501	597,821
Total (include wastewater)	1,178,022	314,762	863,260

[a] From Table D-5 in NCRWQCB (1995)
[b] From Table 3 in NCRWQCB (1995)
[c] Current Annual - Reduction Goal

Ammonia Nitrogen

The 20 percent design discharge to the Laguna and the No Project alternatives would not attain the Regional Board's ammonia load reduction goal of 21,500 pounds per year. Table 4-24 shows the load reduction required to attain the Regional Board's goal.

The Regional Board's *Laguna de Santa Rosa Waste Reduction Strategy* report (NCRWQCB 1995) identifies sources of ammonia nitrogen and establishes ammonia load reduction goals for each source. Sources other than the Subregional System include agriculture, urban runoff, and septic systems. The ammonia load reduction goals were established to attain dissolved oxygen objectives and reduce ammonia toxicity potential in the Laguna. After meeting the NCRWQCB's load reduction goal, each source would continue to discharge ammonia. Table 4-25 summarizes the estimated current ammonia load, the load reduction goal, and the ammonia load that would continue to be discharged after the load reduction goal is met. Table 4-25 shows that the estimated future load from sources other than the Subregional System would be 92,050 pounds per year if the Regional Board's load reduction goals are attained. Table 4-24 shows that the

Subregional System's ammonia load reduction need is 2,976 and 4,699 pounds per year for the 20 percent design discharge to the Laguna and the No Project discharge components, respectively. Thus, sufficient ammonia load remains from non-Subregional System sources after the load reduction goals are accounted for that the Subregional System can meet its load reduction goal by reducing the total nitrogen load to the Laguna from these other sources. Alternatively, ammonia could be reduced by modifying the Laguna treatment plant or be routing discharge through marshes (see *Treatment Wetlands Evaluation* Technical Report, MSC 1996).

Table 4-24.

Summary of Ammonia Load Reduction (Mitigation) Requirement
(pounds per year)

Discharge Component	Load Change Increase Due to Discharge Component[a]	Reduction Goal[b]	Total Load That Would Need to Be Eliminated
20 % Laguna	-18,524	21,500	2,976
No Project	-16,801	21,500	4,699

[a] From Table 4-6

[b] From Table 3 in *Development of Evaluation Criteria for Potential Water Quality Impacts* (MSC 1996)

[c] Load Increase Due to Discharge Component + Reduction Goal

Table 4-25.

Summary of Ammonia Sources in the Laguna
(pounds per year)

Source	Current Annual[a]	Reduction Goal[b]	Future Load[c]
Urban	19,968	2,313	17,655
Wastewater	56,610	21,480	35,130
Non-Irrigated Lands	5,105	0	5,105
Dairy Ag	39,437	22,548	16,889
Septic Systems	51,273	0	51,273
Open Space	1,128	0	1,128
Total (excluding wastewater)	116,911	24,861	92,050
Total (include wastewater)	173,521	71,202	102,319

[a] From Table D-4 in NCRWQCB (1995)

[b] From Table 3 in NCRWQCB (1995)

[c] Current Annual - Reduction Goal

Toxicity Control Program

A mitigation program consisting of increased monitoring, toxicity identification and reduction is recommended regardless of which alternative is implemented. The Subregional System is currently required to monitor for chronic toxicity quarterly during the discharge season. At such time that lethal toxicity is observed in reclaimed water, the sampling frequency shall be increased to biweekly (every two weeks) until three tests have been conducted (the original quarterly test plus two biweekly tests). Tests shall be conducted as described in EPA (1991a), or as otherwise ordered by the Regional Board. If lethal toxicity is observed consistently in the three samples, then a toxicity identification evaluation (TIE - as described in EPA 1991b, EPA 1993a, b) shall be conducted. The purpose of the TIE is to identify the reclaimed water constituent(s) that are causing the toxicity. The reason that a TIE is not appropriate after the first observation of lethal toxicity is that TIE success is dependent on the presence of lethal toxicity. After the TIE provides conclusive evidence of the toxic constituent(s), then sources of the constituent(s) shall be identified and controlled as necessary (TRE) according to the method of EPA (1989) so that lethal toxicity is not observed in reclaimed water.

Effectiveness of Proposed Mitigation

The effectiveness of mitigation proposed for the 1, 5, and 10 percent design discharge, 20 percent design Laguna discharge, 20 percent design River discharge components, and discharge associated with the Geysers alternative are assessed in this section. In addition, measures for the City's consideration to avoid impacts from discharge associated with the No Project alternative are also assessed.

Source Control Program

Cyanide

Cyanide sources are expected to be identifiable and controllable. Therefore, a cyanide control program is expected to fully mitigate the significant impact that may be identified if monitoring of stored effluent shows that stored effluent can cause exceedences of the point of significance in receiving waters.

Nitrogen

Nonpoint source control measures applicable to local conditions have been developed and tested (EPA 1993c, Gold Ridge RCD 1995). Implementation of control measures as needed to achieve the necessary Laguna nitrogen load reduction is considered feasible. Therefore, the adverse impacts of the 10 percent design discharge, 20 percent design Laguna discharge and the No Project discharge components would be considered insignificant if the mitigation is implemented.

Ammonia is a component of total nitrogen which would be reduced by implementing nitrogen control measures. In particular, focusing on nitrogen sources for which ammonia represents a particularly high proportion of the total ammonia (such as dairy agriculture) would increase the ammonia control benefit. The effectiveness of this mitigation is addressed below in the Discharge Management Strategy section.

Toxicity Control Program

The TIE/TRE process may be protracted and expensive, but the technology exists (as described in EPA 1989, EPA 1991b, EPA 1993a, b) to successfully identify and control toxicity-causing constituents in effluents exhibiting consistent toxicity. Therefore, this mitigation measure is considered to be effective.

Discharge Management Strategy

The mitigation operation strategy for biostimulatory substances would reduce, but not eliminate significant adverse impacts of discharge components on benthic algae, planktonic algae, and turbidity. The mitigation operations strategy would not eliminate the single occurrence of a dissolved oxygen significant impact.

The potential water quality impacts of the mitigation operating strategy for biostimulatory substances are compared in Figures 4-36 through 4-39 to the potential impact of project operations. Figures 4-36 through 4-39 compare the water quality impact of project and mitigation operations only for constituents and discharge components for which significant adverse impacts of project operations and/or project operations with mitigation were identified. Therefore, not all constituents are graphed for all discharge components. Tables 4-26 and 4-27 summarize the number of significant adverse and beneficial impacts, respectively, that were identified using the analysis approach described above and the number of significant adverse and beneficial impacts resulting from project and mitigation operations. The number of analyses is equal to the number stream segments in which impacts were summarized (3 for all discharge components except the 20 percent River discharge, in which case 4 reaches were considered) times the number of hydrologic conditions (3; dry, normal and wet years) times the number months in each year (12 months/year). Tables 4-26 and 4-27 show the number of adverse or beneficial impacts for benthic algae, planktonic algae, turbidity, and dissolved oxygen potentially caused by each discharge component expressed as a percentage of the number of analyses. For example, the 1 percent discharge component caused exceedance of the benthic algae point of significance in 4 of 108 cases (4 percent). Table 4-26 does not include conductivity; exceedance would be caused in only one of six cases (in the Russian River above Laguna in a dry year). Tables 4-26 and 4-27 do not include conductivity, cyanide, toxicity or waste reduction strategy (total nitrogen and ammonia loads to the Laguna) because only one opportunity for exceedance (and beneficial impacts in the case of total nitrogen and ammonia loads) is possible, except for ammonia in the Russian River. No significant impacts of ammonia occurred in the Russian River. Table 4-28 describes the locations of significant adverse and beneficial impacts.

Table 4-26 suggests that mitigation operations for biostimulatory substances do not reduce the number of significant impacts for the 1, 5 and 10 percent design discharge components, and that mitigation operation substantially reduces the incidence of significant benthic algae impacts for the other discharge components. Furthermore, the number or incidence of significant impacts for the 1, 5 and 10 percent design discharge components is considered to be low (four percent or less). Therefore, mitigation operations for biostimulatory substances are recommended only for the 20 percent Laguna, 20 percent River, Geysers and No Project design discharge components. Table 4-27 shows that mitigation operations generally increase the number of beneficial impacts of these same discharge components.

Table 4-26 shows the single significant adverse impact on turbidity, which would occur in the River above the Laguna as a result of the 20 percent design discharge to the River. Mitigation operations for biostimulatory substances would avoid this impact.

Table 4-26.

Number of Significant Adverse Impacts of Project and Mitigation Operations (percent of the total number of analyses)

Discharge Component	No. Analyses[a]	Benthic Algae		Planktonic Algae		Turbidity		Dissolved Oxygen	
		Project	Mitig	Project	Mitig	Project	Mitig	Project	Mitig
1%	108	4%	6%[b]	1%	1%	0%	0%	0%	0%
5%	108	1%	1%	1%	1%	0%	0%	0%	0%
10%	108	1%	1%	1%	1%	0%	0%	0%	0%
20%	108	46%	11%	1%	0%	0%	0%	1%	2%[c]
20% River	144	24%	11%	2%	1%	1%	0%	0%	0%
Geysers	108	9%	4%	0%	0%	0%	0%	0%	0%
No Project[d]	108	45%	0%	0%	0%	0%	0%	0%	11%[b]

[a] This column shows the maximum number of significant impacts that could be identified using the evaluation approach described in this report (108 = 3 stream segments *x* 3 types of years *x* 12 months/year, 144 = 4 stream segments x 3 types of years x 12 months/year).

[b] Increases in benthic algae with mitigation probably a result of increased reclaimed water concentrations in one month (March).

c Decreases in dissolved oxygen concentration with mitigation as a result of decreases in oxygen-producing benthic algae.

[d] For No Project, shown are number of significant adverse impacts of project and measures for the City's consideration.

Table 4-27.

Number of Significant Beneficial Impacts of Project and Mitigation Operations (percent of the total number of analyses))

Discharge Component	No. Analyses[a]	Benthic Algae		Planktonic Algae		Turbidity	
		Project	Mitig	Project	Mitig	Project	Mitig
1%	108	14%	14%	0%	0%	0%	0%
5%	108	13%	13%	0%	0%	0%	0%
10%	108	12%	17%	0%	0%	0%	0%
20%	108	0%	16%	4%	2%	4%	0%
20% River	144	9%	17%	12%	15%	8%	8%
Geysers	108	13%	12%	0%	0%	0%	0%
No Project[b]	108	0%	22%	4%	0%	4%	0%

[a] This column shows the maximum number of significant impacts that could be identified using the evaluation approach described in this report (108 = 3 stream segments *x* 3 types of years *x* 12 months/year), 144 = 4 stream segments x 3 types of years x 12 months/year).

[b] For No Project, shown are number of significant beneficial impacts of project and measures for the City's consideration.

Table 4-28

Significant Adverse and Beneficial Impacts of Each Design Discharge Component[a] After Mitigation[b]

Constituent	Santa Rosa Creek	Laguna	Russian River Below Laguna	Russian River Above Laguna
Benthic Algae				
Adverse	1%, 20%, 20% River, G	1%, 20% 20% River, G	20%, 20% River	20% River
Beneficial	1%, 20%, 20% River, G, NP	1%, 20%, 20% River, G, NP	1%,20%, 20% River, G, NP	
Planktonic Algae				
Adverse		1%, 20% River	20%	20% River
Beneficial	20%	20%, NP	20% River	
Dissolved Oxygen	20%, NP	20%, NP		
Turbidity				
Adverse				
Beneficial				
Conductivity				20% River
Cyanide				
Toxicity				
Waste Red. Strat.			Criterion applies only to Laguna system	
Adverse				
Total nitrogen				
Ammonia				
Beneficial				
Total nitrogen	1%, 20% River, G			
Ammonia	1%, 20% River, G			

[a] 1% = 1% design discharge component
20% = 20% design discharge component to Laguna
20% River = 20% design discharge component to River
NP = No Project discharge component
G = Geysers discharge component
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.

[b] Mitigation of benthic algae, planktonic algae, and dissolved oxygen involves revising discharge operations to minimize discharge during fall and spring. Mitigation for cyanide involves a source identification and control program. Mitigation for waste reduction strategy (total nitrogen load and ammonia load) is to reduce nitrogen load to the Laguna at appropriate sources. No mitigation for conductivity impacts is identified.

Removal of nitrogen from reclaimed water down to a total inorganic nitrogen concentration of 2 mg/L with mitigation operations for biostimulatory substances was evaluated as an alternative to mitigation operations for biostimulatory substances alone to mitigate for impacts of project operations. A comparison of mitigation operations to mitigation operations with nitrogen removal is provided in Table 4-29. Table 4-29 does not include waste reduction strategy (total nitrogen and ammonia loads to the Laguna) because only one opportunity for exceedance (and beneficial impacts in the case of total nitrogen and ammonia loads) is possible, except for ammonia in the Russian River. No significant impacts of ammonia occurred in the Russian River. Nitrogen removal for purposes of reducing significant impacts is not recommended for the following reasons:

- The incidence of significant impacts is low with implementation of mitigation operations for biostimulatory substances alone. For example, the incidence of significant impacts on benthic algae for the 20 percent design discharge to the Laguna is 12/108 or 11 percent. Mitigation operations without nitrogen removal can be implemented at no cost.
- Nitrogen removal from reclaimed water does not avoid significant impacts. The 11-percent incidence of significant benthic algae impacts is reduced only slightly to 5 percent. The estimated capital cost of nitrogen removal is up to $21.5 million (see *Treatment Wetlands Evaluation*, September 1995). The water quality benefit of nitrogen removal is considered insufficient to justify the cost.

Table 4-29.

Number of Significant Adverse Impacts of Mitigation Operations and Mitigation Operations With Nitrogen Removal (percent of the maximum)

Discharge Component	Max. No.[a]	Benthic Algae		Planktonic Algae		Dissolved Oxygen	
		Mitig.	Mitig-N	Mitig.	Mitig-N	Mitig.	Mitig-N
1%	108	6%	4%	1%	0	0	0
5%	108	1%	1%	1%	0	0	0
10%	108	1%	1%	1%	0	0	0
20%	108	11%	6%	0	0	2	2%
20% River	144	11%	8%	1%	1	0	0
Geysers	108	4%	3%	0	0	0	0
No Project[b]	108	0	0	0	0	12	11%

a This column shows the maximum number of significant impacts that could be identified usingthe evaluation approach described in this report (108 = 3 stream segments x 3 types of years x 12 months/year), 144 = 4 stream segments x 3 types of years x 12 months/year).

b For No Project shown are number of significant adverse impacts of measures for the City's consideration.

Table 4-30 illustrates the net impact of discharge alternatives on benthic algae, planktonic algae, turbidity and waste reduction strategy. Net impact is calculated by subtracting the number of significant adverse impacts (shown as a percentage of the total possible in Table 4-26) from the number of significant beneficial impacts (shown as a percentage of the total in Table 4-27). Thus, a positive value in Table 4-30 indicates more significant beneficial than adverse impacts on benthic algae, planktonic algae, turbidity and waste reduction strategy. 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 4-30 shows that mitigation would provide a net beneficial impact for the discharge components for which mitigation is recommended (20 percent design discharge, 20 percent River design discharge, No Project and Geysers). Mitigation does not provide a significant improvement for the 1 percent design, 5 percent design and 10 percent design discharges and is, therefore, not recommended. Table 4-30 shows an overall net benefit for all design discharge components except 20 percent design discharge to the Laguna and design discharge associated with the No Project alternative. After mitigation all discharge components show an overall net benefit.

Table 4-30.

Net Impact[a] of Project and Mitigation Operations

Discharge Component	No. Analyses[b]	Benthic Algae		Planktonic Algae		Turbidity		Waste Reduction Strategy	
		Project	Mitig	Project	Mitig	Project	Mitig	Project	Mitig
1%	108	+11	+9	-1	0	0	0	+1	+1
5%	108	+13	+1	-1	0	0	0	+1	+1
10%	108	+12	+17	-1	0	0	0	+1	+1
20%	108	-50	+5	+3	+2	+4	0	-1	0
20% River	144	-21	+8	+14	+21	+10	+12	+1	+1
Geysers	108	+4	+9	0	0	0	0	+1	+1
No Project[c]	108	-49	+24	+4	0	+4	0	-1	0

[a] 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.

[b] 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 stream segments *x* 3 types of years *x* 12 months/year). The maximum number of significant waste reduction strategy impacts is 1.

[c] For No Project, shown are the net impacts of project and measures for the City’s consideration.

4.2 CONTINGENCY DISCHARGE

Contingency discharge is defined as the discharge of reclaimed water in excess of the design discharge rate (see the *Water Balance Contingency Plan* technical memorandum, 27 October 1995). Contingency discharge is evaluated below for the 10 and 20 percent design discharge components. The 1 and 5 percent design discharge components do not include contingency discharge when system operations are simulated using the daily water balance model for the 70-year period of hydrologic record. The No Project and Geysers discharge components do not, by definition, have design discharge rate limitation and, hence, no contingency discharge is associated with these discharge components.

4.2.1 Impact Evaluation Approach

The same approach was used to evaluate the impact of contingency discharge as was used to evaluate design discharges with the following exceptions:

- Contingency discharge impacts were evaluated for the driest year on record (1977). Design project discharges were evaluated in a dry (1976), normal (1961) and wet (1982) year simulation. However, hydrologic conditions were such in the selected dry, normal and wet years that no contingency discharges were produced using the daily simulation of operations. Therefore, a year was selected that produced contingency discharge. The daily simulation indicated that the total contingency volume in 1977 was 69 MG and 178 MG for the 10 and 20 percent components, respectively. The total discharge volume in 1977 was estimated to be 1,062 and 3,008 MG for the 10 and 20 percent components, respectively.
- The impact of the contingency volume that was discharged was evaluated for significance relative to existing conditions. Potential contingency discharge impacts are also described relative to impacts of design discharge without contingency discharge. In addition, the impact of mitigation operations with contingency discharge was evaluated.
- The potential impacts of contingency discharge on benthic algae, planktonic algae, dissolved oxygen, ammonia, and temperature in the Laguna de Santa Rosa and the Russian River were evaluated using a hydraulic and water quality model as described in Section 4.1.4 Impact Evaluation Approach - Constituents Affected by Biological Activity.
- The dilution model approach used in the evaluation of design discharge impacts in Section 4.1 Design Discharges section above was used to evaluate contingency discharge impacts for cyanide, conductivity and toxicity. For other constituents (except phthalates), all of which had a concentration in effluent that is less than the point of significance, the point of significance will not be exceeded as a result of an incremental concentration of reclaimed water that may be caused by contingency discharge. For phthalates, although the concentration in reclaimed water exceeds the point of significance, impacts are considered less than significant for reasons outlined in the Dilution Model Results section above (Section 4.1.5).

4.2.2 Impact Evaluation Results

The evaluation of contingency discharge impacts is focused on eight constituents: benthic algae, planktonic algae, dissolved oxygen, ammonia, temperature, conductivity, cyanide and toxicity. Benthic algae, planktonic algae, dissolved oxygen, ammonia and toxicity were selected because they reflect biological properties of the receiving water, and showed significant impacts in the previous simulation of design discharge impacts. Conductivity and cyanide were selected because their concentrations in reclaimed water exceed their respective points of significance. An analysis of the impact of contingency discharge was not conducted for waste load reduction to the Laguna since the waste load reduction strategy is based on a long-term annual average. Contingency discharge would not enter into the long-term annual average since contingency discharge would occur infrequently.

Algae, Dissolved Oxygen, Temperature and Ammonia

The distribution of daily average reclaimed water concentration in Santa Rosa Creek, the Laguna de Santa Rosa, and the Russian River during a very dry year (1977) is shown in Figures 4-40 through 4-43. These figures show daily average reclaimed water concentrations for discharge components which include contingency discharge. These distributions are very similar to what the distribution of reclaimed water concentration for a 1977 design discharge would be because contingency discharges take place only on a few dates in 1977. Concentrations under mitigation operations are also shown.

The results of the water quality impact evaluation for benthic and planktonic algae, dissolved oxygen, ammonia, and temperature are shown in Figures 4-44 through 4-58 for the 10 percent, 20 percent, and 20 percent River components. Water quality impacts of design discharge alone and design plus contingency discharge are shown. The effects of design plus contingency discharge under mitigation operations is also shown. All months in the simulated year (1977) are shown, but contingency discharge would only occur in January and February under the 10 percent component, and only in January, February, and April under the 20 percent and 20 percent River discharge components. Significant adverse impacts of contingency discharge are listed in Table 4-31. No beneficial impacts of contingency discharge were identified. These impacts are only listed for months during contingency discharge. Except for ammonia (discussed below), an impact is indicated if the simulation for design and contingency discharges resulted in a significant increase. Therefore a significant impact as shown is not necessarily due to the incremental effect of contingency discharge above design discharges. In fact, Figures 4-44 through 4-58 show that the effects of design discharge and design plus contingency discharge are about the same.

The 20 percent River contingency discharge component would result in a significant increase in benthic algae in Santa Rosa Creek; increases in benthic algae, and planktonic algae in the Russian River above the Laguna; and an increase in planktonic algae in the Laguna. Both the 10 percent and 20 percent Laguna discharges would also increase the planktonic algae biomass in the Laguna. All of these impacts are adverse. No beneficial impacts of contingency discharge on these constituents are predicted by the model. Contingency discharges would not significantly affect dissolved oxygen concentrations or temperature in any of the stream zones.

Simulated ammonia concentrations in the Russian River above the Laguna under the 20 percent River component (Figure 4-55) show large (approximately 200 percent) increases, but this is because baseline concentrations were near zero during this period. Actual concentrations simulated would increase from around 0.1 to 0.4 mg/L.

Ammonia was evaluated for significant impacts as described in Section 4.1.4 Impact Evaluation Approach. Most predicted maximum total ammonia concentrations in the Russian River with contingency discharge were less than 0.76 mg-N/L, and thus represent no significant impact of contingency discharge on ammonia. The few predicted total ammonia concentrations in the Russian River with contingency discharge greater than 0.76 mg-N/L were all within five percent of the existing conditions. Thus the impact of contingency discharge on ammonia in the Russian River is considered to be less than significant.

Contingency discharge has no effect on average annual ammonia load. Therefore, contingency discharge has no impact on ammonia in the Laguna and Santa Rosa Creek.

Table 4-32 shows the number of significant adverse impacts of contingency discharge under project and biostimulatory substances mitigation operations. Approximately one-third of the possible impacts on planktonic algae would be adverse under all three contingency discharge components. Mitigation operations would reduce the number of adverse impacts only in a single case.

Table 4-31

Significant Adverse and Beneficial Impacts of Contingency Discharge[a]

Constituent	Santa Rosa Creek	Laguna de Santa Rosa	Russian River below Laguna	Russian River above Laguna
Benthic Algae				
Adverse	20% River			20% River
Beneficial				
Planktonic Algae				
Adverse		10%, 20%, 20%River		20% River
Beneficial				
Dissolved Oxygen				
Adverse				
Ammonia				
Cyanide	10%, 20%	10%, 20%		
Conductivity				20%River
Toxicity	20%	20%		

[a] 10% = 10 percent design discharge scenario component 20% = 20 percent design discharge scenario component to Laguna 20% River = 20 percent design discharge scenario component to River. Since impacts were evaluated for all months and three hydrologic years, both beneficial and adverse impacts can result at different times from the same component.

Table 4-32

Number of Significant Adverse Impacts of Contingency Discharge Under Project and Mitigation Operations

Discharge Component	Max. No.[a]	Benthic Algae		Planktonic Algae		Dissolved Oxygen		Ammonia		Temp-erature	
		Proj	Mit	Proj	Mit	Proj	Mit	Proj	Mit	Proj	Mit
10%	6[b]	0	0	2	2	0	0	0	0	0	0
20%	9[c]	3	3	2	2	0	0	0	1	0	0
20%R	12[d]	0	0	4	3	0	0	0	0	0	0

a This column show the maximum number of significant impacts that could be identified using this evaluation approach.
b 6 = 3 stream segments x 1 type of year x 2 months/year that include contingency discharges.
c 9 = 3 stream segments x 1 type of year x 3 months/year that include contingency discharges.
d 12 = 4 stream segments x 1 type of year x 3 months/year that include contingency discharges.

Significant adverse impacts after biostimulatory substances mitigation operations are listed in Table 4-33. The mitigation discharge operating scenario was developed to reduce design discharge impacts by minimizing discharge in fall and spring and maximizing discharge in winter. Simulations show that this strategy is an effective means of mitigating design discharge impacts, but the strategy causes a slight increase in the frequency of contingency discharge. Nonetheless, mitigation operations would have little effect on the impact of contingency discharge scenarios, in part because mitigation operations that involve decreased discharges would not occur during months when contingency discharges take place. The significant increase in planktonic algae in the Russian River above the Laguna would be mitigated by mitigation operations (see Figure 4-49), but a significant increase in benthic algae in Santa Rosa Creek under the 10 percent component would also result from mitigation operations (Figure 4-44). Ammonia concentrations in the Russian River below the confluence with a 20 percent contingency discharge to the Laguna and biostimulatory substances mitigation operations are predicted to exceed the point of significance for ammonia in one month. This increase in ammonia is greater than five percent above existing conditions. Therefore, the impact of a 20 percent contingency discharge to the Laguna and biostimulatory substances mitigation operations is considered to be significant.

Table 4-33

Significant Adverse and Beneficial Impacts of Contingency Discharge After Biostimulatory Substances Mitigation[a]

Constituent	Santa Rosa Creek	Laguna de Santa Rosa	Russian River below Laguna	Russian River above Laguna
Benthic Algae				
Adverse	**10%**, 20% River			20% River
Beneficial				
Planktonic Algae				
Adverse		10%, 20%, 20%R	**20% River**	~~20% River~~
Beneficial				
Dissolved Oxygen				
Adverse				
Ammonia			**20%**	
Cyanide				
Conductivity				20% River
Toxicity				

[a] Design components shown in ~~strikethrough~~ indicate project impacts removed by mitigation operations; **Boldface** indicate that project impacts are caused by mitigation operations; others remain under mitigation operations.

Cyanide

The concentrations of cyanide in receiving waters resulting from direct contingency discharge were calculated using a dilution model as described in the Impact Evaluation Approach section for conservative constituents. The 95th percentile daily average reclaimed water concentration in Santa Rosa Creek, the Laguna at River Road, and the Russian River at Oddfellows for contingency discharge associated with a 10 percent design discharge and a 20 percent design discharge to the Laguna are shown in Table 4-34.

Table 4-34.

Estimated 95th Percentile Daily Average Reclaimed Water Concentrations with Contingency Discharge

	10% Contingency Discharge		20% Contingency Discharge to Laguna		20% Contingency Discharge to the River	
	Project Operation	Mitigation Operation	Project Operation	Mitigation Operation	Project Operation	Mitigation Operation
Santa Rosa Creek	64.8%	65.4%	80.1%	83.5%	0%	43.0%
Laguna at River Road	39.9%	41.6%	59.5%	65.1%	0%	22.6%
Russian River at Oddfellows Road	10.9%	10.7%	20.8%	28.3%	10.6%	15.4%
Russian River above the Laguna	0%	0%	0%	0%	13.6%	18.2%

The predicted concentrations of cyanide resulting from a 10 percent contingency discharge and a 20 percent contingency discharge are shown in Table 4-35. No receiving water cyanide data were available for Santa Rosa Creek and the Laguna so an estimate of 0.0000 mg/L cyanide was used. This may result in an underestimation of cyanide concentrations in Santa Rosa Creek and the Laguna. The estimated cyanide concentration in Santa Rosa Creek with a 10 percent contingency discharge exceeded the point of significance for cyanide (0.0052 mg/L). The estimated cyanide concentrations in Santa Rosa Creek and the Laguna with a 20 percent contingency discharge also exceeded the point of significance for cyanide. Therefore, the impacts of a direct 10 percent contingency discharge on cyanide in Santa Rosa Creek and a direct 20 percent contingency discharge on cyanide in Santa Rosa Creek and the Laguna are considered to be significant. If the reclaimed water is stored prior to discharge, these impacts are likely to be less than significant. The impacts of a 20 percent contingency discharge to the River on cyanide in the Laguna and Santa Rosa Creek are less than significant. The estimated cyanide concentrations in the Russian River below the confluence with the Laguna (at Oddfellows Road) and above the confluence with the Laguna did not exceed the point of significance for cyanide. Therefore, the impact of a 10 percent contingency discharge, a 20 percent contingency discharge to the Laguna, and a 20 percent contingency discharge to the River on cyanide in the Russian River is considered to be less than significant.

With biostimulatory substances mitigation operations, significant impacts on cyanide in Santa Rosa Creek are predicted with a 10 percent contingency discharge and a 20 percent contingency discharge to the Laguna. The impact on cyanide in the Laguna of biostimulatory substances mitigation operations and a 20 percent contingency discharge exceeds the point of significance and is, therefore, considered significant. The impact on cyanide in the Russian River of biostimulatory substances mitigation operations and a 10 percent contingency discharge, a 20 percent contingency discharge to the Laguna, and a

20 percent contingency discharge to the River are less than the point of significance and are, therefore, considered to be less than significant.

The concentration of cyanide after cyanide mitigation (storage and/or source detection and control) cannot be calculated but is predicted to be less than significant.

Table 4-35.

Estimated Cyanide Concentration with Contingency Discharge (mg/L)

	10% Contingency Discharge		20% Contingency Discharge to the Laguna		20% Contingency Discharge to the River	
	Project Operation	Biostim. Substances Mitigation Operation	Project Operation	Biostim. Substances Mitigation Operation	Project Operation	Biostim. Substances
Santa Rosa Creek	0.0065	0.0065	0.0080	0.0084	0.0000	0.0043
Laguna at River Road	0.0040	0.0042	0.0056	0.0065	0.0000	0.0023
Russian River at Oddfellows Road	0.0033	0.0033	0.0041	0.0046	0.0033	0.0037
Russian River above the Laguna	0.0000	0.0000	0.0000	0.0000	0.0035	0.0039

Conductivity

Predicted conductivity in the Russian River below the confluence with the Laguna with a 10 percent contingency discharge, a 20 percent contingency discharge to the Laguna, and a 20 percent contingency discharge to the River was evaluated as described in the Impact Evaluation Approach section. These values are shown in Table 4-36. For all contingency discharges, the average conductivities in the Russian River below the confluence are predicted to be less than the 50^{th} percentile upper limit point of significance for conductivity (285 µmhos/cm) in six or more months. Since the criterion states that 50 percent (six) or more of the monthly means must be less than or equal to the point of significance, the impacts of a 10 percent contingency discharge, a 20 percent contingency discharge to the Laguna, and a 20 percent contingency discharge to the River on conductivity in the Russian River below the confluence are considered to be less than significant. The results in the River below the confluence are the same for contingency discharge as for contingency discharge with mitigation operations.

The average conductivities in the Russian River above the confluence with the Laguna with a 20 percent contingency discharge to the River are predicted to be less than the 50^{th} percentile upper limit point of significance for conductivity (250 µmhos/cm) in only three months. Therefore. the impact of a 20 percent contingency discharge to the River on conductivity in the Russian River above the confluence with the Laguna are considered to be significant. The results in the River above the confluence are the same for contingency discharge as for contingency discharge with biostimulatory substances mitigation operations.

Table 4-36

Conductivity in the Russian River (in µmhos/cm with Contingency Discharge and Contingency Discharge with Mitigation Operations

	Russian River Below the Confluence with the Laguna						Russian River Above the Confluence with the Laguna		Existing Conditions
	10% Contingency Discharge		20% Contingency Discharge to Laguna		20%Contingency Discharge to River		20%Contingency Discharge to River		
	Project Oper.	Mitig. Oper.	Project Oper.	Mitig. Oper.	Project Oper.	Mitig. Oper.	Project Oper.	Mitig. Oper.	
Oct	232	232	278	232	251	232	256	232	232
Novr	227	227	321	240	275	232	287	234	227
Dec	300	272	357	381	311	326	324	342	267
Jan	318	313	351	369	318	332	330	338	280
Feb	322	314	356	388	316	335	330	349	277
Mar	258	276	288	319	263	285	274	293	233
Apr	294	268	337	266	298	266	309	266	266
May	257	255	272	255	263	255	264	255	255
Jun	266	266	266	266	266	266	266	266	266
Jul	239	239	239	239	239	239	239	239	239
Aug	232	232	232	232	232	232	232	232	232
Sep	238	238	238	238	238	238	238	238	238

Toxicity

Lethal toxicity was found once in 11 tests, or in 9 percent of the tests (see *Reclaimed Water Quality Update* Technical Report, MSC 1996), and the lowest, or worst-case NOEC of reclaimed water is 25 percent. Table 4-37 shows the frequency of days that reclaimed water concentration would exceed 25 percent (the worst-case no-effects concentration) in Santa Rosa Creek in the very dry year with contingency discharge (as described in *Russian River Water Quality Model* Technical Report, RMA 1996). These frequencies of potentially toxic concentrations are then multiplied by the worst-case toxicity frequency (9 percent), to give the expected occurrence of toxic conditions in Santa Rosa Creek. The impact is considered significant if the frequency that toxic conditions would occur in the receiving water is greater for a contingency discharge component than for existing conditions. Thus, the impact of discharge on toxicity is considered to be significant in Santa Rosa Creek and the Laguna for the 20 percent design Laguna discharge only.

4.3 PIPELINES

Potential water quality impacts from transmission and distribution pipelines (used for transport of reclaimed water for irrigation and geysers recharge) are evaluated in this section. Potential impacts from pipelines include: 1) construction-related impacts, and 2) emergency event-related impacts. These potential impacts (as described below) will have a temporary effect (if any) on water quality due to the short duration of the impacts.

Two methods of pipeline construction will be used at stream crossings, jack and bore, and open trench. Jack and bore construction involves digging a pit on either side of the stream and using special equipment to excavate soil while pushing a conductor casing pipe under the stream bed to the other pit. The pipeline is then installed within the conductor casing. Open trench construction involves excavating a trench (to eight inches below the pipe bottom) down both banks of the stream and across the stream bed. The pipeline is then installed from bank to bank by laying the pipe in the trench and covering it with four feet of stockpiled soil from the excavation. Jack and bore construction will be used on all perennial streams. Open trench construction will be used for seasonal streams and only when streams are dry.

A seismically-induced pipeline rupture is the potential emergency event associated with the pipeline component that has been included in the Project Description. The defined emergency event addresses rupture of the urban irrigation mainlines at the Rodgers Creek Fault , and rupture of the Geysers alternative pipeline at the Maacama Fault. Pipelines would potentially release up to 1.7 million gallons (in two hours) of reclaimed water in the case of a break along the Maacama Fault, and a maximum of 100,000 gallons (in 30 minutes) for a rupture along the Rodgers Creek Fault. Due to the limited exposure to reclaimed water, the acute numeric criteria are applicable for evaluating impacts. A detailed description of emergency events appears in Section 3.8 of the EIR.

A description of the evaluation criteria developed for the pipeline analysis, methodology used to evaluate impacts, and the results of the impacts evaluation follows.

Table 4-37.

Calculated Probability of Toxic Conditions In Receiving Waters Resulting From Contingency Discharge
(significant impacts shown in bold)

Discharge Component	Santa Rosa Creek		Laguna		Lower Russian River	
	Days RW Conc. >25 percent[a]	Frequency of Lethally Toxic Conc.[b]	Days RW Conc. >25 percent[a]	Frequency of Lethally Toxic Conc.[b]	Days RW Conc. >25 percent[a]	Frequency of Lethally Toxic Conc.[b]
1% Laguna	No contingency discharge					
5% Laguna	No contingency discharge					
10% Laguna	62.0	5.6	31.6	2.9	0	0
20% Laguna	99.3	**9.0**	93.6	**8.5**	0	0
20% RR	1.0	0.1	4.6	0.4	0	0
No Project	No contingency discharge					
Geysers	No contingency discharge					
Exist. Cond.	84.9	7.7	76.5	7.0	16.3	1.5

[a] Values in this column represent the frequency (percentage) of days that the daily average reclaimed waterconcentration in each waterway would exceed 25 percent in the year that contingency discharge impactswere simulated (1977). This frequency was estimated using water quality model output. Model is describedin the *Russian River Water Quality Modeling* Technical Report (RMA 1996). Model output is graphically presented in the *Water Quality Impacts Analysis* Technical Report (MSC 1996). 25 percent reclaimed water concentrati was selected because it represents the lowest no effects concentration of the worst case lethal toxicity episode.

[b] Values in this column represent the percentage of days in the discharge season that toxic conditions mayoccur in Santa Rosa Creek. These values are calculated by multiplying the frequencies of reclaimed water concentrations over 25 percent (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.

4.3.1 Evaluation Criteria

Surface water quality evaluation criteria were developed to provide a basis for assessing impacts to water quality. These criteria are described in the *Development of Evaluation Criteria for Potential Water Quality Impacts* Technical Report (MSC 1996), and include criteria for numeric objectives, narrative objectives, special sites, and sediment quality.

Special sites (e.g., Gulf of the Farallones National Marine Sanctuary, and the Area of Special Biological Significance at Tomales Point) are not affected by the pipeline component. Pipelines are typically too distant from these sites to have an impact on water quality there. The nearest pipeline crossing is three miles from the mean high water (MHW) boundary of Estero de San Antonio. And while the MHW boundary of Estero Americano is crossed at two locations, jack and bore construction will be used there to avoid impacts. Pipeline impacts to the Sanctuary are therefore considered insignificant. Project pipelines do not cross Walker Creek or a nearby tributary, therefore pipeline impacts to Tomales Point are likewise insignificant.

An analysis of potential water quality impacts relative to sediment criteria appears in the *Sediment Quality Characterization for the Russian River, Laguna de Santa Rosa, Santa Rosa Creek, and Reclaimed Water Storage Ponds* Technical Report (MSC 1996). Sediment quality criteria (SQC) are proposed by the US EPA for acenaphthene, dieldrin, endrin, fluoranthene, and phenanthrene. These compounds are not found in detectable concentrations in reclaimed water nor are they found in detectable concentrations in storage pond sediments. The estimated concentrations of these compounds resulting from maximum projected discharge are all below their respective SQCs. Therefore, analysis of potential pipeline impacts relative to sediment criteria will not be conducted.

The pipelines component has the potential to affect numeric and narrative objectives as follows.

Numeric Objectives

Numeric objectives are evaluated for pipelines since ruptures have the potential to introduce reclaimed water into waterways. 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. This assumption was made as a “worst case scenario” although some dilution by ambient water will occur. Due to the short duration of exposure from a pipeline rupture, the acute EPA guidelines (one hour) were used to evaluate for potential pipeline impacts. Cyanide, phthalate esters, dissolved oxygen, conductivity, toxicity and ammonia are not in compliance with numeric water quality objectives in reclaimed water. Of these constituents, cyanide and phthalate esters are evaluated for pipelines while the remainder have been screened from further analysis as follows.

Dissolved Oxygen

The dissolved oxygen level in reclaimed water at times is below the numeric objective of 7.0 mg/L. A pipeline rupture could introduce reclaimed water into a waterway, however the duration and magnitude of a spill would be limited and therefore dissolved oxygen levels in the receiving water would not likely be depressed. In addition, the likelihood of a rupture occurring, and during a time when dissolved oxygen was below the objective, is remote. Potential impacts from pipelines on dissolved oxygen are therefore considered insignificant.

Conductivity

The water quality criterion for conductivity is specific to the Russian River and is based on average monthly values. Reclaimed water would need to be discharged to the River for an extended period and at a high flow rate for the conductivity point of significance to be exceeded in the River. The maximum emergency event discharge volume (1.7 MG) and duration (2 hours) is insufficient to effect the monthly average conductivity in the River.

Ammonia

A pipeline rupture could introduce reclaimed water with elevated ammonia levels into waterways. The average level of ammonia in denitrified reclaimed water is 2 mg/L. While the EPA chronic objective for ammonia is often exceeded in reclaimed water, an acute objective of 5 mg/L (assuming typical temperatures an pH values) is not exceeded. The acute objective is appropriate for a rupture because of the short duration. Potential impacts from pipelines on ammonia are therefore considered less than significant due to the short duration of a spill.

Toxicity

Chronic toxicity by definition requires a period of exposure to reclaimed water (days) that is longer than that would occur as result of pipeline ruptures (hours in the case of an emergency event). Therefore, pipelines are expected to have no impact on lethal chronic toxicity.

Numeric objectives for cyanide and phthalate esters may be exceeded in an emergency event. A pipeline rupture may introduce reclaimed water into streams at pipeline crossings. In the impacts analysis that follows, the acute objectives were used instead of chronic objectives due to the short duration of a spill.

Narrative Objectives

Narrative objectives for biostimulatory substances, turbidity, and the waste reduction strategy, may be exceeded with the introduction of reclaimed water into waterways. Narrative objectives for suspended sediment may be exceeded since pipeline construction has the potential to introduce sediment into waterways at stream crossings. Suspended sediment is evaluated for pipelines, while biostimulatory substances, turbidity, and the waste reduction strategy have been screened from further analysis as follows.

Biostimulatory Substances

A complex series of interactions in waterways is required for the concentration of biostimulatory substances, as measured by chlorophyll *a*, to exceed the narrative objective. These interactions include the proper temperature, light, pH, and timing to create biostimulatory conditions. In addition, an ongoing supply of reclaimed water is needed to provide the nutrients necessary for excessive chlorophyll *a* growth. This combination of conditions would not occur under the emergency events scenario.

Turbidity

Turbidity, relative to this water quality analysis, is a measure of phytoplankton concentration, and exceedances are subject to the same combination of conditions as biostimulatory substances. This combination of conditions would not occur under the emergency events scenario.

Waste Reduction Strategy

The Waste Reduction Strategy is designed to limit the amount of nitrogen from periodic and/or consistent loads to the Laguna. The Laguna load from an Urban Irrigation pipeline rupture of 100,000 gallons would be 17 pounds, and is insignificant relative to the existing Laguna load of 427,000 pounds per year.

The suspended sediment narrative objective, because of its low threshold, may be exceeded with pipeline construction or in an emergency event. Construction and ruptures may disturb sediment in or adjacent to waterways potentially suspending sediment. An analysis of potential impacts to suspended sediment appears below.

4.3.2 Impacts Evaluation Methodology

Potential impacts of pipeline construction and ruptures on water quality were evaluated for two types of pipeline alignments: 1) where pipelines cross open terrain, and 2) where pipelines cross waterways.

All potential impacts to water quality from pipelines are related to construction and emergency events. There will be no impacts on water quality from the operation and minimal maintenance required for pipelines. Potential effects could arise from excavating a pipe at a crossing for maintenance or replacement, but the likelihood of this event is remote.

In general, pipes will be buried with three feet of cover and be constructed of welded steel pipe, with welded joints, cement mortar-lined and coated, and include isolation valves at regular intervals (see Section 3.4 of the Project Description for construction details). Construction of overland pipelines will not impact stream beds or banks. The burial and integrity of the pipe, the limited volume of water, and short duration of a rupture would minimize any potential threat to nearby waterways. Further analysis of potential water quality impacts from pipelines that cross open terrain has not been conducted.

Each location where a pipeline would cross a distinct waterway was surveyed in the field for potential water quality impacts. The results of the stream crossing surveys are reported in the *Stream Crossings Assessment* Technical Report (MSC 1996). 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. Potential impacts of a pipeline rupture on water quality are related to numeric criteria, and were evaluated by comparing reclaimed water to the appropriate 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.

Best management practices (BMPs) will be employed to minimize construction-related impacts as described in the project description (Section 2.2.5 of the EIR/EIS). Potential impacts to perennial streams will be avoided using jack and bore construction. Section 2.2.5 of the EIR/EIS identifies the 36 streams designated as perennial. Potential impacts to open trench streams will be minimized with careful excavation and replacement of the stream bed substrate. Other construction-related BMPs to protect waterways include Sections 2.2.3, 2.2.8, 2.2.10, 2.2.11, 2.2.12, 2.3.10, 2.3.11, and 2.4.7 of the EIR/EIS. Toxins will be prevented from entering waterways during construction by managing equipment and materials, and good housekeeping. Environmentally sensitive areas (including all waterways) will be delineated with a mesh fence boundary.

Potential impacts from pipeline ruptures will be minimized as described in Section 2.2.3 of the EIR/EIS. Pipelines crossing the active faults (Maacama and Rodgers Creek) in the project area will include isolation valves on both sides of the fault crossing, and high pressure pipe.

4.3.3 Impacts Evaluation Results

The Evaluation Criteria section above identifies several potential exceedances of water quality objectives that may lead to pipeline-related project impacts. Constituents with potential exceedances that require impacts evaluation (those that remain from the screening described in the Evaluation Criteria section) include: suspended sediment, cyanide, and phthalate esters. Potential impacts from exceedances of these constituents are described in the tables that follow for the two kinds of potential impacts related to the pipelines component: construction-related impacts (Table 4-38) and ruptures (Table 4-39). A level of significance and a justification for that significance appear in the tables for each potential impact. Mitigation is described (to reduce the impact to less than significant), for those impacts considered significant

4.4 IRRIGATION

Irrigation is proposed in the Russian River watershed as part of the urban irrigation and agricultural irrigation project components. The impact of each is evaluated below.

4.4.1 Urban Irrigation

Urban irrigation would 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 (*Hydrologic and Water Quality Impacts From Irrigation Component* memorandum, Questa Engineers 1996). Best Management Practices are included in the project description (see Irrigation Management Plan, Section 2.2.1) that preclude management changes upon conversion to reclaimed water for irrigation supply, without .

Table 4-38.

Potential Impacts from Construction at Pipeline Crossings

Evaluation Criteria	Point of Significance	Type of Impact[a]	Level of Significance[b]	Justification	Mitigation
Suspended Sediment	Project causes an increase in suspended sediment in waterways	C	LS	Jack and bore construction methods will not disturb stream beds, but may create minor disturbance to stream banks and adjacent soil. Disturbed soil from banks has the potential to enter streams during the initial runoff event after excavation. Compaction from successive storms will ameliorate this potential impact. Sediment will be disturbed in stream beds as well as banks during open trench construction. Erosion control methods will be employed on stream banks as part of the project construction to reduce or eliminate water quality impacts. Erosion control methods will also be implemented in stream beds, however during the first runoff events of the season (after construction is completed) sediment may be washed downstream in flows of sufficient magnitude. Sediment transport during storms will also be elevated from other sources thereby minimizing the impacts from pipeline construction. In addition, sediment will become compacted and less mobile after the first couple of storms of the season, hence this impact is temporary.	No mitigation is required due to the temporary nature of the impact (with implementation of the appropriate construction techniques, as described in the project description).
Other Criteria	Various	None	LS	None	No mitigation is required.

Source: Technical Report - *Development of Evaluation Criteria for Potential Water Quality Impacts (MSC 1996)*

[a] Impact codes; C = construction, EE = emergency events
[b] Level of significance codes; S = significant, LS = less than significant

Table 4-39.

Potential Impacts from Ruptures at Pipeline Crossings

Evaluation Criteria	Point of Significance	Type of Impact[a]	Level of Significance[b]	Justification	Mitigation
Cyanide	22 µg/L (acute guideline)	EE	LS	A pipeline rupture along either of two geologic faults would introduce reclaimed water into project area streams. The EPA acute numeric guideline for cyanide would not be exceeded in waterways affected by a rupture. The average concentration of cyanide in reclaimed water is 14 µg/L. The acute guideline is applicable here (instead of the chronic 4-day guideline) because the exposure to reclaimed water would be limited from a rupture (less than 2 hours). Dilution in the receiving water would further reduce the cyanide concentration in the waterway.	No mitigation is required.
Phthalate Esters	940 µg/L (acute guideline)	EE	LS	The acute guideline for phthalate esters is not exceeded. The average concentration of phthalate esters in reclaimed water is 5.6 µg/L. See justification for cyanide above.	No mitigation is required.
Suspended Sediment	Project causes an increase in suspended sediment in waterways	EE	LS	A ruptured pipeline would potentially expose a stream bed and banks to reclaimed water under pressure. The brief exposure of soil to pressurized water (less than 2 hours), and the dilutive effects of the receiving water would reduce suspended sediment transport to a negligible level (within the EPA narrative-based guideline).	No mitigation is required.
Other Criteria	Various	None	LS	None	No mitigation is required.

Source: Technical Report - *Development of Evaluation Criteria for Potential Water Quality Impacts (MSC 1996)*

[a] Impact codes; C = construction, EE = emergency events
[b] Level of significance codes; S = significant, LS = less than significant.

additional CEQA review. Thus, adding urban irrigation land would be expected to have no impact on surface water quality.

4.4.2 Agricultural Irrigation

Some of the lands identified in the project description that would be irrigated as part of the South County and West County alternatives are located in the Russian River watershed (see the 21 December 1995 Draft Irrigation Area Maps). Lands east of Rohnert Park are included in the South County Alternative project description maps. Lands located in the Roblar area, and lands located along Canfield Road south of Knowles Corner are included in the West County Alternative project description maps.

South County Irrigation Lands in Russian River Watershed

The effect on surface water of irrigating lands located east of Rohnert Park was evaluated in the *Baseline Hydrology and Irrigation Drainage Evaluation for West and South County Reclamation Alternative* (Questa Engineers 1996). The soil conditions in this area were generally found to lack a shallow impermeable layer that would cause root zone saturation and lateral flow to surface waters under conditions of proper irrigation. Therefore, no measurable impact of these lands on surface water flow or quality is expected. In addition, the irrigation acreage would constitute only a small part of the watersheds of the many small creeks draining the Sonoma Mountain footslopes and the Cotati-Penngrove area.

West County Irrigation Lands in Russian River Watershed

West County irrigation lands located in the Russian River watershed (as described on the 21 December 1995 Draft Irrigation Area Maps) either do not meet irrigation eligibility criteria or irrigation would not affect surface waters. Irrigation eligibility criteria are defined in the *Irrigation Management Plan* (1995) and preclude irrigation of sites with slopes in excess of 15 percent and lands in irrigation suitability Class 6. The City has also established a minimum parcel size requirement of 20 acres. The irrigation suitability classification of these lands is described in Reilly and Debruyn (1990). Eligible lands are shown by Reilly and Debruyn (1990) to have no shallow impermeable layers that would cause root zone saturation and lateral flow to surface waters under conditions of proper irrigation. Therefore, with well-managed irrigation, these lands are expected to have no measurable impact on surface water flow or quality.

4.5 CUMULATIVE IMPACTS

Cumulative impacts are defined as two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts. This section evaluates the cumulative Surface Water Quality impacts of projects that may compound or increase Subregional System project impacts and those that may decrease Subregional System Project impacts. Significant and less-than-significant Subregional System Project Surface Water Quality impacts are evaluated for potential cumulative impacts associated with other projects. Other projects considered in this cumulative impacts evaluation are identified below.

4.5.1 Identification of Projects with the Potential for Cumulative Impacts

A list of projects in Sonoma County with the potential to interrelate with Subregional System project impacts Cumulative Projects List (Appendix D-31 to the EIR/EIS) was developed by HBA.

Proposed projects with a potential nexus with water quality impacts of Subregional System project components are shown in Table 4-40. Proposed projects were selected (and included in Table 4-40) that:

- Appear by their title to involve activities 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 SCWA intakes are already factored into the analysis of design discharge, because the River flows used to estimate Subregional System project effects are based on SCWA 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.

4.5.2 Projects Eliminated From Further Evaluation

Many of the projects in the HBA 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 Subregional System project area identify increased residential and commercial/industrial development in the Subregional System 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 would be expected due to future growth. Some of the smaller jurisdictions in the Subregional System project area may not have pretreatment programs, but the wastewater from any such jurisdictions is assumed to have 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.

Table 4-40

Summary of Proposed 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 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 would 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

Table 4-40

Summary of Proposed 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?
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 Works, Corps	RR	Silt removal from channel on south side of Delta Pond. Not directly connected to Laguna or SR Ck	No
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

Table 4-40

Summary of Proposed 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?
Water System Projects	New wells (9) at Wohler Aquifer Site	Near Wohler Pumping Plan 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 minor.	No

Table 4-40

Summary of Proposed 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?
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	NCRWQCB, 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,	RR	The potential effect of these projects on flow and water quality is evaluated for cumulative impacts	Yes

Table 4-40

Summary of Proposed 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?
			Guerneville, Occidental			

Wastewater Quantity

Cumulative projects could increase the quantity of wastewater discharged to surface waters in the Subregional System 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 Subregional System) 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 NCRWQCB 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 would 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 impact 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 Subregional System's proposed reclaimed water discharge components that have been identified would 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.

4.5.3 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 involved using estimates of reclaimed water dilution (95th percentile daily average 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 Subregional system project impact on constituent concentration. Design discharge was not predicted to cause numeric points of significance to be exceeded for any constituents in reclaimed water except conductivity and cyanide. No point of significance exists for conductivity in the Laguna or Santa Rosa Creek. No cumulative projects have been identified that would 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, but no change in its maximum discharge rate (because of Basin Plan restrictions) or quality (because of pretreatment regulations) are included in cumulative projects. Thus, the Subregional System 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 Subregional System design discharge alternatives caused an exceedance 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 projects) 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 percent design discharge to the Russian River above the Laguna is estimated to cause a significant impact on conductivity, this impact of cumulative projects would 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 (Table 4-41) 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 percent design discharge to the Laguna and 20 percent design discharge to the River (see Table 4-12) to estimate monthly conductivity under cumulative projects conditions. If the median of twelve monthly average conductivity values exceeded the point of significance, then the impact would be considered to be significant.

Toxicity

A 20 percent 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 significant toxicity impact is based on the quality of Subregional System reclaimed water, which would not be affected by cumulative project. 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.

Waste Load Reduction

The impact of the Subregional System project are evaluated with respect to the waste load reduction criterion according to the annual total and ammonia nitrogen load to the Laguna from the Subregional System. None of the cumulative projects would affect the annual total and ammonia nitrogen load to the Laguna from the Subregional System. Therefore, the impact of cumulative projects on waste load reduction was not evaluated.

Water Quality Model

The effect of Subregional System discharges is potentially affected by the changes in other wastewater discharges to the Laguna and Russian River. NCRWQCB estimated the change in the discharges of other permitted discharges in the Russian River basin, and these are summarized Table 4-41. 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 would further increase reclaimed water flows from existing conditions.

Table 4-41

Estimated Future Wastewater Discharges to the Russian River Basin

	Average Dry Weather Flow (mgd)				
Community	**Regional Board Flow Estimate[a]**	**Additional Flow Due to Growth[b]**	**Total Future Flow[c]**	**Existing Flow[d]**	**Incremental Flow[e]**
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
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

[a] General Plan projections reported in (1994)
[b] Based on proposed general plan changes since 1994
[c] Sum of two column to the left
[d] Based on reports submitted by discharges to RWQCB, also summarized in Table 4.6-9 in the EIR/S
[e] Flow used for cumulative impacts analysis

The NCRWQCB has established total nitrogen and ammonia load reduction goals for the Laguna watershed to improve Laguna water quality (NCRWQCB 1995). The total target load reductions for urban, non-irrigated, septic, and open space sources were evaluated for cumulative impacts.

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 (see in Section 4.1.4 Impact Evaluation Approach - Constituents Affected by Biological Activity). The same approach was used to evaluate the cumulative projects impacts with the following exceptions:

- Cumulative projects impacts were evaluated for a normal hydrological year (1961). Design Subregional System project discharges were evaluated in a dry (1976), normal (1961) and wet (1982) year simulation.
- Cumulative projects 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 projects 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 would 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). None of the cumulative projects are expected to affect temperature. Thus, since no significant impacts of design discharge components would occur (see Figure 4-17), no significant impacts of the cumulative projects would occur either.

4.5.4 Results of Cumulative Impacts Assessment

Significant adverse and beneficial impacts of the cumulative projects (projects listed in Table 4-40 plus the Subregional System reclaimed water discharge) are summarized in Tables 4-42 through 4-45. Table 4-42 presents the frequency of adverse impacts (as a percentage of the total possible adverse impacts) of the cumulative projects and cumulative projects plus mitigation for biostimulatory substances. Table 4-43 presents the frequency of beneficial impacts (as a percentage of the total possible beneficial impacts) of the cumulative projects and the cumulative projects plus mitigation for biostimulatory substances. Table 4-44 presents the net number of impacts (the number of significant beneficial impacts minus the number of significant adverse impacts). Tables 4-42 and 4-44 do not include conductivity, cyanide, toxicity because only one opportunity for exceedance is possible, except for ammonia in the Russian River. No significant cumulative projects impacts of ammonia occurred in the Russian River. No significant adverse impacts are estimated to occur as a result of the cumulative projects that are not also estimated to occur as a result of the Subregional System reclaimed water design discharge alone. However, the combination of the cumulative projects (which in the Laguna involves substantial nutrient load reduction) and mitigation of the Subregional System operations avoids all significant water quality impacts of the 20% Laguna design discharge. Impacts are further described below.

Benthic Algae

The impact of the cumulative projects on benthic algae biomass during a normal hydrological year is estimated to be similar to that of the Subregional System design discharge project, as shown in Figure 4-59. The number of significant adverse impacts estimated to result from the cumulative projects is the same as that from the Subregional System project for each discharge component except for the Geysers, in which case the cumulative projects caused two fewer significant impacts than that estimated for the Subregional System project alone (8 percent of the total possible impacts with the Subregional System project alone versus 3 percent for the cumulative projects). Table 4-42 shows that the predicted frequency of significant adverse impacts on benthic algae of the cumulative projects range from zero to 58 percent of the total number of possible significant adverse impacts, depending on discharge scenario. As is the case for the Subregional System project impacts, mitigation reduces the frequency of impacts for cumulative discharge scenarios except for the 1% discharge scenario. In contrast to the mitigated Subregional System project impact (which caused significant impacts after mitigation, depending on discharge scenarios), the cumulative projects with mitigation of Subregional System impacts would cause no significant benthic algae impacts for the 5%, 10%, 20% Laguna alternatives. Impacts persist in the Laguna even with mitigation for the 20% to the Russian River, Geysers and 1% due to reduced flow relative to existing condition. Reduced flow favors benthic algal growth.

The number of significant beneficial impacts estimated to result from the cumulative projects is the same as from the Subregional System project for each discharge component except in the Russian River below the Laguna for the 5 percent and 10 percent discharge to the River (Figure 4-49). In each of these cases, the number of significant beneficial impacts have been reduced from one (3 percent of the total) to zero. The predicted frequency of significant beneficial impacts of the cumulative projects on benthic algae range from zero to 8 percent of the total number of possible significant beneficial impacts (Table 4-43). The frequency of significant beneficial impacts on benthic algae increases with mitigation for the 10 percent, 20 percent and Geysers design discharges.

Planktonic Algae

The impact of the cumulative projects on planktonic algae biomass during a normal hydrological year is estimated to be similar to that of the Subregional System design discharge project (see Figure 4-60). The single significant adverse impact estimated to result from the cumulative projects (on the Russian River below the Laguna with a 20 percent design discharge to the Laguna) is the same as that from the Subregional System project. Mitigation for biostimulatory substances is predicted to reduce the single adverse impact on benthic algae resulting from the cumulative projects to less than significant levels. (Table 4-42).

The number of significant beneficial impacts estimated to result from the cumulative projects is the same as that from the Subregional System project for each discharge component, except the 20 percent River discharge component in the lower Russian River and the 20 percent Laguna discharge component to the Laguna. In the lower Russian River with a 20 percent River discharge, the number of significant beneficial effects of the Subregional System project is reduced by the cumulative projects from seven (19 percent of the total possible impacts) to zero. In the Laguna with a 20 percent Laguna discharge, the frequency of significant beneficial effects of the Subregional System project is reduced by the cumulative projects from 4 to 3 (from 11 percent to 8 percent of the total possible impacts in the normal year). The beneficial impacts on planktonic algae resulting from the cumulative projects are predicted to be reduced by mitigation to below significance (Table 4-43).

Table 4-42.

Frequency of Significant Adverse Impacts of the Cumulative Projects and Mitigation Operations (percent of the total number of analyses)

Discharge Component	No. Analyses[a]	Benthic Algae		Planktonic Algae		Turbidity		Dissolved Oxygen	
		Project	Mitig	Project	Mitig	Project	Mitig	Project	Mitig
No Project	36	55%	-	0%	-	0%	-	0%	-
1%	36	3%	6%	0%	0%	0%	0%	0%	0%
5%	36	3%	0%	0%	0%	0%	0%	0%	0%
10%	36	0%	0%	0%	0%	0%	0%	0%	0%
20%	36	58%	0%	3%	0%	0%	0%	3%	0%
20% River	48	27%	15%	0%	0%	0%	0%	0%	0%
Geysers	36	3%	3%	0%	0%	0%	0%	0%	0%

[a] 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 4-43.

Frequency of Significant Beneficial Impacts of the Cumulative Projects and Mitigation Operations (percent of the total number of analyses)

Discharge Component	No. Analyses[a]	Benthic Algae		Planktonic Algae		Turbidity	
		Project	Mitigation	Project	Mitigation	Project	Mitigation
No Project	36	0%	-	6%	-	6%	-
1%	36	8%	6%	0%	0%	0%	0%
5%	36	8%	8%	0%	0%	0%	0%
10%	36	0%	17%	0%	0%	0%	0%
20%	36	0%	14%	8%	0%	6%	0%
20% River	48	3%	3%	0%	0%	0%	0%
Geysers	36	3%	8%	0%	0%	0%	0%

[a] 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 4-44.

Net Impact[a] of the Cumulative Projects and Mitigation Operations

Discharge Component	No. Analyses[b]	Benthic Algae		Planktonic Algae		Turbidity	
		Project	Mitigation	Project	Mitigation	Project	Mitigation
No Project	36	-20	-	+2	-	0	-
1%	36	+2	0	0	0	0	0
5%	36	+2	+3	0	0	0	0
10%	36	0	+6	0	0	0	0
20%	36	-21	+5	+2	0	+2	0
20% River	48	-12	-6	0	0	0	0
Geysers	36	0	+2	0	0	0	0

[a] 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.

[b] 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 4-45

Significant Adverse and Beneficial Impacts of the Cumulative Projects for Each Discharge Component[a]

Constituent	Santa Rosa Creek	Laguna	Russian River Below Laguna	Russian River Above Laguna
Benthic Algae				
Adverse	**1%,** ~~20%~~, **20% River,** NP	1%, ~~5%~~, ~~20%~~, 20% River, NP, G	~~20%~~ , ~~20% River,~~ NP	20% River
Beneficial	1%, 5%, **10%, 20%,** ~~20% River~~, **G**	**10%, 20%**	1%, 5%, **10%, 20%, 20% River,** G	
Planktonic Algae				
Adverse			~~20%~~	
Beneficial	~~20%,~~ NP	~~20%,~~ NP		
Turbidity				
Adverse				
Beneficial	~~20%,~~ NP	~~20%,~~ NP		
Dissolved Oxygen		~~20%~~		
Ammonia				
Conductivity				*20% River*

[a] Components causing a significant adverse or beneficial impact are shown. Cumulative projects 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. Impacts of mitigation on the No Project component were not analyzed. Components are identified as follows:
1% = 1% design discharge component
20% = 20% design discharge component to Laguna
20% River = 20% design discharge component to River
G = Geysers discharge component

Turbidity

The impact of the cumulative projects on turbidity during a normal hydrological year is estimated to be similar to that of the Subregional System project (see Figure 4-60). The cumulative projects is not predicted to cause significant adverse impacts on turbidity (Table 4-42). Significant beneficial impacts of the cumulative projects are predicted to occur with the 20 percent design discharge to the Laguna (Table 4-43). These beneficial impacts are reduced by mitigation to below significance.

Dissolved Oxygen

The impact of the cumulative projects on dissolved oxygen during a normal hydrological year is estimated to be similar to that of the Subregional System design discharge project (see Figure 4-61). The cumulative projects is estimated to cause exceedance of the point of significance (> 0.5 mg/L decrease) just once (3 percent of the total possible impacts), and this would occur in the Laguna as a result of the 20 percent Laguna design discharge. This significant adverse impact of the cumulative projects is reduced by mitigation for biostimulatory substances to below significance (Table 4-42).

Ammonia-Nitrogen Concentration

The impact of the cumulative projects on the concentration of ammonia nitrogen during a normal hydrological year is estimated to be similar to that of the Subregional System project (see Figure 4-62). No significant impacts are expected from the cumulative projects or from cumulative projects with mitigation for biostimulatory substances.

Conductivity

Russian River Above The Laguna

The 20 percent design discharge to the Russian River above the Laguna is estimated to cause a significant impact on conductivity. With the assumption that the cumulative projects will not lower and may increase baseline conductivity, the impact of the cumulative projects on conductivity in the River above the Laguna would 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 4-46) 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 the 20 percent design discharge to the Laguna or the 20 percent design discharge to the River. Therefore, the cumulative projects is expected to have a less than significant impact on conductivity in the lower Russian River.

Table 4-46.

Estimated Conductivity in the Lower Russian River with 20 Percent Design Discharge to the Laguna and the River

	Lower Russian River (point of significance = 285 µmhos / cm)	
	20 Percent Design Discharge to the Laguna	**20 Percent Design Discharge to the River**
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

5.0 SEBASTOPOL

This section evaluates potential project impacts on water quality in the Sebastopol area.

5.1 IRRIGATION

The effect on surface water of irrigating lands located in the Sebastopol irrigation area (Green Valley/Atascadero watershed) was evaluated in the *Baseline Hydrology and Irrigation Drainage Evaluation for West and South County Reclamation Alternative* (1996). Extensive lands with a shallow impermeable layer that would cause root zone saturation and lateral flow to surface waters generally do not occur in the South County irrigation area. In addition, the proportion of land that would be irrigated in each Sebastopol area watershed would be small and dispersed. Therefore, no measurable impact of these lands on surface water flow or quality is expected under proper irrigation management.

A scenario involving an unplanned runoff of 34,000 gallons discharge over a 12 hour period has been identified as a basis for evaluating agricultural irrigation impacts. Such an event would result in a discharge rate of 0.1 cfs. The runoff flow would be equivalent to or less than the estimated flow in the streams in the Sebastopol irrigation area. Since the concentration of each water quality constituent in undiluted reclaimed water is less than the respective point of significance, the impact of the unplanned runoff event is considered to be less than significant.

5.2 CUMULATIVE IMPACTS

The Subregional System project would not affect water quality in the surface waters of the Sebastopol area. No cumulative projects were identified which would cause the Subregional System project impact to change. Thus, no impacts of the cumulative project on surface water quality are expected to occur.

6.0 WEST COUNTY

This section evaluates potential project impacts on water quality in West County.

6.1 STORAGE AND IRRIGATION

This section evaluates the effects of irrigation and storage in: 1) streams of the Americano and Stemple watersheds, and 2) the Estero de Americano and Estero de San Antonio estuaries.

6.1.1 West County Streams

The *Baseline Hydrology and Irrigation Drainage Evaluation for West and South County Reclamation Alternative* report (Questa Engineers, 1996) indicates that irrigation in the Americano and Stemple watersheds could affect surface water flows, and thus potentially also affect surface water quality. Irrigation can affect surface water flows through subsurface flow. Subsurface flow, as used in this report, is irrigation water that percolates through the soil until it reaches an impermeable layer. The water then travels laterally until it discharges into a stream. Under normal conditions, no surface runoff from irrigation is expected (*Irrigation Management Guidelines for the West County and South County Alternatives* Technical Report Questa Engineers 1996). Impacts from the rare surface runoff are also evaluated in this section.

Screening of Evaluation Criteria

The evaluation of storage and irrigation impacts on water quality in West County was evaluated for specific water quality constituents. Water quality constituents not screened from further analysis in Table 3-1 were evaluated and screened again for appropriateness in the West County Irrigation/Storage impacts evaluation. Table 6-1 shows the evaluation criteria with points of significance that were not screened in Table 3-1, and provides rationale for screening several additional evaluation criteria from consideration in the West County Irrigation/Storage impacts evaluation.

Reclaimed water in surface waterways will be introduced by filtration through reservoir embankments or soils in irrigation areas. The process of filtration through soils affects the transport of reclaimed water quality constituents to surface waterways.

The following compounds, found in detectable concentrations in reclaimed water and for which Evaluation Criteria exist, were screened from consideration of significant impacts and range of impacts to surface waterways by irrigation and storage because they are expected to volatilize from soils and surface waters and/or biodegrade rapidly (see *Human Health Risks from Chemical and Biological Components of Reclaimed Water*, Technical Report, Parsons ES 1996; Howard 1989, 1990, 1991):

Chlorinated benzenes

Table 6-1.

Evaluation Criteria with Criteria of Significance - Surface Water Quality
West County Irrigation/Storage Impacts

Evaluation Criteria	Point of Significance			Justification[a]
	Fresh-water	Salt-water	As Measured By	
1. Numeric-based criteria				
Aluminum	0.087	none	mg/L	EPA criterion
Dissolved Arsenic (all valence states)	0.19	0.036	mg/L	EPA criteria
Dissolved Cadmium	0.0012	0.0093	mg/L	EPA criteria
Dissolved Chromium III	0.21	-	mg/L	EPA criterion
Dissolved Chromium VI	0.01	0.050	mg/L	EPA criteria
Dissolved Copper	0.013[c]	0.0024	mg/L	EPA criteria
Dissolved Lead	0.003	0.0081	mg/L	EPA criteria
Total Mercury[b]	0.0013	0.0011	mg/L	EPA Final Chronic Values
Dissolved Nickel	0.182[c]	0.0082	mg/L	EPA criteria
Total Selenium	0.005	0.071	mg/L	EPA criteria
Dissolved Silver	0.0019[c]	0.0019	mg/L	EPA criteria
Dissolved Zinc	0.121[c]	0.081	mg/L	EPA criteria
Ammonia - Sensitive Species Absent[e]	0.0153	0.035	mg-N/L	EPA criteria
Ammonia - Sensitive Species Present[e]	0.0153	0.035	mg-N/L	EPA criteria
Chloride	230	None	mg/L	EPA criterion

Table 6-1.

Evaluation Criteria with Criteria of Significance - Surface Water Quality West County Irrigation/Storage Impacts

Evaluation Criteria	Point of Significance			Justification[a]
	Fresh-water	Salt-water	As Measured By	
Conductivity	Not considered in the West County Irrigation/Storage impacts evaluation	-	-	No conductivity criteria exist for West County streams.
Dissolved Oxygen	5.0-10.0	5.0-10.0	mg/L	Basin Plans criteria. (Values shown are the range of minimum, lower 50 and 90 percentiles for different water bodies)
Hydrogen sulfide	2	2	µg/L	EPA criteria
pH	6.5-8.5	6.5-8.5		EPA and Basin Plan criteria
Total dissolved solids	Not considered in the West County Irrigation/Storage impacts evaluation	None	mg/L	No total dissolved solids exist for West County streams.
Toxicity (lethal effects)	any increase	any increase	frequency of toxic conditions	Basin Plan Criteria

Table 6-1.

Evaluation Criteria with Criteria of Significance - Surface Water Quality
West County Irrigation/Storage Impacts

Evaluation Criteria	Point of Significance			Justification[a]
	Fresh-water	Salt-water	As Measured By	
Cyanide	Not considered in the West County Irrigation/Storage impacts evaluation			Cyanide in water used for irrigation will volatilize. Cyanide in soils will either volatilize (HCN in pH of 9.2 or less), become immobile part of metallocyanide complexes, or transformed via microbial action (see *Human Health Risks from Chemical and Biological Components of Reclaimed Water*, Parsons ES 1996). Reclaimed water in surface waterways will be introduced by filtration through reservoir embankments or soils in irrigation areas. Thus, cyanide will not be transported to surface waterways.
Aldrin, gamma-BHC (Lindane), phthalate esters, endosulfan-beta, chlorinated benzenes, chloroform, dichlorobenzenes, ethylbenzene, halomethanes (Bromodichloromethane, bromomethane, chloromethane, and dibromomethane only. Bromoform is undetected in reclaimed water), heptachlor, tetrachloroethylene, trichlorinated ethanes, toluene	Not considered in the West County Irrigation/Storage impacts evaluation			These organic compounds adsorb to soil and degrade and/or volatilize rapidly (see *Human Health Risks from Chemical and Biological Components of Reclaimed Water*, Parsons ES 1996; Howard 1991). Reclaimed water in surface waterways will be introduced by filtration through reservoir embankments or soils in irrigation areas. Thus, these organic compounds will unlikely be transported to surface waterways.

Table 6-1.

Evaluation Criteria with Criteria of Significance - Surface Water Quality
West County Irrigation/Storage Impacts

Evaluation Criteria	Point of Significance			Justification[a]
	Fresh-water	Salt-water	As Measured By	
2. Narrative-based criteria				
Biostimulatory Substances - Adverse. An increase in benthic or planktonic algae.	10 % increase	10 % increase	Benthic algae biomass and planktonic algae density as monthly average of chlorophyll *a*	Basin Plans narrative criterion Ten percent is considered an appropriate criterion for identifying aesthetic impacts on benthic or planktonic algae. Ecologically significant impacts on benthic or planktonic algae are addressed by the dissolved oxygen criterion.
Biostimulatory Substances - Beneficial. A decrease in benthic or planktonic algae would be considered beneficial.	10 % decrease	None	Benthic algae biomass and planktonic algae density as monthly average of chlorophyll *a*	Basin Plans narrative criterion Ten percent is considered an appropriate criterion for identifying aesthetic impacts on benthic or planktonic algae. Ecologically significant impacts on benthic or planktonic algae are addressed by the dissolved oxygen criterion.
Sediment. Construction of pipelines in waterways may result in an increase in suspended sediment in the waterways.	any increase	any increase		Basin Plans narrative criterion

Table 6-1.

Evaluation Criteria with Criteria of Significance - Surface Water Quality West County Irrigation/Storage Impacts

Evaluation Criteria	Point of Significance			Justification[a]
	Fresh-water	Salt-water	As Measured By	
Temperature.	5 °F increase in monthly average temperature	4 °F increase in monthly average temperature in estuaries		Basin Plans narrative criterion
Turbidity - Adverse.	20 % increase	20 % increase		Basin Plans narrative criterion A 20 percent criterion is intended to protect visual-related beneficial uses (i.e., aesthetics and fish feeding).
Turbidity - Beneficial.	20% decrease			Basin Plans narrative criterion
Salinity..	Not considered in the West County Irrigation/Storage impacts evaluation			This criterion applies only to San Pablo Bay
Waste Reduction Strategy	Not considered in the West County Irrigation/Storage impacts evaluation			This criterion applies only to the Laguna

Table 6-1.

Evaluation Criteria with Criteria of Significance - Surface Water Quality
West County Irrigation/Storage Impacts

Evaluation Criteria	Point of Significance			Justification[a]
	Fresh-water	Salt-water	As Measured By	
Color, Floating Material, Settleable Matter	Not considered in the West County Irrigation/Storage impacts evaluation			Reclaimed water in surface waterways will be introduced by filtration through reservoir embankments or soils in irrigation areas. Thus, these constituents will not be transported to surface waterways. Indirect impacts associated with stimulation of algae growth (that could be manifest as color, floating material) will be addressed with the Biostimulatory substances criterion.
3. Special site criteria				
The project may cause water quality changes occurs in the Area of Special Biological Significance or in the Sanctuary.	Any change	Any change		Special Site Criteria

Table 6-1.

Evaluation Criteria with Criteria of Significance - Surface Water Quality
West County Irrigation / Storage Impacts

Evaluation Criteria	Point of Significance			Justification[a]
	Fresh-water	Salt-water	As Measured By	

Source: Development of Evaluation Criteria for Potential Water Quality Impacts Technical Report (MSC 1996)

[a] 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 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.

[b] 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

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

[d] 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 would have to be less than the 0.039 µg/L that adversely affected brook trout.

[e] Criteria are temperature and pH dependent. Values shown are for 15°C and pH = 7.5.

- Chloroform
- Dichlorobenzenes
- Ethylbenzene
- Halomethanes (bromomethane, bromodichloromethane, chloromethane, and dibromochloromethane)
- Tetrachloroethylene
- Trichloronated ethanes (volatilization only)
- Toluene

Pesticides

Pesticides that are found in detectable concentrations in reclaimed water were removed from further consideration of significant impacts and range of impacts for reasons discussed below. Other pesticides may be applied to irrigated land but only pesticides with existing Evaluation Criteria are covered in this technical report. A risk assessment of pesticide use in conjunction with irrigation and storage is discussed in the *Ecological Risk Assessment for Santa Rosa Subregional Long-Term Wastewater Project* Technical Report (Parsons ES 1996).

- Aldrin will strongly adsorb to soils and will degrade to dieldrin which will also strongly adsorb to soils. Aldrin may also volatilize. Therefore, aldrin and dieldrin are unlikely to reach surface waterways (*Human Health Risks from Chemical and Biological Components of Reclaimed Water*, Parsons ES 1996; Howard 1991). Aldrin and its degradation product, dieldrin, were removed from consideration of significant impacts and range of impacts.
- Gamma-BHC (Lindane) is expected to volatilize from moistened soils. Some biodegradation is expected to occur. Gamma-BHC may also adsorb to soil (*Human Health Risks from Chemical and Biological Components of Reclaimed Water*, Parsons ES 1996; Howard 1991). Therefore, gamma-BHC was removed from consideration of significant impacts and range of impacts.
- Beta-endosulfan was screened from consideration of significant impacts and range of impacts to surface waterways by irrigation and storage because it is expected to biodegrade rapidly in soils (Howard 1991).
- Heptachlor will strongly adsorb to soils and also will degrade to heptachlor epoxide, which will also strongly adsorb to soils. Heptachlor may also photodegrade and volatilize. Therefore, heptachlor and heptachlor epoxide are unlikely to reach surface waterways (*Human Health Risks from Chemical and Biological Components of Reclaimed Water*, Technical Report, Parsons ES 1996; Howard 1991). Heptachlor and its degradation product, heptachlor epoxide, were removed from consideration of significant impacts and range of impacts.

Cyanide

Cyanide was screened from consideration of significant impacts and range of impacts to surface waterways by irrigation and storage. Of cyanide forms found in waters, free cyanide is the primary toxic agent in the aquatic environment (Eisler 1991). At pH levels found in natural waters, the dominant form of free cyanide is hydrogen cyanide, which is highly volatile (Callahan, et al. 1979). Because of the large surface to volume ratio of water applied as irrigation, it is expected that most free cyanide will be volatilized. Additionally, volatilization of hydrogen cyanide from surface soils is expected to be a primary removal mechanism for soils having a pH of 9.2 or less. Leaching to groundwaters is not expected to be significant due to the probability of cyanide fixation by trace metals found in soils, or transformation of cyanide via microbial action (*Human Health Risks from Chemical and Biological Components of Reclaimed Water*, Parsons ES 1996).

Phthalates

Bis (2-ethylhexyl) phthalate, diethyl phthalate, and di-n-butyl phthalate are found in detectable concentrations in reclaimed water and an Evaluation Criterion exists (as phthalate esters). They were screened from further consideration of significant impacts and range of impacts because they are expected to biodegrade rapidly in soils (Callahan, et al. 1979, Mills 1985, Howard 1989).

Other Constituents

The following constituents, detectable in reclaimed water but with no existing Evaluation Criteria, were removed from consideration from a range of impacts evaluation because they are expected to adsorb to soil, biodegrade and/or volatilize in soils (see *Human Health Risks from Chemical and Biological Components of Reclaimed Water*, Parsons ES 1996; Howard 1989, 1990, 1991):

- Acetone
- Alpha-BHC
- Aldicarb sulfone
- Aldicarb sulfoxide
- Carbon disulfide
- DCPA (Dacthal) (also removed by chemical hydrolysis)

Constituents Not Screened

The impacts on the concentrations in West County streams from irrigation and storage were evaluated for the following constituents

- Metals (aluminum and dissolved arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc)
- Ammonia-nitrogen
- Chloride
- Dissolved oxygen
- Hydrogen sulfide
- Total dissolved solids (range of impacts only - no Evaluation Criteria exists for West County streams)
- Biostimulatory substances (estimated by nitrogen)
- Temperature
- Turbidity

Evaluation Approach

The effects of project alternatives on flow and quality of surface water in Americano and Stemple Creeks was estimated using the Irrigation and Storage Flow and Water Quality Model, as described in the *Water Quality and Flow Model for Irrigation/Storage Area Streams* Technical Report (RMA 1996). The Irrigation and Storage Flow and Water Quality Model is essentially a water balance model that accounts for seepage from reservoirs (as defined in the *Hydrogeology of Storage/Reuse Areas and Evaluation of Potential Groundwater Impacts*, Parsons 1996), irrigation-related and non-irrigation-related discharge to surface water (as defined in the *Baseline Hydrology and Irrigation Drainage Evaluation for West and South County Reclamation Alternative* Technical Report, Questa Engineering 1996), the quality of reservoir seepage (see the *Reclaimed Water Quality Monitoring Results* Technical Report, MSC 1996) and the quality of discharging subsurface flows (*Estimation of Nitrogen, Salts and Pesticide Concentrations in Surface Water, and Mass Loading Analysis From Irrigation With Reclaimed Water, West and South County Alternatives*, Questa Engineers, 1996).

The average flow and quality in various tributary and main stem locations (described below) were estimated for wet months (December, January, February, and March) and dry months (June, July, August, and September) under the following conditions:

1. Location of storage reservoir within the watershed
    - Americano watershed
      Bloomfield
      Carrol Road
      Valley Ford
      No Storage (storage reservoir located in Stemple watershed)
    - Stemple watershed
      Huntley
      Two Rock
      No Storage (storage reservoir located in Americano watershed)
2. Hydrology/irrigation conditions
    - Dry year, normal irrigation (1)
    - Average year, normal irrigation (2)
    - Average year, cool summer irrigation (3)
    - Wet year, normal irrigation (4)
    - Dry year, winter irrigation (contingency program component) (5)
3. Irrigation technology types (as defined in *Estimation of Nitrogen, Salts and Pesticide Concentrations in Surface Water, and Mass Loading Analysis From Irrigation With Reclaimed Water, West and South County Alternatives*, Questa Engineers, 1996) are as follows
    - Low tech (1)
    - Medium tech (2)
    - High tech (3)

Locations in the Americano and Stemple watersheds at which flow and quality were estimated are shown in the appendix of *Aquatic Habitat Survey Results* Technical Report (MSC 1996), and are designated as follows:

Americano	**Stemple**
A1	S1
A2	S2
A3	S4
AVF1	S5
AVF2	SH1
ACR1	SH2
ACR2	STR1
AB1	STR2
AB2	-

Stations A1 through A3 and S1 through S3 are on the main stem of Americano Creek and Stemple Creek, respectively. Stations AVF, ACR, AB are on tributary streams of Americano Creek which run through the Valley Ford, Caroll Road, and Bloomfield reservoir sites, respectively. Stations SH and STR are on tributary streams of Stemple Creek which run through Huntley and Two Rock reservoir sites, respectively. Stations L and A are on the streams that run through the Lakeville and Adobe reservoir sites, respectively. Stations designated 1 are closest to the mouth or confluence with the main stem. Stations designated 2 or 3 are further upstream. On tributary streams, stations designated 2 are at the location corresponding to the base of the proposed dam.

The potential effect of irrigation and storage on flow and quality at any particular location in the watershed depends on the amount of irrigated acreage and the presence of a storage reservoir that would be upstream. As noted above, each of the possible combinations of storage and irrigation were considered, and irrigation acreage would decrease with increasing design discharge rate. Table 6-2 shows the irrigation acreages that were used in this analysis.

Table 6-2.

Irrigation Area Used To Calculate Impacts on Surface Waters

	Required Irrigation Area[a]	Total Area Assumed To Be Irrigated	
		Americano	Stemple
1% design discharge	6200	3055	5493
5% design discharge	4400	3055	4400
10% design discharge	2900	2900	2900

Source: Table 2 in Water Balance Summary and Results, Parsons ES, September 1995

a Units: acres

b 3055 and 5493 acres were determined to be available for irrigation in Americano and Stemple watersheds,respectively. This was calculated using GIS by Sycamore Associates based on criteria identified in the Irrigation Management Plan (Questa Engineers, 1995). Acreage represents total upstream of location where Americano and Stemple creeks discharge to their respective Esteros. In Americano watershed, additional acreage considered suitable for irrigation is located downstream of this location in the watershed, and this land drains directly to Estero Americano.

The maximum potential total irrigation area was assumed to be irrigated in each watershed for each design discharge rate (1, 5 and 10 percent). Thus, the resulting flow/quality impact represents the maximum possible impact in *each* watershed, but the maximum potential impact in *both* watersheds would not occur since the sum of the total area assumed to be irrigated in the Americano and Stemple watersheds is greater than the required irrigation area that is shown in Table 6-2. Some of the land considered suitable for irrigation in the Americano watershed is situated such that it drains directly to Estero Americano instead of to the Estero via Americano Creek. The effect on local streams of irrigating this land is similar to that described below for Americano Creek tributaries. Effects on the Estero of irrigating this land are also addressed below.

The relative proportions of water in West County streams from irrigated land, non-irrigated land, and reclaimed storage reservoir dam seepage were estimated by the Irrigation and Storage Flow and Water Quality Model described in *Water Quality and Flow Model for Irrigation/Storage Area Streams* Technical Report (RMA 1996). From this, the concentrations of metals (dissolved arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc), nitrogen, pesticides, and TDS in West County streams from irrigation and storage of reclaimed water were estimated as follows:

Concentrations of constituents of concern (C_w) were predicted from the percentages of flow contributed by each of the three sources of water (irrigated land, non-irrigated land, and reservoir dam seepage) and the concentration of constituents in each of the sources of water using the following equation:

$$C_w = \frac{(C_{ir} \times P_{ir}) + (C_{nir} \times P_{nir}) + (C_{st} \times P_{st})}{100}$$

Where:

C_{ir}, C_{nir}, and C_{st} = the concentration of a constituent in water originating from irrigated land, non-irrigated land, and storage reservoirs, respectively

P_{ir}, P_{nir}, and P_{st} = the percentage of flow originating from irrigated land, non-irrigated land, and storage reservoirs, respectively, as determined from the Irrigation and Storage Water Quality Model.

The relative proportions of nitrate and ammonia were determined by assuming that all water originating from irrigated and non-irrigated land is well oxygenated so nitrate will be the dominant form of nitrogen. It was further assumed that water originating from dam seepage will be anoxic so ammonia will be the dominant form of nitrogen (*Storage Reservoir Site Analysis: Limnology and Water Quality of T5 and B1A* Technical Memorandum No. 10). This is conservative since the hypolimnion will be anoxic only during periods of stratification (roughly May through August, depending on reservoir operations).

The quality of water from irrigated land, non-irrigated land, and storage reservoirs was determined as follows:

- Storage Reservoir Water Quality. The average of treatment plant reclaimed water quality measurements made from 1991 (1988 for metals) through January 1995 (as summarized in the *Reclaimed Water Quality Monitoring Results* Technical Report, MSC 1996) is assumed to be representative of the quality of reclaimed water discharged from storage reservoirs.
- Water Quality from Non-Irrigated Land. Ambient groundwater data were used as described in *Estimation of Nitrogen, Salts and Pesticide Concentrations in Surface Water, and Mass Loading Analysis From Irrigation With Reclaimed Water, West and South County Alternatives*, Questa Engineers, 1996.
- Water Quality from Irrigated Land. Ambient groundwater flow and quality data, and estimates of irrigation effects on reclaimed water quality and flow were used to estimate the quality of irrigation-affected groundwater (see *Estimation of Nitrogen, Salts and Pesticide Concentrations in Surface Water, and Mass Loading Analysis From Irrigation With Reclaimed Water, West and South County Alternatives*, Questa Engineers, 1996).

Two types of impacts analysis were conducted as follows.

- **Significance of impacts**. The estimated concentrations of constituents in the receiving water were compared to points of significance (described in *Development of Evaluation Criteria for Potential Water Quality Impacts* Technical Report, MSC 1996) for those constituents. If the estimated concentration of a constituent in the receiving water exceeded the point of significance, the impact was considered significant.
- **Range of impacts**. In this analysis, a range of potential water quality impacts was estimated.

Impact Evaluation Results

This section presents the results of the impact evaluation. The Irrigation and Storage Flow and Water Quality Model predicted, in general, little difference in concentrations of constituents between the 1 percent, 5 percent, and 10 percent design discharge components. Large differences between having irrigation in the watershed but no storage reservoir and having irrigation in the watershed and a storage reservoir exist only in tributary streams at the base of the dam since the only source of flow at these stations is from dam seepage.

Significance of Impacts

This section compares the estimated concentrations of constituents in the receiving water with points of significance (described in *Development of Evaluation Criteria for Potential Water Quality Impacts* Technical Report, MSC 1996) for those constituents.

Metals

Potential impacts on dissolved arsenic, dissolved cadmium, dissolved chromium, dissolved lead, dissolved nickel, dissolved silver, and dissolved zinc are not considered significant since baseline concentrations from irrigated and non-irrigated sources, and dam seepage (reclaimed water) do not exceed their respective points of significance (assuming a hardness of 130 mg/L). Aluminum concentration values are not available from irrigated and non-irrigated sources. However, the average concentration of aluminum in reclaimed water does not exceed the point of significance for aluminum. Irrigation and storage effects on dissolved arsenic, dissolved cadmium, dissolved chromium, dissolved lead, dissolved nickel, dissolved silver, and dissolved zinc are predicted to be less than significant.

The point of significance for dissolved copper is 0.014 mg/L (assuming a hardness of 130 mg/L, which is the hardness measured in Valley Ford and Huntley tributary streams - see *Irrigation/Storage Streams Water Quality Monitoring Results* Technical Report (MSC 1996). This hardness is different than the hardness assumed for dissolved copper in Table 6-1.). The predicted concentration of dissolved copper in Americano and Stemple Creeks and their tributaries exceeded 0.014 mg/L during dry weather under some conditions. There were no wet weather metals exceedances. The estimated dry weather concentration of dissolved copper in water from irrigated land is 0.017 mg/L, which exceeds the point of significance for dissolved copper. Water from non-irrigated sources and dam seepage does not exceed the point of significance for dissolved copper (see *Estimation of Metals Concentrations in Surface Water and Groundwater and Mass Loading Analysis from Irrigation with Reclaimed Water, West County and South County Alternatives*, Questa Engineers, 1996). Therefore, the potential exceedances are due to relatively higher concentrations of dissolved copper in irrigation water that enters West County creeks through subsurface flow. The higher concentrations of dissolved copper in irrigation subsurface flow result from concentration through irrigation induced evapotranspiration.

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) (see *Reclaimed Water Quality* Technical Report, MSC 1996). 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 (see *Reclaimed Water Quality Update*

Technical Report MSC 1996). Therefore, the concentration of dissolved copper in irrigation water may also be reduced.

Most of the dissolved copper exceedances occurred under contingency winter irrigation conditions and are described in that section. The remaining exceedances are described here. In the Americano watershed, the predicted concentration of dissolved copper in the dry season equaled or exceeded the point of significance at station AB1 under the conditions shown in Table 6-3. The range of dissolved copper at station AB1 under all non-contingency conditions (excluding No Project) is 0.010 to 0.015 mg/L. The lack of a storage reservoir increases the land area available in the AB1 subwatershed for irrigation and thus increases the proportion of irrigation source water in the AB1 tributary stream. Most of the dissolved copper exceedances were for the 1 and 5 percent discharge components, although there was one exceedance for the 10 percent design discharge component. The 1 and 5 percent design discharge components also have more irrigated land in the AB1 subwatershed relative to the 10 percent design discharge. The percent irrigated land when there is a copper exceedance is 36 percent versus 18 percent with no copper exceedances. Low and medium irrigation technologies involve a larger return of irrigation water to surface water relative to high irrigation technology (see *Estimation of Nitrogen, Salts and Herbicide/Pesticide Concentrations in Surface Water, and Mass Loading Analysis from Irrigation With Reclaimed Water, West County and South County Alternatives*, Questa Engineers 1996). This increase in irrigation water from low and medium technologies results in a higher dissolved copper concentration at station AB1 relative to high technology.

Table 6-3.

Irrigation Conditions Resulting in Copper Concentrations Equal to or Exceeding the Copper Point of Significance in the Americano Watershed[a]

Station	Total Area (acres)	Irrigated Area (acres)	Location of Reservoir	Design Discharge	Hydrology / Irrigation Condition[b]	Irrigation Technology	Predicted Dissolved Copper Concentration (mg / L)
AB1	975	357	No Storage	1%	2	Low	0.014
AB1	975	357	No Storage	5%	2	Low	0.014
AB1	975	357	No Storage	1%	1	Low	0.015
AB1	975	357	No Storage	5%	1	Low	0.015
AB1	975	315	No Storage	10%	1	Low	0.014
AB1	975	357	No Storage	1%	3	Low	0.014
AB1	975	357	No Storage	5%	3	Low	0.014
AB1	975	357	No Storage	1%	1	Medium	0.014
AB1	975	357	No Storage	5%	1	Medium	0.014
AB1	975	357	No Storage	1%	3	Medium	0.014
AB1	975	357	No Storage	5%	3	Medium	0.014

[a] Data from model output described in *Water Quality and Flow Model for Irrigation/Storage Area Streams* Technical Report (RMA 1996).

[b] Numbers refer to Hydrology/Irrigation Conditions described in the Evaluation Approach section above

In the Stemple watershed, the predicted concentration of dissolved copper in the dry season equaled or exceeded the point of significance at stations S2, S3, S4, S5, and SH1 under the conditions shown in Table 6-4. The range of dissolved copper at all stations in the Stemple under all non-contingency conditions (excluding No Project) is 0.007 to 0.015 mg/L. The percent irrigated land when there is a copper exceedance is 24 percent versus 17 percent with no copper exceedances. All dissolved copper exceedances were for irrigation associated with the 1 and 5 percent design discharge components.

Table 6-4.

Irrigation Conditions Resulting in Copper Concentrations Equal to or Exceeding the Copper Point of Significance in the Stemple Watershed[a]

Station	Total Area (acres)	Irrigated Area (acres)	Location of Reservoir	Design Discharge	Hydrology / Irrigation Condition[a]	Irrigation Technology	Predicted Dissolved Copper Concentration (mg / L)
S2	21167	5029	None	1%	1	Low	0.014
S2	21167	5029	Two Rock	1%	1	Low	0.014
S2	21167	5029	None	1%	1	Medium	0.014
S2	21167	5029	Two Rock	1%	1	Medium	0.014
S2	21167	5029	None	1%	1	High	0.014
S2	21167	5029	Two Rock	1%	1	High	0.014
S3	14272	3277	None	1%	1	Low	0.014
S3	14272	3277	Two Rock	1%	1	Low	0.014
S3	14272	3277	None	1%	1	Medium	0.014
S3	14272	3277	Two Rock	1%	1	Medium	0.014
S4	5581	1253	None	1%	1	Low	0.014
S4	5581	1253	None	1%	1	Medium	0.014
S5	5307	1415	None	1%	1	Low	0.015
S5	5307	1415	None	1%	1	Medium	0.015
S5	5307	1159	None	5%	1	Medium	0.014
S5	5307	1415	None	1%	3	Medium	0.014
S5	5307	1415	None	1%	1	High	0.014
SH1	1147	292	None	1%	1	Low	0.015
SH1	1147	292	None	1%	1	Medium	0.015
SH1	1147	239	None	5%	1	Medium	0.014
SH1	1147	292	None	1%	1	High	0.014

[a] Data from model output described in *Water Quality and Flow Model for Irrigation/Storage Area Streams* Technical Report (RMA 1996).

[b] Numbers refer to Hydrology/Irrigation Conditions described in the Evaluation Approach section above

The impact of project irrigation on the concentration of dissolved copper in tributary streams in the Americano watershed is predicted to be significant for the 1, 5, and 10 percent design discharges. Exceedances of the dissolved copper point of significance in the Americano watershed occurred in 11 of the 972 possible combinations of non-contingency conditions. The impact of project irrigation on the concentration of dissolved copper on Stemple Creek and its tributaries is predicted to be significant for the 1 and 5 percent design discharges. Exceedances of the dissolved copper point of significance in the Stemple watershed occurred in 21 of the 864 possible combinations of non-contingency conditions.

The toxicity of several metals, including copper, to aquatic organisms is related to water hardness. The harder the water, the relatively less toxic the metal. Therefore, the point of significance for these metals increases with increasing hardness. Hardness was measured on one occasion in Valley Ford storage site stream and on one occasion in Huntley storage site stream and both measurements were 130 mg/L (*Irrigation/Storage Streams Water Quality Monitoring Results* Technical Report, MSC 1996). This may be an under-estimate of the hardness in tributary streams during the dry season under project conditions when a larger percentage of the flow is from irrigation water and dam seepage. Since the predicted highest dissolved copper concentrations in both the Americano and Stemple watersheds are only slightly higher than the point of significance for dissolved copper, changes in the hardness of the tributary water could change the significance of this impact. For example, with a hardness of 145 mg/L, the point of significance for copper is 0.016 mg/L and no exceedances would occur in the Stemple or Americano watershed from design irrigation and storage.

Ammonia

Under the reducing conditions of an anoxic hypolimnion in a storage reservoir, the dominant form of nitrogen will be ammonia. For the purposes of this analysis, it is assumed that most or all of the dam seepage during dry (warm) weather will be from the hypolimnion and will, therefore, be ammonia. The toxicity of ammonia is temperature and pH dependent. At the temperature (17.9 °C) and pH (9.4) measured in the Valley Ford Reservoir site in May 1995 (*Irrigation/Storage Streams Water Quality Monitoring Results* Technical Report, MSC 1996) the EPA point of significance (CCC or 4-day average concentration for ammonia) is 0.11 mg-N/L. In all modeled tributary creeks and in the main stems of Americano and Stemple creeks during the dry season under the 1 percent, 5 percent and 10 percent design discharge components, the fraction of nitrogen attributable to dam seepage, and thus as ammonia, equals or exceeds 0.11 mg-N/L. During the wet season in the Stemple watershed, assuming all the nitrogen originating from dam seepage is ammonia, exceedances of the ammonia point of significance are predicted to occur at stations located at the base of the dam where the entire flow is due to dam seepage. Sporadic exceedances of ammonia may also occur at station SH1 during the wet season, depending on temperature and pH conditions. During the wet season in the Americano watershed, assuming all the nitrogen originating from dam seepage is ammonia, exceedances of the ammonia point of significance are predicted to occur at stations located at the base of the dam where the entire flow is due to dam seepage (see the appendix of the *Aquatic Habitat Survey Results* Technical Report, MSC 1996). Sporadic exceedances of ammonia may also occur at station AVF1, ACR1, and AB1 during the wet season, depending on temperature and pH conditions. Thus, the impact of project storage with 1 percent, 5 percent, and 10 percent design discharge is considered to be significant for ammonia in West County watershed tributary and main stem streams. This will occur only for a short distance until ammonia changes to nitrate due to aeration and bacterial conversion.

The proportion of ammonia in the irrigation supply water will be low relative to nitrate assuming irrigation water is withdrawn from near the surface of the reservoirs. Since plants take up and utilize ammonia preferentially over nitrate, the proportion of ammonia should be reduced further after application to crops. With appropriate irrigation management techniques, the upper soil layer should be fully oxygenated and nitrification of any remaining ammonia should occur. Therefore, little or no ammonia should enter West County streams from irrigation and the impact of irrigation on ammonia in West County streams is considered to be less than significant.

Biostimulatory Substances

The primary biostimulatory substance that will enter West County streams from Project irrigation and storage is nitrogen, since in project area streams, phosphorus is generally abundant and nitrogen tends to be limiting (*Irrigation/Storage Streams Water Quality Monitoring Results* and *Laguna de Santa Rosa Water Quality Monitoring Results* Technical Report, MSC 1996). Nitrogen in West County streams is currently affected by animal waste management practices. Under project conditions, nitrogen in streams will also be potentially affected by irrigation subflow reaching streams.

The existing data indicate that the concentrations of nitrogen in the main stem of Americano Creek and Stemple Creek are strongly influenced by manure management practices, and tributaries are not strongly influenced by manure management practices (see *Environmental Conditions in West County Waterways* Technical Report, MSC 1996, and the *Irrigation and Storage Stream Monitoring Results* Technical Report, MSC 1996). This is consistent with the location of most feedlot dairies along the main stem, the usual dairy design practice of a previous era. Between 1988 and 1990, total inorganic nitrogen in the main stem of Americano Creek (at Gerike Road) averaged 26.4 mg-N/L and total phosphate averaged 8.7 mg-P/L. Between 1988 and 1990, in Stemple Creek at Highway 1, total inorganic nitrogen averaged 4.9 mg-N/L, total phosphate averaged 1.3 mg-P/L, and chlorophyll *a* averaged 0.05 mg/L (*Environmental Conditions in West County Waterways* Technical Report, MSC 1996). This indicates that the main stems of Americano Creek and Stemple Creek are saturated with nutrients and algal growth is limited by some other factor such as light. The concentration of total inorganic nitrogen in the upper tributaries of Americano and Stemple Creeks is less than 1 mg/L (from data collected in May 1995 see *Irrigation/Storage Streams Water Quality Monitoring Results* Technical Report, MSC 1996). Thus, some tributaries may not exhibit nutrient-saturated conditions.

The proposed irrigation project is expected to affect nitrogen in surface waters as a result of irrigation and changes in the manure management practices on West County dairies. Each of these effects is described below.

Irrigation

The analysis in *Estimation of Nitrogen, Salts and Herbicide/Pesticide Concentrations in Surface Water* (Questa 1996) indicates that irrigation is predicted to cause the concentration of nitrogen in shallow groundwater to increase in the dry season from approximately 2 mg-N/L to approximately 3-4 mg-N/L. Using the method described in the *Water Quality and Flow Model for Irrigation/Storage Area Streams* Technical Report (RMA 1996), such an effect on groundwater would result in nitrogen concentrations ranging from 2.4 - 3.4 mg-N/L in Americano tributaries and 2.4 - 3.5 mg-N/L in Stemple tributaries. Table 6-5 shows the effect of a 1 percent irrigation project (irrigation associated with a 1 percent design discharge component) on nitrogen load to Americano and Stemple watershed based on the groundwater impact evaluation in *Estimation of Nitrogen, Salts and Herbicide/Pesticide Concentrations in Surface Water* (Questa 1996). A 1 percent irrigation project is a worst case scenario since irrigation acreage will decrease with increasing design discharge rates.

Table 6-5.

Design Irrigation Impacts on Nitrogen Load to Surface Water

	Americano Watershed			Stemple Watershed		
	Project[a]	No Project[b]	Project Impact	Project[a]	No Project[b]	Project Impact
4-Month Dry Season						
Nitrogen Conc. (mg-N/L)	2.9	1.9	-	3.0	1.9	-
Flow (cfs)	0.5	0.4	-	1.1	0.7	-
Load (Kg)	426	223	203	970	391	579
4-Month Wet Season						
Nitrogen Conc. (mg-N/L)	0.8	0.8	-	0.9	0.9	-
Flow (cfs)	97	101	-	190	195	-
Load (Kg)	22,809	23,750	-941	50,263	51,585	-1,323

[a] From Location A1 and S1 for Americano and Stemple, respectively assuming 1 percent irrigation and no storage in watershed, as estimated in *Water Quality and Flow Model for Irrigation/*Storage *Area Stream* Technical Report (RMA 1996). Wet season flow is from wet year condition.

[b] From Location A1 and S1 for Americano and Stemple, respectively assuming No Project condition in watershed, as estimated in *Water Quality and Flow Model for Irrigation/Storage Area Streams* Technical Report (RMA 1996). Wet season flow is from wet year condition.

The method used to develop the values that are shown in Table 6-5 did not include the effect of riparian vegetation on nitrogen because of uncertainty about whether riparian buffer areas would be included in the project (see *Estimation of Nitrogen, Salts and Herbicide/Pesticide Concentrations in Surface Water* Technical Report 1996). Since the technical analysis was conducted, riparian buffer areas have been included in the project description (see EIR/S Section 2).

Riparian buffer strips are known to remove nitrogen from subsurface and surface flows at rates up to 190 Kg per acre per year (Mitsch and Gosselink 1993, Peterjohn and Correll 1984, 1986, Jordan et al 1993, Weller et al 1994). A nitrogen removal rate of 18.5 Kg per acre per year is reported by Peterjohn and Correll (1984) for conditions that are similar to those that are expected to exist in riparian buffer strips created by the proposed project. At this nitrogen removal rate (18.5 Kg per acre per year), the 4-month dry season load increase due to the project (203 and 579 Kg) would be eliminated by 33 and 93 acres of riparian buffer area in Americano and Stemple watersheds, respectively. Thus, if 33 and 93 acres of riparian buffer area are provided in Americano and Stemple watersheds, respectively, no increase in nitrogen concentration would occur in tributary streams, and the 1 percent irrigation would be considered to have no impact in tributary streams. To be effective, the buffer areas must be situated downgradient of irrigation areas and sized in proportion to upgradient irrigation area.

Manure Management

The project description (see Section 2 of the EIR/S) describes the requirement that manure management practices be employed such that no impact of manure is expected on surface waters. Thus, the effect of the proposed project would be to cause a reduction in the concentration of nitrogen in the main stem of Americano Creek and Stemple Creek down to background levels. Background nitrogen levels in Americano Creek and Stemple Creek would only be achieved if all dairies meet the manure management performance standard required for participation in the irrigation project. Background nitrogen levels in the main stem are approximated by the nitrogen levels of tributary waters that are unaffected by agriculture. This is estimated in the *Estimation of Nitrogen, Salts and Herbicide/Pesticide Concentrations in Surface Water* Technical Report (Questa Engineering 1996) to be approximately 0.9 and 2 mg-N/L in the wet and dry season respectively.

Not all dairies are expected to participate in the irrigation program, but enforcement of existing regulations and recent development of site-specific manure management practices (Gold Ridge RCD 1995) are expected to cause non-participating dairies to achieve a similar level of manure management to that of dairies that participate in the irrigation program.

To summarize, the proposed irrigation project is expected to have a minor, if any, effect on nitrogen concentration in tributary streams of the Americano and Stemple watersheds, and to reduce the nitrogen concentration in the main stem of Americano Creek and Stemple Creek to approximately 0.9 and 2 mg-N/L in the wet and dry season respectively.

Chloride

No chloride concentrations data were available for West County streams. Chloride concentrations were estimated using the assumption that chloride concentrations vary in proportion to TDS. Existing chloride concentrations in West County streams were estimated using average chloride concentrations from North American streams (Wetzel 1975) weighted by the ratio of the watershed average TDS to North American streams average TDS. The estimated background chloride concentration is 10 mg/L in the wet season and 30 mg/L in the dry season. The chloride concentrations resulting from project irrigation and storage were estimated by multiplying the estimated existing chloride concentrations by the ratio of the TDS predicted from the Water Quality Model to existing TDS. The maximum predicted chloride concentration in the Americano watershed with project irrigation and storage was 86 mg/L. The maximum predicted chloride concentration in the Stemple watershed with project irrigation and storage was 92 mg/L. The point of significance for chloride is 230 mg/L. Therefore the impact of irrigation and storage on chloride in West County streams is predicted to be less than significant.

Dissolved Oxygen

Seepage from dams will come from the hypolimnion of the reservoir, which, during warm (dry) months, will be stratified and anoxic. It is estimated that dissolved oxygen in streams immediately below the dam will be below 5 mg/L for approximately 120 feet (see *Irrigation and Storage Flow and Water Quality Model* Technical Report, MSC 1996). The point of significance for designated warm waters is 5 mg/L and the criterion states that the dissolved oxygen concentrations shall not be reduced below the 5 mg/L point of significance at any time. Therefore, the impact of irrigation and storage on dissolved oxygen in West County tributary streams is predicted to be significant. There are no differences in flow due to dam seepage between the 1 percent, 5 percent, and 10 percent discharge components (*Aquatic Biological Resources Impact Analysis* Technical Report, MSC 1996), so the irrigation components associated with the 1 percent, 5 percent, and 10 percent discharge components are predicted to have a similar effect on dissolved oxygen in the receiving water.

Hydrogen Sulfide

Hydrogen sulfide (H_2S) is likely to be present in the hypolimnion of storage reservoirs soon after stratification (*Storage Reservoir Site Analysis: Limnology and Water Quality of T5 and B1A* Technical Memorandum No. 10 City of Santa Rosa 1990). It is therefore likely to be present in streams immediately below a dam for a distance similar to the distance with low dissolved oxygen. The exact concentration of H_2S is that will be present in tributary streams near the dam are not known, but it may exceed the point of significance of 2.0 mg/L for H_2S. There are no differences in surface water flow between the 1 percent, 5 percent, and 10 percent discharge components (see *Aquatic Biological Resources Impacts Analysis* Technical Report, MSC 1996), so there are no differences predicted between components on H_2S in the receiving water. The predicted impact of irrigation and storage on H_2S in West County tributary streams is considered to be significant for all discharge components.

Total Dissolved Solids

There are no evaluation criteria for TDS in West County streams. The range of impacts of project irrigation and storage are shown in Tables 6-6 through 6-9.

Temperature

Groundwater in irrigated and non-irrigated areas is predicted to reflect the average annual temperature at a particular site (Memorandum from Jeff Peters, Questa Engineering to Dave Smith, MSC dated 12 October 1995). Water from dam seepage may be slightly warmer than existing conditions in the winter because of the large heat capacity of a large body of water. However, in the wet season, the contribution of dam seepage is generally less than 13 percent of the total in West County streams. The exception to this is at the base of dams, where flow is entirely dam seepage. In this case, there is no existing water temperature, so water from dam seepage cannot cause a temperature increase. In dry conditions, the contribution of water from dam seepage can be much higher. However, this will generally be in warm months when the temperature of existing streams is likely to be much higher than the temperature from water seeping from the hypolimnion of a storage reservoir (the point of significance for temperature is an increase in temperature). Thus, the impact of irrigation and storage on temperature in West County streams and tributaries is predicted to be less than significant.

Toxicity

Lethal chronic toxicity has been observed in reclaimed water (see Table 4-7). The toxicity-causing constituent(s) in reclaimed water are unknown at this time. Therefore, the effect of storage and irrigation on toxicity cannot be determined. Furthermore, the episodic and ephemeral nature of the lethal chronic toxicity that has been observed to date (see *Reclaimed Water Quality Update* Technical Report), strongly suggests that the likelihood of toxicity emerging in surface water after passage through storage, irrigation systems and soil is extremely remote. Therefore, the impact of storage and irrigation on lethal toxicity is considered to be less than significant.

If lethal toxicity is found consistently in reclaimed water, it would be identified and controlled to mitigate discharge impacts of all alternatives (see mitigation for discharge impacts).

Turbidity

Turbidity in West County streams is mostly controlled by livestock activity in and near the streambed and algal growth due to manure-nitrogen (see *Environmental Conditions in West County Waterways* Technical Report MSC 1996). The proposed irrigation project is expected to have no effect on nitrogen concentration in tributary streams of the Americano and Stemple watersheds and to reduce the nitrogen concentration in the main stem of Americano Creek and Stemple Creek to approximately 0.9 and 2 mg-N/L in the wet and dry season respectively. In addition, exclusion of livestock from the riparian corridor as part of the project description (see EIR/S Section 2) is expected to substantially reduce turbidity. Thus, the effect of the proposed irrigation project is to reduce turbidity in streams. This impact is considered less than significant.

Range of Impacts

The range of impacts of irrigation and storage was estimated for the following constituents: metals (dissolved arsenic, dissolved cadmium, dissolved chromium, dissolved copper, dissolved lead, dissolved mercury, dissolved selenium, dissolved silver, and dissolved zinc), TDS, and chloride.

Americano Watershed

Tables 6-6 and 6-7 presents the range of impacts in wet and dry seasons on TDS, chloride, pesticides (2,4-D, and carbaryl), and dissolved metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc) in the Americano watershed estimated for Station A1 (on the main stem of Americano Creek near Franklin School Road) and Station AB1 (the tributary of Americano Creek that runs through the Bloomfield reservoir site, just upstream from the confluence with Americano Creek). The range of impacts described at both sites is based on impacts assessment of a storage reservoir (impacts of irrigation plus storage) in the watershed (A1) or subwatershed (AB1) and no reservoir in the watershed or subwatershed (impacts of irrigation alone). The impacts of irrigation alone and irrigation with storage on other Americano Creek tributaries are represented by the Station AB1 data. Irrigation effects vary between tributary depending on the fraction of the tributary's watershed area that would be irrigated. The effect of irrigation on the tributary in which the Bloomfield storage site is located is greater than other tributary watersheds because a greater proportion of that tributary watershed could be irrigated. The location of these stations is shown in the appendix of *Aquatic Habitat Survey Results* Technical Report (MSC 1996).

Estimates of pesticide concentrations shown in Tables 6-6 and 6-7 were developed from concentrations of 2,4-D and carbaryl estimated to enter surface waters in the Americano watershed following typical application rates (*Estimation of Nitrogen, salts, and Herbicide/Pesticide Concentrations in Surface Water, and Mass Loading Analysis from Irrigation with Reclaimed Water, West County and South County Alternatives*, Questa Engineers 1996). These pesticides are representative of the type of pesticides that may be used in conjunction with project irrigation in West County. The estimated concentrations of 2,4-D and carbaryl are presented here to provide a general estimate of the levels of pesticides that may be expected with project irrigation.

Existing concentrations of the constituents are also shown. For the main stem of Americano Creek, existing concentrations are those measured between 1988 and 1990 on Americano Creek at Franklin School Road (*Environmental Conditions in West County Waterways* Technical Report, MSC 1996). The existing conditions for the tributary stream were measured in the Valley Ford tributary stream in May 1995 (*Irrigation/Storage Streams Water Quality Monitoring Results* Technical Report, MSC 1996). Shown also as existing conditions are values measured between 1988 and 1990 on Americano Creek upstream of dairy influence (*Environmental Conditions in West County Waterways* Technical Report, MSC 1996)

. Stemple Watershed

Tables 6-8 and 6-9 presents the range of impacts under wet and dry conditions on TDS, chloride, pesticides (2,4-D, and carbaryl), and dissolved metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc) in the Stemple watershed estimated for Station S1 (on the main stem of Americano Creek near Franklin School Road) and Station SH1 (the tributary of Stemple Creek that runs through the Huntley reservoir site, just upstream from the confluence with Stemple Creek). The locations of these stations is shown in the appendix of *Aquatic Habitat Survey Results* Technical Report (MSC 1996). The range of impacts described at both sites is based on impacts assessment of a storage reservoir (impacts of irrigation plus storage) in the watershed (S1) or subwatershed (SH1) and no reservoir in the watershed or subwatershed (impacts of irrigation alone). The impact of irrigation alone and irrigation with storage on other Stemple Creek tributaries is represented by the Station SH1 data. Irrigation effects vary between tributary depending on the fraction of the tributary's watershed area that would be irrigated.

Estimates of pesticide concentrations shown in Tables 6-8 and 6-9 were developed from concentrations of 2,4-D and carbaryl estimated to enter surface waters in the Americano watershed following typical application rates (*Estimation of Nitrogen, salts, and Herbicide/Pesticide Concentrations in Surface Water, and Mass Loading Analysis from Irrigation with Reclaimed Water, West County and South County Alternatives*, Questa Engineers 1996). These pesticides are representative of the type of pesticides that may be used in conjunction with project irrigation in West County. The estimated concentrations of 2,4-D and carbaryl are presented here to provide a general estimate of the levels of pesticides that may be expected with project irrigation.

Existing concentrations of the constituents are also shown. For the main stem of Stemple Creek, existing concentrations are those measured between 1988 and 1990 on Stemple Creek at Highway 1 (*Environmental Conditions in West County Waterways* Technical Report, MSC 1996). The existing conditions for the tributary stream were measured in the Huntley tributary stream in May 1995 (*Irrigation/Storage Streams Water Quality Monitoring Results* Technical Report, MSC 1996). Shown also as existing conditions are values measured between 1988 and 1990 on Americano Creek upstream of dairy influence since information on Stemple above dairy influence is unavailable (*Environmental Conditions in West County Waterways* Technical Report, MSC 1996).

Table 6-6.

Predicted Range of Concentrations of Constituents in the Main Stem of Americano Creek under Different Discharge Components With and Without a Storage Reservoir (mg/L)

	Irrigation Alone[a]						Irrigation plus Storage[a]							
	1% Design Discharge		5% Design Discharge		10% Design Discharge		1% Design Discharge		5% Design Discharge		10% Design Discharge		Existing Conditions[b]	
	min	max	min	max	min	max	min	max	min	max	min	max	min	max
Wet Season Concentrations														
TDS	105	107	105	107	105	107	105	108	105	108	105	108	350	4100
Chloride	5.9	6.0	5.9	6.0	5.9	6.0	5.9	6.1	5.9	6.1	5.9	6.1	not avail	not avail
2.4-D	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	not avail	not avail
Carbaryl	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	not avail	not avail
Diss. Arsenic	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	not avail	not avail
Diss. Cadmium	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	ND	0.003
Diss. Chromium	0.0024	0.0024	0.0024	0.0024	0.0024	0.0024	0.0024	0.0024	0.0024	0.0024	0.0024	0.0024	ND	0.008
Diss. Copper	0.0043	0.0046	0.0043	0.0046	0.0041	0.0043	0.0043	0.0047	0.0043	0.0047	0.0042	0.0045	ND	0.031
Diss. Lead	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	ND	ND
Diss. Mercury	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	not avail	not avail
Diss. Nickel	0.0027	0.0028	0.0027	0.0028	0.0027	0.0027	0.0027	0.0028	0.0027	0.0028	0.0027	0.0028	not avail	not avail

Table 6-6.

Predicted Range of Concentrations of Constituents in the Main Stem of Americano Creek under Different Discharge Components With and Without a Storage Reservoir
(mg/L)

	Irrigation Alone[a]						Irrigation plus Storage[a]							
	1% Design Discharge		5% Design Discharge		10% Design Discharge		1% Design Discharge		5% Design Discharge		10% Design Discharge		Existing Conditions[b]	
	min	max	min	max	min	max	min	max	min	max	min	max	min	max
Diss. Selenium	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	not avail	not avail
Diss. Silver	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	ND	0.0004
Diss. Zinc	0.011	0.012	0.011	0.012	0.010	0.011	0.011	0.013	0.011	0.013	0.011	0.012	ND	0.11
Dry season Concentrations														
TDS	1052	1374	1052	1374	1019	1337	926	1277	926	1277	906	1249	dry	dry
Chloride	59.2	77.4	59.2	77.4	57.4	75.3	52.2	72.0	52.2	72.0	51.0	70.3	dry	dry
2.4-D	0.00209	0.00293	0.00209	0.00293	0.00195	0.00281	0.00010	0.00016	0.00010	0.00016	0.00009	0.00016	not avail	not avail
Carbaryl	0.00013	0.00018	0.00013	0.00018	0.00012	0.00017	0.00494	0.00666	0.00494	0.00666	0.00482	0.00651	not avail	not avail
Diss. Arsenic	0.0058	0.0071	0.0058	0.0071	0.0055	0.0069	0.0049	0.0067	0.0049	0.0067	0.0048	0.0065	dry	dry
Diss. Cadmium	0.0007	0.0008	0.0007	0.0008	0.0006	0.0008	0.0006	0.0008	0.0006	0.0008	0.0006	0.0008	dry	dry
Diss. Chromium	0.0014	0.0017	0.0014	0.0017	0.0014	0.0017	0.0013	0.0016	0.0013	0.0016	0.0013	0.0016	dry	dry
Diss. Copper	0.0100	0.0130	0.0100	0.0130	0.0095	0.0125	0.0097	0.0126	0.0097	0.0126	0.0094	0.0123	dry	dry

Table 6-6.

Predicted Range of Concentrations of Constituents in the Main Stem of Americano Creek under Different Discharge Components With and Without a Storage Reservoir (mg/L)

	Irrigation Alone[a]						Irrigation plus Storage[a]							
	1% Design Discharge		5% Design Discharge		10% Design Discharge		1% Design Discharge		5% Design Discharge		10% Design Discharge		Existing Conditions[b]	
	min	max	min	max	min	max	min	max	min	max	min	max	min	max
Diss. Lead	0.0015	0.0017	0.0015	0.0017	0.0015	0.0017	0.0015	0.0017	0.0015	0.0017	0.0015	0.0017	dry	dry
Diss. Mercury	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0001	0.0002	0.0001	0.0002	0.0001	0.0002	dry	dry
Diss. Nickel	0.0051	0.0062	0.0051	0.0062	0.0050	0.0060	0.0047	0.0059	0.0047	0.0059	0.0046	0.0058	dry	dry
Diss. Selenium	0.0028	0.0029	0.0028	0.0029	0.0028	0.0029	0.0024	0.0028	0.0024	0.0028	0.0023	0.0027	dry	dry
Diss. Silver	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	dry	dry
Diss. Zinc	0.045	0.062	0.045	0.062	0.043	0.059	0.041	0.058	0.041	0.058	0.040	0.057	dry	dry

[a] Data from model output described in Water Quality and Flow Model for Irrigation/Storage Area Streams Model Technical Report (RMA 1996).
[b] Data from *Environmental Conditions in West County Waterways* Technical Report (MSC 1996).
[c] Indicates the value was below detection. The value shown is the reporting limit.

Table 6-7.

Predicted Range of Concentrations of Constituents in a Tributary of Americano Creek under Different Discharge Components With and Without a Storage Reservoir (mg/L)

	Irrigation Alone[a]						Irrigation plus Storage[a]						Existing Tributary[b]	Existing Mainstem[c]	
	1% Design Discharge		5% Design Discharge		10% Design Discharge		1% Design Discharge		5% Design Discharge		10% Design Discharge			above Dairies	Above Dairy
	min	max	min	max	min	max	min	max	min	max	min	max		min	max
Wet Season Concentrations															
TDS	104	108	104	108	104	108	117	153	117	153	118	152	270	300	75000
Chloride	5.8	6.1	5.8	6.1	5.9	6.1	6.6	8.6	6.6	8.6	6.6	8.6	no data	no data	no data
2.4-D	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	no data	no data	no data
Carbaryl	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	no data	no data	no data
Diss. Arsenic	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0024	0.0024	0.0024	0.0024	0.0024	0.0025	0.005[d]	no data	no data
Diss. Cadmium	0.0004	0.0004	0.0004	0.0004	0.0003	0.0004	0.0004	0.0005	0.0004	0.0005	0.0004	0.0004	0.0005[d]	0.0001[d]	0.01
Diss. Chromium	0.0024	0.0024	0.0024	0.0024	0.0024	0.0024	0.0021	0.0022	0.0021	0.0022	0.0021	0.0022	0.005[d]	0.001[d]	0.001
Diss. Copper	0.0054	0.0058	0.0054	0.0058	0.0050	0.0054	0.0083	0.0086	0.0083	0.0086	0.0077	0.0079	0.005[d]	0.001	0.027
Diss. Lead	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011	0.0012	0.0012	0.0012	0.0012	0.0011	0.0012	0.002[d]	0.0001[d]	0.1[d]
Diss. Mercury	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002[d]	no data	no data

Diss. Nickel	0.0029	0.0029	0.0029	0.0029	0.0028	0.0029	0.0033	0.0033	0.0033	0.0033	0.0032	0.0032	0.005[d]	no data	no data
Diss. Selenium	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0023	0.0025	0.0023	0.0025	0.0023	0.0025	0.002[d]	no data	no data
Diss. Silver	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0006	0.0006	0.0006	0.0006	0.0006	0.0006	0.001[d]	0.00005[d]	0.0001[d]
Diss. Zinc	0.015	0.016	0.015	0.016	0.014	0.015	0.026	0.026	0.026	0.026	0.023	0.024	0.01[d]	0.01[d]	0.06
Dry season Concentrations															
TDS	1183	1524	1183	1524	1145	1480	664	762	664	762	647	736	dry	dry	dry
Chloride	66.7	85.9	66.7	85.9	64.5	83.4	37.4	42.9	37.4	42.9	36.4	41.5	dry	dry	dry
2.4-D	0.00267	0.00342	0.00267	0.00342	0.00250	0.00328	0.00057	0.00099	0.00057	0.00099	0.00051	0.00090	dry	dry	dry
Carbaryl	0.00017	0.00021	0.00017	0.00021	0.00015	0.00020	0.00004	0.00006	0.00004	0.00006	0.00003	0.00006	dry	dry	dry
Diss. Arsenic	0.0067	0.0078	0.0067	0.0078	0.0064	0.0076	0.0034	0.0041	0.0034	0.0041	0.0033	0.0039	dry	dry	dry
Diss. Cadmium	0.0008	0.0009	0.0008	0.0009	0.0008	0.0009	0.0004	0.0005	0.0004	0.0005	0.0004	0.0005	dry	dry	dry
Diss. Chromium	0.0012	0.0015	0.0012	0.0015	0.0012	0.0015	0.0009	0.0009	0.0009	0.0009	0.0009	0.0009	dry	dry	dry
Diss. Copper	0.0121	0.0147	0.0121	0.0147	0.0114	0.0142	0.0106	0.0114	0.0106	0.0114	0.0104	0.0112	dry	dry	dry
Diss. Lead	0.0016	0.0018	0.0016	0.0018	0.0016	0.0018	0.0017	0.0018	0.0017	0.0018	0.0017	0.0018	dry	dry	dry
Diss. Mercury	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	dry	dry	dry
Diss. Nickel	0.0059	0.0068	0.0059	0.0068	0.0057	0.0066	0.0040	0.0044	0.0040	0.0044	0.0039	0.0043	dry	dry	dry
Diss. Selenium	0.0029	0.0030	0.0029	0.0030	0.0029	0.0030	0.0011	0.0014	0.0011	0.0014	0.0011	0.0013	dry	dry	dry
Diss. Silver	0.0007	0.0008	0.0007	0.0008	0.0007	0.0008	0.0007	0.0007	0.0007	0.0007	0.0007	0.0007	dry	dry	dry
Diss. Zinc	0.057	0.071	0.057	0.071	0.053	0.068	0.039	0.044	0.039	0.044	0.038	0.043	dry	dry	dry

a Data from model output described in Water Quality and Flow Model for Irrigation/Storage Area Streams Model Technical Report (RMA 1996).
b Data from Irrigation/Storage Streams Water Quality Monitoring Results Technical Report (MSC 1996).
c Data from Environmental Conditions in West County Waterways Technical Report (MSC 1996).
d Indicates the value was below detection. The value shown is the reporting limit.

Table 6-8.

Predicted Range of Concentrations of Constituents in the Main Stem of Stemple Creek under Different Discharge Components With and Without a Storage Reservoir

(mg/L)

	Irrigation Alone[a]						Irrigation plus Storage[a]						Existing Mainstem[b]	
	1% Design Discharge		5% Design Discharge		10% Design Discharge		1% Design Discharge		5% Design Discharge		10% Design Discharge			
	min	max	min	max	min	max	min	max	min	max	min	max	min	max
Wet Season Concentrations														
TDS	105	107	105	106	105	106	105	107	105	107	105	106	320	590
Chloride	5.9	6.0	5.9	6.0	5.9	6.0	5.9	6.0	5.9	6.0	5.9	6.0	no data	no data
2.4-D	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000		
Carbaryl	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000		
Diss. Arsenic	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0024	0.0025	0.0025	0.0025	0.0025	0.0025	no data	no data
Diss. Cadmium	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002[c]	0.0005
Diss. Chromium	0.0024	0.0024	0.0024	0.0025	0.0025	0.0025	0.0024	0.0024	0.0024	0.0025	0.0025	0.0025	0.001[c]	0.008
Diss. Copper	0.0041	0.0043	0.0038	0.0040	0.0033	0.0034	0.0041	0.0043	0.0038	0.0040	0.0033	0.0034	0.002	0.0062
Diss. Lead	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0010	0.0001[c]	0.0052
Diss. Mercury	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	no data	no data
Diss. Nickel	0.0032	0.0033	0.0031	0.0031	0.0028	0.0029	0.0032	0.0033	0.0031	0.0031	0.0028	0.0029	no data	no data

Table 6-8.

Predicted Range of Concentrations of Constituents in the Main Stem of Stemple Creek under Different Discharge Components With and Without a Storage Reservoir (mg/L)

	Irrigation Alone[a]						Irrigation plus Storage[a]						Existing Mainstem[b]	
	1% Design Discharge		5% Design Discharge		10% Design Discharge		1% Design Discharge		5% Design Discharge		10% Design Discharge			
	min	max	min	max	min	max	min	max	min	max	min	max	min	max
Diss. Selenium	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	no data	no data
Diss. Silver	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0001[c]	0.0001
Diss. Zinc	0.011	0.011	0.010	0.010	0.008	0.008	0.011	0.012	0.010	0.010	0.008	0.008	0.003	0.013
Dry season Concentrations														
TDS	1018	1459	969	1402	861	1264	1004	1448	954	1390	842	1246	dry	dry
Chloride	57.4	82.2	54.6	79.0	48.5	71.2	56.5	81.6	53.7	78.3	47.5	70.2	no data	no data
2.4-D	0.0029	0.0044	0.0026	0.0042	0.0020	0.0035	0.0029	0.0044	0.0025	0.0041	0.0019	0.0034	no data	no data
Carbaryl	0.00009	0.00013	0.00008	0.00012	0.00006	0.00010	0.00008	0.00013	0.00008	0.00012	0.00006	0.00010	no data	no data
Diss. Arsenic	0.0058	0.0075	0.0055	0.0072	0.0047	0.0064	0.0057	0.0075	0.0054	0.0071	0.0046	0.0064	dry	dry
Diss. Cadmium	0.0007	0.0009	0.0006	0.0009	0.0005	0.0008	0.0007	0.0009	0.0006	0.0008	0.0005	0.0007	dry	dry
Diss. Chromium	0.0013	0.0017	0.0013	0.0018	0.0015	0.0019	0.0012	0.0017	0.0013	0.0017	0.0015	0.0019	dry	dry
Diss. Copper	0.0101	0.0140	0.0093	0.0133	0.0076	0.0115	0.0101	0.0140	0.0093	0.0133	0.0077	0.0115	dry	dry

Table 6-8.

Predicted Range of Concentrations of Constituents in the Main Stem of Stemple Creek under Different Discharge Components With and Without a Storage Reservoir
(mg/L)

	Irrigation Alone[a]						Irrigation plus Storage[a]						Existing Mainstem[b]	
	1% Design Discharge		5% Design Discharge		10% Design Discharge		1% Design Discharge		5% Design Discharge		10% Design Discharge			
	min	max	min	max	min	max	min	max	min	max	min	max	min	max
Diss. Lead	0.0015	0.0018	0.0015	0.0017	0.0013	0.0016	0.0015	0.0018	0.0015	0.0017	0.0013	0.0016	dry	dry
Diss. Mercury	0.0002	0.0002	0.0002	0.0002	0.0001	0.0002	0.0002	0.0002	0.0002	0.0002	0.0001	0.0002	dry	dry
Diss. Nickel	0.0052	0.0066	0.0050	0.0064	0.0044	0.0058	0.0052	0.0066	0.0049	0.0064	0.0043	0.0057	dry	dry
Diss. Selenium	0.0028	0.0030	0.0028	0.0029	0.0027	0.0029	0.0027	0.0029	0.0027	0.0029	0.0026	0.0028	dry	dry
Diss. Silver	0.0007	0.0008	0.0007	0.0008	0.0006	0.0007	0.0007	0.0008	0.0007	0.0008	0.0006	0.0007	dry	dry
Diss. Zinc	0.046	0.067	0.042	0.063	0.033	0.054	0.046	0.067	0.041	0.063	0.032	0.0534	dry	dry

a Data from model output described in Water Quality and Flow Model for Irrigation/Storage Area Streams Technical Report (RMA 1996).
b Data from Environmental Conditions in West County Waterways Technical Report (MSC 1996).
c Indicates the value was below detection. The value shown is the reporting limit.

Table 6-9.

Predicted Range of Concentrations of Constituents in a Tributary of Stemple Creek under Different Discharge Components and With Without a Storage Reservoir
(mg/L)

	Irrigation Alone[a]						**Irrigation plus Storage[a]**						**Tributary[b]**	**Mainstem[c]**	
	1% Design Discharge		**5% Design Discharge**		**10% Design Discharge**		**1% Design Discharge**		**5% Design Discharge**		**10% Design Discharge**				
	min	**max**	**min**	**max**	**min**	**max**	**min**	**max**	**min**	**max**	**min**	**max**		**min**	**max**
Wet Season Concentrations															
TDS	105	107	105	107	105	106	107	113	107	112	107	111	240	300	75000
Chloride	5.9	6.0	5.9	6.0	5.9	6.0	6.0	6.4	6.0	6.3	6.0	6.3	no data	no data	no data
2.4-D	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	no data	no data	no data
Carbaryl	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	no data	no data	no data
Diss. Arsenic	0.0024	0.0024	0.0025	0.0025	0.0025	0.0025	0.0024	0.0024	0.0024	0.0024	0.0025	0.0025	0.005[d]	no data	no data
Diss. Cadmium	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0004	0.0004	0.0004	0.0004	0.0003	0.0003	0.0005[d]	0.0001[d]	0.01
Diss. Chromium	0.0024	0.0024	0.0024	0.0024	0.0025	0.0025	0.0024	0.0024	0.0024	0.0024	0.0024	0.0024	0.005[d]	0.001[d]	0.001
Diss. Copper	0.0045	0.0047	0.0041	0.0043	0.0035	0.0036	0.0056	0.0059	0.0050	0.0053	0.0040	0.0042	0.005[d]	0.001	0.027
Diss. Lead	0.0010	0.0011	0.0010	0.0010	0.0010	0.0010	0.0011	0.0011	0.0011	0.0011	0.0010	0.0010	0.002[d]	0.0001[d]	0.1[d]
Diss. Mercury	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002[d]	no data	no data
Diss. Nickel	0.0034	0.0034	0.0032	0.0033	0.0029	0.0030	0.0038	0.0039	0.0036	0.0037	0.0031	0.0032	0.005[d]	no data	no data
Diss. Selenium	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.005[d]	no data	no data

Table 6-9.

Predicted Range of Concentrations of Constituents in a Tributary of Stemple Creek under Different Discharge Components and With Without a Storage Reservoir
(mg/L)

	Irrigation Alone[a]						Irrigation plus Storage[a]						Tributary[b]	Mainstem[c]	
	1% Design Discharge		5% Design Discharge		10% Design Discharge		1% Design Discharge		5% Design Discharge		10% Design Discharge				
	min	max	min	max	min	max	min	max	min	max	min	max		min	max
Diss. Silver	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.001[d]	0.00005[d]	0.0001[d]
Diss. Zinc	0.012	0.013	0.011	0.011	0.008	0.009	0.016	0.017	0.014	0.015	0.010	0.011	0.01[d]	0.01[d]	0.06
Dry season Concentrations															
TDS	1074	1518	1021	1461	902	1319	900	1260	845	1186	728	1009	dry	dry	dry
Chloride	61	86	57	82	51	74	51	71	48	67	41	57	dry	dry	dry
2.4-D	0.0033	0.0047	0.0029	0.0044	0.0022	0.0038	0.0023	0.0035	0.0020	0.0032	0.0013	0.0024	dry	dry	dry
Carbaryl	0.00010	0.00014	0.00009	0.00013	0.00007	0.00011	0.00007	0.00011	0.00006	0.00009	0.00004	0.00007	dry	dry	dry
Diss. Arsenic	0.0062	0.0078	0.0058	0.0075	0.0050	0.0067	0.0051	0.0065	0.0048	0.0061	0.0040	0.0052	dry	dry	dry
Diss. Cadmium	0.0007	0.0009	0.0007	0.0009	0.0006	0.0008	0.0006	0.0008	0.0006	0.0007	0.0005	0.0006	dry	dry	dry
Diss. Chromium	0.0012	0.0016	0.0013	0.0017	0.0015	0.0019	0.0010	0.0012	0.0010	0.0013	0.0011	0.0014	dry	dry	dry
Diss. Copper	0.0110	0.0147	0.0101	0.0140	0.0083	0.0122	0.0114	0.0137	0.0107	0.0130	0.0093	0.0114	dry	dry	dry
Diss. Lead	0.0016	0.0018	0.0015	0.0018	0.0014	0.0016	0.0017	0.0018	0.0016	0.0018	0.0016	0.0017	dry	dry	dry
Diss. Mercury	0.0002	0.0002	0.0002	0.0002	0.0001	0.0002	0.0002	0.0002	0.0001	0.0002	0.0001	0.0002	dry	dry	dry

Table 6-9.

Predicted Range of Concentrations of Constituents in a Tributary of Stemple Creek under Different Discharge Components and With Without a Storage Reservoir
(mg/L)

	Irrigation Alone[a]						Irrigation plus Storage[a]						Tributary[b]	Mainstem[c]	
	1% Design Discharge		5% Design Discharge		10% Design Discharge		1% Design Discharge		5% Design Discharge		10% Design Discharge				
	min	max	min	max	min	max	min	max	min	max	min	max		min	max
Diss. Nickel	0.0056	0.0069	0.0052	0.0067	0.0046	0.0060	0.0050	0.0061	0.0048	0.0058	0.0042	0.0051	dry	dry	dry
Diss. Selenium	0.0028	0.0030	0.0028	0.0030	0.0027	0.0029	0.0020	0.0024	0.0020	0.0023	0.0018	0.0021	dry	dry	dry
Diss. Silver	0.0007	0.0008	0.0007	0.0008	0.0006	0.0007	0.0007	0.0008	0.0007	0.0008	0.0007	0.0007	dry	dry	dry
Diss. Zinc	0.051	0.071	0.046	0.067	0.036	0.057	0.048	0.062	0.044	0.058	0.036	0.048	dry	dry	dry

a Data from model output described in Water Quality and Flow Model for Irrigation/Storage Area Streams Technical Report (RMA 1996).
b Data from Irrigation/Storage Streams Water Quality Monitoring Results Technical Report (MSC 1996).
c Data from Environmental Conditions in West County Waterways Technical Report (MSC 1996).
d Indicates the value was below detection. The value shown is the reporting limit.

Proposed Mitigation

This section summarizes the significant impacts of irrigation and storage on West County streams and describes suggested mitigation.

Summary of Significant Impacts to be Mitigated

Table 6-10 summarizes the significant impacts of irrigation and storage on West County Streams.

Table 6-10.

Significant Adverse Impacts of Design Irrigation and Storage in West County Streams

	Americano Creek	**Americano Tributaries**	**Stemple Creek**	**Stemple Tributaries**
Irrigation Impacts				
Copper		1%, 5%, 10%	1%, 5%	1%, 5%
Storage Impacts				
Ammonia	1%, 5%, 10%	1%, 5%, 10%	1%, 5%, 10%	1%, 5%, 10%
Dissolved oxygen		1%, 5%, 10%		1%, 5%, 10%
H_2S		1%, 5%, 10%		1%, 5%, 10%

Summary of Proposed Mitigation

Dissolved Copper

Exceedances of the point of significance for dissolved copper are due to relatively higher concentrations of dissolved copper in irrigation water from concentration through evapotranspiration. Mitigation to reduce dissolved copper reaching surface waters in the Americano watershed would be to initially limit design irrigation acreage to 4,500 acres in the Stemple watershed. Irrigation shall be limited to 360 acres in the subwatershed in which the Bloomfield reservoir is proposed. These acreage limitations are based on the estimated maximum acreage that may be irrigated without causing the dissolved copper point of significance to be exceeded (assuming a hardness of 130 mg/L. Streams in the Stemple and Americano watersheds should be monitored monthly for dissolved copper and hardness. Adjustments can then be made to the irrigation acreage, depending on the monitoring results for dissolved copper concentration, and the evaluation criterion as determined by the measured hardness..

Ammonia, Dissolved Oxygen, and H_2S

Exceedances of points of significance for ammonia, dissolved oxygen, and H_2S are caused from dam seepage of anoxic hypolimnetic water. Options to reduce ammonia, low dissolved oxygen, and H_2S include artificial reservoir circulation or hypolimnetic oxygenation, and pumping any seepage that reaches surface water back to the reservoir. The objective of artificial circulation is to eliminate thermal stratification, or to prevent its formation, through the injection of compressed air from a pipe or ceramic diffuser at the reservoir's bottom. The rising column of bubbles, if sufficiently powered, will produce reservoir-wide mixing at a rate that will eliminate temperature differences between top and bottom waters and thus cause destratification (EPA 1988).

The pump-back option would involve installing wells and/or a cut-off wall to intercept seepage. This mitigation is considered to be equally effective as the artificial circulation option, but less costly. Therefore, the pumpback option is recommended.

Effectiveness of Proposed Mitigation

Dissolved Copper

The estimated concentration of dissolved copper at a particular location in a West County stream depends on the fraction of land upstream of the location that would be irrigated. Thus, reducing the irrigated fraction reduces the estimated dissolved copper concentration. The irrigation acreage reduction needed to avoid impacts has been estimated using the same method used to evaluate impacts. Thus, the recommended irrigation acreage reduction will avoid the estimated potential impact. Monitoring should be conducted to verify effectiveness.

Ammonia, Dissolved Oxygen, and H_2S

A properly designed system of wells, possibly in combination with a cut-off wall, is an accepted practice for managing groundwater plumes. Conditions at reservoir sites are generally amenable to this technique (e.g., layer of very low impermeability near the surface). Therefore, this mitigation measure is considered to be effective.

6.1.2 Esteros

The effect of irrigation and storage on Americano Creek and Stemple Creek flows and quality is identified in the preceding section of this report. This section describes the effect of the project-affected creek flows on Estero Americano and Estero de San Antonio. Since no reclaimed water will be discharged directly into either Estero, impacts are only indirect.

Screening of Evaluation Criteria

A water quality evaluation criterion was established specifically for special sites such as the two Esteros. The evaluation criterion is that any water quality change is considered significant.

The screening of evaluation criteria described above for West County streams identified metals, ammonia, biostimulatory substances, chloride, dissolved oxygen, hydrogen sulfide, total dissolved solids, temperature, and turbidity. Of these, the following constituents are addressed in the evaluation of irrigation and storage impacts on the Esteros:

- Total Dissolved Solids

- Ammonia. No change in ammonia due to nitrification in the creeks is assumed so the resulting concentration of ammonia may be overestimated.
- Biostimulatory Substances. The project effect on planktonic and benthic algae is addressed.
- Dissolved Oxygen.
- Temperature
- Metals

Reasons for not considering the remaining constituents in the analysis of irrigation and storage effects on the Esteros are as follows:

- **Chloride.** Chloride is a component of total dissolved solids, which is a more relevant parameter in an estuarine environment like the Esteros.
- **Hydrogen Sulfide.** Hydrogen sulfide could be present in the seepage from a stratified storage reservoir. However, hydrogen sulfide readily oxidizes and is not expected to be present in streamflows upon discharge to the Esteros because the travel time of water in the streams from the storage site to the Esteros is long relative to the oxidation rate of hydrogen sulfide.
- **Turbidity.** Turbidity consists of an organic (e.g., algae) and inorganic (e.g., silt) fraction. The project has been defined such that no increase in erosion, and thus inorganic turbidity, will occur (see Section 2 of the EIR/S).

Impact Evaluation Approach

A hydraulic and water quality model was developed to simulate the effect of various irrigation and hydrology conditions on Estero water quality. The details of the model are described in the *Water Quality and Flow Model for Irrigation/Storage Area Streams* Technical Report (RMA 1996). Water quality conditions in the Esteros were simulated under two watershed conditions as follows:

- Existing conditions.
- Irrigation associated with the 1 percent design Russian River/Laguna discharge rate.

Under each watershed condition, Estero water quality was also simulated under the following hydrologic conditions:

- Dry year (which includes the effect of contingency irrigation, and therefore is addressed in the Contingency Irrigation section below)
- Average year
- Wet Year

Under each combination of watershed and hydrologic condition, Estero water quality was simulated for spring and summer Estero inflow conditions. As described in Section 6.2.1 West County Creeks, nitrogen in irrigation-affected subsurface flows is expected to be removed to background concentrations by the riparian corridor that is included in the project description. The Estero water quality impacts assessment is based on this expectation. Spring and summer inflows of 9 and 3 cfs were assumed for Estero Americano, respectively. Spring and summer inflows of 8 and 3 cfs were assumed for Estero de San Antonio, respectively. These inflows were developed based on hydrologic data, as described in the *Water Quality and Flow Model for Irrigation/Storage Area*

Streams Technical Report (RMA 1996). Impacts to the Esteros are all indirect since no reclaimed water will be discharged directly into either Estero.

Under each combination of watershed, hydrologic condition, and inflow condition, Estero water quality was simulated for bar-open and bar-closed conditions. The dynamics of the sand bar at the inlet of each Estero are described in Section 4.6 of the EIR/S (Water Quality Affected Environment (Setting) section).

Impact Evaluation Results

The effect of a 1 percent irrigation project on water quality in the Esteros is considered significant according to the evaluation criteria described in Section 3 because water quality conditions would be affected by the project. Figures 6-1 through 6-5 illustrate potential project effects on total dissolved solids, ammonia, planktonic algae, benthic algae, and dissolved oxygen. Tables 6-11 through 6-15 summarize the impacts described in each of Figures 6-1 through 6-5, respectively. Figures 6-1 through 6-5 show the estimated daily average, daily minimum and daily maximum values for existing conditions and project conditions for each inflow condition (spring and summer), hydrologic condition (dry, average, wet years), and inlet condition (open and closed).

The simulations presented in Figures 6-1 through 6-5 show that water quality in the Esteros would be changed by irrigation or by irrigation with storage, although the effect is slight in many cases. Irrigation and storage effects on total dissolved solids, ammonia, planktonic algae, benthic algae, and dissolved oxygen, metals and temperature are described below for irrigation scenarios other than winter (contingency) irrigation. Winter irrigation impacts are evaluated separately in the Contingency irrigation section below.

Figures 6-1 through 6-5 do not show the full range of water quality conditions that can occur in the Esteros because inflow conditions other than those simulated occur. The particular inflow and season conditions that were simulated were selected because the watershed model indicated that the project would have the greatest impact on stream flow and quality under the conditions that were selected.

Tables 6-11 through 6-15 are each structured such that each cell relates to one of 24 sheets of each of Figure 6-1 through 6-5. In cases where the same description applies to more than one irrigation condition (and thus more than one figure), table cells have been merged. For example, the first data cell of Table 6-11 describes Figures 6-1.1, 6-1.2, and 6-1.3. The second data cell in Table 6-11 describes Figures 6-1.4, and 6-1.5, and the third data cell describes only Figure 6-1.6. The numeric values that are included in the cells of Table 6-11 through 6-15 describe the *difference* between existing and project conditions, and these values are approximate.

Total Dissolved Solids

Effects of irrigation and storage on total dissolved solids in the Esteros are summarized in Table 6-11 and Figure 6-1. Total dissolved solids would be increased in both Esteros under all scenarios considered. This would occur in spring because inflows are expected to be reduced as a result of the storage and improved watershed management (*Aquatic Biological Resources Impacts Analysis* Technical Report, MSC 1996). The increased total dissolved solids would occur in summer because the total dissolved solids in the creeks would increase as a result of deficit-mode irrigation.

In Estero de San Antonio, total dissolved solids increases of 2,500 mg/L would occur throughout the Estero under summer inflows and bar-closed spring inflows. Total dissolved solids in Estero Americano would also be about 2,500 mg/L, and would occur near the inlet under bar-closed conditions in spring, and all summer inflow scenarios.

Ammonia

Effects of irrigation and storage on ammonia in the Esteros are summarized in Table 6-12 and Figure 6-2. The concentration of total ammonia in both Esteros would be reduced by implementing an irrigation project or irrigation with storage relative to existing conditions.

Planktonic Algae

Effects of irrigation and storage on planktonic algae in the Esteros are summarized in Table 6-13 and Figure 6-3. Planktonic algae would be reduced in both Esteros under all irrigation scenarios. The magnitude of the planktonic algae reduction would be largest during spring. Under bar-open conditions, reductions in planktonic algae would be greatest at the upper end of each Estero. Under bar-closed conditions, algae reductions would extend through the Esteros. Estimated algae biomass is reduced because nutrient loading to the Esteros would be reduced by the project.

Table 6-11.

Summary of Irrigation and Storage Impacts on TDS in the Esteros

The information in this table summarizes the information in Figure 6-1.1 through 6-1.24. Values in parentheses in each cell of this table relate the text in the cell to the appropriate part of Figure 6-1. The numeric values in the cells describe the *difference* between existing and project conditions, and these values are approximate. Locs= locations, and mi = distance from mouth in miles

Spring Inflow Condition						Summer Inflow Condition					
Bar Open			Bar Closed			Bar Open			Bar Closed		
Wet	Average	Dry[a]	Wet	Average	Dry[a]	Wet	Average	Dry[a]	Wet	Average	Dry[a]
Estero Americano											
(1)(2)(3) increase of 2500 mg/L, mi. 1-6			(4)(5) No change in upper end; increasing downstream by 2500 mg/L at mouth		(6) increase all locs, 2500 mg/L	(7)(8)(9)(10)(11)(12) No change at mouth; increases upstream to max increase of 2500 mg/L at upper end					
Estero de San Antonio											
(13)(14) no change upper part (mi. 5-8); increase of max. 2500 mg/L downstream		(15) increase all locs; max increase in middle 2500 mg/L	(16) increase all locs; max increase 500 mg/L upper part, 300 mg/L lower part	(17) Slight decrease (by 600 mg/L) upper part; increase lower part (mi 0-5) w/ max increase near mouth 2500 mg/L	(18) increase all locs, by 2000 mg/L	(19)(20) increase all locs; max increase in middle of 2500 mg/L		(21) increase all locs; max increase in middle of 1600 mg/L	(22)(23) increase all locs of 2000 mg/L		(24) increase all locs; small at mouth, increasing to max increase of 1600 mg/L at mi 8

[a] Includes effect of winter irrigation

Table 6-12.

Summary of Irrigation and Storage Impacts on Ammonia in the Esteros

The information in this table summarizes the information in Figure 6-2.1 through 6-2.24. Values in parentheses in each cell of this table relate the text in the cell to the appropriate part of Figure 6-2. The numeric values in the cells describe existing and project conditions, and these values are approximate. Locs= locations, and mi = distance from mouth in miles

Spring Inflow Condition						Summer Inflow Condition					
Bar Open			Bar Closed			Bar Open			Bar Closed		
Wet	Average	Dry[a]	Wet	Average	Dry[a]	Wet	Average	Dry[a]	Wet	Average	Dry[a]
Estero Americano											
(1)(2)(3) greatly reduced in variability and conc. in upper part (mi 3-8); max. now <0.5, down from 5 mg-N/L			(4)(5)(6)greatly reduced in variability and conc. all locs; max. now <1, down from 5 mg-N/L			(7)(8)(9)reduced all locs; max now 0.3 mg-N/L, down from 0.8-1 mg-N/L in upper end			(10)(11)(12) reduced all locs; max now 0.8-1.0 mg-N/L, down from 1.5-2 mg-N/L		
Estero de San Antonio											
(13)(14)(15) greatly reduced in variability and conc. all locs, to <0.5 mg-N/L, down from 5 mg-N/L at upper locs			(16) greatly reduced in variability and conc. all locs, to <0.5 mg-N/L, down from 2.5 mg-N/L (mouth), 5 at upper locs	(17) greatly reduced in variability and conc. all locs, to <0.75 mg-N/L, down from 2.5 mg-N/L (mouth), 5 at upper locs	(18) reduced all locs, to 0.75 mg-N/L down from 2.5 mg-N/L (mouth), 5 at upper locs	(19)(20)(21) reduced in variability and conc.; max now <0.4 mg-N/L, down from 1.6-1.8 mg-N/L at upper end			(22)(23)(24) reduced all locs, to <1 mg-N/L, down from 1-1.5 mg-N/L		

[a] Includes effect of winter irrigation

Table 6-13.

Summary of Irrigation and Storage Impacts on Planktonic Algae in the Esteros

The information in this table summarizes the information in Figure 6-3.1 through 6-3.24. Values in parentheses in each cell of this table relate the text in the cell to the appropriate part of Figure 6-3. The numeric values in the cells describe existing and project conditions or the *difference* between existing and project conditions, and these values are approximate. Locs= locations, and mi = distance from mouth in miles

Spring Inflow Condition						Summer Inflow Condition					
Bar Open			Bar Closed			Bar Open			Bar Closed		
Wet	Average	Dry[a]	Wet	Average	Dry[a]	Wet	Average	Dry[a]	Wet	Average	Dry[a]
Estero Americano											
(1)(2)(3) decrease from 20-45 mg/L to 10-15 at mi 2-8			(4) decrease all locs by about 20 mg/L	(5)(6) decrease all locs; by 10 mg/L at mouth, 15 mg/L mid, 25 mg/L at mi. 8		(7)(8)(9) decrease by about 30 mg/L at upper end, decreases diminishing to 5 mg/L at mount			(10)(11)(12) decrease by about 20 mg/L upper end, decreases diminishing to <5 mg/L at mouth		
Estero de San Antonio											
(13)(14)(15) decrease from about 30 mg/L to 10-15 mg/L at mi 1-8			(16)(17)(18) decrease all locs by 25-30 mg/L			(19)(20)(21) decreases from 50-60 to 15-30 at mi 3-8			(22)(23)(24) decrease all locs by about 5 mg/L		

[a] Includes effect of winter irrigation

Table 6-14.

Summary of Irrigation and Storage Impacts on Benthic Algae in the Esteros

The information in this table summarizes the information in Figure 6-4.1 through 6-4.24. Values in parentheses in each cell of this table relate the text in the cell to the appropriate part of Figure 6-4. The numeric values in the cells describe the *difference* between existing and project conditions, and these values are approximate. Locs= locations, and mi = distance from mouth in miles

Spring Inflow Condition						Summer Inflow Condition					
Bar Open			Bar Closed			Bar Open			Bar Closed		
Wet	Average	Dry[a]	Wet	Average	Dry[a]	Wet	Average	Dry[a]	Wet	Average	Dry[a]

Table 6-14.

Summary of Irrigation and Storage Impacts on Benthic Algae in the Esteros

The information in this table summarizes the information in Figure 6-4.1 through 6-4.24. Values in parentheses in each cell of this table relate the text in the cell to the appropriate part of Figure 6-4. The numeric values in the cells describe the *difference* between existing and project conditions, and these values are approximate. Locs= locations, and mi = distance from mouth in miles

Spring Inflow Condition						Summer Inflow Condition					
Bar Open			Bar Closed			Bar Open			Bar Closed		
Wet	Average	Dry[a]	Wet	Average	Dry[a]	Wet	Average	Dry[a]	Wet	Average	Dry[a]
Estero Americano											
(1) no change or slight increase mi 5-8; increase (0.4 g/m^2) mi 3.5-5 and 1-2; slight decrease at mouth	(2) no change or slight increase mi 5-8; increase (0.4 g/m^2) mi 3-5; decrease of about 1 g/m^2 mi 0-1	(3) no change or slight increase mi 5-8; increase (0.2 g/m^2) mi 3-5; decrease of about 0.2-1 g/m^2 mi 0-3	(4)(5) increase of 0.2-0.5 g/m^2 mi 2-8; no change mi 0.5-2; slight decrease at mouth		(6) increase of 0.1-0.2 g/m^2 at mi 2-8; no change mi 1-1.5; slight decrease at mouth	(7)(8)(9) no change mi 3-8; decrease of up to 1 g/m^2 mi 1-3			(10)(11)(12) no change mi 1-8; decrease of about 1.5 g/m^2 at mouth		

Table 6-14.

Summary of Irrigation and Storage Impacts on Benthic Algae in the Esteros

The information in this table summarizes the information in Figure 6-4.1 through 6-4.24. Values in parentheses in each cell of this table relate the text in the cell to the appropriate part of Figure 6-4. The numeric values in the cells describe the *difference* between existing and project conditions, and these values are approximate. Locs= locations, and mi = distance from mouth in miles

Spring Inflow Condition						Summer Inflow Condition					
Bar Open			Bar Closed			Bar Open			Bar Closed		
Wet	Average	Dry[a]	Wet	Average	Dry[a]	Wet	Average	Dry[a]	Wet	Average	Dry[a]
Estero de San Antonio											
(13) slight increase (0.5 g/m^2) at mi 4-6; greater increase (up to 2 g/m^2) mi 1-2 and 6-8	(14) slight increase (0.5 g/m^2) at mi 3-8; greater increase (up to 2 g/m^2) mi 1-2	(15) slight increase (0.5 g/m^2) at mi 3-8; greater increase (up to 1 g/m^2) mi 1-2	(16) increase all locs 0.5-2 g/m^2	(17) increase all locs 0.5-1 g/m^2	(18) slight increase (0.2 g/m^2) at mi 2-6; greater increase (1 g/m^2) mi 7-8; slight decrease near mouth	(19)(20) slight increase (0-0.2 g/m^2) mi 3-8; greater increase (1 g/m^2) mi 1-2		(21) slight increase (0-0.2 g/m^2) mi 3-8; slight decrease (<0.5 g/m^2) mi 0-2.5	(22)(23)(24) increase at upper locs of about 0.6 g/m^2, diminishing to 0 at mi 2; slight decrease (up to 0.6 g/m^2) mi 0-1.5		

[a] Includes effect of winter irrigation

Table 6-15.

Summary of Irrigation and Storage Impacts on Dissolved Oxygen in the Esteros

The information in this table summarizes the information in Figure 6-5.1 through 6-5.24. Values in parentheses in each cell of this table relate the text in the cell to the appropriate part of Figure 6-5. The numeric values in the cells describe the *difference* between existing and project conditions, and these values are approximate. Locs= locations, and mi = distance from mouth in miles

Spring Inflow Condition						Summer Inflow Condition					
Bar Open			Bar Closed			Bar Open			Bar Closed		
Wet	Average	Dry[a]	Wet	Average	Dry[a]	Wet	Average	Dry[a]	Wet	Average	Dry[a]
Estero Americano											
(1)(2) less variability all locs; 1 mg/L increase lower locs, 1 mg/L decrease mi 5-6		(3) less variability all locs; increase 1-1.5 mg/L all locs	(4)(5) decrease, up to 1.5 mg/L at mi 2-5		(6) no change mi 0-4; decrease 1.5 mg/L mi 5-8	(7)(8)(9) less variability all locs; no change at upper end & mouth; increase in middle (max of 1.5 mg/L at mi 5)			(10)(11) no change mi 0-5; slight decrease (1-2 mg/L) mi 6-8		(12) slight increase & more variability , mi 1-5; decrease up to 3 mg/L at mi 6-8

Table 6-15.

Summary of Irrigation and Storage Impacts on Dissolved Oxygen in the Esteros

The information in this table summarizes the information in Figure 6-5.1 through 6-5.24. Values in parentheses in each cell of this table relate the text in the cell to the appropriate part of Figure 6-5. The numeric values in the cells describe the *difference* between existing and project conditions, and these values are approximate. Locs= locations, and mi = distance from mouth in miles

Spring Inflow Condition						**Summer Inflow Condition**					
Bar Open			**Bar Closed**			**Bar Open**			**Bar Closed**		
Wet	**Average**	**Dry[a]**	**Wet**	**Average**	**Dry[a]**	**Wet**	**Average**	**Dry[a]**	**Wet**	**Average**	**Dry[a]**
<u>Estero de San Antonio</u>											
(13)(14) less variability all locs; slight increase (up to 1 mg/L) mi 1-7		(15) less variability all locs; slight decrease (up to 1 mg/L) mi 3-7	(16) less variability at all locs; decrease (up to 2 mg/L) mi 0-3; increase up to 2 mg/L mi 4-7	(17) decrease all locs, slight to max of 3 mg/L at mi 3	(18) decrease mi 3-7 (max of 3 mg/L at mi 6	(19)(20) less variability all locs; decrease at mi 3-7 (max of 2.5 mg/L at mi 6		(21) less variability all locs; decrease at mi 3-7 (max <1 mg/L at mi 5-6	(22)(23) decrease mi 5-8 (max of ca 2 mg/L); increase mi 0-3 (max of 1 mg/L		(24) decrease mi 6-8 (max 1 mg/L); increase mi 0-3 (max 1.5 mg/L

[a] Includes effect of winter irrigation

Benthic Algae

Effects of irrigation and storage on benthic algae in the Esteros are summarized in Table 6-14 and Figure 6-4. In Estero de San Antonio, spring inflow scenarios, the amount of benthic algae would increase within 1 to 2 miles of the inlet (bar-open) or throughout (bar-closed). Under summer inflow scenarios, benthic algae biomass would increase less than in spring. Under bar-closed conditions, benthic algae biomass would increase only slightly in the upper reaches of Estero de San Antonio, but biomass would decrease near the inlet.

In Estero Americano, benthic algae biomass would decrease slightly near the mouth as a result of project implementation, especially under summer inflow scenarios.

Dissolved Oxygen

Effects of irrigation and storage on dissolved oxygen in the Esteros are summarized in Table 6-15 and Figure 6-5. Simulated dissolved oxygen values for most project conditions are less variable than existing conditions, and projected minima and maxima are within the range of simulated existing minima and maxima. Simulated average dissolved oxygen values in many of the scenarios are mixed, with increased dissolved oxygen in part of each Estero and decreases in other parts. The maximum magnitude of the differences between simulated existing and project conditions is less than 2 mg/L.

Metals

Effects of irrigation and storage on dissolved metals in the Esteros are summarized in Figure 6-6. Predicted metals concentrations in the Esteros show little variation between different hydrology years and between bar condition. Slightly more variation existed between stations in the Estero and between spring and summer than between hydrology years or bar condition. No consistent pattern exists with respect to existing conditions. With some metals and/or project conditions the predicted concentrations were lower than existing concentrations; with other metals and/or project conditions the predicted concentrations were higher than existing concentrations. The variation between existing and predicted metals concentrations is within the variation observed in dissolved metals in the Esteros (*Environmental Conditions in West County Waterways* Technical Report, MSC 1996).

Temperature

The effects of irrigation and storage on temperature in the Esteros are small (less than 1 °C. However, under the strict evaluation criterion, which requires finding any water quality change to be a significant impact, the potential impact of irrigation associated with the 5 and 10 percent design discharges would be considered significant.

Proposed Mitigation

Water quality changes in the Esteros are expected to result from the altered quantity and quality of the water flowing into the Esteros from the watershed. The primary water quality changes in the Esteros, their causes, and possible mitigation measures are summarized as follows:

Effect in Esteros	Project-Related Cause	Potential Mitigation
Elevated Salinity	In spring, the rate of inflow would be reduced slightly and salt content of the inflow would be increased slightly. In summer, the rate of inflow and salt content of the inflow would be increased. Salt is increased in the creeks because of the natural process of evapotranspiration in irrigated areas that leaves behind some of the dissolved constituents in reclaimed water.	Reduce salinity by constructing a desalination plant to treat water in creeks prior to discharge into the Esteros. A pipeline around the Esteros to the ocean or deep aquifer injection would be needed for brine disposal. Develop a water source to increase springtime flows in the stream reach below the selected storage site. Intercept a portion of streamflow during summer to provide existing inflow conditions. The intercepted water would need to be returned to the irrigation system.
Reduced Algae	The project description in Section 2 includes several elements that will reduce the amount of manure that enters the Esteros.	Existing manure management practices would continue if stream corridor protection and manure management provisions in the project description were eliminated.
Reduced Dissolved oxygen variation	Reduced algal growth and manure inputs due to the project	Same as above for "Reduced Algae"
Increased Metals	A small portion of the dissolved constituents in reclaimed water are metals. Like other dissolved reclaimed water constituents, metals are concentrated by evapotranspiration.	Treating creek water with reverse osmosis would be expected to reduce metals to background levels.
Reduced sediment load	The project description in Section 2 includes several elements that will reduce the amount of manure that enters the Esteros.	Maintenance of the existing erosion conditions could be achieved by modifying cultivation restrictions, and by removing stream corridor protection management provisions in the project description

These potential mitigation and avoidance measures are not recommended for the following reasons:

- **Effectiveness.** The threshold of significance for Estero impact is extremely stringent: any water quality change from existing conditions is considered significant. The potential mitigation measures listed above would not completely avoid significant impacts because they cannot be implemented to perfectly re-create existing conditions. The potential impacts that would persist after implementation of mitigation and avoidance measures would be different than those without mitigation, but the potential impacts that would persist after implementation of mitigation and avoidance measures would also be significant. Criteria have not been established by which to determine which set of impacts (project impacts vs. those that would persist after mitigation) are preferable.
- **Practicality.** Eliminating project components that generally enhance environmental quality, such as manure management requirements and riparian corridor buffers for the sake of avoiding change in the Esteros is impractical.

6.2 CONTINGENCY IRRIGATION

6.2.1 West County Creeks

Contingency (winter) irrigation would cause effects in the West County streams that are generally similar to those of design irrigation with some exceptions. The effect of contingency irrigation on specific constituents is evaluated below.

Total Dissolved Solids

Contingency (winter) irrigation is predicted to cause an increase in TDS in West County streams relative to existing conditions. The predicted range of TDS for Americano Creek (A1), a tributary of Americano Creek (AB1), Stemple Creek (S1), and a tributary of Stemple Creek (SH1) are shown in Table 6-16. No evaluation criterion exits for TDS in West County streams so the increase in TDS is not considered significant.

Chloride

Contingency (winter) irrigation is predicted to cause an increase in chloride in West County streams relative to other irrigation scenarios. The predicted ranges of chloride for Americano Creek (A1), a tributary of Americano Creek (AB1), Stemple Creek (S1), and a tributary of Stemple Creek (SH1) are shown in Table 6-16. The maximum concentration of chloride predicted to occur with contingency irrigation is 91.8 mg/L, which does not exceed the point of significance for chloride (230 mg/L). Therefore, the impact of contingency irrigation on chloride in West County streams is predicted to be less than significant.

Ammonia

Predicted exceedances of ammonia points of significance in West County streams under project irrigation scenarios are due to seepage from dams, which is unaffected by winter irrigation. Even in winter it is a good assumption that between the reservoir processes and the processes that occur in soil, ammonia will be almost or completely undetectable in water that passes through the root zone (*pers. comm.* Jeff Peters, Questa Engineering 3 April 1996). Thus, ammonia from irrigation water should not cause ammonia exceedances. Therefore, the impact of contingency irrigation on ammonia in West County streams, is predicted to be less than significant.

Biostimulatory Substances - Planktonic Algae and Benthic Algae

The riparian buffers that are part of the project description are expected to prevent impact of irrigation on nitrogen in tributary streams. The manure management provisions of the project description (see Section 2 of the EIR/S) are expected to reduce the nitrogen concentration in main stem creeks. The net effect of the project is to reduce the amount of nutrients available for algae growth. Contingency irrigation impacts would not be different from design irrigation impacts since manure management practices will reduce nitrogen under all conditions, including contingency conditions. In addition, the riparian buffers function in winter and spring (Mitsch and Gosselink 1993, Peterjohn and Correll 1984, 1986, Jordan et al 1993, Weller et al 1994), when contingency irrigation would be implemented. Thus, contingency irrigation, like design irrigation, is expected to reduce the biostimulatory substances in West County streams. This impact is considered less than significant.

Dissolved Oxygen and Hydrogen Sulfide

Predicted exceedances of dissolved oxygen and hydrogen sulfide points of significance in West County streams under project irrigation scenarios are due to seepage from dams which is unaffected by contingency irrigation. Therefore, the impact of contingency irrigation on dissolved oxygen and H_2S in West County streams is predicted to be less than significant.

Metals

The predicted ranges of metals entering West County streams with winter irrigation (Table 6-16) are similar to the ranges of metals entering West County streams with other irrigation scenarios. Most metals are not predicted to exceed their points of significance. The exception is dissolved copper, which is predicted to exceed the point of significance for dissolved copper in both the main stem and tributaries of Americano and Stemple Creeks. Most of the exceedances occur under the condition of no storage reservoir in the watershed (therefore more land under irrigation). Because of these predicted exceedances of the point of significance for dissolved copper, the impact of contingency irrigation in West County streams is predicted to be significant.

Contingency irrigation should not be done in any lands in the Stemple or Americano irrigation areas prior to collection of dissolved copper and hardness data (in association with design irrigation mitigation discussed 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 if the results of the evaluation indicate impacts on dissolved copper would be less than significant. Monitoring of contingency irrigation impacts should be conducted to verify the impacts analysis that is based on the post-design irrigation monitoring data.

Temperature

Since groundwater in irrigated and non-irrigated areas is predicted to reflect the average annual temperature at a particular site (Memorandum from Jeff Peters, Questa Engineering to Dave Smith, MSC dated 12 October 1995), the impact of contingency irrigation on temperature in West County streams is predicted to be less than significant.

Turbidity

Since the impact of contingency irrigation on planktonic algae in West County streams is predicted to be similar to the impact of design irrigation, the impact of contingency irrigation on turbidity due to planktonic algae is predicted to be less than significant

Table 6-16.

Range of Impacts of Contingency Irrigation in the Americano and Stemple Watersheds

	A1	AB1	S1	SH1

	minimum[a]	**maximum[a]**	**minimum[a]**	**maximum[a]**	**minimum[a]**	**maximum[a]**	**minimum[a]**	**maximum[a]**
Wet Season Concentrations								
TDS	178	201	105	370	150	200	160	270
Chloride	10.0	11.3	5.9	20.8	8.5	11.3	9.0	15.2
2.4-D	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Carbaryl	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Diss. Arsenic	0.0025	0.0025	0.0024	0.0025	0.0024	0.0025	0.0024	0.0025
Diss. Cadmium	0.0003	0.0003	0.0003	0.0005	0.0003	0.0003	0.0003	0.0004
Diss. Chromium	0.0024	0.0024	0.0021	0.0025	0.0024	0.0025	0.0023	0.0025
Diss. Copper	0.0044	0.0049	0.0025	0.0089	0.0036	0.0047	0.0038	0.0064
Diss. Lead	0.0010	0.0011	0.0010	0.0012	0.0010	0.0011	0.0010	0.0011
Diss. Mercury	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Diss. Nickel	0.0027	0.0028	0.0025	0.0033	0.0030	0.0035	0.0031	0.0042
Diss. Selenium	0.0025	0.0025	0.0024	0.0025	0.0025	0.0025	0.0025	0.0025
Diss. Silver	0.0005	0.0005	0.0005	0.0006	0.0005	0.0005	0.0005	0.0005
Diss. Zinc	0.012	0.013	0.005	0.028	0.009	0.013	0.010	0.019
Dry season Concentrations								
TDS	1123	1516	483	1656	1148	1576	909	1630
Chloride	63.2	85.4	27	93	64.6	88.8	51.2	91.8
2.4-D	0.0024	0.0034	0.000000	0.0038	0.0037	0.0050	0.0024	0.0052
Carbaryl	0.00015	0.00021	0.000000	0.00024	0.00011	0.00015	0.00007	0.00016
Diss. Arsenic	0.0062	0.0078	0.0025	0.0085	0.0067	0.0081	0.0052	0.0084
Diss. Cadmium	0.0007	0.0009	0.0003	0.00010	0.0008	0.0010	0.0006	0.0010
Diss. Chromium	0.0011	0.0013	0.0009	0.0025	0.0011	0.0014	0.0009	0.0013
Diss. Copper	0.013	0.015	0.025	0.016	0.013	0.015	0.012	0.016
Diss. Lead	0.0017	0.0018	0.0010	0.0019	0.0017	0.0019	0.0017	0.0019
Diss. Mercury	0.0002	0.0002	0.0001	0.0002	0.0002	0.0002	0.0002	0.0002
Diss. Nickel	0.0057	0.0068	0.0025	0.0073	0.0060	0.0072	0.0052	0.0074

Table 6-16.

Range of Impacts of Contingency Irrigation in the Americano and Stemple Watersheds

	A1		AB1		S1		SH1	
	minimum[a]	maximum[a]	minimum[a]	maximum[a]	minimum[a]	maximum[a]	minimum[a]	maximum[a]
Diss. Selenium	0.0025	0.0030	0.0012	0.0031	0.0028	0.0030	0.0019	0.0030
Diss. Silver	0.0007	0.0008	0.0005	0.0008	0.0007	0.0008	0.0007	0.0008
Diss. Zinc	0.057	0.071	0.050	0.079	0.058	0.075	0.051	0.078

[a] Data from model output described in *Water Quality and Flow Model for Irrigation/Storage Area Streams* Technical Report (RMA 1996).

6.2.2 Esteros

Contingency (winter) irrigation would cause effects in the Esteros that are generally similar to other those of other irrigation scenarios. Tables 6-11 through 6-15 and Figures 6-1 through 6-5 illustrate the effect of winter irrigation. The effect on specific constituents is evaluated below.

Total Dissolved Solids

The magnitude of total dissolved solids increases due to winter irrigation would not be different from other design irrigation, but increases would occur over a larger area in both Esteros.

Ammonia

All of the irrigation scenarios would reduce the concentration of ammonia in the Esteros, but winter irrigation would lead to the smallest reduction.

Planktonic Algae

The effect of winter irrigation on planktonic algae density is similar to the effect of project irrigation in an average year.

Benthic Algae

Winter irrigation would result in a similar or slightly reduced benthic algae biomass than that predicted to result from irrigation in an average year.

Dissolved Oxygen

The magnitude of the dissolved oxygen decrease due to winter irrigation is greater than for other irrigation scenarios, and can be as much as 3 mg/L.

Metals

The effect of winter irrigation on dissolved metals concentrations in the Esteros is similar to the effect of project irrigation in average and wet years.

6.3 UNPLANNED EVENT

A scenario involving an unplanned runoff of 34,000 gallons discharge over a 12 hour period has been identified as a basis for evaluating agricultural irrigation impacts. Such an event would result in a discharge rate of 0.1 cfs. The runoff flow would be equivalent to or less than the estimated flow in the streams in the west county irrigation area (see Appendices A and B of *Aquatic Biological Resources Impacts Assessment* Technical Report (MSC 1996) for estimate stream flows). Since the concentration of each water quality constituent in undiluted reclaimed water is less than the respective point of significance, the impact of the unplanned runoff event is considered to be less than significant.

6.4 CUMULATIVE IMPACTS

The Stemple Creek/Estero de San Antonio Watershed Enhancement Plan (Prunuske Chatham 1994) is the one proposed 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 project description and mitigation (see Section 2.2 of the EIR/S) and, as such, would 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 would result in changes to the flow and quality of Stemple Creek that would 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 would 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, implying that not all potential impacts in Esteros are considered to be adverse by all scientists familiar with the ecology of the Esteros.

7.0 SOUTH COUNTY

This section evaluates potential project impacts on water quality in South County.

7.1 IRRIGATION AND STORAGE

The effect on surface water of irrigating South County lands was evaluated in the *Baseline Hydrology and Irrigation Drainage Evaluation for West and South County Reclamation Alternative* (1996). The report evaluated the surface hydrology effect of irrigating lands in the Tolay watershed, Baylands with Reyes soils, and other South County lands.

7.1.1 Tolay Watershed

Screening of Evaluation Criteria

The evaluation of storage and irrigation impacts on water quality in South County was evaluated for specific water quality constituents. Water quality constituents not screened from further analysis in Table 3-1 were evaluated and screened again for appropriateness in the South County Irrigation/Storage impacts evaluation. The results of this screening were identical to the screening results for West County with exceptions for Baylands irrigation noted in that section. Table 6-1 shows the evaluation criteria with points of significance that were not screened in Table 3-1, and provides rationale for screening several additional evaluation criteria from consideration in the West County and South County Irrigation/Storage impacts evaluation.

Evaluation Approach

The *Baseline Hydrology and Irrigation Drainage Evaluation for West and South County Reclamation Alternative* report (1996) indicates that irrigation in the Tolay watershed could affect surface water flows, and thus potentially also affect surface water quality. The method for determining effect of irrigation and irrigation with storage on flows is the same as that described above for West County, and is also described in *Water Quality and Flow Model for Irrigation/Storage Area Streams* Technical Report (RMA 1996). Locations modeled in the watersheds of Tolay, Lakeville and Adobe storage sites at which flow and quality were estimated are shown in the appendix of *Aquatic Habitat Survey Results* Technical Report (MSC 1996) and are designated as follows:

Tolay	Lakeville	Adobe
TT	L1	A1
TS	L2	A2
TA	-	-

Stations TT, TS, and TA are on Tolay Creek. TT encompasses the total watershed, TS is below the proposed Sears Point dam site, and TA is below the lowest proposed Tolay dam site. Proposed storage facilities in the Tolay watershed are the Sears Point, the Tolay

A, and the Tolay C storage reservoirs. Irrigation would occur in the Tolay watershed upstream of any of the storage reservoirs. Irrigation drainage and stormwater would be diverted around whichever reservoir might be built. Thus, irrigation drainage could potentially affect the quality of water downstream of any storage reservoir built in the Tolay watershed. This is different from the West County storage sites in that the influence of any irrigation occurring upstream of the West County storage sites would be contained to waters upstream of the reservoir.

The analysis of water quality impacts in the Tolay watershed is restricted to the non-tidal portion of the watershed. Obstructions in the Tolay Creek channel between Highways 121 and 37 currently cause dispersion of Tolay Creek flows from the channel into adjacent marsh such that low spring and summer creek flows evapotranspire and do not discharge to the tidal segment of the habitat below the channel obstruction. Project-related creek flows will also be so impounded and will not affect the tidal environment during spring and summer. During periods when Tolay Creek flows are sufficient to overcome the effects of the channel obstruction, the quality of Tolay Creek flows would not be affected significantly by the proposed project because this only occurs in wet conditions when project contribution is a small percentage.

Impact Evaluation Results

Significant Impacts

This section compares the estimated concentrations of constituents in the receiving water with points of significance (described in *Development of Evaluation Criteria for Potential Water Quality Impacts* Technical Report, MSC 1996) for those constituents.

Metals

Potential impacts of project storage and irrigation on dissolved arsenic, dissolved cadmium, dissolved chromium, dissolved lead, dissolved nickel, dissolved silver, and dissolved zinc in Tolay Creek are not considered significant since baseline concentrations from irrigated and non-irrigated sources, and dam seepage (reclaimed water) do not exceed their respective points of significance (assuming a hardness of 240 mg/L see *Irrigation/Storage Streams Water Quality Monitoring Results* Technical Report, MSC 1996). Aluminum concentration values are not available from irrigated and non-irrigated sources. However, the average concentration of aluminum in reclaimed water does not exceed the point of significance for aluminum. Therefore, irrigation and storage effects on dissolved arsenic, dissolved cadmium, dissolved chromium, dissolved copper, dissolved lead, dissolved nickel, dissolved silver, and dissolved zinc are predicted to be less than significant for all reservoir configurations.

Ammonia

Under the reducing conditions of an anoxic hypolimnion in a storage reservoir, the dominant form of nitrogen will be ammonia. For the purposes of this analysis, it is assumed that most or all of the dam seepage during dry (warm) weather will be from the hypolimnion and nitrogen will, therefore, be in the ammonia form. The toxicity of ammonia is temperature and pH dependent. At the temperature (17.7 °C) and pH (7.6) measured in the Sears Point Reservoir site in May 1995 (*Irrigation/Storage Streams*

Water Quality Monitoring Results Technical Report, MSC 1996) the EPA point of significance (CCC or 4-day average concentration for ammonia) is 1.2 mg-N/L. In all modeled Tolay stations during the dry season with Tolay A reservoir present, the predicted fraction of nitrogen attributable to dam seepage equals or exceeds 1.2 mg-N/L. With Tolay C and Sears Point Reservoirs, these ammonia exceedances are not predicted to occur, given the above temperature and pH conditions. During the wet season, assuming all the nitrogen originating from dam seepage is ammonia, exceedances of the ammonia point of significance are predicted to occur at Tolay at the base of the dam where the entire flow is due to dam seepage (see the appendix of the *Aquatic Habitat Survey Results* Technical Report (MSC 1996). Therefore, the impact of Project storage on ammonia in Tolay Creek is predicted to be significant with Reservoir A, and may occasionally be significant with Reservoirs C and Sears Point.

The proportion of ammonia in the irrigation supply water will be low relative to nitrate assuming irrigation water is withdrawn from near the surface of the reservoirs. Since plants take up and utilize ammonia preferentially over nitrate, the proportion of ammonia should be reduced further after application to crops. With appropriate irrigation management techniques, the upper soil layer should be fully oxygenated and nitrification of any remaining ammonia should occur. Therefore, no ammonia should enter Tolay Creek from irrigation and the impact of irrigation on ammonia in Tolay Creek is considered to be less than significant.

Biostimulatory Substances

The primary biostimulatory substance that will enter Tolay Creek from project irrigation and storage is nitrogen since, in California streams, phosphorus is generally abundant and nitrogen tends to be limiting. Total inorganic nitrogen in Tolay Creek was less than 0.2 mg-N/L. Predicted inorganic nitrogen concentrations at all three station were all greater than or equal to 0.8 mg-N/L. Table 7-1 shows the effect of project design irrigation on nitrogen load to Tolay Creek.

Table 7-1.

Design Irrigation Impacts on Nitrogen Load to Surface Water in Tolay Creek

	Project[a]	No Project[b]	Project Impact
4-Month Dry Season			
Nitrogen Conc. (mg-N/L)	2.8	1.9	-
Flow (cfs)	0.1	0.1	-
Load (Kg)	82	56	26
4-Month Wet Season			
Nitrogen Conc. (mg-N/L)	0.8	0.8	-
Flow (cfs)	35	36	-
Load (Kg)	8,230	8,465	-235

a From Location TT assuming no storage in watershed, as estimated in *Water Quality and Flow Model for Irrigation/Storage Area Streams* Technical Report (RMA 1996). Wet season flow is from wet year condition.

b From Location TT assuming no storage in watershed, as estimated in Water Quality and Flow Model for Irrigation/Storage Area Streams Technical Report (RMA 1996). Wet season flow is from wet year condition.

The method used to develop the values that are shown in Table 7-1 did not include the effect of riparian vegetation on nitrogen because of uncertainty about whether riparian buffer areas would be included in the project (see *Estimation of Nitrogen, Salts and Herbicide/Pesticide Concentrations in Surface Water* Technical Report, Questa Engineering 1996). Since the technical analysis was conducted, riparian buffer areas have been included in the project description (see EIR/S Section 2.2.5).

Riparian buffer strips are known to remove nitrogen from subsurface and surface flows (Mitsch and Gosselink 1993, Peterjohn and Correll 1984, 1986, Jordan et al 1993, Weller et al 1994). A nitrogen removal rate of 18.5 Kg per acre per year is reported by Peterjohn and Correll (1984) for conditions that are similar to those that are expected to exist in riparian buffer strips created by the proposed project. At this nitrogen removal rate, the 4-month dry season load increase due to the project (26 Kg) would be eliminated by 4 acres of riparian buffer area in the Tolay watershed. Section 2 of the EIR/S indicates that at least 4 acres of riparian buffer area would be provided in the Tolay watershed. Thus, no increase in nitrogen load would occur and the impact of design irrigation would be considered less than significant. To be effective, the buffer areas must be situated downgradient of irrigation areas and sized in proportion to upgradient irrigation area.

Chloride

No chloride concentration data were available for Tolay Creek. Chloride concentrations were estimated using the assumption that chloride concentrations vary directly with TDS. Existing chloride concentrations in Tolay Creek were estimated using average chloride concentrations from North American streams (Wetzel 1975) weighted by the ratio of the watershed average TDS to North American streams average TDS. The chloride concentrations resulting from project irrigation and storage were estimated by multiplying the estimated existing chloride concentrations by the ratio of the TDS predicted from the Water Quality Model to existing TDS. The maximum predicted chloride concentration resulting from project irrigation and storage in the Tolay watershed was 94.4 mg/L. The point of significance for chloride is 230 mg/L. Therefore the impact of irrigation and storage on chloride in Tolay Creek is predicted to be less than significant for all reservoir configurations.

Dissolved Oxygen

Seepage from dams will come from the hypolimnion of the reservoir, which, during warm (dry) months, will be stratified and anoxic. It is estimated that dissolved oxygen in streams immediately below the dam will be below 5 mg/L for approximately 120 feet (*Water Quality and Flow Model for Irrigation/Storage Area Streams* Technical Report (RMA 1996)). The point of significance for designated warm waters is that dissolved oxygen concentrations shall not be reduced below the 5 mg/L point of significance at any time. The contribution of seepage to Tolay flow is greater for Tolay A than for Tolay C and Sears Point, particularly during the dry season, so the extent of dissolved oxygen exceedances are likely to be greater for Tolay A. The impact of irrigation and storage on dissolved oxygen in Tolay Creek at the base of a dam is predicted to be significant for all reservoir configurations.

Hydrogen Sulfide

Hydrogen sulfide (H_2S) is likely to be present in the hypolimnion of storage reservoirs soon after stratification (*Storage Reservoir Site Analysis: Limnology and Water Quality of T5 and B1A* Technical Memorandum No. 10). It is therefore likely to be present in Tolay Creek immediately below a dam for a distance similar to the distance with low dissolved oxygen. The exact concentration of H_2S is that will be present in Tolay Creek near the dam is not known, but it may exceed the point of significance of 2.0 mg/L for H_2S. The predicted impact of irrigation and storage on H_2S in Tolay is considered to be significant for all reservoir configurations.

Total Dissolved Solids

There are no evaluation criteria for TDS in Tolay. The range of impacts of project irrigation and storage are shown in Table 7-2.

Temperature

Groundwater in irrigated and non-irrigated areas is predicted to reflect the average annual temperature at a particular site (Memorandum from Jeff Peters, Questa Engineering to Dave Smith, MSC dated 12 October 1995). Water from dam seepage may be slightly warmer than existing conditions in the winter because of the large heat capacity of a large body of water. However, in the wet season, the contribution of dam seepage is 13 percent or less of the total flow in Tolay Creek. The exception to this is at the base of dams, where flow is entirely dam seepage. In this case, there is no existing water temperature, so water from dam seepage cannot cause a temperature increase. In dry conditions, the contribution of water from dam seepage can be much higher. However, this will generally be in warm months when the temperature of existing streams is likely to be much higher than the temperature from water seeping from the hypolimnion of a storage reservoir (the point of significance for temperature is an increase in temperature). Thus, the impact of irrigation and storage on temperature in Tolay Creek is predicted to be less than significant.

Toxicity

Lethal chronic toxicity has been observed in reclaimed water (see Table 4-7). The toxicity-causing constituent(s) in reclaimed water are unknown at this time. Therefore, the effect of storage and irrigation on toxicity cannot be determined. Furthermore, the episodic and ephemeral nature of the lethal chronic toxicity that has been observed to date (see *Reclaimed Water Quality Update* Technical Report, MSC 1996), strongly suggests that the likelihood of toxicity emerging in surface water after passage through storage, irrigation systems and soil is extremely remote. Therefore, the impact of storage and irrigation on lethal toxicity is considered to be less than significant.

If lethal toxicity is found consistently in reclaimed water, it would be identified and controlled to mitigate discharge impacts of all alternatives (see mitigation for discharge impacts).

Turbidity

As discussed in the biostimulatory impacts section above, nitrogen from Project irrigation and storage is predicted to have a less than significant impact on phytoplankton in Tolay Creek. Therefore the impact of irrigation and storage on turbidity due to phytoplankton in Tolay Creek is predicted to be less than significant for all reservoir configurations.

Range of Impacts

Table 7-2 presents the range of impacts in wet and dry seasons on TDS, inorganic chloride, pesticides (2,4-D, and carbaryl), and dissolved metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc) estimated for all stations in the Tolay watershed. The range of impacts described are based on impacts assessment of a storage reservoir (impacts of irrigation plus storage) in the watershed and no reservoir in the watershed or subwatershed (impacts of irrigation alone).

Estimates of pesticide concentrations shown in Table 7-2 were developed from concentrations of 2,4-D and carbaryl estimated to enter surface waters in the Tolay watershed following typical application rates (*Estimation of Nitrogen, salts, and Herbicide/Pesticide Concentrations in Surface Water, and Mass Loading Analysis from Irrigation with Reclaimed Water, West County and South County Alternatives*, Questa Engineers 1996). These pesticides are representative of the type of pesticides that may be used in conjunction with project irrigation in South County. The estimated concentrations of 2,4-D and carbaryl are presented here to provide a general estimate of the levels of pesticides that may be expected with project irrigation.

Existing concentrations of the constituents are also shown. Data are from Tolay Creek at Highway 121 and Tolay Creek at the proposed Sears Point dam site (*Irrigation/Storage Streams Water Quality Monitoring Results* Technical Report, MSC 1996).

Table 7-2.

Predicted Concentrations of Constituents in Tolay Reservoir with Project Irrigation and Project Irrigation plus Storage

	Impacts due to Irrigation Alone		**Impacts due to Irrigation and Storage**		**Existing Conditions**	
	min[a]	**max[a]**	**min[a]**	**max[a]**	**at Hwy 121[b]**	**at Sears point dam site[b]**
Wet Season Concentrations						
TDS	107	109	105	109	480-610	450
Chloride	6.0	6.1	5.9	6.1	no data	no data
2.4-D	0	0	0	0	no data	no data
Carbaryl	0	0	0	0	no data	no data
Diss. Arsenic	0.0058	0.0063	0.0058	0.0070	0.01	0.007
Diss. Cadmium	0.0003	0.0004	0.0003	0.0004	0.0005[c]	0.0005[c]
Diss. Chromium	0.0023	0.0024	0.0023	0.0025	0.005[c]	0.005[c]
Diss. Copper	0.0046	0.0059	0.0025	0.0058	0.005[c]	0.005[c]
Diss. Lead	0.0010	0.0011	0.0010	0.0011	0.002[c]	0.002[c]
Diss. Mercury	0.0001	0.0001	0.0001	0.0001	0.0002[c]	0.0002[c]
Diss. Nickel	0.0102	0.0151	0.0025	0.0147	0.007	0.005[c]
Diss. Selenium	0.0025	0.0026	0.0025	0.0026	0.005[c]	0.005[c]
Diss. Silver	0.0005	0.0005	0.0005	0.0005	0.001[c]	0.001[c]
Diss. Zinc	0.027	0.032	0.020	0.032	0.01	0.02
Dry season Concentrations						
TDS	1011	1464	488	1429	dry	dry
Chloride	56.9	82.5	27.5	80.5	dry	dry
2.4-D	0.0026	0.0040	0.0000	0.0039	dry	dry
Carbaryl	0.00010	0.00015	0	0.00015	dry	dry
Diss. Arsenic	0.0079	0.0084	0.0048	0.0082	dry	dry
Diss. Cadmium	0.0006	0.0008	0.0003	0.0008	dry	dry

Table 7-2.

Predicted Concentrations of Constituents in Tolay Reservoir with Project Irrigation and Project Irrigation plus Storage

	Impacts due to Irrigation Alone		Impacts due to Irrigation and Storage		Existing Conditions	
	min[a]	max[a]	min[a]	max[a]	at Hwy 121[b]	at Sears point dam site[b]
Diss. Chromium	0.0011	0.0016	0.0011	0.0020	dry	dry
Diss. Copper	0.0088	0.0122	0.0047	0.0121	dry	dry
Diss. Lead	0.0013	0.0015	0.0012	0.0015	dry	dry
Diss. Mercury	0.0002	0.0002	0.0001	0.0002	dry	dry
Diss. Nickel	0.0053	0.0068	0.0028	0.0067	dry	dry
Diss. Selenium	0.0027	0.0028	0.0017	0.0028	dry	dry
Diss. Silver	0.0007	0.0008	0.0006	0.0008	dry	dry
Diss. Zinc	0.050	0.066	0.024	0.065	dry	dry

a Data from model output described in *Water Quality and Flow Model for Irrigation/Storage Area Streams* Technical Report (RMA 1996).

b Data from Irrigation/Storage Streams water Quality Monitoring Results Technical Report (MSC 1996)

c Indicates the value was below detection. The value shown is the reporting limit.

7.1.2 Baylands

Screening of Evaluation Criteria

The Evaluation Criteria used to evaluate significance of irrigation impacts in the Baylands area of South County are identical to those used for the remainder of South County, with the exception of chloride, aluminum, dissolved oxygen, and copper. Chloride and
aluminum were eliminated from consideration because the receiving water for Baylands irrigation is the Petaluma River estuary and there are no Evaluation Criteria for chloride and aluminum in brackish or saline waters. The San Francisco Bay Regional Water Quality Control Board Basin Plan water quality objective for dissolved oxygen in tidal waters downstream of Carquinez Bridge is a 5.0 mg/L minimum. The San Francisco Bay Regional Water Quality Control Board developed a site specific water quality objective for total copper in San Francisco Bay and estuaries of 0.0049 mg/L. When the California Inland Surface Water Plan and Enclosed Bays and Estuaries Plan were ruled invalid by a County Superior Court, the copper site specific objective was also ruled invalid. However 0.0049 mg/L is considered by the San Francisco Bay Regional Water Quality Control Board to be an appropriate number to use as an evaluation criterion to apply to

the Petaluma River estuary (pers. comm. Kim Taylor, SFRWQCB, to D. W. Smith, MSC, 16 April, 1996).

Evaluation Approach and Results

Baylands are addressed separately from other project areas because the soils and drainage characteristics of Baylands soils are fundamentally different from other project areas. Baylands areas are former tidal marsh diked from the Bay for agricultural purposes around the turn of the century. Approximately 2,500 acres of Baylands along the Petaluma River, below Lakeville Highway and north of Highway 37 are being considered for agricultural irrigation as part of the South County irrigation and storage alternative. Irrigation drainage from the Baylands area would be pumped into the Petaluma River Estuary during the fall/winter season, and managed similar to the Novato Sanitation District (NSD) Baylands irrigation project. This management approach and potential effects of irrigation of Baylands areas on surface water quality are described in *Hydrologic/Water Quality Evaluation of Irrigation of Baylands (Reyes Soils) with Reclaimed Water,* Questa Engineers Technical Memorandum (1996).

The evaluation of potential Baylands irrigation impacts was conducted by examining water quality in ditches draining pasture irrigated with reclaimed water from NSD. The NSD irrigated pastures are located on Baylands areas similar to those proposed for irrigation under the South County alternative and discharge into Novato Creek estuary. The water quality in NSD drainage ditches was used to predict the water quality of similar drainage ditches receiving Santa Rosa's reclaimed water. The impact of discharging ditch water into the Petaluma River was evaluated for significance. The results of this evaluation are summarized and applied to potential South County irrigation below.

pH and Acidity

Reyes soils are extremely acidic in their surface layers with pH levels typically between 3.5 and 4.5. The pH in ditches that drain NSD-irrigated land vary both seasonally and spatially with values ranging from 3.2 to 7.2. Currently, the San Francisco Bay Regional Water Quality Control Board prohibits the NSD from pump discharging irrigation drainage water to Novato Creek during the irrigation season. This water quality management strategy tends to maintain saturated conditions in the subsoil of the fields, limiting the oxidation of sulfide compounds to acid-forming sulfates. In addition, this management strategy restricts discharge to the rainy season, when ditch water quality has stabilized and dilution from freshwater inflow to the fields and Novato Creek occurs. At this location, Novato Creek is a tidal estuary similar to the Petaluma River estuary, which would receive irrigation water under the South County alternative. Tidal waters have acid buffering capacities and any effects from discharge of acidic drainage waters to estuaries are likely short-term and localized. Effects could possibly be minimized further if pumping were timed to avoid lower tides. Therefore, with proper management techniques, the impact of South County Baylands irrigation on pH in the Petaluma River estuary is predicted to be less than significant.

Sulfates and Sulfides

Formation of H_2S and oxidation of pyritic-like compounds can occur in Baylands soils and result in elevated levels of sulfides and salts. H_2S dominates over HS in the acidic range. The management strategy described above for pH and acidity will also reduce H_2S. H_2S was evaluated in one sample of NSD irrigation ditch water and was below detection (reporting limit = 1.0 mg/L). The moderate amounts of dissolved oxygen present in the irrigation ditches will inhibit the presence of H_2S. Therefore, the impact of South County Baylands irrigation of H_2S in the Petaluma River estuary is predicted to be less than significant. The effect of elevated levels of HS is to increase TDS, typically 8,000 to 12,000 mg/L. Potential impacts of South County Baylands irrigation on TDS in the Petaluma River Estuary are discussed below.

TDS

The average salt concentration of drainage water from Baylands areas that would be discharged to the Petaluma River during the early fall and winter period would decrease as a result of Baylands irrigation with reclaimed water, but the total load of salts would increase over present conditions. The San Francisco Bay Basin Plan evaluation criterion for salinity/TDS states that controllable water quality factors shall not increase the TDS or salinity of waters. The Petaluma River is estuarine in the location of potential Baylands irrigation water discharge and TDS fluctuates widely (from approximately 300 mg/L to approximately that of seawater which is 32,000 mg/L). TDS in the lower Petaluma River is controlled by the salinity in San Pablo Bay and freshwater flow of the Petaluma River. When salinity in the lower Petaluma River is low, flows are high and discharged drainage from the Baylands will disperse quickly with no measurable effect on salinity. When salinity in the lower Petaluma River is high, TDS in Baylands drainage will be less than that in the lower Petaluma River and, hence, the discharge would not cause TDS to increase. Therefore the impact of South County Baylands irrigation on TDS in the Petaluma River estuary is predicted to be less than significant.

Metals

Zinc and copper data are available from the NSD monitoring program and can be used to evaluate potential concentrations of metals in irrigation water. Other metals which were not analyzed by NSD (lead, nickel, chromium, and cadmium) are expected to behave similarly to these elements under certain conditions. Based on a comparison of the concentrations of copper and zinc in the NSD effluent and the generally lower concentrations of copper and zinc in ditch water, it was concluded that metals attenuation occurs within the system. Table 7-3 shows the concentrations of zinc and copper in NSD irrigation ditch water scaled for the concentration of these metals in Santa Rosa’s reclaimed water versus the concentrations in NSD reclaimed water. Table 7-3 also shows the Evaluation Criteria for dissolved copper and dissolved zinc in salt water. Although there is attenuation of metals as they pass through irrigated land, the resulting concentration of copper exceeds the saltwater point of significance for dissolved copper. The saltwater point of significance for dissolved zinc is not predicted to be exceeded. Table 7-4 shows the concentration of metals in effluent relative to their saltwater points of significance.

Table 7-3.

Predicted Concentration of Copper and Zinc in Project Irrigation Ditches
(mg/L)

Location	Date	Predicted dissolved copper concentration	Predicted dissolved zinc concentration
Ditch 1	8-Aug-90	<0.01	<0.032
	6-Sep-90	0.012	<0.032
Ditch 2	8-Aug-90	<0.01	<0.032
	6-Sep-90	0.016	<0.032
Ditch 3	8-Aug-90	<0.01	0.051
	6-Sep-90	0.014	0.038
Ditch 4	8-Aug-90	<0.01	<0.032
	6-Sep-90	0.014	<0.032
Ditch 5	8-Aug-90	0.01	<0.032
	6-Sep-90	0.012	<0.032
Average		0.0118	
Evaluation Criterion		0.0049	0.081

Table 7-4.

Concentration of Metals in Effluent and their Saltwater Points of Significance

	Concentration in Effluent[a] (mg/L)	Saltwater Points of Significance (mg/L)
Dissolved Arsenic (all valence states)	0.0024	0.036
Dissolved Cadmium	0.00032	0.0093
Dissolved Chromium VI	0.00089	0.050
Dissolved Copper	0.010	0.0049
Dissolved Lead	0.0017	0.0081
Total Mercury[b]	0.00037	0.0011
Dissolved Nickel	0.0034	0.0082
Total Selenium	0.00095	0.071
Dissolved Silver	0.00072	0.0019
Dissolved Zinc	0.032	0.081

[a] Data from *Reclaimed Water Quality* Technical Report (MSC 1996).

Dissolved copper is the only metal in effluent that exceeds the saltwater point of significance. Since other heavy metals are expected to behave similarly to zinc and attenuate from irrigation of Baylands, it is unlikely that metals other than copper will exceed their respective points of significance in irrigation ditches when discharged to the Petaluma River estuary.

Whether the discharge of copper in irrigation ditch water into the Petaluma River estuary will cause an exceedance of the saltwater point of significance will depend on the dilution of the copper when it enters the Petaluma River estuary. The average predicted concentration of copper in irrigation ditch water (using half reporting limits for non-detectable values) is 0.010 mg/L. The concentration of copper in the Petaluma River estuary was measured in May 1994 (see Water Quality Affected Environment (Setting) section of the EIR/S) and was less than 0.005 mg/L. The concentration of copper in San Pablo Bay (to which the Petaluma River flows) was measured on three occasions in 1993 and ranged from 0.0013 to 0.0025 mg/L (see Water Quality Affected Environment (Setting) section of the EIR/S). Assuming the concentration of copper in the Petaluma River estuary is 0.0025 mg/L, a dilution ratio of just 2:1 would be required to avoid exceeding the point of significance for copper.

The drainage pumping facilities have not been designed, so attainment of the 2:1 dilution cannot be definitively assessed. However, existing drainage facilities in the Baylands area appear to have a capacity of approximately 100 gallons per minute. Drainage discharged at this rate would mix to 2:1 almost instantaneously. Therefore, impact of South County Baylands irrigation on copper in the Petaluma River estuary is considered to be less than significant.

Biostimulatory Substances

Nitrogen in NSD reclaimed water used for irrigation was readily taken up by the forage crops on the irrigated pasture established on the NSD lands. The average inorganic nitrogen (average nitrate using half reporting limits for non-detectable values plus average ammonia) was 1.2 mg-N/L. The NSD effluent inorganic nitrogen concentration (24.2 mg-N/L) is higher than the estimated maximum storage inorganic nitrogen concentration (16.2 mg-N/L). Scaling for the lower inorganic nitrogen concentration in project storage reservoirs, the predicted inorganic nitrate concentration in ditches receiving project irrigation would be 0.8 mg-N/L. The concentration of total inorganic nitrogen in the Petaluma River estuary measured at the Marina in May 1994 was 0.63 mg-N/L. The similarity in inorganic nitrogen concentrations between predicted irrigation ditch water and Petaluma River estuary indicate that the impact of South County Baylands irrigation on biostimulatory substances in the Petaluma River estuary will be less than significant.

Ammonia

Total ammonia concentrations in NSD reclaimed water average 7.7 mg-N/L but the ammonia in irrigation ditches ranged from 0.59 to 1.4 mg-N/L. The decrease in ammonia may be due to volatilization, plant uptake, or nitrification in the soil or wetlands environment. The maximum concentration of total ammonia recorded in the NSD irrigation ditches, 1.4 mg-N/L, does not exceed the point of significance for total ammonia at the pH and temperature of the sample. Toxicity of ammonia is lower with lower pH and temperature conditions. The relatively low pH and temperatures at the time of discharge (rainy season) into the Petaluma River estuary, and the dilution effect in the Petaluma River estuary would thus combine to reduce any potential for ammonia toxicity. Therefore, the impact of South County Baylands irrigation on ammonia toxicity in the Petaluma River estuary is predicted to be less than significant

Dissolved Oxygen

Dissolved oxygen measured in NSD irrigation ditches ranged from 3.3 to 8.0 mg/L with an average of 5.5 mg/L. Measured dissolved oxygen concentration in the Petaluma River estuary and San Pablo Bay range from 6.3 to 10 mg/L (see Water Quality Affected Environment (Setting) section of the EIR/S). The levels of dissolved oxygen in the irrigation ditches, when discharged into Petaluma River estuary, are unlikely to cause the dissolved oxygen in the Petaluma River estuary to fall below the point of significance of 5.0 mg/L. Therefore the impact of South County Baylands irrigation on dissolved oxygen in the Petaluma River estuary is predicted to be less than significant.

Temperature

Water contained in irrigation ditches should be in equilibrium with the surrounding environment and should not differ significantly from the temperature of the Petaluma River estuary. The impact of South County Baylands irrigation on temperature in the Petaluma River estuary is predicted to be less than significant.

Turbidity

Since the impact of South County Baylands irrigation on biostimulatory substances in the Petaluma River estuary is predicted to be less than significant, the impact on turbidity due to phytoplankton is also predicted to be less than significant.

7.1.3 Other South County Lands

Evaluation Approach

The effect on surface water of irrigating lands located outside of the Tolay watershed and not on Reyes soils was evaluated in the *Baseline Hydrology and Irrigation Drainage Evaluation for West and South County Reclamation Alternative* (1996). Extensive lands with shallow impermeable layers that would cause root zone saturation and lateral flow to surface waters generally do not occur in the South County irrigation area. Therefore, no measurable impact of project irrigation to these lands on surface water flow or quality is expected under proper irrigation management. Potential storage impacts were evaluated as described above for Tolay and West County.

Impact Evaluation Results

Predicted impacts from Adobe and Lakeville reservoirs on surface waters in South County are limited to those due to seepage from dams. These impacts are discussed below.

Significant Impacts

Flow from dam seepage is small and expected to be limited in extent (less than 0.1 cfs). It is expected flow due to dam seepage will not reach any surface waters other than the seepage itself immediately below the dam. Therefore the impact of storage on water quality in the Adobe and Lakeville watersheds is predicted to be less than significant.

Range of Impacts

Table 7-5 presents the range of impacts in wet and dry seasons on TDS, inorganic nitrogen, and chloride. Since there is no contribution from irrigation, pesticides are not included. Metals from dam seepage would have the same concentration as in reclaimed water (*Reclaimed Water Quality* Technical Report, MSC 1996).

Table 7-5.

Predicted Concentration of Constituents from Adobe and Lakeville Dam Seepage (In mg/L)

	Adobe		Lakeville	
	min[a]	**max[a]**	**min[a]**	**max[a]**
Wet Season Concentrations				
TDS	105	106	127	453
Chloride	5.9	6.0	7.2	25.5
Nitrogen	0.85	0.89	1.8	16.2
Dry Season Concentrations				
TDS	483	489	499	503
Chloride.	27	28	28.1	28.3
Nitrogen	1.9	6.1	10.5	11.0

[a] Data from model output described in *Water Quality and Flow Model for Irrigation/Storage Area Streams* Technical Report (RMA 1996).

7.1.4 Proposed Mitigation

This section summarizes the significant impacts of irrigation and storage on South County streams and describes suggested mitigation.

Summary of Significant Impacts to be Mitigated

Project impacts from Baylands irrigation and storage in Adobe and Lakeville watersheds are all predicted to be less than significant. Table 7-6 summarizes the significant impacts of irrigation and storage on Tolay Creek.

Table 7-6.

Summary of Significant Impacts of Irrigation and Storage on Tolay Creek

	Tolay Creek	Baylands-Petaluma River Estuary	Adobe and Lakeville
Metals	less than significant	less than significant	less than significant
Ammonia	significant	less than significant	less than significant
Biostimulatory substances - benthic algae	less than significant	less than significant	less than significant
Biostimulatory substances - planktonic algae	less than significant	less than significant	less than significant
Dissolved oxygen	significant	less than significant	less than significant
H_2S	significant	less than significant	less than significant
Temperature	less than significant	less than significant	less than significant
Turbidity	less than significant	less than significant	less than significant
TDS	less than significant	less than significant	less than significant

Summary of Proposed Mitigation

Exceedances of points of significance for ammonia, dissolved oxygen, and H_2S are caused from dam seepage of anoxic hypolimnetic water. Options for mitigation to reduce ammonia, low dissolved oxygen, and H_2S include artificial reservoir circulation or hypolimnetic oxygenation, and pumping any seepage that reaches surface water back to the reservoir.

The objective of artificial circulation is to eliminate thermal stratification, or to prevent its formation, through the injection of compressed air from a pipe or ceramic diffuser at the reservoir's bottom. The rising column of bubbles, if sufficiently powered, will produce reservoir-wide mixing at a rate that will eliminate temperature differences between top and bottom waters and thus cause destratification (EPA 1988).

The pump-back option would involve installing wells and/or a cut-off wall to intercept seepage. This mitigation is considered to be equally effective as the artificial circulation option, but less costly. Therefore, the pumpback option is recommended.

Effectiveness of Proposed Mitigation

A properly designed system of wells, possibly in combination with a cut-off wall, is an accepted practice for managing groundwater plumes. Conditions at reservoir sites are generally amenable to this technique (e.g., layer of very low impermeability near the surface). Therefore, the pump-back mitigation measure is considered to be effective.

7.2 CONTINGENCY IRRIGATION

7.2.1 Tolay Watershed

Contingency (winter) irrigation would cause effects in the Tolay Creek that are generally similar to other those of other irrigation scenarios with some exceptions. The effect on specific constituents is evaluated below.

Total Dissolved Solids

Contingency (winter) irrigation is predicted to cause in increase in TDS in Tolay Creek relative to existing conditions. The predicted range of TDS in Tolay Creek with contingency irrigation are shown in Table 7-7. No evaluation criterion for TDS exists for Tolay Creek.

Chloride

Contingency (winter) irrigation is predicted to cause in increase in chloride in Tolay Creek relative to other irrigation scenarios. The predicted range of chloride in Tolay Creek with contingency irrigation are shown in Table 7-7. The predicted maximum concentration of chloride with contingency irrigation does not exceed the point of significance for chloride (240 mg/L). Therefore, the impact of contingency irrigation on chloride in Tolay Creek is predicted to be less than significant.

Ammonia

Predicted exceedances of ammonia points of significance in Tolay Creek under project irrigation scenarios are due to seepage from dams, which is unaffected by winter irrigation. Even in winter it is a good assumption that between the reservoir processes and the processes that occur in irrigated soil, ammonia will be almost or completely undetectable in water that passes through the root zone (pers. comm. Jeff Peters, Questa Engineering 3 April 1996). Thus, ammonia from irrigation water should not cause ammonia exceedances.. Therefore, the impact of contingency irrigation on ammonia on Tolay Creek is predicted to be less than significant.

Biostimulatory Substances - Planktonic Algae and Benthic Algae

The maximum concentrations of nitrogen predicted to enter Tolay Creek with winter irrigation exclusive of any nitrogen removal benefit of riparian corridor are shown in Table 7-7 to be similar to the maximum concentration of nitrogen entering Tolay Creek with other irrigation scenarios. Therefore, the riparian corridor is expected to reduce the nitrogen load to background levels for contingency irrigation as in the case of design irrigation (see Table 7-1 above).

Dissolved Oxygen and Hydrogen Sulfide

Predicted exceedances of dissolved oxygen and hydrogen sulfide points of significance in Tolay Creek under project irrigation scenarios are due to seepage from dams, which is unaffected by contingency irrigation as well as other irrigation scenarios. Therefore, the impact of contingency irrigation on dissolved oxygen and H_2S on Tolay Creek is predicted to be less than significant.

Metals

The predicted ranges of metals entering Tolay Creek with winter irrigation (Table 7.7) are similar to the ranges of metals entering Tolay Creek streams with other irrigation scenarios. None of the predicted concentrations of metals in Tolay Creek exceed their respective points of significance. Therefore, the impact of contingency irrigation on metals in Tolay Creek is predicted to be less than significant.

Temperature

Since groundwater in irrigated and non-irrigated areas is predicted to reflect the average annual temperature at a particular site (Memorandum from Jeff Peters, Questa Engineering to Dave Smith, MSC dated 12 October 1995), the impact of contingency irrigation on temperature in Tolay Creek is predicted to be less than significant.

Turbidity

The impact of contingency irrigation on planktonic algae in Tolay Creek is predicted to be similar to the impact of other irrigation scenarios. With riparian corridors described in the EIR/EIS Section 2.2.5, no impact of design and contingency irrigation on planktonic algae, and thus turbidity, is expected because riparian corridors will remove nitrogen to background levels.

7.2.2 Baylands

Contingency (winter) irrigation is not proposed for Baylands areas

7.2.3 Other South County Lands

Extensive lands with shallow impermeable layers that would cause root zone saturation and lateral flow to surface waters generally do not occur in the South County irrigation area. Therefore, no measurable impact of contingency irrigation on these lands on surface water flow or quality is expected under proper irrigation management.

7.3 UNPLANNED EVENT

A scenario involving an unplanned runoff of 34,000 gallons discharge over a 12 hour period has been identified as a basis for evaluating agricultural irrigation impacts. Such an event would result in a discharge rate of 0.1 cfs. The runoff flow would be equivalent to

Table 7-7.

Predicted Range of Concentrations with Contingency Irrigation in Tolay Watershed
(mg/L)

	Tolay	Tolay
	minimum[a]	maximum[a]

Table 7-7.

Predicted Range of Concentrations with Contingency Irrigation in Tolay Watershed
(mg/L)

	Tolay minimum[a]	Tolay maximum[a]
Wet Season Concentrations		
Nitrogen	0.96	1.07
TDS	181	257
Chloride	10.2	14.5
2.4-D	0	0
Carbaryl	0	0
Diss. Arsenic	0.0056	0.0063
Diss. Cadmium	0.0003	0.0004
Diss. Chromium	0.0022	0.0024
Diss. Copper	0.0044	0.0064
Diss. Lead	0.0010	0.0011
Diss. Mercury	0.0001	0.0001
Diss. Nickel	0.0096	0.0167
Diss. Selenium	0.0025	0.0026
Diss. Silver	0.0005	0.0005
Diss. Zinc	0.027	0.034
Dry season Concentrations		
Nitrogen	1.9	6.2
TDS	1235	1675
Chloride	69.5	94.4
2.4-D	0.0039	0.0049
Carbaryl	0.00015	0.00019
Diss. Arsenic	0.0082	0.0087
Diss. Cadmium	0.0008	0.0010
Diss. Chromium	0.0008	0.0011
Diss. Copper	0.012	0.014
Diss. Lead	0.0015	0.0016

Table 7-7.

Predicted Range of Concentrations with Contingency Irrigation in Tolay Watershed
(mg/L)

	Tolay minimum[a]	Tolay maximum[a]
Diss. Mercury	0.0002	0.0002
Diss. Nickel	0.0067	0.0078
Diss. Selenium	0.0028	0.0029
Diss. Silver	0.0008	0.0008
Diss. Zinc	0.064	0.076

[a] Data from model output described in *Water Quality and Flow Model for Irrigation/Storage Area Streams* Technical Report (RMA 1996).

or less than the estimated flow in the streams in the south county irrigation area (see Appendix C of *Aquatic Biological Resources Impacts Assessment* Technical Report (MSC 1996) for estimate stream flows). Since the concentration of each water quality constituent in undiluted reclaimed water is less than the respective point of significance, the impact of the unplanned runoff event is considered to be less than significant.

7.4 CUMULATIVE IMPACTS

Proposed projects with a potential nexus with water quality impacts of project components are shown in Table 7-8. Potential impact of the cumulative project (projects listed in Table 7-8 plus Santa Rosa's proposed irrigation and storage project) on surface water quality are evaluated below. 7.4.1 Tolay Creek

As noted in Section 7.1.1, obstructions in the Tolay Creek channel are expected to limit the effect of the Subregional System's project to Tolay Creek above Highway 121. These obstructions would not be eliminated by the projects cited in Table 7-8. The projects cited in Table 7-8 would enhance tidal circulation in the slough downstream of the obstructions. Thus, the impact of the cumulative project is considered to be less than significant.

7.4.2 Petaluma River

The Petaluma Wastewater Facilities Project has a potential water quality nexus with Project irrigation in the Petaluma watershed. The project description (Chapter 2 of the *Petaluma Wastewater Facilities Project and Long-Range Management Program* Draft EIR) 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

Table 7-8

Summary of Proposed 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

reduced from current impacts. The concentration of some metals in undiluted Petaluma wastewater exceeds applicable water quality criteria (see Table 4.6-19 in the EIR/EIS). 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 Baylands Subregional System irrigation are less than the applicable points of significance. The estimated concentration of copper in ditch water from Baylands Subregional System irrigation (11.8 mg/l) is less than the concentration of copper in Petaluma's wastewater (20 mg/L - see Table 4.6-19 in the EIR/EIS). Therefore, discharge of Baylands irrigation water could only lessen any impacts of Petaluma's discharge. Thus, the Subregional System 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 the cumulative project impact is considered to be less than significant.

8.0 GEYSERS

8.1 PIPELINES

Pipelines are the only project component in the Geysers area that could potentially affect surface water quality. The potential impact of the Geysers pipeline on surface water quality is described in Section 4.3.

8.2 CUMULATIVE IMPACTS

The Subregional System's Geyser's 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 impacts of the cumulative project on surface water quality are expected to occur.

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