California Regional Water Quality Control Board
Santa Ana Region

Total Maximum Daily Load for Fecal Coliform Bacteria in Newport Bay, California

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Section 1. Introduction

Section 303(d)(1)(A) of the Clean Water Act (CWA) requires that "Each State shall identify those waters within its boundaries for which the effluent limitations...are not stringent enough to implement any water quality standard applicable to such waters." The CWA also requires states to establish a priority ranking for waters on the 303(d) list of water quality limited waters and to develop and implement Total Maximum Daily Loads (TMDLs) for such waters. As part of California's 1996 303(d) list submittal to the United States Environmental Protection Agency

(USEPA), the Santa Ana Regional Water Quality Control Board (RWQCB) identified Newport Bay as water quality limited due, in part, to pathogens. This report proposes a TMDL (Appendix A) for fecal coliform bacteria, a pathogen indicator, in Newport Bay, and provides the technical basis for the necessity of the TMDL and the elements of the TMDL.

The requirements of a TMDL are described in 40 CFR 130.2 and 130.7 and Section 303(d) of the CWA, as well as in EPA guidance documents (e.g., EPA, 1991). A TMDL is defined as "the sum of the individual waste load allocations for point sources and load allocations for nonpoint sources and natural background" (40 CFR 130.2) such that the capacity of the waterbody to assimilate pollutant loadings (the Loading Capacity) is not exceeded. The TMDL is also required to address seasonal variations and to include a margin of safety to address uncertainty in the analysis. In addition, pursuant to the regulations at 40 CFR 130.6, states must develop water quality management plans that incorporate approved TMDLs and implementation measures necessary to implement the TMDLs.

The RWQCB identified Newport Bay (Figure 1) as a high priority for TMDL development and committed to the development and adoption of a pathogen TMDL for the Bay by January 15, 2000. This is because of the significance of the beneficial uses of the Bay and the nature of the numerous threats to water quality that affect these uses. Newport Bay has over 10,000 small boats and more than 30 beaches that provide a significant resource for body contact and non-body contact water recreation. Additionally, the Upper Newport Bay Ecological Reserve provides over 700 acres of salt marsh habitat that is home to a number of endangered species. (OCPFRD, 1998)

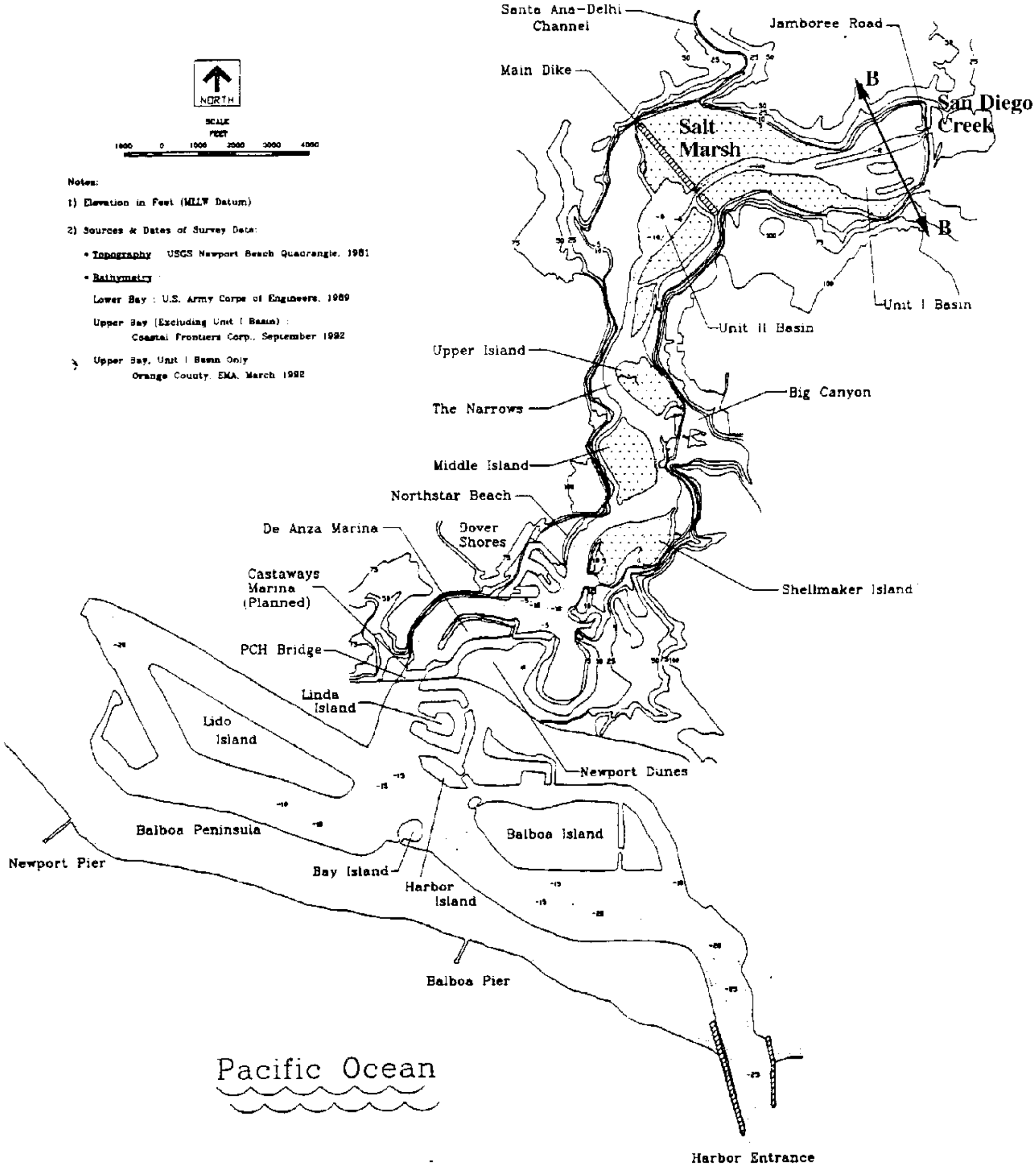

Figure 1: Newport Bay
(Source: U.S. Army Corps of Engineers 1993)

To protect the water contact recreation (REC-1) beneficial use of the Bay, the Water Quality Control Plan for the Santa Ana River Basin (Basin Plan) establishes numeric objectives for fecal coliform. These objectives are expressed in two ways: first, as a log mean less than 200 organisms/100 ml based on five samples/30 day period; and second, not more than 10% of the samples may exceed 400 organisms/100 ml for any 30 day period. (The first objective can be considered as a "chronic" objective since it is intended to address average conditions over a 30 day period. The second objective can be considered as an "acute" objective since it addresses instances of higher coliform counts.) The Bay is also designated with the shellfish harvesting beneficial use (SHEL). The Basin Plan objectives for fecal coliform for the protection of the SHEL use are also expressed as "chronic" and "acute", namely, a median of 14 MPN (Most Probable Number[1])/100 ml and not more than 10 % of samples exceed 43 MPN/100 ml. The Basin Plan also establishes water quality objectives for fecal coliform in the tributaries to Newport Bay. Since they are designated REC-1, any surface water drainage in the watershed that discharges to Newport Bay must also meet the REC-1 objectives specified above. The tributaries are not designated SHEL so the more stringent shellfish objectives do not apply.

Fecal coliform are used as an indicator of contamination by bacteria or other pathogens. Fecal coliform are a subset of total coliform bacteria, measurements of which are used also by the Orange County Health Care Agency (OCHCA) to assess the suitability of waters for recreation and shellfish harvesting. The OCHCA is the local health care agency responsible for the protection of public health, in accordance with authority granted by the California Health and Safety Code. The OCHCA uses total coliform objectives specified for body contact recreation in the California Health and Safety Code (Sections 7957 and 7958 of Title 17 California Code of Regulations), and United States Public Health Service criteria for shellfish harvesting, in determining whether Bay waters are suitable for water contact recreation and shellfish harvesting. (These objectives are the same as the water contact and shellfish harvesting water quality objectives for total coliform in the California Ocean Plan.). For water contact recreation, these objectives are a total coliform density of less than 1000 MPN/100 ml, and no more than 20% of the samples in a month greater than 1000 MPN/100 ml. The objectives for total coliform for the protection of shellfish harvesting, are a median of no more than 70 MPN/100 ml, and no more than 10% of the samples greater than 230 MPN/100 ml. The TMDL proposed herein is for fecal coliform bacteria, consistent with the requirement to assure attainment of Basin Plan standards. Compliance with the fecal coliform TMDL will also assure compliance with relevant total coliform standards.

Because of consistently high coliform bacteria levels, bans on shellfish harvesting and water contact recreation in the upper parts of Upper Newport Bay were imposed by the Orange County Health Care Agency (OCHCA) in 1974. In 1998, the shellfish harvesting prohibition was expanded to include the Upper Bay as a whole. These prohibitions remain in effect. The OCHCA has also temporarily closed numerous beaches in Lower Newport Bay due to coliform bacteria contamination levels that exceed the objectives established in the California Health and Safety Code for total coliform, resulting in the loss of water contact recreation beneficial uses between 1974 and the present. Assuming a 5:1 ratio of total coliform to fecal coliform[2], violations of the total coliform objectives also result in violations of the Basin Plan fecal coliform objectives. The vast majority of the violations of water quality objectives for fecal

[1] The MPN is a statistical representation of the results of the standard coliform test. Coliform test results can also be expressed as fecal coliform units (FCUs) or total coliform units (CUs).

[2] The fecal coliform objectives were derived from the total coliform objectives based on the approximate 5:1 total to fecal coliform ratio observed in key epidemiological studies. (USEPA, 1986 Ambient Water Quality Criteria for Bacteria)

coliform, and the loss of water contact recreation and shellfish harvesting beneficial uses in the Bay, occur during the rainy season, when water contact recreation is minimal. (Some water contact recreation occurs year round in portions of the Bay.) Except for some localized problems, the majority of Newport Bay beach areas meet water contact recreation objectives during the summer months, when use of the beaches is the highest. The water quality of Newport Bay rarely meets the water quality objectives for shellfish harvesting. This TMDL for fecal coliform in Newport Bay is necessary to correct ongoing violations of existing Basin Plan water quality objectives for fecal coliform and the impairment of beneficial uses resulting therefrom.

In the 1970's and 1980's, the main sources of coliform bacteria contamination and the shellfish harvesting and body contract recreation bans were vessel waste discharges (principally in the Lower Bay) and urban/stormwater runoff. The Bay was designated a No-Discharge harbor for vessel wastes in 1976, and the City of Newport Beach and the County of Orange have instituted a vessel waste control program. The current effectiveness of the vessel waste control program is unknown, so vessel waste may still be a source of coliform bacteria and the loss of beneficial uses of Newport Bay. However, it is known that the tributaries to Newport Bay continue to be a source of violations of water quality objectives for fecal coliform, and the loss of body contact recreation and shellfish harvesting beneficial uses in Newport Bay. Monitoring data collected from four major tributaries to Newport Bay over the past 18 months show consistently high coliform bacteria levels and violations of water quality objectives for all four tributaries, during the entire period.[3]

This report recommends that the RWQCB consider changes to Chapter 5 (Implementation Plan) of the Basin Plan to incorporate a TMDL that will address the bacterial quality problems in Newport Bay via a prioritized, phased approach. Priorities and compliance schedules are proposed based on the use and area affected, the nature and magnitude of the bacterial objective violations, and the time at which the violations occur. The proposed TMDL includes quantifiable targets; Load Allocations for non-point sources; Waste Load Allocations (WLAs) for point sources; an implementation plan for the development and implementation of Best Management Practices (BMPs) to achieve these targets and to comply with existing water quality objectives for water contact recreation and shellfish harvesting by 2014 and 2020, respectively; and a monitoring program to assess the degree and effectiveness of BMP implementation and compliance with the numeric targets identified in the TMDL. The proposed TMDL also includes a commitment for periodic review of its elements. The TMDL should be re-evaluated and revised, as appropriate, based on the results of the monitoring program and other relevant studies. Other studies of the Bay that are expected to be conducted in the near future include a health risk assessment that will characterize public exposure to pathogens in the Bay and the health risks associated with such exposure. The assessment may lead to recommendations for revised water quality objectives and/or beneficial use designations and is expected to result in

[3] Since the RWQCB now has sufficient monitoring data on the major tributaries to Newport Bay to show that these tributaries do not meet water quality objectives for fecal coliform, Regional Board staff will propose the listing of these water bodies as water quality limited in the next update of the Region's Section 303(d) list. The TMDL for fecal coliform proposed in this report is intended to address pathogens in Newport Bay, and the tributaries as sources of fecal coliform pollution.

recommendations for pathogen control strategies that assure the reasonable protection of beneficial uses.

The Environmental Protection Agency (EPA) has oversight authority for the 303(d) program and is required to review and either approve or disapprove the TMDLs submitted by states. If the EPA disapproves a TMDL submitted by a state (or if the State fails to develop a TMDL), the EPA is required to establish a TMDL for that waterbody.

If the TMDLs are established by EPA, the State is required to incorporate these TMDLs, along with appropriate implementation measures, into the State Water Quality Management Plan (40 CFR 130.6(c)(1), 130.7). The Regional Board Basin Plan, which includes applicable state-wide plans, serves as the State Water Quality Management Plan governing the Newport Bay watershed. If the State subsequently adopts TMDLs which are different from the TMDLs established by EPA, EPA will review the State-submitted TMDLs to determine if they meet all TMDL requirements. If EPA approves the State TMDLs, then the State TMDLs would supersede EPA's TMDLs.

This TMDL report is organized in the following sections, which provide the analytical basis for the TMDL:

2.0 TMDL Summary
3.0 Problem Statement
4.0 Source Analysis
5.0 Estimates of Loading Capacity, TMDL, Numeric Targets, and Allocations
6.0 Margin of Safety
7.0 Seasonal Variations
8.0 Critical Conditions
9.0 Public Participation
10.0 Implementation and Monitoring
11.0 Proposed Basin Plan Amendment for a TMDL for Fecal Coliform in Newport Bay
12.0 Environmental Checklist
13.0 Alternatives
14.0 Economic Impacts to Agriculture

Section 2. Summary of Proposed TMDL for Fecal Coliform in Newport Bay

Table 1 provides the final proposed TMDL, WLAs, and LAs for fecal coliform in Newport Bay. Table 2 identifies in detail the phased numeric targets, interim WLAs and LAs, and a schedule for implementing the numeric targets, and interim WLAs and LAs, which will lead to attainment of the final TMDL.

Table 1: Final TMDL, WLAs, and LAs for Fecal Coliform in Newport Bay

Final TMDL for Fecal Coliform In Newport Bay	Final WLAs for Fecal Coliform in Urban Runoff Discharged to Newport Bay	Final LAs for Fecal Coliform in Agricultural Runoff Discharged to Newport Bay	Final WLAs for IRWD	Final LAs for Fecal Coliform from Natural Sources in all Discharges to Newport Bay	Final WLAs for Vessel Waste
As soon as possible but no later than Jan. 1, 2014			**In Effect**	**In Effect**	**In Effect**
5-Sample/Month Geometric Mean less than 200 organisms/100 mL, and not more than 10% of the samples exceed 400 organisms/ 100 mL for any 30-day period.	5-Sample/Month Geometric Mean less than 180 organisms/100 mL, and not more than 10% of the samples exceed 360 organisms/ 100 mL for any 30-day period.	5-Sample/Month Geometric Mean less than 180 organisms/ 100 mL, and not more than 10% of the samples exceed 360 organisms/ 100 mL for any 30-day period.	2.2 MPN/100 mL Total Coliform from plant to ponds and LAs for Natural Sources from ponds to creek, for reclaimed water discharges only	5-Sample/Month Geometric Mean less than 50 organisms/100 mL, and not more than 10% of the samples exceed 100 organisms/ 100 mL for any 30-day period.	0 MPN/100 mL No discharge.
As soon as possible but no later than Jan. 1, 2020					
Monthly Median less than 14 MPN/100 mL, and not more than 10% of the samples exceed 43 MPN/100 mL.	Monthly Median less than 14 MPN/100 mL, and not more than 10% of the samples exceed 43 MPN/100 mL.	**Monthly Median less than 14 MPN/100 mL, and not more than 10% of the samples exceed 43 MPN/100 mL.**	2.2 MPN/100 mL Total Coliform from plant to ponds and Monthly Median less than 14 MPN/100 mL, and not more than 10% of the samples exceed 43 MPN/100 mL. (Discharges to creek.)	**Monthly Median less than 14 MPN/100 mL, and not more than 10% of the samples exceed 43 MPN/100 mL.**	0 MPN/100 mL No discharge.

Table 2: Numeric Targets and Interim WLAs and LAs for Fecal Coliform in Newport Bay

Numeric Targets for Fecal Coliform In Newport Bay	Interim WLAs for Fecal Coliform in Urban Runoff Discharged to Newport Bay	Interim LAs for Fecal Coliform in Agricultural Runoff Discharged to Newport Bay	Interim WLAs for IRWD	Interim LAs for Fecal Coliform from Natural Sources in all Discharges to Newport Bay	Interim WLAs for Vessel Waste
Phase 1, As soon as possible but no later than Jan. 1, 2002: Compliance with REC-1 objectives at The Dunes during May-October					
5-Sample/Month Geometric Mean less than 200 MPN/100 mL, and not more than 10% of the samples exceed 400 organisms/100 mL for any 30-day period. Full compliance with REC-1 Objectives During May-October in the Dunes Resort Embayment Only	5-Sample/Month Geometric Mean less than 180 MPN/100 mL, and not more than 10% of the samples exceed 360 organisms/100 mL for any 30-day period. During May-October, for Backbay Drive Drain Only	5-Sample/Month Geometric Mean less than 180 MPN/100 mL, and not more than 10% of the samples exceed 360 organisms/100 mL for any 30-day period. During May-October, for Backbay Drive Drain Only	2.2 MPN/100 mL Total Coliform from plant to ponds and LAs for Natural Sources from ponds to creek, for reclaimed water discharges only	5-Sample/Month Geometric Mean less than 50 MPN/100 mL, and not more than 10% of the samples exceed 100 organisms/100 mL for any 30-day period.	0 MPN/100 mL Discharge prohibition currently in effect.
Phase 2, As soon as possible but no later than Jan. 1, 2004: Compliance with REC-1 Acute Objective Baywide During May-October					
No more than 10% of the samples exceed 400 organisms/100 mL for any 30-day period.	No more than 10% of the samples exceed 360 organisms/100 mL for any 30-day period.	No more than 10% of the samples exceed 360 organisms/100 mL for any 30-day period.	2.2 MPN/100 mL Total Coliform from plant to ponds and LAs for Natural Sources from ponds to creek, for reclaimed water discharges only	5-Sample/Month Geometric Mean less than 50 MPN/100 mL, and not more than 10% of the samples exceed 100 organisms/100 mL for any 30-day period.	0 MPN/100 mL Discharge prohibition currently in effect.

Table 2: Numeric Targets and Interim WLAs and LAs for Fecal Coliform in Newport Bay

Numeric Targets for	Interim WLAs for	Interim LAs for Fecal	Interim WLAs for	Interim LAs for Fecal	Interim WLAs for

Fecal Coliform In Newport Bay	Fecal Coliform in Urban Runoff Discharged to Newport Bay	Coliform in Agricultural Runoff Discharged to Newport Bay	IRWD	Coliform from Natural Sources in all Discharges to Newport Bay	Vessel Waste
Phase 3, As soon as possible but no later than Jan. 1, 2005: Compliance with REC-1 Objectives Baywide During May-October					
5-Sample/Month Geometric Mean less than 200 MPN/100 mL, and not more than 10% of the samples exceed 400 organisms/100 mL for any 30-day period.	5-Sample/Month Geometric Mean less than 180 MPN/100 mL, and not more than 10% of the samples exceed 360 organisms/100 mL for any 30-day period.	5-Sample/Month Geometric Mean less than 180 MPN/100 mL, and not more than 10% of the samples exceed 360 organisms/100 mL for any 30-day period.	2.2 MPN/100 mL Total Coliform from plant to ponds and LAs for Natural Sources from ponds to creek, for reclaimed discharges water only	5-Sample/Month Geometric Mean less than 50 MPN/100 mL, and not more than 10% of the samples exceed 100 organisms/100 mL for any 30-day period.	0 MPN/100 mL Discharge prohibition currently in effect.
Phase 4, As soon as possible but no later than Jan. 1, 2008: Compliance with REC-1 Acute Objective During Nov.- April at High Priority Body Contact Areas					
No more than 10% of the samples exceed 400 organisms/100 mL for any 30-day period.	No more than 10% of the samples exceed 360 organisms/100 mL for any 30-day period, for discharges to high priority body contact areas.	No more than 10% of the samples exceed 360 organisms/100 mL for any 30-day period, for discharges to high priority body contact areas.	2.2 MPN/100 mL Total Coliform from plant to ponds and LAs for Natural Sources from ponds to creek, for reclaimed water discharges only	5-Sample/Month Geometric Mean less than 50 MPN/100 mL, and not more than 10% of the samples exceed 100 organisms/100 mL for any 30-day period.	0 MPN/100 mL Discharge prohibition currently in effect.
Phase 5 As soon as possible but no later than Jan. 1, 2011: Compliance with REC-1 Objectives at High Priority Body Contact Areas and Acute REC-1 Objective Baywide During Nov.- April					
5-Sample/Month Geometric Mean less than 200 MPN/100 mL at all high priority body contact areas, and not more than 10% of the samples exceed 400 organisms/100 mL for any 30-day period throughout the Bay.	5-Sample/Month Geometric Mean less than 180 MPN/100 mL for discharges to high priority body contact areas, and not more than 10% of the samples exceed 360 organisms/100 mL for any 30-day period.	5-Sample/Month Geometric Mean less than 180 MPN/100 mL for discharges to high priority body contact areas, and not more than 10% of the samples exceed 360 organisms/100 mL for any 30-day period.	2.2 MPN/100 mL Total Coliform from plant to ponds and LAs for Natural Sources from ponds to creek, for reclaimed water discharges only	5-Sample/Month Geometric Mean less than 50 MPN/100 mL, and not more than 10% of the samples exceed 100 organisms/100 mL for any 30-day period.	0 MPN/100 mL Discharge prohibition currently in effect.

Table 2: Numeric Targets and Interim WLAs and LAs for Fecal Coliform in Newport Bay

Numeric Targets for Fecal Coliform In Newport Bay	Interim WLAs for Fecal Coliform in Urban Runoff Discharged to Newport	Interim LAs for Fecal Coliform in Agricultural Runoff Discharged to Newport	Interim WLAs for IRWD	Interim LAs for Fecal Coliform from Natural Sources in all Discharges to Newport	Interim WLAs for Vessel Waste

	Bay	**Bay**		**Bay**	
Phase 6, As soon as possible but no later than Jan. 1, 2014: Full Compliance with REC-1 Objectives, Year-round					
5-Sample/Month Geometric Mean less than 200 MPN/100 mL, and not more than 10% of the samples exceed 400 organisms/100 mL for any 30-day period.	5-Sample/Month Geometric Mean less than 180 MPN/100 mL, and not more than 10% of the samples exceed 360 organisms/100 mL for any 30-day period.	5-Sample/Month Geometric Mean less than 180 MPN/100 mL, and not more than 10% of the samples exceed 360 organisms/100 mL for any 30-day period.	2.2 MPN/100 mL Total Coliform from plant to ponds and LAs for Natural Sources from ponds to creek, for reclaimed water discharges only	5-Sample/Month Geometric Mean less than 50 MPN/100 mL, and not more than 10% of the samples exceed 100 organisms/100 mL for any 30-day period.	0 MPN/100 mL Discharge prohibition currently in effect.
Phase 7, As Soon as possible but no later than Jan. 1, 2014: Compliance With the Acute Shellfish Objective at High Priority Shellfish Harvesting Areas During May-October					
No more than 10% of the samples exceed 43 MPN/100 mL at high priority shellfish harvesting areas.	No more than 10% of the samples exceed 43 MPN/100 mL for discharges to high priority shellfish harvesting areas.	No more than 10% of the samples exceed 43 MPN/100 mL for discharges to high priority shellfish harvesting areas.	2.2 MPN/100 mL Total Coliform from plant to ponds and LAs for Natural Sources from ponds to creek, for reclaimed water discharges only	5-Sample/Month Geometric Mean less than 50 MPN/100 mL, and not more than 10% of the samples exceed 100 organisms/100 mL for any 30-day period.	0 MPN/100 mL Discharge prohibition currently in effect.
Phase 8, As soon as possible but no later than Jan. 1, 2017: Compliance with Shellfish Harvesting Objectives Baywide during May-October					
Monthly Median less than 14 MPN/100 mL, and not more than 10% of the samples exceed 43 MPN/100 mL.	Monthly Median less than 14 MPN/100 mL, and not more than 10% of the samples exceed 43 MPN/100 mL.	Monthly Median less than 14 MPN/100 mL, and not more than 10% of the samples exceed 43 MPN/100 mL.	2.2 MPN/100 mL Total Coliform from plant to ponds and LAs for Natural Sources from ponds to creek, for reclaimed water discharges only	5-Sample/Month Geometric Mean less than 50 MPN/100 mL, and not more than 10% of the samples exceed 100 organisms/100 mL for any 30-day period.	0 MPN/100 mL Discharge prohibition currently in effect.

Table 2: Numeric Targets and Interim WLAs and LAs for Fecal Coliform in Newport Bay

Numeric Targets for Fecal Coliform In Newport Bay	**Interim WLAs for Fecal Coliform in Urban Runoff Discharged to Newport Bay**	**Interim LAs for Fecal Coliform in Agricultural Runoff Discharged to Newport Bay**	**Interim WLAs for IRWD**	**Interim LAs for Fecal Coliform from Natural Sources in all Discharges to Newport Bay**	**Interim WLAs for Vessel Waste**
Phase 9, As soon as possible but no later than Jan. 1, 2017: Compliance with Acute Shellfish Harvesting Objective at High Priority Shellfish Harvesting					

Areas, November –April					
No more than 10% of the samples exceed 43 MPN/100 mL at high priority shellfish harvesting areas.	No more than 10% of the samples exceed 43 MPN/100 mL for discharges to high priority shellfish harvesting areas.	No more than 10% of the samples exceed 43 MPN/100 mL for discharges to high priority shellfish harvesting areas.	2.2 MPN/100 mL Total Coliform from plant to ponds and LAs for Natural Sources from ponds to creek, for reclaimed water discharges only	No more than 10% of the samples exceed 43 MPN/100 mL at high priority shellfish harvesting areas.	0 MPN/100 mL Discharge prohibition currently in effect.
Final Numeric Targets, TMDL, WLAs, and LAs for Fecal Coliform in Newport Bay **Phase 10, As soon as possible but no later than Jan. 1, 2020: Full Compliance with REC-1 and SHEL Objectives, Year-round**					
Final TMDL for Fecal Coliform In Newport Bay	**Final WLAs for Fecal Coliform in Urban Runoff Discharged to Newport Bay**	**Final LAs for Fecal Coliform in Agricultural Runoff Discharged to Newport Bay**	**Final WLAs for IRWD**	**Final LAs for Fecal Coliform from Natural Sources in all Discharges to Newport Bay**	**Final WLAs for Vessel Waste**
Monthly Median less than 14 MPN/100 mL, and not more than 10% of the samples exceed 43 MPN/100 mL.	Monthly Median less than 14 MPN/100 mL, and not more than 10% of the samples exceed 43 MPN/100 mL.	Monthly Median less than 14 MPN/100 mL, and not more than 10% of the samples exceed 43 MPN/100 mL.	2.2 MPN/100 mL Total Coliform from plant to ponds and LAs for Natural Sources from ponds to creek, for reclaimed water discharges only	Monthly Median less than 14 MPN/100 mL, and not more than 10% of the samples exceed 43 MPN/100 mL.	0 MPN/100 mL Discharge prohibition currently in effect.

As shown in these Tables, it is proposed that the existing Basin Plan fecal coliform objectives applicable to Newport Bay for REC-1 and SHEL beneficial use protection be established as the TMDL in the form of a density-based TMDL. Density-based WLAs and LAs needed to achieve the TMDL are proposed for point and nonpoint source inputs of fecal coliform.[4]

Recognizing the complexity of the bacterial quality problem, the paucity of relevant data on bacterial sources, the expected difficulties in identifying and implementing appropriate control measures, and uncertainty regarding the nature and attainability of the SHEL use in the Bay, a phased TMDL approach is proposed. As reflected in Table 1, compliance with the REC-1 objectives and full protection of the REC-1 use is proposed to be achieved by 2014, while compliance with the SHEL standards is to be achieved by 2020. This is consistent with available information from local residents, the Orange County Health Care Agency and others that indicates that the Bay is heavily used for water contact recreational activities, but only for limited shellfish harvesting.

As shown in Table 2, Board staff proposes a series of interim numeric targets, with appropriate WLAs and LAs, that lead to ultimate compliance with the TMDL. These interim targets are proposed based on other identified priorities for the control of bacterial quality, including season, location, and the nature and magnitude of the violations. As proposed, priority is assigned to compliance in the summer months when recreational activity in the Bay is at its height. Bacterial quality control in the summer is also expected to be less difficult to achieve than in the winter. The proposed targets also recognize that certain areas of the Bay should be given higher priority, based on usage, the severity of violations or other factors (the selection of high priority areas would be made by the Regional Board through a public participation process). However, this TMDL proposes that the highest priority be given to the Dunes Resort Embayment, in light of both its intensive use and staff's assessment that the control of the major contributor of bacterial inputs at this location (the Back Bay drain) can and should be achieved in a very timely manner. Finally, priority is assigned based on the premise that the more immediate need is to control violations of the "acute" bacterial objectives as opposed to the "chronic" objectives, since the public health risk associated with higher coliform counts is considered more significant. Additionally, there are more violations of the "acute" portion of the bacterial quality objectives

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[4] Unlike most TMDLs, which establish a limitation on the mass per day of a pollutant that can be discharged while still complying with water quality objectives, the proposed TMDL is expressed in terms of density because of the difficulty in, and limited usefulness of quantifying the mass of coliform organisms. It is the number of organisms in a given volume of water (i.e., their density) , and not their mass, that is significant with respect to public health and the protection of beneficial uses. The density of coliform organisms in a discharge and in the receiving waters is the technically relevant criterion for judging the impact of the discharges and the suitability of the affected receiving waters. Federal guidance on the development of TMDLs suggests establishing a TMDL in this manner for a pollutant that is not readily controlled on a mass basis.

Similarly, unlike the mass-based WLAs and LAs established to meet most TMDLs, density-based WLAs and LAs are proposed in this report. The density-based WLAs and LAs do not add up to equal the TMDL, since this makes no scientific sense. The densities of individual bacterial sources are not additive. To achieve a density-based TMDL, it is simply necessary to assure that each WLA and LA itself meets the density-based TMDL. That is the approach taken here. An adequate margin of safety is provided to account for any uncertainty in the relationship between the maximum allowable bacteria loads and resulting water quality impacts.

during periods of high use, than the violations of the "chronic" part of the objectives which appear to be caused by rainfall runoff. The violations of the acute part of the objective are also caused by acute discharge events that should be more feasible to control than the rainfall runoff related violations of the bacterial quality objectives.

Consideration of these combined factors led to the phased TMDL approach outlined in Table 2. In brief, the approach provides for: (1) compliance with REC-1 objectives (both "acute" and "chronic") at the Dunes Resort Embayment in the summer (May through October) by January, 2002; (2) full compliance with REC-1 objectives throughout the Bay in the summer (May through October) by January, 2005; (3) full compliance with REC-1 objectives throughout the Bay, year round, by January 2014; (4) full compliance with the SHEL objectives (both "acute" and "chronic") throughout the Bay in the summer by January, 2017; and (5) full compliance with both REC-1 and SHEL objectives throughout the Bay, year-round, by 2020.

The technical bases for the WLAs and LAs proposed are described in detail later in this report (see Sections 3-9). Briefly, the WLA for urban runoff and the LA for agricultural runoff are based directly on the density-based TMDLs, adjusted to include a margin of safety. The LAs for natural sources of fecal coliform input were derived from empirical data provided by the Irvine Ranch Water District (IRWD) Wetlands Water Supply Project (WWSP) (about 70 acres of waterfowl ponds adjacent to San Diego Creek, approximately two miles upstream of Newport Bay). IRWD may propose a long-term discharge of reclaimed water from the WWSP ponds to San Diego Creek and thence Newport Bay. A WLA that would apply to such a discharge is proposed based on the expected quality of the reclaimed water discharged to the ponds and inputs from natural sources. Finally, a WLA allocation (zero) is shown for discharges of vessel sanitary wastes. This reflects the Bay's 1976 designation as a No-Discharge harbor for such wastes, and the fact that 40 CFR Section 122.2 designates vessel as point sources.

Board staff proposes that the Santa Ana Region Water Quality Control Plan (Basin Plan) be amended to incorporate the TMDL, WLAs, LAs, numeric targets and schedules shown in Tables 1 and 2. The amendment would include certain implementation measures and requirements for monitoring to assess the degree and effectiveness of TMDL compliance. These implementation and monitoring requirements are discussed in Section 10. The proposed Basin Plan amendment is shown in Appendix A.

The phased TMDL proposed herein will allow for further data collection and analyses concerning the sources and impacts of fecal coliform inputs to Newport Bay, the effectiveness of Best Management Practices employed to control those inputs, the nature of shellfish harvesting activities in the Bay, etc. These additional analyses may warrant changes to this TMDL. Board staff believes that additional information and analyses are particularly needed in two areas. First, data is needed to evaluate bacterial die-off and dilution, especially in the wintertime. Second, information is needed concerning shellfish harvesting activities in the Bay and the attainability and, perhaps, propriety of the bacterial objectives specified to protect this use. The need for this data is evident from a review of the proposed load and waste load allocations to achieve compliance with the shellfish harvesting objectives (see Table 2, Phases 7-10). As shown, the proposed allocations are extremely stringent. For example, in phase 10, the LA for natural sources is reduced to 14 MPN from the 50 MPN estimated to occur naturally. Board staff is concerned that attainment of this LA may be feasible only if wildlife management measures are implemented which clearly conflict with important wildlife management goals (e.g., enhancement of wildlife habitat in wetland areas). The TMDL's phased implementation framework provides time to conduct further monitoring and assessment which may provide an analytical basis for modifying the TMDL and or individual allocations. If sufficient evidence is collected that substantiates adequate dilution and die-off in the wintertime, the LAs and WLAs could and should be revised. Similarly, additional data on shellfish harvesting in the Bay and the health risk associated with such use may warrant some refinement of the SHEL beneficial use and/or bacterial quality objectives and, in turn, may lead to changes in the TMDL. Accordingly, this TMDL indicates the Regional Board's commitment to periodic review of this TMDL, and refinement as necessary via the Basin Plan amendment process.

Section 3. Problem Statement

The following sections provide an overview of the Newport Bay and its watershed and the bacterial quality problems affecting the uses of Newport Bay. In summary, Newport Bay is a very significant water resource for body contact and non-contact recreation. There are over 10,000 small boats moored in the Bay and more than 30 swimming beaches. Urban/agricultural runoff, and likely vessel waste, contribute fecal coliform to Newport Bay at levels that cause water quality objectives to be exceeded and result in the OCHCA posting areas warning against body contact recreation. Additionally, fecal coliform contamination causes violations of the water quality objectives for the protection of shellfish harvesting.

Section 3.1 The Newport Bay Watershed

The Newport Bay watershed is located in central Orange County, California (Figure 2). The watershed encompasses 154 square miles and includes portions of the Cities of Newport Beach, Irvine, Laguna Hills, Lake Forest, Tustin, Orange, Santa Ana, and Costa Mesa. The watershed is encircled by mountains on three sides: the Santa Ana Mountains to the north, the Santiago Hills to the northeast, and the San Joaquin Hills to the south. The runoff from these mountains drains across the Tustin Plain and enters Newport Bay via Peters Canyon Wash and San Diego Creek. The San Diego Creek watershed, which encompasses Peters Canyon Wash, is 105 square miles in area. The other 49 square miles of drainage that enter Newport Bay include the Santa Ana-Delhi Channel, Bonita Creek, Big Canyon Wash, and a large number of smaller tributaries that drain to the Lower Newport Bay. Newport Bay is a long, enclosed estuary roughly divided into the Upper and Lower Bay areas by the Pacific Coast Highway Bridge. The entire Bay up to the mouth of San Diego Creek is subject to tidal influence.

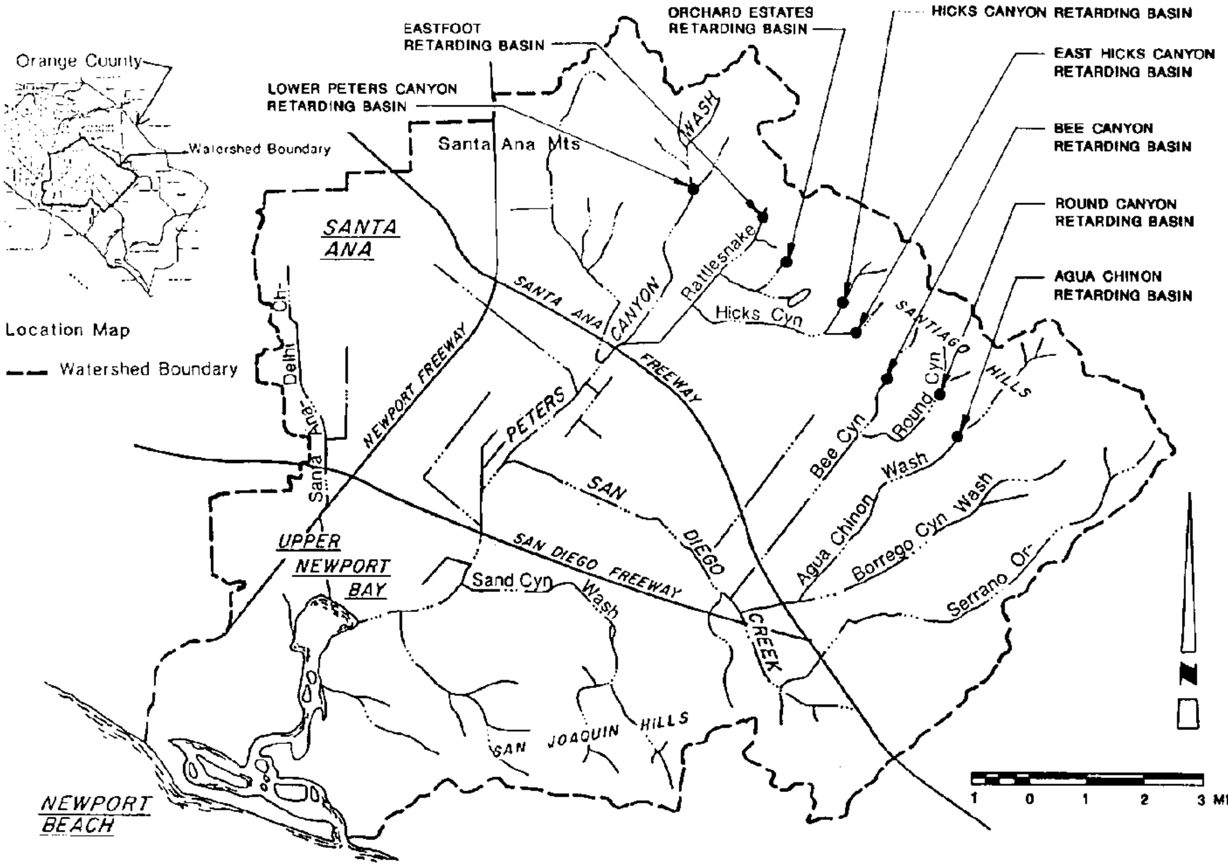

Figure 2: Newport Bay Watershed
(Boyle Engineers 1983 & Tettemer 1993)

The nature of the Newport Bay watershed has changed dramatically over the last 150 years, both in terms of land use and drainage patterns. In the late 19th and early 20th centuries, land use changed from ranching and grazing to farming. Following World War II, land use again began to change, from farming to residential and commercial development. In 1983, agriculture accounted for 22% and urban uses for 48% of the area of the Newport Bay watershed (OCPFRD, 1998). In 1993, agricultural uses accounted for 12% and urban uses for over 64% of the area. Table 3 summarizes the land use and area of the two largest subwatersheds, San Diego Creek and Santa Ana-Delhi. Agricultural activities in the watershed include row crops (primarily strawberries), avocados, lemons, and commercial nurseries. Urban development in the area consists of residential, commercial, and light industrial land uses.

Table 3: Summary of Land Use in the San Diego Creek and Santa Ana Delhi Watersheds(OCPFRD, 1998)

Land Use	**San Diego Creek**	**San Diego Creek**		**Santa Ana Delhi**	**Santa Ana Delhi**	
	Sq. Mi.	**% of watershed**		**Sq. Mi.**	**% of watershed**	
Residential	17.9	15		5.6	33	
Commercial	9.5	8		2.9	17	
Industrial	7.5	6.3		1.4	8	
Open Space	27.5	23.1		1	5.6	
Agricultural	11.9	10		0.3	1.5	
Public	0.4	0.3		0.2	1.2	
Recreation	0.4	0.3		0.2	1.3	
Transportation Utilities	1.4	1.2		0.5	3	
Roads	42.6	35.8		5.2	30.4	

Significant drainage modifications were made in the watershed to accommodate these changes in land use (Figure 3). In the mid-19th century, the Santa Ana River flowed into Newport Bay, while San Diego Creek and the small tributaries from the Santiago Hills drained into an ephemeral lake and the Swamp of the Frogs and then into the River. To make room for farming, the ephemeral lake and the Swamp of the Frogs were drained and the vegetation was cleared. Channels that did not always follow natural drainage patterns were constructed to convey runoff to San Diego Creek and then Newport Bay. In the early 20th century, a major flood event on the Santa Ana River caused a significant amount of sediment to be deposited into the Lower Bay, and the local community dug a channel for the River to bypass the Bay and discharge directly to the Pacific Ocean. In 1920, the River was permanently diverted into the current flood control channel that discharges to the ocean. As urban development in the watershed proceeded (and proceeds), the drainages were further modified to expand their capacity in order to provide flood protection to the structures being built. These changes to the drainage patterns in the San Diego Creek Watershed culminated in the channelization of San Diego Creek in the early 1960s by the Orange County Flood Control Department. The channelization isolated the San Joaquin Marsh, the last remaining portions of the historic marsh upstream of Upper Newport Bay, from San Diego Creek.

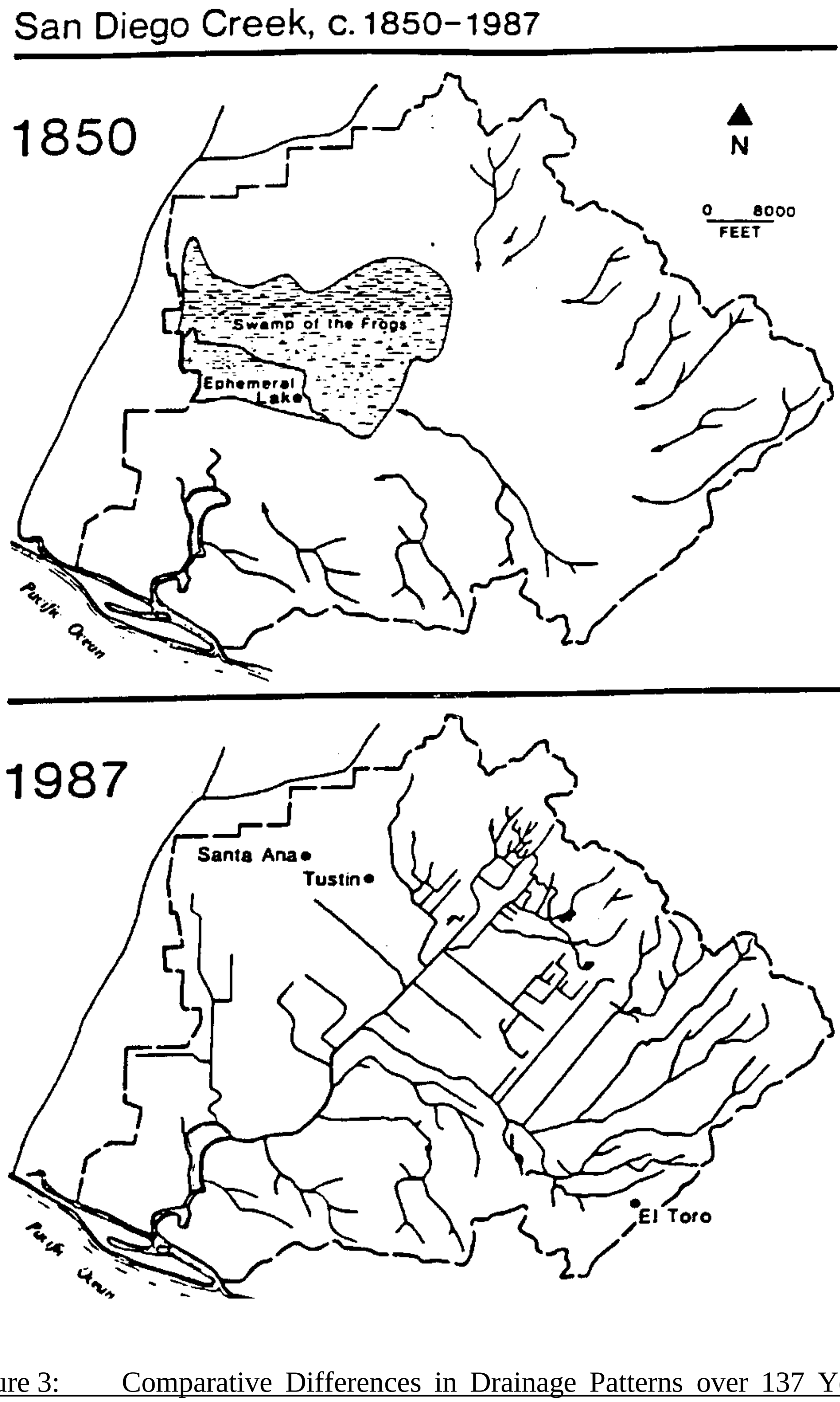

Figure 3: Comparative Differences in Drainage Patterns over 137 Years in the Newport Bay/San Diego Creek Watershed (Trimble, 1987)

These land use and drainage modifications have affected the nature and magnitude of fecal coliform discharges to the Bay. Changing land use introduced new sources of fecal coliform, while the drainage of historic marshes and wetlands reduced the pathogen removal benefits such habitats can provide.

Major portions of San Diego Creek and the other tributaries are basically flood control channels with flows consisting largely of urban runoff. During the dry season, the flow volumes in San Diego Creek and the other tributaries to the Bay are generally low, comprised of urban runoff and surfacing groundwater, and are insufficient for most swimming. Water contact recreation would be limited to wading and swimming by children. During rain events, when the flow volumes increase, the flow velocity makes it unsafe for swimming. The Orange County Flood Control District had restricted public access to many of the drainages to Newport Bay because of the unsafe conditions during storm events.

The watershed has a Mediterranean type climate characterized by short, mild wet winters and hot dry summers. There are two types of rainstorms in this region: most are related to the extra tropical cyclones of winter, and the others are infrequent summer thunderstorms. Both types of storms produce intense rainfall. According to the Orange County Environmental Management Agency, the 40-year average annual rainfall recorded at Tustin-Irvine Ranch Station was calculated to be 12.67 inches, of which 90% occurs between November and April.

3.2 Beneficial Uses and Water Quality Objectives

Table 4 below summarizes the beneficial uses of Newport Bay (divided into the Lower and Upper Bay), as identified in the Basin Plan. The listed beneficial uses are Navigation, Water Contact Recreation, Non-Body Contact Recreation, Commercial and Sport Fishing, Biological Habitats of Special Significance, Wildlife Habitat, Rare and Endangered Species Habitat, Spawning reproduction and development, Marine Habitat, Shellfish Harvesting, and Estuarine Habitat.

Table 4: Designated Beneficial Uses of Newport Bay

Water Body	NAV	REC-1	REC2	COMM	BIOL	WILD	RARE	SPWN	MAR	SHEL	EST
Upper Newport Bay		X	X	X	X	X	X	X	X	X	X
Lower Newport Bay	X	X	X	X		X	X	X	X	X	

The Basin Plan specifies the following bacterial quality objectives for Newport Bay:

"…Water quality objectives for numbers of total and fecal coliform vary with the uses of the waters, as shown below:

REC-1	Fecal coliform: log mean less than 200 organisms/100 mL based on five or more samples/30 day period, and not more than 10% of the samples exceed 400 organisms/100 mL for any 30-day period
SHEL	Fecal coliform: median concentration not more than 14 MPN(most probable number)/100 mL and not more than 10% of samples exceed 43 MPN/100 mL."

Fecal coliform are used as indicators of the presence of pathogens (bacteria, viruses, and parasites) that pose a public health risk. Appendix B provides a summary of these pathogens and their associated health effects. Because of analytical difficulty and cost, it is not practical to monitor receiving waters routinely for the pathogens themselves, so surrogates such as fecal coliform are used. As previously noted, measurements of total coliform are also used to assess the suitability of waters for various uses. Fecal coliform are a subset of the total coliform group and are a more specific indicator of the presence of fecal wastes from humans and other warm-blooded animals, which can pose a significant risk of disease. Total coliform include soil bacteria that may or may not be pathogenic (Chapra, S., 1997).

3.3 Fecal Coliform Problems in Newport Bay

To protect public health and assure the suitability of Newport Bay waters for water contact recreation and shellfish harvesting, the Orange County Health Care Agency (OCHCA) routinely monitors the bacterial quality of the Bay at approximately 30 sampling locations (Figure 4). OCHCA supplements this intensive routine effort with special investigations in areas with known bacterial quality problems. For the most part, the OCHCA samples are analyzed only for total coliform, consistent with the Agency's reliance on Health and Safe Code total coliform standards to judge bacterial quality. However, samples from selected stations of particular concern are also analyzed for fecal coliform. The OCHCA has monitored the Bay for more than 25 years.

The OCHCA banned shellfish harvesting and water contact recreation in the upper part of the Upper Bay in 1974, based on the consistently high coliform densities measured in that area. These prohibitions remain in effect. (It may be noted that this part of the Bay encompasses the Upper Newport Bay Ecological Reserve, where water contact recreation and shellfish harvesting activities would likely be restricted in the interest of wildlife, irrespective of bacterial quality concerns.) The OCHCA has temporarily closed other parts of the Bay to water contact recreation in response to the results of its monitoring program. Such closures typically occur in response to storm events or sewage spills. As a health precaution measure, the OCHCA generally advises against the collection of shellfish anywhere in the Bay.

OCHCA data collected in 1997 and 1998 provide a good characterization of the bacterial quality problems in the Bay. Table 5 (a,b,c, and d), provides a summary of violations of the Basin Plan fecal coliform objectives (and Health and Safety Code total coliform standards) for both REC-1 and SHEL during the summer (May through October, 1997) and winter (November, 1997 through May, 1998). It should be noted that actual fecal coliform data are available only for 5 of the listed stations; for the other stations, it is assumed that violations of the Health and Safety Code total coliform standards would also result in violations of the Basin Plan fecal coliform standards[5].

A review of Table 5 demonstrates the following. First, it is evident from Tables 5c and 5d that the Bay rarely meets objectives for shellfish harvesting, either in summer or winter. Table 5a and 5b show that bacterial quality problems are most severe in the winter, when inputs of coliform to the Bay via runoff are expected to be highest. In the drier summer months, there is generally good compliance in the Bay with the bacterial quality objectives for water contact recreation (Table 5a). But there are some notable problem areas, particularly the Dunes area, located in the lower part of the Upper Bay, and the channels at the west end of the Lower Bay (Rhine Channel, 43rd, 38th and 33rd Street stations) (Figure 3). The Dunes area (Dunes Resort Embayment) is heavily used for water contact recreation. The extent of recreational use in the west end channels is unclear, but appears to be relatively limited. The OCHCA agency has conducted intensive investigations in both of these areas to determine bacterial sources (see Section 4. Source Analysis).

[5] Table 5 demonstrates that this assumption is justified. At the 5 locations where both total and fecal coliform are measured, there is generally a greater number (or at least an equivalent number) of weeks of violations of the fecal coliform objectives than the total coliform standards. It is recognized that there may be situations in which the total coliform measured in violation of the standard do not include sufficient fecal coliform to result in violation of the fecal coliform objective. However, the assumption that fecal coliform would be present at elevated levels is reasonable for the general characterization of bacterial quality problems intended and provided in this report.

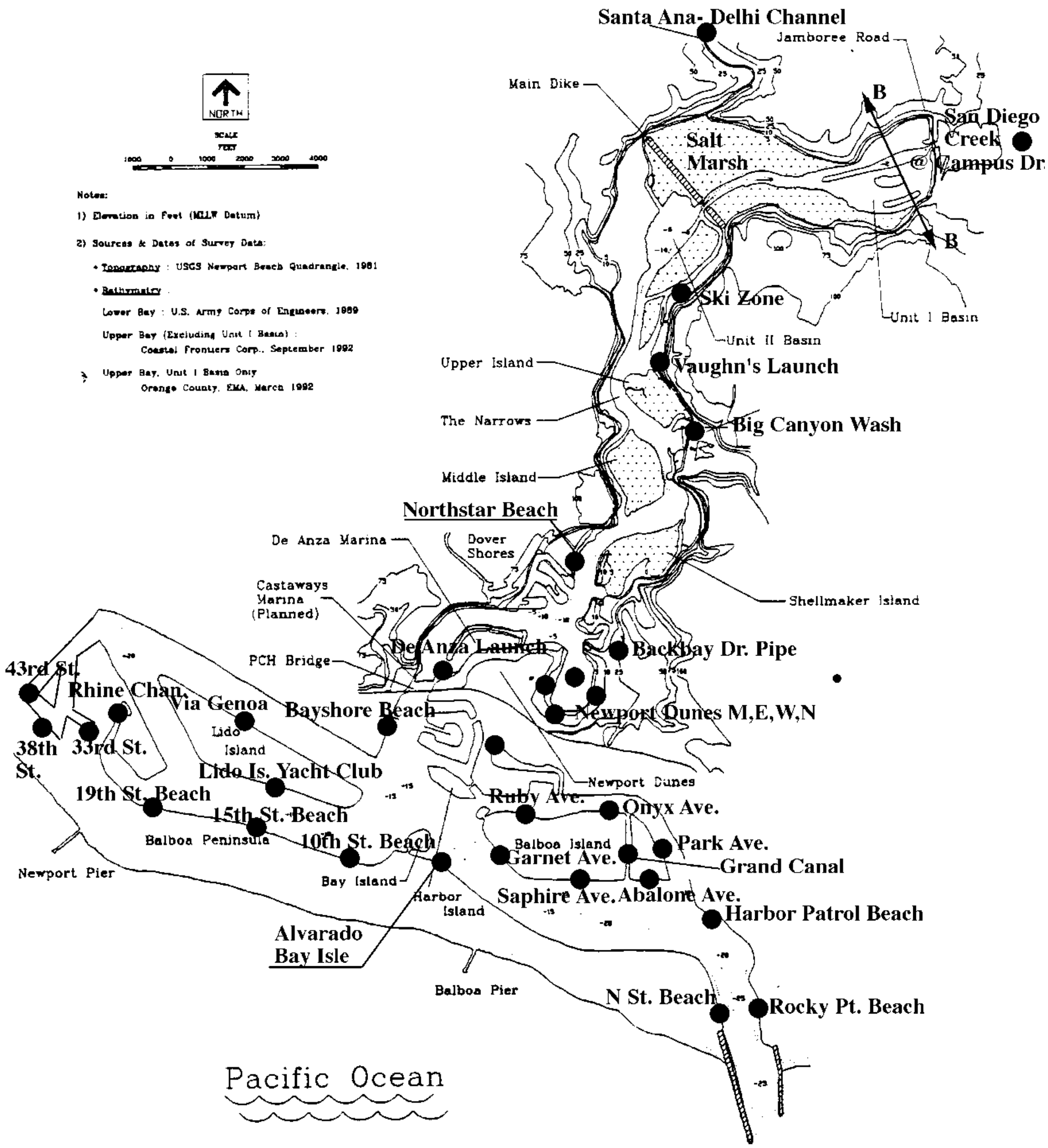

Figure 4: OCHCA's Newport Bay Sampling Stations
(USACOE, 1993, OCHCA 1998)

Table 5a: Summary of the Number of Weeks of Violations of the Total and Fecal Coliform Water Quality Objectives for Body Contact Recreation at Newport Bay Beaches (OCHCA & OCPFRD 1997-98)

Violations of Water Quality Objectives for Body Contact May through October 1997				
Sampling Location	**No. of Weeks w/GeoM >1000 MPN Total and >200 MPN Fecal**	**% Time in Violation of WQOs**	**Weeks w/20% Samples >1000 MPN Total and 10% >400 MPN Fecal**	**% Time in Violation of WQOs**
SKI ZONE	0	0	0	0
VAUGHNS LAUNCH	0	0	4	21
NORTHSTAR BEACH	0	0	0	0
NORTHSTAR-FECAL	0	0	0	0
DUNES E	1	5	16	84
DUNES E-FECAL	1	5	12	63
DUNES M	0	0	0	0
DUNES M-FECAL	0	0	0	0
DUNES W	0	0	4	29
DUNES W-FECAL	0	0	4	31
DUNES N	0	0	0	0
DUNES N-FECAL	0	0	4	31
DE ANZA	0	0	4	21
PROMONTORY PT	0	0	0	0
BAYSHORE BEACH	0	0	0	0
ONYX AVENUE	0	0	8	35
GARNET AVENUE	0	0	12	63
RUBY AVE.	0	0	4	15
SAPPHIRE AVENUE	0	0	4	15
ABALONE AVENUE	0	0	0	0
PARK AVENUE	0	0	0	0
VIA GENOA	0	0	0	0
ALVARADO/BAY IS	0	0	0	0
10TH STREET	0	0	0	0
15TH STREET	0	0	0	0
19TH STREET	0	0	4	15
LIDO IS.YACHT CL.	0	0	0	0
HARBOR PATROL	2	8	4	15
N STREET BEACH	0	0	0	0
ROCKY POINT	0	0	0	0
43RD STREET	4	21	12	63
38TH STREET	0	0	12	46
33RD STREET	6	43	14	100
RHINE CHANNEL	1	7	14	100
Average in Bay=	0	3	4	22

Table 5b: Summary of the Number of Weeks of Violations of the Total and Fecal Coliform Water Quality Objectives for Body Contact Recreation at Newport Bay Beaches (OCHCA & OCPFRD 1997-98)

Violations of Water Quality Objectives for Body Contact Recreation November 1997 through May 1998					
Sampling Location	**Weeks w/Total >1000 MPN and fecal >200 MPN**	**% Time in Violation of WQOs**		**Weeks w/20% Samples Total>1000 MPN and 10% fecal >400 MPN**	**% Time in Violation of WQOs**
SKI ZONE	5	42		12	100
VAUGHNS LAUNCH	6	50		16	100
NORTHSTAR BEACH	17	61		20	71
NORTHSTAR-FECAL	Na			Na	
DUNES E	20	71		24	86
DUNES E-FECAL	24	86		24	86
DUNES M	13	46		20	71
DUNES M-FECAL	15	54		24	86
DUNES W	15	54		24	86
DUNES W-FECAL	17	61		20	71
NEW. DUNES N	16	57		24	86
DUNES N-FECAL	19	68		24	86
DE ANZA	10	36		16	57
PROMONTORY PT	0	0		8	29
BAYSHORE BEACH	7	26		24	89
ONYX AVENUE	6	21		20	71
GARNET AVENUE	6	21		24	86
RUBY AVE.	6	21		12	43
SAPPHIRE AVENUE	5	18		12	43
ABALONE AVENUE	5	18		8	29
PARK AVENUE	3	11		12	43
VIA GENOA	1	4		12	43
ALVARADO/BAY IS	5	18		16	57
10TH STREET	4	14		12	43
15TH STREET	2	7		16	57
19TH STREET	1	4		8	29
LIDO IS. YACHT CLUB	1	4		12	43
HARBOR PATROL	3	11		16	57
N STREET BEACH	3	11		12	43
ROCKY POINT	0	0		12	43
43RD STREET	9	32		28	100
38TH STREET	1	4		12	43
33RD STREET	25	89		28	100
RHINE CHANNEL	2	7		12	43
Average in Bay=	8	31		17	65

Table 5c: **Summary of the Number of Weeks of Violations of the Total and Fecal Coliform Water Quality Objectives for Shellfish Harvesting at Newport Bay Beaches (OCHCA & OCPFRD 1997-98)**

Violations of Water Quality Objectives for Shellfish Harvesting May through October 1997				
Sampling Location	**Weeks w/30-day Median Fecal > 14 MPN/100 and Median Total> 70 MPN**	**% Time in Violation of WQOs**	**Weeks w/10% Samples Fecal> 43 MPN/100 and Total> 230 MPN/100**	**% Time in Violation of WQOs**
SKI ZONE	6	32	4	21
VAUGHNS LAUNCH	8	42	8	42
NORTHSTAR BEACH	0	0	0	0
NORTHSTAR-FECAL	9	56	16	100
DUNES E	23	100	24	100
DUNES E-FECAL	23	100	24	100
DUNES M	9	35	8	31
DUNES M-FECAL	22	85	12	46
DUNES W	10	71	8	57
DUNES W-FECAL	20	100	12	92
DUNES N	16	100	12	86
DUNES N-FECAL	19	100	16	100
DE ANZA	10	53	16	84
PROMONTORY PT	0	0	0	0
BAYSHORE BEACH	5	23	12	55
ONYX AVENUE	12	52	16	70
GARNET AVENUE	20	100	4	21
RUBY AVE.	4	15	12	46
SAPPHIRE AVENUE	2	8	12	46
ABALONE AVENUE	1	4	4	15
PARK AVENUE	0	0	0	0
VIA GENOA	0	0	8	31
ALVARADO/BAY IS	0	0	0	0
10TH STREET	0	0	4	15
15TH STREET	11	42	12	46
19TH STREET	8	31	4	15
LIDO IS. YACHT CLUB	0	0	0	0
HARBOR PATROL	6	23	16	62
N STREET BEACH	1	4	0	0
ROCKY POINT	4	15	4	15
43RD STREET	20	100	24	100
38TH STREET	22	85	24	92
33RD STREET	17	100	16	100
RHINE CHANNEL	17	100	20	100
Average in Bay=	10	52	10	54

Table 5d: Summary of the Number of Weeks of Violations of the Total and Fecal Coliform Water Quality Objectives for Shellfish Harvesting at Newport Bay Beaches (OCHCA & OCPFRD 1997-98)

Violations of Water Quality Objectives for Shellfish Harvesting November 1997 through May 1998				
Sampling Location	**Weeks w/Fecal 30-day Median > 14 MPN/100 and Median Total> 70 MPN**	**% Time in Violation of WQOs**	**Weeks w/10% Samples Fecal > 43 MPN/100 and >230 MPN Total**	**% Time in Violation of WQOs**
SKI ZONE	12	100	12	100
VAUGHNS LAUNCH	12	100	12	100
NORTHSTAR BEACH	21	75	24	86
NORTHSTAR-FECAL				
DUNES E	24	86	24	86
DUNES E-FECAL	24	86	24	86
DUNES M	24	86	24	86
DUNES M-FECAL	21	75	24	86
DUNES W	24	86	24	86
DUNES W-FECAL	24	86	24	86
NEW. DUNES N	24	86	24	86
DUNES N-FECAL	24	86	24	86
DE ANZA	22	79	24	86
PROMONTORY PT	11	39	12	43
BAYSHORE BEACH	23	85	24	89
ONYX AVENUE	24	86	20	71
GARNET AVENUE	24	86	24	86
RUBY AVE.	20	71	16	57
SAPPHIRE AVENUE	21	75	24	86
ABALONE AVENUE	17	61	24	86
PARK AVENUE	23	82	16	57
VIA GENOA	18	64	16	57
ALVARADO/BAY IS	16	57	16	57
10TH STREET	16	57	16	57
15TH STREET	17	61	16	57
19TH STREET	16	57	12	43
LIDO IS. YACHT CLUB	16	57	16	57
HARBOR PATROL	17	61	20	71
N STREET BEACH	21	75	20	71
ROCKY POINT	16	57	16	57
43RD STREET	25	89	24	86
38TH STREET	19	68	16	57
33RD STREET	24	86	24	86
RHINE CHANNEL	22	79	24	86
Average in Bay=	20	75	20	75

Section 4. Source Analysis

In order to determine the fecal coliform reductions needed to achieve water quality standards and to allocate allowable fecal coliform inputs among the sources, it is necessary to consider the existing and potential coliform sources, including point, non-point and natural sources. In the language of federal regulations, individual Waste Load and Load Allocations for the different sources must be determined that together will result in compliance with the TMDL. To do this, the sources must be characterized.

Fecal coliform have diverse origins. They are generally, but not necessarily, associated with fecal wastes from warm-blooded animals. They are found in the wastes of humans, household pets, horses, grazing animals and wildlife. They are often found in restaurant wastes, such as discarded meat (most of us are familiar with the significant health risk posed by E. coli in inadequately cooked meat). Fecal coliform are also found in runoff from agricultural fields or household lawns where manure has been applied as fertilizer, and in other waste discharges.

Monitoring conducted by the OCHCA demonstrates that the predominant coliform sources to the Bay are its tributary inflows, which are composed largely of urban and agricultural runoff. Birds and other animals inhabiting the watershed are natural sources of coliform input. Other existing or potential sources include discharges of vessel sanitary wastes and a proposed discharge by the Irvine Ranch Water District of recycled water from wetlands ponds to San Diego Creek and thence Newport Bay (here, coliform would be derived not from the recycled water, per se, but from the waste discharges of animals inhabiting the ponds).

Section 4.1 Urban and Agricultural Runoff

As described in Section 3, the drainage system tributary to Newport Bay has been significantly modified and created by man, so that both urban runoff and agricultural runoff combine to make up the majority of the flow discharged to Newport Bay when there is no rain. This same system is also used to convey stormwater runoff that is mixed with the urban and agricultural waste discharges. Monitoring data collected by the OCHCA demonstrates that these tributary inputs are significant sources of fecal coliform input to the Bay. This is consistent with findings elsewhere in California (for example, Santa Monica Bay) and the nation that runoff is a significant source of bacterial quality problems in the receiving water. (USEPA, September 1982, Results of the Nationwide Urban Runoff Program)

For example, Figure 5 below shows the geometric mean fecal coliform densities in the four major tributaries to the Bay, San Diego Creek, Santa Ana Delhi Channel, Big Canyon Wash, and the Backbay Drive Drain from May, 1997 through May, 1998. Also shown for comparison is the REC-1 bacterial objective of 200 MPN/100 mL that applies to these tributaries. Table 6 summarizes the weeks of violations of the water quality objective in the four tributaries during this period. As shown, the geometric mean fecal coliform density in each of the four major tributaries discharging to Newport Bay generally exceeds the objective of 200 MPN/100 mL. The fecal coliform densities in the tributaries typically range between 300 MPN/100 mL and 1000 MPN/100 mL in the summer, to average densities exceeding 10,000 MPN/100 mL in the winter. San Diego Creek and the Santa Ana Delhi Channel never meet the fecal coliform objectives, while Big Canyon Wash and the Back Bay drain do so only intermittently.

Figure 5: Geometric Mean Fecal Coliform Density, Newport Bay Tributaries

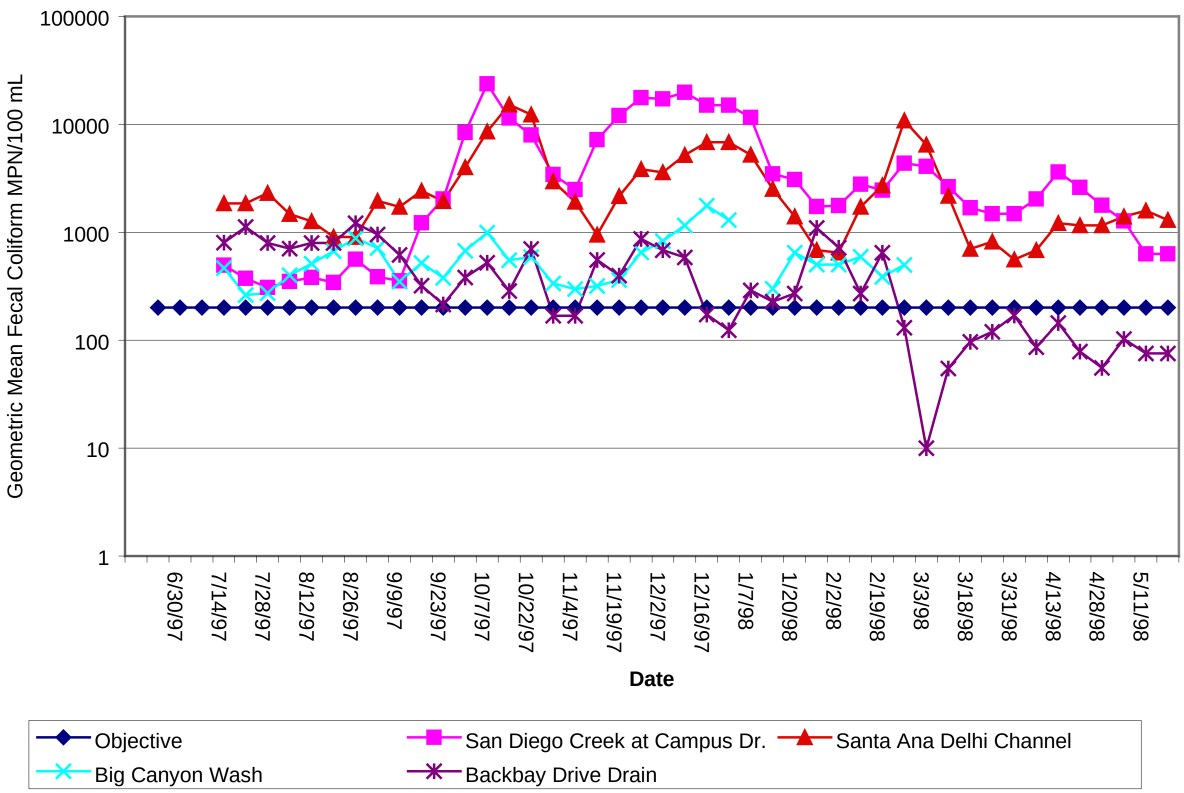

Table 6: Summary of the Number of Weeks of Violations of Water Quality Objectives for Total and Fecal Coliform in the Four Major Tributaries that Discharge into Newport Bay

5/1/97-5/31/98	**MAY THROUGH OCTOBER**			**NOVEMBER THROUGH APRIL**		
LOCATION	**Weeks of Violation**	**Total Weeks**	**% Violation May-Oct**	**Weeks of Violation**	**Total Weeks**	**% Violation Nov-Apr**
SAN DIEGO CREEK @CAMPUS	22	22	100	22	22	100
SDC@CAMPUS FECAL	22	22	100	22	22	100
SANTA ANA DELHI	22	22	100	22	22	100
SANTA ANA DELHI FECAL	22	22	100	22	22	100
BIG CANYON WASH	27	31	87	31	31	100
BIG CYN. WASH FECAL	22	22	100	18	22	82
BACKBAY DR. DRAIN	19	19	100	21	25	84
BACKBAY DR. DR. FECAL	16	19	84	14	25	56

There is little information available concerning the magnitude and type of the specific sources of coliform input to these tributaries. Likewise, there is a paucity of such information from other areas in the country, as shown by an Internet search and review of the literature. Comparison of the fecal coliform densities measured in each of the four major tributaries to the Bay (Figure 5) shows that they are generally quite similar, even though the character of the land uses (and, presumably, the types of bacterial sources) in the watersheds of each of the tributaries is somewhat different. For example, there is a large agricultural land use component in the San Diego Creek watershed that does not exist in the largely urbanized Santa Ana Delhi watershed (see Table 3), but the coliform densities measured are nevertheless essentially the same. Fecal coliform inputs to the Bay from the tributaries appear to be correlated with flow rather than land use (as reflected in Figure 5, fecal coliform inputs increase during the winter season, when flows increase due to rain). This is confirmed by investigations in Mission Bay in San Diego, where runoff from two tributaries (Rose Creek and Tecolote Creek) was shown to be the source of bacterial contamination necessitating closure of beaches (low flow diversions of these tributaries have since been implemented so that the urban runoff is now discharged to the sanitary sewer system.) The bacterial quality of runoff from different types of land uses in the watersheds to these tributaries was measured, using several bacterial indicators, including fecal coliform. As seen in Figure 6 (K. Schiff, SCCWRP, personal communication, October 1998), the bacterial densities measured were very similar; there were no distinct differences based on land use type. It is noteworthy also that the bacterial densities measured in these tributaries were similar to those measured in the Newport Bay tributaries. Like results have been demonstrated in studies of bacterial quality problems in Santa Monica Bay. This watershed-watershed similarity, and the lack of apparent bacterial quality distinctions based on land use, likely reflect the ubiquitous nature and diverse origins of coliform organisms.

A source evaluation completed as part of the Santa Monica Bay Restoration Project (SMBRP) indicated that there is a human fecal waste component to urban runoff; human enteric viruses were prevalent in all the urban runoff sites sampled (SMBRP, June 1992 and May, 1996). The

Orange County Sanitation District collected 4 samples in San Diego Creek for genetic testing to determine if a human fecal waste component was present (C. McGee, Orange County Sanitation District, 1992). This genetic monitoring showed, at least qualitatively, that some portion of the fecal coliform pollution found in San Diego Creek may be due to human fecal coliform. However, there is no information available regarding the specific quantity of the fecal pollution due to human causes, and what portion is due to other animals, or other sources, in the watershed.

The OCHCA has conducted a number of investigations in the watershed to identify possible sources of specific bacterial quality problems in the Bay. These include special studies at the Dunes Resort Embayment and at the channels in the west corner of the Bay. These studies have demonstrated that the Back Bay Drain is a significant source of the bacterial contamination affecting the Dunes area, although again, the specific contributors to the bacterial levels in the Drain are not known. OCHCA's work indicates that a significant source of the chronic bacterial quality problems in the west end channels is likely the discharge of food waste from restaurants in the area. Many restaurants wash down equipment and floor mats into storm drains tributary to this part of the Bay, and improperly dispose of food waste such that it also washes into the storm drains. This food waste may contain large numbers of fecal coliform and other bacteria. During its investigation, the OCHCA found more than 1,300,000 fecal coliform organisms/100 mL in wastewater draining from a restaurant dumpster (personal communication with Monica Mazur, OCHCA). This waste is washed down to the storm drain system. The bacterial quality problems in these channels are aggravated by the limited water circulation and tidal flushing in this area.

A final point must be made concerning the bacterial inputs from the tributaries to Newport Bay and their effects on the Bay's quality. As already discussed, fecal coliform densities in the tributaries during the summer generally range between 300 MPN/100 mL and 1000 MPN/100 mL. Even so, the bacterial quality in much of the Bay during the summer generally meets the REC-1 objective of 200 MPN/100 mL. Clearly, bacterial dilution and die-off occur in the Bay such that the objective can be met, but these processes are not well understood in the Bay. Additional work to determine bacterial fate is needed to refine the proposed TMDL; requirements to conduct such additional work are included as part of the monitoring program proposed (see Section 10).

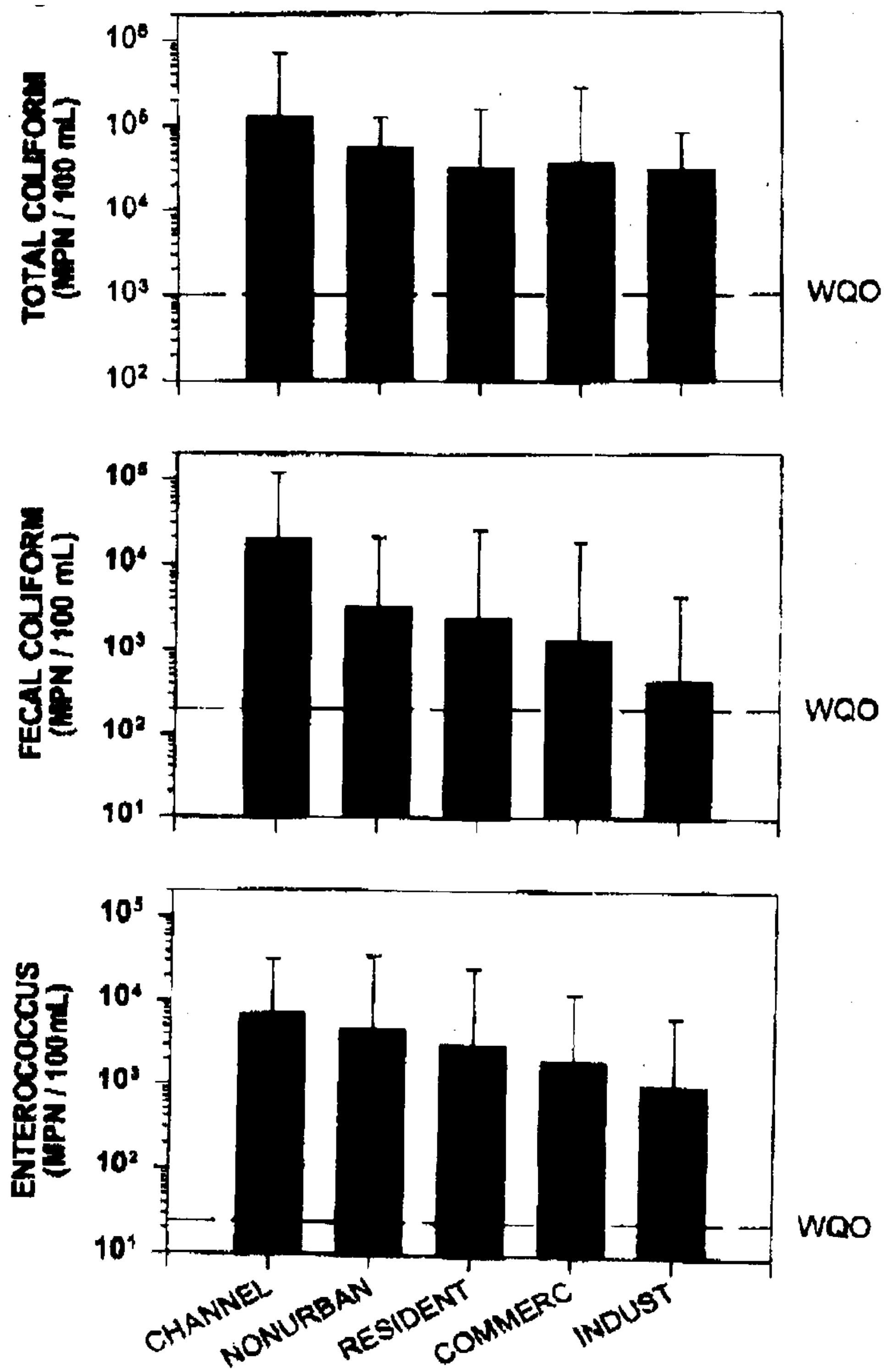

Figure 6: **Bacterial Water Quality of Various Land Uses, Rose Canyon Creek Watershed (K. Schiff, SCCWRP, October 1998)**

Section 4.2 Natural Sources

Birds and animals live throughout the watershed tributary to Newport Bay and contribute fecal coliform to the overall levels of fecal coliform measured in the Bay. The 700+ acre Upper Newport Bay Ecological Reserve is used heavily by birds and other wildlife, and open space in the foothills of the watershed also contains populations of wildlife. This wildlife contributes fecal waste throughout the watershed, that is part of the total load of fecal coliform discharged to the Bay. IRWD has provided monitoring data from its Wetland Water Supply Project (WWSP) that provide clear evidence of the coliform load resulting from such natural sources. The WWSP involves the discharge of disinfected reclaimed water from IRWD's treatment plant to about 70 acres of wetland ponds. The ponds provide further treatment of the wastewater and habitat for waterfowl and other wildlife. IRWD has measured the total and fecal coliform and bacteriophage densities in the discharge from the treatment plant to the ponds, and in the discharge from the ponds back to the treatment system, as part of their demonstration of the WWSP. A summary of these data is provided in Table 7 below.

These data show that an average of 90 MPN/100 mL of total coliform, 40 MPN/100 mL of fecal coliform, and non detectable amounts of phage were picked up in the reclaimed water as the water circulated through the ponds, where there are essentially only natural sources of total and fecal coliform. (Phage is a more human specific indicator of pathogen pollution that is expected to be removed at the treatment plant. Phage contributions from wildlife are not expected.)

A 1991 study of natural sources of bacteria (Calderon, Dufour, Mood, 1991) supports this proposed LA for natural sources. This 1991 study, entitled "Health Effects of Swimmers and Nonpoint Sources of Contaminated Water," evaluated the risk of swimming in a pond that was shown to be impacted only by natural sources of bacteria. The study measured densities of total and fecal coliform, *enterococci*, *staphlococci*, and pseudonomas bacteria and assessed the risk of swimming in the pond at the measured densities. This study found that there were no human sources of the bacteria found in the pond, only natural sources, and the geometric mean fecal coliform density measured in the pond was 62 MPN/100 mL. This is consistent with coliform densities measured from natural sources in the WWSP.

Table 7: Summary of IRWD WWSP Monitoring Data[6]

Date	Total Coliform Discharge 001 MPN/100ml	Total Coliform Discharge 002 MPN/100ml	Fecal Coliform Discharge 001 MPN/100ml	Fecal Coliform Discharge 002 MPN/100ml	Phage Discharge 001 MPN/100ml	Phage Discharge 002 MPN/100ml
3/2/98	2	170	<2	30	<1	<1
3/3/98	<2	300	<2	30	1	
3/4/98	2	27	<2	22	<1	
3/5/98	2	80	<2	80	<1	
3/6/98	<2	300	<2	300	1	
3/9/98	<2	70	<2	22	<1	
3/10/98	2	220	<2	30	<1	<1
3/11/98	2	130	<2	22	<1	
3/12/98	<2	50	<2	7	<1	
3/13/98	<2	50	<2	4	<1	
3/16/98	<2		<2		<1	
3/17/98	<2	80	<2	30	<1	<1
3/18/98	<2	50	<2	30	<1	
3/19/98	<2	30	<2	30	<1	
3/20/98	<2	<2	<2	<2	<1	
3/23/98	<2	30	<2	30	<1	<1
3/24/98	<2	30	<2	23	<1	
3/25/98		500		80	<1	
3/26/98		70			<1	
3/27/98		80		<2	<1	
3/30/98	<2	110	<2	21	<1	<1
3/31/98	<2	23	<2	13	<1	
4/1/98	2	50	<2	50	<1	
4/2/98	2	110	<2	70	<1	
4/3/98	<2	30	<2	11	<1	
4/6/98	<2	6	<2	17	<1	<1
4/7/98	<2	11	<2	2	<1	
4/8/98	<2	23	<2	2	<1	
4/9/98	<2	17	<2	110	<1	
4/10/98	<2		<2		<1	
4/13/98	<2	80	<2	23	<1	
4/14/98	<2	23	<2	8	<1	
4/15/98	<2	20	<2	30	<1	
4/16/98	<2	7	<2	2	<1	<1
4/17/98	<2	80		7	<1	
4/20/98	<2	170	<2	2	<1	<1
4/21/98	<2	80	<2	4	<1	
4/22/98	<2	34	<2		<1	
4/23/98	<2	23	<2	13	<1	

[6] Discharge serial 001 is the IRWD disinfected discharged into the WWSP ponds. Discharge Serial 002 is the discharge from the ponds to the IRWD treatment plant.

Table 7: Summary of IRWD WWSP Monitoring Data

	Total Coliform Discharge 001	Total Coliform Discharge 002	Fecal Coliform Discharge 001	Fecal Coliform Discharge 002	Phage Discharge 001	Phage Discharge 002
Date	MPN/100ml	MPN/100ml	MPN/100ml	MPN/100ml	MPN/100ml	MPN/100ml
4/27/98	2	17	<2	2	<1	
4/28/98	<2	14	<2	8	<1	
4/29/98	<2	80	<2	8	<1	<1
4/30/98	<2	30	<2	30	<1	
5/1/98	<2	130	<2	130	<1	
5/4/98	<2	11	<2	11	<1	
5/5/98	<2	220	<2	140	<1	
5/6/98	<2	11	<2	4	<1	
5/7/98	2	240	<2	240	<1	
5/8/98	<2	240	<2	80	<1	
5/11/98	<2	80	<2	22	<1	
5/12/98		130		23		
5/13/98		220		50		<1
5/14/98		500		50		
5/15/98		26		14		
5/18/98		70		<2		
5/19/98		<2		<2		
5/20/98		2		<2		
5/21/98		2		<2		<1
5/22/98		2		2		
5/26/98		11		<2		
5/27/98		30		<2		<1
5/28/98		50		<2		
5/29/98		30		<2		
Average	2	90	<2	40	1	<1

Section 4.3 Irvine Ranch Water District

The Irvine Ranch Water District may propose a long-term discharge of tertiary-treated recycled water from its Michelson Water Reclamation Plant to approximately 70 acres of waterfowl ponds adjacent to the plant, and from the ponds to San Diego Creek and thence Newport Bay. The recycled water discharged to the ponds would be required to meet the 2.2 MPN/100 mL total coliform standard specified by the Department of Health Services in its Wastewater Reclamation Criteria (Title 22, California Code of Regulations, Division 4, Chapter 3). (IRWD's treated wastewater consistently shows total coliform less than 2.2 MPN/100 mL; fecal coliform are not detected.) Waterfowl use of the ponds will add coliform; as discussed in the preceding section, the fecal coliform addition from these natural sources is estimated to be on the order of 40-60 MPN/100 mL.

Section 4.4 Vessel Waste Discharges

According to Clean Water Section 502(14) and 40 CFR, Section 122.2, marine vessels are classified as point sources. With more than 10,000 vessels moored throughout the Bay, these point sources of fecal coliform pose a potentially significant threat to water quality. The Bay was designated a No Discharge harbor for vessel sanitary wastes in 1976, based on the determination by the U.S. EPA Administrator that adequate pumpout facilities were in place in the Bay. The Regional Board reviewed the adequacy of the pumpout facilities in the early 1990's and required that several additional pumpouts be installed. The City of Newport Beach and the County of Orange have instituted a vessel waste program that includes public education and periodic inspection of the pumpouts, but there are no data available on the effectiveness of this program. It is possible, and, unfortunately, likely that vessel wastes still contribute to fecal contamination in the Bay. Since the wastes are of human origin, these discharges are of immediate and potentially significant public health concern.

Section 4.5 Recommendations for Further Source Analysis

Given the paucity of information concerning sources of coliform contamination in the watershed, staff proposes that the RWQCB require the completion of a source analysis, coupled with a water quality modeling effort to determine the impacts of inputs from the identified sources on the bacterial quality of the Bay. Ideally, the modeling effort would use the hydrodynamic model recently completed by the Corps of Engineers. These efforts are expected to result in recommendations for changes to the TMDL and/or implementation measures proposed in this report. The intent is to assure that the TMDL and implementation measures provide reasonable protection of beneficial uses. The implementation plan section (Section 10) outlines a task schedule for the completion of these efforts.

Section 5. Loading Capacity, Total Maximum Daily Load, Waste Load Allocations, Load Allocations, and Numeric Targets

The loading capacity of a water body for a particular pollutant is essentially the same as the TMDL for the waterbody. A TMDL is the greatest amount of pollutant loading that a waterbody can receive without violating water quality standards. Waste Load and Load Allocations indicate how responsibility for achieving the TMDL will be assigned. Allocations may be assigned in a variety of ways (e.g. discharger sector, land use), but the relationship between the allocations and the loading capacity must be clear and consistent. The regulations at 40 CFR 130.2(g) state that "Load allocations are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading." Numeric Targets help establish definable goals for taking the steps necessary to ensure compliance with water quality objectives, and establish the linkage between attainment of the standards and the TMDL. EPA guidance recommends that where the cause of, or significant contributor to, violations of water quality objectives is diffuse (e.g. urban, agricultural, and stormwater runoff), and where substantial complexity and uncertainty exist (as is the case here), then a Phased TMDL should be used. A phased TMDL approach is recommended here, including a schedule for compliance with the final TMDL, WLAs, LAs, and interim numeric targets, WLAs, and LAs. Table 2 above summarizes the proposed TMDL, WLAs, LAs and Numeric Targets for fecal coliform in Newport Bay, and the following sections provide further discussion of these requirements.

Section 5.1 Total Maximum Daily Load and Loading Capacity for Fecal Coliform in Newport Bay

Expressed as a load, the Total Maximum Daily Load, and loading capacity, of fecal coliform that can be discharged into Newport Bay is the total number of fecal coliform organisms that can be discharged from all sources while not causing the water quality in the Bay to exceed a 5 sample/month geometric mean fecal coliform density of 200 organisms/100 mL with no more than 10% of the samples exceeding 400 organisms/100 mL in a 30-day period (the REC-1 objectives), and a median of 14 MPN/100 mL, with no more than 10% of the samples exceeding 43 MPN/100 mL (the SHEL objectives). The actual number of coliform organisms that can be discharged while complying with the bacterial objectives varies with flow. As previously noted, it is not the total number (or mass) of coliform organisms discharged to the Bay that is significant with respect to the protection of beneficial uses and compliance with water quality objectives. Rather, it is the density of the organisms, that is, the number of organisms in a given volume of water, that is important. Therefore, the TMDL is density-based. As shown in Table 1, it is proposed that the TMDL established to ensure protection of the REC-1 use be the REC-1 bacterial quality objectives, which are density-based, with compliance to be achieved no later than 2014. Because shellfish harvesting is a designated beneficial use of Newport Bay, the more stringent shellfish harvesting objectives, which again are expressed as the density of coliform organisms, are ultimately controlling. Therefore, the final TMDL for fecal coliform in Newport Bay is proposed to be the same as the shellfish harvesting objectives for fecal coliform, which require that the water quality of the Bay be maintained to ensure a median of 14 MPN/100 mL of fecal coliform with no more than 10% of the samples in the Bay exceeding 43 MPN/100 mL. Final compliance with this TMDL, and with the WLAs and LAs necessary to meet the TMDL, is proposed to be achieved no later than January 1, 2020. An extended schedule is appropriate, given substantial uncertainties about the sources and fate of coliform inputs to the Bay, the ability to identify and implement reasonable bacterial control measures, and the nature and attainability of the SHEL use. This schedule will allow needed studies to proceed, based on which the TMDL can be revised as appropriate.

Section 5.2 Waste Load Allocations for Point Source Discharges of Fecal Coliform to Newport Bay

Based on information currently available, the tributaries to the Bay are the principal source of bacterial inputs. Flows in the tributaries are composed largely of urban runoff and stormwater, commingled with agricultural runoff and rising groundwater. The Regional Board regulates the quality of urban and stormwater runoff pursuant to an NPDES permit issued to Orange County and the cities within the County (Order No. 96-31, NPDES No. CAS618030), "Waste Discharge Requirements for The County of Orange, Orange County Flood Control District, and The

Incorporated Cities Within the Santa Ana Region Areawide Stormwater Permit." Since they are regulated under an NPDES permit, these discharges are considered point sources. Accordingly, this TMDL specifies WLAs for these bacterial inputs.

Section 5.2.1 Waste Load Allocations for Urban Runoff

The WLAs were developed based on the premise that if discharges to the Bay do not exceed the bacterial quality objectives, then the objectives should be achieved in the Bay. Some degree of conservatism is built into this assumption since, at least at certain times of the year, dilution and die-off of bacterial inputs to the Bay will result in bacterial quality in the Bay that is better than the objectives. An additional 10% margin of safety is factored into the WLAs specified for REC-1 objective compliance. The final WLAs for compliance with the REC-1 objectives are a five sample per month log mean fecal coliform less than 180 MPN/100 mL, and no more than 10% of the samples exceeding 360 MPN/100 mL. It is not feasible or reasonable to specify such a numeric margin of safety into the WLAs for shellfish harvesting compliance, given the extremely low numbers proposed. The final WLAs are the same as the SHEL objectives: a median of 14 MPN/100 mL and no more than 10% of the samples exceeding 43 MPN/100 mL.

These WLAs are consistent with and would implement the provisions of the Areawide Stormwater Permit that prohibit the discharge of waste that causes a violation of water quality objectives.

Section 5.2.2 Waste Load Allocations for Irvine Ranch Water District

As discussed above, IRWD may propose a long term discharge of reclaimed water to San Diego Creek and Newport Bay. If this project is pursued, the reclaimed water discharge will be required to comply with a total coliform density less than 2.2 MPN/100 mL. Waterfowl and other animals inhabiting the ponds will contribute fecal coliform waste to the ponds, which would then be discharged to the creek. As discussed in Section 4.2, such natural source contributions are expected to be on the order of 40-60 MPN/100 mL. The WLAs proposed for the IRWD discharge reflect these circumstances and require that the recycled water discharged to the ponds meet 2.2 MPN/100 mL and that the discharge from the ponds to the creek not exceed the proposed LA for natural sources. (see Section 5.3.3)

Section 5.2.3 Waste Load Allocation for Fecal Coliform from Vessel Waste Discharges to Newport Bay

Given that Newport Bay is designated as a no discharge harbor for vessel sanitary wastes, and that there are adequate pump-out facilities throughout the Bay, the proposed fecal coliform allocation from vessel waste discharges is zero for all times of the year. This prohibition is already in effect, and therefore, immediate compliance with this WLA is required.

Section 5.3 Load Allocations for Non-Point Sources of Fecal Coliform Discharged to Newport Bay

Table 2 includes LAs that are proposed for agricultural runoff and vessel waste. Although the agricultural runoff is mixed with the urban runoff, the discharge of agricultural runoff is exempted from the requirements of the areawide stormwater NPDES permit, Order No. 96-31. Therefore, a separate LA is proposed for the agricultural runoff.

Section 5.3.1 Load Allocation for Fecal Coliform in Agricultural Runoff Discharged to Newport Bay

The proposed LA for agricultural runoff (Table 2) is the same as the WLA proposed for urban runoff, and the basis for this LA is also the same as for urban runoff. If agricultural runoff discharges are controlled to have a fecal coliform density at or less than the proposed phased targets, these discharges should not cause an exceedance of the water quality objectives for fecal coliform in Newport Bay.

Section 5.3.2 Load Allocations for Discharges of Fecal Coliform to Newport Bay from Natural Sources

As discussed in Section 4.2, data provided by IRWD's demonstration of its WWSP indicate that fecal coliform contributions from natural sources are on the order of 40 MPN/100 mL, and the study of natural sources by Calderon, Dufour, and Mood indicate fecal coliform contributions from natural sources on the order of 62 MPN/100 mL. The proposed LA for natural sources is an approximate average of these two values (i.e. 50 MPN/100 mL).

As already noted (see Section 2, Summary of the TMDL), to achieve full, year-round compliance with both the REC-1 and SHEL objectives, a LA for natural sources of 14 MPN/100 mL is proposed for Phase 10 (no later than 2020). This is less than the 50 MPN/100 mL LA. Compliance with this LA may require the implementation of wildlife management measures that clearly conflict with important wildlife management goals (e.g. enhancement of wildlife habitat in the Upper Newport Bay Ecological Reserve). This LA is specified because there are not now sufficient data available to demonstrate that there would be adequate dilution/die-off of natural source inputs at 50 MPN/100 mL in the wintertime to assure compliance with the 14 MPN/100 mL SHEL objective. To satisfy the requirements of the Clean Water Act and implementing regulations, the TMDL, including WLAs, LAs, and numeric targets, must provide this assurance. The TMDL's phased implementation framework provides time to conduct further monitoring and assessment, including bacterial dilution and die-off studies relating to shellfish harvesting attainability and activity in the Bay. The results of these studies may provide the analytical basis for modifying this LA and/or other elements of the TMDL. The risk assessment that will be completed should provide the necessary information for the review of shellfish harvesting attainability.

Section 5.4 Numeric Targets

Numeric targets help establish definable goals for taking steps necessary to ensure compliance with water quality objectives, and establish a linkage between attainment of the standards and the TMDL. As shown in Table 2, a series of interim numeric TMDLs, WLAs, and LAs are proposed to assure progress toward final compliance with the TMDL. Ten phases are proposed that would result in compliance with the REC-1 objectives no later than 2014, and with the SHEL objectives by 2020, as already noted. The phases are proposed based on the priorities identified and discussed in Section 2.

Section 6. Margin of Safety

Section 303(d) and the regulations at 40 CFR 130.7 require that "TMDLs shall be established at levels necessary to attain and maintain the applicable narrative and numerical water quality standards with seasonal variations and a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality." The margin of safety can either be incorporated implicitly through conservative analytical approaches and assumptions used to develop the TMDL, or added explicitly as a separate component of the TMDL (EPA, 1991). This TMDL for fecal coliform includes a number of conservative assumptions and approaches which provide the needed margin of safety.

A significant margin of safety provided in the TMDL is the establishment of WLAs and LAs that are 10% below the water quality objective for REC-1. This provides a numeric margin of safety that complies with Section 303(d) and 40 CFR 130.7. There is also a substantial margin of safety provided by the fact that the TMDL does not apply criteria for dilution, natural die-off , and tidal flushing, with minor exception. (Sufficient dilution and/or die-off of coliform inputs from natural sources (estimated at 50 MPN/100 mL) is assumed to occur in the summer such that shellfish harvesting objectives are met. (see Table 2, Phases 7 and 8) This assumption is justified based on empirical evidence of dilution and die-off in the Bay and the fact that the natural source inputs are minor relative to the inputs from urban and agricultural runoff, which are held to the shellfish harvesting objectives.) The monitoring data show significant evidence that there is coliform die-off and/or they are diluted when discharged into the more salty water of Newport Bay. Although the monitoring of the four tributaries shows consistent coliform densities greater than 1000 MPN/100 mL total coliform and 200 MPN/100 mL fecal coliform during the period between May and November, there is only one set of violations of the 200 MPN/100 mL fecal coliform objective in Bay sampling stations that appear to be correlated with one of these four inputs. The violations at the East Dunes beach are clearly caused by the discharge from the Backbay Drive Drain Pipe, and the violations are isolated near the East Dunes beach and do not extend throughout the Dunes embayment. This shows that the coliform discharges from the Backbay Drain pipe are diluted by the salt water and/or that there is die-off of the coliform organisms before impacts extend to the other stations within the Dunes area.

No die-off studies have been conducted in Newport Bay. Dufour (February 1984) evaluated die-off rates for several bacteriological indicators elsewhere, and found die-off rates ranging from 0.8 days in marine water to 4 days in fresh water. This means that approximately 0.8 days are likely required for 90% of the bacteria and other pathogens discharged to the Bay to die. Die-off of the organisms in the freshwater of the creek/stormwater drainage system is expected to be minimal. Since the die-off rate for 90% of the organisms in freshwater is 4 days, and the freshwater is only in the tributaries less than one day, less than 25% of the organisms are likely to die in the tributaries before being discharged to the bay.

Although this report provides some evidence for dilution and die-off of coliform organisms in the Bay, staff has not proposed that the TMDL, WLAs, and LAs account for these factors because of the lack of sufficient supporting evidence in the record. There is uncertainty about the actual die-off rates of fecal coliform in Newport Bay, as well as uncertainty about the actual dilution that occurs at various locations throughout the Bay. Additionally, the data appear to show that die-off and dilution are not likely to occur during the winter months when fresh water discharges to the Bay are the greatest. Die-off and dilution will also not address exceedances of water quality objectives at the mouths of the tributaries.

Therefore, even though dilution and die-off do occur, there is too much uncertainty at this time to allow those to be factored into the TMDL, WLAs, and LAs. With additional modeling and other studies, actual die-off and dilution can be better characterized and quantified, at which time the TMDL, WLAs, and LAs could be revised. In the interim, staff proposes a conservative approach and that any benefit from die-off and dilution be considered as part of the margin of safety.

Section 7. Seasonal Variation

The greatest discharges of fecal coliform bacteria, and most of the violations of the bacterial objectives in the Bay, are associated with rainfall, particularly during the winter season. During rainfall events, use of the Bay for water contact recreation and shellfish harvesting activities is reduced but not necessarily eliminated. Control of bacterial discharges in stormwater runoff is expected to be very difficult. Recreational use of the Bay is most intense in the summertime, when bacterial objectives, at least for REC-1 activities, are already generally met. It is expected that consistent compliance with these objectives can be more readily assured via the implementation of best management practices (BMPs). Based on these considerations, this TMDL proposes different schedules for compliance with the REC-1 and SHEL bacterial objectives for the Bay, based on season.

Section 8. Critical Conditions

The regulations at 40 CFR 130.7 state that TMDLs shall take into account critical conditions for stream flow, loading and water quality parameters. As discussed in the previous section, beneficial use impacts associated with water contact recreation vary with season. The most critical condition will be when there is a high intensity rain event during the summer months when the highest water contact recreation use occurs. Intense rain storms during July, August, and September, when the most water contact recreation occurs, will expose the greatest number of people to the greatest level of risk from coliform pollution. However, because of their short duration, these summer rain events may not cause a violation of a water quality objective based on a monthly average, although there may be exceedances of the "acute" objective. Nevertheless, this TMDL requires that an implementation program be developed to address both the short term and long term violations that occur at all times of the year. The development and implementation of BMPs to comply with this TMDL should minimize the threat from these summer rain events by finding and controlling sources that contribute to the coliform load.

Another critical condition of most concern in this Newport Bay TMDL is associated with extremely high fecal coliform loadings caused by unusually high or sustained rainfall and runoff levels, which can cause sewage to spill from the collection systems in the watershed. Such events cause the OCHCA to close beaches and post health advisory warnings to avoid water contact recreation. This existing system provides a good method of monitoring the effectiveness of the sewage collection system in the watershed. If monitoring shows high total coliform values, the OCHCA initiates a sanitary survey to find the source and require correction of the cause of the violations of water quality objectives. However, sewage spills will still occur, so there will be the need to close areas until repairs are completed. The OCHCA monitoring program has proven to be very effective in tracking down these kinds of point source problems.

Section 9. Public Participation

Federal regulations at 40 CFR 130.7 require that TMDLs be subject to public review. The Basin Planning public review process will be followed by the Regional Board in their consideration, and adoption, of this proposed TMDL for fecal coliform in Newport Bay. Additionally, working drafts of this TMDL will be presented to the Newport Bay Watershed Executive Committee, and its Management Committee, for review and comments concurrently with the public workshops and hearings before the RWQCB. This process is expected to occur prior to April 1, 1999. Beginning in December 1998, the RWQCB will hold a number of public workshops to consider evidence and testimony related to the proposed TMDL, and is expected to hold a public hearing for adoption of a TMDL by May 1999. This schedule will allow the RWQCB to submit the Basin Plan amendment incorporating the TMDL to the State Water Resources Control Board and Office of Administrative Law for approval by the end of 1999, in order to meet its commitment to have State approval of this TMDL by January 1, 2000. This process of public involvement exceeds the federal public participation requirements.

Section 10. Implementation and Monitoring Recommendations

Federal regulations require the State to identify measures needed to implement TMDLs in the state water quality management plan (40 CFR 130.6). The proposed Basin Plan amendment outlined in Appendix A includes an implementation plan and monitoring program designed to implement the TMDL and evaluate its effectiveness. TMDL implementation is expected to result in compliance with the water quality objectives for fecal coliform and ensure protection of the beneficial uses of Newport Bay. The proposed Basin Plan amendment (Appendix A) also includes requirements that the following implementation and monitoring measures be completed by the County of Orange, the cities within the Newport Bay Watershed, and agricultural operators.

1. Complete a water quality model of fecal coliform inputs into Newport Bay;

2. Complete a beneficial use assessment in Newport Bay to identify and quantify body contact recreation and shellfish harvesting throughout the Bay;

3. Identify sources of fecal coliform contamination in urban runoff;

4. Identify sources of fecal coliform contamination in agricultural runoff;

5. Develop and implement BMPs that will result in compliance with water quality objectives for fecal coliform in Newport Bay;

6. Implement a monitoring program for fecal and total coliform that includes collecting at least 5 samples per month from the monitoring stations identified in Fig. 2, and for the tributaries discharging into Newport Bay; and

7. Evaluate the effectiveness of the vessel waste control program.

Section 11. Proposed Basin Plan Amendment Incorporating a TMDL for Fecal Coliform in the Newport Bay/San Diego Creek Watershed.

Appendix A includes a proposed Basin Plan amendment establishing TMDLs, WLAs, LAs and implementation plan for fecal coliform in Newport Bay. The proposed Basin Plan amendment is in the form of Tentative Resolution No. 99-10, with attached specific language changes to the Implementation Plan (Chapter 5) of the Basin Plan to be considered by the RWQCB.

Section 12. Environmental Checklist

The RWQCB's Basin Plan amendment process has been certified by the Secretary of Resources as functionally equivalent to the CEQA EIR process. The RWQCB is required to complete an environmental assessment of any changes it proposes to make to the Basin Plan. The checklist (Appendix D) notes that there are no significant adverse environmental impacts from the proposed Basin Plan amendment. However, the checklist summarizes the types of impacts that will, or may, occur as the result of the implementation of coliform control measures. Since any implementation measures would probably be considered a project under CEQA, further detailed analysis of the impacts of projects to control fecal coliform will have to be evaluated as projects are developed and implemented.

This report, including the Environmental Checklist, is a functionally equivalent document similar to a programatic Environmental Impact Report. As the implementation program is developed, the Regional Board will amend the Basin Plan and consider any new and additional impacts associated with resulting amendments.

Section 12.1 No Project

The "No Project" alternative would be no action by the Regional Board to adopt a TMDL with implementation measures and monitoring program. This alternative would not meet the purpose of the proposed action, which is to correct ongoing violations of the Basin Plan objectives for fecal coliform in Newport Bay, and beneficial use impairments resulting therefrom. This alternative would result in continuing water quality standards violations and threats to public health, and would not comply with the requirements of the Clean Water Act

Section 12.2 Alternatives Based on Revised Compliance Schedules or Priorities

Another alternative to the proposed action is the Regional Board's adoption of an alternate compliance schedule for the TMDL for fecal coliform in Newport Bay. In the development of the proposed TMDL, staff considered numerous alternate time schedules for the completion of tasks necessary to comply with the proposed TMDL, WLAs, LAs, and numeric targets. Obviously, there is an infinite number of alternate compliance schedules that could be considered. Adoption of a longer schedule (greater than 20 years) would prolong the non-attainment of water quality standards and result in on-going public health risks. The Regional Board could also consider alternatives that modify the recommended phased approach, which is based on season, beneficial use, and geographic priorities. By its nature, the phased approach is intended to allow for such adjustments, based on the results of additional studies. Any such alternative will entail some degree of implementation of controls on bacterial inputs to the Bay and, therefore, would or may have the same possible environmental effects as those described in the environmental checklist for the recommended alternative.

Section 12.3 Proposed Alternative

Staff believes that the recommended TMDL reflects a reasoned and reasonable approach to the control of bacterial quality in Newport Bay. The proposed schedule provides a realistic time frame in which to complete the very complex tasks required by the TMDL. The approach is to address the greatest threats to public health as soon as possible, while giving the watershed stakeholders ample time to complete additional investigations and modeling, and to evaluate alternatives for compliance with the TMDL and changes to the TMDL per se.

Section 13. Alternatives for Compliance with the Proposed TMDL

Staff has conducted a preliminary evaluation of some alternative methods that have been used by other communities in the country to address impacts to body contact and shellfish harvesting uses resulting from fecal coliform. Most of the areas researched by staff were in watersheds that had septic tank problems as one of the causes. This is not the case in the Newport Bay Watershed.

Alternatives for the treatment of bacterial contamination in urban runoff include the following:

1. Source Control Best Management Practices

   Traditional source control mechanisms to address diffuse inputs of coliform from the Newport Bay watershed could include the following:

   - public education programs aimed at providing the watershed communities with information on how to keep pollutants out of the creeks and the Bay;
   - local ordinances requiring pet waste cleanup;
   - local ordinances requiring restaurants to curtail wash down procedures (or determine other appropriate waste disposal mechanisms); and,
   - installation of additional vessel pump-out and restroom facilities.

   There is no information available on the success of any of these strategies in reducing coliform densities.

2. Detention/retention ponds with wetlands

The U.S. Environmental Protection Agency completed a report entitled, “Results of the Nationwide Urban Runoff Program”, (USEPA, 1982) that evaluated bacterial water quality problems in urban runoff from several locations across the country. This report found that wetlands, comprising between 1% and 5% of the drainage area, were the most effective method of addressing bacteriological water quality problems in urban runoff. The study evaluated detention/retention ponds and flow-through systems that were used to trap sediment and filter bacteria. The study found that, up to a certain flow, these wetland systems provided the most cost effective method for treating bacteria, and provided up to 100% removal of pathogens.

The Irvine Ranch Water District’s (IRWD) Wetland Water Supply Project (WWSP) has provided some preliminary monitoring data that support the findings of the Nationwide Urban Runoff Program regarding the effectiveness of wetlands in removing fecal coliform. During September and October 1998, IRWD was diverting approximately 3 to 5 cfs of water from San Diego Creek into the WWSP. IRWD monitored the total and fecal coliform densities in the water diverted from San Diego Creek, and the coliform densities in the water discharged from the WWSP back into the IRWD treatment plant, after the water had been in the pond system for approximately 7 to 10 days. Table 8 below summarizes this monitoring data, and shows that there was almost an order of magnitude reduction in total and fecal coliform densities through the wetlands.

Table 8: Reduction in Coliform through the Irvine Ranch Water District's Wetland Water Supply Project

Date	Influent Total Coliform	Effluent Total Coliform	Influent Fecal Coliform	Effluent Fecal Coliform
	MPN/100 mL	MPN/100 mL	MPN/100 mL	MPN/100 mL
9/14/98	3000	800	300	300
9/21/98	3000	1700	500	300
9/28/98	90000	500	13000	130
10/5/98	5000	1700	1300	170
Average	25250	1175	3775	225

3. Ozonation Treatment of low flows

Staff has also requested Irvine Ranch Water District's assistance in evaluating the cost of treating up to 50 CFS of flow in San Diego Creek with ozonation and/or ultraviolet disinfection. IRWD estimates that it would cost approximately $6 million to construct either an ozonation or ultraviolet disinfection facility, and that annual maintenance costs would be between $125,000 and $315,000, depending on the flow treated and the type of facility constructed. This estimate does not include land costs, which could be $1 million to $2 million, or costs to divert the runoff to the treatment facility.

4. Diversion of low flows

As discussed previously, Mission Bay in San Diego is also impacted by a tributary discharges of coliform. In order to address these discharges, the City of San Diego is diverting low flows from the two significant contributing tributaries to the sewer system for treatment and ocean disposal. This has resulted in significant water quality improvement and reduction in beneficial use impairment. This is also a potential treatment mechanism for addressing coliform discharges from the tributaries and storm drains to Newport Bay.

Section 14. Estimated Costs of Agriculture Water Quality Control Programs and Potential Sources of Funding

Section 13141 of the Porter-Cologne Water Quality Control Act requires the Regional Board to estimate the cost of any agricultural water quality control program prior to requiring its implementation, and to identify funding sources.

Staff estimated that the costs to agriculture to implement the nutrient TMDL range from $690,000 per year up to $4,730,000 per year; total costs to agriculture to implement the sediment TMDL were estimated to be between $1,000,000 and $1,500,000. Given that staff has not found significant evidence of the use of manure fertilizer in the watershed, there is not likely to be a significant amount of fecal coliform produced on agricultural lands and thus the reduction required of the agricultural operators is likely to be less than the reduction required to implement the nutrient and sediment TMDLs. Staff estimates the potential costs to agriculture to comply with the fecal coliform TMDL to be less than $690,000 per year.

Potential funding sources could include the following:

1. Private financing by individual sources;
2. Bonded indebtedness or loans from governmental institutions;
3. State or federal grants or low-interest loan programs;
6. Single-purpose appropriations from federal or state legislative bodies (including land retirement programs).